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Eshmetov Daler

MUNDARIJA

TEXNIKA FANLARI

6 NEXT-GENERATION INTRUSION DETECTION FOR IOT EVCS: INTEGRATING CNN, LSTM, AND GRU MODELS

Dusmurod Kilichev

12 MODERN METHODS OF MATHEMATICAL MODELING IN BIOMEDICAL RESEARCH

Beknazarova Saida, Khalikova Nasiba

20 ANALYSIS OF SMART GLASSES SYSTEM FOR BLIND AND VISUALLY IMPAIRED PEOPLE

Mukhriddin Mukhiddinov, Oybek Djuraev, Jasurbek Djuraev

27 MOBIL QURILMALARDAGI MA'LUMOTLARNI CLOUDDA XAVFSIZ SAQLASH ALGORITMI

Odilbek Asqaraliyev, Samandar Yusupov, Sirojiddin Xalilov

35 AXBOROT-BOSHQARUV TIZIMLARI DASTURIY TA'MINOTINING ISHONCHLILIGINI BAHOLASH MODEL

Maqsud Mardiyev, Sirojiddin Xalilov, Farangiza Omonullayeva

42 TELEKOMMUNIKATSIYA OBYEKTINING ELEKTR TA'MINOTI TIZIMINI MORFOLOGIK TAHLIL ORQALI MODELASHTIRISH

Qodirov Fazliddin Misliddinovich

**55 TIMSOLLARNI TANIB OLIISHDA BELGILAR FAZOSINI QISQARTIRISH
USULLARINING QIYOSIY TAHLILI**

Rashidov X.Sh., Xandamov Y.X., Inomxo'jayev A.A.

**65 OPPORTUNISTIK TARMOQLAR: ARXITEKTURASI, MOBILLIK MODELLARI VA
MARSHRUTLASH PROTOKOLLARI**

Elyanora Jolimbetova

**72 АЛГОРИТМЫ ВОССТАНОВЛЕНИЯ ГЕОЛОГИЧЕСКИХ СИГНАЛОВ С
ПОМОЩЬЮ СПЛАЙНОВ**

Гофуржонов Мухаммадали, Гофуржонова Маржона

**80 AXBOROT KOMMUNIKATSIYA VA RAQAMLI TEXNOLOGIYALARDA
AXBOROT ALMASHINUVINI TA'MINLASHDA QUYOSH VA SHAMOL
ENERGIYASIDAN FOYDALANISH ISTIQBOLLARI**

Avazbek Madolimov

**88 RAQAMLI TEXNOLOGIYALAR VA AXBOROT XAVFSIZLIGINI TA'MINLASHDA
SUN'IY YO'LDOSH ALOQA TIZIMINI QO'LLASH USULLARI VA
ALGORITMLARI**

Rustam Davronov

**99 O'ZBEKISTON HUDUDIDA QO'LLANILADIGAN YO'L BELGILARI
MA'LUMOTLAR TO'PLAMINI SHAKLLANTIRISH**

Umarov Muhridin, Rayimova Shaxnoza

IJTIMOIIY FANLAR

113 DIGITAL MARKETING COMMUNICATION TOOLS ANALYSIS

Dadabayeva Rano, Abdulakhatov Muzaffarjon, Abdullaeva Iroda

**124 JAHON BLOKCHEYN TEXNOLOGIYALARI BOZORI DINAMIKASINING
PROGNOZI**

Azimov Dilmurod

130 РАЗВИТИЕ ЦИФРОВОЙ ЭКОНОМИКИ В УЗБЕКИСТАНЕ

Юсупова Дильбар

**137 KOMMUNAL SOHADA BOSHQARUV, HISOBINI YURITUVCHI TIZIMNI
MODELLASHTIRISH VA ISHLAB CHIQISH**

Mirkarimov Akmal, Ro'ziev Faxriddin, Xasanov Ahmadjon

**144 SAVDO TASHKIOTLARIDA MAHSULOT HISOBINI YURITISH JARAYONLARI
AXBOROT MODELLARINING O'RNI VA AHAMIYATI**

Elov Jamshid, Maxmudov Abduxalil

**155 O'ZBEKISTONDA KICHIK VA O'RTA BIZNES SOHA VAKILLARINI SOLIQQA
TORTISH TIZIMI**

Abdibositova Muxlisaxon

164 OBJECTIVES, TYPES AND METHODOLOGY OF CRM SYSTEM SELECTION

Abdullayev Munis, Abdulakhatov Muzaffarjon

МАТЕМАТИКА VA FIZIKA FANLARI

**172 ОБ ОДНОМ АЛГОРИТМЕ ЧИСЛЕННОГО РЕШЕНИЯ КРАЕВЫХ ЗАДАЧ
УПРУГО-ПЛАСТИЧНОСТИ**

U.Z. Djumayozov

**180 РОЛЬ ПРИМЕНЕНИЯ ЗАКОНОВ РАСПРЕДЕЛЕНИЯ В ОБСЛУЖИВАНИИ
РАЗНОРОДНОГО ТРАФИКА В СЕТЯХ 5G**

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NEXT-GENERATION INTRUSION DETECTION FOR IOT EVCS: INTEGRATING CNN, LSTM, AND GRU MODELS

Abstract: In the evolving landscape of Internet of Things (IoT) and Industrial IoT (IIoT) security, novel and efficient intrusion detection systems (IDSs) are paramount. In this article, we present a groundbreaking approach to intrusion detection for IoT-based electric vehicle charging stations (EVCS), integrating the robust capabilities of convolutional neural network (CNN), long short-term memory (LSTM), and gated recurrent unit (GRU) models. The proposed framework leverages a comprehensive real-world cybersecurity dataset, specifically tailored for IoT and IIoT applications, to address the intricate challenges faced by IoT-based EVCS. The ensemble algorithm, accessible via GitHub, represents a significant stride in fortifying IoT-based EVCS against a diverse array of cybersecurity threats.

Keywords: cybersecurity, electric vehicle charging station (EVCS), ensemble learning; Internet of Things (IoT), intrusion detection system (IDS).



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Introduction

As we navigate the rapidly evolving terrain of the Internet of Things (IoT) and Industrial IoT (IIoT), the role of robust intrusion detection systems (IDS) in safeguarding electric vehicle charging stations (EVCSs) becomes increasingly critical [1]. The dynamic and multifaceted nature of IoT environments demands innovative solutions that transcend traditional cybersecurity approaches.

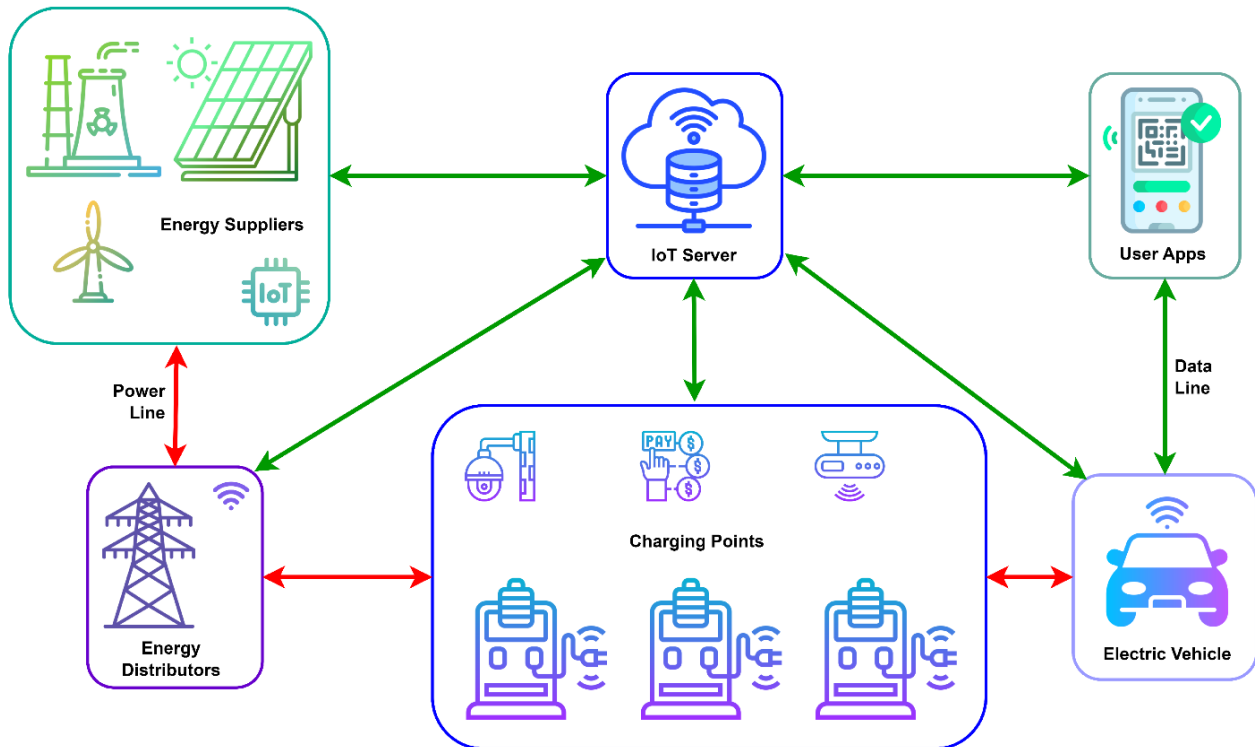


Figure 1. IoT Network Architecture for EVCS.

The integration of IoT technologies into essential services, such as EVCS, poses significant cybersecurity risks (Figure 1). Traditional IDS, struggling to keep pace with the evolving sophistication of cyber threats and unique constraints of IoT environments, establish the need for our research. Our study is anchored on enhancing intrusion detection in IoT-based EVCS, leveraging advanced neural network architectures to address the intricate challenges inherent in these systems.

Existing IDS solutions face numerous challenges, such as scalability, adaptability, resource constraints, diverse attack vectors, and the necessity for real-time detection [2]. These challenges are exacerbated by high false alarm rates, rendering many systems unreliable. In this study, we propose a novel IDS framework tailored for IoT environments in EVCS to address these critical issues.

Our objectives are centered on developing an ensemble IDS model using convolutional neural network (CNN) [3], long short-term memory (LSTM), and gated recurrent unit (GRU) models, evaluating its performance with the “Edge-IIoTset” dataset [4], optimizing it for resource efficiency, and benchmarking it against existing solutions. We evaluate the ensemble model’s efficacy in enhancing detection accuracy, its performance using comprehensive datasets, its feasibility in resource-constrained environments, and its adaptability to evolving cyber threats.

Proposed NIDS Framework for IoT-Based EVCS

The proposed NIDS framework is an integration of advanced neural network architectures adept at learning and identifying complex patterns indicative of cyber threats. The proposed model harnesses the strengths of CNN, LSTM, and GRU algorithms to analyze network traffic data for intrusion detection. A detailed representation of this ensemble architecture is shown in Figure 2.

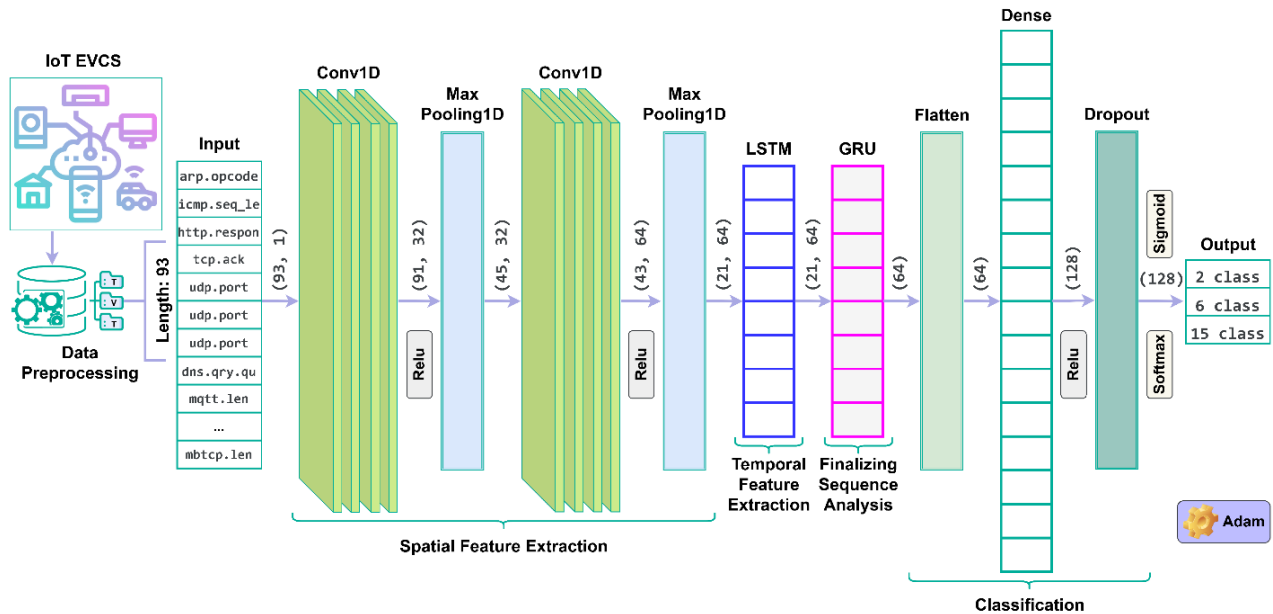


Figure 2. Ensemble Model Design and Architecture.

At the heart of our NIDS framework lies a DL model that operates in two critical dimensions: spatial feature extraction and temporal sequence processing. First, the CNN layers effectively capture spatial dependencies within individual data packets. This process uses convolutional filters that slide across the input data to identify crucial features such as specific packet sizes or unusual protocol behavior that could signify an intrusion attempt.

Following the spatial analysis, the temporal characteristics of the data are deciphered by the LSTM and GRU layers. LSTMs are adept at recognizing long-term dependencies, preserving knowledge of events that occurred many steps back in the sequence, which is essential when attacks comprise a series of discreet but related actions. GRUs complement this by focusing on more recent information, allowing the model to adapt rapidly to the most current data inputs and enhancing its ability to detect anomalies in real-time traffic flow.

The proposed model begins with an input layer designed to receive a vectorized form of network traffic data. The input shape is tailored to the dimensions of the feature set extracted from the network packets. The data undergo a series of transformations through two Conv1D layers, each followed by a MaxPooling1D layer to reduce dimensionality and emphasize the most salient features.

The sequential aspect of the data is then processed through a hybrid LSTM-GRU arrangement—a single LSTM layer with return sequences set to true feeds into a GRU layer, creating a deep, sequential model capable of handling complex time-dependent patterns. This combination captures a comprehensive temporal profile of traffic data, encompassing both short-term fluctuations and long-term trends indicative of intrusive behavior.



To finalize the classification, the model is flattened and passed through a dense layer with ReLU activation, introducing nonlinearity and aiding in learning complex patterns. A dropout layer is included to mitigate overfitting, followed by a softmax activation layer that classifies the traffic data into predefined categories ranging from normal to various types of attack vectors.

The model is compiled with the Adam optimizer, which is known for its efficiency in handling large datasets and its adaptive learning rate capabilities. The loss function employed is sparse categorical cross-entropy, which is particularly suited for classification problems in which the classes are mutually exclusive.

This innovative NIDS framework is designed to be a cornerstone in defense against cyber threats in IoT-based EVCS. Using a DL approach that integrates CNN layers for feature extraction with LSTM and GRU layers for temporal data analysis, the proposed model not only identifies existing threat patterns but also adapts to emerging anomalies. It stands as a testament to the potential of AI in fortifying the cybersecurity measures of critical infrastructure within the smart city ecosystem.

Experimental Results and Discussion

The essence of empirical validation lies in the rigor of experimental analysis, wherein theoretical models confront the test of practical performance. This section presents a detailed exposition of the experimental results derived from the evaluation of the ensemble model, tailored for intrusion detection within the intricate framework of IoT-based EVCS. Using a methodological approach, the model was subjected to various tests, ranging from binary to multifaceted multiclass classifications. Each test was meticulously designed to probe the model's predictive prowess across a spectrum of scenarios that mirror the heterogeneity of potential security breaches in IoT environments.

Binary classification trials were aimed at discerning the presence or absence of intrusion attempts, thus laying the groundwork for the model's capability to distinguish between normal operations and anomalies. Progressing to more granular levels, six-class and fifteen-class classification tests were orchestrated to evaluate the model's ability to identify specific types of intrusions, each with its unique signature and implications (Table 1).

Table 1. Model Performance Metrics.

Performance Metric	2 Class	6 Class	15 Class
Test Loss	0	0.0532	0.0632
Test Accuracy (%)	100	97.44	96.9
Epoch	6	50	50
Training time (s)	1885.46	14803.63	14719.47
Testing time (s)	42.53	42.2	40.65

We performed a comprehensive examination of the CNN-LSTM-GRU ensemble model within the diverse and challenging domain of IoT security for EVCS. A comparative analysis, as detailed

in Table 2, situates the ensemble model within the context of recent advancements, delineating its standing against contemporary architectures in the field.

Table 2. Comparison of Model Accuracies.

Model	Year	Accuracy (%)		
		2 Class	6 Class	15 Class
DNN [5]	2022	99.99	96.01	94.67
Inception Time [6]	2022	-	-	94.94
CNN-LSTM [7]	2022	100	98.69	-
VGG-16 [8]	2023	100	-	94.86
DeepAK-IoT [9]	2023	-	-	94.96
LNKDSEA [10]	2023	99.99	84.97	80.12
RNN [11]	2023	100	92.53	90.22
MAGRU [12]	2023	99.99	-	-
CNN-LSTM-GRU	2023	100	97.44	96.9

Conclusions

Our investigation into the domain of cybersecurity for IoT infrastructures, particularly focusing on EVCS, culminates with a suite of notable contributions that set a new benchmark for IDS. The introduction of an innovative ensemble architecture that leverages the combined strengths of CNN, LSTM, and GRU, represents a leap forward in the detection of intricate intrusion patterns. The model, rigorously trained and validated against real-world datasets, demonstrates a superior ability to navigate the complexities of cyber threats with impressive accuracy. This study not only demonstrates the feasibility of employing advanced neural network architectures for intrusion detection but also paves the way for future research in securing IoT ecosystems against sophisticated attacks.



References

1. Rimal, B.P.; Kong, C.; Poudel, B.; Wang, Y.; Shahi, P. Smart Electric Vehicle Charging in the Era of Internet of Vehicles, Emerging Trends, and Open Issues. *Energies* 2022, 15, 1908.
2. Aldaej, A.; Ahanger, T.A.; Ullah, I. Deep Learning-Inspired IoT-IDS Mechanism for Edge Computing Environments. *Sensors* 2023, 23, 9869.
3. Kilichev, D.; Kim, W. Hyperparameter Optimization for 1D-CNN-Based Network Intrusion Detection Using GA and PSO. *Mathematics* 2023, 11, 3724.
4. Rashid, M.M.; Khan, S.U.; Eusufzai, F.; Redwan, M.A.; Sabuj, S.R.; Elsharief, M. A Federated Learning-Based Approach for Improving Intrusion Detection in Industrial Internet of Things Networks. *Network* 2023, 3, 158–179.
5. Ferrag, M.A.; Friha, O.; Hamouda, D.; Maglaras, L.; Janicke, H. Edge-IIoTset: A New Comprehensive Realistic Cyber Security Dataset of IoT and IIoT Applications for Centralized and Federated Learning. *IEEE Access* 2022, 10, 40281–40306.
6. Tareq, I.; Elbagoury, B.M.; El-Regaily, S.; El-Horbaty, E.S.M. Analysis of ToN-IoT, UNW-NB15, and Edge-IIoT Datasets Using DL in Cybersecurity for IoT. *Appl. Sci.* 2022, 12, 9572.
7. Khacha, A.; Saadouni, R.; Harbi, Y.; Aliouat, Z. Hybrid Deep Learning-based Intrusion Detection System for Industrial Internet of Things. In Proceedings of the 2022 5th International Symposium on Informatics and its Applications (ISIA), M'sila, Algeria, 29–30 November 2022; pp. 1–6.
8. Tomar, K.; Bisht, K.; Joshi, K.; Katarya, R. Cyber Attack Detection in IoT using Deep Learning Techniques. In Proceedings of the 2023 6th International Conference on Information Systems and Computer Networks (ISCON), Mathura, India, 3–4 March 2023; pp. 1–6.
9. Ding, W.; Abdel-Basset, M.; Mohamed, R. DeepAK-IoT: An effective deep learning model for cyberattack detection in IoT networks. *Inf. Sci.* 2023, 634, 157–171.
10. Koppula, M.; LM, L.J. LNKDSEA: Machine Learning Based IoT/IIoT Attack Detection Method. In Proceedings of the 2023 International Conference on Advances in Electronics, Communication, Computing and Intelligent Information Systems (ICAECIS), Bengaluru, India, 19–21 April 2023; pp. 655–662.
11. Salih, K.M.M.; Ibrahim, N.B. Enhancing IoT Forensics through Deep Learning: Investigating Cyber-Attacks and Analyzing Big Data for Improved Security Measures. In Proceedings of the 2023 4th International Conference on Big Data Analytics and Practices (IBDAP), Bangkok, Thailand, 25–27 August 2023; pp. 1–8.
12. Ullah, S.; Boulila, W.; Koubâa, A.; Ahmad, J. MAGRU-IDS: A Multi-Head Attention-Based Gated Recurrent Unit for Intrusion Detection in IIoT Networks. *IEEE Access* 2023, 11, 114590–114601.



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MODERN METHODS OF MATHEMATICAL MODELING IN BIOMEDICAL RESEARCH

Abstract: The subject of the study. The main approaches to the mathematical modeling of the interaction of optical radiation with biological tissues are investigated. Method. The Monte Carlo method is an approximation of the solution of the radiation transfer equation. This solution is achieved by sampling a set of possible trajectories of light quanta (photon packets) as they pass through the fabric. The resulting stochastic model allows us to simulate the propagation of light in a cloudy (scattering) medium. The paper considers the main types of interaction of photons with tissue: scattering, absorption and reflection/refraction at the boundary of the medium. The main results. Effective methods for modeling the problem of Raman spectroscopy in turbid media are shown, taking into account the detector parameters and sample size. The reconstructed Raman spectrum of the skin is compared with clinically measured skin spectra in vivo. The general correspondence of the simulated process and experimental data is shown.

Keywords: optical radiation, absorption, scattering, modeling, biological tissues, Monte Carlo method.



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Introduction

The relevance of a detailed study of the radiation distribution in multilayer biological media is due to the development of effective methods of optical diagnostics. One of these approaches is mathematical modeling of these processes. As part of the solution to the problem of radiation distribution, there is a need to develop remote optical diagnostic methods for multilayer biological tissues. However, not all known methods fully take into account the optical and geometric characteristics of the analyzed objects, primarily local inhomogeneities. The most effective way to solve such problems is to use the probabilistic Monte Carlo method (MC), which is based on the representation of radiation propagation in the form of a stream of model wave packets. The MK method is one of the computational methods that is based on a random sample of physical quantities. Due to its versatility, this method is widely used in various fields of science, including optics of biological tissues [1]. Its popularity in the last two decades in modeling the problems of photon transport in biological tissues is due to the possibility of obtaining a flexible and rigorous solution to the problem of light propagation in turbid media with a complex structure.

The MK method is used to solve the radiation transfer equation (UPI) with any required accuracy, provided that the required computational load is available. For this reason, this method is considered as the gold standard among methods for modeling light propagation in biological tissues, the results of which are often used to test other, less rigorous methods, such as the diffusion approximation of UPI. The work [8] can serve as an illustration of the legitimacy of choosing the MK method as the main tool for modeling the propagation of optical radiation in biological tissues. A seven-layer skin model was used to simulate the reflection spectra of human skin. Despite the fact that the MK method is the gold standard among methods for modeling light propagation in cloudy media, its main disadvantage is the requirement of intensive calculations to achieve results with the desired accuracy due to the stochastic nature of MK modeling, which requires a lot of time compared to other analytical or empirical methods. Over the past decades, significant efforts have been made to accelerate the process of micromodeling light propagation in biological tissues.

To achieve optimal performance of the models in [9, 10], parallel computing technology known as NVidia CUDA was used, which accelerates the modeling process up to 1000 times[2]. The technology of accelerating calculations by the MK method using NVidia CUDA GPUs is very relevant today. Many works are devoted to improving the existing MC algorithm and speeding up its operation in two-dimensional or three-dimensional cases. A breakthrough in the field of non-surgical diagnostic methods has long been provided by X-ray and computed tomography, now we can expect development from optical imaging due to the use of non-ionizing radiation and its non-invasiveness [3]. Diffuse reflection spectroscopy, near infrared spectroscopy, diffuse optical tomography, Raman imaging, fluorescence imaging, optical microscopy, optical coherence tomography and photoacoustic imaging are among the widely used optical methods in biomedicine and their potential has not been fully studied. The modeling of light propagation in the medium is based on the absorption and scattering characteristics that dominate the propagation of light in biological tissues.

A common approach to modeling the propagation of light in an environment is the use of UPI. Several numerical solutions for UPI based on suitable approximations have been proposed, but effective solutions for heterogeneous media (tissue) are still a problem. The Monte Carlo method for

modeling the propagation of radiation in biological tissues, as a rule, when modeling MC, a large number of photons propagate through the medium under study (tissue). Photons undergo reflection, refraction, absorption or scattering [4,5]. The optical properties of the medium, such as the refractive index (n); absorption coefficients (μ_a) and scattering coefficients (μ_s), as well as the scattering anisotropy (g), determine the path traveled by photons in the medium. The absorption coefficient (μ_a) is defined as the probability of photon absorption in a medium per unit (infinitesimal) path length [3]. The geometry of the medium in which the propagation of light is modeled can be defined as an infinite or semi-infinite continuous medium, depending on the needs of modeling. For scattering, the polar (θ) and azimuthal (φ) angles of the scattered photon depend on the optical properties of the tissue and the sampling of random values. The angle θ is calculated using the Henyi–Greenstein phase function, of the form: $p \cos \theta =$ and $\varphi = 2\pi\xi$, (1) where ξ is a uniformly distributed random number $\xi = [0, 1]$. In addition to using the approaches of numerical solution of the UPI and the MK method, many studies are aimed at developing models for multiple scattering processes. Such studies include the random walk theorem [6], empirical predictions, and addition-doubling methods. These methods often use simplified analytical expressions to predict the behavior of experimental details, such as the total transmission distribution, the average cosine of scattering, and the distance traveled.

The use of simple phase functions in these simplified models to describe, for example, the anisotropy of g scattering or isotropic scattering also has disadvantages. Although simplifications give reasonable results for some averaged observations, they cannot distinguish between similar phase functions, for example, phase functions with the same g , but completely different probability density functions. Another problem is the limitation of working with anisotropic scattering, absorbing media and/or inhomogeneous distributions of optical density/phase functions. Note that the choice of the phase function is not limited to the classical Henyi–Greenstein function. For example, in [7] a solution in the form of a Markov chain is given for modeling multiple scattering of photons through turbid media through the processes of anisotropic scattering — Mie scattering (Fig. 1).

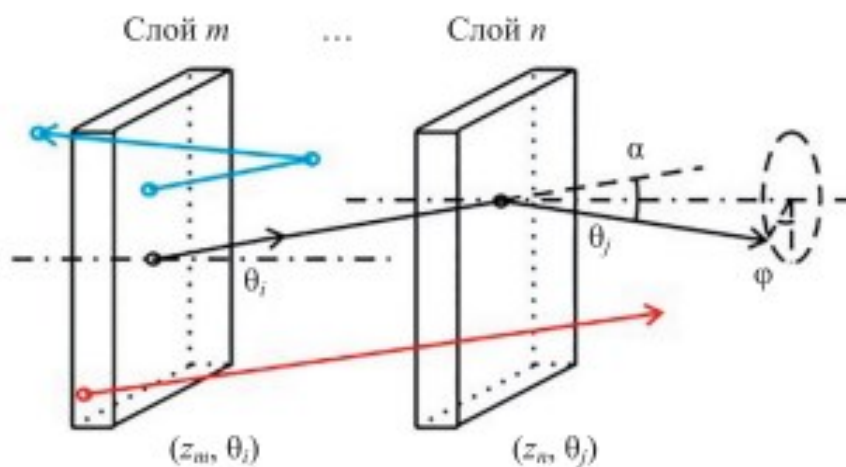


Figure 1. Multiple scattering scheme in accordance with the Markov chain model In the diagram, the plate is discretized into several layers with the same thickness Δz .

Let's assume that the optical properties inside each layer are the same. m and n are arbitrary



indices of the layers, and z_m and z_n are the distances between the layer and the incident plane for layers m and n . Let two successive scattering acts occur in the m th and n th layers; θ_i and θ_j are the angles of photon propagation (zenith angles); φ is the azimuth angle, and $\varphi = 0^\circ$ for the m layer due to symmetry; α is the angle between the two propagation vectors.

Methods

Application of the Monte Carlo method in optical coherence tomography: Optical coherence tomography (OCT) is a non—invasive method that allows you to quickly obtain high—resolution images - up to one micron. For the needs of modern medicine, high-speed imaging techniques are also needed, allowing you to work in real time whenever possible. This task is being solved by the latest developments in the field of tunable laser technologies and miniaturization concepts [9]. The mathematical model of the interaction of laser radiation and biological tissue has been developed taking into account the technical characteristics of the installation and additional installation parameters, such as realistic geometric parameters of the medium and installation, as well as requirements for the detection of inhomogeneities. So far, most numerical approaches to solving the problem of optical radiation propagation in highly scattering, including biological media, are based on the MK method. The OCT model has been developed taking into account the geometric implementation of a probe with low-coherence interferometric detection. It turned out that OCT as a whole registers only minimally scattered photons — individual photons or, within the framework of the model, packets of photons that were scattered a minimum number of times before hitting the detector.

Simulation of Raman scattering processes using the Monte Carlo method: Another approach for visualization and analysis of the characteristics of biological tissues is Raman spectroscopy [10]. Numerical simulation of Raman scattering consists of two stages: calculation of the photon flux at each point of the medium and subsequent generation of the corresponding number of Raman photons at each point. Two approaches are used to effectively simulate Raman scattering of light in cloudy media. Both approaches use the MK method to simulate the Raman scattering process. In the first approach, the direct method, it is assumed that the absorption coefficients $\mu_a(\lambda_{\text{Raman}})$ and raman scattering $\mu_s(\lambda_{\text{Raman}})$ are constant throughout the sample. When a photon propagates in a medium, with some probability P_{Raman} , a new, Raman-scattered photon may be re-emitted. The second approach, the so-called two-step approach, creates a sufficient number of Raman scattered photons without increasing the probability of Raman scattering or the number of photons. The first step is identical to the MK code in [10]. The migration of raman photons and Tyndall photons, photons scattered by particles with dimensions of the order of the wavelength of light, in opaque samples under isotropic and direct scattering, was studied using MK modeling.

A suitable Raman probability value ($P_{\text{Raman}} = 0.01$) was used to simulate a sufficient number of photons for statistical reasons. Note that currently most models are based on a two-step approach to Raman modeling. In Fig. 2 presents the results of modeling Raman scattering processes in a solution of β -carotene + ink using NVidia CUDA technology. The mathematical model of Raman scattering is based on the principles of fluorescence modeling, while the propagation of excitation

photons is modeled by the classical MC algorithm. The simulation results showed that the optical properties of the β -carotene solution studied using Raman scattering made significant changes in the profile of the detected signal. At the same time, the consistency of the simulation results and experimental data for the intensity of peaks in the Raman spectrum of β -carotene is observed. One of the main applications of Raman spectroscopy is to determine the chemical composition of a sample, which can then be used to extract static or dynamic biological information from the sample. In addition, in relation to the studied samples, the model effectively simulates Raman scattering for single-layer and multilayer samples of arbitrary geometry, including both focused and collimated laser beams for excitation, as well as various values of the numerical aperture NA and the radius of the exciting beam [11]. For convenience, we introduce into the model the concept of a Raman cross section or, alternatively, the probability of a Raman scattering event, which is similar to the elastic scattering cross section.

Experimental Results

The advantage of using this parameter is that for each step of the simulation, it represents the probability of re-emission of the photon in question in the form of a Raman photon. When calculating the photon distribution, a two-step approach is more advantageous. Given the fact that the Raman scattering process is very weak, this approach significantly accelerates the simulation of Raman scattering, which is mandatory for modeling multicomponent media with complex geometries [12].

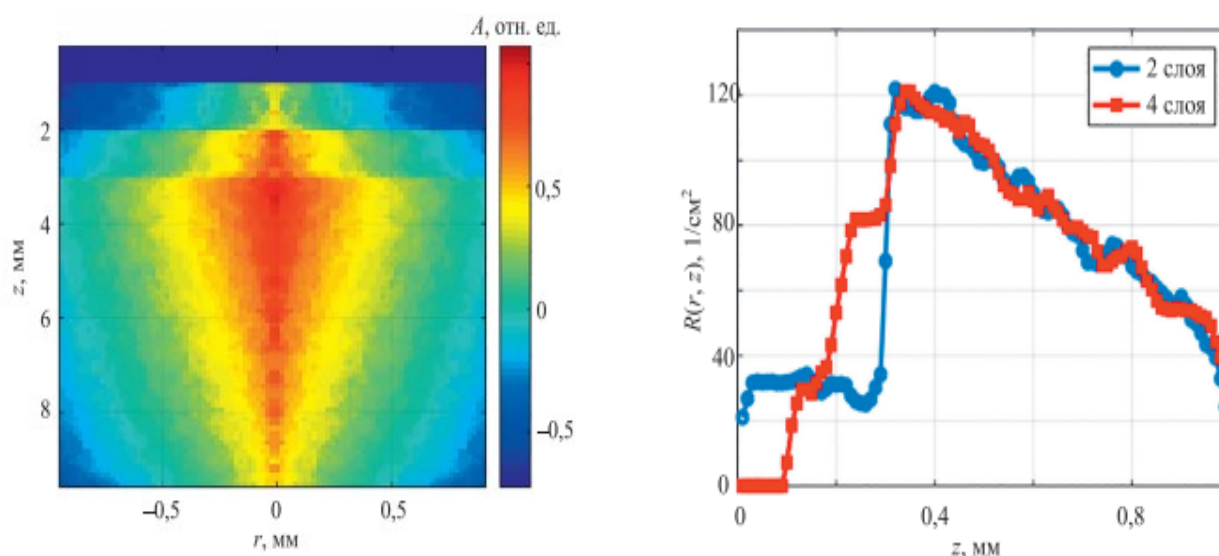


Figure 2. Probability distribution of absorption (A) of re-emitted Raman photons in a four-layer medium of β -carotene + ink (a). $R(r, z)$ is the density of the Raman photon flux for two- and four-layer media distributed over depth (b)

The paper considers an attempt to simulate Raman scattering of normal human skin in the near infrared wavelength range.

An eight-layer skin model with transport parameters is constructed. The distribution of exciting light with a wavelength of 785 nm inside the model medium was calculated using the MK code [13]. To simulate Raman scattering, similar modeling procedures were used, as in fluorescence modeling.



Raman spectra of sections of normal skin tissue were measured ex vivo to quantify the internal microspectral properties of various skin layers. The reconstructed Raman scattering spectrum of the skin was compared with clinically measured skin spectra in vivo to confirm the correctness of the choice of an approach to modeling (Fig. 3) the distribution and efficiency of the output of Raman photons.

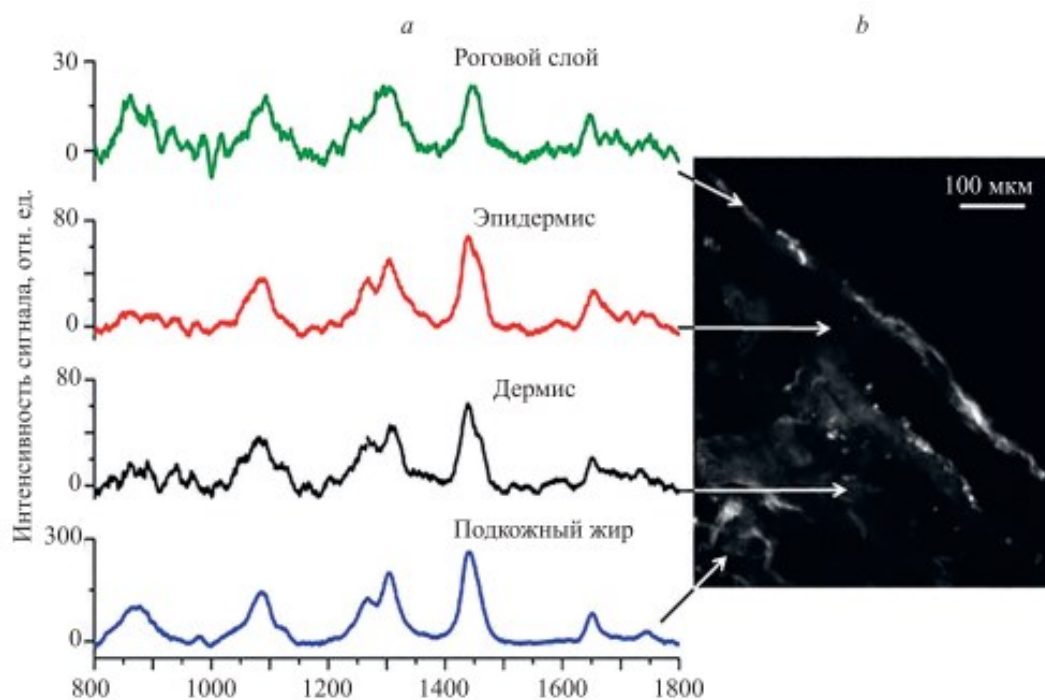


Figure 3. Proper Raman spectra measured for different layers of an unpainted excised sample of normal skin (a). Near infrared autofluorescence image of a skin section showing the measurement sites (b) [14]

The chosen modeling process showed that most of the measured in vivo Raman skin signals originate from the dermis (70%) and epidermis (28%). The stratum corneum, although very thin, still makes a significant contribution (1.3%) due to its close location to the surface, which facilitates the release of Raman photons. The contribution of the subcutaneous layers is also not insignificant (1.1%) due to its much higher Raman scattering efficiency compared to other tissue layers (4-5 times higher than that of the epidermis/dermis), although it is located deep inside the skin. As a result, a high correspondence between the simulated and measured data was obtained.

Conclusion

Modeling the propagation of light in biological tissues based on the Monte Carlo method has become an important tool for understanding the intricacies of the interaction of light and matter in complex environments relevant, for example, to the fields of medicine and life sciences. In addition to efficient modeling algorithms, accurate modeling is the key to the latest advances in this field. The new ideas obtained from the simulation serve as a valuable contribution to the development of new tools based on non-invasive optical principles, or facilitate the interpretation of measurement data



obtained from biological samples. The modeling methods presented in this paper are mainly focused on biomedical optical imaging and spectroscopy. Additional benefits will come from the ever-increasing available computing power and artificial intelligence concepts such as machine learning and deep learning concepts, which are likely to also contribute to the development of modeling as well as data analysis.



References

1. Тучин В.В. Оптика биологических тканей. Методы рассеяния света в медицинской диагностике. М.: Физматлит, 2012. 812 с. 2
2. Arridge S.R. Optical tomography: forward and inverse problems // *Inverse Problems*. 2009. V. 25. N 12. P. 123010. <https://doi.org/10.1088/0266-5611/25/12/123010>
3. Bassi A., D'Andrea C., Valentini G., Cubeddu R., Arridge S.R. Temporal propagation of spatial information in turbid media // *Optics Letters*. 2008. V. 33. N 23. P. 2836–2838. <https://doi.org/10.1364/OL.33.002836>
4. Meglinski I., Doronin A.V. Monte Carlo modeling of photon migration for the needs of biomedical optics and biophotonics // *Advanced Biophotonics*. 2012. P. 1–72.
5. Fischer D.G., Prahl S.A., Duncan D.D. Monte Carlo modeling of spatial coherence: free-space diffraction // *Journal of the Optical Society of America A*. 2008. V. 25. N 10. P. 2571–2581. <https://doi.org/10.1364/JOSAA.25.002571>
6. Jacques S. Monte Carlo modeling of light transport in tissue // *Optical-thermal response of laser-irradiated tissue*. Springer Netherlands, 2010. P. 109–144. https://doi.org/10.1007/978-90-481-8831-4_5
7. Flock S.T., Patterson M.S., Wilson B.C., Wyman D.R. Monte Carlo modeling of light propagation in highly scattering tissues. I. Model predictions and comparison with diffusion theory // *IEEE Transactions on Biomedical Engineering*. 1989. V. 36. N 12. P. 1162–1168. <https://doi.org/10.1109/tbme.1989.1173624>
8. Flock S.T., Wilson B.C., Patterson M.S. Monte Carlo modeling of light propagation in highly scattering tissues. II. Comparison with measurements in phantoms // *IEEE Transactions on Biomedical Engineering*. 1989. V. 36. N 12. P. 1169–1173. <https://doi.org/10.1109/10.42107>
9. Alerstam E., Lo W., Han T., Rose J., Andersson-Engels S., Lilje L. Next-generation acceleration and code optimization for light transport in turbid media using GPUs // *Biomedical Optics Express*. 2010. V. 1. N 2. P. 658–675. <https://doi.org/10.1364/boe.1.000658>
10. Li P., Liu C., Li X., He H., Ma H. GPU acceleration of Monte Carlo simulations for polarized photon scattering in anisotropic turbid media // *Applied Optics*. 2016. V. 55. N 27. P. 7468–7476. <https://doi.org/10.1364/ao.55.007468>
11. Doronin A., Meglinski I. Peer-to-peer Monte Carlo simulation of photon migration in topical applications of biomedical optics // *Journal of Biomedical Optics*. 2012. V. 17. N 9. P. 090504. <https://doi.org/10.1117/1.jbo.17.9.090504>
12. Korhonen V.O., Myllylä T.S., Kirillin M.Yu., Popov A.P., Bykov A.V., Gorshkov A.V., Sergeeva E.A., Kinnunen M., Kiviniemi V. Light propagation in NIR spectroscopy of the human brain // *IEEE Journal of Selected Topics in Quantum Electronics*. 2014. V. 20. N 2. P. 7100310. <https://doi.org/10.1109/jstqe.2013.2279313>
13. Wang L.V., Wu H.-I. *Biomedical Optics: Principles and Imaging*. Hoboken, NJ, USA
13. Wang L.V., Wu H.-I. *Biomedical Optics: Principles and Imaging*. Hoboken, NJ, USA: Wiley, 2009. 376 p.
14. Yun S.H., Kwok S.J. Light in diagnosis, therapy and surgery // *Nature Biomedical Engineering*. 2017. V. 1. N 1. P. 0008. <https://doi.org/10.1038/s41551-016-0008>



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ANALYSIS OF SMART GLASSES SYSTEM FOR BLIND AND VISUALLY IMPAIRED PEOPLE

Abstract: In recent decades, advancing navigation and routing technologies has presented a formidable challenge for researchers aiming to devise sophisticated and intelligent guidance systems for individuals with visual impairments, both indoors and outdoors. Individuals suffering from visual impairments and blindness encounter difficulties in moving independently and overcoming various problems in their routine lives. As a solution, artificial intelligence and computer vision approaches facilitate blind and visually impaired (BVI) people in fulfilling their primary activities without much dependency on other people. Smart glasses are a potential assistive technology for BVI people to aid in individual travel and provide social comfort and safety. However, practically, the BVI are unable to move alone, particularly in dark scenes and at night. In this analysis, we examine a technologically advanced eyewear system designed for individuals with visual impairments (BVIPs), which integrates computer vision methodologies and deep learning algorithms, alongside auditory cues and tactile representations, to enhance autonomous navigation within nocturnal settings.

Keywords: smart glasses; artificial intelligence; blind and visually impaired; deep learning; low-light images; assistive technologies; object detection; refreshable tactile display.



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Introduction

In the contemporary landscape of information and communication technology, the quality of life and mobility independence for individuals with blindness and visual impairments (BVI) stands as a paramount societal concern warranting attention. Governments and specialized entities have enacted legislation and standards to support those with visual disabilities, establishing essential infrastructure for their benefit. As per the World Health Organization, global statistics indicate that as of 2020, approximately 2.2 billion individuals suffer from vision impairment or blindness, with at least 1 billion enduring preventable or unaddressed vision impairments. Various factors contribute to vision impairment, including cataracts, uncorrected refractive errors, glaucoma, corneal opacities, diabetic retinopathy, and trachoma, among others [1]. The primary challenges confronting BVI individuals in their daily lives pertain to spatial navigation and environmental awareness, prompting the development of navigation and object recognition solutions. However, prevalent navigation aids such as canes, guide dogs, and smartphone applications exhibit limitations; canes are ineffective over extended distances and in crowded environments, lacking in providing information concerning potential hazards like vehicular traffic when crossing roads, while guide dog training entails considerable expense and care demands. Although smartphone applications tailored for BVI users, such as voice assistants and navigation maps, are advancing, widespread adoption and optimal utilization remain limited.

The intersection of embedded systems and artificial intelligence has significantly impacted the domain of wearable assistive technologies for the visually impaired, leading to the introduction of various devices into the market. These assistive systems aim to aid BVI individuals in navigation and daily activities, including currency identification [2], road crossing assistance [3], accessible video media consumption [4], image sonification for navigation [5], facial recognition [6], privacy-sensitive visual information recognition, clothing selection, and both indoor and outdoor navigation. For instance, Daescu et al. [7] proposed a facial recognition system utilizing smart glasses and a server-based deep learning model, employing a client-server architecture to mitigate power consumption and computational overhead. Similarly, Joshi et al. introduced an assistive device integrating a deep learning model for object recognition, complemented by a distance-measuring sensor to identify obstacles during travel between locations.

Smart glasses, among the wearable assistive technologies, are highly regarded for their comfort and utility for individuals with visual impairments (BVI), offering enhanced vision capabilities akin to a computer interface. Since Google's introduction of "Google Glass" for BVI individuals in 2013, numerous companies such as Epson, Sony, Microsoft, Envision, eSight, NuEyes, Oxsight, and OrCam have entered the market, each offering smart glasses with varying degrees of functionality. Typically equipped with an integrated operating system and supporting wireless connectivity via Wi-Fi or Bluetooth, these glasses facilitate real-time exploration and access to information over the Internet, alongside their inherent camera functionalities. Interaction between users and their smart glasses is facilitated through touch-sensitive interfaces or voice recognition mechanisms. Additionally, real-time image or video capture of the surrounding environment is enabled through front-mounted cameras, leveraging computer vision techniques. Comparative performance and parameters of the proposed system and other commercially available smart glass solutions for BVI users are presented

in Table 1 below.

Table 1. The performance comparison of the commercially available smart glasses.

Smart Glasses	Target Users	Object Recognition	Text Recognition	Independent	Tactile Graphics	Walking Night-Time	Battery Capacity
eSight [8]	Low vision	No	Yes	Yes	No	No	2 h
NuEyes Pro [9]	Low vision	No	Yes	Yes	No	No	3.5 h
OrCam My Eye [10]	BVI	Yes	Yes	Yes	No	No	NA
Oxsight [11]	VI	Yes	Yes	Yes	No	No	2 h
Oton glass [12]	Low vision	No	Yes	Yes	No	No	NA
AngleEye [13]	Low vision	Yes	Yes	Yes	No	No	2 h
EyeSynth [14]	BVI	No	No	Yes	No	No	8 h
Envision [15]	BVI	Yes	Yes	Yes	No	No	5.5 h

Recently, scholars have conducted comprehensive reviews on wearable assistive technologies for individuals with visual impairments (BVI). Hu et al. scrutinized various assistive devices including glasses, canes, gloves, and hats, examining their behavioral, structural, functional, principled, contextual, and operational aspects. Their analysis encompassed multiple assistive devices along with 14 research works on assistive glasses and 6 commercially available models. Their findings suggest that many assistive devices are constrained in their spatial performance due to inadequate sensor coverage and feedback mechanisms. In 2020, Manjari et al. conducted a survey on assistive technologies for BVI, compiling devices developed up to 2019 and discussing their respective advantages and limitations. Gupta et al., in the same year, investigated existing assistive devices tailored for daily tasks, emphasizing simplicity and wearability to enhance user experience for BVI individuals. Their observations highlight that many devices address only specific aspects of the user's needs, thereby posing challenges in delivering a holistic user experience, and further note the financial burden associated with these devices relative to their functional features. El-Taher et al. undertook an extensive analysis of research pertinent to outdoor navigation aids for BVI, encompassing both commercial and non-commercial navigation applications spanning from 2015 to 2020. Among their findings, they observed that camera-based systems are susceptible to environmental factors such as illumination and weather conditions, albeit offering enhanced features regarding obstacle detection such as shape and color recognition, which aligns with aspects of our proposed smart glass system.



Smart Glass System for BVI People

In this segment, we examine research conducted in the realm of smart glass systems and object recognition. Wearable assistive systems have emerged as a highly convenient and effective means for individuals with visual impairments (BVI) to enhance independent mobility and undertake daily activities autonomously. Smart glass systems have found application across various domains including healthcare, aiding individuals with visual disabilities, computer science, social sciences, education, service industries, agriculture, and sports. Throughout this literature review, we emphasize the advantageous aspects of smart glass systems for BVI individuals.

One of the foremost challenges for individuals with visual impairments (BVI) is the recognition of familiar faces and identity information of acquaintances. Daescu et al. developed a face recognition system integrated into smart glasses, where facial images captured by the device's camera are processed on a server using deep convolutional neural network (CNN) models such as FaceNet and Inception-ResNet. However, this system necessitates retraining to identify new faces, leading to increased operational time. Mandal et al. focused on enhancing face recognition capabilities under diverse lighting conditions and facial poses, employing a wearable face recognition system based on Google Glasses and subclass discriminant analysis. Despite successfully recognizing faces of 88 subjects, the model requires retraining for new faces not initially included in the dataset.

Moreover, the prohibitive cost of existing commercial assistive technologies imposes significant financial strain on BVI individuals, particularly in developing nations. To address this issue, Chen et al. introduced a cost-effective smart wearable system for object recognition, leveraging a client-server architecture. The image processing tasks are predominantly executed on the server side, utilizing low-cost components such as Raspberry Pi and micro cameras, connected to cloud servers via Wi-Fi or 4G networks. Additionally, Ugolino and Fuks documented collaborative workshops involving BVI users, designers, mobility instructors, and computer engineering students, resulting in the prototyping of wearable devices integrated with verbal and haptic feedback to aid in landmark recognition, a crucial aspect for spatial orientation and cognitive mapping. Kumar et al. proposed a smart glass system for object and obstacle recognition, employing Raspberry Pi, ultrasonic sensors, and image capture capabilities. This system utilizes Tensorflow models to identify surrounding objects and alert users about potential collisions with obstacles through audio feedback facilitated by ultrasonic sensors.

Navigating through expansive, open spaces presents challenges for individuals with visual impairments due to the absence of tactile cues and braille guides. Fiannaca et al. introduced a navigation aid utilizing Google Glass to assist visually impaired users in traversing large open areas. The system facilitates secure navigation towards prominent landmarks such as doors, stairs, intersections, floor transitions, and water coolers by providing auditory feedback to guide users. However, the study revealed that blind individuals typically hold their cane in their right hand for navigation, posing difficulties in operating the smart glass touchpad with the same hand. To address this, it was suggested that positioning the touchpad on the left side would enhance interaction efficiency when using both the cane and smart glass concurrently.

Addressing the challenge of establishing eye contact among blind individuals in social settings, Qiu et al. implemented a social glass system and tactile wristband to facilitate eye contact and provide

tactile feedback during interactions with sighted individuals. Lee et al. proposed a solution to assist visually impaired individuals in acquiring visual information about pedestrians in their vicinity, incorporating a client-server architecture. The server component analyzes visual data and identifies pedestrians based on captured photographs, offering features such as face recognition, gender, age estimation, distance calculation, and head pose recognition, with the client providing audio feedback via text-to-speech.

Moreover, the utilization of ultrasonic sensors alone in smart glass systems has garnered attention from researchers. Hiroto and Katsumi introduced a walking support system comprising a wearable assistive device with ultrasonic obstacle sensors and bone conduction earphones. Adegoke et al. proposed a wearable eyeglass equipped with an ultrasonic sensor to aid visually impaired individuals in safe navigation, detecting both fixed and movable objects within a range of 3–5 meters and providing prompt voice feedback to alert users. However, these systems lack a camera for environmental analysis.

Figure 1 depicts the comprehensive design of the smart glasses system. The local component consists of the smart glasses and a smartphone, facilitating data transmission via Bluetooth connectivity. Concurrently, the artificial intelligence server receives images from the local unit, conducts processing, and delivers outcomes in audio format. It is important to highlight that the smart glasses hardware incorporates a built-in speaker for direct audio output, while an earphone port enables audio connectivity for conveying returned audio results from the smartphone to users.

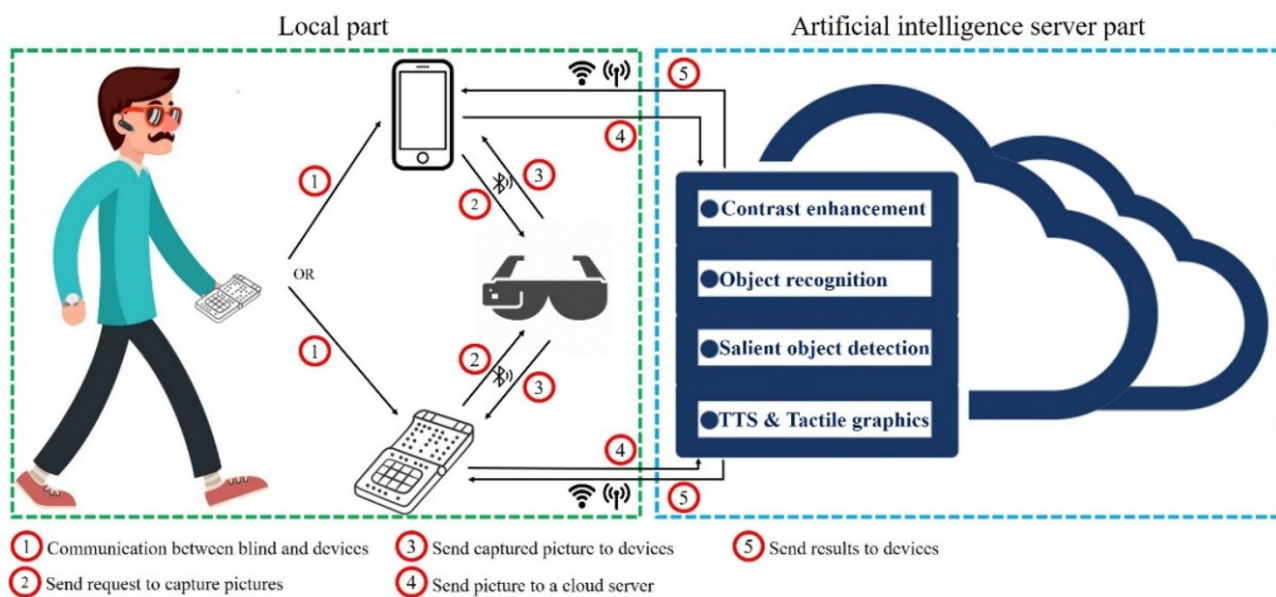


Figure 1. The overall design of the smart glasses system.



Conclusions

This study examines a smart glass system incorporating object detection, salient object extraction, and text recognition models utilizing computer vision and deep learning techniques tailored for individuals with visual impairments (BVI). Operating on an artificial intelligence server, this fully automated system is designed to detect and identify objects within low-light and dark environments to aid BVI individuals during nighttime navigation. Leveraging deep learning models and the inclusion of salient object extraction for tactile graphics and text recognition for text-to-speech functionality, the traditional smart glass system has been expanded. However, the implementation of deep learning models in smart glass systems demands increased energy and memory resources in embedded systems. With the advent of the 5G era, concerns regarding image data transmission to servers or real-time result retrieval for users have been mitigated. Experimental findings indicate the robust performance of object detection, salient object extraction, and text recognition models, particularly when augmented with low-light enhancement techniques in dark scene environments. Future endeavors aim to curate datasets specifically tailored for low-light and dark-image scenarios, encompassing bounding box annotations and ground truth data, to further refine object detection and text recognition capabilities and facilitate nighttime evaluations.

References

1. Steinmetz, J.D.; Bourne, R.R.; Briant, P.S.; Flaxman, S.R.; Taylor, H.R.; Jonas, J.B.; Abdoli, A.A.; Abrha, W.A.; Abualhasan, A.; Abu-Gharbieh, E.G.; et al. Causes of blindness and vision impairment in 2020 and trends over 30 years, and prevalence of avoidable blindness about VISION 2020: The Right to Sight: An analysis for the Global Burden of Disease Study. *Lancet Glob. Health* 2021, 9, e144–e160.
2. Dunai Dunai, L.; Chillarón Pérez, M.; Peris-Fajarnés, G.; Lengua Lengua, I. Euro banknote recognition system for blind people. *Sensors* 2017, 17, 184.
3. Patrycja, B.-A.; Osiński, D.; Wierzchoń, M.; Konieczny, J. Visual Echolocation Concept for the Colorophone Sensory Substitution Device Using Virtual Reality. *Sensors* 2021, 21, 237.
4. Yu, S.; Lee, H.; Kim, J. Street crossing aid using light-weight CNNs for the visually impaired. In *Proceedings of the IEEE/CVF International Conference on Computer Vision Workshops*, Seoul, Korea, 27–28 October 2019.
5. Spagnol, S.; Hoffmann, R.; Martínez, M.H.; Unnthorsson, R. Blind wayfinding with physically-based liquid sounds. *Int. J. Hum.-Comput. Stud.* 2018, 115, 9–19.
6. Skulimowski, P.; Owczarek, M.; Radecki, A.; Bujacz, M.; Rzeszotarski, D.; Strumillo, P. Interactive sonification of U-depth images in a navigation aid for the visually impaired. *J. Multimodal User Interfaces* 2019, 13, 219–230.
7. Daescu, O.; Huang, H.; Weinzierl, M. Deep learning based face recognition system with smart glasses. In *Proceedings of the 12th ACM International Conference on PErvasive Technologies Related to Assistive Environments*, Rhodes, Greece, 5–7 June 2019.
8. eSight. Available online: <https://esighteyewear.com/> (accessed on 28 October 2021).
9. NuEyes Pro. Available online: <https://www.nueyes.com/> (accessed on 28 October 2021).
10. OrCam My Eye. Available online: <https://www.orcam.com/en/myeye2/> (accessed on 28 October 2021).
11. Oxsight. Available online: <https://oxsightglobal.com/> (accessed on 28 October 2021).
12. Oton Glass. Available online: <https://www.jamesdysonaward.org/en-GB/2016/project/oton-glass/> (accessed on 28 October 2021).
13. AngleEye. Available online: <https://www.closingthegap.com/angeleye-series-angleeye-smart-reader-and-angeleye-smart-glasses/> (accessed on 28 October 2021).



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MOBIL QURILMALARDAGI MA'LUMOTLARNI CLOUDDA XAVFSIZ SAQLASH ALGORITMI

Annotatsiya: Ushbu ilmiy tadqiqot ishida axborotni kriptografik himoyalash tizimlari nazariyasi, ehtimollar nazariyasi, sonlar nazariyasi, matematik mantiq va kombinatorika metodlaridan foydalanilgan. Bulardan tashqari solishtirish, testlash va qiyosiy tahlil usullaridan foydalanildi. Mobil qurilmalardagi ma'lumotlarni xavfsizligini ta'minlash, Cloud Storage da ma'lumotlarni himoyalash va Cloud Storage texnologiyasida mavjud zaifliklarni bartaraf etishga qaratilgan xavfsizlik choralarini ishlab chiqish ishining nazariy ahamiyati sanaladi. Ma'lumotlarni himoyalashning mujassamlashgan usulidan foydalangan holda mobil qurilmalarda saqlanadigan va ishlanadigan axborotlarni Cloud Storage texnologiyasi asosida himoyalash samaradorligini oshirishga qaratilgan algoritmlar ishlab chiqildi.

Kalit so'zlar: Cloud computing, Cloud Storage, AES va SALSA20, SHA1 va MD5, shifrlash, Cloud da xavfsiz, Deshifrlash algoritmi.



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ALGORITHM FOR SAFE STORAGE OF DATA ON MOBILE DEVICES IN THE CLOUD

Abstract: The theory of cryptographic information protection systems, probability theory, number theory, mathematical logic and combinatorics methods were used in this research work. In addition, comparison, testing and comparative analysis methods were used. The theoretical importance of the development of security measures aimed at ensuring the security of data in mobile devices, protecting data in Cloud Storage and eliminating existing vulnerabilities in Cloud Storage technology is considered. Algorithms aimed at increasing the efficiency of protection of information stored and processed on mobile devices based on Cloud Storage technology using the integrated method of data protection were developed.

Keywords: Cloud computing, Cloud Storage, AES and SALSA20, SHA1 and MD5, Encryption, Secure in the Cloud, Decryption algorithm.



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Kirish

Hozirgi kunda hayotimizni mobil qurilmalar, internet umuman olganda axborot texnologiyalarisiz tasavvur etish qiyin. Ular hayotimizning ajralmas qismiga aylanib ulgurdi. Ularning rivojlanishi natijasida ma'lumotlarimizni saqlash va ulardan foydalanish imkoniyatlari oshib bormoqda. Biz doimiy ravishda mobil qurilmalarimizda o'zimiz uchun kerakli bo'lgan axborotlarini saqlaymiz, vaqti kelganida ularni kimgadir yuboramiz va kimdandir qabul qilib olamiz.

Bundan tashqari bulutli hisoblash texnologiyalari (Cloud computing) rivojlanishi natijasida biz o'z ma'lumotlarimizni bulutli serverlarda ya'ni Cloud Storagelarda [1] saqlash imkoniyatidan keng foydalanmoqdamiz.

Cloud computing elektron hisoblash xizmatlarini kompyuter tarmoqlari orqali yetkazib berishni nazarda tutadi va o'zida ma'lumotlarni saqlash tizimlari, turli ilovalar uchun platformalar, katta hisoblashlarni internet tarmog'ida mavjud kompyuterlardan foydalanib yechish kabi imkoniyatlarni yaratadi.

Bulutli texnologiyalar qulayliklar yaratish bilan bir qatorda muammolarni ham o'rta qo'yimoqda. Ushbu texnologiya mavjud imkoniyatlar bilan birgalikda Cloud Storageda saqlanayotgan ma'lumotlar xavfsizligini ta'minlash masalasini keltirib chiqarmoqda.

Materillar va usullar

Yuqorida aytib o'tilganidek, mobil qurilmalardagi ma'lumotlarni Cloudda xavfsiz saqlash dasturini ishlab chiqish uchun AES va SALSA20 shifrlash algoritmlari hamda SHA1 va MD5 heshlash funksiyalaridan foydalanilgan bo'lib, ulardan mujassamlashgan holda foydalanish orqali mobil qurilmalarda saqlanadigan va ishlanadigan axborotlarni Cloud Storage texnologiyasi asosida himoyalash samaradorligini oshirish mumkin. Mazkur mujassamlashgan usul orqali quyidagi muammolar hal etilgan:

- Foydalanuvchilarni autentifikatsiyalash;
- fayl nomi va mazmunini oshkor etmaslik;
- faylning kimga tegishli ekanligini yashirish;
- bir martalik kalitlardan foydalanish;
- ma'lumotlarni serverda shifrlangan ko'rinishda saqlash.

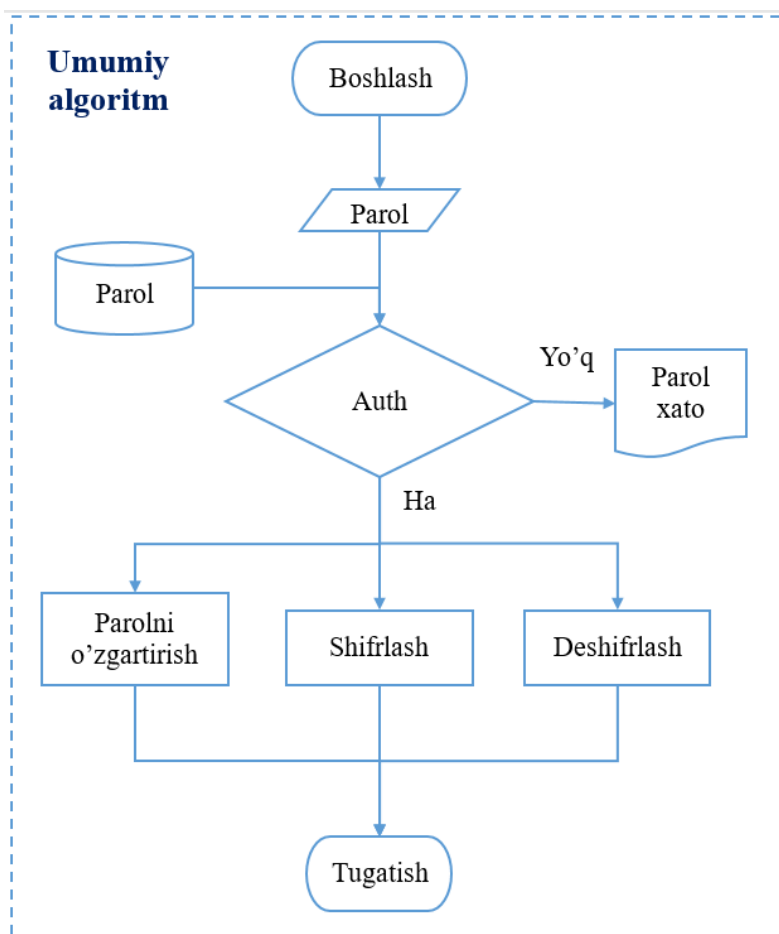
Foydalanuvchilarni autentifikatsiyalashda foydalanuvchining nomi mobil qurilmada ro'yhatdan o'tgan pochta manzili orqali unga ulanish paroli esa, shifrlash kalitidan foydalangan holda faylda saqlanadi. Ushbu parol joylashgan faylni ma'lumot tashuvchi qurilmada saqlash yoki bulutli serverlarda saqlash mumkin. Ushbu jarayonni amalga oshirish natijasida, klaviatura va qo'pol kuch hujumlaridan oldi olinadi[56].

Faylning kimga tegishli ekanligini yashirish. Ya'ni, faylning o'zi shifrlangan holda Cloudga yuboriladi. Foydalanuvchi emailaridan esa xesh qiymati hisoblanib unga shifrlangan kalit qo'shiladi va u ham Cloudda saqlash uchun yuboriladi.

Hosil bo'lgan hesh qiymat tasodifiy belgilardan iborat bo'lib, u kimga tegishli ekanligini o'zida berkitib turadi.

Bir martalik kalitlardan foydalanish. Bir martalik kalitlar har bir to'plam nomi orqali yaratiladi. Ushbu kalit AES shifrlash algoritmi yordamida shifrlanadi va hosil bo'lgan kalitni foydalanuvchi uchun tushunarli bo'lgan joyda saqlab qo'yiladi. Faylga har safar murojaat bo'lganida ushbu fayl yangisiga o'zgaradi. Ya'ni bir kalit faqat bir marta qo'llaniladi.

Ma'lumotlarni serverda shifrlangan ko'rinishda saqlashda SALSA algoritmidan foydalaniladi. Unda kalit sifatida yuqorida AES yordamida shifrlab faylda saqlangan tasodifiy, bir martalik kalit qo'llaniladi.

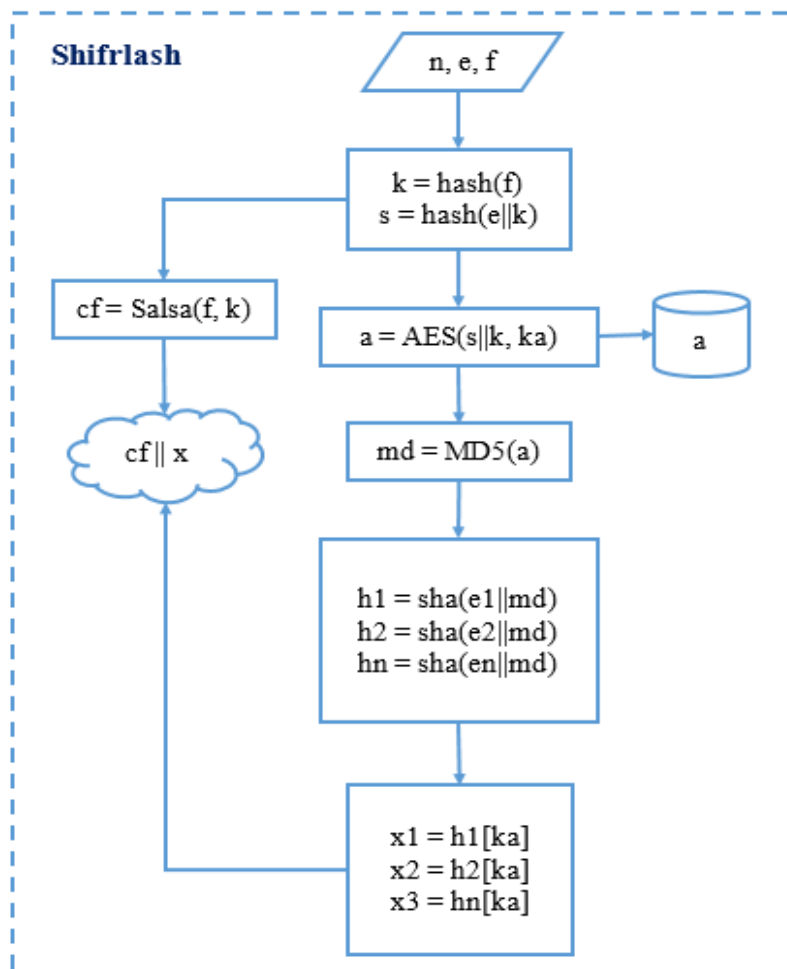


1-rasm. Dastur algoritmi.

Dasturga kirgandan so'ng, dastlab foydalanuvchidan maxfiy parolni kiritish so'raladi. Agar parol xato kiritilsa, dasturdan foydalanishga ruxsat berilmaydi.

Agar parol to'g'ri kiritilsa, dastur keying bosqichga o'tadi. Unda quyidagilarni amalga oshirish mumkin:

- Maxfiy parolni o'zgartirish;
 - Ma'lumotlarni shifrlab Cloudga yuborish va deshifrlash uchun kerakli bo'lgan qiymatlarni saqlab qo'yish;
 - Ma'lumotlarni Clouddan yuklab olish va ularni deshifrlab, foydalanuvchiga taqdim etish.
- Shifrlash algoritmini ko'radigan bo'lsak, unda quyidagi ketma-ketliklar bajariladi:



2-rasm. Ma'lumotlarni shifrlab, Cloudga yuborish

Bunda, quyidagilarni izohlab o'tish zarur:

n – to'plam nomi;

e – foydalanish ruxsati berilgan electron pochta, ular bir nechta bo'lishi mumkin;

f – xavfsizligi ta'minlanishi kerak bo'lgan fayllar, ular shifrlanib, Cloud serverda saqlanadi;

Salsa – ma'lumotlarni shifrlash uchun ishlatiladigan algoritm, to'liq nomi Salsa20;

AES – shifrlashda ishlatilgan kalitni maxfiylikini ta'minlash uchun foydalaniladigan shifrlash algoritmi;

MD5, sha – xesh funksiyalar.

Dastlab kirish qiymati sifatida, to'plam nomi, foydalanish ruxsati berilishi kerak bo'lgan email va konfidensialligi ta'minlanishi kerak bo'lgan fayllar tanlanadi.

So'ngra, belgilangan fayllar maxsus algoritm orqali shifrlanadi va belgilangan serverga yuboriladi. Shifrlashda ishlatilgan kalit esa, to'plam nomi bilan birgalikda AES shifrlash algoritmi orqali shifrlanadi.

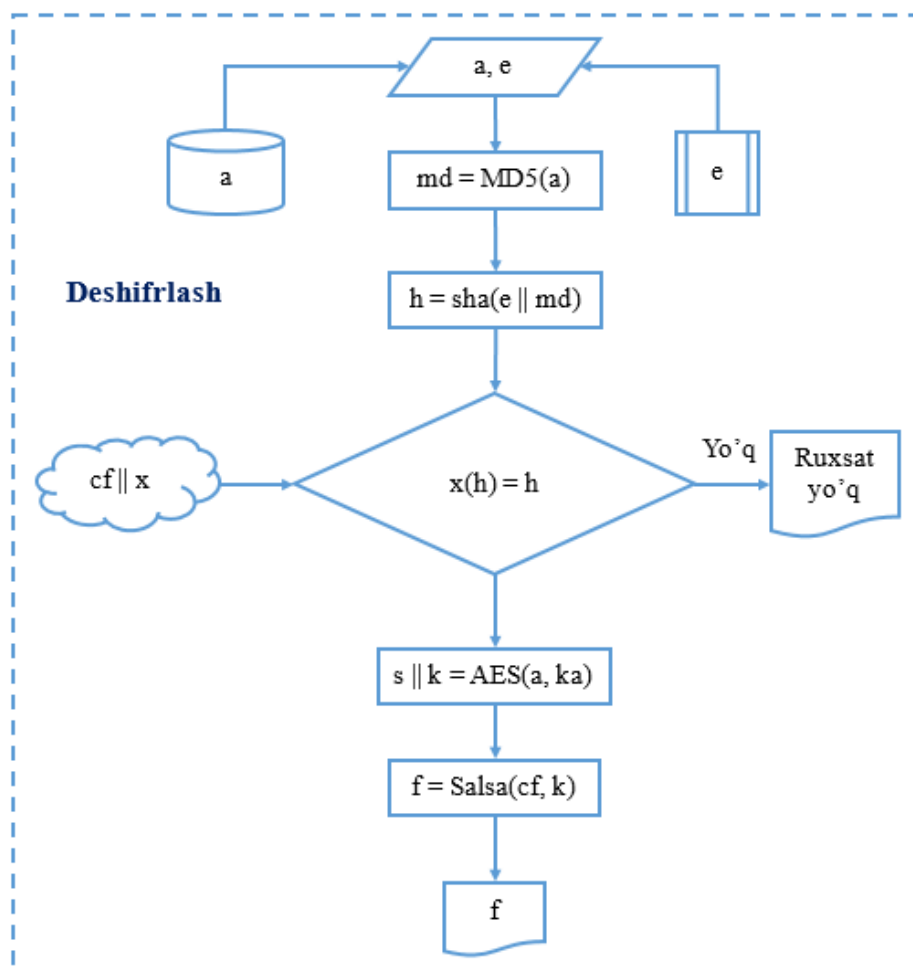
Keyin undan xesh qiymat olinib, ruxsat berilgan har bir emailga qo'shilgan holda yana bir bor xesh qiymatlar hosil qilinadi. Ushbu hech qiymatlarning har biriga, shifrlangan kalit biriktirilib, ular

ham belgilangan serverda saqlash uchun yuboriladi.

Keyingi algoritm Clouddan ma'lumotlarni yuklab olish va deshifrlab foydalanuvchiga taqdim etish bo'lib, 28-rasmda keltirilgan.

Aytish mumkinki bu bundan oldingi algoritmni aksi bo'lib, unda ham yuqorida keltirilgan shifrlash algoritmlari va xeshlash funksiyalaridan foydalanilgan.

Shuni ta'kidlab o'tish lozimki, deshifrlash jarayonida hech qanday qiymat klaviatura orqali kiritilmaydi, ya'ni, algoritmda ko'rsatilgan akey va e qiymatlar mobil qurilmadan olinadi. Aniqroq qilib aytganda, akey shifrlash jarayonida mobil qurilmaga maxsus saqlab qo'yilgan kalit bo'lib, u mobil qurilma xotirasidan ko'rsatib qo'yiladi. E esa mobil qurilmada autentifikatsiyadan o'tgan electron pochta bo'lib, emailni kiritish paytida, mobil qurilmadagi electron pochta ro'yxati taqdim etiladi va ulardan birini tanlash so'raladi[55].



3-rasm. Deshifrlash algoritmi

Deshifrlash jarayoni qachonki foydalanuvchi o'zini haqiqiylikni tasdiqlagandagina amalga oshiriladi. Buning uchun, foydalanuvchi o'zining haqiqiylikni, unga foydalanish ruxsati berilganligini va unda maxsus kalit fayl mavjud ekanligini tasdiqlashi talab etiladi. Agar foydalanuvchi ularni to'g'ri taqdim eta olmasa, deshifrlash jarayoni amalga oshirilmaydi.



Xulosa

Tadqiqot ishida mobil qurilmalardagi ma'lumotlarni Cloudda xavfsiz saqlash dasturini ishlab chiqishga qaratilgan bo'lib, quyidagi natijalar olindi:

- Ma'lumotlarni Cloudda xavfsiz saqlash dasturida foydalanilgan shifrlash algoritmlari va xeshlash funksiyalari tadqiq etildi;
- Mazkur shifrlash algoritmlarining asosini tashkil etuvchi funksiyalar tadqiq etildi;
- Dastur algoritmi yaratildi;
- Yaratilgan algoritm asosida mobil qurilmalardagi ma'lumotlarni Cloudda xavfsiz saqlash dasturiy ta'minoti ishlab chiqildi;
- Dasturdan foydalanish imkoniyatlari batafsil keltirildi.

Adabiyotlar

1. Zhang, Yinghui, et al. "Ensuring attribute privacy protection and fast decryption for outsourced data security in mobile cloud computing." *Information Sciences* 379 (2017): 42-61.
2. Aware, Preeti A., Vinayak Shinde, and Anand Aware. "Security Issues in Mobile Cloud Computing." Kaufman, Lori M. "Data security in the world of cloud computing." *IEEE Security & Privacy* 7.4 (2009).
3. Gupta, Shaurya, and Piyush Gupta. "A Study of the Issues and Security of Cloud Computing." *International Journal of Computer Science and Information Technologies*, Vol. 5 (4) , 2014, 5429-5434
4. Sarode, Rashmi P., Piyush Gupta, and Neeraj Manglani. "A comparative analysis of RSA and MD5 algorithms." *Journal of Computer Science and Applications*. ISSN (2014): 2231-1270.
5. Eswaraprasad, R., & Raja, L. (2017). A review of virtual machine (VM) resource scheduling algorithms in cloud computing environment. *Journal of Statistics and Management Systems*, 20(4), 703-711.
6. Suo, Hui, et al. "Security and privacy in mobile cloud computing." *Wireless Communications and Mobile Computing Conference (IWCMC)*, 2013 9th International. IEEE, 2013.



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AXBOROT- BOSHQARUV TIZIMLARI DASTURIY TA'MINOTINING ISHONCHLILIGINI BAHOLASH MODELI

Annotatsiya: Mazkur tadqiqot ishida axborot-boshqaruv tizimlarning zamonaviy dasturiy ta'minoti sifatini aniqlovchi muhim omil bo'lib, uning ishlash ishonchligi hisoblanadi. Bu muammo bilan dunyoda dasturiy majmualar va mahsulotlar ishlab chiqaruvchilar hamda tadqiqotchilar shug'ullanishadi. Aks holda mijozlarga xizmat ko'rsatish va butun bir ishlab chiqarishlarni to'xtashga, maxfiy ma'lumotlarning chiqib ketishi va loyihalovchilarning xatolari sababli juda katta moliyaviy va obro'-e'tiborga xavflar dasturiy to'xtab qolishga olib kelishi mumkin. Axborot-boshqaruv tizimlari dasturiy ta'minoti ishonchligini baholash amaliyoti va nazariyasining hozirgi holatini tahlil qilish hamda ularning kelgusi rivojlanishi va takomillashtirish tendensiyalarini baholash modellari keltirilgan.

Kalit so'zlar: Model, xatoliklar, baholash, axborot, ta'minot.



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THE RELIABILITY ASSESSMENT MODEL OF INFORMATION-MANAGEMENT SYSTEMS SOFTWARE

Abstract: In this research work, an important factor determining the quality of modern software of information management systems is its operational reliability. Developers of software packages and products, as well as researchers, deal with this problem. Failure to do so can lead to customer service and entire production shutdowns, software downtime, enormous financial and reputational risks due to confidential data leaks and designer mistakes. Analysis of the current state of the practice and theory of the reliability of information management systems software, as well as models for assessing the trends of their future development and improvement are presented.

Keywords: Model, errors, assessment, information, supply.



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Kirish

Jahonda intellektual tizimlar va texnologiyalar XXI asrning asosiy muhim texnologiyalaridan bo'lib, insoniyat faoliyatining ijtimoiy va barcha ishlab chiqarishda muhim ahamiyatga ega bo'lgan sohalarida qo'llaniladi. Ularning sifatli yangi imkoniyatlari, ma'lumotlarning noaniqligi va xatoligi sharoitida, xavflarning mavjudligi va murakkab tizimlar hayot siklining barcha pog'onalarida vaqtning yetishmasligi, sun'iy intellekt vositalari va usullarini qo'llash bilan masalalarning yangi darajalarini yechish hisobiga uni hisoblash texnikasida tatbiq qilishning an'anaviy sohalarida samarali qo'llashni anchagina oshirishga imkoniyat beradi.

Jahonda axborot-boshqaruvchi tizimlarning jahonda rivojlanishi ishlab chiqarish boshqaruv tizimlarining hayot siklini axborotli qo'llab-quvvatlashda, murakkab texnik va texnologik boshqaruv ob'ektlarning ishlash sifatini talab darajasida ta'minlovchi ishonchli dasturiy ta'minotni ishlab chiqishga asoslanuvchi joriy etishning natijaviyligi yangi usullarning paydo bo'lishiga olib keldi.

Dasturiy ta'minotning ishonchliligini baholashga qiziqish kompyuter dasturlarining paydo bo'lishi bilan bir vaqtda vujudga keldi va ishlashi asosan dasturiy ta'minotning (DT) ishlashi uchun mo'ljallangan texnik qurilmaning (hisoblash mashinasi yoki personal kompyuterning) ishonchliligini an'anaviy ehtimollikli baholashni olishga tabiiy intilishi bilan kelib chiqdi. Binobarin, dasturiy ta'minot mashina qismlaridan biri sifatida aniqlanadi, dasturiy tashkil etuvchining ishonchliligini baholashga yondashish dastlab texnik qurilmalarning ishonchliligini baholashdan kam farqlandi va texnik tizimlar ishonchliligi klassik nazariyasining ma'lum statistik usullarini yangi muhitga o'tkazishdan iborat bo'ldi va uning alohida tarmog'i – DTning ishonchliligi nazariyasini tashkil etdi [1-2].

Materillar va usullar

Dasturiy ta'minot rasmiy hujjatlar va foydalanuvchiga qo'yilgan spesifikasiyalarga muvofiq o'zini tutadigan vaziyatda xatoliklar ham dasturda, ham spesifikasiyalarda bo'lishi yoki ko'rsatmalarda faqat hisoblash tizimi bilan kutiladigan va rejalashtiriladigan ishlar tavsiflangan bo'lishi mumkin.

“Xatolik”, “nuqson” va “uzilish” atamaları ko'pincha ma'noga ajratmasdan ishlatiladi. Dasturiy ta'minotda “xatolik” bu kodning bajarilishi vaqtida uzilishlarga olib keladigan DTdagi nuqsonlarni keltirib chiqaradigan dasturchining amali hisoblanadi [3]. “Uzilish” kod bajarilganida kerakli holatdan tizimning chiqishni rad etishini bildiradi. Nuqson tizimning chiqishigacha bo'ladi va xatolikka ega bo'lgan kod bajarilganda uzilishni keltirib chiqaradi. Nuqsonning testlanishi darajasi tasodifiy tanlangan chiqishda uzilishni aniqlanishi ehtimolligi sifatida aniqlanadi. Tizimdan tizimga o'zgaradiga quydagi uzilish darajalari mavjud: halokatli, yuqori, o'rta, past, sezilarsiz.

Oddiy (yoki “osilib qolish”) uzilish bu ham tizimning apparatlar qismidagi, ham dasturiy tashkil etuvchisidagi uzilishlarga yoki foydalanuvchining noto'g'ri amallariga bog'liq bo'lgan uzailishning alohida turi hisoblanadi.

Dasturiy ta'minotning ishonchliligi parametrlarini baholash predmetlar sohasidan ko'plab ishlar orasidan dasturiy ta'minotning ishonchliligini xarakterlaydigan u yoki bu miqdoriy

ko'rsatkichlarni o'lchash yoki baholash usullariga bir necha o'nlab yondashishlarni aniqlash mumkin [4].

Ulardan asosiylarini ajratib ko'rsatamiz [5].

Ishonchlilik - R (reliability) belgilashga ega va uzilishni vujudga kelmasiligi ehtimolligi sifatida o'lchanadi. Ishonchlilik deyarli barcha modellarda asosiy ko'rsatkich sifatida ishlatiladi.

Uzilishni paydo bo'lishi o'rtacha vaqti - MTTF (Mean Time To Failure) qisqartmaga ega va ikkita ketma-ket uzilishlar orasidagi vaqtni o'lchaydi.

Uzilishlarning intensivligi – MTTFga teskari bo'lgan kattalik, vaqt birligi ichidagi uzilishlar sonini aniqlaydi.

O'rtacha turib qolish vaqti (TR) – uzilishdan keyin tizimni (yoki uning tarkibiy qismini) aniqlash, tuzatish va qayta tiklashga sarflanadigan vaqtni aniqlaydigan kattalik hisoblanadi.

Tizimning tayyorlik koeffitsienti (S) – uzilishni paydo bo'lishi o'rtacha vaqti va tizimning turib qolishi o'rtacha vaqti orasidagi farqni uzilishni paydo bo'lishi o'rtacha vaqtiga nisbati sifatida aniqlanadi.

DT kodida qolgan xatoliklar soni – dasturiy ta'minotni ishlab chiqishda ishlatiladi va dastlabki kodning har bir mingta satriga koddagi xatoliklar sonini ko'rsatadi.

Koddagi xatoliklar zichligi – odatda dastlabki kodning har bir mingta satriga xatoliklar soni sifatida aniqlanadi [6].

Dasturiy ta'minot ishonchliligining yetarli darajasini ta'minlash bajariladigan loyihaning 60 % resurslarini tashkil etishi mumkin, shu tufayli testlashni eng sinchiklab rejalashtirish, loyihani berilgan muddatlarda o'tkazish kerak. Hatto uzoq muddatli testlash davridan keyin qo'shimcha sinovlar yangi xatoliklarni aniqlashi mumkin. Dasturiy ta'minot loyihaning natijasi sifatida kerakli ishonchlilik darajasiga ega, lekin xatoliklarga ega bo'ladi.

An'anaviy tarzda rejalashtirish va qarorlarni qabul qilish uchun SGRM (Software Growth Reliability Model) – dasturiy ta'minotning ishonchliligini ortishi modellari ishlatiladi, ularda ishonchlilik testlash vaqtiga proporsional ortishi ko'zda tutiladi, protsessordan foydalanish davomiyligi o'lchanadi. Bunda ishonchlilikni ortishi t vaqt davomida $\mu(t)$ kutiladigan xatoliklar soniga bog'liq ravishda $\lambda(t)$ uzilishlar intensivligi atamalarida ifodalanadi:

$$\lambda(t) = \frac{d}{dt} \mu(t), \quad (1.1)$$

t vaqt davomidagi xatoliklar soni $N(t)$ qabul qilinadi va xatoliklar aniqlanishi bilan tuzatilishi ko'zda tutiladi. Asosga topilgan va tuzatilgan xatoliklar soni mavjud xatoliklar soniga proporsional bo'lishini ko'zda tutadigan eksponensial model olinadi. Ko'rsatish mumkinki, β_1 quydagicha aniqlanadi:

$$\beta_1 = \frac{k}{SQ \frac{1}{r}}, \quad (1.2)$$

bu yerda S – kod tarkibidagi ko'rsatmalar soni; Q – kodning har bir ko'rsatmalaridagi ob'ektlar



ko'rsatmalar soni; r – kompyuter ko'rsatmani bajarilishi darajasi; k – xatoliklarga uchrash koeffitsienti deyiladi va 1×10^{-7} dan 10×10^{-7} gacha o'zgaradi; t vaqt protsessor vaqtining bajarilishi sekundlarida o'lchanadi:

$$N(t) = N(0) \exp(-\beta t), \quad (1.3)$$

bu yerda $N(0)$ – xatoliklarning boshlang'ich soni; t vaqt davomidagi umumiy xatoliklar soni:

$$\mu(t) = N(0) - N(t) = N(0) (1 - \exp(-\beta t)), \quad (1.4)$$

Umumiy holda:

$$\mu(t) = \beta_0 (1 - \exp(-\beta_1 t)), \quad (1.5)$$

bu yerda β_0 – aniqlanishi mumkin bo'lgan umumiy xatoliklar soni. Sozlash vaqtida yangi xatoliklar qilinmasligi ko'zda tutiladi.

Uzilishlar intensivligi uchun ifoda quyidagi ko'rinishga ega:

$$\lambda(t) = \beta_0 \beta_1 \exp(-\beta_1 t), \quad (1.6)$$

Ekspontensial model qo'llanishda oson, β_0 va β_1 parametrlar testlash jarayoni boshlanguncha aniqlanadi.

SGRM yondashish quyidagi holarda maqsadga muvofiq:

– *testlash boshlanguncha*, bunda dastlabki testlash rejasiga ega bo'lish zarur. Ekspontensial yoki logarifmik model qo'llanganida talab qilinadigan uzilishlar intensivligi qiymati, MTTF yoki xatoliklar zichligiga erishish vaqtini baholash mumkin. t vaqt kishi-soatlarda o'lchanadi va loyihalarni bajarilishi tajribasi asosida aniqlanadigan mos koeffitsientga ko'paytirilishi kerak;

– *testlash vaqtida*, bunda SGRM asosida kerakli ishonchlilik darajasiga erishish uchun zarur bo'ladigan testlash vaqti baholanadi.

SGRMning qo'llanishi algoritmining asosiy qadamlari quyidagilar:

1. *Ma'lumotlarni to'plash*. Uzilishlar intensivligi g'aqidagi ma'lumotlar ko'pincha silliqanishi kerak bo'ladigan ko'plab xatoliklar va "shovqinlarni" o'z ichiga oladi. Testni intervallrga bo'lishni o'z ichiga oladigan ma'lumotlarni guruhlashtirishdan foydalaniladi. Bunda har bir intervaldagi uzilishlar intensivliklarining o'rtacha qiymati hisoblanadi.

2. *Modelni tanlash va parametrlarni aniqlash*. Modelning tanlashning eng yaxshi usuli bu bunday loyihalarni bajarishda to'plangan tajribaga tayanish hisoblanadi. Bunda ko'pincha parametrlarni ekstrapolyatsiyalash uchun ekspontensial va logarifmik modellar ishlatiladi. Birinchi testlar ma'lumotlari ko'p sonli xatoliklarga ega bo'ladi. Testlashning oldingi bosqichlarida parametrlar real qiymatlaridan kuchli og'ishi va ular stabillanmaguncha ishlatilishi mumkin emas.

3. *Qo'shimcha testlarning soni haqida tahlilni bajarish*. To'g'ri keladigan model asosida uzilishlarning intensivligi ma'lum darajasiga erishish uchun zarur bo'ladigan qo'shimcha testlar sonini baholash mumkin. Bunda testlash uchun zarur bo'ladigan minimal vaqt hisoblanadi.

Testlash jarayonida SGRM modeli asosidagi xatoliklarni qidirish yagona uslubi ishlatiladi. Har bir yangi strategiya dastlab ma'lum xatoliklar sinfini qidirish va baholashdan samarador bo'ladi, bu

silliqlash hisoblash protseduralaridan foydalanishni zarur qiladi. Dasturiy ta'minot testlash vaqtida ham modernizatsiyalanishni davom etishi muammoli vaziyatni yuzaga keltiradi. Agar bu o'zgarishlar sezilarli bo'lsa, tanlashdan oldingi olingan ma'lumotlarni chiqarib tashlashga to'g'ri keladi.

SGRM samaradorligi muhimparametrlaridan biri bo'lib S_v tarmoqlanish qamrab olish koeffitsientiga chiziqli bog'liq bo'lgan S_d xatoliklarni qamra olish koeffitsienti xizmat qiladi. Tarmoqlanish qamrab olish koeffitsienti dasturning barcha bo'lishi mumkin tarmoqlanish yo'llari qanchalik samarali "qamrab olinganligini" ko'rsatadi:

$$S_d = -a + b S_v, S_v > 0. \quad (1.7)$$

Ifoda (1.8) da a va b parametrlarning qiymatlari dasturi ta'minotning o'lchmlariga va xatoliklar boshlang'ich zichligiga bog'liq. Qamrab olish koeffitsientlaridan foydalanishning avzalligi shundan iboratki, ular dastur qanchalik puxta tadqiq qilinishiga to'g'ridan-to'g'ri bog'liq bo'ladi. dasturiy ta'minotning yuqori ishonchliligiga erishish uchun dasturning ichki o'zini tutishiga ta'sir qiladigan shartli operatorlar hisoblanadigan predikatlarini qamrab olish koeffitsienti kabi qat'iy o'lcham ma'qbulroq hisoblanadi.

Xulosa

Axborot-boshqaruvchi tizimlar dasturiy ta'minotining sifat va ishonchliligini baholash ilmiy-texnik muammolarining zamonaviy holat tahlili, tendensiyalari va kelajakdagi rivojlanishi hamda takomillashtirilishi ko'rinishida adabiyot manbalarining tahliliy obzor qilingan. Ishlab chiqarishni avtomatlashtirish global bozorining rivojlanish tendensiyalari va harakatlantiruvchi kuchlari, ssenariylar va ishlab chiqarish Internet hamda kelajak aqlli fabrikalarining imkoniyatlari aniqlangan, shu jumladan neft va gazni qayta ishlash, kimyoviy va ishlab chiqarishning murakkab sohalari axborot-boshqaruvchi tizimlarining rivojlanish trendlari aks ettirilgan. Zamonaviy infokommunikatsiya texnologiyalar asosida ishlab chiqarishni avtomatlashtirish tizimlari evolyusiyasining qisqacha tavsifi berilgan.



Adabiyotlar

1. Kasymov S.S., Usmanova N.V. On developing the environment for multiagent system of distributed computing: using the associations. *Chemical Technology: Control and Management/ Journal of Korea Multimedia Society/International Scientific and Technical Journal*, 2015. №3-4.
2. Boehm B.W., Haile A.C. *Information Processing // Data Automation Implications of Air Force Command and Control Requirements in the 1980's (CCPI - 1985). Vol. I. Highlights, Report SAMSO/XRS-71-1. U. S. Air Force Systems Command (NTIS: AD 900031L). Los Angeles, CA, 1982.*
3. Terzic, et al, *Usability of Multi-agent Based Control Systems in Industrial Automation // A. Zoitl (Eds.): HoloMAS 2009, LNAI 5696, Springer-Verlag Berlin Heidelberg, 2009.*
4. Neelu Nihalani, Sanjay Silakari. *Natural language Interface for Database: A Brief review // IJCSI.org Online, Vol. 8, Issue 2, March 2011.600-608 pag.*
5. Choi J.G., Kang H.G. *Reliability Estimation of nuclear digital I&C systems using Software Functional Block Diagram and control flow. FastAbstract ISSRE Copyright, 2002.*
6. Usmanova N. *Resource Management Issues in Distributed Environment // International Journal of Ubiquitous Computing and Internationalization, S.Korea, Vol.3, №2, 2011. - pp. 25-28.*



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TELEKOMMUNI- KATSIYA OBYEKTINING ELEKTR TA'MINOTI TIZIMINI MORFOLOGIK TAHLIL ORQALI MODELASHTIRISH

Annotatsiya. Telekommunikatsiya elektr ta'minoti tizimi uchun uning elektr ta'minoti tizimlarini maqbul loyihalash muammosini hal qilish uchun texnik yechimlarni morfologik tahlil qilish va tahlil qilishga asoslangan loyihalash tamoyillari va usullarini ishlab chiqish zarur. Morfologik tahlil usulining mohiyati shundaki, ko'rib chiqilayotgan muammo uchun ahamiyatli bo'lgan bir nechta morfologik xususiyatlarni (tipik, o'ziga xoslik, farqlash) aniqlash va ushbu xususiyatlarni barcha mumkin bo'lgan kombinatsiyalar tuziladi.

Kalit so'zlar: elektr ta'minoti tizimi, elektr energiyasini ishlab chiqarish, o'zgartirish, uzatish, taqsimlash va iste'mol qilish, kombinator-mantiqiy tahlil, morfologik to'plam, morfologik tahlil.



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MODELING OF ELECTRICAL SUPPLY SYSTEM OF TELECOMMUNICATION FACILITY THROUGH MORPHOLOGICAL ANALYSIS

Abstract: For the telecommunication power supply system, it is necessary to develop design principles and methods based on morphological analysis and analysis of technical solutions to solve the problem of optimal design of its power supply systems. The essence of the morphological analysis method is to identify several morphological features (typical, distinctive, differentiating) that are important for the problem under consideration, and to compile all possible combinations of these features.

Keywords: power supply system, electricity generation, transformation, transmission, distribution and consumption, combinatorial logic analysis, morphological set, morphological analysis.



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Kirish

Raqamli texnologiyalarni telekommunikatsiya tizimlarida keng qo'llanilishi elektr ta'minoti tizimida elektr energiyasini o'zgartirish sifatini oshirish, ishonchligi, qurilmalarning elektromagnit moslashuvchanligi va uzluksiz elektr ta'minotini yaxshilashni talab qiladi.

Har qanday jamiyatning iqtisodiy rivojlanishida energetik resurslardan samarali foydalanish uning mustahkam rivojlanishining asosiy omillaridan biri hisoblanadi. Elektr energiyasini ishlab chiqarish, o'zgartirish, uzatish, taqsimlash va iste'mol qilish ob'ektlarida elektr stansiyalari, podstansiyalari, tarmoqlari, qurilmalari va elektr ta'minoti tizimlarini loyihalash, montaj qilish, sozlash, ta'mirlash, ishlatish, ularda sinovlar o'tkazish, texnik xizmat ko'rsatish, rostlash, dispatcherlash, avtomatlashtirilgan va avtomatik boshqarish, iste'mol qilishga oid muhandislik masalalarini yechish, algoritmlash va matematik ta'minotni yaratish, texnologik yechimlarni ishlab chiqish bu tarmoqda sanoatni yuksak darajada rivojlantirishning asosiy vazifalari sanaladi.

Hozirgi vaqtda ichki va tashqi sanoati elektr qurilmalarining juda ko'plab turlarini ishlab chiqaradi, bu esa o'z navbatida elektr qurilmalarining texnik tavsiflari xilma-xilligi va ko'pligi bilan ajralib turadi. Shuning uchun elektr ta'minoti qurilmalari (ETQ) va tizimlarini loyihalashdagi asosiy muammo bu tizim tarkibini kerakli talablarni ta'minlay oladigandigan yechimlarni oqilona tanlash hisoblanadi. Elektr ta'minoti tizimlarini an'anaviy loyihalashning asosini ma'lum bir sohada ishlab chiquvchilar tajribasi va texnik yechimlarni analoglari tashkil etadi. ETQ tizimini loyihalashda ushbu yondashuvning asosiy kamchiliklari texnik qarorlar qabul qilishda sub'ektiv hisoblanadi. Bundan tashqari, loyihalash jarayonining o'zi rasmiylashtirilmagan va shuning uchun uni avtomatlashtirish mumkin emas.

Hozirgi kunda ETQni loyihalashning mavjud usullarining alohida bosqichlari ETQ strukturasi tanlash, elektr ta'minoti sxemalari, yerga ulash tizimlari, havoni shamollashtirish (kondensierlash) va shamollatish tizimlari mavjud. Loyihalash jarayonida strukturali, parametrik yoki strukturali-parametrik sintez usullari qo'llaniladi.

Odatda loyihalash jarayonida ekspluatatsiya qilish tajribasidan olingan empirik va intuitiv tadqiqodlarga asoslangan strukturali, parametrik yoki strukturali-parametrik sintez qilish usullari qo'llaniladi va yechimini topishda chiziqli dasturlash usulidan foydalaniladi.

Hozirda dunyoning ko'plab rivojlangan mamlakatlarida, jumladan AQSh, Rossiya, Xitoy, Germaniya, Buyuk Britaniya, Fransiya, Yaponiya, Daniya, Gollandiyada telekommunikatsiya tizimlarida elektr energiyasidan keng qamrovli foydalanilib kelinmoqda. Bu borada quyosh, shamol, dizel generatorlari va akkumulyator batareyalari kabi energiya manbalarining ishlab chiqilayotgan konstruksiyalarining doimiy ravishda murakkablashishini hisobga olib, noananaviy yechimlar, materiallar va texnologiyalarni qo'llash, qo'yilgan vazifalarni hal qilishda zamonaviy hisoblash vositalarini qo'llash, konstruktorlik hisob-qitoblarni takomillashtirish, bunday hisob-kitoblarning aniq algoritmini ishlab chiqish va yaratish dolzarb hisoblanmoqda.

Bunday tizimlarni o'rganishda kuchli matematik apparatlar va dasturiy vositalardan yetarlicha foydalanish kerak. Ushbu muammoni elektr ta'minoti tizimlarini loyihalashtirishni avtomatlashtirish, shuningdek zamonaviy matematik usullar va dasturiy ta'minotlarni qo'lash orqali hal qilish mumkin.



Muammoning o'rganilganlik darajasi

Hozirgi vaqtda zamonaviy telekommunikatsiya elektr ta'minoti tizimlari va ularning tashkil etuvchi qurilmalarining loyihaviy yechimlarini tahlil va sintez qilish, ularda sodir bo'ladigan fizik jarayonlarni aniqlash, ularning tuzilish va qo'llanilish tamoyillarini rivojlantirish, elektr energiya sifat ko'rsatkichlarini aniqlash, hisoblash, ishlov berish, qayd qilish va boshqaruvida qo'llanilayotgan datchiklari asosida energiya ta'minoti muammolarining samarali, sifatli va ishonchli yechimini topish, elektr ta'minot tizimidagi jarayonlarni matematik modellari va dasturiy ta'minoti bo'yicha dunyoning etakchi ilmiy tadqiqot markazlari va muassasalari tomonidan, shu jumladan AQSh (SMA, Solar Technology AG, General Electric, Satcon, Solectria), Rossiya (Elektroapparat, Elektromit), Buyuk Britaniya (Chloride, HAWK, Cummins), Xitoy (Sassin, Tide Power System, SunAccess, LS Industrial Systems), Germaniya (ABB, Schneider Electric, Siemens, Yaponiya (Sony, Iconics), GFS, AEG Power Solutions, Inpotron Schaltzetzteile GmbH), Fransiya (Legrand, Chloride Industrial, KOHLER-SDMO), Italiya (GMGen Power Systems, GMUPS, Riello), Daniya (MOX), Gollandiya (Honeywell), Finlandiyada (Elego) ilmiy tadqiqotlar olib borilmoqda.

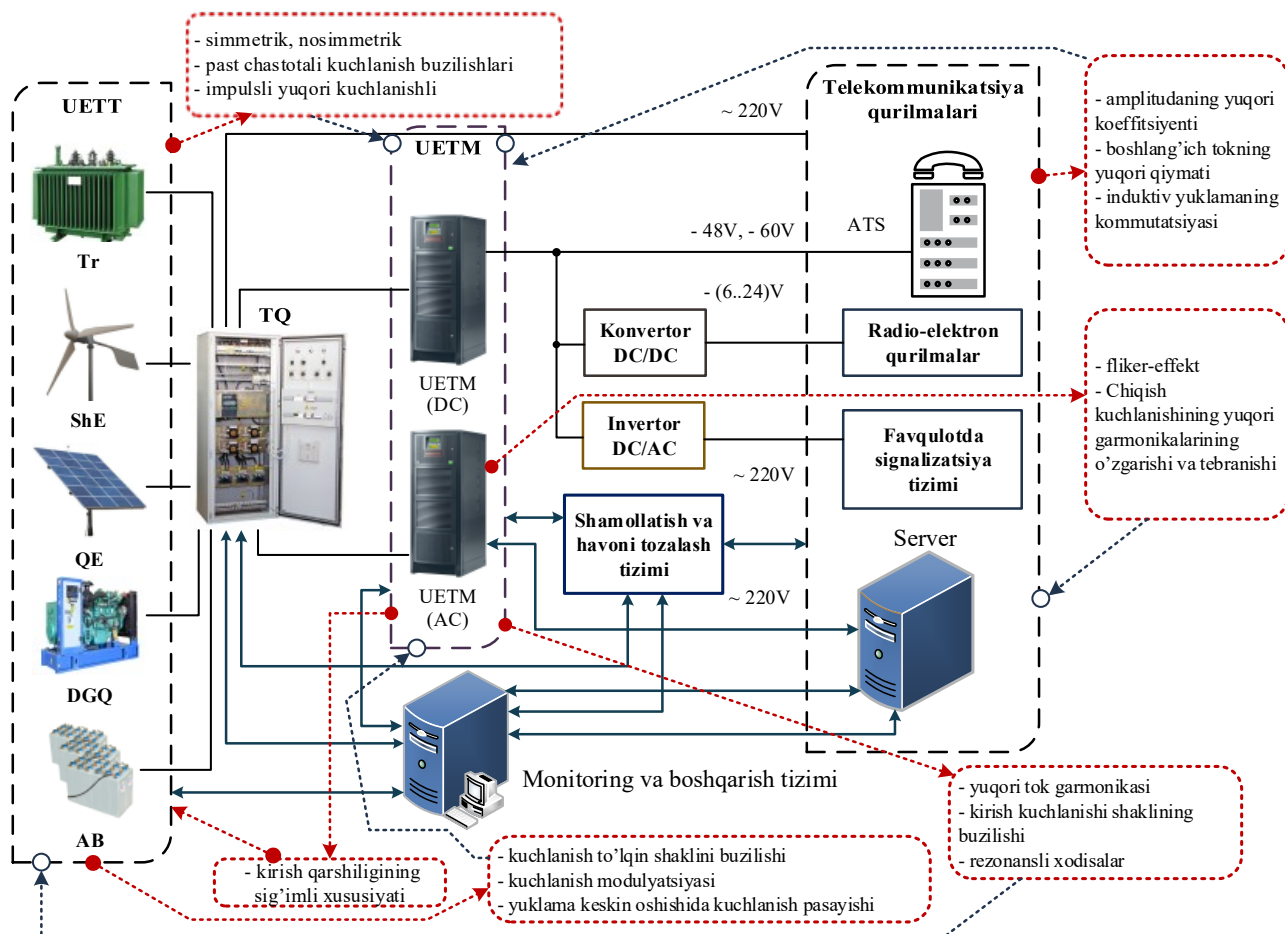
Tahlillar shuni ko'rsatadiki, birlamchi energiya manbalari bilan loyihalanyotgan telekommunikatsiya elektr ta'minoti tizimining kirish xarakteristikallari va ta'minot manbai qurilmalari bilan chiqish xarakteristikallari orasidagi funksional muvofiqlik talablarini bajarish uchun destruktiv ta'sir va dinamik rejimlardagi fizik jarayonlarni aks ettiruvchi bir qator modellar, shuningdek ularni parametrlash usullarini ishlab chiqish kerak.

Murakkab texnik tizimlarni yaratishda tahlilning bir necha bosqichlarini, ya'ni strukturaviy, funksional va parametrik bosqichlarini bosib o'tiladi. Ilmiy tadqiqotlar sohasida hech qanday mezon asosida murakkab tizim yoki qurilmaning optimal tuzilishini darhol tanlashga imkon beruvchi usullar mavjud emas. Shuning uchun murakkab texnik tizimlarni yaratish jarayoni takroriydir (iterativ) [10-11]. Birinchidan, modellashtirilayotgan qurilma qaysi sinfga tegishli ekanligi aniqlanadi, so'ngra bu sinf chegaralarini qisqartirib, shu sinfga tegishli bo'lgan bir necha yechimlarni sinab ko'rib va eng maqbuli tanlanadi. Hozirgi vaqtda texnik obyektlarni loyihalashning dastlabki bosqichlarida qarorlarni qo'llab-quvvatlash uchun kompyuter komponentlaridan keng foydalanilmoqda. Analitik modellar va raqamli optimallashtirish usullaridan tortib, evristik usullar va ekspert baholash tizimlarigacha qaror qabul qilish tizimlarini ishlab chiqish uchun asos bo'la oladigan juda ko'p konseptual yondashuvlar mavjud [6].

Masalaning qo'yilishi

Har qanday qurilma yoki tizim strukturaga ega bo'lgani va ushbu strukturani tashkil etuvchi elementlari parametrlarga ega bo'lgani uchun strukturaviy-parametrik tahlil usullarini ilmiy-texnik bilimlarning deyarli barcha sohalarida qo'llash mumkin. Shuning uchun ushbu dissertatsiya ishida morfologik to'plam tarkibiga kiruvchi elektr ta'minoti tizimining (ETT) strukturalari va alohida qurilmalari, konduktiv xalaqitlarni hisobga olgan holda (1-rasm) ETTning modellarini o'z ichiga oluvchi morfologik tahlil nazariyasini ishlab chiqishni rivojlantirish taklif qilingan. Morfologik usulni amalga oshirish uchun morfologik to'plamni ko'rib chiqilayotgan obyektlarni matematik modellashtirish usullari bilan, shuningdek, ularning ishlash jarayonida olingan muhandislik hisob-

kitoblari va bilimlar bilan to'ldirish kerak. Shuni ta'kidlash kerakki, morfologik usullar asosan murakkab texnik tizimlarni modellashtirish uchun asos bo'lib, barcha darajadagi ierarxiyaning modellarida mavjud. Shu sababli telekommunikatsiya tizimlari uchun optimal ETTni loyihalashtirish tamoyillari morfologik usullar, matematik modellashtirish usullari va muxandislik ishlanmalarining yig'indisidir.

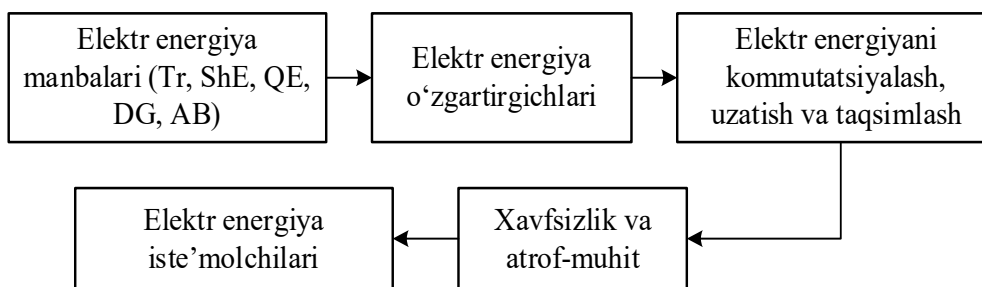


1 – rasm. Elektr ta'minoti tizimlarining telekommunikatsiya obyekti elektr ta'minoti qurilmalari bilan o'zaro aloqa sxemasi

Keng polosali energetik spektri bilan impulsli konduktiv xalaqitlarni batafsil ko'rib chiqamiz. 1-rasmda elektr ta'minoti tizimlarining telekommunikatsiya obyekti elektr ta'minoti qurilmalari bilan o'zaro ta'sirining tipik diagrammasi keltirilgan.

Sxema qo'yidagi qurilmalarni o'z ichiga oladi: umumiy elektr ta'minoti tizimi (UETT), taqsimlash qurilmasi (TQ), doimiy (UETM (DC)) va o'zgarmas (UETM (AC)) uzluksiz elektr ta'minoti manbalari, monitoring va boshqarish tizimi, shamollatish va havo tozalash tizimi, konvertor, invertor, telekommunikatsiya qurilmalari (ATS, radio-elektron qurilmalari, favqulodda signalizatsiya tizimi, server).

Elektr ta'minoti tizimini modellashtirish jarayonini tizimlashtirish murakkab nohiziqli tizimni bir qator kichik tizimlarga ajratish va besh sathli iyerarxik struktura - M1 makro modelini yaratishdan iborat (2-rasm).



2-rasm. Telekommunikatsiya obyekti elektr ta'minoti tizimining M1 makro modeli

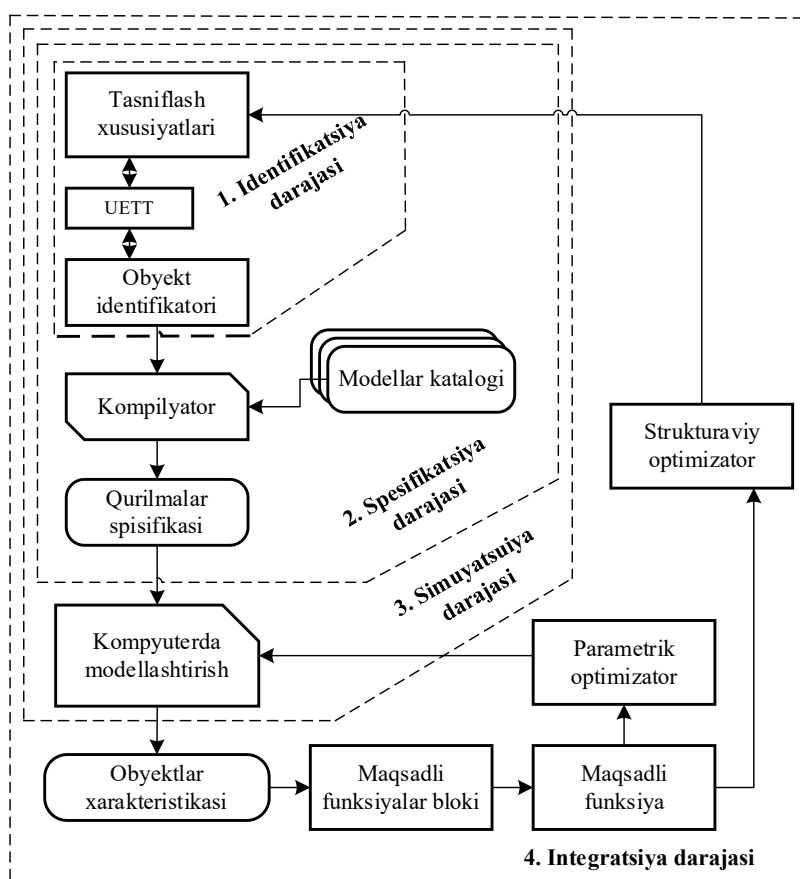
Morfologik usulning mohiyati shundaki, hal qilinayotgan muammo uchun ahamiyatli bo'lgan bir nechta morfologik xususiyatlarni (tipik, o'ziga xoslik, farqlash) aniqlash va ushbu xususiyatlarni (parametrlarni) barcha mumkin bo'lgan kombinatsiyalarni tuzish kerak. Takomillashtirilayotgan texnik tizimlarda unga xos bo'lgan bir qancha strukturaviy yoki funksional morfologik xususiyatlar mavjud bo'lib, masalan, har bir xususiyat tizimning qandaydir tarkibiy biriligini, uning qandaydir vazifasini, tizimning qandaydir ishlash rejimini, ya'ni muammoning yechimi va asosiy maqsadga erishish bilan bog'liq bo'lgan tizimning parametrlari yoki xususiyatlarini tavsiflashi mumkin. Morfologik usulning afzalligi uning rasmiylashtirishda, algoritmlashda va kompyuterda amalga oshirish imkoniyatlarini kengligidir. Morfologik sintez natijasida ko'rib chiqilayotgan tizimning variantlarining haqiqatda xam mavjudligi va gipotetik, patentlanadigan tuzilmalarining barcha strukturaviy yechimlarini o'z ichiga olgan morfologik to'plam aniqlanadi. Morfologik to'plam hajmini kattaligi sababli butun bir tizimni yaratish mumkin emas.

Tizimni yaratish uchun ushbu to'plamga kiritilgan qurilmalar tavsiflanadi, tasniflash xususiyatlari aniqlanadi va ularning mumkin bo'lgan qiymatlari oralig'i aniqlanadi. Ushbu tasniflashning o'ziga xos xususiyati tasniflash xususiyatlarining barcha qiymatlarini belgilash orqali qurilmaning tuzilishini aniqlay olamiz. Morfologik sintez kombinator-mantiqiy sintez usullari sinfiga mansub bo'lib, uning kamchiliklaridan biri mumkin bo'lgan variantlarni to'liq sanab chiqishni hisobga olgan holda kompyuterda amalga oshirish murakkab jarayon hisoblanadi. Bundan tashqari mavjud universal algoritmlar qisqa vaqtda kerakli natijani aniqlash va sintez qilishgaga kafolat bermaydi. Shuning uchun bunday muammolarni hal qilishda everestik usullardan (prototipni takomillashtirish, daraxtsimon va labirint konstruksiyalarini mukammallashtirish) keng foydalaniladi. So'nggi paytlarda evolyusion jarayonlarni simulyatsiya qiluvchi genetik algoritmlar morfologik sintezda tobora ko'proq qo'llanilmoqda. Agar strukturadan tashqari shu strukturani tashkil etuvchi elementlarning parametrlarini topish kerak bo'lsa, strukturaviy-parametrik sintezdan foydalaniladi.

Har qanday qurilma yoki tizim strukturaga ega bo'lgani va ushbu strukturani tashkil etuvchi elementlari parametrlarga ega bo'lgani uchun strukturaviy-parametrik sintez usullarini ilmiy-texnik bilimlarning deyarli barcha sohalarida qo'llash mumkin. Shuning uchun ushbu dissertatsiya ishida morfologik to'plam tarkibiga kiruvchi ETTning strukturalari va alohida qurilmalari, konduktiv xalaqitlarni hisobga olgan holda ETTning modellarini o'z ichiga oluvchi morfologik sintez nazariyasini ishlab chiqishni rivojlantirish taklif qilingan. Morfologik usulni amalga oshirish uchun morfologik to'plamni ko'rib chiqilayotgan ob'ektlarni matematik modellashtirish usullari bilan, shuningdek, ularning ishlash jarayonida olingan muhandislik hisob-kitoblari va bilimlar bilan to'ldirish kerak. Shuni ta'kidlash kerakki, morfologik usullar asosan murakkab texnik tizimlarni

modellashtirish uchun asos bo'lib, barcha darajadagi ierarxiyaning modellarida mavjud. Shu sababli telekommunikatsiya tizimlari uchun optimal ETTni loyihalashtirish tamoyillari morfologik usullar, matematik modellashtirish usullari va muxandislik ishlanmalarining yig'indisidir.

Konduktiv xalaqitlar ta'sirini hisobga olgan holda elektr ta'minoti tizimining makromodeli bir necha sinf qurilmalarining modeli bo'lib, bu qurilmalarni ma'lum mezonlar bo'yicha (konduktiv xalaqitlarning past darajasi, ishonchliligi, energiyani o'zgartirish sifati, yuqori energetik ko'rsatgichlar, minimal tan narxi va hokazo) optimallashtirish bilan sintez qilish usullari va algoritmlari bilan to'ldiriladi.



3 – rasm. Telekommunikatsiya elektr ta'minoti tizimining strukturaviy-parametrik sintezini avtomatlashtirish to'rt darajali integrativ modeli

Morfologik to'plam ETTning barcha strukturasi (masalan, markazlashtirilgan yoki markazlashtirilmagan) o'z ichiga oladi. Alohida elementlarning morfologik to'plami ko'rib chiqilayotgan tizim ob'ektlari parametrlari bilan farq qiluvchi turli xil sxemotexnik yechimlar mavjud. Misol uchun, to'g'rilash qurilmalarini transformatorsiz kirishli sxemasini quvvat koeffitsienti korrektori (QKK) zvenosi orqali xam va uni qo'llamagan holda xam amalga oshirish mumkin. Morfologik to'plam elementlari tizim strukturasi va parametrlari (transformatorlar, tshg'rilash qurilmalari va boshqalar) bilan farq qiladi. Bunday to'plamlar tartibsiz yoki qisman tartiblangan bo'lishi mumkin.

Telekommunikatsion tizimlarining ETTning morfologik to'plami tartiblanmagan barcha ob'ekt strukturalarining butun majmuasini tushunamiz. ETTlari majmuini morfologik daraxt yordamida



ifodalash uchun to'plam elementlarini ba'zi xususiyatlariga ko'ra - funksional, struktura yoki boshqa jihatlarga ko'ra tartibga solish kerak. Tasniflash xususiyatlari bir xil bo'lishiga qaramasdan telekommunikatsion tizimlarining elektr ta'minoti tizimlari va qurilmalari xususiyatlarining morfologik to'plamini xar xil usullar bilan tartiblash mumkin.

Tasniflash xususiyatlarini aniqlab, ularni bir tizimga keltirgan holda, identifikatsiya darajasida morfologik to'plamning modelini ifodalaydigan to'plamni olamiz.

O'rganilayotgan elektr ta'minoti tizimining bu modeli (3-rasm). Uni morfologik daraxt yoki morfologik jadval sifatida ifodalanishi mumkin. Morfologik to'plamning u yoki bu shaklda ifodalanishini matematik modellar (tenglamalar sistemalari ko'rinishida) shakliga keltiriladi.

Shunday qilib, loyihalayotgan elektr ta'minoti tizimini morfologik tahlil qilish algoritmi (1-rasm) va uning natijalarini makromodeli M1 ko'rinishida ifodalash quyidagi ketma-ketlikdan iborat:

- elektr ta'minoti tizimi ob'ektlarining sinflari aniqlanadi;
- tasniflash xususiyatlari belgilanadi;
- bu xususiyatlarning qiymatlari aniqlanadi;
- sinflarning tasnifiy xususiyatlari va o'zaro aloqalari tizimi tuziladi.

Shu sinf ob'ektlarini tahlil qilishda algoritm quyidagi amallar ketma-ketligini o'z ichiga oladi:

- tasniflash xususiyatlari belgilanadi;
- bu xususiyatlarning qiymatlari aniqlanadi;
- ularning qiymatlari mosligini hisobga olgan holda tasniflash xususiyatlari tizimi tuziladi.

Elektr ta'minoti tizimining makromodelini o'z ichiga olgan asosiy sinfni funksional aspektlarini hisobga olgan holda kichik sinflarga ajratish mumkin. Sanoat obyektining uskunalarini normal ishlashini ta'minlash uchun elektr ta'minoti tizimi quyidagi funksiyalarni bajarishi kerak:

- elektromagnit moslashuvchanlik (EMM) talablari, shu jumladan, ma'lum bir iste'molchiga manbadan sifatli elektr energiyasini uzatish; xodimlarning elektr xavfsizligini ta'minlash va jihozlarni tashqi ta'sirlardan himoya qilish;

- uskunalarining normal ishlashi va xizmat xodimlarining hayoti uchun havoni muhitining belgilangan holatini ta'minlash.

Bu funksiyalarni bajarish nuqtai nazaridan elektr ta'minoti tizimini 1-rasmda ko'rsatilgan beshta blok (iyerarxik sathlar) dan iborat makromodel sifatida ifodalash mumkin. Model quyidagi bloklarni (kichik tizimlarni) o'z ichiga oladi:

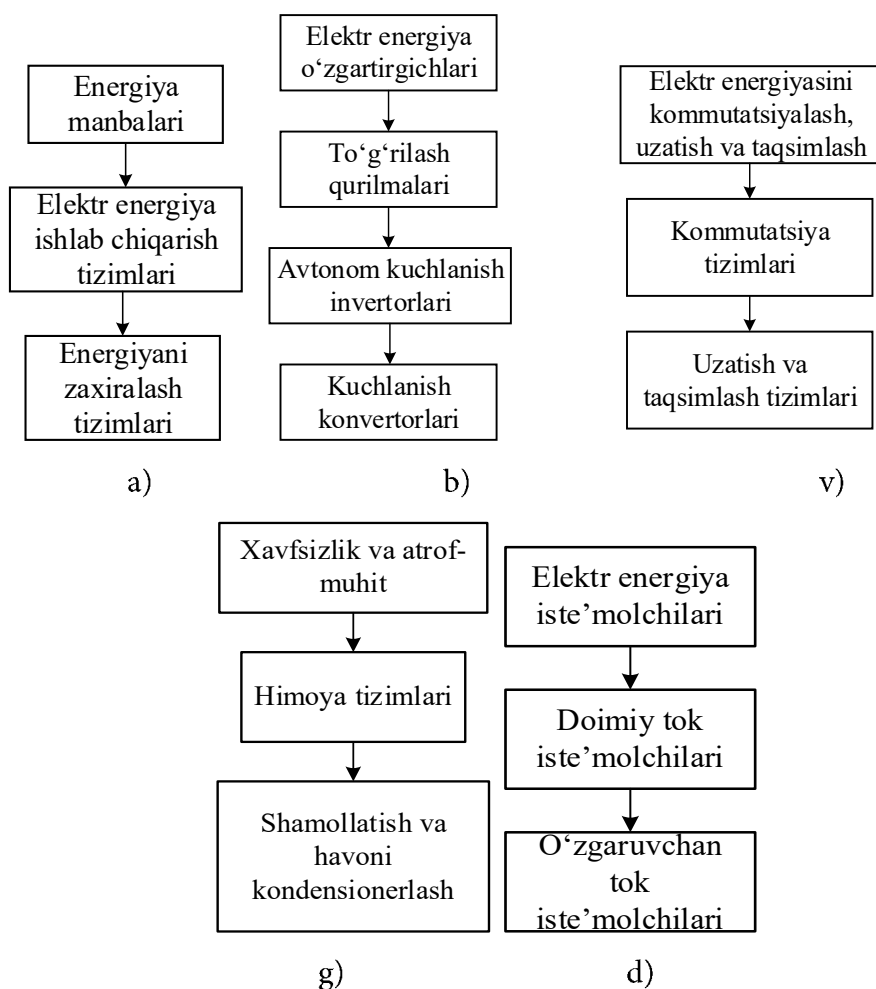
- elektr energiya manbalari bloki;
- bir turdagi energiyani boshqa turdagi energiyaga o'zgartirish bloki;
- boshqa quyi tizimlar, shuningdek elektr energiyasini uzatish va taqsimlash tarmoqlari, kommutatsiya qurilmalari bloki;
- himoya, shamollatish va havoni kondensiyalash tizimlari bloki;

- sanoat obyektining uskunalarini EMMgiga, elektr energiyasi sifatiga, turli parametrlar va talablarga ega bo'lgan iste'molchilar bloki.

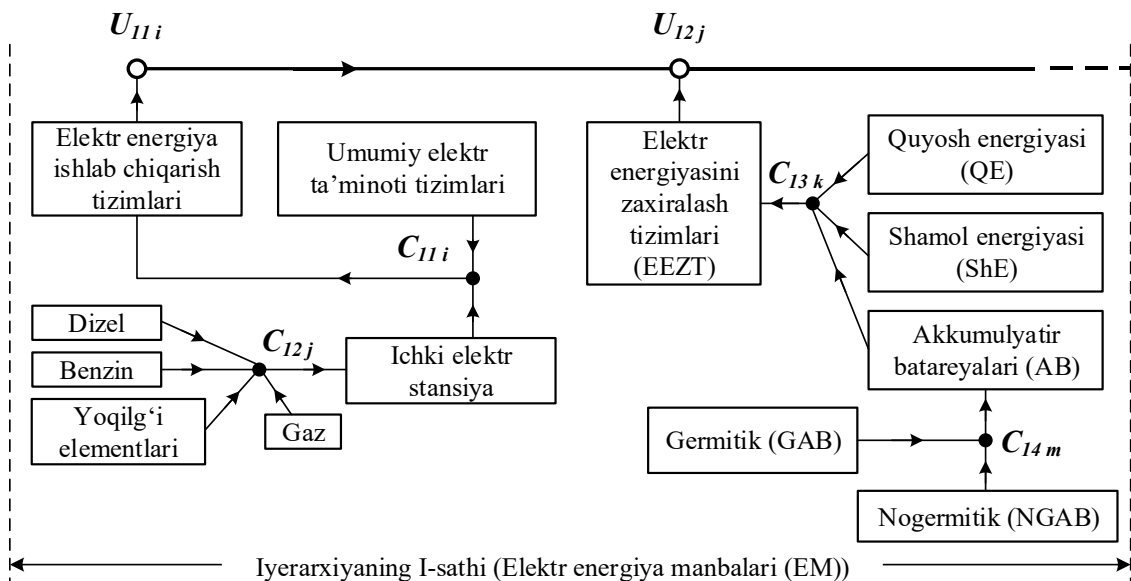
M1 makromodelini yanada dekompozitsiyalashda va quyi tizimlarni tahlil qilishda ularni klassifikatsiyalashning funksional xususiyatini hisobga olamiz. Bu klassifikatsiya 4-rasmda ko'rsatilgan. 4-rasmda keltirilgan quyi tizimlar tarkibiga kiruvchi bloklarning dekompozitsiyasini keyingi tahlilida klassifikatsiyaning strukturaviy va parametrik xususiyatlari hisobga olinadi. Har qanday mezonlarga muvofiq optimallashtirish bilan tahlil muammosini hal qilish uchun ETTning alohida elementlari parametrlarining mosligini hisobga olishda klassifikatsiyalash xususiyatlari va blok parametrlari orasida ustuvorliklarni belgilaymiz (5, 6, 7, 8-rasm).

Elektr ta'minoti tizimining asosiy funksional vazifasi - manbadan iste'molchiga elektr energiyasini o'zgartirish, boshqarish, taqsimlash va doimiy va o'zgaruvchan kuchlanishlar bilan uzluksiz ta'minlashdan iboratdir [11].

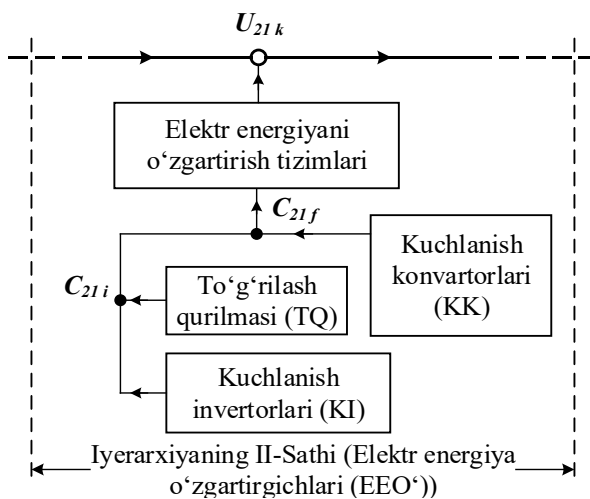
ETT chiqishida elektr energiya sifati telekommunikatsiya qurilmalari va boshqa sanoat obyektlarining elektr ta'minoti sxemalarining kirishlarida elektr energiyasi sifati uchun belgilangan me'yorlarga mos kelishi kerak. Bundan tashqari, elektr qurilmalari uchun zarur elektr energiyani o'zgartirish samarali bo'lishi kerak.



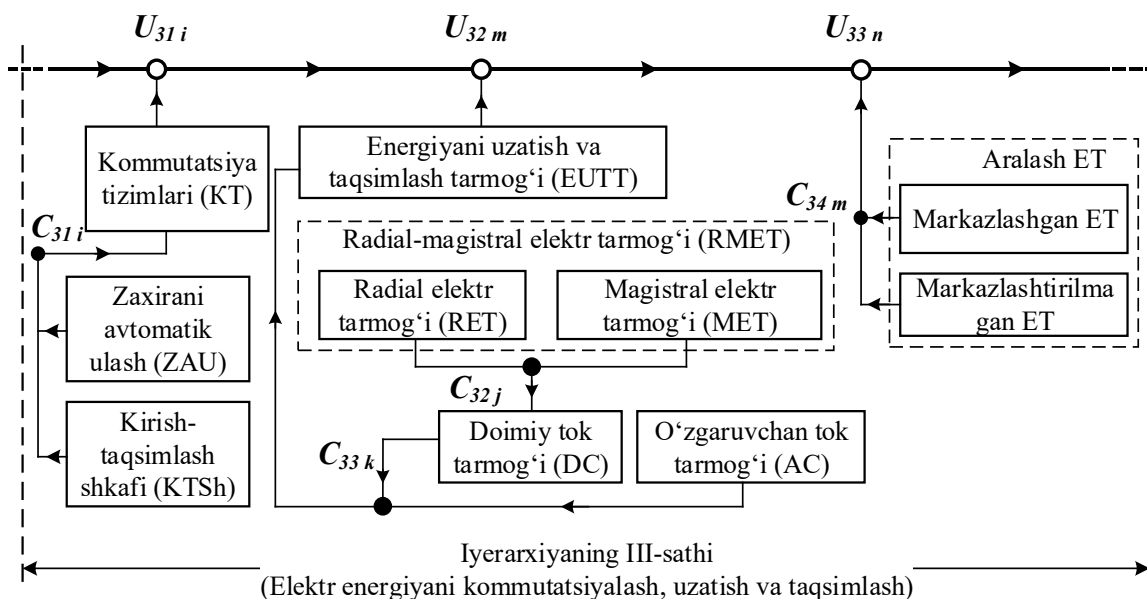
4-rasm. Besh sathli M1 makromodelli telekommunikatsiya objekti elektr ta'minoti tizimining iyerarxik tuzilishi.



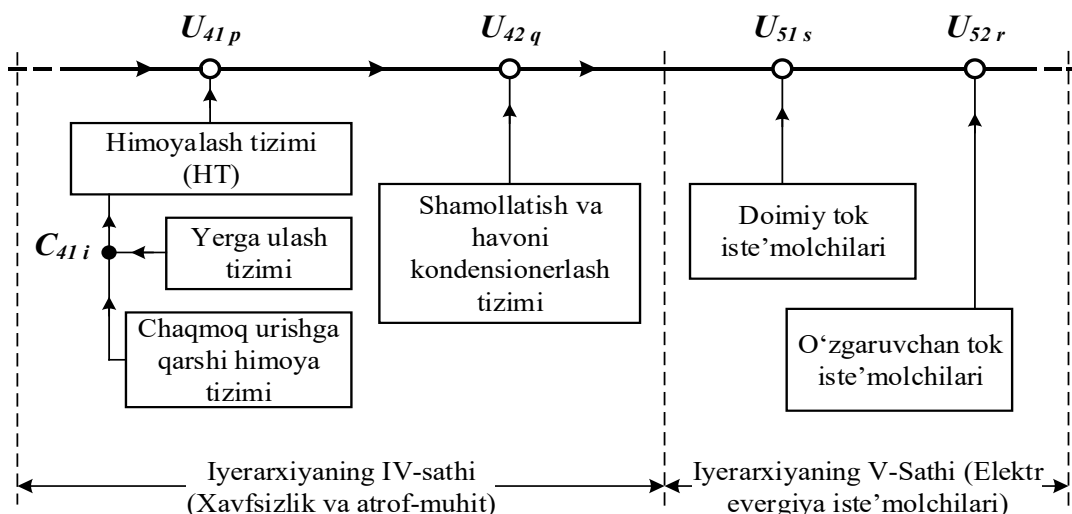
5-rasm. Iyerarxiyaning I-sathi.



6-rasm. Iyerarxiyaning II-sathi.



7-rasm. Iyerarxiyaning III-sathi.



8-rasm. Iyerarxiyaning IV va V -sathi.

Elektr energiya iste'molchilari quyidagi tizimni bir qator funksional xususiyatlarga ko'ra quyidagicha tasniflaymiz:

- kirish tokining xarakteriga ko'ra: doimiy va o'zgaruvchan tok iste'molchilari;
- kirishdagi kuchlanish og'ishi bo'yicha: kuchlanishni boshqarish va kuchlanishni boshqarmaslik;
- qurilmalarning elektr ta'minotini uzluksizligi bo'yicha: uzluksiz va kafolatlangan.

Parametrik xususiyatlariga ko'ra:

- kuvvati bo'yicha: iste'mol quvvati 2 kVt gacha va quvvati 2 kVt dan ortiq bo'lgan qurilmalar;
- elektr ta'minoti kuchlanish sathi bo'yicha: doimiy tok zanjiridagi kuchlanishlar 24 V, 48 V, 60 V, o'zgaruvchan tok zanjirida esa 110 V, 220 V, 380 V.

Xulosa

1. Modellashtirish usullarining tahlili shuni ko'rsatdiki, elektr ta'minoti tizimining iyerarxik daraxtlarida morfologik tahlil usuli eng maqbul usul hisoblanadi.

2. Elektr energiya sifatining eng yaxshi ko'rsatkichlarini bo'yicha elektr ta'minoti tizimining avtomatlashtirilgan loyihalash tizimlarini yaratish, shuningdek, turli iyerarxik sathdagi elementlar o'rtasidagi aloqalarni o'rnatish uchun eng maqbul modellash to'plami hisoblanadi.

3. Elektr ta'minoti tizimlarini tahlil qilishning tizimli yondashuvi uning tarkibiga kiruvchi qo'yi tizimlarning klassifikatsion xususiyatlari ierarxiyasi tartibli majmuini shakllantirish, kelajakda M1 makromodelining bir qismi bo'lgan morfologik daraxt va subgraflarni yaratish, makromodel daraxtining tugunlari orasidagi ramziy-raqamli munosabatlarni matritsalar ko'rinishida shakllantirish imkonini beradi.



Adabiyotlar

1. Qodirov, F. (2023). Methods and algorithms for determining the optimal structure of the telecommunications power supply system based on morphological synthesis. In E3S Web of Conferences (Vol. 461, p. 01084). EDP Sciences.
2. Qodirov, F., & Qodirova, S. (2023). Algorithms of determining the optimal structure of a telecommunications power supply system based on morphological synthesis.
3. Sapaev M., Qodirov F.M., Qodirova S.F. Elektr ta'minoti tizimining telekommunikatsiya obyekt bilan o'zaro ta'sir mexanizmi. Muxammad al-Xorazmiy avlodlari, № 1(19), mart 2022. – 84 b.
4. Кодиров Ф.М., Аюпова Д.А., Тохиров К.М., & Торабаева Н.П. (2023). Инфокоммуникация тизимлари электр таъминотининг морфоло-гик тахлил қилишнинг алгоритмини ишлаб чиқиш. Образование наука и инновационные идеи в мире, 22(8), 40–49.
5. Qodirov, F. (2023). Optimization of telecommunications power supply systems based on reliability criteria. Science and innovation, 2(A12), 15-20.
6. Anatolevna, A. D., & Misliddinovich, Q. F. (2023, June). Infokommunikatsiya elektr ta'minoti tizimlarining parametrik va strukturaviy tahlil qilishni optimallashtirish. In "Canada" international conference on developments in education, sciences and humanities (Vol. 9, No. 1).
7. Qodirov, F., Saidova, G., & Agzamova, M. (2022). Development of a multilevel model of the telecommunications power supply system through morphological analysis. Science and innovation, 1(8), 584-594.
8. Qodirov, F., Saidova, G., & Agzamova, M. (2022). Development of a design algorithm for the development of automated control systems in a telecommunications source. Science and Innovation, 1(8), 567-577.
9. Qodirov, F. M. (2022). Telekommunikatsiya elektr ta'minoti tizimini morfologik sintez orqali uning optimal strukturasi aniqlash. Mu-xammaд al Xorazmiy avlodlari ilmiy-amaliy va axborot-tahliлий журнал, 4, 22.
10. Umarov, S., Maxammatov, D., Akhunov, F., & Qodirov, F. (2021, November). The mathematical model for calculating transient modes of a valve converter. In AIP Conference Proceedings (Vol. 2402, No. 1). AIP Publishing.
11. Кодиров, Ф. М. (2016). Комбинированное управление источниками реактивной мощности в электрических сетях на основе блока микропроцессорного управления. Проблемы и достижения современной науки, (1), 98-100.
12. Qodirov F.M. Telekommunikatsiya elektr ta'minoti tizimlarini loyihalashda AKTdan foydalanish. «Yangi O'zbekistonda islohotlarni amalga oshirishda zamonaviy axborot-kommunikatsiya texnologiyalaridan foydalanish» mavzusida Xalqaro ilmiy-amaliy konferentsiya. Andijon 27-29 oktabr 2021 yil. 565 b.
13. Qodirov, F. (2024). Morfologik tahlil orqali telekommunikatsiya obyektining elektr ta'minoti tizimi modelini ishlab chiqish. Ilm-fan va ta'lim, 2(2(17)).
14. Qodirov Fazliddin Misliddinovich (2024). Infokommunikatsiya elektr ta'minoti tizimlarining energetik mezonlarini tahlil qilishni optimallashtirish. Science and innovation, 3 (Special Issue 17), 508-515. doi: 10.5281/zenodo.10725663.
15. Фазлиддин Мислиддинович Кадиров, Наталья Юрьевна Амурова, Сурайё Мунировна Абдуллаева, Елена Анатольевна Борисова. Энергетика нового образца, внедрение

интеллектуальных сетей SMART GRID и возможности ее применения. Актуальные проблемы системы электроснабжения // Сборник трудов международной научно-технической конференции. – Ташкент. ТашГТУ, 2022.

16. Borisova Yelena, Amurova Natalya, Kodirov Fazliddin, & Abdullayeva Surayyo (2022). Computerized environmental monitoring systems. *Universum: технические науки*, (2-6 (95)), 66-70.
17. 17. Э.Абдуллаев Ф.М. Кадиров, Ф.Д. Назаров. A method for improving the harmonic content of voltage and current. Информационные технологии и моделирование процессов в фундаментальных и прикладных исследованиях. Материалы I Международной молодежной школы конференции. 15–17 декабря 2016



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TIMSOLLARNI TANIB Olishda BELGILAR FAZOSINI QISQARTIRISH USULLARINING QIYOSIY TAHLILI

Annotatsiya. Mashinaviy o'qitishda belgilar fazosi juda katta bo'lib ketganda belgilar fazosi o'lchamlarini qisqartirish muhim ahamiyat kasb etadi. Ushbu maqolada belgilar fazosini qisqartirishning ikkita eng mashhur usullari BKT (Bosh komponent tahlili) va CHDT (chiziqli diskriminant tahlili) qiyosiy tahlili keltirilgan. Umuman olganda, CHDT-ga asoslangan algoritmlar BKT-ga asoslangan algoritmlardan ustundir. Ushbu maqolada biz bu har doim ham shunday emasligini ko'rsatamiz. Bizning xulosamiz shundan iboratki, agar o'quv ma'lumotlar to'plami kichik bo'lsa, BKT CHDT dan ustun bo'lishi mumkin, shuningdek, BKT turli xil o'quv ma'lumotlar to'plamlariga nisbatan sezgir emas.

Kalit so'zlar: Bosh komponent, chiziqli diskriminant, kovariatsiya matritsasi, dispersiya, xos qiymat.



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COMPARATIVE ANALYSIS OF SIGN SPACE REDUCTION METHODS IN SIGN RECOGNITION

Abstract: In machine learning, reducing the size of the character space becomes important when the character space becomes too large. This article presents a comparative analysis of the two most popular methods of character space reduction, BKT (Principal Component Analysis) and CHDT (Linear Discriminant Analysis). In general, CHDT-based algorithms outperform BKT-based algorithms. In this article, we will show that this is not always the case. Our conclusion is that BKT can outperform CHDT if the training dataset is small, and also BKT is insensitive to different training datasets.

Keywords: Principal component, linear discriminant, covariance matrix, variance, eigenvalue.



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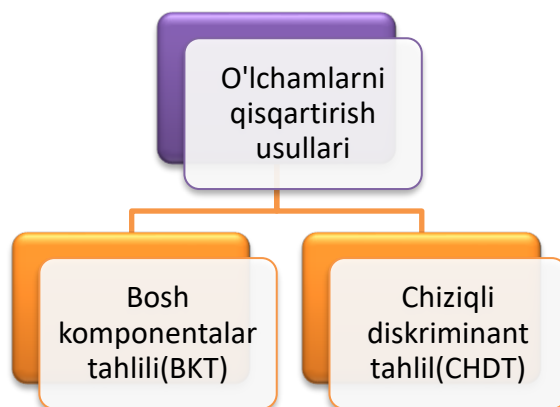
Kirish

Mashinaviy o'qitishda belgilar fazosi juda kata bo'lib ketganda belgilar fazosi o'lchamlarini qisqartirish bir nechta afzalliklarni beradi, masalan:

- U ma'lumotlarni siqadi va shu bilan ma'lumotlarni saqlash joyiga bo'lgan talablarni kamaytiradi.
- Bu hisoblash uchun zarur bo'lgan vaqtni qisqartiradi, chunki kamroq o'lchamlar kamroq hisoblashni talab qiladi.
- Bu ortiqcha belgilarni yo'q qiladi.
- Bu modelning ishlashini yaxshilaydi.

Mashinaviy o'qitishda o'lchamlarni qisqartirishning bir necha usullarini misol keltirishimiz mumkin. Hozirgi kunda eng keng tarqalgan o'lchamlarni qisqartirish usullariga quyidagilarni misol keltirishimiz mumkin[1]:

1. Bosh komponentalar tahlili(PCA - Principal Component Analysis)
2. Chiziqli discriminant tahlil(LDA-Linear Discriminant Analysis)



1-rasm. Bosh komponentalar tahlili(BKT - Principal Component Analysis) usuli.

Bosh komponentalar tahlili(BKT)ning asosiy xususiyatlari quyidagilar:

U o'zgaruvchilarni asosiy komponentalar deb ataladigan yangi o'zgaruvchilar to'plamiga aylantiradi.

Ushbu asosiy komponentalar asl o'zgaruvchilarning chiziqli kombinatsiyasi hisoblanib va o'zaro ortogonaldir.

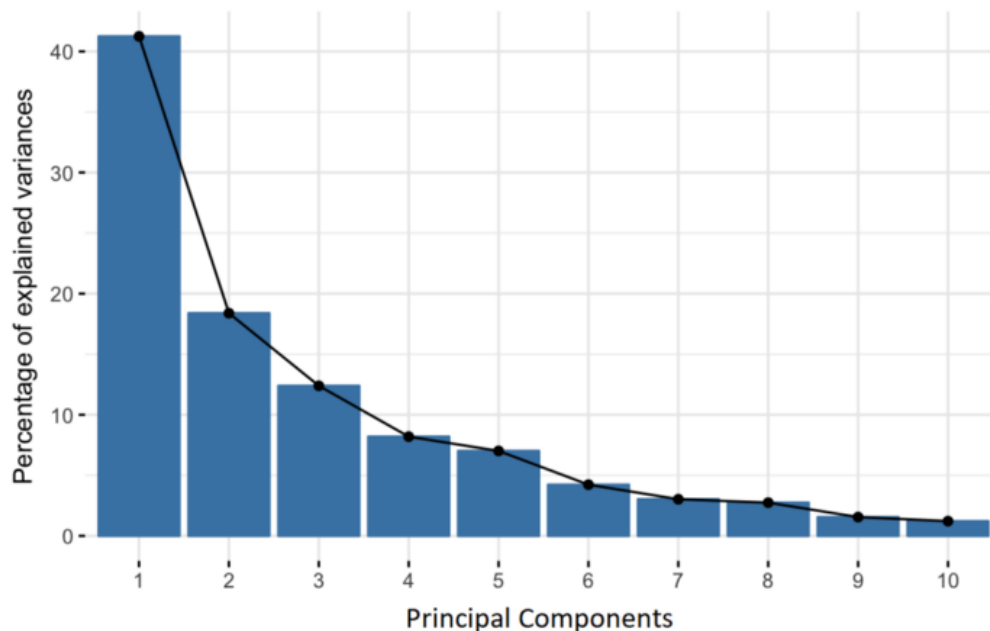
Birinchi bosh komponenta asl ma'lumotlarning mumkin bo'lgan o'zgarishining ko'p qismini tashkil qiladi.

Ikkinchi asosiy komponenta ma'lumotlardagi tafovutni olish uchun xizmat qiladi.

Ikki o'lchovli ma'lumotlar to'plami uchun faqat ikkita asosiy komponenta bo'lishi mumkin.

Bosh komponentalar - bu chiziqli kombinatsiyalar yoki boshlang'ich o'zgaruvchilarning aralashmasi sifatida tuzilgan yangi o'zgaruvchilar. Ushbu kombinatsiyalar shunday amalga oshiriladiki, yangi o'zgaruvchilar (ya'ni, asosiy komponentalar) o'zaro chiziqli bog'lanmagan va boshlang'ich o'zgaruvchilar ichidagi ma'lumotlarning aksariyati birinchi komponentalarga siqiladi.

Shunday qilib, g'oya 10 o'lchovli ma'lumotlar sizga 10 ta asosiy komponentni beradi, ammo BKT birinchi komponentga maksimal mumkin bo'lgan ma'lumotni, so'ngra qolgan maksimal ma'lumotni ikkinchisiga va shunga o'xshash keyingilariga joylashtirishiradi[2].



2-rasm. Asosiy komponentalar.

Ma'lumotni asosiy komponentalarda shu tarzda tashkil qilish ko'p ma'lumotni yo'qotmasdan o'lchamlarni kamaytirishga imkon beradi, bu esa kam ma'lumotga ega bo'lgan komponentalarni tashlab, qolgan komponentalarni yangi o'zgaruvchilar sifatida ko'rib chiqish imkonini beradi.

Bu yerda tushunish kerak bo'lgan muhim narsa shundaki, asosiy komponentalar kamroq izohlanadi va hech qanday haqiqiy ma'noga ega emas, chunki ular boshlang'ich o'zgaruvchilarning chiziqli kombinatsiyasi sifatida tuzilgan.

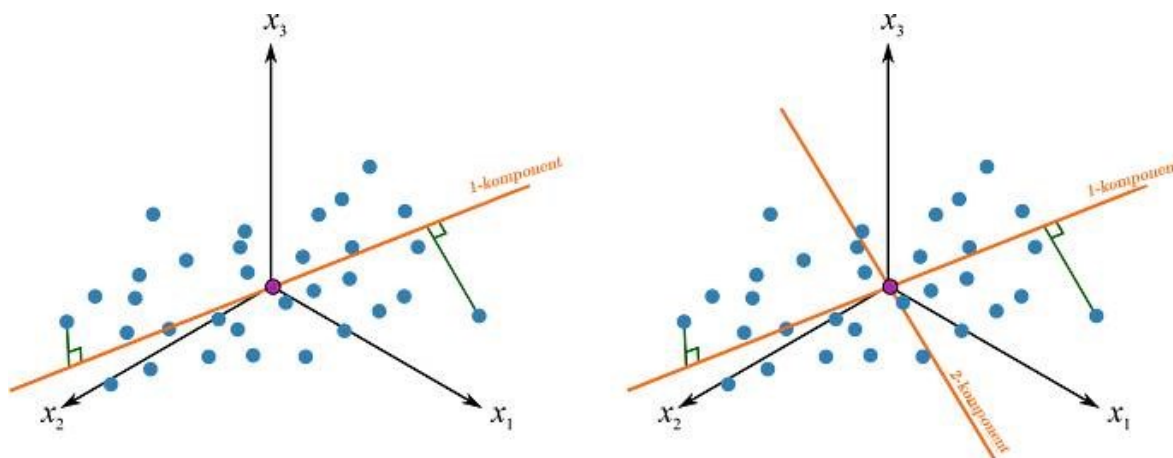
Geometrik jihatdan aytganda, asosiy komponentalar maksimal dispersiya miqdorini tushuntiruvchi ma'lumotlarning yo'nalishlarini, ya'ni ma'lumotlarning ko'p ma'lumotlarini qamrab oladigan chiziqni ifodalaydi[3].

Bu yerda dispersiya va axborot o'rtasidagi bog'liqlik shundan iboratki, chiziq bo'ylab ma'lumotlar nuqtalarining tarqalishi va chiziq bo'ylab dispersiya qanchalik katta bo'lsa, u shunchalik ko'p ma'lumotga ega bo'ladi.

Bularning barchasini sodda qilib aytadigan bo'lsak, asosiy komponentalarni ma'lumotlarni ko'rish va baholash uchun eng yaxshi burchakni ta'minlaydigan yangi o'qlar deb tasavvur qiling, shunda kuzatishlar orasidagi farqlar yaxshiroq ko'rinadi.

Ma'lumotlarda qancha o'zgaruvchi bo'lsa, shuncha asosiy komponentalar mavjud bo'lgani uchun, asosiy komponentalar shunday tuzilganki, birinchi asosiy komponent ma'lumotlar to'plamidagi mumkin bo'lgan eng katta farqni hisobga oladi. U dispersiyani maksimal darajada oshiradigan chiziq (prognoz qilingan nuqtalardan boshlang'ichgacha bo'lgan kvadratik masofalarning o'rtacha qiymati). Ikkinchi asosiy komponenta ham xuddi shu tarzda, birinchi asosiy

komponenta bilan korrelyatsiyasiz (ya'ni, perpendikulyar) va keyingi eng yuqori dispersiyani hisobga olish sharti bilan hisoblanadi. Bu o'zgaruvchilarning umumiy soniga teng bo'lgan asosiy komponentalar hammasi hisoblanmaguncha davom etadi[4,5].



3-rasm. BKT algoritmi.

BKT algoritmidagi qadamlar quyidagilardan iborat:

1-qadam: Ma'lumotlarni olish $\vec{x}_k \in X$.

2-qadam: O'rtacha vektorni ($\vec{\mu}$) hisoblash $\vec{\mu} = \left\{ \frac{\sum_{k=1}^N x_{i,k}}{N} \right\}, i = 1, 2, \dots, M..$

3-qadam: Berilgan ma'lumotlardan o'rtachani ayirish $\vec{x}_k = \vec{x}_k - \vec{\mu}$.

4-qadam: Kovariatsiya matritsasini hisoblash $Cov(\vec{x}_k, \vec{\mu}) = \frac{\sum_{k=1}^N (\vec{x}_k - \vec{\mu})(\vec{x}_k - \vec{\mu})^T}{N-1}$.

5-qadam: Kovariatsiya matritsasining xos vektorlari va xos qiymatlarini hisoblaymiz $|Cov(\vec{x}_k, \vec{\mu}) - \lambda E| = 0$ formuladan λ xos sonlari topiladi va eng kata xos songa mos vektor $|Cov(\vec{x}_k, \vec{\mu}) - \lambda E| \vec{w} = 0$ formuladan topiladi.

6-qadam: Komponentalarni tanlash va belgilar vektorini shakllantirish.

7-qadam: Yangi ma'lumotlar to'plamini olish.

CHDT usuli

CHDT belgini ajratib olish va o'lchamlarni qisqartirishning mashhur usuli bo'lib, u nutqni aniqlash, yuzni tanish, multimediya ma'lumotlarini qidirish va boshqalar kabi ko'plab ilovalarda keng qo'llaniladi. Chiziqli diskriminant tahlilning maqsadi ma'lumotlar to'plamini pastki o'lchamli fazoga joylashtirish va sinflarning ajratilishini maksimal darajada oshirish hisoblanadi. CHDT va

BKT juda o'xshaydi, ammo ba'zi muhim farqlar mavjud. BKT - bu nazoratsiz algoritm, ya'ni u y sinf belgilariga muhtoj emas. BKT ning maqsadi ma'lumotlar to'plamidagi farqni maksimal darajada oshiradigan bosh komponentalarni topishdir. CHDT, boshqa tomondan, bir nechta sinflar orasidagi ajratishni maksimal darajada oshiradigan chiziqli diskriminantlarni topish uchun kirish ma'lumotlari X va Y sinf belgilaridan foydalanadigan nazorat ostidagi algoritmdir[5].

CHDT algoritmidagi qadamlar quyidagilardan iborat:

1-qadam: Ma'lumotlarni olish $\vec{x}_k \in X$.

2-qadam: Ma'lumotlar to'plamidan turli sinflar uchun o'rtacha vektorlarni hisoblang.

$$\mu = \left\{ \frac{\sum_{k=1}^N \vec{x}_k}{N} \right\} \text{- umumiy o'rtacha qiymat, } \mu_i = \left\{ \frac{\sum_{i=1}^{N_i} \vec{x}_i}{N_i} \right\} \text{- har bir sinfning o'rtacha qiymati}$$

N_i -har bir sinfga tegishli elementlar soni.

3-qadam: Tarqalish matritsalarini hisoblash (sinf ichidagi va sinflar orasidagi tarqalish matritsalarini).

$$\text{➤ Sinf ichidagi tarqalish matritsasi } S_W = \sum_{i=1}^c S_i$$

$$\text{bu yerda } S_i \text{ - ma'lum bir sinf uchun tarqalish matrisasi } S_i = \sum_{x \in D_i} (x - \mu_i)(x - \mu_i)^T$$

$$\text{➤ Sinflar orasidagi tarqalish matritsasi } S_B = \sum_{i=1}^c N_i (\mu_i - \mu)(\mu_i - \mu)^T$$

bu yerda μ - umumiy o'rtacha qiymat, μ_i - tegishli sinfning o'rtacha qiymati va N_i - bu sinfdagi tanlanma hajmi.

4-qadam: Tarqalgan matritsalar uchun xos vektorlarni va ularga mos xos qiymatlarni hisoblash.

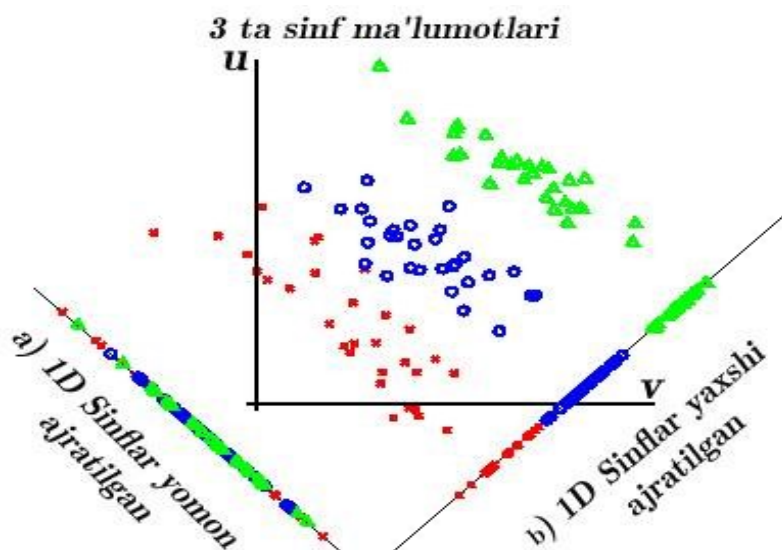
$$S_W^{-1} S_B \vec{w} = \lambda \vec{w} \Rightarrow |S_W^{-1} S_B - \lambda E| = 0 \text{ tenglamadan } \lambda \text{ - xos sonlar va ularga mos xos vektorlarni topish.}$$

5-qadam: Xos vektorlarni xos qiymatlarni kamaytirish orqali tartiblanadi va eng katta xos qiymatli k ta xos vektorlarni tanlash. k - biz saqlamoqchi bo'lgan o'lchamlar soni.

6-qadam: O'quv tanlanmalarni yangi pastki fazoga joylashtirish uchun ushbu xos vektor matritsasiidan foydalanish. k ta xos vektorlarni tanlagandan so'ng, biz quyidagi tenglama orqali ma'lumotlarni yangi kichik fazoga aylantirish uchun hosil bo'lgan $-d \times k$ o'lchovli xos vektor matritsasi W dan foydalanishimiz mumkin:

$$Y = W^T X$$

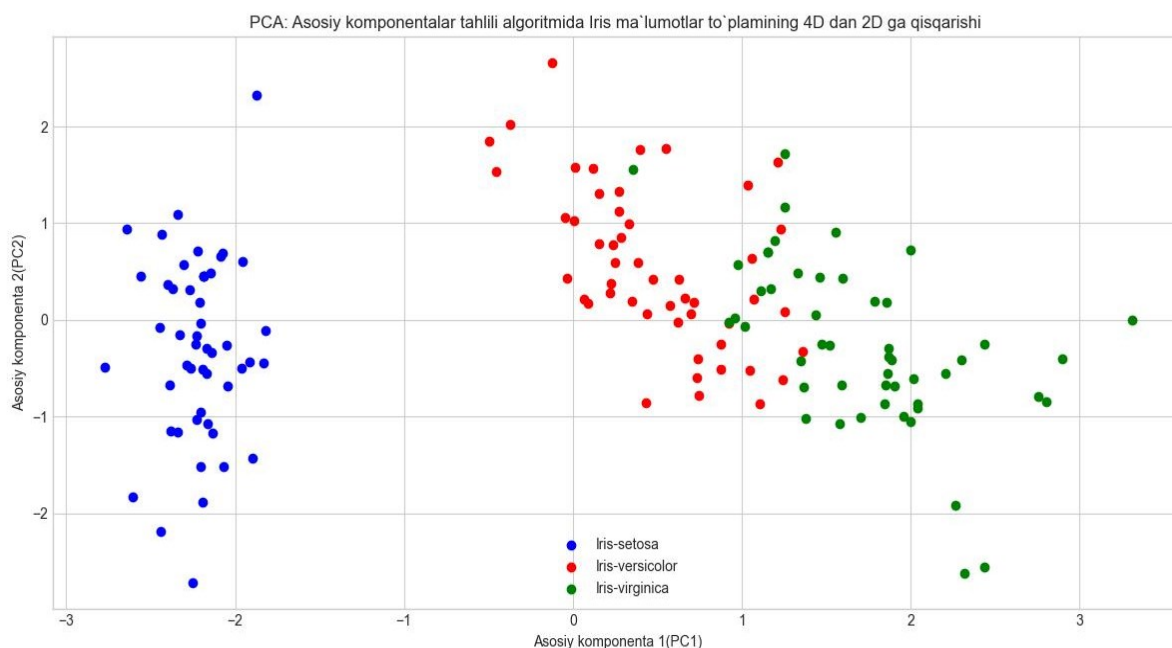
7-qadam: Yangi ma'lumotlar to'plamini olish.



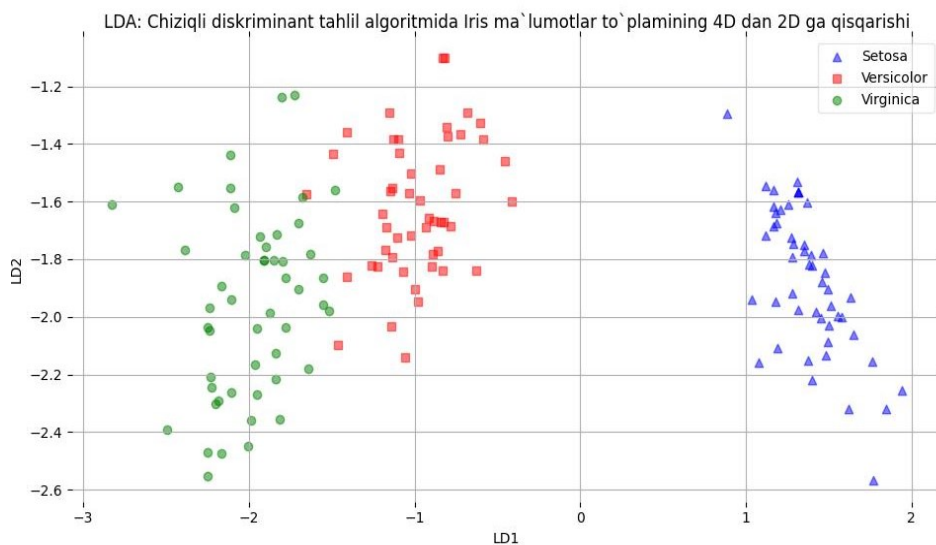
4-rasm. Klassifikatsiya natijalari.

Grafikda a) ma'lumotlarning o'qdagi proyeksiyasidan ko'rinib turibdiki uchta sinf prognoz qilinganda yaxshi ajratilmagan ya'ni sinflardagi ma'lumotlar aralashib ketgan. b) Ma'lumotlarning o'qdagi proyeksiyasidan ko'rinib turibdiki uchta sinf prognoz qilinganda chiziq uchta sinfni ajratishga muvaffaq bo'ldi va shu bilan birga bizning muammomizning o'lchovligini ikkita belgidan (u, v) faqat y skalyar qiymatiga qisqartirdi.

Fisherning chiziqli diskriminant tahlili va asosiy komponentalar tahlili algorimlaridan foydalanib Iris gullari ma'lumotlar to'plamidagi belgilar fazosini 4 o'lchovidan 2 o'lchovga qisqartirishni Python dasturida grafigi chizildi.



5-rasm. BKT algoritmidan foydalanib Iris ma'lumotlar to'plami o'lchovining qisqarishi va



tasniflanis

6-rasm. CHDT algoritmidan foydalanib Iris ma'lumotlar to'plami o'lchovining qisqarishi va tasniflanishi.

1-jadval. BKT va CHDT usullarining natijalarini taqqoslash.

Method	Training Set Score				Validation Set Score			Test
	Metrics							
BKT	Class name	F1	Precision	Recall	F1	Precision	Recall	
	Setosa	0.901	0.901	0.901	0.975	0.974	0.977	0.805
	Versicolor	0.950	0.950	0.950	0.925	0.928	0.9375	0.814
	Virginica	0.962	0.962	0.963	0.901	0.902	0.905	0.888
CHDT								
	Setosa	0.975	0.975	0.977	1.0	1.0	1.0	1.0
	Versicolor	1.0	1.0	1.0	0.925	0.928	0.928	1.0
	Virginica	0.975	0.975	0.975	0.975	0.976	0.976	1.0

Xulosa

Xulosa qilib aytish mumkinki yuqoridagi Iris gullari ma'lumotlar to'plami uchun Fisherning chiziqli diskriminant tahlili(LDA-Linear Discriminant Analysis) bosh komponentalar tahlili(PCA-Principal Component Analysis)ga nisbatan yaxshiroq natijani qayd etdi. Lekin, Bu degani Fisherning chiziqli diskriminant tahlili har doim ham bosh komponentalar tahliliga nisbatan yaxshi degani emas. Chiziqli diskriminant tahlili(LDA-Linear Discriminant Analysis) turli sinflar orasidagi masofani



maksimal oshiradi, bosh komponentalar tahlili(*PCA-Principal Component Analysis*) esa ma'lumotlarning farqini maksimal darajada oshiradi. Har bir sinfda o'quv tanlanmalar kamroq bo'lsa, bosh komponentalar tahlili yaxshiroq ishlaydi. Biroq, chiziqli diskriminant tahlili ko'plab sinflarga ega kata ma'lumotlar to'plamlarida yaxshiroq ishlaydi.



Adabiyotlar

1. Borade, S. N., Adgaonkar, R. P. Comparative analysis of PCA and LDA. 2011 International Conference on Business, Engineering and Industrial Applications (pp. 203-206). 2011, June
2. <https://builtin.com/data-science/step-step-explanation-principal-component-analysis>
3. Holland S. M. Principal components analysis (PCA) .Department of Geology, University of Georgia, Athens, GA. – 2008. – T. 30602. – C. 2501.
4. Smith L. I. “A tutorial on principal components analysis.” (2002).
5. Cheng Li, and Bingyu Wang. “Fisher linear discriminant analysis.” CCIS Northeastern University 6. 2014.



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OPPORTUNISTIK TARMOQLAR: ARXITEKTURASI, MOBILLIK MODELLARI VA MARSHRUTLASH PROTOKOLLARI

Annotatsiya. Opportunistik tarmoqlar – uzluksiz ulanish, yuqori dinamika va cheklangan infratuzilma kabi qiyin sharoitlarda ishlaydigan tarmoqlarning noyob sinfidir. Ushbu tarmoqlar turli ssenariylarda, jumladan, favqulotda holatlar yuz berganda, chekka hududlar va avtomobil aloqalarida qo'llanilishi tufayli katta e'tibor qozondi. Ushbu tezisda opportunistik tarmoqlarning dolzarbligi, arxitekturasi, mobillik modellari va marshrutlash protokollari o'rganiladi.

Kalit so'zlar: DTN, MANET, Oppnet, marshrutizatsiya, mobillik modeli.



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OPPORTUNISTIC NETWORKS: ARCHITECTURE, MOBILITY MODELS AND ROUTING PROTOCOLS

Abstract: Opportunistic networks are a unique class of networks that operate under challenging conditions such as continuous connectivity, high dynamics, and limited infrastructure. These networks have gained a lot of attention due to their use in various scenarios, including emergencies, remote areas and vehicular communications. This thesis examines the relevance, architecture, mobility models and routing protocols of opportunistic networks.

Keywords: DTN, MANET, Oppnet, routing, mobility model.



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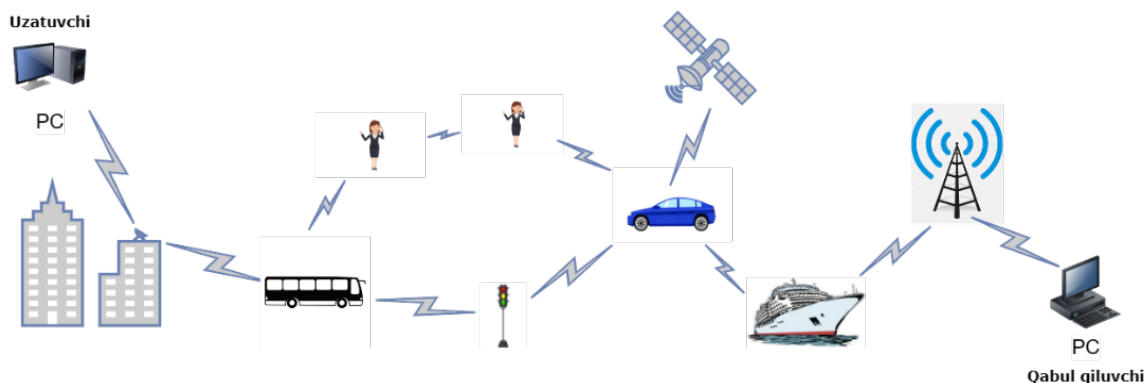
Kirish

XXI asrning boshidan to hozirgi kungacha simsiz aloqa texnologiyalarining o'sishi ma'lumotlarni yo'naltirish tezligini soniyasiga kilobaytdan soniyasiga gigabaytgacha sezilarli darajada oshishiga olib keldi. Tadqiqotchilar, shuningdek, paketlarning yo'qolishini minimal darajaga kamaytirish orqali xavfsiz nuqtadan nuqtaga yetkazib berishni yaxshilashga e'tibor qaratdilar. Natijada, ma'lumotlarni yo'naltirishda aloqa osonroq, arzonroq va ilgari qiyin bo'lgan hududlarda ham foydalanish imkoniyati paydo bo'ldi. Biroq, o'rmonlar, urush maydonlari va suv osti hududlari kabi ba'zi joylar va sozlamalar zamonaviy aloqa texnologiyalari uchun qiyinchiliklar tug'diradi, chunki ular vaqti-vaqti bilan tez va xavfsiz aloqa talablarini qondirish uchun kurashadilar. Opportunistik tarmoqlar (OppNets – Opportunistic Networks) ushbu muammolarni hal qilish va ushbu sohada aloqa samaradorligini oshirish uchun texnologik yechim sifatida paydo bo'ldi [1].

OppNets sifatida ham tanilgan opportunistik tarmoqlar, farqlariga qaramay, kechikishga chidamli tarmoqlar (DTN-Delay Tolerance Network) ichida alohida kichik to'plamdir. OppNets tugunlar o'rtasida xabarlarini yo'naltirish uchun "saqlash-tashish-yo'naltirish" (store-carry-forward) usulidan foydalanadi, bu esa oxirgi tugunlar orasidagi yo'l (end-to-end path)ga bo'lgan ehtiyojni bartaraf etadi. Biroq, bu kechikishlarga olib kelishi mumkin, chunki tugunlar qo'shni tugunlarga darhol kirish imkoniga ega bo'lmasligi mumkin. Bundan tashqari, qo'shni tugunlar haqida cheklangan ma'lumotlar tufayli noaniqlik paydo bo'lishi mumkin. OppNets, ayniqsa, mavjud infratuzilma mavjud bo'lmagan holatlarda foydali bo'lib, ularni odamlar kirish imkoni bo'lmagan hududlarda qulay variantga aylantiradi. Ushbu noyob xususiyatlar katta tadqiqot qiziqishini keltirib chiqardi. Samarali dizayn OppNets muvaffaqiyatli ishlashi uchun kalit bo'lib, mobillik modellari va marshrutlash protokollari muhim parametrlar bo'lib xizmat qiladi. Mobillik modellari tugunlar qanday harakatlanishini aniqlaydi, marshrutlash protokollari esa tugunlarning o'z manzillariga etib borishi uchun eng maqbul va samarali yo'llarni o'rnatadi. Ushbu parametrlarni sinchkovlik bilan tanlash samarali marshrutlash protokolini yaratishda hal qiluvchi ahamiyatga ega [2].

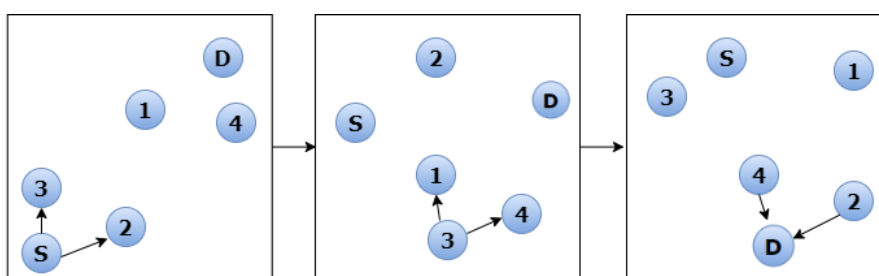
Arxitekturasi

Opportunistik tarmoq - klassik tarmoqlardan farqli o'laroq, manba tugun va maqsad tugun o'rtasida ma'lumotlarni yo'naltirish uchun oraliq tugunlardan foydalanadigan tarmoq. Bu erda tugunlar simsiz ulanadi. Butun jarayon davomida oraliq tugunlar yaqin atrofdagi boshqa faol tugunga duch kelmaguncha ma'lumotlarni o'z omborida saqlaydi. Ushbu ketma-ket jarayon ma'lumotlar asosiy tugundan boshlab yakuniy tugunga muvaffaqiyatli yetib borgunga qadar davom etadi. Opportunistik tarmoqlarda tarmoq topologiyasi dinamik va oldindan belgilanmagan. Manba va maqsad tugunlari o'rtasida qat'iy belgilangan yo'nalish kafolati yo'q. Tugunlarni faollashtirish yoki o'chirish vaqt o'tishi bilan tarmoq topologiyasini o'zgartirishi mumkin. Agar manba tugun o'zining aloqa diapazoni doirasidagi maqsad tuguniga bevosita ulanish imkoniga ega bo'lmasa, u xabarni o'z diapazonidagi eng yaqin tugunga uzatadi. Bu takrorlanuvchi jarayon xabar belgilangan manzilga yetguniga qadar davom etadi [3]. 1-rasmda Opportunistik tarmoqlarning oddiy misoli tasvirlangan.



1-rasm. Opportunistik tarmoqlarning oddiy misoli [2].

Opportunistik tarmoqlarda qoʻllaniladigan mexanizmlardan biri saqlash-tashish-yoʻnaltirish mexanizmidir. Ushbu mexanizmدا tugun paketni qabul qilganda, u maʼlumotni darhol keyingi tugunga uzatmaydi. Buning oʻrniga, tugun maʼlum vaqt davomida paketni vaqtincha saqlaydi. Tugun harakatlanayotganda, u oʻzi bilan birga paketni olib yuradi. Agar tugun harakat paytida boshqa tugunlarga duch kelsa, u paketni shu tugunlarga yoʻnaltiradi. Ushbu mexanizm, ayniqsa, paketlarni toʻgʻridan-toʻgʻri yoʻnaltirish uchun uchdan-uchgacha yoʻl mavjud boʻlmagan holatlarda foydalidir. Saqlash-tashish-yoʻnaltirish mexanizmidan foydalangan holda, opportunistik tarmoqlar paketlarni yetkazib berish uchun uzluksiz yoʻlning yoʻqligi bilan bogʻliq qiyinchiliklarni yengib oʻtishlari mumkin. Ushbu mexanizm 2-rasmda koʻrsatilgan.



2-rasm. Opportunistik tarmoq arxitekturasi

Mobillik modellari va marshrutlash protokollari

Mobillik modellari opportunistik tarmoqlarda (OppNets) hal qiluvchi rol oʻynaydi, chunki ular tugun harakati yoʻllarini yaratish algoritmlari va qoidalarini belgilaydilar[6]. Soʻnggi tadqiqotlar OppNets-dagi mobillik modellarining anʼanaviy modellarga nisbatan oʻziga xosligini taʼkidlaydi. Mobillik modellarini ikki toifaga ajratish mumkin: trassirovka va sintetik modellar.

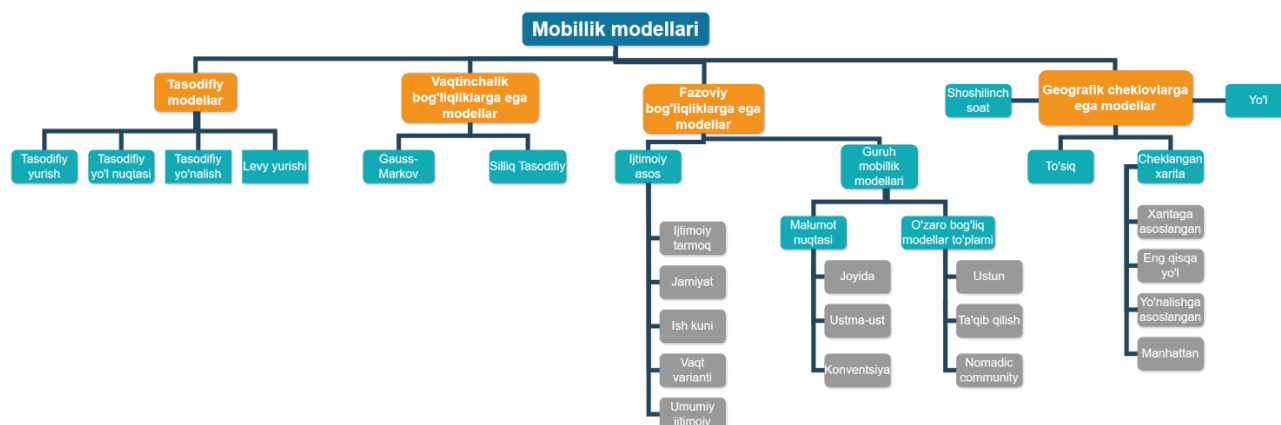
Trassirovka modellari tugun harakati yondashuvlarini aniqlash uchun statsionar infratuzilmalardan toʻplangan haqiqiy maʼlumotlardan foydalanadi. Ushbu modellar tarmoqdagi tugunlarning harakatchanligini taqlid qilish uchun qayd etilgan izlarga tayanadi.

Boshqa tomondan, sintetik modellar oldindan mavjud boʻlgan yoʻllardan foydalanmasdan tugun harakati yoʻllarini yaratadi. Ushbu modellar tugun harakati xususiyatlariga koʻra yana ikkita toifaga boʻlinadi.

1. Obyektlarning harakatchanlik modellari: obyektlarning harakatchanlik modellarida har bir

tugun boshqalardan mustaqil ravishda ishlaydi. Bitta mobil tugunning harakati tarmoqdagi boshqa tugunlarning harakatiga bevosita taʼsir qilmaydi. Har bir tugun oʻz yoʻlidan boradi va avtonom tarzda harakat qiladi.

2. Guruh harakatchanlik modellari: Guruh harakatchanligi modellarida tugunlar guruhlar yoki klasterlarni tashkil qiladi va ularning harakati bir-biriga bogʻliqdir. Xuddi shu guruhdagi tugunlar muayyan vazifalar yoki maqsadlarga erishish uchun harakatlarini muvofiqlashtiradi va hamkorlik qiladi. Guruhning jamoaviy xatti-harakati tarmoqning umumiy dinamikasiga taʼsir qiladi[5]. Opportunistik tarmoqlar mobillik modellari taksonomiyasi 3-rasmda keltirilgan.



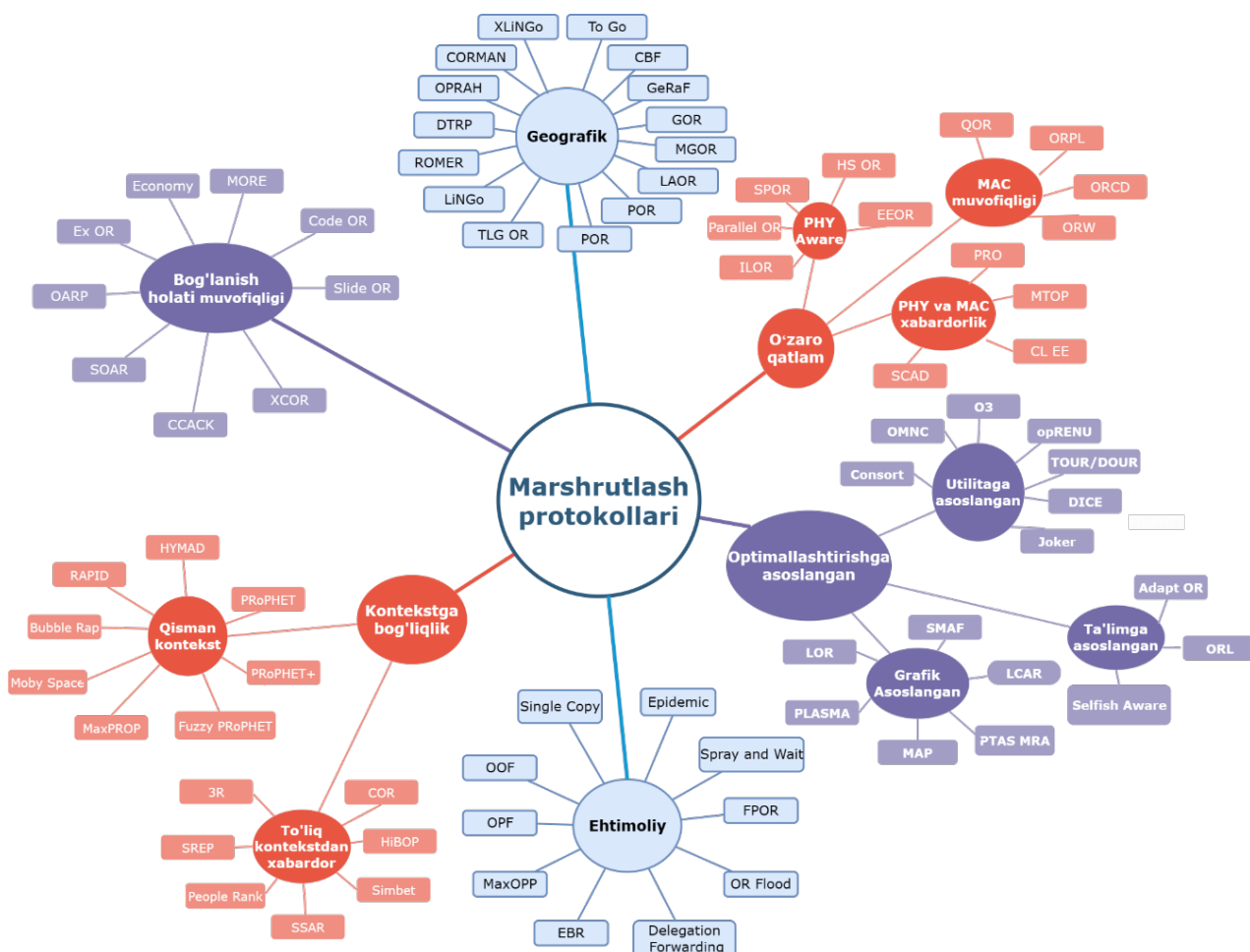
3-rasm: Mobillik modellarining taksonomiyasi

Marshrutlash protokollari

OppNets-ning oʻziga xos stsenariylari va talablariga javob beradigan koʻplab marshrutlash protokollari ishlab chiqilgan. Biroq, hozirgacha ushbu tarmoqlarning murakkabligi va xilma-xilligini koʻrsatadigan standart marshrutlash protokoli paydo boʻlmagan.

OppNets-da tugunlar oʻrtasidagi aloqalar xabarlar oʻz manzillariga oʻtishlari uchun yagona vositadir. Natijada, marshrutlash protokollarining ishlashini aniqlashda tugunlar orasidagi aloqa vaqtini taqsimlash hal qiluvchi rol oʻynaydi. Aloqalarning vaqti va chastotasi toʻgʻridan-toʻgʻri xabarlarni yetkazib berish samaradorligiga taʼsir qiladi va yoʻnaltirish strategiyasini tanlashga taʼsir qiladi.

OppNets-dagi marshrutlash protokollari ushbu tarmoqlarning dinamik va noaniqligini hisobga olgan holda, xabarlarni samarali yetkazib berishga erishishda asosiy rol oʻynaydi. Standartlashtirilgan marshrutlash protokolining yoʻqligi protokolni loyihalashda asosiy omil sifatida tugunlar oʻrtasidagi aloqa vaqtini taqsimlashni hisobga oladigan moslashtirilgan yondashuvlar zarurligini taʼkidlaydi [2]. Opportunistik tarmoqlarda qoʻllaniluvchi barcha marshrutlash protokollarining taksonomiyasi 4-rasmda keltirilgan.



4-rasm: Marshrutlash protokollar taksonomiyasi

Xulosa

Xulosa qilib aytganda, opportunistik tarmoqlar ularni muvaffaqiyatli amalga oshirish uchun hal qilinishi kerak bo'lgan bir qator muammolarni keltirib chiqaradi. Bu muammolar tugunlarning harakatchanligi, uzluksiz ulanish, cheklangan resurslar, xavfsizlik va kengayish qobiliyatini o'z ichiga oladi. Biroq, bu qiyinchiliklarga qaramay, opportunistik tarmoqlar turli sohalarda, jumladan, favqulotda holatlarni boshqarish, chekka hududlarda aloqa o'rnatish, atrof-muhit monitoringi va transport tarmoqlarida katta ahamiyatga ega.

Opportunistik tarmoqlarning kelajakdagi yo'nalishlari samarali marshrutlash protokollarini, resurslarni boshqarish usullarini va kontekstdan xabardor ilovalarni ishlab chiqishda yotadi. Mashinali o'qitish va ma'lumotlarni tahlil qilish sohasidagi yutuqlar ushbu tarmoqlarning ishlashi va moslashuvchanligini sezilarli darajada oshirishi mumkin. Bundan tashqari, opportunistik tarmoqlarni mavjud infratuzilma va texnologiyalar bilan birlashtirish, masalan, buyumlar interneti (IoT – Internet of Things) va bulutli hisoblash, ularning imkoniyatlarini yanada oshirishi mumkin.



Adabiyotlar

1. Puneet Garg, Ashutosh Dixit and Preeti Sethi – “Opportunistic Networks: Protocols, Applications & Simulation Trends” - International Conference on Innovative Computing and Communication (ICICC - 2021) .
2. Khaleel Ahmad, Muneera Fathima, Md.Sharif Hossen, Jameel Ahamed, Khairol Amali Bin Ahmad – “Opportunistic Networks: An Empirical Research of Routing Protocols and Mobility Models”, A SPRINGER NATURE journal. SN Computer Science(2023) 4:652 <https://doi.org/10.1007/s42979-023-02054-y>
3. Navneet Kaur, And Gauri Mathur – “Opportunistic Networks: A Review”, IOSR Journal of Computer Engineering (IOSR-JCE) e-ISSN: 2278-0661,p-ISSN: 2278-8727, Volume 18, Issue 2, Ver. III (Mar-Apr. 2016), PP 20-26 www.iosrjournals.org
4. Zhenyou Sui – “The Research of the Route Protocols in Opportunistic Network”, Inner Mongolia University for the Nationalities Tongliao Neimenggu China e-mail: 358778555@qq.com, 2015 International Conference on Computational Intelligence and Communication Networks
5. Muneera Fathima, Khaleel Ahmad and Afrah Fathima, School of Computer Science & Information Technology, Maulana Azad National Urdu University (A Central University), India muneera.csit@gmail.com, af.fathima1@gmail.com – “Mobility Models and Routing Protocols in Opportunistic Networks: A Survey”, International Journal of Advanced Research in Computer Science.
6. A. Keränen, J. Ott, and T. Kärkkäinen, “The ONE simulator for DTN protocol evaluation,” Proceedings of the Second International ICST Conference on Simulation Tools and Techniques, 2009.
7. A. Passarella and M. Conti, “Analysis of Individual Pair and Aggregate Intercontact Times in Heterogeneous Opportunistic Networks,” IEEE Transactions on Mobile Computing, vol. 12, no. 12, pp. 2483–2495, 2013.



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АЛГОРИТМЫ ВОССТАНОВ- ЛЕНИЯ ГЕОЛОГИЧЕСКИХ СИГНАЛОВ С ПОМОЩЬЮ СПЛАЙНОВ

Аннотация: в статье обсуждается, как использовать сплайн-функции для геологических сигналов, и предлагаются алгоритмы параметризации сплайнов. Для этого возьмем в качестве примера трехточечный вынос, работающий режиме реального времени. Уникальность этих формул заключается в независимости значения оцениваемого сплайна на этом участке.

Ключевые слова: сплайн, базисный сплайн, аппроксимация, b -коэффициенты, «точечные» формулы, приближения, полиномы Ньютона, алгоритм.



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ALGORITHMS FOR RECOVERING GEOLOGICAL SIGNALS USING SPLINES

Abstract: The article discusses how to use spline functions for geological signals and proposes spline parameterization algorithms. For this purpose, we take a three-point offset operating in real time as an example. The uniqueness of these formulas lies in the independence of the estimated spline value in this section.

Keywords: spline, basis spline, approximation, b-coefficients, “point” formulas, approximations, Newton polynomials, algorithm.



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Введение

Рост населения, загрязнение окружающей среды, переполненность бытовых систем водоснабжения, изменение климата, производство продуктов питания и промышленные потребности оказывают постоянное давление на обеспечение населения высококачественной питьевой водой [1,2]. Было три основных причины огромного расширения инфраструктуры водных ресурсов на территории Узбекистана в прошлом веке: [3,7] рост населения; промышленное развитие; и [8] расширение орошаемого земледелия. Все три фактора значительно возросли в последние годы. Сегодня нам нетрудно увидеть доказательство возможности непрерывного обеспечения населения питьевой водой при дистанционном контроле процесса использования питьевой воды, взятой из-под земли на определенных участках, путем анализа аномальных изменений уровня подземных вод. Однако есть несколько факторов, негативно влияющих на этот процесс: среди них недостаточное количество скважин, дающих информацию о подземных водах по всей стране. Неспособность специалистов в данной области точно предсказать изменение уровня грунтовых вод в районах, где нет колодцев, значительно снижает возможность разумного использования воды в этих районах.[10]

Построение кубического В-сплайна

Для предварительной аппроксимации на всем интервале $[a, b]$ В-сплайны должны быть заданы на более широкую область назначения $2m$ дополнительных узлов $i=-m, m+1, n+m$ при этом все узлы могут быть подключены неравномерно.

Кубические В-сплайны задаются выражениями:

$$B_3(x) = \begin{cases} 0, & x \geq 2, \\ (2-x)^3/6, & 1 \leq x < 2, \\ 1/6(1 + 3(1-x) + 3(1-x)^2 - 3(1-x)^3), & 0 \leq x < 1, \\ B_3(-x), & x < 0. \end{cases}$$

На рис. 1 представлен один базисный сплайн, а на **рис.2** семейства кубических базисных В-сплайнов сдвинутых на постоянный шаг $h=1$.

Для сплайнов 3-й степени локальные 3-точечная формула имеет следующий вид:

$$b_i = (1/6)(-f_{i-1} + 8f_i - f_{i+1}); \quad (1.2)$$

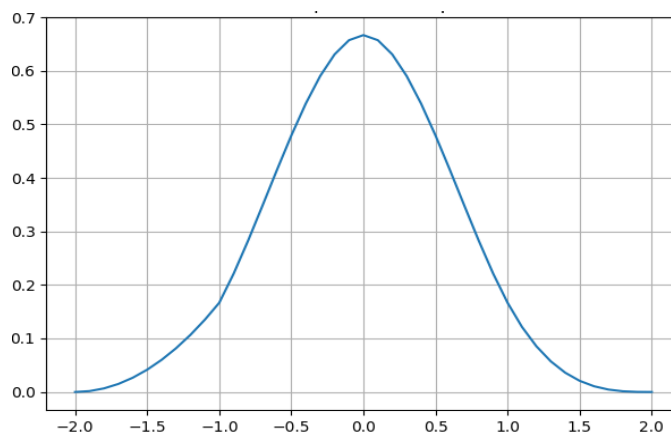


Рис.1. Кубический базисный В-сплайн.

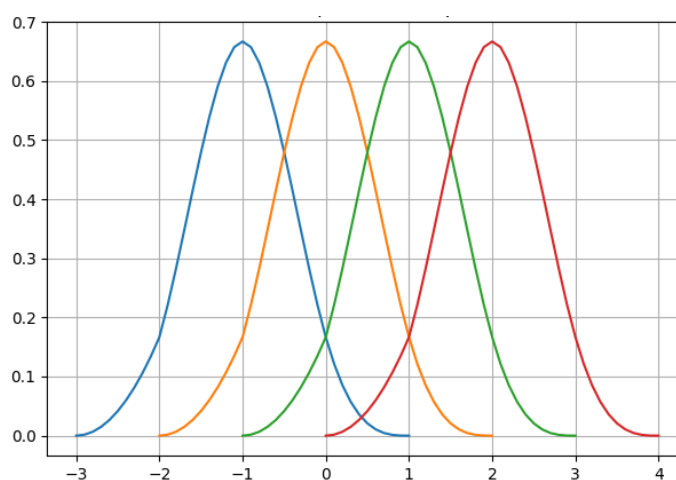


Рис.2 Семейства кубических базисных сплайнов.

Любой сплайн $S_m(x)$ степени m дефекта 1, интерполирующий заданную характеристику $f(x)$ может встречаться представленными B -сплайнами в виде сумм [2,3,9,10]:

$$f(x) \cong S_m(x) = \sum_{i=-1}^m b_i B_i(x) \quad a \leq x \leq b \quad (1.3)$$

где b_i - фактор, представляющий его описание в формуле (2). Согласно формуле (1.3) значение интерполируемой функции в достижении поставленного интервала значения определения $m+1$ сокращаемых – парных функций основанных на усилении функций на коэффициенты. Например, кубические B -сплайны требуют четырех основных слагаемых.

Значение функции вычисляется по формуле:

$$f(x) \cong S_3(x) = b_{-1}B_{-1}(x) + b_0B_0(x) + b_1B_1(x) + b_2B_2(x); \quad \text{при } x \in [0,1] \quad (1.4)$$

Остальные базисные сплайны на этом подинтервале имеют значение и, следовательно, в совокупности не имеют значения.

b -коэффициенты применения различных методов: интерполяционные и «точечные» формулы, поглаживающие сплайны, метод наименьших квадратов. Однако для системно функционирующих в масштабе времени следует использовать «точечные» формулы. Особенность результатов измерений в независимости значений аппроксимирующего сплайна на точность определения результатов измерений.

Методическая погрешность интерполяции функций $f(x)$ кубическими базисными сплайнами Решение о неравенстве:

$$\varepsilon \leq \frac{5}{384} h^4 \max |f^{IV}(x)| \quad (1.5)$$

для функции, $f(x) = \ln(1+x)$ утверждение:

$$\varepsilon \leq \frac{5}{384 \cdot 1,0 \cdot 32^4} = 0,12 \cdot 10^{-7} \quad (1.6)$$

Для сравнения допустимого значения погрешности интерполяции классических кубических полиномов Ньютона:

$$\varepsilon \leq \frac{1}{24} h^4 \max |f^{IV}(x)| = \frac{1}{24 \cdot 32^4 \cdot 1,0} = 0,4 \cdot 10^{-7} \quad (1.7)$$

Как видно из (1.7), погрешность превышает максимальную, полученную в (1.6), более чем в три раза.

Процесс восстановления геологических сигналов с использованием В-сплайн функции третьего порядка и их цифровая обработка.

Для решения задач, стоящих перед специалистами в организованной сфере, аппроксимируем геологический сигнал, полученный в эксперименте, предложенным математическим аппаратом, создадим процесс восстановления недостающих данных в регионах, проведем сравнительный анализ. анализ в виде графиков и таблиц.

Для выполнения анализа мы реализуем задачу восстановления, используя значения значимых индикаторов сложной системы подземных вод через предложенную нами функцию В-сплайна 3-й степени. Сначала проведем процесс восстановления геологических (уровень подземных вод) сигналов, полученных в результате следующего эксперимента.

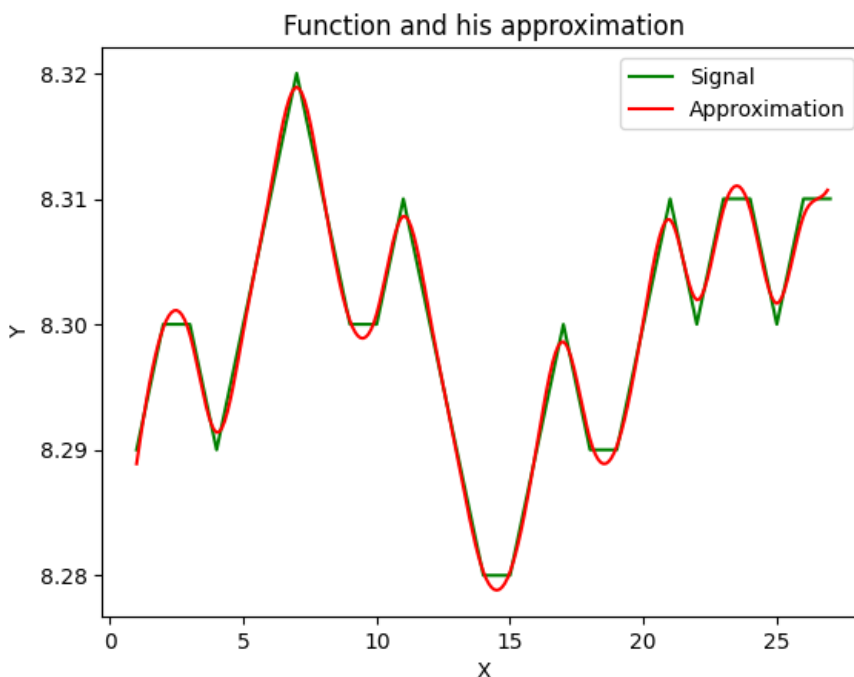


Рис 3. График аппроксимации геологических сигналов кубическим В-сплайном

Как видно на картинке, наша функция очень близка к исходному значению сигнала. Это доказывает, что достаточно решить поставленную перед нами задачу. Ниже мы приводим сравнительный анализ процесса восстановления геофизического сигнала в виде таблицы.

Таблица 1. Табличный вид процесса аппроксимации геологических сигналов кубическим В-сплайном.

№	Signal	S(x)	$R = f(x) - S(x) $	№	Signal	S(x)	$R = f(x) - S(x) $
1	8.3	8,288889	0,011111	14	8.28	8,280278	0,000278
2	8.3	8,299722	0,000278	15	8.29	8,280278	0,009722
3	8.29	8,299167	0,009167	16	8.3	8,290278	0,009722
4	8.3	8,291389	0,008611	17	8.29	8,298611	0,008611
5	8.31	8,299444	0,010556	18	8.29	8,290833	0,000833
6	8.32	8,310556	0,009444	19	8.3	8,290278	0,009722
7	8.31	8,318889	0,008889	20	8.31	8,300278	0,009722
8	8.3	8,310278	0,010278	21	8.3	8,308333	0,008333
9	8.3	8,300278	0,000278	22	8.31	8,301944	0,008056
10	8.31	8,300833	0,009167	23	8.31	8,309167	0,000833

11	8.3	8,308611	0,008611	24	8.3	8,309167	0,009167
12	8.29	8,300556	0,010556	25	8.31	8,301667	0,008333
13	8.28	8,289722	0,009722	26	8.31	8,308611	0,001389

Заклучение

Таким образом, Сплайны как класс кусочных функций вследствие универсальности алгоритмов обработки отсчетов, хороших дифференциальных и экстремальных свойств, высокой сходимости оценок приближений, простоты вычислений форм и параметров, слабого влияния ошибок округления находят все более широкое применение при создании аппаратных и программных средств анализа и восстановления одномерных и многомерных сигналов, расширяя рамки традиционных подходов. Основные результаты, полученные в рамках настоящей диссертационной работы, заключаются в следующем:

Мы также предложили В-сплайн функцию 3-го уровня в качестве математической модели для мониторинга подъема или падения уровня грунтовых вод в районе исследования и для восстановления информации об изменении уровня воды в районах, где нет скважин, и результаты представлены графически и проанализированы нами в таблицах.



Adabiyotlar

1. Сви́нѣин С.Ф. Базисные сплайны в теории отсчётов сигналов. С-Пбг.: Наука, 2003. –118с.
2. Svin'in S.F. Bazisnyye splayny v teorii otschotov signalov. S-Pbg.: Nauka, 2003. –118s.
3. X.H. Зайнидинов, С.А. Бахрамов Теориясплайнов. // Монография –Т.: “Aloqachi”, 2020, -188
4. H. N. Zaynidinov, I. Yusupov, J. U. Juraev, and Dhananjay Singh. Digital Processing of Blood Image by Applying Two-Dimensional Haar Wavelets // Intelligent Human omputer Interaction 12th International Conference, IHCI 2020 Daegu, South Korea, November 24–26, 2020 Proceedings, Part I,
5. Farkhad Rajabov, Dhananjay Singh. IoT-Enabled Mobile Device for Electrogastrography Signal Processing // Intelligent Human Computer Interaction 12th International Conference, IHCI 2020 Daegu, South Korea, November 24–26, 2020 Proceedings, Part II, (Indexed by SCOPUS), p. 346-356
6. X.H. Зайнидинов, Ж.Н. Нурмуродов, М.Р.Гофуржонов // Алгоритмы и программы восстановления функций с помощью кубических базисных сплайнов.”№1(39) 2022. –б. 67-72.
7. Зайнидинов X.H., Махмудов А.Х. Методы и модели восстановления сигналов на основе многомерных базисных сплайнов. // Известия ВУЗов. Ташкент. -1998., № 1-4, С. 163-164.
8. Zaynidinov H.N., Bakhromov S.A., Azimov B.R., Kuchkarov M.A. Local Interpolation Bicubic Spline Method in Digital Processing of Geophysical Signals // Advances in Science, Technology and Engineering Systems Journal. United states, Vol. 6, №. 1, 2021. – P. 487-492. (№3; Scopus; IF=0.655). 3.1
9. Kh.N. Zaynidinov, S.A. Bakhramov Teoriya splaynov. // Monografiya –Т.: “Aloqachi”, 2020, -188 str.
10. Bahramov S.A., Jovliev S. Bicubic Splines in Problems of Modeling of Multidimensional Signal. “International journal of “the korea institute of maritime information & communication sciences”. Vol.9, No.4, August 2011, p.420-423.



Muallif

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AXBOROT KOMMUNIKATSIYA VA RAQAMLI TEXNOLOGIYA- LARDA AXBOROT ALMASHINUVINI TA’MINLASHDA QUYOSH VA SHAMOL ENERGIYASIDAN FOYDALANISH ISTIQBOLLARI

Annotatsiya. Ushbu maqolada Mudofaa vazirligi 41564 harbiy qismda modernizatsiya qilinayotgan va Mudofaa vazirligi tizimidagi harbiy qism va muassasalarga aloqani tashkillashtirish uchun yetkazib berilayotgan Universal aloqa majmualarida shamol va quyosh energiyasidan foydalanish imkoniyatlarini o‘rganish orqali davlat elektr energiyasini uzatish va taqsimlash qiyin bo‘lgan hududlarda gibridd quyosh-shamol elektr stansiyasini loyihani ishlab chiqish hamda aloqa texnikalarining harakat vaqtida shamol dvigatellarini o‘rnatish orqali elektr energiyasini hosil qilish, aloqa vositalarini uzluksiz ishlashini va bu orqali boshqaruvning doimiyligini ta‘minlash masalalari ko‘rib chiqilgan.

Kalit so‘zlar. Energiya resurslar, SHES (shamol elektr stansiyasi), gibridd quyosh-shamol elektr stansiyasi, qayta tiklanuvchi energiya, “Mir-solar” kompaniyasi, elektr ta‘minot, Xitoyning Bojin kompaniyasi.



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PROSPECTS OF USING SOLAR AND WIND ENERGY IN PROVIDING INFORMATION EXCHANGE IN INFORMATION COMMUNICATION AND DIGITAL TECHNOLOGIES

Abstract: In this article, by studying the possibilities of using wind and solar energy in Universal communication complexes, which are being modernized in 41564 military units of the Ministry of Defense and are being delivered to the military units and institutions of the Ministry of Defense for the organization of communication, hybrid solar-wind in regions where it is difficult to transmit and distribute state electricity development of the project of the power plant and generation of electricity by installing wind engines during the operation of communication equipment, the continuous operation of communication means and thus ensuring the continuity of management were considered.

Keywords: Energy resources, SHES (wind power station), hybrid solar-wind power station, renewable energy, "Mir-solar" company, electricity supply, China's Bojin company.



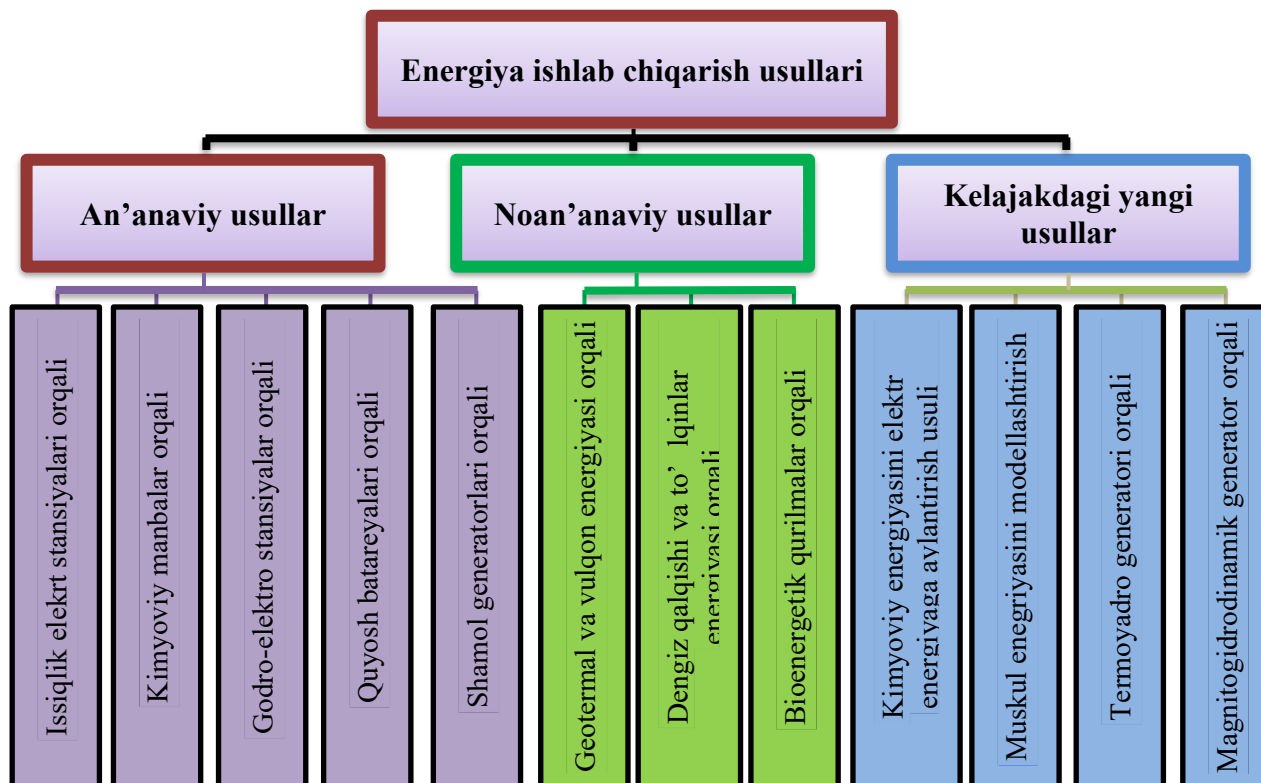
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Kirish

Insoniyat qadimgi davrlardan boshlab o'zining moddiy ehtiyojlarini qondirish maqsadida bir qancha tabiat bergan ne'matlardan foydalanib kelmoqda. Bunday ehtiyojlar sarasidan esa elektr energiyasi ham muhim o'rin egallaydi. Vaqtlar o'tishi bilan zamon rivojlanib inson qo'l mehnatini yengillashtirish, uzoq masofalardan turib axborot almashinuvini ta'minlash, aqilli uylarni barbo qilish jarayoni sezilarli darajada jadallashib ketdi. Bu rivojlanishlar natijasida barcha qurilmalar, vositalar elektr energiyasiga bo'lgan talabni haddan ortiq oshishiga olib keldi. Bu o'z navbatida energiya resurslari taqchilligi va ekologiya muommolarini keltirib chiqarmoqda. Bunday sharoitda insonlarda energiyadan oqilona foydalanish haqidagi tushunchalarni hosil qilish dolzarb ahamiyatga ega.

Bugungi kunda elektr energiyasi olishning turli usullaridan foydalaniladi. Quyidagi (1-diagramma)da bugungi kundagi dunyoda elektr energiyasi olishning an'anaviy, noan'anaviy va kelajakda ishlatilishi ko'zda tutilgan usullari keltirilgan. Diagrammada keltirilgan usullarning har biri o'ziga xos afzalliklar va kamchiliklarga ega bo'lib u yoki bu usulning ishlatilishi tabiiy resurslarning joylashuvi, energiyaga bo'lgan ehtiyoj va boshqa sabablarga ko'ra aniqlanadi. [1]



1-rasm. Elektr energiyasini olishning usullari.

Bugungi kunda tabiiy yoqilg'i ishlatish miqdori dunyo bo'yicha yiliga 12 milliard tonna neft ekvivalentiga to'g'ri keladi. Bu esa har bir kishiga taxminan 2 tonna tabiiy yoqilg'i to'g'ri keladi, deganidir. Ma'lumotlarga qaraganda, so'nggi 40 yil davomida butun insoniyat tarixi mobaynida qazib olingan organik yoqilg'idan ham ko'p yoqilg'i iste'mol uchun o'zlashtirilgan. Bu esa ularning zaxirasini juda tez kamayib ketishiga sabab bo'lmoqda.

2017-2021 yillarda O'zbekiston Respublikasini rivojlantirishning beshta ustuvor yo'nalishlari bo'yicha harakatlar strategiyasi IV yo'nalishi Ijtimoiy sohani rivojlantirishning ustuvor

yoʻnalishlarida koʻrsatilgandek yangi elektr ishlab chiqarish quvvatlarini qurish va mavjudlarini modernizatsiya qilish asosida aholini elektr energiyasi bilan taʼminlashni yaxshilash, past kuchlanishli elektr tarmoqlari va transformator punktlarini yangilash, shuningdek, aholini boshqa yoqilgʻi-energiya resurslari bilan taʼminlashni yaxshilash va qayta tiklanadigan energiya manbalaridan foydalanishni kengaytirish boʻyicha chora-tadbirlarni amalga oshirish toʻgʻrisida va Oʻzbekiston Respublikasi Prezidentining 2017-yil 13- noyabrdagi PQ-3384-son “Elektr energiyasi va tabiiy gaz nazorati va hisobining avtomatlashtirilgan tizimini jadal joriy etish chora-tadbirlari toʻgʻrisida” va 2017-yil 8- noyabrdagi PQ-3379-son “Energiya resurslaridan oqilona foydalanishni taʼminlash chora-tadbirlari toʻgʻrisida” qarorlarida Respublikamizda noan’anaviy energiya manbalaridan foydalanish va arzon energiya ishlab chiqarish texnologiyalarini qoʻllash kabi vazifalar belgilab berilgan.

Yuqoridagi fikrlardan kelib chiqqan holda 41564 harbiy qismda modernizatsiya qilinayotgan universal aloqa majmuasidagi aloqa va telekommunikatsiya vositalarini shamol energiyasidan foydalangan holda ekspluatatsiya qilish aloqa qoʻshinlarini harakat vaqtida ham aloqani uzluksizligini taʼminlashga xizmat qiladi. Ushbu maqolada biz Oʻzbekiston Respublikasi Mudofaa vazirligi aloqa qoʻshinlari uchun modernizatsiya qilinayotgan universal aloqa majmualari uchun mablagʻ nuqtai nazardan qulay, sifat jihatidan ishonchli boʻlgan shamol energiyasi haqida soʻz yuritamiz.[4]

Dastavval, shamol elektr stansiyasini tanlash misolidan oldin shuni nazarda tutish lozimki, shamol elektrostansiyasi oʻzi nima, qanday tartibda shamol energiyasi elektr energiyasiga aylanadi va harakat vaqtida shamol generatori orqali qancha miqdorda bunday energiya olish mumkin?



2-rasm. Shamol tegirmonidan elektr energiyasini olishning usullari.

Shamol elektr stansiyalari (keyingi oʻrinlarda SHES) — shamol oqimining kinetik energiyasini elektr energiyaga aylantiruvchi qurilma hisoblanadi. U xalq orasida shamol parraklari yoki shamol tegirmoni deb ham yuritiladi. Ular foydalanish mumkin boʻlgan, qayta tiklanuvchi elektr manbai sanaladi.

Shamol elektr stansiyalar tarkibi shamol dvigateli, elektr toki generatori, generator va

dvigatelning ishini boshqaruvchi avtomatik qurilma hamda ular o'rnatiladigan inshootlardan tashkil topadi.

Shamol tegirmonlari qanday ishlaydi? Shamol parraklari shamol energiyasini elektr energiyasiga aylantiradi. Hosil bo'lgan kuchlanish elektr energiyasini ishlab chiqaruvchi generator rotoriga uzatiladi. Bundan tashqari, ishlab chiqarilgan elektr energiyasi ham tarmoqqa ulanadi.[2]

Quyidagi formula biz yashaydigan hududda esib yurgan shamol energiya quvvatini ifodalaydi:

$$P = v^3 \cdot \rho \cdot S = 5^3 \cdot 1,25 \cdot 12,5 = 1953,125$$

v - shamol tezligi, (m/s), ρ - havo zichligi, (kg/m³), S - shamol esadigan maydon yuzi, (m²)

Misol uchun 3 kvadrat metr maydonda o'rtcha zichlikdagi esadigan shamolning tezligi 5 m/s bo'lganda quyidagini olishimiz mumkin. Idial holatda qarshiliklarni hisobga olmagan holatda deyarli 2 kVt tashkil qilmoqda.

Real holatda esa havo oqiminring potensial energiyasidan 30-40% foydalanish mumkin. Bu chegaralanish shamol generatorining fizik va texnologik faktorlari bilan bog'liq, aniqroq hisob kitoblar quyidagi formula orqali aniqlanadi.[3],[6]

$$P = \xi \cdot \pi \cdot R^2 \cdot 0,5 \cdot v^3 \cdot \rho \cdot \eta_{red} \cdot \eta_{gen}$$

3-rasm. Shamol elektr stansiyasining elektr ishlab chiqarish quvvati

u yerda: ξ - shamol energiyasidan foydalanish koeffisienti (maksimal qiymati 0,4÷0,5), R - rotorning radiusi (m), V - havo oqiminig tezligi (m/s), ρ - havo qatlamaning zichligi (kg/m³), η_{red} - Reduktorning FIK, η_{gen} - Genretorning FIK.

Masalan: $\xi = 0,45$, $R = 2$ m, $v = 5$ m / s, $\rho = 1,25$ kg/m³, $\eta_{red} = 0,9$, $\eta_{gen} = 0,85$

Hisoblaymiz:

$$P = \xi \cdot \pi \cdot R^2 \cdot 0,5 \cdot v^3 \cdot \rho \cdot \eta_{red} \cdot \eta_{gen} = 0,45 \cdot \pi \cdot 2^2 \cdot 0,5 \cdot 5^3 \cdot 1,25 \cdot 0,9 \cdot 0,85 = 3,5 \text{ kV}$$

Ko'rinib turibdiki unchalik katta qiymat chiqmaydi, lekin nima uchun shamol energiyasidan foydalanish maqbul. Chunki shamol energiyasi ekologik sof toza maxsulot. Atrof muhitga ekologik jifatdan zara keltirmaydi. Texnogen xavfga ega emas. Neft maxsulotlariga nisbatan arzon energiya bilan ta'minlaydi. Cho'l zonalari, borishi qiyin bo'lgan joylar va tog'li hududlar elektr bilan ta'minlanadi.

Yurtimizning aksariyat viloyatlarini geografik joylashuvidan kelib chiqqan holda hududimizda shamol oqimi mavsumiy tusga ega ekanligini inobatga olganda shamol energiyasidan foydalanish imkoniyatini tashkil qiladi. Shamol energiyasidan foydalanishda shamolning energetik xarakteristikalarini o'rganildi. Bular quyidagilarni tashkil etadi:

- shamolning yillik, oylik va kunlik o'rtacha tezligi;
- shamol tezligini turi va qaytarilish parametrlari;
- shamolning o'rtacha vertikal rejimdagi tezligi;
- shamolning muayan quvvati va energiyasi;

- dala o'quv maydonlarini hududnig shamol energiya resursi.

Shamol elektr stansiyalarinig afzalliklari bilan bir qatorda ayrim kamchilik tomonlari ham mavjud: bular, SHES larning ishlashi bevosita shamolga bog'liqligi, ishlashi davomida yetarlisha shovqin yuzaga kelishi hamda energita ishlab chiqarish hajmi hajmga bo'gliqligi.




Biz ko'rib chiqayotgan shamol tegirmoni Universal aloqa apparatxonasining to'plamida o'rnatilgan aloqa apparatularini ta'minlab berish uchun yetarli sanalib, harakat vaqtida quyosh panellari bilan gibrit usulda foydalanish maqsadga muvofiqdir. Buning uchun Xitoyning Bojin kompaniyasida ishlab chiqarilgan vertikal o'qqa ulangan 2 kW energiya hosil qiluvchi shamol generatori (3-rasm).



3-rasm. "Bojin" kompaniyasining vertikal o'qi tarmoqqa ulangan 2 kw shamol shamol turbinasi

Universal aloqa malmuasiga o'rnatish va harakat vaqtida qo'llash mumkin bo'lgan shamol generatorlaridan bizga aynan vertikal turbinalar mos keladi va ular bir qancha turlariga bo'linadi (4-rasm).[4]

1-jadval. Vertikal shamol turbinalarining xususiyatlari.

Xususiyati			
	FS turdagi	FX-3000 turdagi	Q-5000 turdagi
Nominal quvvat (Vt)	400w	3000 w	5000w
Maksimal quvvat (Vt)	450W	3100 w	5200w
Boshlangan shamol tezligi (m/s)	1,0 m/s	1,5 m/s	1,5 m/s
Nominal shamol tezligi (m/s)	10m/s	11 m/s	11 m/s
Nominal kuchlanish (AC)	12v/24v	48v/96 v	48v/96 v
Pichoqlar balandligi (m)	1,1 m	2 m	3.38 m
Xavfsiz shamol tezligi (m/s)	≤40m/s	≤40m/s	≤45 m/s

Pichoqlar miqdori	2	3	3
Generator	Uch fazali doimiy magnit osma dvigatel		
Tog' balandligi (m)	7~12m (9m)		2~12m (9m)
Haddan tashqari tezlikni himoya qilish	Elektromagnit tormoz		
Ish muhitining namligi	90%	90%	-25~+45°C,
Ishlab chiqaruvchi	Xitoy	Xitoy	Xitoy
Narxi (so'm):	9 025 535	8 857 000	3 561 721



5-rasm. Universal aloqa majmuasiga shamol turbinasini o'rnatish chizmasi.

Xulosa

Xulosa o'rnida shuni takidlash lozimki, mobil shamol turbinalarini o'rnatish orqali eng avvalo universal aloqa majmuasining harakat vaqtida ham aloqa vositalarini elektr ebergiyasi bilan ta'minlashga erishiladi, shu bilan bir qatorda dala o'quv mashg'ulotlarida ochiq maydonlarda joylashganda shamol geberatorlari yordamida elektr energiyasi hosil qilinib aloqani uzluksizligini ta'minlashga erishiladi. Elektroagregatlar uchun ortiqcha yoqilg'I sarfi kamayishiga hamda atrof muhitga zararli gazlarni tarqatilishini kamaytirishga erishiladi.

Aloqaning asosiy vazifalarida biri – bu uning uzluksizligini ta'minlash bo'lsa, bugungi kunda universal aloqa majmuasiga o'rnatilib kelinayotgan UPS uzluksiz tok manbai qurilmasi, benzoelektr agregatlarga qo'shimcha tarzda shamol generatorlarini o'rnatish foydadan holi bo'lmasligini guvohi bo'lib kelmoqdamiz.



Adabiyotlar

1. Berdiev U.T., Pirmatov N.B. Elektromexanika. Texnika oliy oquv yurtlarining “Elektr texnikasi, elektr mexanikasi va elektr texnologiyalari” va “Elektr energetika” yonalishi talabalari uchun darslik. –T.:Shams-Asa. 2014.– 386b.
2. Андрианов В.Н. “Ветроэлектрические станции”.Москва-Ленинград, 1966. – 136b.
3. Аллаев Г.С. “Электрэнергетика Узбекистана и мира”, Т.: “Fan va texnologiya”, 2009, 464b.
4. Nabijonovich J.A. Renewable energy sources in Uzbekistan // *Academicia: An International Multidisciplinary Research Journal*. -2020. T.10. -№11 –S.769-774.
5. Jumanov A.N. Elektr Tarmoqlaridagi elektr energiya isroflarini tuzilishi // *Academic research in educational sciences*. – 2021 – T.2. – № 4.
6. Shodiyev O.A., Yuldashev E.U., Yuldasheva M.A., Uralov J.T., Elektrik kundaligi, ООО “LESSON PRESS” nashriyoti ISBN 978 9943-9288-3-1 Toshkent 2023.



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RAQAMLI TEXNOLOGIYALAR VA AXBOROT XAVFSIZLIGINI TA’MINLASHDA SUN’IY YO‘LDOSH ALOQA TIZIMINI QO‘LLASH USULLARI VA ALGORITMLARI

Annotatsiya: Maqolada O‘zbekiston Respublikasi Mudofaa vazirligi qo‘shinlarida Aloqa texnikalariga sun‘iy yo‘ldosh aloqa tizimini qo‘llash usullari va algoritmlari keltirib o‘tilgan. Ishning maqsadi aloqa texnikalarida sun‘iy yo‘ldosh aloqasi qanday ishlashi va spektrlariko‘rib chiqildi. Hamda ularning telekommunikatsiya, radio, internet yetkazib berishdagi ahamiyati ustida ham to‘xtalgan. Maqolada tizimning asosiy elementlari va ularning tamoyillari haqida so‘z boradi. YAT (yo‘ldoshli aloqa tizimlari) chastotalari, uzatish va qabul qilish turlari ko‘rib chiqildi. Transponder uzatadigan chastota haqida gapirganda, ulanish chastotasi haqida gapirish muhim. Sun‘iy yo‘ldosh aloqa tizimining bir nechta rasmlari keltirilgan. Bunday tizimlarni ishlatishning afzalliklari va kamchiliklari tavsiflanadi. Shuningdek SYA (sun‘iy yo‘ldosh aloqasi) dan foydalanish sohalari ko‘rsatilgan. SYA ning qiyosiy jadvallari taqdim etilgan va tahlil qilingan. Xulosa o‘rnida, sun‘iy yo‘ldosh aloqa tizimining radioresurslarini tezkor taqsimlash bo‘yicha qarorlarni qo‘llab quvvatlash tizimini ishlab chiqish bo‘yicha takliflar tayyorlangan.

Kalit so‘zlar: sun‘iy yo‘ldosh, repitor, SYA signalni uzatish, orbita, sun‘iy yo‘ldosh aloqa tizimi, past chastotaga ulanish chastotasi, stasionar sun‘iy yo‘ldosh, qamrov sayyora, teleradiostansiya, vacuum, radioeshittirish, radioto‘lqinlar.



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METHODS AND ALGORITHMS OF USING SATELLITE COMMUNICATION SYSTEM IN ENSURING DIGITAL TECHNOLOGIES AND INFORMATION SECURITY

Abstract: The article describes the methods and algorithms of using the satellite communication system for communication equipment in the troops of the Ministry of Defense of the Republic of Uzbekistan. The purpose of the work was to consider how satellite communication works and its spectrum in communication techniques. And their importance in telecommunication, radio, and Internet delivery was also discussed. The article talks about the main elements of the system and their principles. YAT (satellite communication systems) frequencies, types of transmission and reception were considered. When talking about the frequency at which the transponder transmits, it is important to talk about the connection frequency. Here are some pictures of the satellite communication system. Advantages and disadvantages of using such systems are described. Areas of use of SYA (satellite communication) are also indicated. Comparative charts of SYA are presented and analyzed. In the conclusion, proposals for the development of a decision support system for the rapid allocation of radio resources of the satellite communication system have been prepared.

Keywords: satellite, repeater, SYA signal transmission, orbit, satellite communication system, low frequency connection frequency, stationary satellite, coverage planet, TV and radio station, vacuum, radio broadcasting, radio waves.



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Kirish

Barcha mamlakatlarda telekommunikatsiya va radiokommunikatsiya tizimlarining texnik va texnologik sohalarda rivojlanish jarayoni sezilarli darajada jadallashib ketgan. Shu sababli telekommunikatsiya va radiokommunikatsiya tizimlarida yangi bosqichlarga chiqish zarurligi borasida bir qancha ishlar olib borilmoqda. Bugungi turmushimizda, kasbiy faoliyatimizda duch kelayotgan har qanday turdagi katta va keng hajmli ma'lumotlarni izlash va ularni uzatish, yangiliklarni ommaga xavola qilishda, uzoq masofali xavfsiz radioaloqani tashkillashtirishda, aloqa tizimlarining, internet va axborot-kommunikatsiya texnologiyalarining roli tobora kengayib bormoqda.

Shu jumladan O'zbekiston Respublikasi Prezidenti - Qurolli Kuchlar Oliy Bosh qo'mondoni Sh.M.Mirziyoyevning 2017-2021 yillarda O'zbekiston Respublikasini rivojlantirishning beshta ustuvor yo'nalishi bo'yicha Harakatlar strategiyasini "Ilm, ma'rifat va raqamli iqtisodiyotni rivojlantirish yili" da amalga oshirishga oid davlat dasturida belgilangan vazifalarga muvofiq hamda iqtisodiyot tarmoqlari va davlat boshqaruvi tizimiga zamonaviy axborot texnologiyalarini keng joriy etish va telekommunikatsiya tarmoqlarini kengaytirish orqali respublika iqtisodiyotini raqobatbardoshligini yanada oshirish to'g'risidagi va boshqa qator rahbariy hujjatlarga asosan Qurolli Kuchlarimizdagi qurol aslaha va texnikalar hamda aloqa va axborotlashtirish vositalarini jadallik bilan modernizatsiya qilish ishlari amalga oshirib kelinmoqda.

Telekommunikatsiya va radiokommunikatsiya tizimlarining rivojlanishida sun'iy yo'ldosh aloqa tizimlarini qo'llash muhim rol o'ynamoqda. Albatta, siz o'ying sun'iy yo'ldosh ekanligini eshitgansiz. Buning sababi shundaki, tabiiy va sun'iy yo'ldoshlar mavjud. Ularning har biri o'ziga xos xususiyat va funksiyaga ega va ularni alohida o'rganish kerak.

Shuning uchun, ushbu maqolada biz sun'iy yo'ldosh nima, uning xususiyatlari va ularning har birining ahamiyati, sun'iy yo'ldosh aloqa tizimlari va ularning kelib chiqish tarixi, o'tkazilgan tajribalar, afzalliklari, matematik modellari haqida aytib o'tilgan.

Sun'iy yo'ldoshning tabiiy qismi yoki sun'iy qismini nazarda tutayotganimizga qarab, ikkita ta'rif bo'ladi. Agar biz tabiiy qism haqida gapiradigan bo'lsak, biz asosiy sayyora atrofida aylanadigan shaffof bo'lmagan osmon jismi haqida gapiramiz. Ikkinchidan, Sun'iy yo'ldosh - bu ilmiy, harbiy yoki aloqa maqsadida Yer atrofida orbitaga joylashtirilgan qurilma.

Sun'iy yo'ldoshlar tabiiy va sun'iy yo'ldoshlar turlariga bo'linadi.

Tabiiy yo'ldosh - bu boshqa orbitada aylanadigan odam yaratmagan samoviy jism. Sun'iy yo'ldoshning o'lchami, odatda, uni o'rab turgan samoviy jismdan kichikdir. Bu harakat kattaroq jismning kichik jismga tortishish kuchi bilan bog'liq. Shuning uchun ular uzluksiz ishlashni boshlaydilar. Xuddi shu narsa Yerning Quyoshga nisbatan orbitasi uchun ham amal qiladi.

Tabiiy yo'ldoshlar haqida gapirganda, u ko'pincha sun'iy yo'ldoshlarning umumiy nomi deb ham ataladi. Biz oyimizni oy deb ataganimiz uchun, boshqa sayyoralarning boshqa yo'ldoshlari xuddi shu nom bilan tasvirlangan. Har safar biz oy so'zini ishlatganimizda, u Quyosh sistemasidagi boshqa osmon jismi atrofida aylanadigan samoviy jismni nazarda tutadi, garchi u aylana oladi. Kichkina sayyoralar, masalan, ichki sayyoralar, tashqi sayyoralar va hatto asteroidlar kabi boshqa kichik



samoviy jismlar kiradi.

Quyosh tizimida 8 ta sayyora joylashgan, 5 ta kichkina sayyora, kometalar, asteroidlar va kamida 146 ga yaqin tabiiy sayyora yo'ldoshlaridan iborat. Eng mashhuri - bizning oyimiz. Agar biz ichki sayyoralar bilan tashqi sayyoralar orasidagi oy sonini solishtirishni boshlasak, katta farqni ko'ramiz. Ichki sayyoralarda yo'ldoshlar kam yoki umuman yo'q. Boshqa tomondan, ekzoplanetalar deb nomlangan qolgan sayyoralar katta o'lchamlari tufayli bir nechta yo'ldoshlarga ega.

Gazdan yasalgan tabiiy yo'ldoshlar yo'q. Barcha tabiiy yo'ldoshlar qattiq toshdan qilingan. Eng oddiy narsa shundaki, ular o'z atmosferasiga ega emaslar. Kichik o'lchamlari tufayli bu osmon jismlari mos atmosferaga ega emas. Atmosferaga ega bo'lish Quyosh tizimi dinamikasida bir nechta o'zgarishlarni keltirib chiqaradi.

Hamma tabiiy yo'ldoshlarning o'lchamlari bir xil emas. Biz aniqladikki, ularning ba'zilari oydan katta, boshqalari esa kichikroq. Eng katta oyning diametri 5 262 kilometr. Ajablanarlisi shundaki, Quyosh sistemasidagi eng katta sayyoralar ham eng katta yo'ldoshlarga ega bo'lishi kerak. Agar biz treklarni tahlil qilsak, ularning muntazam yoki tartibsiz ekanligini bilib olamiz.

Morfologiyaga kelsak, xuddi shunday bo'ladi. Ba'zi narsalar sferik, boshqalari esa notekis shaklga ega. Bu ularning mashg'ulot jarayoni bilan bog'liq. Bu ham uning tezligi bilan bog'liq. Trayektoriyalar va vaqt davrlari kabi, sekinroq shakllanadigan narsalarga qaraganda, tez shakllanadigan ob'ektlar tartibsizroq shaklga ega bo'ladi. Masalan, Oyning Yer atrofida aylanishi uchun taxminan 27 kun kerak bo'ladi.

Sun'iy yo'ldoshlar - ular inson texnologiyasining mahsulidir va ular o'rganayotgan samoviy jismlar haqida ma'lumot olish uchun ishlatiladi. Ko'pchilik sun'iy yo'ldoshlar Yer atrofida aylanadi. Ular insoniyat ilm -fani va texnikasining rivojlanishi uchun katta ahamiyatga ega.

Oy kabi tabiiy yo'ldoshlardan farqli o'laroq, sun'iy yo'ldoshlar odamlar tomonidan yaratilgan. Ular o'zlaridan kattaroq ob'ektlar atrofida harakat qilishadi, chunki ular tortishish kuchi bilan tortiladi. Ular odatda inqilobiy texnologiyaga ega bo'lgan juda murakkab mashinalardir. Ular sayyoramiz haqida ko'p ma'lumot olish uchun kosmosga yuborilgan. Buni aytishimiz mumkin boshqa mashinalarning qoldiqlari, kosmonavt bilan ishlaydigan kosmik kemalar, orbital stansiyalar va sayyoralararo zondlar ular sun'iy yo'ldoshlar hisoblanmaydi.

Bu ob'ektlarning asosiy xususiyatlaridan biri shundaki, ular raketalar yordamida uchirilgan. Raketa - bu sun'iy yo'ldoshni yuqoriga ko'taradigan raketa, kosmik kemasi yoki samolyot kabi har qanday transport turidan boshqa narsa emas. Ular belgilangan marshrut bo'yicha marshrutni kuzatib borish uchun dasturlashtirilgan. Ularda bulutni kuzatish kabi muhim vazifa bor. Sayyoramiz atrofida aylanadigan sun'iy yo'ldoshlarning aksariyati doimo o'z atrofida aylanishda davom etmoqda. Ikkinchidan, bizda boshqa sayyoralar yoki osmon jismlariga yuborilgan yo'ldoshlar bor, ular ma'lumot va kuzatuv uchun kuzatilishi kerak.

Sun'iy yo'ldosh aloqa tizimlari tarixi

Sun'iy yo'ldosh aloqasi tushunchasi 1945- yilda angliyalik olim Artur Klarkning "Yerdan tashqari retranslyatorlar" nomli ilmiy ishi chop etilishidan boshlanadi.

Olimning ilmiy qarashlariga dunyo hamjamiyati 10 yil davomida uncha katta e'tibor

qaratmaydi. Bu holat 1960- yilda transatlantik aloqa sifatini oshirish maqsadida “Exo-1” nomli birinchi kosmik retranslyatori amerikaliklar tomonidan fazoga uchirilgunga qadar davom etadi.

Bugungi kunda shaxsiy aloqaga mo'ljallangan zamonaviy sun'iy yo'ldosh aloqaning yangi texnologiyalari o'tgan asrning o'rtalaridagi prototiplardan sezilarli darajada farq qiladi.

Aloqa sun'iy yo'ldoshi - transponder orqali radio telekommunikatsiya signallarini uzatuvchi va kuchaytiruvchi sun'iy yo'ldosh yerning turli joylarida manba uzatuvchi va qabul qiluvchi o'rtasida aloqa kanalini yaratadi. Aloqa sun'iy yo'ldoshlari televizor, telefon, radio, internet va harbiy dasturlar uchun ishlatiladi^[1] Ko'pgina aloqa sun'iy yo'ldoshlari 22,300 milya (35,900 km) geostatsionar orbitada joylashgan. Ekvatordan yuqorida, shuning uchun sun'iy yo'ldosh osmonning bir nuqtasida harakatsiz ko'rinadi. Shuning uchun yerosti stansiyalarining sun'iy yo'ldosh antennalari doimiy ravishda shu nuqtaga yo'naltirilishi mumkin va sun'iy yo'ldoshni kuzatish uchun harakat qilish shart emas. Boshqalar esa past Yer orbitasida sun'iy yo'ldosh turkumlarini hosil qiladi, bu yerda yerdagi antennalar sun'iy yo'ldoshlar o'rnini kuzatishi va tez-tez sun'iy yo'ldoshlar o'rtasida almashinishi kerak^[2]

Telekommunikatsiya aloqalari uchun ishlatiladigan yuqori chastotali radio to'lqinlar ko'rish chizig'i bo'ylab tarqaladi va shuning uchun Yerning egri chizig'i bilan to'sqinlik qiladi. Aloqa sun'iy yo'ldoshlarining maqsadi signalni Yerning egri chizig'i bo'ylab uzatishdir, bu esa keng tarqalgan geografik nuqtalar o'rtasida aloqa o'rnatish imkonini beradi [3]. Aloqa sun'iy yo'ldoshlari keng doiradagi radio va mikroto'lqinli chastotalardan foydalanadi. Signal aralashuvining oldini olish uchun xalqaro tashkilotlarda ma'lum tashkilotlarga chastota diapazonlari yoki “bandlari” dan foydalanishga ruxsat berilgan qoidalar mavjud. Tarmoqlarning bunday taqsimlanishi signal aralashuvi xavfini kamaytiradi.

1945 yil oktyabr oyida Artur C. Klark Britaniyaning Wireless World jurnalida “Yerdan tashqari releylar” nomli maqolani nashr etdi[4]. Maqolada radio signallarini uzatish uchun sun'iy yo'ldoshlarni geostatsionar orbitalarda joylashtirish asoslari tasvirlangan. Shu sababli, Artur C. Klark ko'pincha aloqa sun'iy yo'ldoshi kontseptsiyasining ixtirochisi sifatida tilga olinadi va “Klark Belt” atamasi orbitaning tavsifi sifatida ishlatiladi[5].

Birinchi sun'iy Yer sun'iy yo'ldoshi 1957 yil 4 oktyabrda Sovet Ittifoqi tomonidan orbitaga chiqarilgan Sputnik-1 edi. U Mixail Tixonravov va Sergey Korolev tomonidan Konstantin Tsiolkovskiy tomonidan ishlab chiqilgan [6]. Sputnik-1 20.005 va 40.002 ikkita chastotada ishlaydigan bortli radio uzatgich bilan jihozlangan. MHz yoki to'lqin uzunligi 7 va 15 metr. Sun'iy yo'ldosh Yerning bir nuqtasidan boshqasiga ma'lumot yuborish uchun orbitaga joylashtirilmagan, radiouzatgich ionosferada radioto'lqinlarning tarqalishi xususiyatlarini o'rganish uchun mo'ljallangan edi. Sputnik-1 ning ishga tushirilishi koinot va raketalarni tadqiq qilishda muhim qadam bo'lib, kosmik asrning boshlanishini anglatadi[7].

Erta faol va passiv sun'iy yo'ldosh tajribalari

Aloqa sun'iy yo'ldoshlarining ikkita asosiy sinfi mavjud, ular passiv va faol. Passiv sun'iy yo'ldoshlar faqat manbadan keladigan signalni qabul qiluvchining yo'nalishi bo'yicha aks ettiradi. Passiv sun'iy yo'ldoshlar bilan, aks ettirilgan signal sun'iy yo'ldoshda kuchaytirilmaydi va qabul

qiluvchiga uzatiladigan energiyaning juda oz qismigina etib boradi. Sun'iy yo'ldosh Yerdan juda uzoqda joylashganligi sababli, radio signali bo'sh joy yo'qolishi tufayli zaiflashadi, shuning uchun Yerdan qabul qilingan signal juda va juda zaif. Boshqa tomondan, faol sun'iy yo'ldoshlar qabul qilingan signalni yerdagi qabul qiluvchiga qayta uzatishdan oldin uni kuchaytiradi[8]. Passiv sun'iy yo'ldoshlar birinchi aloqa sun'iy yo'ldoshlari edi, ammo hozir juda kam qo'llaniladi.

1951 yilda Amerika Qo'shma Shtatlari Dengiz tadqiqot laboratoriyasida elektr razvedkasi to'plash sohasida boshlangan ish Communication Moon Relay nomli loyihaga olib keldi. Harbiy rejalashtirishchilar uzoq vaqtdan beri xavfsiz va ishonchli aloqa liniyalariga taktik zarurat sifatida katta qiziqish bildirishgan va bu loyihaning yakuniy maqsadi Oyning passiv o'rni bo'lgan Yerning tabiiy sun'iy yo'ldoshi bilan insoniyat tarixidagi eng uzun aloqa sxemasini yaratish edi.

1956 yil 23 yanvarda Vashington, Kolumbiya okrugi va Gavayi orollari o'rtasida birinchi transokeanik aloqaga erishilgandan so'ng, ushbu tizim ommaviy ravishda ochildi va 1960-yil yanvar oyida rasmiy ishlab chiqarishga topshirildi [9]

Aloqalarni faol o'tkazish uchun yaratilgan birinchi sun'iy yo'ldosh SCORE loyihasi bo'lib, Ilg'or tadqiqot loyihalari agentligi (ARPA) tomonidan 1958 yil 18 dekabrda ishga tushirilgan bo'lib, u saqlangan ovozli xabarni uzatish, shuningdek, qabul qilish, saqlash uchun magnitafondan foydalangan va xabarlarini qayta uzatgan. U AQSh prezidenti Duayt Eyzexauerdan dunyoga Rojdestvo tabrigini yuborish uchun ishlatilgan. 1958 yil 30 dekabrda sakkiz soatlik haqiqiy ishlamay qolgandan so'ng qayta zaryadlanmaydigan batareyalar ishlamay qolishidan oldin sun'iy yo'ldosh bir nechta real vaqtda uzatishni amalga oshirdi[10][11].

SCORE ning to'g'ridan – to'g'ri vorisi ARPA tomonidan boshqariladigan Courier deb nomlangan boshqa loyiha edi. Courier 1B 1960 yil 4 oktyabrda "kechiktirilgan takrorlanuvchi" sun'iy yo'ldoshlar yordamida global harbiy aloqa tarmog'ini o'rnatish mumkinmi yoki yo'qligini o'rganish uchun ishga tushirildi, ular ma'lumotlarni qayta translyatsiya qilish uchun buyruq berilgunga qadar saqlaydi. 17 kundan so'ng, buyruq tizimidagi nosozlik tufayli sun'iy yo'ldoshdan aloqa uzildi[12][13].

NASA sun'iy yo'ldosh ilovalari dasturi 1960 yil 12 avgustda Echo-1 da passiv relely aloqa uchun ishlatiladigan birinchi sun'iy yo'ldoshni uchirdi. Echo-1 mikro to'lqinli signallarning passiv reflektori sifatida ishlaydigan alyuminlangan shar sun'iy yo'ldoshi edi. Aloqa signallari sun'iy yo'ldoshdan Yerning bir nuqtasidan boshqasiga uzatildi. Ushbu tajriba telefon, radio va televideniya signallarini butun dunyo bo'ylab eshittirishning maqsadga muvofiqligini aniqlashga harakat qildi [14][15].

Sun'iy yo'ldosh aloqa tizimining ustunliklari:

Zamonaviy sun'iy yo'ldosh aloqa tizimlari boshqa axborot almashinuvi yo'nalishlariga qaraganda bir qancha samarali hisoblanadi:

-barqarorlik. Keng qamrov tufayli, hatto bitta sun'iy yo'ldosh ham yer osti oraliq stansiyalarini jalb qilmasdan katta masofalarga signalni uzatish uchun yetarli;

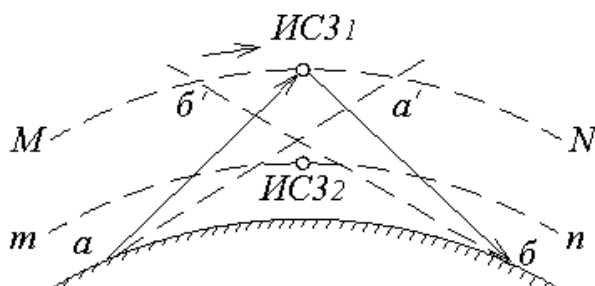
-kam xarajat. Aloqa kanalidan foydalanish narxi abonentlar soniga bog'liq emas. Bugungi kunda qo'shimcha xarajatlarsiz mijozlar bazasini kengaytirish (uskunalarni modernizatsiya qilish, yangi sun'iy yo'ldoshlarni ishga tushirish, yer usti retranslyatorlarini qurish) tufayli sun'iy yo'ldosh

aloqa xizmatlari narxini pasaytirish tendensiyasi mavjud;

-kanal kengligi. Keng qamrov polosadan foydalanish orqali qisqa vaqt ichida katta ma'lumotlar oqimini uzatish imkonini beradi;

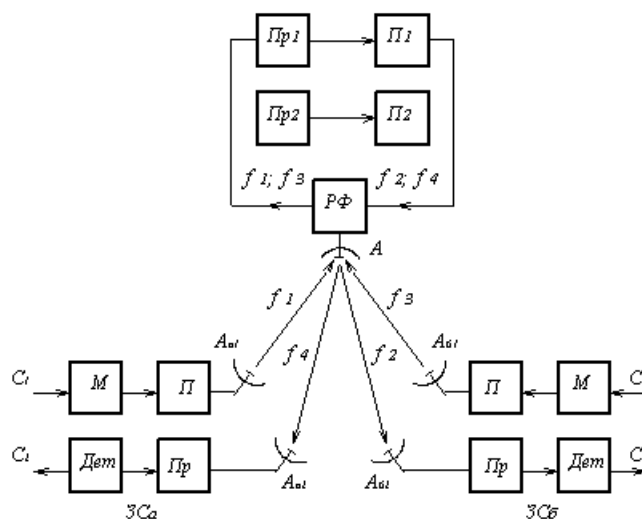
-ishonchlilik. Noto'g'ri axborot paketini uzatish ehtimoli (buzilish va boshqalar.) deyarli nolga teng, chunki zamonaviy texnologiyalar ularni aniqlaydigan va signaldagi buzilishlarni to'g'irlaydi.

Sun'iy yer yo'ldoshlari yordamida aloqa tizimini amalga oshirish printsiplari 1- rasmda ko'rsatilgan. Bu yerda a va b orqali yer stansiyalari (YS) belgilanadi, ular o'rtasida aloqa o'rnatiladi va to'g'ri chiziqlar va a va b nuqtalarda Yer yuzasiga tegib, bu nuqtalarning ufq chiziqlari. Shuning uchun MN orbitasida harakatlanayotgan AYS (antenna yer stansiyasi) sun'iy yo'ldoshi 1 orbital u segmenti bo'ylab harakatlanayotganda bir vaqtning o'zida a va b stansiyalardan kuzatilishi mumkin. Shunday qilib, antenna tizimi tomonidan AYS (antenna yer stansiyasi) yo'nalishi bo'yicha a nuqtada chiqariladigan elektromagnit tebranishlar sun'iy yo'ldoshning bortdagi radio uskunasi tomonidan qabul qilinishi mumkin va kuchaytirilgandan va chastotani o'zgartirgandan so'ng, ular qabul qilinadigan Yerga yo'naltiriladi. a va b nuqtasi antennalari har doim sun'iy yo'ldosh tomon yo'naltirilgan bo'lishi kerak. Shunday qilib, sun'iy yo'ldosh harakatlanayotganda, antennalar aylanib, sun'iy yo'ldoshning kosmosdagi harakatini doimiy ravishda "kuzatish" ni amalga oshirishi kerak.



1- rasm. Sun'iy yer yo'ldoshlari yordamida aloqa tizimini amalga oshirish usullari

Signalning faol qayta uzatilishi bilan a va b nuqtalarda joylashgan YS o'rtasidagi dupleks aloqaning strukturaviy sxemasini ko'rib chiqamiz 2- rasm. Bu erda C_1 xabari $3C_a$ stansiyasining M modulyatoriga beriladi, buning natijasida f_1 tashuvchi chastotasi bilan tebranishlarni modulyatsiya qilish amalga oshiriladi. Transmitter Π dan keladigan bu tebranishlar A_{a1} antennisiga beriladi va sun'iy yo'ldosh tomon radiatsiya qilinadi va u yerda takrorlagichning bort antenasi A tomonidan qabul qilinadi. Keyin f_1 chastotali tebranishlar o'zaro faoliyat filtrga (PФ) beriladi, Π_{p1} qabul qilgich tomonidan kuchaytiriladi, f_2 chastotasiga aylantiriladi va Π_1 uzatgichga beriladi. Transmitterning chiqishidan f_2 chastotali tebranishlar PФ orqali bort antenasi A ga uzatiladi va Yerga qarab nurlanadi. Bu tebranishlar A_{b2} antenasi tomonidan $3C_b$ stansiyasi tomonidan qabul qilinadi, qabul qiluvchiga (ИП) va detektorga (Дет) beriladi, uning chiqishida C_1 xabari ajratiladi. $3C_b$ dan $3C_a$ stansiyasiga C_2 xabarining uzatilishi xuddi shunday tarzda f_3 chastotada sodir bo'ladi va bort transponderi f_3 tashuvchi chastotali tebranishlarni f_4 chastotali tebranishlarga aylantiradi.



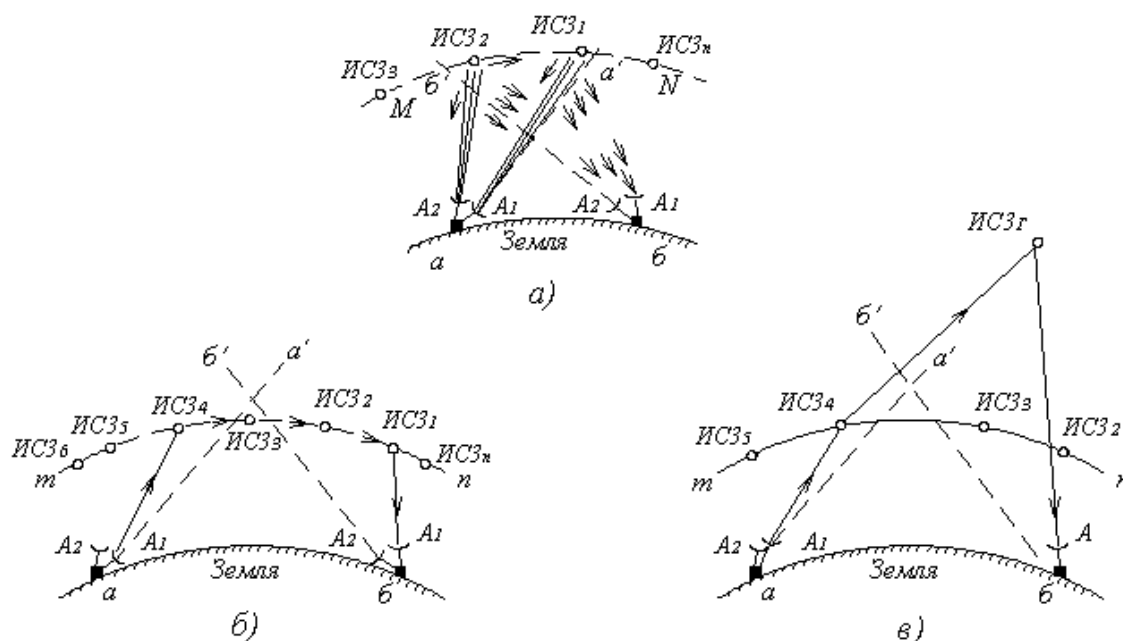
2- rasm. Signalling faol qayta uzatilishi bilan a va b nuqtalarda joylashgan YS o‘rtasidagi dupleks aloqaning strukturaviy sxemasini

Sun’iy yo‘ldoshlardan foydalanganda signallarni faqat bitta sun’iy yo‘ldosh orqali emas, balki bir nechta sun’iy yo‘ldoshlar orqali ham qayta uzatish mumkin. Bunday holda, past orbitalar bo‘lsa, yer stantsiyalarida signallarni uzluksiz uzatish uchun ikkita antennaga ega bo‘lish kerak.

3- rasmda bitta past orbita bo‘ylab soat yo‘nalishi bo‘yicha harakatlanuvchi sun’iy yo‘ldoshlar ko‘rsatilgan, ularning bir qismi mn yoy shaklida ko‘rsatilgan. A stantsiyasidan A_1 antenasi orqali signal AYS 4 (antenna yer stansiyasi) ga kiradi va AYS 3 (antenna yer stansiyasi), AYS 2 (antenna yer stansiyasi), AYS 1 (antenna yer stansiyasi) orqali b stansiyasining A_1 qabul qiluvchi antenasi qayta uzatiladi. Shunday qilib, bu holda signalni qayta uzatish uchun A_1 antennalari va AYS 4 (antenna yer stansiyasi) - AYS 1 (antenna yer stansiyasi) ni o‘z ichiga olgan orbita segmenti ishlatiladi. AYS 4 (antenna yer stansiyasi) ufq chizig‘ining chap tomonidagi zonani tark etganda, signalni uzatish va qabul qilish A_2 antennalari va AYS 5 (antenna yer stansiyasi) - AYS 2 (antenna yer stansiyasi) ni o‘z ichiga olgan segment orqali amalga oshiriladi. Keyin signallarni uzatish va qabul qilish A_1 antennalari va AYS 6 (antenna yer stansiyasi) - AYS 3 (antenna yer stansiyasi) va hokazo sun’iy yo‘ldoshlardan iborat segment tomonidan amalga oshiriladi.

Past balandlikdagi orbitalarda harakatlanuvchi sun’iy yo‘ldoshlardan foydalanish yer stantsiyalarining jihozlarini soddalashtiradi, chunki bu holda yer antennalarining kuchayishini, transmitterlarning kuchini kamaytirish va shovqin haroratiga qaraganda bir oz yuqori ekvivalent shovqin haroratiga ega bo‘lgan qabul qiluvchilar bilan ishlash mumkin. Biroq bu holda, sun’iy yo‘ldoshlar soni ortib boradi va ularning orbitadagi harakatini nazorat qilish talab etiladi.

Sun’iy yo‘ldosh aloqa tizimining matematik modelini ko‘rib chiqadigan bo‘lsak: Antenna yer stansiyasining harakat tezligining komponentini r bilan belgilaymiz va 1- antenna yer stansiyasining va 2- antenna yer stansiyasining orasidagi masofa qisqargan taqdirda r manfiy qiymatini hisobga olamiz.



3- rasm. Bir nechta sun'iy yo'ldoshli aloqa tizimi

Ma'lumki, signal manbai $\pm r$ tezlikda harakat qilganda, qabul qilingan tebranishlarning chastotasi f nurlangan tebranishlar chastotasi f_0 nisbati bilan bog'liq.

$$f = f_0 / (1 \pm v_r / c), \quad (1)$$

Bu erda c – yorug'lik tezligi. $C=3 \cdot 10^8$ m/s

Odatga $r / c \ll 1$ shart bajarilganda qabul qilingan tebranishlarning chastotasi f nurlangan tebranishlar chastotasi f_0 ga quyidagicha bog'liq bo'ladi. (2)

$$f = f_0 (1 \mp v_r / c), \quad (2)$$

(2) ga muvofiq, ta'sir tebranishlar chastotasining o'zgarishi tashuvchi chastotasining o'zgarishiga olib keladi, shunday qilib, agar modulyatsiya f chastotali tebranish orqali amalga oshirilgan bo'lsa, Doppler effektini hisobga olgan holda detektor chiqishida qabul qilingan tebranish chastotaga ega bo'ladi. Shuning uchun, $f_1 = 1$ kHz va $f_2 = 104$ kHz chastotalar tebranishlar bilan modulyatsiya qilishda detektorning chiqishida biz mos ravishda f_1 va f_2 chastotalarini olamiz. Bundan kelib chiqadiki, birinchidan, xabar spektridagi yuqori chastotalar katta miqdorda o'zgaradi, ikkinchidan, qabul qilingan tebranish spektrining kengligi modulyatsiya qiluvchi tebranishlar spektrining kengligidan farq qiladi.

Shuni ta'kidlash kerakki, sun'iy yo'ldoshlar orqali aloqa tizimlari uchun eng yaxshi chastota diapazonlari 2 ... 8 gigagertsli chastotalardir.

Qabul qiluvchining kirishidagi signal kuchini quyidagi formula bilan aniqlash mumkin:



$$P_{c.BX} = \frac{P_{\pi} G_{\pi} G_{\pi p} \eta_{\pi} \eta_{\pi p} V^2(t)}{A_{\Sigma} A_{\pi} A_{\pi p}} K_{\text{пот}} \quad (3)$$

Bu yerda A_{Σ} - antennalar orasidagi bo'limdagi umumiy signal zaiflashuvi;

$V(t)$ - t vaqt davomida oshib bo'lmaydigan zaiflashuv koeffitsienti;

A_{π} va $A_{\pi p}$ - mos ravishda uzatuvchi chiqishi va antenna, qabul qiluvchi chiqishi va antenna o'rtasida joylashgan filtrlardagi signalning zaiflashishini (susayishi) tavsiflaydi;

K qavat - antennalarning qutblanish xususiyatlarining noaniqligi va Faraday effekti natijasida yuzaga kelgan qutblanish tekisligining o'zgarishi tufayli qutblanish yo'qotishlarining qiymati.

Xulosa

Xulosa qilib aytganda so'nggi paytlarda zamonaviy jamiyatda olimlar, muxandislar, konstruktorlarning ijtimoiy mas'uliyatining ortishi munosabati bilan texnologiyaning axloqiy muammolari tobora ko'proq e'tiborga tushmoqda, chunki harbiy sohadagi texnologiyaning asosiy maqsadi harbiy xizmatchilarga tobora ko'proq qulayliklar yaratish, mavjud muammolarni ijobiy hal qilishdir.

Ushbu maqolada taklif etilayotgan Aloqa texnikasiga o'rnatilgan sun'iy yo'ldosh aloqa tizimi orqali katta hajmli ma'lumotlarni uzoq masofalarda uzatish va qabul qilish, videokonfrens aloqasining uzluksiz va sifatli ishlashiga erishish ko'zda tutilmoqda. Bundan tashqari, sun'iy yo'ldosh aloqa tizimi yordamida Aloqa texnikasining hududlarning istalgan nuqtasida ularning joylashishini alohida aniqlash mumkin. Shu bilan birga, foydalanuvchilarni kichik tranzistor kabi kichik o'lchamli va arzon individual navigatsiya qurilmalari bilan ta'minlash hisobga olinmoqda. Sun'iy yo'ldosh aloqa tizimi nafaqat aloqa qo'yilgan talabni ta'minlashga ko'maklashadi balki tezkor, uzluksiz, xavfsiz, sifatli aloqa tizimi bilan ta'minlanishiga zamin yaratadi.

Adabiyotlar

1. Labrador, Virgil (2015-02-19). Britannica.com. Qaraldi: 2016-02-10.
2. Military Satellite Communications Fundamentals | The Aerospace Corporation. Aerospace (1-aprel 2010-yil). 5-sentyabr 2015-yilda asl nusxadan arxivlandi.
3. Satellites - Communication Satellites. Satellites.spacesim.org.
4. Arthur C. Clarke. „Extraterrestrial Relays: Can Rocket Stations Give World-wide Radio Coverage?“. Arthur C. Clarke Institute for Space Education (oktyabr 1945).
5. Mike Mills. „Orbit Wars“. The Washington Post (3-avgust 1997-yil).
6. Asif Siddiqi. „The Man Behind the Curtain“. Air & Space Magazine (noyabr 2007)..
7. Anatoly Zak. „Design of the first artificial satellite of the Earth“. RussianSpaceWeb.com (2017).
8. „Military Satellite Communications Fundamentals | The Aerospace Corporation“. Aerospace (1-aprel 2010-yil). 5-sentyabr 2015-yilda asl nusxadan arxivlandi.
9. van Keuren, David K. „Chapter 2: Moon in Their Eyes: Moon Communication Relay at the Naval Research Laboratory, 1951-1962“,. Beyond The Ionosphere: Fifty Years of Satellite Communication Butrica: . NASA History Office, 1997.
10. Martin, Donald. Communications Satellites: Project SCORE, 5th, AIAA, March 16, 2007. ISBN 978-1884989193.
11. „United States Aeronautics and Space Activities - first Annual Report to Congress“. Published as House Document Number 71, 86th Congress, first Session 13–14. The White House (2-fevral 1959-yil).
12. „Courier 1B“. NASA (2020).
13. „United States Aeronautics and Space Activities 1960“ 12–13, 26. The White House (18-yanvar 1961-yil).



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O'ZBEKISTON HUDUDIDA QO'LLANILADIGAN YO'L BELGILARI MA'LUMOTLAR TO'PLAMINI SHAKLLANTIRISH

Annotatsiya. O'zbekiston yo'llarida qo'llaniladigan yo'l belgilari to'g'risida batafsil ma'lumot berishga qaratilgan. Ushbu maqola yo'l harakati xavfsizligini ta'minlash va yo'l-transport hodisalarining oldini olish maqsadida yo'l belgilari tizimini tahlil qiladi. Maqolada O'zbekistonda amaldagi belgilarning toifalari, ularning mazmuni, ahamiyati va qo'llanish tartibi ko'rib chiqiladi. Shuningdek, maqolada yo'l belgilari bo'yicha ma'lumotlar bazasi shakllantirish metodologiyasi va uni yo'l harakati ishtirokchilari uchun qulay tarzda taqdim etish usullari ham tahlil qilinadi. Bu to'plam yo'l harakati xavfsizligini oshirishga va yo'lovchilar hamda haydovchilarning bilimlarini mustahkamlashga qaratilgan amaliy vosita sifatida xizmat qiladi.

Kalit so'zlar: yo'l belgilari, yo'l harakati xavfsizligi, ma'lumotlar to'plami.



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CREATION OF A DATA SET OF ROAD SIGNS USED IN THE TERRITORY OF UZBEKISTAN

Abstract: It is aimed at providing detailed information about road signs used on the roads of Uzbekistan. This article analyzes the system of road signs in order to ensure road safety and prevent road traffic accidents. The article examines the categories of signs in Uzbekistan, their meaning, significance, and the procedure for their use. The article also analyzes the methodology of creating a database of road signs and ways of presenting it in a convenient way for road users. This kit serves as a practical tool aimed at improving road safety and strengthening the knowledge of passengers and drivers.

Key words: road signs, traffic safety, data set.



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Kirish

Yo'l belgilari haydovchilarga yo'l infratuzilmasi haqida muhim ma'lumotlarni berish maqsadida yaratilgan bo'lib, ularni ishlab chiqishda haydovchilar yaxshi ko'rishi uchun ma'lum shakl va ranglardan foydalanilgan. Turli davlatlarda yo'l belgilarini standartlashtirish maqsadida 1968 yilda yo'l belgilari bo'yicha Vena konvensiyasi deb nomlanuvchi xalqaro shartnoma imzolangan. Bugungi kunga qadar ushbu shartnomani 52 ta davlat imzolagan. Vena konvensiyasi yo'l belgilarini A-H harflari bilan belgilangan sakkiz toifaga ajratdi: ogohlantiruvchi belgilar (A), imtiyozli belgilar (B), taqiqlovchi belgilar (C), buyuruvchi belgilar (D), axborot-ishora belgilari (E), servis belgilari (F), axborot belgilari (G) va qo'shimcha belgilar (H). Vena shartnomasida aniq belgilangan qonunlarga qaramay, shartnomani imzolagan davlatlar o'rtasida yo'l belgilari ko'rinishidagi o'zgarishlar mavjud[1]. Ushbu o'zgarishlardan maqsad haydovchilar tomonidan ko'rish va tushunish uchun qulaylashtirish bo'lib, ammo ularni yo'l belgilarini tanib olish tizimiga katta qiyinchilik tug'dirishi mumkin. Turli davlatlardagi toshlar qulash xavfi yo'l belgilarining turli ko'rinishlari 1-rasmda keltirilgan.



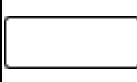
Davlat	AQSH	Australiya	Shvetsiya	Isroil	Polsha	O'zbekiston
Yo'l belgisi						

1-rasm. Turli davlatlardagi tosh qulash xavfi yo'l belgilari








O'zbekistonda 2001 yilda xalqaro me'yorlar asosida va mahalliy sharoitni hisobga olgan holda, "Yo'l harakati qoidalari" ishlab chiqildi. Bu qoidalarga yo'l belgilarining asosiy 7 ta guruhi kiritildi. O'zbekistondagi yo'l belgilari 7 ta turga bo'linib, jami 269 ta yo'l belgilaridan iborat. O'zbekiston hududida qo'llaniladigan yo'l belgilarining umumiy tasnifi va xususiyatlari 1-jadvalda keltirilgan.

1-jadval. O'zbekiston hududida qo'llaniladigan yo'l belgilari turlari

No	Yo'l belgilarining turlari	Shablon	Xususiyatlari	Soni
1.	Ogohlantiruvchi belgilar		Hoshiyasi qizil, foni oq	46
2.	Imtiyoz belgilari		Hoshiyasi oq, belgi sariq	9
3.	Taqiqlovchi belgilar		Hoshiyasi qizil, belgi qora	35
4.	Buyuruvchi belgilar		Foni ko'k, belgi oq	24

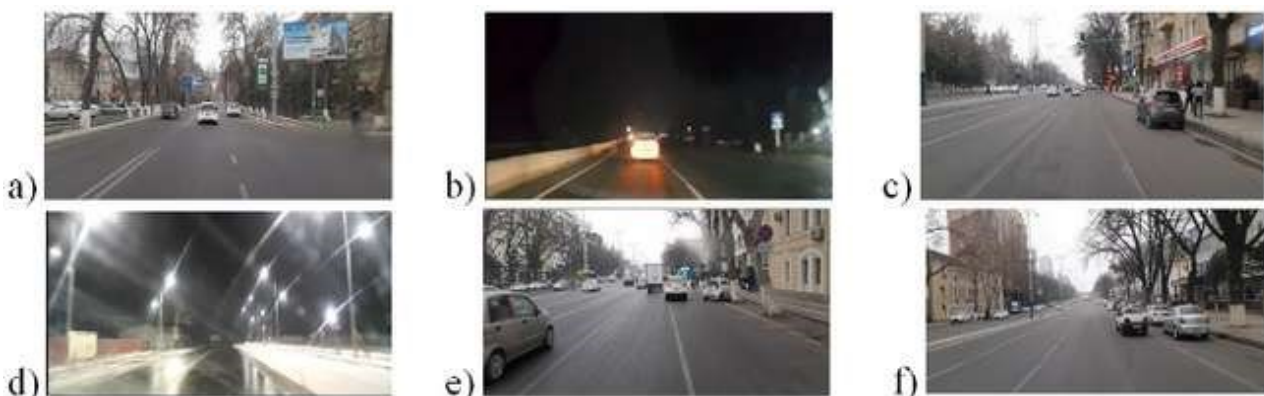
5.	Axborot-ishora belgilari		Foni ko'k, tasvir qora va oq	73
6.	Servis belgilar		Foni ko'k va oq, belgi qora	15
7.	Qo'shimcha axborot belgilari		Foni oq, belgi qora	55

O'zbekiston hududida qo'llaniladigan yo'l belgilarining har bir turi uchun misollar 2-rasmda ko'rsatilgan.

A	B	C	D	E	F	G
						

2-rasm. Yo'l belgilariga misollar: (A) ogohlantiruvchi belgi, (B) imtiyozli belgi, (C) taqiqlovchi belgi, (D) buyuruvchi belgi, (E) axborot-ishora belgisi, (F) servis belgisi va (G) qo'shimcha axborot belgisi

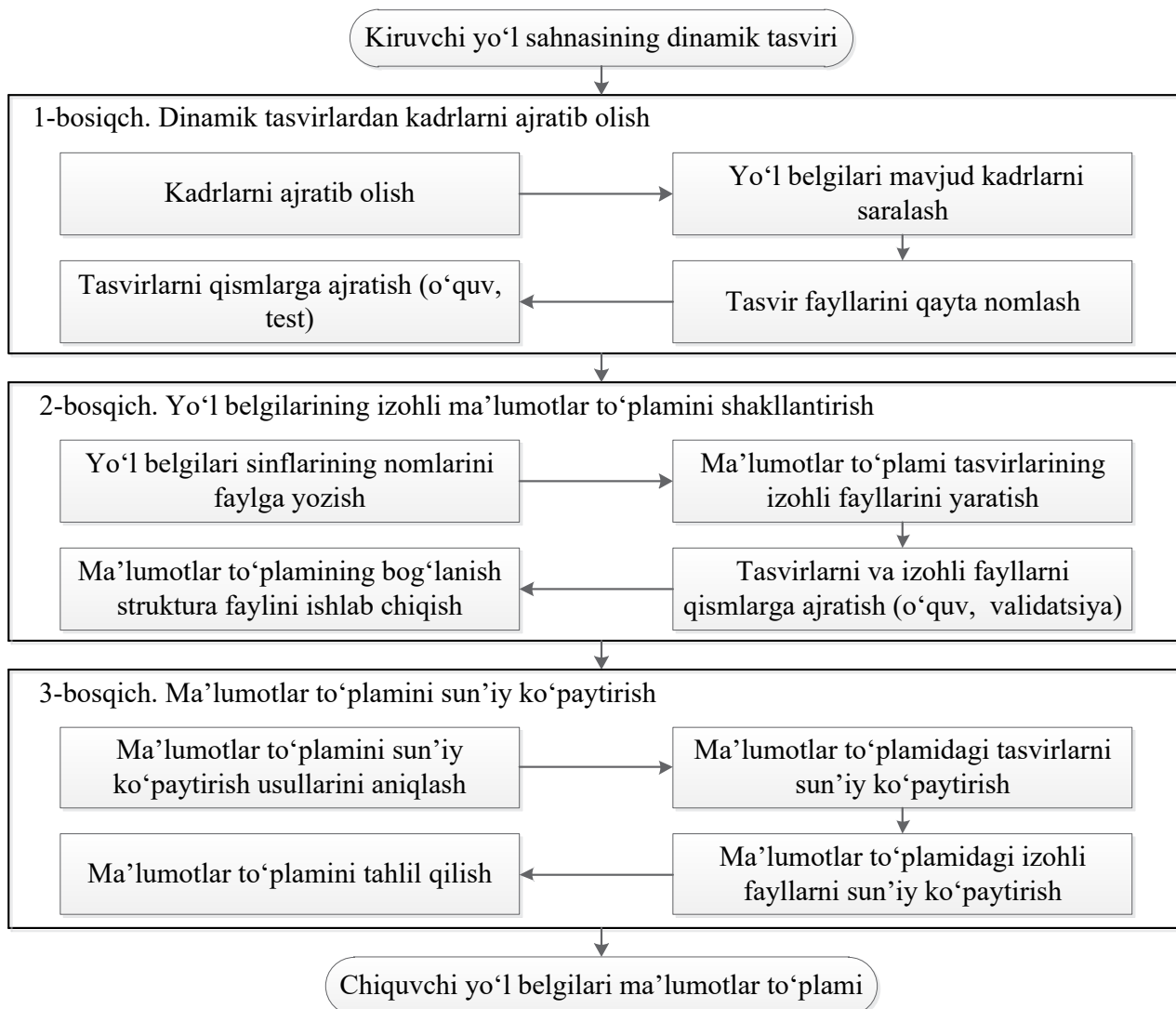
Ma'lumotlar to'plami (dataset). O'zbekiston hududidagi yo'l belgilarining ma'lumotlar bazalarini yig'ish maqsadida Toshkent va Samarqand shaharlaridagi ko'p avtomobil qatnovli ko'chalarida video tasvirlar olindi. Tasvirlar yilning turli fasllarida (bahor, kuz, qish, yoz) hamda kunning turli vaqtlarida (ertalab, tushdan keyin, kechqurun) va turli ob-havo sharoitlarida (yomg'irli, qorli, quyoshli, tumanli) olindi (3-rasm).



3-rasm. Turli fasllar, kunning turli vaqtlari va turli ob-havo sharoitlarida olingan tasvirlarga misollar

Yo'l belgilari ma'lumotlar to'plamini shakllantirish jarayonida 70 km/soat tezlikda harakatlangan avtomobilga o'rnatilgan videoregistrator qurilmasining HD formatdagi video tasvirlar foydalanildi. Kadr o'lchamlari - 1280x720. Kiruvchi yo'l sahnasi dinamik tasviridan foydalanib yo'l

belgilari ma'lumotlar to'plamini ishlab chiqish bosqichlari va ma'lumotlar to'plamini boshqarish hamda sun'iy ko'paytirish usullari quyidagi 4-rasmda keltirilgan.



4-rasm. Yo'l belgilari ma'lumotlar to'plamini shakllantirish bosqichlari

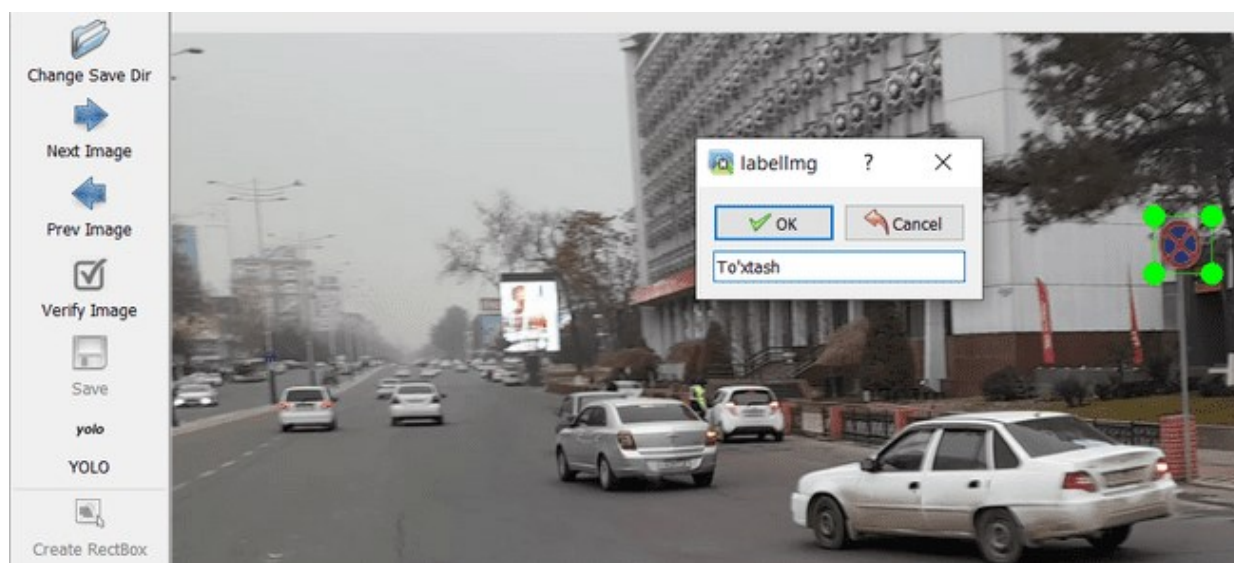
1-bosqich. Dinamik tasvirlardan kadrlarni ajratib olish. Tasvirlardan sekundiga 30 ta kadrni olish mumkin, bunda ushbu kadrlarning har 10 ta oralig'idan 1 tasini (1 soniyali dinamik tasvirning 3 ta kadrini) olib .jpg kengaytmali formatda kadr tasviri saqlandi[2]. Shunday qilib, O'zbekiston hududida qo'llaniladigan yo'l belgilari ma'lumotlar to'plami (UTSD – Uzbek Traffic Sign Dataset) shakllantirildi. UTSD da 4998 ta tasvir mavjud bo'lib, ularning 3957 tasini o'quv va 1041 tasini test qismlarga ajratildi. Tadqiqot ishida ma'lumotlar to'plami uchun tanlab olingan 56 ta yo'l belgilari sinfi 2-jadvalda ko'rsatilgan.

2-jadval. Yo'l belgilari ma'lumotlar to'plamidagi sinflar

No	Yo'l belgisi sinflari	No	Yo'l belgisi sinflari
1.	Shlagbaumli temir yo'l kesishmasi	29.	Qayrilish taqiqlanadi

2.	Shlagbaumsiz temir yo'l kesishmasi	30.	Quvib o'tish taqiqlanadi
3.	Bir izli temir yo'l	31.	Quvib o'tish ta'qiqlangan hududning oxiri
4.	Ko'p izli temir yo'l	32.	Yuqori tezlik cheklangan
5.	Teng ahamiyatli yo'llar kesishuvi	33.	Yuqori tezlik cheklangan hududning oxiri
6.	Aylanma harakatlanish bilan kesishuv	34.	Tovush moslamalaridan foydalanish taqiqlangan
7.	Svetofor tartibga soladi	35.	To'xtash taqiqlangan
8.	Xavfli burilish	36.	To'xtab turish taqiqlangan
9.	Xavfli burilish	37.	Harakatlanish to'g'riga
10.	Xavfli burilishlar	38.	Harakatlanish o'ngga
11.	Xavfli burilishlar	39.	Harakatlanish chapga
12.	Piyodalar o'tish joyi	40.	Harakatlanish to'g'riga yoki o'ngga
13.	Bolalar	41.	Harakatlanish to'g'riga yoki chapga
14.	Asosiy yo'l	42.	To'siqni o'ngdan chetlab o'tish
15.	Asosiy yo'lning oxiri	43.	To'siqni chapdan chetlab o'tish
16.	Ikkinchi darajali yo'l bilan kesishuv	44.	Aylanma harakatlanish
17.	Tutashuv o'ngdan	45.	Qayrilish joyi
18.	Tutashuv chapdan	46.	Avtobus va trolleybus to'xtash joyi
19.	Yo'l bering	47.	To'xtab turish joyi
20.	To'xtamasdan harakatlanish taqiqlangan	48.	Piyodalar o'tish joyi
21.	Kirish ta'qiqlangan	49.	Piyodalar o'tish joyi
22.	Harakatlanish ta'qiqlangan	50.	Piyodalarning yer ostidan o'tish joyi
23.	Mexanik transport vositalarining harakatlanishi taqiqlangan	51.	Piyodalarning yer ostidan o'tish joyi
24.	Yuk avtomobillarining harakatlanishi taqiqlangan	52.	Piyodalarning yer ustidan o'tish joyi
25.	Motosikllar harakatlanishi taqiqlangan	53.	Piyodalarning yer ustidan o'tish joyi
26.	Piyodalarning harakatlanishi taqiqlangan	54.	Surat va video
27.	O'ngga burilish ta'qiqlanadi	55.	Radar
28.	Chapga burilish taqiqlanadi	56.	Qizil rangda o'ng tomonga burilish

2-bosqich. Yo'l belgilarining izohli ma'lumotlar to'plamini shakllantirish. Tasvirli ma'lumotlar to'plamining ikki xil shakli mavjud: izohli ma'lumotlar to'plami va izohsiz ma'lumotlar to'plami. Izohli ma'lumotlar to'plamida har bir tasvirning izohli fayli mavjud bo'lib (fayl nomlari bir xil bo'lishi shart), unda tasvirdagi yo'l belgisi sinfining raqami, uning joylashgan koordinatalari berilgan bo'ladi. Ushbu izohlar obyektlarni sinflashtirish va tasniflash uchun muhim hisoblanadi[3]. Chuqur o'qitishga asoslangan algoritmlar odatda izohli ma'lumotlar to'plamidan foydalanadi. Shu kabi, YOLO arxitekturasi ham o'zining izohli ma'lumotlar to'plami formatiga ega bo'lib, chuqur o'qitish uchun izohli ma'lumotlar to'plamini talab qiladi. Ushbu tadqiqot ishida *labelImg* dasturiy vositasidan foydalanib har bir tasvirning izohli fayllari yaratildi (5-rasm).



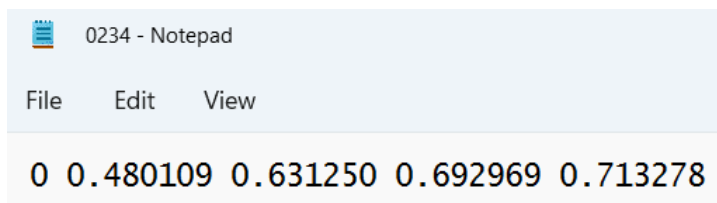
5-rasm. *labelImg* dasturiy vositasining interfeysi

Bunda tasvirning izohli fayllari *.txt* kengaytmali faylda saqlanadi, fayldagi har bir satr tasvirdagi mavjud yo'l belgisini ifodalaydi. Agar yo'l belgisi tasvirda mavjud bo'lmasa, izohli fayl yaratiladi va fayl ichi bo'sh bo'ladi. Quyidagi *0234.jpg* nomli tasvirda yo'l belgisining izohlarini ko'rishingiz mumkin (6-rasm).



6-rasm. Tasvirdagi yo‘l belgisining izohlari

Yuqoridagi 0234.jpg nomli tasvir uchun 0234.txt nomli izohli fayli yaratiladi va fayl ichiga quyidagi strukturada 5 ta ustundan iborat ma’lumotlar yoziladi (7-rasm).



7-rasm. Izohli faylning strukturasi

Izohli fayl ichidagi satrlar soni tasvirdagi yo‘l belgilari soniga teng bo‘lib, 5 ustundan iborat. Har bir ustunning tavsifi va parametrlari quyidagi 3-jadvalda ko‘rsatilgan.

3-jadval. Izohli faylning ustun parametrlari

Sinf indeksi, n	Obyekt markazining absissasi, x ($1 \geq x \geq 0$)	Obyekt markazining ordinatasi, y ($1 \geq y \geq 0$)	Obyekt eni, w	Obyekt bo‘yi, h
0	0.480109	0.631250	0.692969	0.713278

0234.txt faylining har satrining xususiyati quyidagicha:

- har bir yo‘l belgisi uchun bitta satr ajratiladi;
- har bir satrda yo‘l belgisining quyidagi ketma-ketlikda izohli parametrlari beriladi: yo‘l

belgisining sinf indeksi, obyekt markazining absissasi, obyekt markazining ordinatasi, obyekt eni, obyekt bo'yi.

- yo'l belgisining sinf indeksi noldan boshlanadi (indekslar soni sinf soniga teng bo'ladi).

- Yo'l belgisini chegaralovchi ramkaning kordinatalarini tasvir o'lchamlari bilan normallashtiriladi (ya'ni, 0 dan 1 gacha bo'lgan qiymatlarga tasvir o'lchami moslashtiriladi).

Chuqur o'qitishga asoslangan boshqa obyektlarni aniqlash usullarining ham o'ziga xos formatlari mavjud, masalan, SSD (Single Shoots Detect) usulida ma'lumotlar to'plamining VOC2007 formatini talab qiladi. VOC2007 formatida tasvirlarning izohli fayllari *.xml* kengaytmali faylda saqlanadi[4]. Tadqiqot ishida yaratilgan UTSD ni SSD usulida sinovdan o'tkazish uchun izohli ma'lumotlar to'plamini VOC2007 formati (*.xml* fayl kengaytmasi) ga o'tkazishga to'g'ri keladi. Bunday muammo maxsus konvertatsiya funksiyalarini yaratish orqali amalga oshiriladi. Ma'lumotlar to'plamlarini (VOC XML, COCO JSON, TensorFlow Object Detection CSV) turli formatlarda saqlash mumkin.

COCO Explorer 2017 uchun ma'lumotlar to'plami 8-rasmda ko'rsatilgan bo'lib, unda 80 ta sinf uchun 123287 ta tasvir, 886284 ta holat berilgan.



8-rasm. COCO Explorer 2017 sinflari

Yo'l belgilarining eng katta ochiq ma'lumotlar to'plamlarini ko'rib chiqildi va tahlil qilindi. Bularga Germaniya (GTSDRB), Shvetsiya (STSD), Belgiya (BTSD), Rossiya (RTSD) va Amerika qo'shma shtatlari (LISAD) yo'l belgilari ma'lumotlar to'plamini misol keltirish mumkin. Ushbu ma'lumotlar to'plamlaridagi umumiy statistikalar 4-jadvalda keltirilgan.

4-jadval. Turli davlatlarning yo'l belgilari ma'lumotlar to'plamlari statistikasi

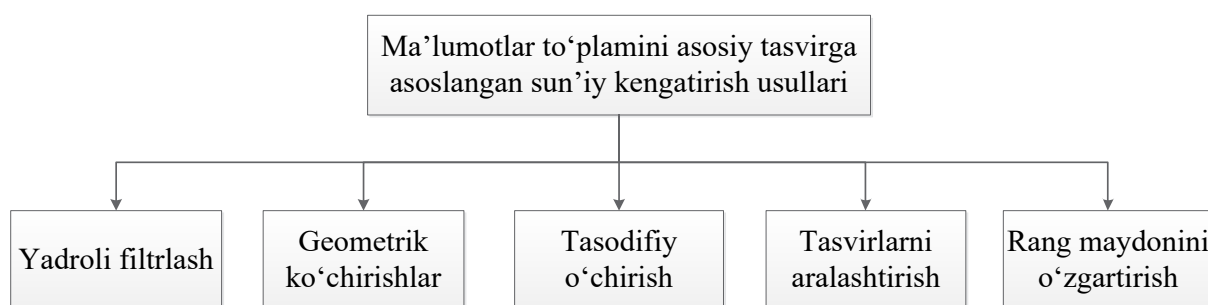
Ma'lumotlar to'plami	GTSDRB	BTSD	LISAD	RTSD	UTSD
Sinflar soni	43	108	49	140	56
Kadrlar soni	1446	9006	6610	-	4998
Tasvir o'lchami	1360x800	1628x1236	1024x522	1280x720	1280x720
Davlat	Germaniya	Belgiya	AQSH	Rossiya	O'zbekiston

3-bosqich. Ma'lumotlar to'plamini sun'iy ko'paytirish. Hozirgi kunda chuqur o'qitishga asoslangan algoritmlarni ishlab chiqish jadal suratlarda oshib bormoqda. Katta yutuq va istiqbollarga qaramasdan, bunda tez-tez tilga olinadigan muammo, ya'ni ma'lumotlar to'plamining yetarli miqdori yo'qligi va sifatining pastligidir. Ushbu muammoni hal qilish usullaridan biri ma'lumotlar to'plamini sun'iy ko'paytirish hisoblanadi. Izohli yo'l belgilari ma'lumotlar to'plamini sun'iy ko'paytirish usullari odatda ranglarning qiymatlarini o'zgartirish (shovqin, xiralashish, kontrast) va geometrik o'zgartirish (aylantirish, kesish, masshtablash) orqali amalga oshiriladi. Ushbu sun'iy ko'paytirish usullari ma'lumotlar to'plami hajmini sun'iy ravishda oshiradi. S.Cubuk tomonidan avtomatik ravishda takomillashtirilgan ma'lumotlarni sun'iy ko'paytirish uchun AutoAugment nomli yangi usul taklif qilindi. Tadqiqotlarda Mosaic, SnapMix, Erasing, CutMix, Mixup va Translate X/Y kabi ma'lumotlarni sun'iy ko'paytirish usullari mavjud[5].

Hozirgi kunda ma'lumotlar to'plamini sun'iy ko'paytirish usullarini turli xil formatdagi ma'lumotlarga qo'llash mumkin. Misol uchun ovozli, matnli, tasvirli ma'lumotlarga qo'llaniladi. Ushbu tadqiqot ishida tasvirli ma'lumotlar to'plamidan foydalanilayotganligi sababli tasvirli ma'lumotlarni sun'iy ko'paytirish usullari ustida tadqiqotlar olib borildi. Tasvirli ma'lumotlar to'plamini sun'iy ko'paytirishning ikki asosiy yondashuvi mavjud bo'lib, ular quyidagilar:

1. Asosiy tasvirga asoslangan yondashuvlar;
2. Chuqur o'qitishga asoslangan yondashuvlar.

Yuqoridagi asosiy tasvirga asoslangan yondashuv usullari 9-rasmda keltirilgan.



9-rasm. Tasvirli ma'lumotlar to'plamini sun'iy ko'paytirish yondashuvlari

Ma'lumotlar to'plamini asosiy tasvirga asoslangan sun'iy ko'paytirish usullari tavsifi quyidagilardan iborat:

1. Geometrik ko'chirishlar - tasvirlarni tasodifiy tekislik bo'ylab aylantirish, kesish yoki masshtablashga doir amallar hisoblanadi.

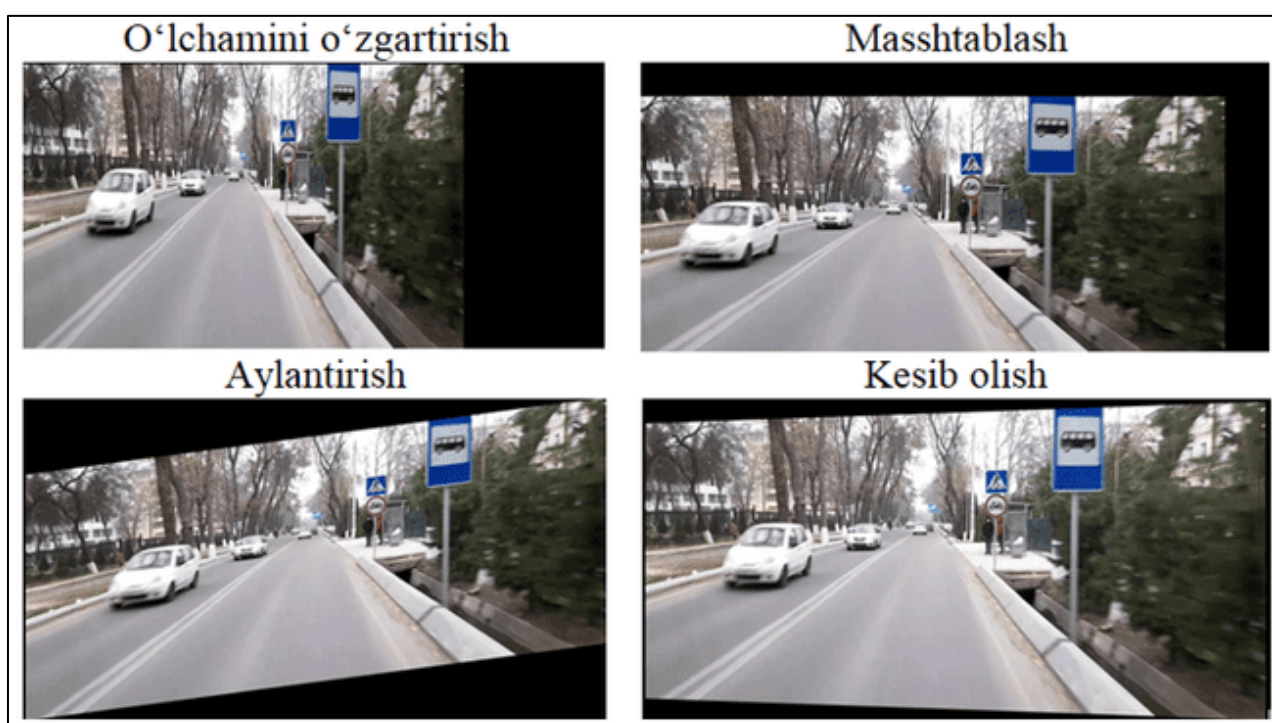
2. Rang maydonini o'zgartirish - tasvirning piksellarining rang qiymatlarini o'zgartirish, har qanday rangni kuchaytirish.

3. Yadroli filtrlash – tasvir xususiyatlarini aniqlashtirish yoki xiralashtirish.

4. Tasodifiy o'chirish - tasvirning bir qismini tasodifiy o'chirish.

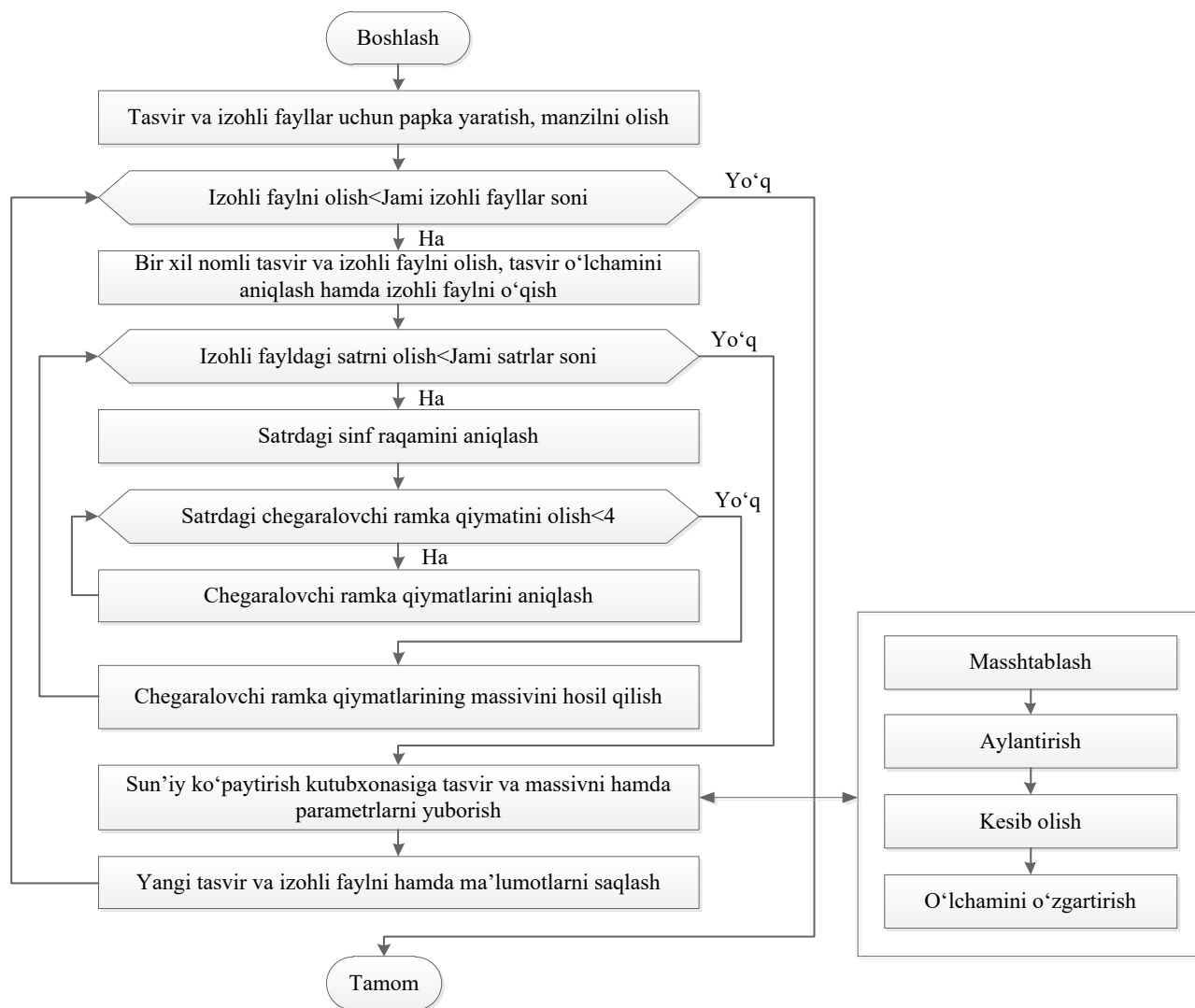
5. Tasvirlarni aralashtirish - tasvirlarni bir-biri bilan birlashtirish.

Ma'lumotlar to'plamini sun'iy ko'paytirish odatda tasvirdagi obyektlarning xususiyatini ajratib olish va tanib olish aniqligini oshirish maqsadida amalga oshiriladi. Quyidagi 10-rasmda izohli ma'lumotlar to'plamini sun'iy ko'paytirishning 4 usuli tadqiqotlar natijasida taklif etildi.



10-rasm. Tasvirli ma'lumotlar to'plamini sun'iy ko'paytirish usullari

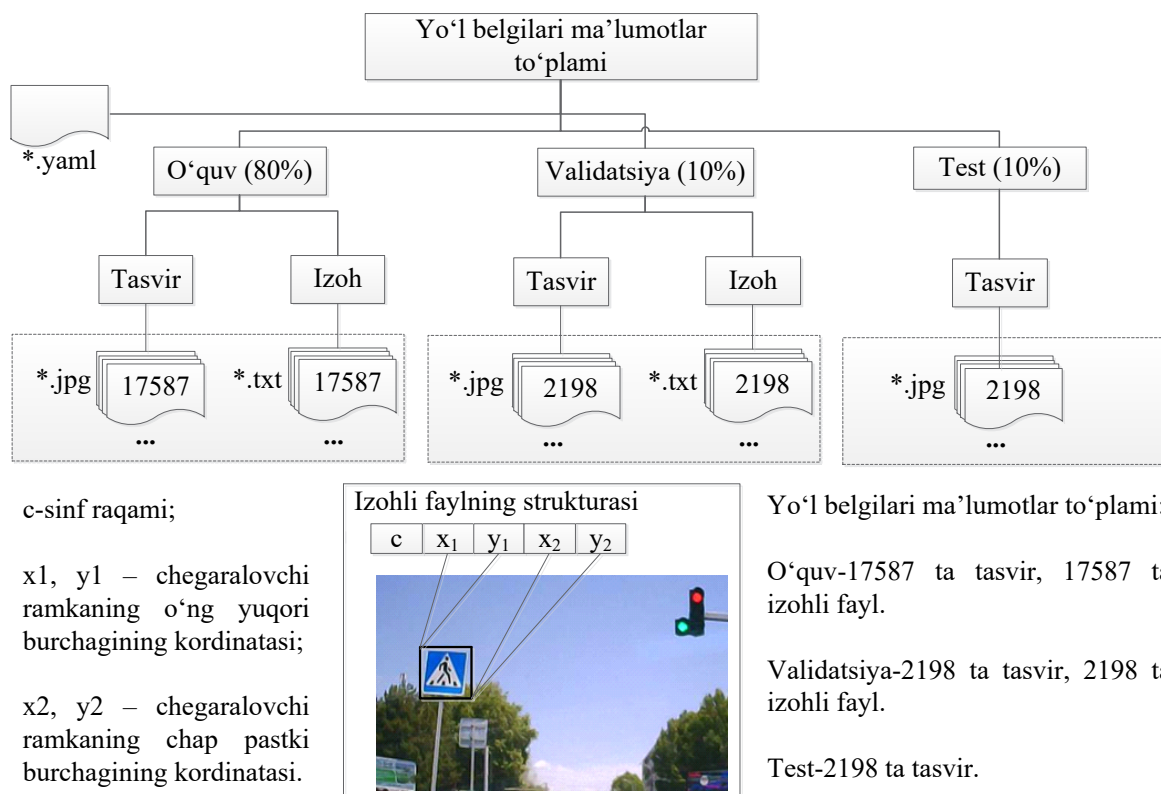
Izohli yo'l belgilari ma'lumotlar to'plamini sun'iy ko'paytirish usullarining blok sxemasi 11-rasmida ko'rsatilgan.



11-rasm. Yo'l belgilari ma'lumotlar to'plamini sun'iy ko'paytirish algoritmi

Yuqoridagi usullar yordamida yo'l belgilari ma'lumot to'plamini sun'iy ko'paytirish orqali yaxshi samaralarga erishish mumkin. Bunda qisqa vaqt ichida sifatli ma'lumotlar to'plamini shakllantirish va tasvirlardan obyektlarni tanib olish tizimining aniqligini oshirish muhim ahamiyatga ega.

Izohli ma'lumotlar to'plamini ishlab chiqishda *labelImg* dasturiy vositasidan foydalanildi. Ma'lumotlar to'plami sifatini va hajmini oshirish uchun sun'iy ko'paytirish usullari ishlab chiqildi. Odatda yo'l belgilari ma'lumotlar to'plamining izohli fayllarini ishlab chiqish ko'p vaqt va mehnat talab qiladi. Ushbu tadqiqot ishida izohli yo'l belgilari ma'lumotlar to'plami ishlab chiqildi (12-rasm).



12-rasm. Yo'l belgilari ma'lumotlar to'plami (UTSD)

Tasvirli ma'lumotlar to'plamini sun'iy ko'paytirishdan oldin izohli fayllar ishlab chiqildi va izohli fayllarni ham mos ravishda sun'iy ko'paytirish usullari taklif qilindi. Bunda masalaning murakkabligi o'quv namunalari sun'iy ko'paytirish bilan bir qatorda mos izohli fayllardagi chegaralovchi ramkalarining koordinatalarini ham o'zgartirishni talab qiladi.

Xulosa

Tasvirning intensivligi past bo'lgan kanali asosida statik tasvirlardan shovqinlarni tozalash algoritmlari yaxshi natijalarni ko'rsatmoqda. Biroq, ushbu algoritmnining murakkabligi sababli real vaqt rejimida dinamik tasvirlarga ishlov berish talablariga javob bermaydi. Ushbu tadqiqot ishida kuzatuv kamerasidan olingan yo'l sahnasi tasvirlariga grafik protsessorda parallel ishlov berish modeli va algoritmlari taklif qilindi. O'tkazilgan tadqiqot natijalari 1080p formatdagi video tasvirlarni qayta ishlash imkonini ko'rsatdi. Asinxron xotira uzatish va ko'chirilgan filtrlashga asoslangan algoritmlardan foydalangan holda grafik protsessorda bajarish markaziy protsessorga nisbatan 8.94 marta yuqori tezlikka erishdi. Tadqiqot ishida chuqur o'qitishga asoslangan algoritmlardan foydalanilganligi sababli izohli yo'l belgilari ma'lumotlar to'plami ishlab chiqildi. Har bir davlatning yo'l belgilarida sezilarli farq mavjudligini inobatga olgan holda O'zbekiston hududida qo'llaniladigan 56 ta sinf tegishli 21923 ta yo'l belgilarining maxsus ma'lumotlar to'plami ishlab chiqildi. Ma'lumotlar to'plamining izohi fayllarini yaratish uchun *labelImg* dasturiy vositasidan foydalanildi va *YOLO* formatida saqlandi. Ma'lumotlar to'plamini sun'iy ko'paytirish orqali ma'lumotlar to'plamining hajmini 5 marta oshirish va ma'lumotlar to'plami sifatini yaxshilash usullar taklif etildi Ushbu usullar yordamida yetishmaydigan obyektlarning xususiyatlarini hosil qilish va tasvirlardan obyektlarni tanib olish tizimlarini aniqlik darajasini oshirishga erishildi.

Adabiyotlar

1. Ahmed Hechri, Abdellatif Mtibaa. Two-stage traffic sign detection and recognition based on SVM and convolutional neural networks // IET Image Process., 2020, Vol. 14 Iss. 5, pp. 939-946.
2. Ahmed Madani, Rubiyah Yusof. Malaysian Traffic Sign Dataset for Traffic Sign Detection and Recognition Systems // Journal of Telecommunication, Electronic and Computer Engineering. ISSN: 2180-1843 e-ISSN: 2289-8131 Vol. 8 No.11.
3. Aleksej Avramović, Davor sluga, Domen Tabernik, Danijel Skočaj, Ladan Stojnić, Nejc Il. Neural-Network-Based Traffic Sign Detection and Recognition in High-Definition Images Using Region Focusing and Parallelization // Digital Object Identifier 10.1109/ACCESS.2020.3031191, Volume 8, 2020.
4. Alexander Shustanova, Pavel Yakimov. CNN Design for Real-Time Traffic Sign Recognition // 3rd International Conference "Information Technology and Nanotechnology", ITNT-2017, 25-27 April 2017, Samara, Russia. Procedia Engineering 201 (2017) 718-725.
5. Artamonov N.S., Yakimov P.Y. Towards Real-Time Traffic Sign Recognition via YOLO on a Mobile GPU // The IV International Conference on Information Technology and Nanotechnology, Journal of Physics: Conf. Series 1096(2018) 012086. doi:10.1088/1742-6596/1096/1/012086.



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DIGITAL MARKETING COMMUNICATION TOOLS ANALYSIS

Abstract: This paper conducts an analysis of digital marketing communication tools, exploring the diverse array of platforms and strategies employed by businesses to engage with their target audiences in the digital landscape. The study delves into the evolving dynamics of digital marketing, investigating the role of tools such as social media, email marketing, search engine optimization (SEO), and content marketing. The research examines the effectiveness and impact of these communication tools in reaching and resonating with consumers in an increasingly interconnected world. Special attention is given to the nuances of each tool, considering factors such as audience segmentation, personalization, and the real-time nature of digital interactions.

Keywords: Digital marketing, communication tools, social media, email marketing, search engine optimization (seo), content marketing, audience segmentation, marketing strategies, consumer engagement, data privacy, data security, innovation, artificial intelligence, business strategies



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Introduction

In the ever-evolving landscape of marketing, the significance of digital communication tools cannot be overstated. As technology continues to reshape the way businesses interact with their audiences, a thorough analysis of these tools becomes imperative for organizations striving to stay ahead in the dynamic realm of digital marketing. This paper seeks to delve into the intricacies of various digital marketing communication tools, exploring their roles, impact, and challenges in the contemporary business environment. The advent of the digital era has ushered in a multitude of platforms and strategies that enable businesses to connect with their target audiences in ways that were once unimaginable. From social media and email marketing to search engine optimization (SEO) and content marketing, each tool brings its unique strengths and challenges to the marketing landscape. Understanding the nuances of these tools is essential for marketers aiming to craft effective, targeted, and resonant messages that cut through the digital noise. This analysis aims to shed light on the effectiveness of digital marketing communication tools in reaching and engaging diverse consumer segments. By examining the intricacies of audience segmentation, personalization, and the real-time nature of digital interactions, the paper will provide insights into how businesses can leverage these tools to create meaningful connections and foster brand loyalty.

However, the digital marketing landscape is not without its complexities. Privacy concerns, data security issues, and the ethical considerations surrounding targeted advertising present challenges that demand careful examination. As businesses navigate this terrain, understanding both the opportunities and pitfalls associated with digital communication tools is crucial for developing strategies that resonate with consumers while maintaining ethical standards.

Focusing on interactive components will help digital marketers engage customers in the marketing process. According to Shmit (2010), 100, the following conditions must be met in order to launch a full and effective digital marketing start-up:

- Infrastructure needs, such as those for the internet, fixed broadband, networks, mobile telecommunications, satellite communications, and applications.
- Process criteria, which include a good quality and trademarked product or service, Seller (firm or person), Purchaser (firm or person who is interested in specific thing).

Environment requirements, such as:

- a convenient legal system;
- a payment or banking system;
- a secure electronic system;
- a shipping system, taxes;
- and trained human workers.

For marketers, the internet unlocked a whole new world of possibilities. Digital marketing channels are now considerably more prevalent because they are inexpensive and simple to use, especially for small enterprises with limited resources and staff. The most significant digital marketing channels will be described, examined, and illustrated in this section of the thesis.

Digital marketers use technology that can be of assistance to them in order to contact their target audience. Consider the most widely used online communication technologies (Figure 1).

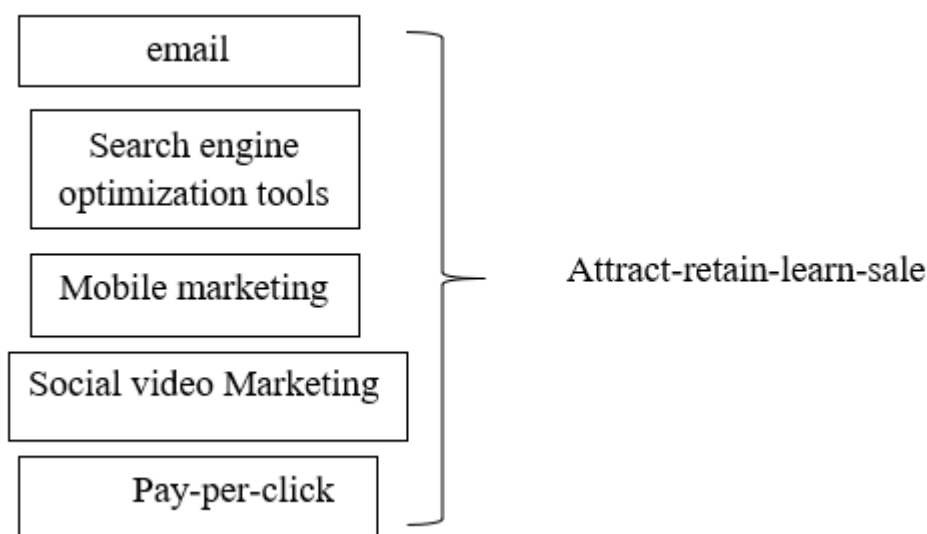


Figure 1. Online marketing communication tools

Email. Despite the rise of social media, smartphone applications, and other platforms, one of the most successful marketing strategies is email. Email marketing is the practice of sending promotional emails to a large number of potential clients (Bala & Verma, 2018, p.11). Through the use of efficient email software, a company can keep track of a list of emails that are divided based on criteria as shown by client behaviors.

According to Stokes (2011), email marketing, which use electronic means to send commercial and promotional messages to both potential and current clients, is one of the most traditional and significant types of direct marketing. According to research, there are over 4 billion email users worldwide, and that 500 million more people will use email in three years (Vujasin, 2020). Figure 1 demonstrates that emails are being sent and received at a rising rate each year, and predictions indicate that between 2017 and 2023, there will be 30% more emails sent and received. Because everyone on earth has an email address, email marketing is therefore highly appreciated by businesses because it allows them to contact a large target audience. Promotional emails and retention-based emails are the two primary categories of commercial emails.

Email advertisements tend to be blunter and encourage users to act right away. Retention-based emails, or newsletters, on the other hand, are more concerned with giving users useful information in order to develop long-term relationships. Transactional emails, catalogs, alerts, invites, and communicational messages are other types of emails outside those that are promotional and retention-based. Utilizing email marketing as a component of a company's digital marketing initiatives has many benefits. Companies can first divide their clientele into various categories and offer messages and content that are tailored to the tastes of each group.

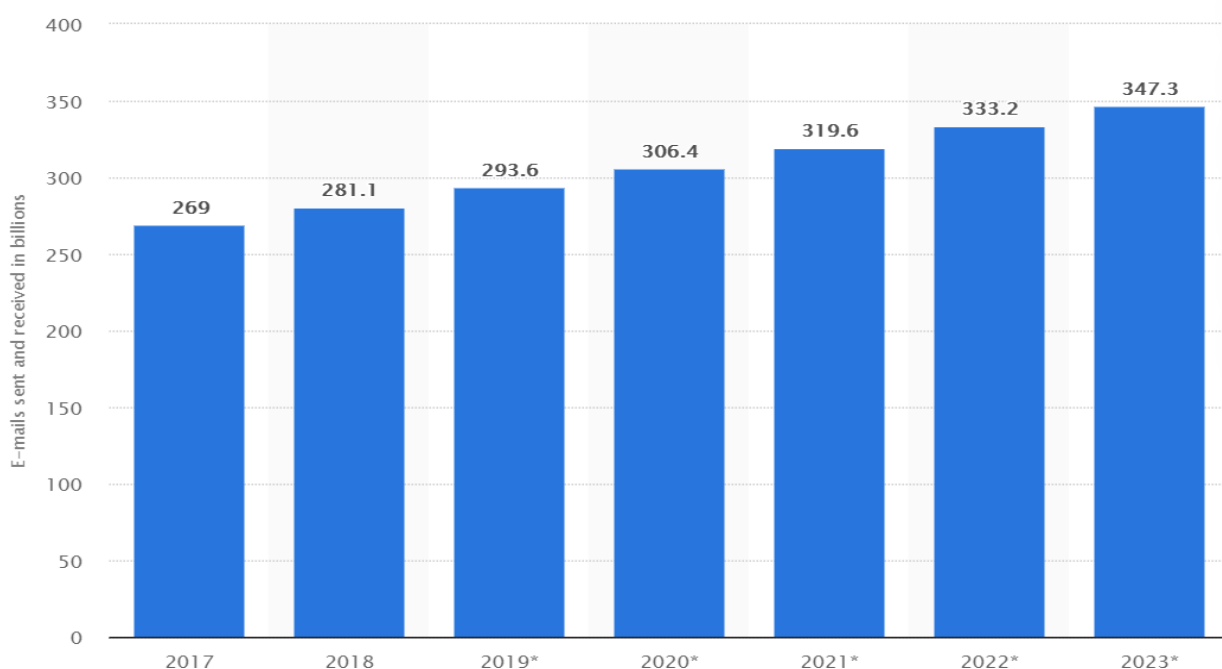


Figure 2. Number of sent and received emails per day worldwide 2017-2023 (Source: Statista.com 2019)

By altering substance for distinctive gatherings of people, companies make certain that their emails offer to each fragmented client bunch. One of the extraordinary preferences of mail promoting is the plausibility of totally robotizing it, by making particular triggers. The company chooses when to send personalized messages to potential clients. That trigger can be based on specific time of the day or specific activity that potential client had with past substance. For case, a client is browsing through a company's ecommerce site, and chooses to put a thing within the cart. In any case, something happens, and they choose to abandon the cart within the middle of the purchasing process, which may be a common issue within the e commerce. Various companies send a mail a day or two afterward, to remind clients of the surrendered cart, and now and then offer uncommon reduced offers for that specific thing to deliver the clients extra thrust to purchase the item. In addition, e-mail promoting strategies are simple to degree, and this is often critical for companies to get it in case their e-mail promoting methodology is working or on the off chance that it needs changes.

Search engine optimization, way better known as SEO, alludes to all the methods connected to look motors that progress website's deceivability by making it rank higher in look motor comes about such as Google, Yahoo and Bing. It is one of the foremost capable shapes of advanced showcasing. As can be watched from the figure 6, natural look is the prevailing source of trackable web activity with 53% of all tractable looks being sourced from natural look.

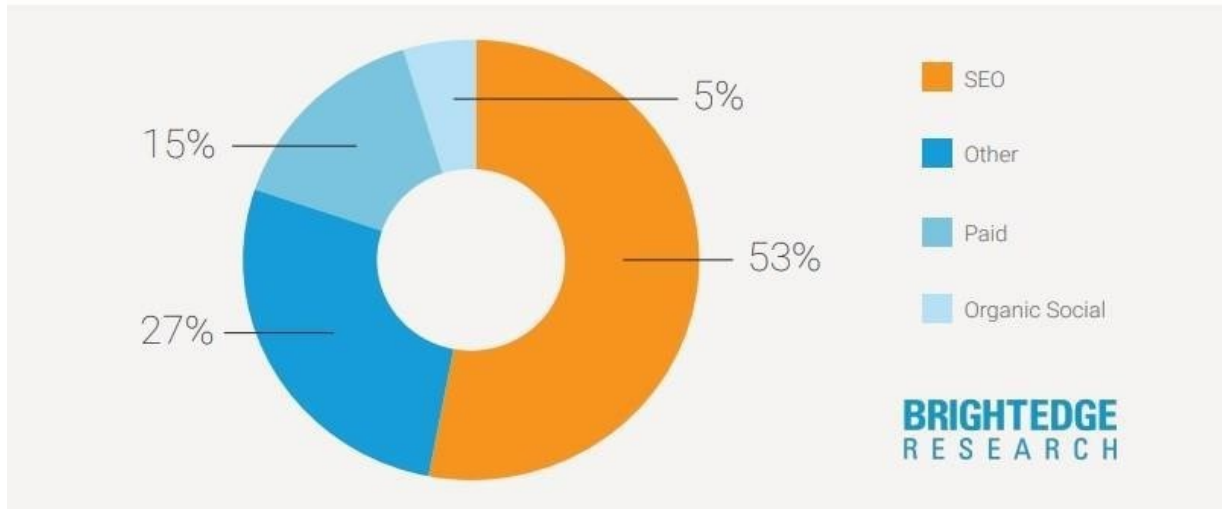


Figure 3. Source of web traffic in 2019 (Source: BrightEdge 2019)

This computerized promoting procedure has the objective of making a difference a commerce rank higher in comes about of Google look, in the long run tolling higher look motor activity to the site of the commerce. In an endeavor to have this objective finished, SEO marketers inquire about expressions and words that shoppers utilize to look data online. A SEO envelop a number of components from words on the business’s site to the way other webpages interface to the business’s site. The arrangement of forms is efficiently conducted to move forward “volume and quality of activity through look motor visits driving to particular locales by utilizing the working component or calculation the look engine” (Iskandar & Komara, 2018). Concurring to Bhandari & Bansal (2018), the engineering plan of look motor is exhausted a way that a client looks words in web crawler, in which web record has the catchphrase title looked by client which is procured exceptionally quick.

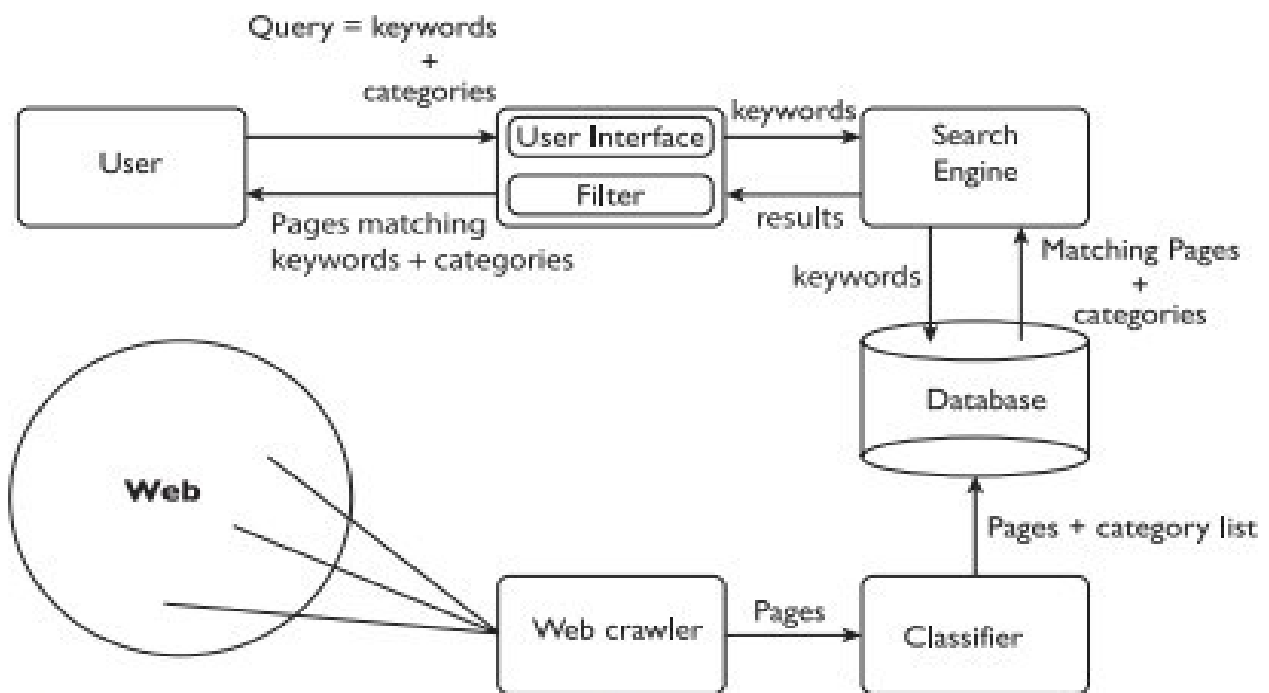


Figure 4. An architectural design of SEOs (Source: The figure was developed by Barbar & Ismail)

(2019), to demonstrate architectural design of SEO)

Note. Barbar & Ismail (2019), to illustrate building plan of SEO, created the figure in figure 7 over is a building plan of look motor optimization. In arrange to look pages significant to what the client is trying to find and give input, SEO works essentially through three capacities to be specific slithering, ordering and positioning. Slithering makes a difference the SEO filter web substance; ordering makes a difference in organizing and putting away the substance that have been found amid slithering in classifiers and database separately whereas positioning best gives substance important to the searchers query.

Google (and other look motors) is centered on giving quality substance to their clients. They are able to do that by composing genuine time calculations to bring, what they consider to be, the most excellent comes about. Look motors have crawlers that go from page to page to accumulate data almost all the substance that can be found on the web. After all the information is accumulated, look motors construct a record (library of web pages), which is bolstered through a calculation that endeavors to coordinate all the information with the asked inquiry. In arrange to appear best comes about, look motors based their positioning on different variables.

To begin with and most critical calculate is significance, which suggests that it is pivotal that Look motors see fundamentally for closely related pages to look catchphrases, which suggests that it is vital for website to offer the data that client is trying to find (Google considers over 200 components when determining the pertinence of the content). In any case, due to the truth that there are thousands of pertinent pages for each look term, look motors don't basically rank the foremost important pages at the beat.

In arrange to put the finest substance on best of the look comes about they depend on other components of the calculation. For instance, authority. This means that look motors seek for substance that's precise and reliable. perfect way">The most perfect way to impact a page's specialist is to extend the number of joins that connect to that webpage, particularly by getting outside joins from existing tall specialist pages.

Other components that look motor calculations take into thought when deciding the rank of the site are geological area of the client, clicks, bounce rates, watchwords, meta labels, pictures, HTML of webpage and interface sorts.

Mobile marketing. This sort of computerized promoting centers on coming to target group of onlookers of a trade on their tablets or smartphone through social media, content messages, websites, portable applications and emails. Concurring to a writing by Bala and Verma (2018), portable showcasing shapes the foremost impact sort of computerized promoting as portable clients are expanding day by day. It is becoming a progressive tool of interfacing businesses with their clients through portable contraptions at the correct time, within the right put and with the correct coordinate message.

Social video Marketing. In today's cutting edge world, social media is exceedingly intuitively and permits everybody to share their contemplations, thoughts, and convictions, which thus impacted the way that companies begun connection with their clients and showcase their items and administrations. Neil Patel characterized social media showcasing as a handle of making custom fitted

substance for each person social media stage in arrange to extend client engagement and sharing.

This may incorporate a brief video clip or longer organize which is instructive and engaging, either prerecorded or indeed live gushed in genuine time. As a shape of computerized showcasing, “Video showcasing is one of the finest promoting techniques at the minute, the smaller than expected recordings shared between distinctive advanced and versatile stages are being a victory for the dispatch of unused items or brand information” (Romo et al., 2017, p.146).

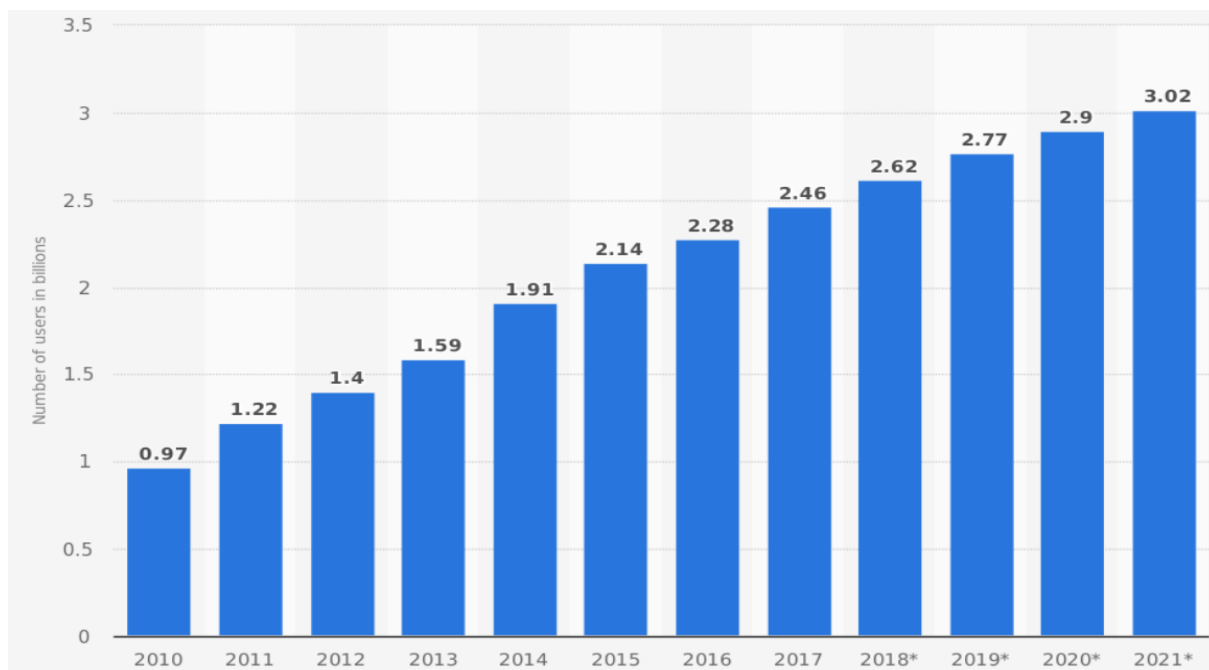


Figure 5. Number of social network users worldwide 2010-2021 (Source: Statista 2020)

Within the final decade, social media experienced explosive growth as is obvious within the increment of the number of social organize clients within the final ten years. It can be watched from Figure 8, that the number of social organize clients nearly tripled within the period 2010- 2020.

Social media showcasing empowers companies to straightforwardly interface with their clients which increments client dependability, progresses deals, makes a difference in building brand value and brand awareness. Well thought social media technique includes creating substance that people will share with their companions, family, and colleagues, and depending on word of mouth procedure. By doing this companies increment the reach of their messages, and their messages carry understood support when shared by individuals near to the beneficiary (Kenton, 2018). Social media promoting increments presentation which leads to the increment in activity and more revenue.

However, since most little businesses have a constrained promoting budget and they are cautious when contributing in showcasing procedures, the larger part of them utilize social showcasing media to extend deals and reach target clients, as social media marketing is one of the foremost adaptable and fetched compelling promoting channels. The most important social media stages that affect computerized showcasing the foremost are: Facebook, YouTube, Twitter, WhatsApp, WeChat, Instagram and most as of late TikTok Even in spite of the fact that there are a lot of preferences of social media showcasing, there are moreover a few issues which will emerge. For case, in case a client is baffled in a company's item or a benefit, they are able to voice their conclusion

on any social media stage, and by doing that, hurt brand picture and influence obtaining choices of other potential or indeed existing clients, particularly the ones that are near to that despondent customer.

Pay-per-click marketing. As contradicted to natural look strategies, PPC promoting may be a strategy of utilizing look motor publicizing to create clicks on the site. Agreeing to Sentance (2018), PPC promoting permits businesses promoting openings within the supported posting area of a SERP, by paying a charge each time the advertisement is clicked on. In spite of the fact that natural look is more fetched compelling than PPC, there are certain circumstances when it is more valuable to select PPC over SEO. For case, in the event that a company is in require of quick comes about, they will select PPC as their advertisements will be shown immediately for thousands of individuals to see (e.g. propelling a modern item or a benefit, or on the off chance that SEO campaign falls flat and the offer terminates before long) (Kim, 2020).

Moreover, PPC advertisements are customizable which permits for numerous little alterations to progress their execution and they are simple to degree and track return on speculation. Moreover, PPC permits companies to center on candidates based on their statistic characteristics. They can appear their advertisements and target clients based on their age, sexual orientation, instruction, relationship status or indeed leisure activities, which could be a helpful way to lead the correct individuals to a company's business to their website. Google Advertisements is the foremost well-known PPC promoting framework within the world. Clients make Google campaigns; each campaign incorporates a bunch of advertisements that contain distinctive catchphrases that clients are attempting to rank. Each of those watchwords has its possess cost depending on the recurrence that that catchphrase is being looked for. The fetched of watchwords may change from 50 cents to 50 dollars. The competition level and the industry that the company is in decide cost.

Utilizing all these apparatuses exceptionally imperative gotten to be the issue of content. As the substance is all over, particularly on the Web it showed up to be a conceivable apparatus of fascination and interaction with the client and as a result, it gave birth to the Substance showcasing. These days, Substance Promoting could be an apparatus for making a benefit through foundation tough client communication and utilization of motivating and curiously substance to draw in craved targets. It is worth to say that Content Marketing isn't a coordinate way to form incomes or to offer an item, but in the event that it is done appropriately it leads to that. It serves as a solid communicator between the company and the client, which endeavors to never halt and deliver more pertinent substance to be able to control customer's activities. Once communication circle is made it is less demanding to provide the data, advance unused thoughts and recognitions or essentially to motivate, since their consideration is as of now gotten. (Substance Promoting Founded 2016)

Coordinate client communication could be a source of preferences for the company. When the client devoured the great or benefit, the encounter is ordinarily recalled, since it made a few feelings and contemplations. For the company, client encounter can be utilized as a source of feed- back or improvement proposal. The client isn't upbeat – something went wrong. The speedier company will get the answer approximately what isn't fulfilling for one client the sooner the issue can be hindered. (Substance Showcasing Established 2016) To reach more prominent commerce comes about businesses ought to keep in mind that substance creation, as well as focusing on, cannot be

coordinated to all bunches of clients because it makes everything exceptionally dubious and does not lead to anything. That's why there ought to be a fanciful representation of the company's client, whereas substance emanation. (Fast Grow 2016).

The marketers doing substance showcasing highlighted the way how the correct substance ought to be. It cannot be as well complicated but ought to be visual and well organized. The substance itself ought to be recognizable and brand related (DeMers 2013). Other than awesome sum of composed data, social media pages are strongly utilizing pictures and pictures to imagine. The picture as the center of the site structure can be seen on Pinterest and Instagram. As of late Instagram picked up an extraordinary sum of clients and it appears relentless development rates.

Already, blogs were too as it were almost composed data, but today's hones appeared that blogs are moreover influenced by visualization. Increasingly pictures show up within the posts each day. (DeMers 2013) The data which contains pictures is continuously more important, acquainted and curiously. For illustration, a few online retailer shops such as AlliExpress permitted clients to connect pictures to their comments and surveys that draw in more gathering of people to associated with the company and other clients. In conclusion, pictures might too carry out a few basic capacities, shape and join together the content.

In today's picture substance ought to be recognizable, but not as well pushy or aggressive, since individuals are over-burden by diverse includes which are coming to them each diminutive. That's why effortlessness and clearness are exceedingly acknowledged by the present day buyer. The substance ought to be curiously and directing for the client to consider items of the company (DeMers 2013). The client shows up as a center of the substance showcasing of nowadays, so also in online and any other sort of showcasing. Substance creation does not appear tricky or cost-increasing, due to the promoting devices advertised by the Web. Substance Showcasing procedures and instruments show up nearly each day and permit businesses to select the leading and make required substance with their offer assistance essentially and nearly for free.

Conclusion

Summing up, properly addressed content marketing strategy is a mean that can change a lot and bring meaningful advantages to the company. Some of them are shortly listed below:

- Stimulates communication and supports established customer relationships.
- Increases traffic to the company's website and converts visitors in-to customers.
- Give a guarantee to the company that product awareness is high and the created image is perceived right.
- Shows serious intentions of the company through raising its trust-worthiness and reliability.
- Ensures presence of the company in various social media channels.

Helps buyer think less about purchase and buy more impulsively. (Handley, Chapman 2011, 8.)

In conclusion, the analysis of digital marketing communication tools underscores their pivotal role in shaping contemporary marketing strategies. The multifaceted nature of digital tools, ranging

from social media and email marketing to SEO and content strategies, offers businesses unprecedented opportunities to connect with diverse audiences in the digital landscape.



References

1. Decree of the President of the Republic of Uzbekistan dated February 28, 2023 No. PF-27 “New Development Strategy of Uzbekistan for 2022-2026”. Tashkent city, 2023.
2. Weber, C. (2018): ‘What are the Disadvantages of Digital Marketing?’ (Content Marketing Institute 2016) (Quick Sprout 2016).
3. Alexander, L. (2020): ‘The who, what, why & how of digital marketing’
4. Alshaketheep, K. M. K. I., Salah, A. A., ALOMARI, K. M., KHALED, A., & Jay, A. A. A.
5. (2020). Digital Marketing during COVID 19: Consumer’s Perspective. WSEAS Transactions on Business and Economics, 831-841.
6. Bala, M., & Verma, D. (2018). A critical review of digital marketing. M. Bala, D. Verma (2018). A Critical Review of Digital Marketing. International Journal of Management, IT & Engineering, 8(10), 321-339.
7. Bhandari, P, (2020): ‘An introduction to quantitative research’
8. BrightEdge Channel Report (2019): ‘Organic Search Improves Ability to Map to Consumer Intent’ (Iskandar & Komara, 2018).
9. Buttle, F. (2009). Customer relationship management: concepts and technologies. Butterworth-Heinemann Ltd. ISBN 9781856175227
10. Cyber Planet (2019): ‘Top disadvantages of digital marketing’
11. Abdulakhatov M. M, “The main impacts of digital transformation on small to medium-sized business enterprises” Scientific electronic journal of Digital Economy and Information Technologies No. 2, 2022
12. Abdulakhatov M. M “The digital economy is the basis for economic development” Scientific journal of Economy and Society No. 10, October 7, 2022
13. Kobilov A.U, Abdulakhatov M.M, Rajabov Sh.B, “Artificial intelligence as a technological innovation for economic development of the republic of Uzbekistan” ICFNDS ’22, December 15, 2022, Tashkent, TAS, Uzbekistan.



Muallif

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Raqamli iqtisodiyot va axborot
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JAHON BLOKCHEYN TEXNOLOGIYALARI BOZORI DINAMIKASINING PROGNOZI

Annotatsiya: Axborot texnologiyalaridan foydalangan holda raqamli muhitda tranzaksiyalarning xavfsizligi va samaradorligini oshirish imkoniyatlarini tahlil qilishga bag'ishlangan ushbu ish yanada dolzarb bo'lib bormoqda. Ilmiy tadqiqotning maqsadi aqlli kontraktlar va blokcheyn texnologiyalaridan foydalanishning shakllanish o'ziga xosligi va ijobiy oqibatlarini, shuningdek, raqamli aktivlar bozorini rivojlantirish istiqbollarini aniqlashdan iborat.

Kalit so'zlar: Blokcheyn texnologiya, ta'minot zanjiri, logistika, transport.



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FORECAST OF GLOBAL BLOCKCHAIN TECHNOLOGY MARKET DYNAMICS

Abstract: This work, dedicated to the analysis of opportunities to improve the security and efficiency of transactions in the digital environment using information technologies, is becoming more relevant. The purpose of the scientific research is to determine the specificity and positive consequences of the use of smart contracts and blockchain technologies, as well as the prospects for the development of the digital asset market.

Keywords: Blockchain technology, supply chain, logistics, transport.



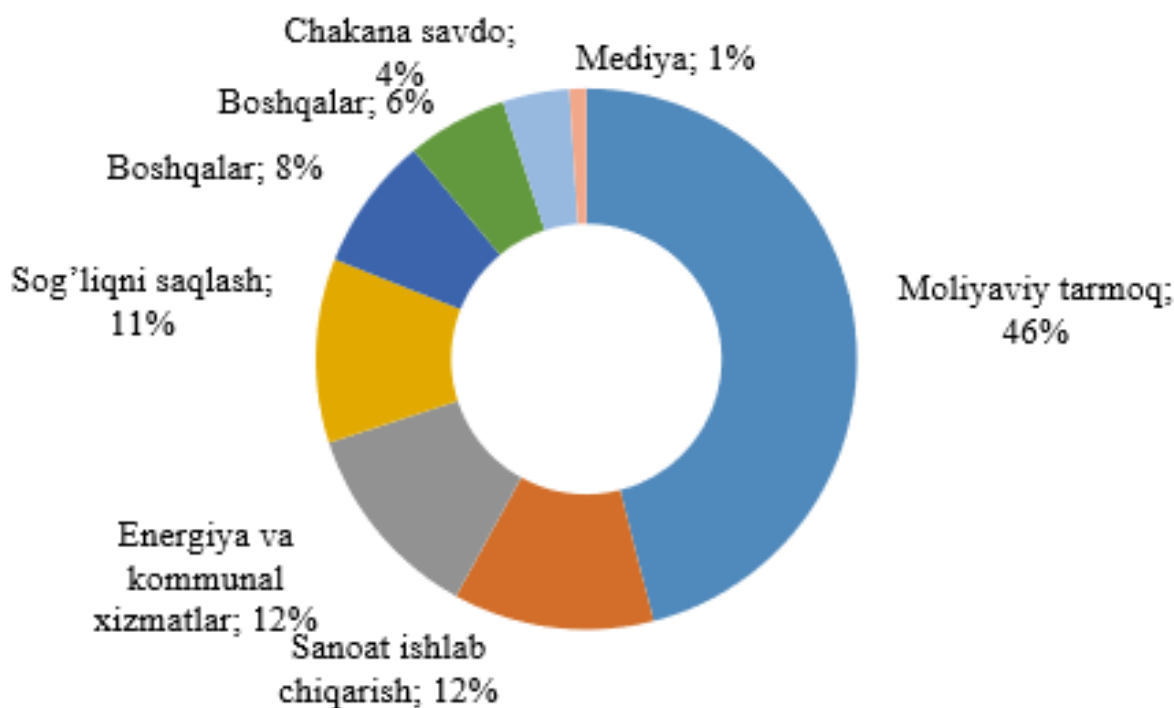
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Kirish

COVID-19 va boshqa global inqirozlar oqibatida yuzaga kelgan pandemiya va ularning oqibatlari bilan bog'liq hozirgi holat hukumatlarga yangi raqamli texnologiyalarni joriy etishga yangi turtki berdi. Butun dunyoda Blokcheyn texnologiyasi davlat sektorida innovatsiyalar va mahsuldorlikni oshirishning strategik vositasiga aylandi, chunki blokcheyn jamoatchilik samaradorligi, ishlashi, innovatsiyasi va o'sishi uchun vosita hisoblanadi.¹

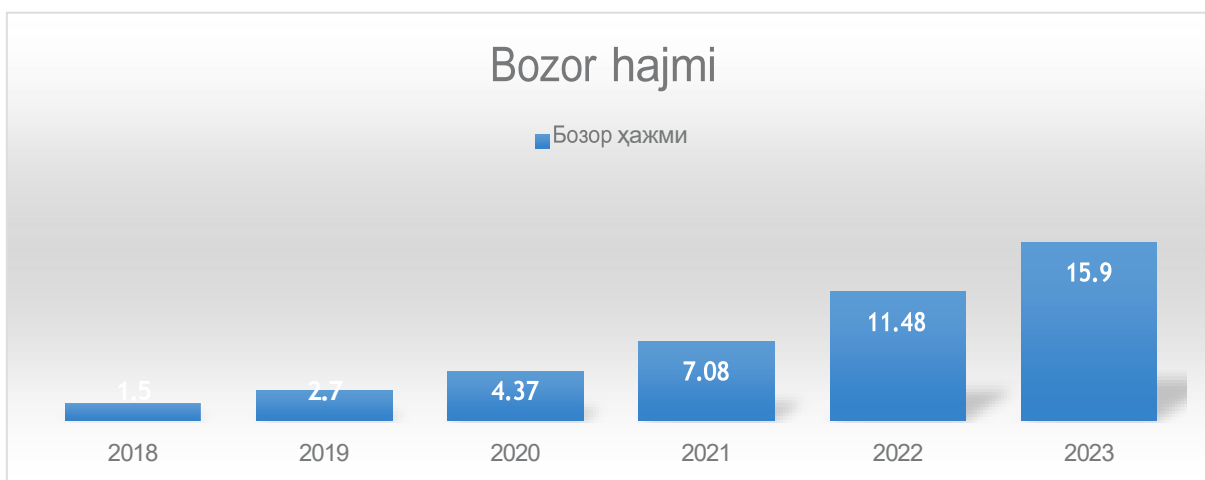
2020-yildan boshlab, Kanadaning yetakchi texnologiya kompaniyasi bilan hamkorlikda, Qo'shma loyiha doirasida, blokcheyn texnologiyasini O'zbekiston fuqarolik holati dalolatnomalarini yozish tizimiga kiritish imkoniyati ishlab chiqilmoqda. Bu O'zbekistonda davlat xizmatlarini ko'rsatishning blokcheyn texnologiyasiga asoslangan birinchi haqiqiy axborot tizimi bo'ladi. Butun mamlakat bo'ylab ro'yxatga olish idoralarining barcha xizmatlari onlayn, tez, byurokratiya va navbatlarsiz ko'rsatiladi. Ammo, agar Gartner tadqiqot kompaniyasi ma'lumotlariga ko'ra, 2017-yilda ro'yxatga olingan blokcheyn loyihalarining 82 foizi moliyaviy xizmatlar ko'rsatishda amalga oshirilgan bo'lsa, 2018-yilda boshqa tarmoqlar va tarmoqlar o'rtasida qayta taqsimlanish natijasida ularning ulushi 46 foizgacha kamaygan [67]. Blokcheyn texnologiyalaridan foydalanishning potensial yetakchilari haqidagi ma'lumotlar 1 – rasmda keltirilgan.



1– rasm. Jahonda blokcheyn texnologiyasidan foydalanayotgan yetakchi tarmoqlar.

Jahon blokcheyn texnologiyalari bozorining baholari haqida gapirganda, shuni ta'kidlash kerakki, yetakchi analitik va konsalting kompaniyalari va agentliklarining hisobotlarida prognoz qilingan hajmlar farqiga qaramay, bozor hajmining sezilarli o'sish tendensiyasi mavjud. Shunday qilib, beshta analitik kompaniyalar ma'lumotlariga ko'ra (Transparency Market Research, Esticast Research & Consulting, Grand View Research, MarketsendMarkets, Report Sellers), 2025 yilga kelib global blokcheyn texnologiyalari bozori hajmi 4,4 dan 20 milliard AQSh dollarigacha yetishi mumkin.

Transport logistikasini blokcheyn tizimi orqali integratsiyalashuvi korxonadagi asosiy axborot oqimlarini tizimlashtirish, tovar oqimlarini qayd etish uchun mehnat xarajatlarini kamaytirish va qimmatli axborot xavfsizligini oshirish imkonini beradi [26]. Hozirgi vaqtda logistika sohasida blokcheyn uchun yechim yo'qligi ushbu tadqiqotning korxonalar uchun dolzarbligini ko'rsatadi [27]. Blokcheynga asoslangan yechimlar uchun joriy bozor tez sur'atlar bilan o'sib bormoqda. Jahon bozorining eng yirik auditori PwC kompaniyalar tarmog'i tomonidan olingan ma'lumotlarga ko'ra, 2030 yilga borib blokcheyn texnologiyalaridan foydalanish jahon iqtisodiyotining 1,7 trillion dollarga o'sishini ta'minlaydi [14]. Blokcheyn bozori rivojlanish dinamikasi va istiqbollari 2-rasmda keltirilgan.



2-расм. Jahon blokcheyn texnologiyalari bozorining rivojlanish dinamikasi, milliard AQSH dollarda

Shunday qilib, blokcheyn texnologiyalari bozorining o'sishi prognozini quyidagi funktsiyalar orqali aniqlash mumkin:

$$y = 1.0104e^{0.4751x} \tag{1}$$

$$y = 0.4818x^2 - 0.4853x + 1.5648 \tag{2}$$

bu yerda y – funktsiyaning qiymati, milliard dollarda; x – funktsiya argumenti (yilning tartib raqami).

2018–2023 yillar (eksponensial va polinom tendentsiyalari) ma'lumotlari asosida olingan natijalar 2030-yilgacha blokcheyn bozorining dinamikasini prognoz qilish imkonini beradi. Belgilangan ma'lumotlar quyidagi jadvalda ko'rsatilgan.

1-jadval. 2030-yilgacha jahon blokcheyn texnologiyalari bozorini rivojlantirish istiqbollarini baholash

Blockchain texnologiyasi bozori ko'rsatkichi, yil bo'yicha, milliard AQSh dollarida						
2024	2025	2026	2027	2028	2029	2030

Ekspontensial tendentsiya $y = 1.0104e^{0.4751x}$						
202	46.60	73.37	121.83	196.93	318.36	514.64
Polinomial tendentsiyasi $y = 0.4818x^2 - 0.4853x + 1.5648$						
21.85	28.47	36.23	44.89	54.53	65.12	76.68

2030-yilga qadar blokcheyn texnologiyalari bozori hajmi bo'yicha olingan prognoz, voqealar rivojlanishi uchun o'rtacha pessimistik stsenariyda hisoblangan ko'rsatkichlar PwC tomonidan bashorat qilinganidan sezilarli darajada past. Ushbu prognozning kechikishining asosiy sabablari foydalanuvchilarning raqamli tengsizligi, bir qator mamlakatlar, shu jumladan O'zbekistonning raqamlashtirish jarayonidan sezilarli darajada orqada qolishi, shuningdek, raqamli muhitga potentsial foydalanuvchilarning ishonchsizligi mavjudligi bo'lishi mumkin.



Adabiyotlar

1. Lee, H.L., Padmanabhan, V. & Whang, S. 1997. The bullwhip effect in supply chains. *Sloan Management Review*, Vol. 38, No. 3, pp. 93-102.
2. Angeles, R. 2005. RFID Technologies: Supply-Chain Applications and Implementation Issues, *Information Systems Management*, Vol. 22, No. 1, pp. 51-56.
3. Tapscott, Don. *The digital economy: promise and peril in the age of networked intelligence*. – New York: McGraw-Hill. – 1994. – 368 r.
4. Kouhizadeh, M., Saberi, S., & Sarkis, J. (2021). Blockchain technology and the sustainable supply chain: Theoretically exploring adoption barriers. *International Journal of Production Economics*, 231, Article 107831.



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РАЗВИТИЕ ЦИФРОВОЙ ЭКОНОМИКИ В УЗБЕКИСТАНЕ

Аннотация. В данной статье основное внимание уделяется развитию цифровой экономики в Узбекистане и устранению существующих проблем. Удобство и использование новых возможностей цифровой экономики. Необходимость для нашей страны быть в числе развитых стран. Несравненная роль цифровой экономики во всех сферах.

Ключевые слова: цифровая экономика, цифровые технологии, связь, инфраструктура, электронная коммерция, инвестиции, логистика, операторы связи, инновация.



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DEVELOPMENT OF THE DIGITAL ECONOMY IN UZBEKISTAN

Abstract: This article focuses on the development of the digital economy in Uzbekistan and the elimination of existing problems. Convenience and use of new opportunities of the digital economy. The need for our country to be among the developed countries. The incomparable role of the digital economy in all areas.

Keywords: digital economy, digital technologies, communications, infrastructure, e-commerce, investments, logistics, telecom operators, innovation.



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Введение

Рост цифровой экономики является одной из характеристик XXI века. Конечно, сегодня сложно представить себя без цифровых технологий. Интеллект и наука – крылья развития. Вершина современной науки видна в высоких технологиях, в цифровом мире. Четвертая промышленная революция знаменует собой начало новой формы развития – «цифровой экономики». Сегодня у нас есть амбициозные цели, которых мы хотим достичь в ближайшем будущем. Для этого нам обязательно нужны зрелые кадры и специалисты. Цифровые технологии влияют на общество и экономику во многих отношениях, в том числе через новые средства коммуникации и сотрудничества; новые продукты с сильной сервисной составляющей; роль информации как фактора экономического роста; автоматизация задач с использованием искусственного интеллекта (ИИ); и появление новых бизнес-моделей, таких как платформы. Вот почему цифровизация фундаментально изменит то, как мы живем и работаем вместе. Это означает развитие и процветание всей страны. Также это оказывает большое влияние на эффективность, время, пропускную способность, навыки, правильное распределение доходов предприятий и организаций во всех сферах, окружающей среде и внешнем мире. В настоящее время мы не должны прекращать работу, чтобы быть в числе развитых стран Узбекистана. Зарубежные страны имеют более развитую цифровую экономику, чем наша. Цифровизация экономики важна для развития этой страны. Сегодня развитие цифровой экономики тесно связано с развитием всех сфер.

Материалы и методы

Цифровая экономика сегодня является одной из горячих тем. В принципе, как развивать эту тему в Узбекистане, зависит от нас, молодежи. Термин «цифровая экономика» впервые был опубликован в 1995 году Доном Тэпкоттом.

Цифровая экономика: перспективы и опасности в эпоху сетевого интеллекта определяется как отдельная концепция. В данной публикации среди основных составляющих цифровой экономики выделяются фундаментальные инновации (полупроводники, процессоры), базовые технологии (компьютеры) и соединительные инфраструктуры (интернет и телекоммуникационные сети).

Полученные результаты

В развитых странах внедрение цифровой экономики уже началось. В условиях глобализации мировой экономики и развития технологий экономическое развитие Узбекистана не может быть достигнуто без развития цифровой экономики. По данным Всемирного банка, 66 процентов общего богатства нашей страны - 365 триллионов долларов США - соответствует человеческому капиталу, то есть главным образом уровню знаний человека. В США этот показатель равен 77 % национального богатства – 95 триллионов долларов. Именно поэтому в своем обращении в этом году глава нашего государства сказал: «Самое большое богатство – это ум и знания, величайшее наследство – хорошее образование,



а величайшая бедность – это невежество!» он упомянул об этом мнении отдельно. На сегодняшний день подсчитано, что цифровая экономика в мире стоит 2 триллиона долларов США в 20 развитых странах. В Великобритании, мировом лидере по развитию цифровой экономики, она уже достигла 12% национального ВВП. Цифровая экономика предполагает цифровизацию технологических и бизнес-процессов, производства, логистики и торговли готовой продукцией. В нашей стране в 2020 году принято решение о полной цифровизации таких сфер, как транспорт, геология, образование, архивы. Подтверждением нашего мнения являются «ИТ-парки» с современной инфраструктурой. Недостаточные цифровые навыки у всех слоев населения стали еще одним препятствием на пути развития цифровой экономики.

Цифровой оборот также считался низким. В связи с этим стоит вспомнить мнение Билла Гейтса, основателя корпорации Microsoft, хорошо известного в мире технологий:

«Скоро на планете будет только два типа компаний». Первый — это компании, которые ведут бизнес в Интернете и второе – это компании, вышедшие из бизнеса». Учитывая этот аспект, предпринимателям целесообразно организовывать свою деятельность на основе всемирно известных принципов «бизнес для потребителей, бизнес для бизнеса», и потребители для потребителей. Для формирования цифрового промышленного рынка Узбекистана необходимо определить три важных условия: Нормативное регулирование цифровой среды (концепция, программа и закон), развитие инфраструктуры (ЦОД, мобильная связь, интернет, устройства автоматизации бизнеса и производственных процессов) и обучение специалистов станут основой создания здорового рынка.

ОБСУЖДЕНИЕ.

Цифровая экономика – это виртуальная среда, дополняющая реальную реальность. Обеспечение тесного сотрудничества государственных органов и субъектов предпринимательства в области внедрения инновационных идей, технологий и разработок для дальнейшего развития цифровой экономики. Подготовка квалифицированных кадров с практическими навыками работы в сфере производства и использования блокчейн-технологий. Учитывая зарубежный опыт, необходимо поставить цель и реализовать ряд задач, таких как создание правовой базы для внедрения технологий блокчейн. Экономика цифровизации существует как отдельная область экономики по двум причинам. Во-первых, необходимы новые экономические модели, поскольку многие традиционные представления об информации больше не верны в цифровом мире. Во-вторых, новые типы данных, генерируемые в результате оцифровки, требуют новых методов анализа. Международный опыт показывает, что сегодня цифровые технологии бурно развиваются преимущественно в научном сообществе и частном секторе. Поэтому государство должно создать благоприятную экосистему, поддерживая инновационные проекты в этих сферах. Несмотря на наличие Click, Рауме, М-банка, Урау, Oson и других платежных систем, допускающих онлайн-платежи, уровень онлайн-платежей по мобильным платежам, интернету и коммунальным платежам не высок. В 2017 году 34 процента владельцев счетов осуществляли цифровые платежи. Для сравнения, в Великобритании этот показатель составляет 96%. Развивая эту сферу, нам необходимо развивать электронную коммерцию и электронные переводы. Если цифровые

платежи в Узбекистане составляют 34%, нам необходимо увеличить этот показатель до 100%. В целом кибербезопасность является важным условием цифровой экономики. После цифровизации экономики необходимо полностью исключить меры безопасности. Концепции цифровизации и кибербезопасности всегда идут рука об руку. Потому что наряду с цифровизацией всех систем и процессов важно обеспечить их технически безупречную и безошибочную работу и безопасность. Чем больше внимания уделяется развитию цифровой экономики в нашей стране, тем актуальнее становится обеспечение кибербезопасности. Узбекистан укрепляет свои позиции в глобальном индексе кибербезопасности. В 2017 году наша страна заняла 93 место в этом рейтинге, а в 2018 году поднялась на 52 место. Кибербезопасность — это форма информационной безопасности, которая отличается от понятия высокой духовности, служащего для сортировки информации. Речь идет о более технических процессах, для обычного пользователя это означает установку надежных и надежных паролей в почте, социальных сетях, платежных системах, а также защиту своего персонального компьютера и смартфона от вирусов. В более широком смысле кибербезопасность — это комплекс мер, направленных на защиту сетей, мобильных приложений и устройств. Это означает сохранение конфиденциальности данных, защиту их целостности и полноценной работы того или иного сайта, приложения или программы. По данным анализа «Центра кибербезопасности» СУК, в 2019 году на сайтах национального сегмента сети Интернет было обнаружено 268 инцидентов кибербезопасности. Это означает, что количество преступлений в цифровом мире снизилось на 44% по сравнению с предыдущим годом. Из них 222 были связаны с несанкционированной загрузкой контента, 45 — с дефейсом (хакерская атака, при которой одна страница веб-сайта заменяется другой, например страницей с рекламой), и один — со скрытым майнингом (скрытая активность на криптовалютной платформе). В Узбекистане с каждым днем все системы оцифровываются. Особенно в условиях карантина, введенного из-за коронавируса, увеличился спрос на онлайн-товары и услуги, расширился спектр цифровых функций по всем направлениям. Сегодня можно совершать платежи, не выходя из дома, без проблем получать дистанционное образование, пользоваться крупнейшими библиотеками мира и даже работать. По сравнению с традиционным типом цифровые услуги имеют ряд преимуществ, таких как отсутствие бумажной работы, формальностей и экономия времени. Например, если вы получаете государственные услуги в цифровом формате, вы получите скидку в размере 10 процентов от фиксированной платы. Цифровизация открывает огромные и беспрецедентные возможности. В то же время остаются серьезные неопределенности в развитии таких преобразующих технологий. Правительства должны стремиться лучше понять потенциальные последствия для общества и критические проблемы, которые эти новые технологии создают для их управления.

ВЫВОДЫ

Подводя итог, можно сказать, что для развития каждой страны необходимы новые изменения, идеи и новые процедуры, которые время от времени меняются. Перспектива развития нашей страны также зависит от развития цифровой экономики и уровня охвата цифровыми технологиями. Как сказал лидер нашего государства, «построение экономики



требует много денег и труда. Но мы не должны этого бояться и формировать цифровую экономику. Мы должны начать эту работу с ответственностью и решимостью с сегодняшнего дня. Каждый человек несет ответственность». для развития страны. Каждый из нас должен серьезно отнестись к этому вопросу». Некоторые элементы цифровой экономики уже успешно работают в жизни нашей страны. В частности, на электронные платформы переводятся массовый перевод документов и сообщений на цифровые средства, авторизация электронных подписей, связь с государством. По сути, электронные платформы должны быть организованы в образовании, и цифровизация в этой сфере не должна прекращаться, а переход к цифровой экономике должен осуществляться и в других сферах.

Литература

1. International Conference On Developments In Education Hosted From Toronto, Canada May 21st 2022 215 MAVZU: RAQAMLI IQTISODIYOTNI RIVOJLANTIRISH OMILLARI, Rahimov Bahromjon Qaxramon o'g'li
2. G.M. Porsaev, B.Sh. Safarov, D.Q. Usmanova Raqamli Iqtisodiyot asoslari (Darslik)
3. Raqamli iqtisodiyot mamlakatimiz taraqqiyoti garovidir. [review.uz]
4. "Iqtisodiyot va innovatsion texnologiyalar" (Economics and Innovative Technologies) ilmiy elektron jurnali O'zbekiston Iqtisodiyotini Raqamlashtirish Sharoitida "Elektron Sog'liqni Saqlash" Tizimining Istiqbollari, Mirzarahimova Aziza Baxrom qizi
5. "Iqtisodiyot va innovatsion texnologiyalar" ilmiy elektron jurnali. № 1, yanvar-fevral, 2021 yil 1/2021 (№ 00051) <http://iqtisodiyot.tsue.uz> 309 RAQAMLI IQTISODIYOTNING BUGUNGI HOLATI: MUAMMO VA YECHIMLAR Kurpayanidi Konstantin Ivanovich Farg'ona politexnika instituti dotsenti, i.f.n. Ilyosov Asrorjon Axrorjon o'g'li Farg'ona politexnika instituti
6. "Raqamli iqtisodiyot: taraqqiyot sari qisqa yo'l" Sanobar Jumanova "Yangi o'zbekiston" gazetasi 17-sentabr 2020
7. "Iqtisodiyot Va Innovatsion Texnologiyalar" Ilmiy Elektron Jurnali. № 1, Yanvar-Fevral, 2021 Yil 288 1/2021 (№ 00051) [Http://Iqtisodiyot.Tsue.Uz](http://Iqtisodiyot.Tsue.Uz) Рақамли Иқтисодиётнинг Ахамияти Ва Ривожланиш Йўналишлари Аскарлов Нодир Ибрагимович
8. Bahromkulovich m. G. Design of a span beam of a bridge made of triangular cross section beams made of materials with different physical and mechanical properties. – 2022.



Mualliflar

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KOMMUNAL SOHADA BOSHQARUV, HISOBINI YURITUVCHI TIZIMNI MODELLASHTIRISH VA ISHLAB CHIQISH

Annotatsiya. Ushbu maqolada xususan, bugungi kundagi iqtisodiyotdagi islohotlar, iqtisodiyotni yanada rivojlantirishda, undagi kamchilik va muammolarni o'rganish va ularni bartaraf etish, xususan kommunal sohada boshqaruv, hisobini yurituvchi tizimni modellashtirish, va ishlab chiqish taraqqiyotning hozirgi bosqichida kommunal soha deb, odatda suv, gaz, elektr energiyasi, issiqlik ta'minoti va chiqindilarni boshqarishni nazarda tutadi. Ushbu sohada boshqaruv tizimlari kamchiliklari va ularni takomillashtirish faoliyatining samaradorligi oshirish, kommunal sohada boshqaruvning har bir bo'g'inida yo'lga qo'yilmoqda, boshqaruv hisobini tizimisiz tasavvur qilish murakkab, kommunal sohada boshqaruv hisobi tizimini ishlab chiqish hamda ushbu jarayonda xarajatlarni rejalashtirish, eng samarali va optimal usulidan foydalanish, rejalarning amalda bajarilishiga ta'sir etuvchi omillarni aniqlash va ularni bartaraf etish chora-tadbirlarini ishlab chiqish kabi bo'lgan eng muhim masalalar yuzasidan so'z yuritiladi.

Kalit so'zlar: kommunal sohada, kommunal sohada boshqaruv, boshqaruv hisobi, ishlab chiqarish, xarajatlar hisobi, innovatsion yondashuvlar, moliyaviy hisobot, mahsulotlarni sotish, investitsiya, daromad, axborot texnologiyalari.



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MANAGEMENT IN THE COMMUNAL SECTOR, MODELING AND DEVELOPING ACCOUNTING SYSTEMS

Abstract: This article specifically addresses the reforms in today's economy, the study and elimination of deficiencies and issues in the development of the economy, with a focus on the management and modeling of accounting systems in the communal sector, as well as their development. The communal sector (usually referring to water, gas, electricity, heating supply, and waste management) is examined. It discusses the shortcomings of management systems in this sector and ways to improve their effectiveness. The article emphasizes that effective management accounting systems are essential and that developing such systems is complex. Key issues include planning expenses, using the most efficient and optimal methods, identifying and addressing factors affecting the implementation of plans, and developing measures to eliminate these factors.

Keywords: communal sector, management in the communal sector, management accounting, production, cost accounting, innovative approaches, financial reporting, product sales, investment, revenue, information technology, accounting.



Kirish

Iqtisodiy taraqqiyotning hozirgi bosqichida xo'jalik yurituvchi subyektlar faoliyatining samaradorligi boshqaruvning har bir bo'g'inida yo'lga qo'yilmoqda, boshqaruv hisobini tizimisiz tasavvur qilish murakkab, kommunal sohada boshqaruv hisobi, samarali boshqaruv qarorlarini qabul qilishda xarajatlarni rejalashtirish, shakllantirish va nazorat qilish jarayonlari bilan uzviy bog'liq.

Kommunal sohada xo'jalik yurituvchi subyektlarning ichki boshqaruv tizimida axborotlarga bo'lgan ehtiyojini aynan boshqaruv hisobi tizimi ta'minlaydi.

Rivojlangan mamlakatlarda firma va kompaniyalar buxgalteriya hisobi sohasidagi ish vaqti va resurslarining 90 foizini boshqaruv hisobini yo'lga qo'yish va yuritishga, qolgan 10 foizini esa moliyaviy hisobga sarflashadi.

Kuchli raqobat muhitida kommunal xo'jalik yurituvchi subyektlar faoliyat yuritayotgan tarmoqning o'ziga xos xususiyati yoki faoliyat turidan qat'i nazar, boshqaruv tizimini yo'lga qo'yish orqali ko'zlangan natijaga erishishi va samarali faoliyat yuritishi mumkin.

Kommunal sohaga qisqacha ta'rif berib o'tamiz.

Kommunal soha bu odatda suv, gaz, elektr energiyasi, issiqlik ta'minoti va chiqindilarni boshqarishni nazarda tutadi. Ushbu sohada boshqaruv tizimlari kamchiliklari va ularni takomillashtirish haqida so'z yuritiladi. Iqtisodiyot taraqqiyot sari ildamlayotgan bir paytda xo'jalik yurituvchi subyektlar faoliyatining samaradorligini boshqaruvning har bir bo'g'inida yo'lga qo'yilgan boshqaruv hisobi tizimisiz tasavvur qilish murakkab.

Hozirgi kunda Mamlakatimizda kommunal soha va xo'jalik yurituvchi subyektlar faoliyatini tashkil etish bugungi kunda soddalashtirilgan tartibda amalga oshirilmoqda. Tadbirkorlik faoliyatini yo'lga qo'yishda ko'plab qulayliklar va imtiyozlar yaratilmoqda, Jumladan aylanma mablag'ni shakllantirish uchun bank kreditlari, soliq to'lovidagi imtiyozlar va hokazo. Xo'jalik yurituvchi subyektlar faoliyati tashkil etilganidan so'ng faoliyatni davom ettirish masalasi dolzarb ahamiyat kasb etmoqda. Ya'ni boshqaruv jarayoni, xarajatlar va ishlab chiqarish faoliyatini to'g'ri tashkil etish va yuritish mablag'ni to'g'ri yo'naltirish va o'z vaqtida soliqlarni to'lash hamda ishchi xodimlarga yetarlicha shart-sharoitlar yaratish birmuncha murakkab hisoblanadi.

Tadqiqot va izlanishlar shuni ko'rsatadiki, ko'plab korxonalar xarajatlar hisobini noto'g'ri yuritishi oqibatida salbiy natijalarga erishishi yakunida faoliyati tugatilishiga olib kelishi holatlari ham kuzatilmoqda. Boshqaruv hisobini tashkil qilish va yuritishda o'zining ijobiy yechimini kutayotgan bir qator muhim masalalar mavjudki, ana shu muhim, ya'ni o'zining ijobiy yechimini kutayotgan dolzarb masalalar qatoriga kommunal sohada xo'jalik yurituvchi subyektlarning boshqaruvi hisobini ishlab chiqariladigan mahsulot (ish, xizmat) birligi tannarxini aniqlashdagi muhim omil bo'lgan amaldagi tizimida muammolarni ham kiritish kerak, deb hisoblaymiz. Sababi, bugungi kunda ishlab chiqarilayotgan mahsulotlar (ish xizmat)ning sifatli va arzon bo'lishi uning xaridorgirligini ta'minlashga xizmat qilmoqda. Shuni ta'kidlab o'tish joizki (ish xizmat)ning sifatli va arzon bo'lishi ba'zi holatlarda xaridorlarning faqat arzon narx qiziqtirib sifatga e'tibor qaratishmagan holatlarga afsuski guvoh bo'lmoqdamiz.

Mavzuga oid adabiyotlar sharhi

Boshqaruv borasidagi va rahbar bo'lgan shaxslarga tavsiya qilinadigan shu kabi maslahatlarni zamonaviy adabiyotlarda ham uchratish mumkin. Xususan, shunday sifatli maslahatlarni to'plab, ularni ma'lum tamoyillar asosida guruhlashga harakat qilishgan. Ular tomonidan ishlab chiqilgan ana shunday guruhli maslahatlar rahbarlarga aniq yo'nalishlar bo'yicha qo'l keladi.

Qadimgi Gretsiyada Platon ishlab chiqarish jarayonlarini ixtisoslashtirish zarurligi to'g'risida gapirgan edi. Suqrot turli faoliyat sohalari boshqaruvchilarining faoliyatlarini tahlil qila turib, ular mehnatining asosini tashkil qiluvchi umumiy tamoyillar to'g'risida gapirgan edi: Asosiy vazifa – kerakli odamni kerakli joyga qo'yish va o'zining ko'rsatmalarini bajarilishiga erishish.

Qadimgi Rimda Katta Katon (eramizgacha 234–149 y.) yer egasiga quyidagicha maslahat bergan: Qarash kerak, ishning borishi qanday, nimalar qilindi va yana nimalar qilinishi kerak. Shundan keyin u boshqaruvchidan bajarilgan ishlar to'g'risida hisobot va nima uchun ishning bir qismi bajarilmaganligi to'g'risida tushuntirish talab qilishi lozim. Shuningdek, boshqaruvchiga yillik ish rejasini berish taklif etilgan [3].

Yevropada XVIII asrning o'rtalarida sanoat inqilobidan keyin boshqaruvga oid qarashlar intensiv rivojlandi. Undan keyin ishlab chiqarishning gurrurab rivojlanishi yig'uv kombaynining va mashinaning o'zaro almashinuvchi qismlarini joriy qilinishiga, sifat nazorati usullaridan foydalanishga (E.Uitni), ishlab chiqarish ishchilarining ixtisoslashuviga (Ch.Bebbidj) olib keldi[4].

Hozirga kelib, boshqaruv bo'yicha juda ko'p yo'nalish hamda tadqiqot natijalari mavjud, binobarin, jamiyat taraqqiyotining turli bosqichlarida boshqaruv faoliyatini yoki uning tarkibiy qismlarini tizimlashtirishga (bir tizimga solishga) urinishlar ko'p bo'lgan[5]. Kommunal sohada boshqaruv hisobini yangilash va amaldagi tizimni o'zgartirish uchun texnologiyalar va odamlar bilan birgalikda uyg'unlikda qanday foydalanishini tubdan qayta ko'rib yaxshilash va takomillashtirishni ko'rib chiqishdilar.

Tadqiqot metodologiyasi

Taraqqiyotning hozirgi bosqichida, boshqaruvga oid qarashlarning tez rivojlanayotganligini kuzatish mumkin. Bu taraqqiyot bosqichidagi boshqaruv qanday bo'lishi, xo'jalik yurituvchi subyektlar faoliyatini samarali tashkil qilish uchun uning qaysi yo'nalishlari, tamoyillari va usullari asos qilib olinishi lozim degan muhim masalani yechish maqsadida uning iqtisodiy rivojlanish tarixiga yaqin bo'lgan davrdagi nazariyasi mohiyatini, tashkil qilishning yo'nalishi va usullarini yaqindan o'rganish lozim.

Bu borada butun dunyoda tan olingan amerikalik injener Teylorning (1856–1915y.) hissasi katta bo'lgan. U boshqaruv nazariyasining rivojlanishiga katta hissa qo'shgan. Bunga, asosan, XX asr boshlarida AQSHda yuzaga kelgan ijtimoiy-siyosiy vaziyat turtki bo'lgan. AQSH uchun ushbu davrda sanoatning gurrurab rivojlanishi xususiyatli bo'lib, temir yo'l tarmoqlari mamlakatni samarali boshqaruvga ehtiyoj sezgan yirik ishchi kuchi bozoriga aylantirdi. Birinchi navbatda tadbirkorlar boshqarish usullariga katta e'tibor bergan xo'jalik yurituvchi subyektlar gullab-yashnadi. Yangi tizimda joriy qilinadigan yana bir muhim jihat, hisob-kitoblarning shaffofligini ta'minlash bilan



bog'liq. Buning uchun boshqaruv kompaniyalarining elektron reyting resteri yuritiladi.

Yangi elektron raqamli dastur asosida xarajatlar bo'yicha ma'lumot berish maqsadida SMS-xabarnoma tizimi yo'lga qo'yiladi. Smartfon yoki planshetdagi maxsus dastur orqali aholi o'zining xarajatlar smetasi bilan tanishish imkoniyati yaratiladi.

Har bir fuqaro boshqaruv kompaniyasiga to'layotgan puli qayerga ketayotganini tiyintiyinigacha ko'rib turadi, – dedi vazir Sherzod Hidoyatov 28 aprel kuni jurnalistlarga bergan intervyusida.

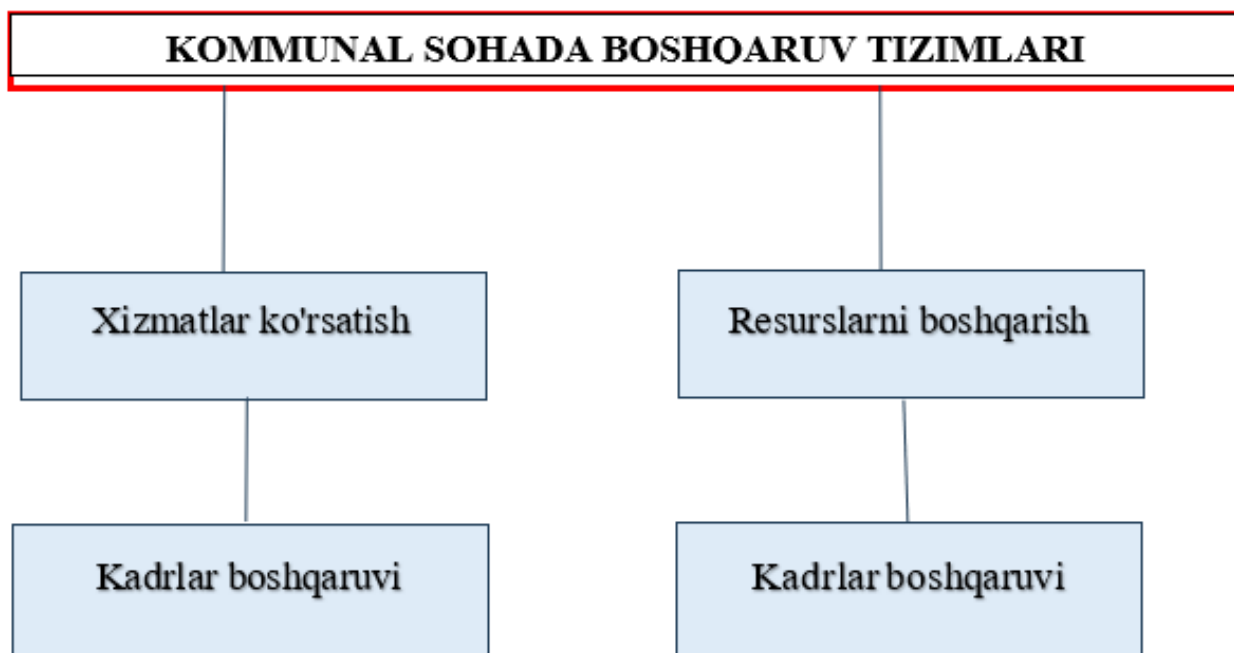
Hidoyatovning aytishicha, respublika miqyosida bu tizimga o'tish uchun viloyatlardan bittadan hudud tanlab olingan. 2021 yil yakuniga qadar Toshkent shahri va viloyatlar shu tizimga o'tkaziladi.

Prezidentimiz kommunal tizimi og'ir holatdagi ko'p qavatli uylarda holatni yaxshilash maqsadida mablag' ajratilishini aytdi. Bu borada ish boshladik: butun respublikaga xabarnoma chiqardik. Olingan ma'lumotlarni o'rganib chiqib, ketadigan mablag'ni aniqlab, taqdim qilamiz.[1]

Butun dunyoda kommunal soha – oxiriga yetmagan, o'rganish talab qiladigan soha. Bevosita davlat rahbarining bu tizimga e'tibor qaratishi bizga katta kuch berdi», – dedi vazir.

Ma'lum qilinishicha, Uy-joy kommunal xizmat ko'rsatish vazirligi respublikadagi ko'p qavatli uylarga xizmat ko'rsatuvchi shirkatlar faoliyatini turkiyalik konsultantlarni jalb qilgan holda o'rganib chiqqan. O'rganishlar natijasiga ko'ra, 4 430 ta shirkatdan 1 351 tasining moliyaviy holati yaxshi, 1 903 tasiniki o'rta va 1 176 tasiniki og'ir holatda ekani aniqlangan[2]. Afsuski bu haqiqat, ushbu og'ir holatga boshqaruv hisobining noto'g'ri olib borilganligi sabab bo'lgan bo'lishi ham mumkin.

Boshqaruv hisobida mas'uliyat markazlari bo'yicha hisobni o'rganish va tahlil etish bo'yicha mavjud adabiyotlar, ilmiy tadqiqotlar natijalari, amaliy tajribalar tahlili shuni ko'rsatmoqdaki, hozirgi vaqtgacha bu boradagi masalalarning ko'pchiligi bahsli xarakterga ega va bu bahsli holatlar bartaraf etilmagan. O'z navbatida, bu boradagi mavjud muammolarni bartaraf etish uchun yanada chuqur tadqiqot ishlarini olib borish lozim. Buning uchun esa quyidagi tadqiqot usullaridan foydalanish yuqori samara beradi. Ular: kuzatish, umumlashtirish, guruhlash, qiyosiy tahlil, anketa so'rovnomasini o'tkazish, natijalarni ekspert baholash, iqtisodiy tahlil va iqtisodiy-statistik usullar kabi usul [5].



1-rasm. Kommunal sohadagi boshqaruv tizimlari

Darhaqiqat, har qaysi sohaga qarasaq raqamli texnologiya kirib borib insonlar mushkulini osonlashtirmoqda endi biz shu texnologiyadan Kommunal sohada ham unumli foydalanib to'g'ri joriy eta olsak maqsadga muvofiq bo'lar edi. Kommunal soha deb atalganda, odatda suv, gaz, elektr energiyasi, issiqlik ta'minoti va chiqindilarni boshqarishni nazarda tutadi. Ushbu sohada boshqaruv tizimlari quyidagilarni o'z ichiga olishi mumkin

1-jadval. Kommunal sohadagi asosiy bo'limlar.

Xizmatlar ko'rsatish	Muhim xizmatlarning to'g'ri va uzluksiz ta'minlanishini nazorat qilish.
Resurslarni boshqarish	Energiya va suv kabi resurslarni samarali ishlatish va tejash.
Kadrlar boshqaruvi	Ishchilar va xizmat ko'rsatuvchi xodimlarni boshqarish
Mijozlar bilan aloqalar	Abonentlar bilan aloqa, shikoyatlar va talablarni qayta ishlash.

Xulosa va takliflar

Bizning maqsadimiz har xil turdagi yashirin ishlarni oldini olish soliqlardan qochish, arzon ammo sifatsiz bo'lgan mahsulotlardan foydalanmaslik, Kommunal soha boshqaruvida aholiga sifati yuqori va arzon mahsulotlar va xizmatlar sifatini oshirib xizmat ko'rsatish, bizga qimmatli bo'lgan vaqtni tejash qisqa vaqt ichida ko'plab ma'lumotlarni topish, va shakllantirish balki ortiqcha xarajatlarni kamaytirish.



Adabiyotlar

1. Kommunal soha yangi tizimga o'tmoqda. Ko'p qavatli uyda yashovchilarni nimalar kutyapti? (kun.uz).
2. O'zbekiston Respublikasi Davlat statistika qo'mitasi ma'lumotlari www.stat.uz
3. Паркинсон С.Н., Рустомджи М.К. Искусство управления. - М.: Агентство "ФАИР", 1997., и Ховард К., Коротков Э. Принципы менеджмента: Управление в системе цивилизованного предпринимательства. - М.: 1996.
4. Бобришев Д.Н., Семенцов С.П. История управленческой мысли: Учебное пособие. - М.: 1987. 46-71 стр.
5. Sobirov Otabek Olimjonovich. Boshqaruv hisobida mas'uliyat markazlarini tashkil etish masalalari. // "Yashil iqtisodiyot va taraqqiyot" ilmiy jurnali. – T.: TDIU, 2024-yil.
6. A.X. Pardayev. Z.A. Pardayeva Boshqaruv hisobi Toshkent IQTISOD MOLIYA 2019 yil O'zbekiston Respublikasi Oliy va o'rta maxsus ta'lim vazirligi tomonidan darslik sifatida tavsiya etilgan.



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SAVDO TASHKILOT- LARIDA MAHSULOT HISOBINI YURITISH JARAYONLARI AXBOROT MODEL- LARINING O'RNINI VA AHAMIYATI

Annotatsiya: Ushbu maqolada savdo tashkilotlarida mahsulot hisobini yuritish jarayonlari va bu jarayonlarda axborot modellarining o'rne hamda ahamiyatini tahlil qiladi. Savdo tashkilotlarining muvaffaqiyatli faoliyat yuritishi mahsulot hisobini aniq va samarali boshqarishga bog'liq. Maqolada axborot modellarining mahsulot hisobi tizimidagi roli va ularning mahsulot miqdori, narxi va harakatlarini kuzatishda qanchalik muhim ekani ko'rib chiqiladi. Axborot texnologiyalari rivojlanishi savdo tashkilotlarida mahsulot hisobi jarayonlarini avtomatlashtirishga va optimallashtirishga katta imkoniyat yaratdi. Ushbu jarayonlar mahsulotlarning kirimi va chiqimini kuzatish, inventarizatsiya qilish, mahsulot zaxiralarini boshqarish hamda moliyaviy hisobotlarni tuzishda axborot modellaridan samarali foydalanish orqali amalga oshiriladi. Bu jarayonlar korxonalariga vaqt va resurslarni tejash, moliyaviy oqimlarni to'g'ri rejalashtirish va mijozlarga xizmat ko'rsatish sifatini oshirish imkonini beradi. Maqolada shuningdek, axborot modellarining savdo jarayonlarini avtomatlashtirishda roli, ular orqali turli mahsulotlar va zaxiralar haqidagi ma'lumotlarni real vaqtda olish, taxminiy talabni aniqlash va strategik qarorlar qabul qilish jarayonlarini takomillashtirish masalalari yoritilgan. Maqolaning xulosasi sifatida, axborot modellarining mahsulot hisobi va savdo tashkilotlarining umumiy samaradorligiga ijobiy ta'sir ko'rsatishi ta'kidlangan.

Kalit so'zlar: Savdo tashkilotlari, mahsulot hisoboti, axborot modellarini, avtomatlashtirish, inventarizatsiya, zaxira boshqaruvi, moliyaviy hisobot, mahsulot harakati, talab prognozi, raqamli texnologiyalar, samaradorlik.



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THE ROLE AND SIGNIFICANCE OF INFORMATION MODELS OF PRODUCT ACCOUNTING PROCESSES IN COMMERCIAL ORGANIZATIONS

Abstract: This article analyzes the processes of product accounting in trade organizations and the role and importance of information models in these processes. The successful operation of trade organizations depends on the accurate and effective management of the product account. The article examines the role of information models in the product accounting system and how important they are in tracking product quantities, prices, and movements. The development of information technologies has created a great opportunity to automate and optimize product accounting processes in trade organizations. These processes are carried out through the effective use of information models in monitoring the input and output of products, inventory, product stock management and financial reporting. These processes allow enterprises to save time and resources, plan financial flows correctly and improve the quality of customer service. The article also covers the role of information models in the automation of sales processes, obtaining real-time information about various products and stocks, determining the estimated demand, and improving strategic decision-making processes. As a conclusion of the article, it is noted that information models have a positive effect on the overall efficiency of product accounting and sales organizations.

Keywords: Sales organizations, product reporting, information models, automation, inventory, stock management, financial reporting, product movement, demand forecasting, digital technologies, efficiency.

Kirish

Bugungi kunda jahonda va mamlakatimizda savdo tashkilotlari tobora rivojlanib takomillashib bormoqda. Vaqt o'tgan sari mahsulot, xizmat va ish hajmlari ortib, ko'payib bormoqda. Savdo bilan shug'ullanuvchi tashkilot va korxonalarining hozirgi kunda ishlash tartibi murakkablashib va qiyinlashib bormoqda. Buning sababi bir tomondan mahsulot va xizmatlarning turlari va hajmi ortganidan bo'lsa, ikkinchi tomonda ularning hisobini yuritish jarayonlar murakkablashib bormoq. Mahsulot hisobini yuritish jarayonlari inson omiliga bog'liq holatda bo'ladigan mahsulot hisobini yuritish masalalari qiyinlashadi. Buning sababi inson omili bor joyda xato qilish, adashish va aldov holatlari ko'p bo'lishi mumkin. Shuning uchun hozirgi kunda ko'plab tashkilotlar mahsulot hisobini yuritishda avtomatlashtirilgan va sun'iy intellekt texnologiyalari asosida ishlaydigan modellar va tizimlarda foydalanadi.

Savdo tashkilotlarida mahsulot hisobini yuritish jarayonlarini tashkil etishda xo'jalik operatsiyalarini qayd etib borish asosiy ahamiyatga ega. Xo'jalik jarayonlarini va ularning natijalarini nazorat qilish kuzatish, o'lchash va ro'yxatga olish orqali amalga oshiriladi. Kuzatish orqali korxonalar va tashkilotlarning xo'jalik faoliyatini tashkil etuvchi ko'p sonli va turli xil faktlar olinadi. Bu faktlarni esa ma'lum o'lchov birliklarida ifodalash hamda tegishli ravishda guruhlariga ajratib qayd qilib borish zarur. Shu tariqa xo'jalik faoliyatiga baho berish uchun zarur ma'lumotlarga ega bo'linadi.

Savdo tashkilotlari mahsulot hisobini yuritish haqidagi tezkor ma'lumotlarni olish, uning faoliyatini baholab borish va undagi kamchiliklarni aniqlashda axborot modellarining amaliy ahamiyati kattadir. To'g'ri tashkil etilgan modellashtirish faqatgina savdo tashkilotlaridagi kamchiliklarni aniqlabgina qolmay, balki uning oldini olishga ham yordam beradi. Savdo tashkilotlarida mahsulot hisobini yuritish jarayonlarining axborot modellari va tizimini ishlab chiqish juda katta ahamiyatga ham egadir.

ADABIYOTLAR SHARHI

Zamonaviy xo'jalik sharoitida savdo korxonalarida tovarlarni sotish jarayonini samarali boshqarish ko'p jihatdan menejerlarni ushbu jarayonning daromadlari, xarajatlari va moliyaviy natijalari to'g'risida tezkor buxgalteriya hisobi va tahliliy ma'lumotlar bilan ta'minlashga bog'liq. Bunday ma'lumotni xo'jalik ichidagi (boshqaruv) buxgalteriya ma'lumotlari asosida olish mumkin.

Xorijiy va mahalliy olimlarning ko'plab ilmiy ishlari boshqaruv hisobini tashkil etish muammolari va metodologiyasini o'rganishga bag'ishlangan. Ushbu masalaga V. Bachinskiy, F. Yefimova, S. Golov, B. Griniv, K. Druri, G. Jeleznyak, T. Karpova, P. Kutsik, A. Polyanskaya, N. Levushkina, L. Makarova, G. Myuller, J. Foster, O. Chernin, C. Xorngren va boshqalar.

Quyidagi mualliflarning asarlari mahsulot hisobini yuritish jarayonlarining axborot modellari va tizimini ishlab chiqishga bag'ishlangan: V. Paliy, R. Entoni, J. Rays, L. Bernsteyn, R. Dismuratov, B. Menglikulov, A. Karimov, F. Islomov, A. Avloqulov, A. Sotivoldiye, B. Xasanov, A. Xashimov, Z. Pardayeva, K. Urazov, M. Po'latov.

O'zbekistonda so'nggi yillarda savdo tashkilotlarida mahsulot hisobini yuritish jarayonlarining axborot modellari va tizimini ishlab chiqish uchun yaratilgan sharoitlar bakalavr va magistrlik sifatiga yanada ko'proq talablar qo'ymoqda. Biroq, tarkibiy o'zgarishlar jarayonida



mutaxassislarning aksariyati ularga tayyor emasligi, bilim, malaka va ko'nikmalari zamonaviy talablarga javob bermasligi munozarali bo'lib qolmoqda. Shuningdek, tadqiqot ishini olib borishda O'zbekiston Respublikasi Oliy majlisi tomonidan qabul qilingan Qonunlardan, O'zbekiston Respublikasi Prezidentining Farmonlaridan, Qarorlaridan, O'zbekiston Respublikasi Vazirlar Mahkamasining Qarorlaridan, turli matbuot organlarida e'lon qilingan materiallardan keng foydalanildi.

Savdo tashkilotlarida biznes-jarayonlar modellarini yaratishning asosiy vazifasi kompaniyaning biznes yo'nalishini to'g'ri avtomatlashtirish va axborot bilan ta'minlashdir. Umuman olganda, biznes jarayonlarini modellashtirish to'g'ridan-to'g'ri simulyatsiya qilingan biznes jarayonini optimallashtirish uchun ishlatiladi. Bugungi kunda tizimni tahlil qilishning turli xil modellari va usullarini birlashtirish tendentsiyasi mavjud. Biznes jarayoni – bu iste'molchi uchun eng noyob va qimmatli mahsulotni yaratishga qaratilgan o'zaro bog'liq harakatlar majmui. Biznes-jarayon modeli – bu keyinchalik ular bilan ishlash uchun yaratilgan vizual tasvir hisoblanadi [2].

So'nggi yillarda faol raqamlashtirish jarayonlari amalga oshirilayotgan paytda mahalliy va xorijiy ekspertlar ushbu pozitsiyani hisobga olgan holda biznes jarayonlarini aniq baholay boshladilar. Shunday qilib, Bormotko A.S., Fedorova A.A. “biznes operatsiyalari” atamasini maqsadga erishish uchun asosiy va yordamchi harakatlar majmuasi sifatida izohlaydilar [3]. Bu erda raqamli vositalardan foydalanish zaruriy shartdir. Bundan tashqari Gileva T.A. “biznes operatsiyalari” tushunchasi kompaniyalarning faol rivojlanishi va samaradorligini oshirishga yordam beradigan raqamli transformatsiya omili bilan bevosita bog'liqligini ta'kidlaydi [3].

Savdo tashkilotlarida mahsulot hisobini yuritish jarayonlarini optimallashtirishda axborot modellarining o'рни juda muhim. Axborot texnologiyalari va avtomatlashtirish tizimlari mahsulotlarni hisoblashda aniqlik, samaradorlik va tezkorlikni ta'minlaydi. ERP tizimlari, REA modeli, bulut texnologiyalari va boshqa zamonaviy tizimlar orqali tashkilotlar mahsulot hisobini yuritishda aniq va oson boshqarish imkoniyatiga ega bo'ladi. Ushbu modellar va tizimlar nafaqat ishni avtomatlashtiradi, balki resurslardan samarali foydalanish va biznes jarayonlarini yaxshilashda ham katta rol o'ynaydi.

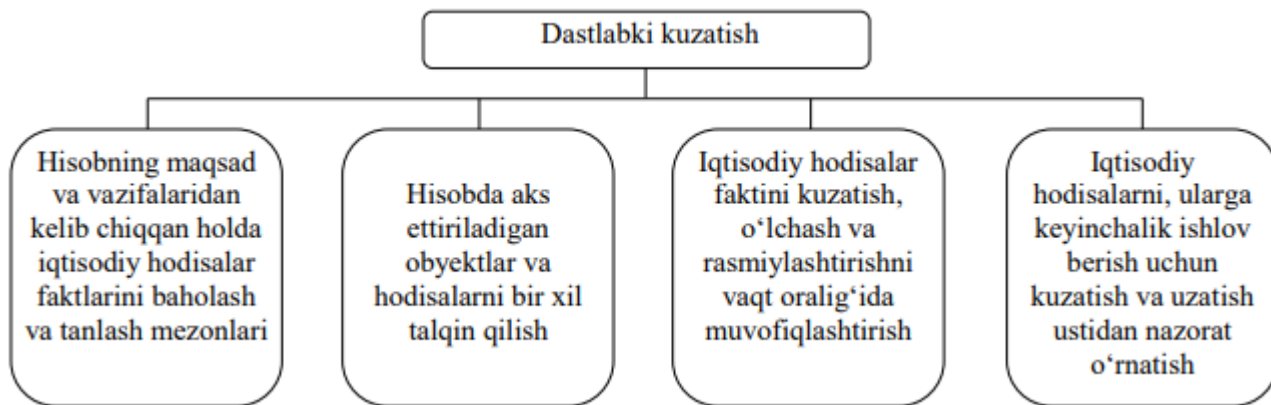
Tadqiqot metodologiyasi

Tadqiqot jarayonida savdo tashkilotlarida mahsulot hisobini yuritish jarayonlari axborot modellarining o'рни va ahamiyati bo'yicha ilmiy tadqiqotlar o'rganildi. Maqolani shakllantirish jarayonida kuzatish va tanlab olish, ilmiy-nazariy, empirik kuzatuv usullardan foydalanilgan. Tadqiqot natijalarining ishonchligi tadqiqotda qo'llanilgan xorijiy va milliy statistik rasmiy manbalardan foydalanilgani bilan izohlanadi.

Tahlil va natijalar

Savdo tashkilotlarida mahsulot hisobini yuritish jarayonlarini tashkil etishda xo'jalik operatsiyalarini hujjatlashtirish asosiy ahamiyatga ega. Xo'jalik jarayonlarini va ularning natijalarini nazorat qilish kuzatish, o'lchash va ro'yxatga olish orqali amalga oshiriladi. Kuzatish orqali korxonada

va tashkilotlarning xo‘jalik faoliyatini tashkil etuvchi ko‘p sonli va turli xil faktlar olinadi. Bu faktlarni esa ma’lum o‘lchov birliklarida ifodalash hamda tegishli ravishda guruhlariga ajratib qayd qilib borish zarur. Shu tariqa xo‘jalik faoliyatiga baho berish uchun zarur ma’lumotlarga ega bo‘linadi (1-rasm).



1-rasm. Xo‘jalik faoliyatiga baho berish usullari

Yuqoridagi rasmda berilganidek xo‘jalik faoliyatiga baho berish usullari orqali xo‘jalik faoliyatidagi harakatlarni aniq baholash va unga mos savdo tashkilotlarida axborot modellarini tuzish mumkin. Dastlabki kuzatish orqali biz hisobning maqsad va vazifalaridan kelib chiqqan holda iqtisodiy hodisalar faktlarini baholaymiz va mezonlarni tanlaymiz, hisobda aks ettiriladigan obyektlar va hodisalarni bir xil talqin qilishga urinamiz, undan so‘ng iqtisodiy hodisalar faktini kuzatib, ularni o‘lchaymiz va rasmiylashtiramiz, eng so‘nggida esa iqtisodiy hodisalarni, ularga keyinchalik ishlov berish uchun kuzatamiz va uzatish ustidan nazorat o‘rnatamiz.

Iqtisodiy munosabatlarning murakkablashishi va bozor munosabatlarining mexanizmi, yangi bozor vositalarining paydo bo‘lishi, iqtisodiy faoliyatni boshqarish usullari va vositalari buxgalteriya hisobida moliyaviy, soliq va boshqaruvning bo‘linishiga olib keldi. Har bir buxgalteriya quyi tizimi doirasida daromadlarni shakllantirish va taqsimlash jarayonini tartibga solish uchun zarur bo‘lgan ma’lumotlar shakllantiriladi. Bu daromadlar va xarajatlarni tan olish, daromadlarni soliqqa tortish, dividendlarni to‘lash, foydani qayta investitsiya qilish va kapitalashtirish xususiyatlarini ochib beradi. Boshqaruv, moliyaviy va soliq hisobining o‘zaro bog‘liqligiga qaramay, bizning nuqtai nazarimizga ko‘ra, ularning orasidagi farq, birinchi navbatda, daromadlar va xarajatlar tafsilotlari darajasida.

Tashkilot foydasini boshqarish uchun zarur ma’lumotlarni olishda axborot manbalarini tizimlashtirish uchun biz yagona buxgalteriya maydonida axborot modelini ishlab chiqdik (1-jadval).

1-jadval. Savdo tashkilotlarida mahsulot hisobini yurutishda tashkilot foydasini boshqarishning axborot modeli

Axborotni qo‘llab-quvvatlashning buxgalteriya tizimi		
Moliyaviy buxgalteriya hisobi	Boshqaruv hisobi	Soliq hisobi
buxgalteriya hisobi uchun	daromadlar va xarajatlarni hisobga olish bo‘yicha tezkor	soliq hisobi maqsadlari uchun



<p>buxgalteriya siyosati;</p> <p>daromadlar va xarajatlarni hisobga olish bo'yicha dastlabki hujjatlar;</p> <p>sintetik buxgalteriya registrlari va boshqalar (buyurtma jurnallari, schyot-fakturalarni tahlil qilish, balans varaqalari);</p> <p>analitik buxgalteriya registrlari (bayonotlar, kitoblar, kartalar);</p> <p>bosh kitob;</p> <p>buxgalteriya (moliyaviy) hisoboti;</p> <p>konsolidatsiyalangan (konsolidatsiyalangan) hisobot</p>	<p>ma'lumotlar;</p> <p>daromadlarni hisobga olish bo'yicha yig'ma va guruhlash vedomostlari;</p> <p>xarajatlarni hisobga olish bo'yicha konsolidatsiya va guruhlash varaqalari;</p> <p>operatsion ichki hisobot;</p> <p>boshqaruv hisoboti;</p> <p>segmental hisobot.</p>	<p>buxgalteriya siyosati;</p> <p>daromadlar va xarajatlarni hisobga olish bo'yicha dastlabki hujjatlar;</p> <p>foydani shakllantirish va taqsimlash bo'yicha soliq registrlari (soliq kartalari, soliq varaqalari);</p> <p>daromadlar va xarajatlarni hisobga olish bo'yicha analitik soliq hisobi registrlari (sertifikatlar, registrlar, hisob-kitoblar);</p> <p>soliq hisobotlari, soliq deklaratsiyalari;</p> <p>yig'ma soliq hisoboti</p>
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Buxgalteriya hisobining milliy standartlari mazmunini tahlil qilish bizga buxgalteriya quyi tizimlarining har bir turi turli xil maqsad va vazifalarga ega ekanligini, ob'ektlarni hisobga olishning ma'lum usullaridan foydalanilishini va heterojen yakuniy axborot natijalari shakllanishini aniqlashga imkon berdi. Biroq, bu faoliyat natijalarini moliyaviy va soliq hisobida shakllantirilgan ma'lumotlar faqat tashqi foydalanuvchilar uchun, boshqaruv hisobi ma'lumotlari esa ichki foydalanuvchilar uchun zarur degani emas.

Savdo tashkilotlarida mahsulot hisobini yuritishning harakatini hisobga olishning avtomatlashtirilgan axborot tizimini yaratishda tovarlarni hisobga olishning umumiy tamoyillari ham, mavzu sohasi tomonidan belgilanadigan o'ziga xosliklar ham hisobga olinadi. Savdo tashkilotlarida tovarlarni hisobga olishning umumiy prinsiplari quyidagi jarayonlarni o'z ichiga oladi: tovarlarni qabul qilishni hisobga olish, tovarlarni sotishni hisobga olish, tovarlarni hisobdan chiqarishni hisobga olish (sotishni hisobga olgan holda birlashtirilishi mumkin), kafolat xizmatlarini hisobga olish.

Ushbu jarayonlarni amalga oshirish uchun quyidagi ob'ektlarni o'z ichiga olgan axborot tizimining ma'lumotlar bazasi qo'llaniladi:

- yetkazib beruvchi;
- tovarlar;
- kiruvchi schyot-faktura;

- kiruvchi schyot-faktura pozitsiyalari;
- mahsulot iste'moli;
- iste'mol pozitsiyalari;
- kafolat xizmati.

Agar tovarlarning harakatini hisobga olish o'rtacha narxda amalga oshirilsa, unda bunday ob'ektlar to'plami etarli hisoblanadi. Agar FIFO yoki LIFO texnologiyalari bo'yicha buxgalteriya hisobi nazarda tutilgan bo'lsa, unda reestr mohiyati qo'shiladi. Bu aslida tovarlarni qabul qilish va iste'mol qilishning umumiy jadvali hisoblanadi [5].

Savdo tashkilotlarida uskunalarda tovarlarni standart sotish ham, to'plamlarni shakllantirish ham amalga oshirilishi mumkin, masalan, tizim bloklarini yig'ish va sotish. To'plamni yig'ish jarayonini hisobga olish uchun yana bir mohiyat kerak, bu – yig'ish tarkibidir.

Zamonaviy dunyoda ro'y berayotgan iqtisodiy sub'ektlarning raqamli transformatsiyasi ushbu o'zgarishni biznes jarayonlari sifatida belgilaydi. Ushbu jarayonlar kompaniyaning tashqi omillari ta'siri ostida amalga oshiriladi va bu ko'pincha faol mijozlar tajribasi ta'siri ostida sodir bo'ladi. Zamonaviy sharoitda zamonaviy kompaniyaning biznes sheriklari va potentsial mijozlari korxonada faoliyati, uning tovarlari, xizmatlari to'g'risida ma'lumotlarning ochiqligi va mavjudligi nuqtai nazaridan juda yuqori darajadagi talablarga ega. Bozor iqtisodiyoti sharoitida sheriklar va mijozlar uchun ma'lumotlarni qayta ishlash va umumlashtirishga qodir bo'lgan texnologiyalardan foydalangan holda biznes ma'lumotlarining bunday darajasini ta'minlash mumkin. Mijozlarning ijobiy tajribasidan foydalanish kompaniyalarga raqobat sharoitida ishonch hosil qilish, tovarlar va xizmatlarni sotish bozorlarida o'z ta'sir chegaralarini sezilarli darajada kengaytirish imkonini beradi. Bu esa faoliyat samaradorligini oshiradi [6].

Iqtisodiyotning raqamlashtirish orqali savdo tashkilotlarida mahsulot hisobini yuritish jarayonlarini tashkil etishda yanada jadashlashdi. Raqamlashtirish jarayonida ko'p daromad va foydaga erish uchun biznes-jarayonlari samaradorligini oshirish kerak va buning turli xil usullardan foydalanish mumkin (2-jadval):

2-jadval. Raqamlashtirish sharoitida kompaniyaning biznes-jarayonlari samaradorligini oshirish usullari

Usul nomi	Umumiy xususiyatlar	Raqamlashtirish sharoitida kompaniyaning biznes jarayonlari samaradorligini oshirishga ta'siri
Funksional xarajatlarni tahlil qilish	Kompaniyaning tashqi va ichki muhitini keng miqyosda baholash	Biznes-jarayonning narxini baholash, kompaniyani rivojlantirishning ustuvor yo'nalishlarini aniqlash imkonini beradi
CVP usuli	Ushbu usulning ta'siri shundaki, daromadning har qanday o'zgarishi	Biznes-jarayonlarning individual vositalariga ta'sirini aniqlash, ularning



	joriy foydaning yanada kuchli o'zgarishiga olib keladi va aksincha	samaradorligini baholash
8D usuli	Muammoni hal qilish usuli	Ma'lumotlar bazasini yaratish va kengaytirish, tuzatish harakatlarini amalga oshirish ko'nikmalarini takomillashtirish; tizim o'zgarishlarini aniqlash qobiliyatini oshirish
Biznes jarayonlarining ahamiyatini aniqlash usuli	Sifatli baholash asosida asosiy yoki yordamchi biznes jarayonining ahamiyati baholanadigan usul	Raqamlashtirish sharoitida kompaniyaning biznes-jarayonlari samaradorligini oshirish uchun zarur omillar va sharoitlarni izlash, zarur ta'sir omillarini baholash
Tuzilish	Tashkiliy birliklar o'rtasidagi o'zaro ta'sir qanday tashkil etilganligini ko'rsatadigan usul biznes jarayonining asosiy ishtirokchilari to'g'risidagi ma'lumotlarni ochib beradi	Raqamlashtirish sharoitida ularning samaradorligini oshirishga yordam beradigan biznes-jarayonlarning samarali tuzilishini (ishlari, harakatlari, tadbirlari) yaratish
Aqliy hujum usuli	Mutaxassislar guruhi yordamida raqamlashtirish sharoitida kompaniyaning biznes-jarayonlari samaradorligini oshirish uchun zarur choralarni taklif qilishga imkon beradigan sifatli usul	Mutaxassislarning malakasi raqamlashtirish sharoitida kompaniyaning biznes jarayonlari samaradorligini oshirish uchun samarali vositalar va tadbirlarni ishlab chiqishga imkon beradi. Jarayonlarni raqamlashtirish sohasida samarali innovatsion yechimlarni ishlab chiqish
Rasmiylashtirilgan universal-printsipial (FUP) usullar	Muvaffaqiyatli kompaniya tajribasidan faol foydalanish	Biznes jarayonining asosiy ko'rsatkichlarini oshirish
Benchmarking usullari	Muvaffaqiyatli kompaniyalar faoliyatini o'rganish va tahlil qilish	Raqamlashtirish sharoitida kompaniyaning biznes jarayonlari samaradorligini oshirish choralarni amalga oshirishda raqobatchilar tajribasidan foydalanish

Yuqoridagi jadvalda so'nggi yillarda faol qo'llanilgan raqamlashtirish sharoitida kompaniyaning biznes-jarayonlari samaradorligini oshirishga yordam beradigan bir necha usullarni qayd etildi. Ular orasida funksional xarajatlarni tahlil qilish, CVP usuli, 8D usuli, biznes-jarayonlarning ahamiyatini aniqlash usuli, tuzilishi, aqliy hujum usuli, rasmiylashtirilgan universal-prinsipial (FUP) usullari va benchmarking usullari o'z ahamiyatiga ega. Har bir usul o'ziga xos xususiyatlarga ega va ular raqamlashtirish sharoitida kompaniyaning biznes-jarayonlari samaradorligini oshirishga bevosita ta'sir qiladi.

Xulosa

Xulosa qilib aytadigan bo'lsak, bugungi kunda savdo tashkilotlarida mahsulot hisobini yuritish jarayonlarida axborot modellari va axborot texnologiyalari muhim rol o'ynaydi. Ular uning turli qirralarini qamrab oladi, qo'lda usullarga nisbatan sezilarli afzalliklarga ega. Buxgalteriya hisobini avtomatlashtirish – bu shaxsiy hisoblash qurilmasida buxgalteriya operatsiyalarini amalga oshirish natijasida har qanday korxonada buxgalteriya hisobi samaradorligi va sifati yaxshilanadigan jarayon. Zamonaviy axborot texnologiyalari buxgalterga mobil va talabga javob beradigan mutaxassis bo'lishga imkon beradi.

Aniq dalillarga asoslangan bo'lsak, inventarizatsiya va tovar hisobi avtomatlashtirilgan tizimlarni joriy etgan kompaniyalar mahsulot qidirish va hisobot yuritishda samaradorlikni 25% gacha oshgan.

Savdo tashkilotlarida mahsulot hisobini yuritish jarayonlarida axborot modellaridan foydalangan kompaniyalar va ularning asosiy iqtisodiy ko'rsatkichlarini ko'rishimiz mumkin:

2023-yilda Amazonning yillik daromadi taxminan \$513,98 milliardni tashkil etdi. 2023-yilda Amazonning operatsion daromadi \$22,84 milliardni tashkil etdi. Amazonda mahsulot zaxiralari doimiy ravishda kuzatiladi va bu inventarizatsiya samaradorligini oshiradi. Amazonning zaxira aylanmasi (inventory turnover) 2023-yilda 11,58 marta bo'ldi, ya'ni kompaniya yil davomida zaxiralarini 11 martadan ko'proq aylanma qilgan.

Walmartning 2023-yilda yillik daromadi \$611 milliarddan oshdi, bu uni dunyodagi eng yirik chakana savdo kompaniyasi qilib qo'ydi. 2023-yilda Walmartning operatsion foydasi \$25,6 milliardni tashkil etdi. Walmartda zaxiralar aylanmasi ko'rsatkichi 2023-yilda 8,8 martani tashkil etdi. Bu kompaniya mahsulotlarni tez aylanma qilayotganini va samarali boshqarayotganini ko'rsatadi.

2023-yilda Zara brendi egasi Inditexning umumiy daromadi \$33,9 milliardni tashkil etdi. 2023-yilda Inditexning operatsion foydasi \$6,1 milliardni tashkil etdi. Zara o'zining tez moda modeli tufayli yiliga zaxiralarni 11-12 marta aylantiradi, ya'ni mahsulot zaxiralari qisqa muddat ichida sotilib, yangi mahsulotlar joylanadi. Bu yuqori tezlikda aylanma ko'rsatkichi kompaniyaning mahsulot hisobini samarali boshqarishida axborot texnologiyalarining muhimligini ko'rsatadi.

2023-yilda Tesla kompaniyasining yillik daromadi \$100,35 milliardni tashkil etdi. Tesla 2023-yilda \$13,7 milliard operatsion foyda ko'rsatkichiga erishdi. Tesla o'z mahsulotlari, jumladan, avtomobillar va butlovchi qismlar zaxiralarini ERP va IoT texnologiyalari yordamida boshqaradi.



Tesla kompaniyasining zaxira aylanmasi 2023-yilda 6,47 marta bo'ldi, bu esa ta'minot zanjirini optimallashtirish va mahsulot hisobini samarali boshqarish orqali erishilgan.

Savdo tashkilotlarida mahsulot hisobini yuritish jarayonlarida axborot modellaridan foydalanadigan kompaniyalar mahsulot hisobining aniqligi, operatsion samaradorlik, zaxiralarni boshqarish va logistika jarayonlarini optimallashtirishda katta muvaffaqiyatlarga erishgan. Amazon, Walmart, Zara, Tesla va Alibaba kabi kompaniyalar axborot texnologiyalari orqali mahsulot hisobini real vaqt rejimida kuzatib borish, buyurtmalarni tezkor va aniq bajarish va mijozlar talablariga javob berish imkoniga ega bo'lishdi. Bu esa ularning moliyaviy ko'rsatkichlarini oshirishga va raqobatbardoshlikni saqlab qolishga yordam beradi.

Savdo tashkilotlarida raqamli texnologiyalardan foydalanishning shubhasiz afzalliklariga qaramay, shuni unutmaslik kerakki, bu buxgalteriya xodimlarining malakasiga qo'yiladigan talablarni oshiradi, korxonani boshqarish tarkibini o'zgartirish, yangi xodimlarni tanlash va allaqachon ishlayotgan xodimlarni o'qitish zarurati tug'iladi. Axborot texnologiyalarini joriy etish boshqaruv qarorlarini qabul qilish nazorati va sifatini oshiradi.

Adabiyotlar

1. O'zbekiston Respublikasi Prezidentining 2023-yil 11-sentabrdagi "O'zbekiston – 2030" strategiyasi to'g'risida"gi PF-158-sonli Farmoni
2. Абдуллаев, Н.А., Абдуллаева М.Г. Оптимизация основных бизнес-процессов предприятия в методологии ARIS // Региональные проблемы преобразования экономики. – Махачкала: Дагестанский государственный университет, 2020. – С. 116-122.
3. Бормотко, А.С., Федорова А.А. Цифровизация бизнес-процессов в экономике РФ в условиях пандемии коронавируса // Теоретические и прикладные вопросы экономики, управления и образования: сборник статей международной научно-практической конференции. – Пенза: Пензенский государственный аграрный университет, 2020. – С. 30-34.
4. Гилева Т.А. Стратегия цифровой трансформации предприятия: сущность и структура // Цифровая экономика и индустрия 4.0: сборник трудов научно-практической конференции с зарубежным участием. – Санкт-Петербург: Санкт-Петербургский политехнический университет Петра Великого, 2020. – С. 40-54.
5. Грибанова-Подкина М.Ю. Программная реализация партионного учета FIFO в клиент-серверной архитектуре // Технические науки – от теории к практике. –2014.– № 30. – С. 13–17.
6. Лаврентьева И.В., Руденко Д.С. Организационная культура как управленческий инструмент в условиях развития цифровизации // Вестник Челябинского государственного университета. – 2019. – № 11 (433). – С. 132-137.
7. <http://www.lex.uz> – O'zbekiston Respublikasi qonunlari bazasi sayti
8. <https://www.imv.uz> – Iqtisodiyot va moliya vazirligi sayti
9. <http://www.soliq.uz> – O'zbekiston Respublikasi Davlat soliq qo'mitasi sayti
10. <http://www.stat.uz> – O'zbekiston Respublikasi Davlat statistika qo'mitasi sayti



Muallif

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O'ZBEKISTONDA KICHIK VA O'RTA BIZNES SOHA VAKILLARINI SOLIQQA TORTISH TIZIMI

Annotatsiya: Ushbu ilmiy maqola O'zbekistonda kichik va o'rtta biznes (KOB) subyektlarini soliqqa tortish tizimini tahlil qilishga qaratilgan bo'lib, ushbu sohada amalga oshirilgan islohotlar va ularning iqtisodiy o'sishga ta'siri chuqur o'rganiladi. Kichik va o'rtta biznes O'zbekiston iqtisodiyotida muhim o'rin egallaydi va 2017-2023 yillar davomida davlat tomonidan ushbu sohani qo'llab-quvvatlash uchun bir qator imtiyozlar va soddalashtirilgan soliq rejimlari joriy etildi. Biroq, soliqqa tortish tizimining amaldagi holati biznes subyektlari uchun qator qiyinchiliklarni ham keltirib chiqarishi mumkin.

Maqolada kichik va o'rtta biznesni soliqqa tortish tizimining ijobiy va salbiy jihatlari, uning biznesni rivojlantirishga ko'rsatgan ta'siri va davlat tomonidan ko'rsatilgan imtiyozlarning samaradorligi tahlil qilinadi. Tadqiqot doirasida O'zbekistonning soliqqa oid qonunlari va Soliq kodeksidagi o'zgarishlar, soliqlar stavkalari va kichik biznesning iqtisodiy ko'rsatkichlari statistik ma'lumotlar asosida o'rganildi.

Tahlillar shuni ko'rsatdiki, soliqqa tortish tizimidagi islohotlar kichik va o'rtta biznesni qo'llab-quvvatlash va ularni rivojlantirishda sezilarli rol o'ynagan. Xususan, 2020 yildan boshlab yagona soliq rejimining joriy etilishi va kichik korxonalar uchun 4-5% soliq stavkasining belgilanishi, tadbirkorlarning soliqqa bo'lgan munosabatini o'zgartirdi va soliq yukini kamaytirdi. Natijada, 2021 yilda kichik biznesning umumiy iqtisodiy faolligi sezilarli darajada oshgan. Biroq, ayrim tadbirkorlar soliq tizimidagi murakkab hisob-kitoblar va ba'zi ma'muriy to'siqlarga duch kelayotgani ham aniqlangan.

Kalit so'zlar: kichik va o'rtta biznes, soliqqa tortish tizimi, soliq islohotlari, soliq imtiyozlari, iqtisodiy o'sish, O'zbekiston, soliq yukini kamaytirish, yagona soliq rejimi, soliqlar, (KOB).



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SYSTEM OF TAXATION OF REPRESENTATIVES OF SMALL AND MEDIUM BUSINESS FIELDS IN UZBEKISTAN

Abstract: This scientific article is aimed at analyzing the system of taxation of small and medium-sized businesses (SMEs) in Uzbekistan, the reforms implemented in this area and their impact on economic growth are studied in depth. Small and medium-sized businesses play an important role in the economy of Uzbekistan, and in 2017-2023, the state introduced a number of incentives and simplified tax regimes to support this sector. However, the current state of the taxation system can cause a number of difficulties for business entities.

The article analyzes the positive and negative aspects of the small and medium-sized business taxation system, its impact on business development, and the effectiveness of state incentives. As part of the research, changes in the tax laws and Tax Code of Uzbekistan, tax rates and economic indicators of small businesses were studied based on statistical data.

The analysis showed that the reforms in the taxation system played a significant role in supporting and developing small and medium-sized businesses. In particular, the introduction of a single tax regime starting from 2020 and the establishment of a 4-5% tax rate for small enterprises changed the attitude of entrepreneurs to taxes and reduced the tax burden. As a result, the overall economic activity of small businesses increased significantly in 2021. However, it was also determined that some entrepreneurs face complex calculations and some administrative obstacles in the tax system.

Keywords: small and medium business, taxation system, tax reforms, tax incentives, economic growth, Uzbekistan, tax burden reduction, unified tax regime, taxes (SME).



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Kirish

O'zbekistonda kichik va o'rta biznes (KOB) mamlakat iqtisodiyotining asosiy ustunlaridan biri hisoblanadi. Ushbu sektor aholini ish bilan ta'minlashda va mahalliy ishlab chiqarishni rivojlantirishda muhim rol o'ynaydi. Xususan, KOB subyektlari O'zbekiston yalpi ichki mahsulotining (YaIM) 50% dan ortig'ini tashkil etib, 75% dan ziyod ishchi kuchini band qilishga yordam beradi. Shu sababli, davlat tomonidan kichik va o'rta biznesni qo'llab-quvvatlash, xususan, soliqqa tortish tizimini soddalashtirish va moslashuvchan qilish masalasi o'ta dolzarbdir.

So'nggi yillarda O'zbekistonda kichik va o'rta biznesni soliqqa tortish tizimi sezilarli islohotlarga duch keldi. Xususan, 2019 yilda yangi Soliq kodeksining qabul qilinishi va 2020 yilda yagona soliq rejimining joriy etilishi kichik biznes uchun moliyaviy yukni kamaytirishga qaratilgan edi. Ushbu islohotlar kichik va o'rta biznes vakillari uchun soddalashtirilgan soliqqa tortish tizimini taklif qilgan bo'lsa-da, amaliyotda turli qiyinchiliklar yuzaga kelishi mumkin. Shu nuqtayi nazardan, soliq tizimining biznes rivojlanishiga qanchalik ta'sir etishi va soliq yukining qanchalik kamaygani haqida savollar paydo bo'ladi.

Mazkur tadqiqotning asosiy maqsadi O'zbekistonda kichik va o'rta biznes sohasini soliqqa tortish tizimini chuqur tahlil qilish, soliqqa tortishning iqtisodiy rivojlanishga ta'sirini baholash va mavjud muammolarni aniqlashdir. Shu bilan birga, davlat tomonidan taqdim etilgan imtiyozlarning samaradorligi ham tadqiqot doirasida o'rganiladi. Bu tahlillar kichik va o'rta biznes sohasining barqaror rivojlanishini ta'minlash maqsadida soliqqa tortish tizimida zarur o'zgarishlar kiritishga yordam beradi.

KOB qisqartmasi "Kichik va o'rta biznes" degan ma'noni anglatadi. Bu termin kichik va o'rta o'lchovdagi korxonalar va tadbirkorlik subyektlarini ifodalaydi. O'zbekistonda KOB iqtisodiyotni diversifikatsiya qilish, ish o'rinlari yaratish va innovatsion rivojlanishni qo'llab-quvvatlashda muhim ahamiyatga ega.

Adabiyotlar tahlili

Kichik va o'rta biznes (KOB) rivoji va soliqqa tortish tizimi O'zbekistonning iqtisodiy barqarorligi uchun muhim masalalardan biri hisoblanadi. Shu munosabat bilan, bu mavzuni o'rganishga oid ilmiy va amaliy manbalar, qonuniy hujjatlar va iqtisodiy tahlillar ko'plab tadqiqotchilar tomonidan yoritilgan. Ushbu bo'limda kichik va o'rta biznesning soliqqa tortilishi bo'yicha muhim manbalar va tadqiqotlarni ko'rib chiqamiz.

➤ 1. Soliq islohotlari va iqtisodiy o'sish (Davlat manbalari)

O'zbekistonda soliqqa tortish tizimi bo'yicha islohotlarning asosiy manbasi yangi Soliq kodeksi hisoblanadi. 2019 yilda qabul qilingan Soliq kodeksi kichik va o'rta biznes subyektlariga nisbatan soliqlarni soddalashtirish va imtiyozli soliq rejimlarini joriy etishni o'z ichiga oldi. Davlat manbalari, xususan, O'zbekiston Respublikasi Soliq qo'mitasi va O'zbekiston Respublikasi Prezidenti farmonlari bu islohotlarning amaliy jihatlarini yoritadi. Ushbu hujjatlar soliqqa tortish tizimining soddalashtirilishi va imtiyozlar ko'lamini haqida aniq ma'lumotlar beradi.

➤ 2. Xalqaro tajriba va o'zbek modeli (Ilmiy tadqiqotlar)

Xalqaro darajadagi tadqiqotlar kichik va o'rtta biznes sohasini rivojlantirish uchun soliqqa tortish tizimining roli haqida muhim xulosalar beradi. Masalan, Taxation and Small Business Growth: Evidence from Emerging Markets nomli tadqiqotda kichik biznesning rivojlanishi uchun soliqqa tortish tizimining soddalashtirilishi zarurligi aytiladi. O'zbekistonda qabul qilingan yagona soliq rejimi ana shu xalqaro tendensiyalarga mos ravishda ishlab chiqilgan. Bu rejim kichik biznesga soliq yukini kamaytirish orqali ularning faoliyatini kengaytirishga ko'maklashmoqda.

➤ 3. Kichik biznes va soliqqa tortishning iqtisodiy ta'siri (Mahalliy tadqiqotchilar tahlili)

O'zbekistondagi iqtisodchilar va tadqiqotchilar ham kichik va o'rtta biznes sohasini soliqqa tortish masalasiga alohida e'tibor qaratgan. Mirzayev va Karimov (2021) tomonidan olib borilgan tadqiqotlar soliqqa tortish tizimining kichik biznes uchun qanday ijobiy va salbiy ta'sir ko'rsatishini o'rgandi. Ushbu tadqiqotlar soliqqa tortishning qisqarishi orqali kichik korxonalar sonining ko'payishi va ularning ishlab chiqarish salohiyatining oshishi haqida dalillar keltiradi. Biroq, ularning tahlillari soliqqa oid ma'muriy yuklar va tartib-taomillarning ba'zi tadbirkorlar uchun qiyinchilik tug'dirayotganini ham qayd etadi.

➤ 4. Soliq imtiyozlari va ularning samadorligi

Yana bir muhim adabiyot yo'nalishi soliq imtiyozlarining samaradorligi haqida. Rahimova (2020) tadqiqotida soliq imtiyozlari kichik va o'rtta biznesni rivojlantirishga qanchalik ta'sir ko'rsatishini o'rganadi. Tadqiqotlar natijasida ma'lum bo'ldiki, imtiyozli soliqqa tortish rejimi kichik biznes subyektlariga qisqa muddatli moliyaviy yordam bersa-da, uzoq muddatli samaradorlikni ta'minlash uchun soliq tizimining shaffofligi va qulayligi muhim omil hisoblanadi. Shu boisdan, soliqqa oid byurokratik jarayonlar va hisob-kitob tizimining soddalashtirilishi masalasi dolzarbligini yo'qotmagan.

➤ 5. Xorijiy davlatlar tajribasi va O'zbekiston modeli o'rtasidagi farqlar

Kichik va o'rtta biznesni soliqqa tortish borasida qator xorijiy davlatlar tajribasi ham e'tiborga loyiqdir. Xususan, Turkiya, Janubiy Koreya va Polsha kabi davlatlarda soliqqa tortish tizimi kichik biznesni rag'batlantirishga qaratilgan soddalashtirilgan rejimlar asosida ishlaydi. Bu davlatlarda kichik korxonalar uchun soliq stavkalari past darajada belgilangan bo'lib, imtiyozlar uzoq muddatli barqarorlikka erishishda muhim omil sifatida ko'riladi. O'zbekiston modeli ham aynan ushbu tendensiyalarga moslashgan bo'lib, 2020 yildan boshlab kichik biznes uchun soliq stavkalari 5% ga tushirilgani va imtiyozlar ko'lami kengaytirilgani tahlil qilinadi.

Adabiyotlar tahlili shuni ko'rsatadiki, O'zbekistonning kichik va o'rtta biznes sohasini soliqqa tortish tizimi milliy iqtisodiyotni rivojlantirishda katta ahamiyatga ega bo'lib, xalqaro tajribalar bilan mos ravishda islohotlar amalga oshirilmoqda. Soliq imtiyozlari va soddalashtirilgan soliq tizimi kichik va o'rtta biznes uchun keng imkoniyatlar yaratadi, biroq soliqqa oid ma'muriy yuklarni kamaytirish, shaffoflikni oshirish va uzoq muddatli barqarorlikni ta'minlash uchun qo'shimcha choralar ko'rish talab qilinadi.

Tadqiqot usullari

Mazkur tadqiqotda O'zbekistonda kichik va o'rtta biznes (KOB) sohasini soliqqa tortish tizimini o'rganish uchun bir nechta ilmiy-uslubiy yondashuvlardan foydalanilgan. Tadqiqot natijalari



ishonchli va aniq bo'lishi uchun quyidagi usullar qo'llanildi:

➤ 1. Huquqiy hujjatlar tahlili

Soliqqa tortish tizimining rivojlanishi va islohotlari haqida aniq tasavvur hosil qilish uchun O'zbekiston Respublikasi Soliq kodeksi va boshqa normativ-huquqiy hujjatlar o'rganildi. Tadqiqotda quyidagi hujjatlar tahlil qilindi:

- O'zbekiston Respublikasi Soliq kodeksi (2019 yilgi yangi tahriri),
- O'zbekiston Respublikasi Prezidentining kichik va o'rta biznesni rivojlantirishga oid farmonlari va qarorlari,
- Soliq imtiyozlariga doir qonunlar va hujjatlar.

Bu hujjatlar soliqqa tortish tizimining huquqiy bazasini tushunishga, shuningdek, kichik va o'rta biznes subyektlariga qaratilgan soliq siyosatini aniqlashga imkon berdi.

➤ 2. Statistik ma'lumotlar tahlili

Kichik va o'rta biznes subyektlariga nisbatan soliqqa tortishning amaliy ta'sirini o'rganish uchun 2017-2023 yillar davomida O'zbekistonning rasmiy statistik ma'lumotlari tahlil qilindi. Ushbu davr ichida kichik biznesga solinadigan soliqlar stavkalari, soliq yukining o'zgarishi va kichik biznesning umumiy iqtisodiyotdagi ulushi tahlil qilindi. Asosiy statistika manbalari quyidagilarni o'z ichiga oladi:

- O'zbekiston Respublikasi Davlat statistika qo'mitasi ma'lumotlari,
- O'zbekiston Soliq qo'mitasi tomonidan e'lon qilingan rasmiy hisobotlar,
- Jahon banki va Xalqaro valyuta jamg'armasining O'zbekiston iqtisodiyoti va soliqqa tortish tizimiga oid hisobotlari.

Bu usul kichik va o'rta biznes subyektlari soliqlarining o'sish yoki kamayish tendensiyalarini kuzatishga imkon berdi.

➤ 3. So'rovnoma va intervyu usuli

Kichik va o'rta biznes vakillarining soliqqa tortish tizimiga bo'lgan munosabati va ushbu tizimning biznes faoliyatlariga ta'sirini o'rganish uchun so'rovnoma va intervyu usuli qo'llanildi. So'rovnoma kichik biznes vakillari, tadbirkorlar va soliq maslahatchilari orasida o'tkazildi. Unda tadbirkorlarning soliq siyosatiga munosabati, soliqlarni to'lash bilan bog'liq muammolar va ularning biznes faoliyatiga soliq yukining ta'siri haqida ma'lumotlar olindi. Intervyu natijalari soliqqa oid muammolarni aniqroq tushunishga va real biznes tajribasini o'rganishga yordam berdi.

➤ 4. Soliq yukini tahlil qilish

Kichik va o'rta biznes subyektlari uchun soliq yukining amaldagi holatini aniqlash va soliq yukining biznes rivojlanishiga ta'sirini baholash maqsadida soliq yukining tahlili o'tkazildi. Ushbu tahlil uchun kichik va o'rta biznes vakillari tomonidan to'lanadigan soliqlarning o'rtacha miqdori, ularning sof daromadlariga ta'siri va soliq yukining yillar davomida qanday o'zgarishi o'rganildi. Soliq yukini tahlil qilish uchun quyidagi ma'lumotlardan foydalanildi:

- KOB subyektlarining moliyaviy hisobotlari,
- Soliq organlaridan olingan soliq miqdorlari bo'yicha ma'lumotlar.

Bu usul soliqqa tortish tizimi biznes subyektlari faoliyatiga qanday ta'sir ko'rsatishini chuqurroq tahlil qilishga yordam berdi.

➤ 5. Xalqaro tajriba bilan solishtirish

O'zbekistonning kichik va o'rta biznesni soliqqa tortish tizimini xalqaro tajriba bilan solishtirish maqsadida bir qator xorijiy davlatlarning soliqqa tortish tizimi o'rganildi. Xususan, Turkiya, Janubiy Koreya va Polsha kabi davlatlarning soliqqa tortish amaliyotlari tahlil qilindi. Ushbu solishtirish orqali O'zbekiston modeli qaysi jihatlarida xorijiy modellardan farq qilishi yoki ularga o'xshashi aniqlanib, soliqqa tortish tizimini takomillashtirishga oid tavsiyalar ishlab chiqildi.

Ushbu tadqiqotda huquqiy hujjatlar tahlili, statistik ma'lumotlarni tahlil qilish, so'rovnoma va intervyu usuli, soliq yukini tahlil qilish hamda xalqaro tajribani solishtirish usullari qo'llanildi. Bu yondashuvlar soliqqa tortish tizimining kichik va o'rta biznesga ko'rsatgan ta'sirini har tomonlama o'rganishga va aniq xulosalar chiqarishga imkon berdi.

Tahlil va natijalar

Mazkur tadqiqot O'zbekistonda kichik va o'rta biznes (KOB) subyektlarini soliqqa tortish tizimining amaliy ta'siri va natijalarini baholashga qaratilgan bo'lib, 2017-2023 yillar davomidagi islohotlar, soliqlar stavkalari va soliq imtiyozlari hamda ushbu tizimning biznes rivojiga ko'rsatgan ta'siri o'rganildi.

➤ Soliqqa tortish tizimining rivojlanishi va islohotlar ta'siri

O'zbekistonda 2019 yilda qabul qilingan yangi Soliq kodeksi soliqqa tortish tizimining rivojlanishida muhim qadam bo'ldi. Kodeksda kichik va o'rta biznes subyektlari uchun imtiyozli soliq rejimlari joriy etilib, 2020 yildan boshlab yagona soliq rejimi qo'llanila boshlandi. Kichik biznes subyektlari uchun belgilangan soliq stavkasi 4-5% bo'lib, bu bizneslar uchun moliyaviy yukni sezilarli darajada kamaytirdi.

Tahlil natijalari shuni ko'rsatdiki, 2020-2021 yillarda kichik biznes uchun soliqqa tortish tizimining soddalashtirilishi natijasida mamlakatdagi kichik korxonalar soni 12% ga oshgan. Soliq imtiyozlari esa 2021 yilda kichik biznesning YaIMdagi ulushini 53% ga yetkazishga yordam berdi. Ushbu natijalar soliqqa tortish islohotlarining iqtisodiyotning ushbu segmentiga ijobiy ta'sir ko'rsatganini ko'rsatadi.

➤ 2. Soliq yukining biznesga ta'siri

Kichik va o'rta biznes sohasida soliq yukini kamaytirish bo'yicha amalga oshirilgan islohotlar tadbirkorlar uchun moliyaviy barqarorlikni ta'minlashga yordam berdi. 2019 yilgacha kichik biznes vakillarining soliq yukidan shikoyatlari ko'paygan bo'lsa, yangi soliqqa tortish tizimi qabul qilinganidan so'ng tadbirkorlar soliq to'lovlari kamayganini ta'kidlashdi.

Tahlil natijalariga ko'ra, kichik biznes vakillari uchun soliqlar to'lovlari o'rtacha 30% ga



qisqardi. Bu esa tadbirkorlarning moliyaviy resurslarini biznesni kengaytirish va ishlab chiqarishni yaxshilashga yo'naltirish imkoniyatlarini oshirdi. Xususan, soliq yukining kamayishi natijasida kichik va o'rta korxonalar soni 2022 yilda 15% ga oshgan.

➤ 3. Soliqqa tortish tizimining murakkabligi va ma'muriy to'siqlar

Tahlil natijalari shuni ko'rsatadiki, kichik biznes vakillari soliqqa tortish tizimining soddalashtirilishi bo'yicha ijobiy fikr bildirgan bo'lsalar-da, ba'zi tadbirkorlar hali ham ma'muriy jarayonlarning murakkabligi va soliqlarni hisoblashda qiyinchiliklarga duch kelayotganini qayd etgan. Ayniqsa, soliqlarning murakkab hisob-kitoblari va elektron deklaratsiya topshirish jarayonida yuzaga keladigan texnik qiyinchiliklar tadbirkorlar orasida norozilik keltirib chiqaradi.

So'rovnomalar natijasida ma'lum bo'ldiki, kichik biznes vakillarining 40% i soliqqa tortish bilan bog'liq texnik va ma'muriy muammolarga duch kelgan. Ushbu muammolarni bartaraf etish uchun soliq tizimini yanada soddalashtirish va ma'muriy jarayonlarni optimallashtirish zarurligi tahlillar asosida xulosa qilindi.

➤ 4. Xalqaro tajriba va solishtirish

Tahlillar davomida O'zbekistonning kichik va o'rta biznesni soliqqa tortish tizimi xorijiy davlatlar tajribasi bilan solishtirildi. Turkiya, Polsha va Janubiy Koreya kabi davlatlarda kichik biznes uchun soliqqa tortish stavkalari va soliqqa oid imtiyozlar o'xshash bo'lib, ular iqtisodiyotni rag'batlantirishda muhim omil bo'lgan.

O'zbekistondagi soliqqa tortish tizimi xalqaro andozalarga mos kelishi bilan bir qatorda, ayrim jihatlar bo'yicha xorijiy tajribadan farq qiladi. Masalan, Janubiy Koreyada kichik biznes uchun soliq imtiyozlari texnologik rivojlanishni rag'batlantirishga qaratilgan bo'lsa, O'zbekistonda bu asosan soliqqa oid byurokratik yuklarni kamaytirishga yo'naltirilgan. Xorijiy tajriba bilan solishtirish shuni ko'rsatadiki, O'zbekistonda soliqqa tortish tizimini yanada optimallashtirish uchun qo'shimcha imkoniyatlar mavjud.

Tahlil va natijalar shuni ko'rsatadiki, O'zbekistonda kichik va o'rta biznesni soliqqa tortish tizimidagi islohotlar kichik biznesning rivojlanishiga sezilarli ijobiy ta'sir ko'rsatgan. Xususan, soliq stavkalarining kamayishi va soliq imtiyozlari kichik biznesni rag'batlantirgan va ularning iqtisodiyotdagi ulushini oshirishga xizmat qilgan. Biroq, soliqqa oid ma'muriy jarayonlarning murakkabligi va texnik to'siqlar kabi masalalar hali ham dolzarb bo'lib qolmoqda. Shu sababli, soliqqa tortish tizimining yanada soddalashtirilishi va texnologik qulayliklar yaratish kelajakdagi islohotlar uchun muhim vazifa sifatida ko'rilishi zarur.

Xulosa

Mazkur tadqiqot O'zbekistonda kichik va o'rta biznes subyektlarini soliqqa tortish tizimini o'rganishga qaratildi. Olingan natijalar quyidagi xulosalarga olib keladi:

1. Soliqqa tortish tizimining ijobiy ta'siri: 2019 yildan boshlab amalga oshirilgan soliq islohotlari, xususan yangi Soliq kodeksi qabul qilinishi va soddalashtirilgan yagona soliq rejimining joriy etilishi kichik va o'rta biznes subyektlariga sezilarli darajada moliyaviy yordam berdi. Soliq

yukining kamayishi va soliq imtiyozlarining kengaytirilishi natijasida kichik korxonalar soni ko'paydi va ularning iqtisodiyotdagi ulushi oshdi.

2. Soliq yukining kamayishi: Soliq stavkalarining pasaytirilishi va soliq to'lovlari hajmining qisqarishi kichik biznes vakillari uchun moliyaviy barqarorlikni oshirishga yordam berdi. Kichik va o'rta biznes vakillari soliqlarni o'z vaqtida to'lash va biznes faoliyatlarini rivojlantirish imkoniyatlariga ega bo'ldi, bu esa biznesning iqtisodiy salohiyatini kuchaytirdi.

3. Ma'muriy to'siqlar va texnik muammolar: Soliq islohotlariga qaramay, tadbirkorlar orasida soliqqa oid ma'muriy jarayonlarning murakkabligi va texnik muammolar mavjudligi haqida shikoyatlar saqlanib qolmoqda. Ayniqsa, elektron deklaratsiya topshirish va soliqlarni hisoblashda yuzaga keladigan qiyinchiliklar tadbirkorlar uchun ma'lum to'siqlar tug'dirmoqda.

4. Xalqaro tajriba bilan mos kelish: O'zbekistonda soliqqa tortish tizimi xalqaro tajriba bilan mos keladi, xususan, kichik biznesni rag'batlantirish uchun soliq stavkalarini pastlashtirish va imtiyozli rejimlarni joriy qilish bo'yicha. Biroq, ayrim xorijiy davlatlar tajribasida texnologik va innovatsion bizneslar uchun soliq imtiyozlari keng qo'llanilishi, O'zbekistonda esa soliqqa oid ma'muriy jarayonlarni soddalashtirish muhim omil sifatida ko'rilmogda.

Takliflar

1. Ma'muriy jarayonlarni yanada soddalashtirish: Soliq to'lovlarini amalga oshirish jarayonidagi texnik va ma'muriy qiyinchiliklarni bartaraf etish uchun soliq tizimini yanada soddalashtirish kerak. Elektron deklaratsiya topshirish va soliqlarni hisoblash jarayonlarini yanada optimallashtirish orqali tadbirkorlar uchun qulay sharoit yaratish zarur.

2. Soliq imtiyozlarini kengaytirish: Kichik va o'rta biznes uchun soliq imtiyozlarini yanada kengaytirish, ayniqsa texnologik va innovatsion bizneslar uchun qo'shimcha imtiyozlar joriy etish iqtisodiyotning innovatsion sektori rivojlanishini qo'llab-quvvatlaydi.

3. Davlat tomonidan ko'proq qo'llab-quvvatlash dasturlari: Soliq yukini kamaytirish bo'yicha davomli choralar ko'rish va davlat tomonidan kichik biznesni moliyaviy qo'llab-quvvatlash dasturlarini kengaytirish zarur. Bu, ayniqsa, yangi korxonalar ochilishi va ularning barqaror rivojlanishi uchun muhimdir.

4. Xalqaro tajribadan foydalanish: Xorijiy davlatlar tajribasidan foydalanib, soliqqa tortish tizimining samaradorligini oshirish va kichik biznes subyektlari uchun soliq to'lovlari bilan bog'liq texnik yechimlarni tatbiq etish lozim.

5. Uzoq muddatli soliq strategiyasini ishlab chiqish: Kichik va o'rta biznesni rivojlantirish uchun soliq siyosatini barqaror rivojlantirishga qaratilgan uzoq muddatli strategiya ishlab chiqish muhim. Bu nafaqat biznes subyektlarini rag'batlantirish, balki iqtisodiyotning umumiy barqarorligini ta'minlashda ham muhim omil bo'lib xizmat qiladi.

Ushbu takliflar kichik va o'rta biznesni rivojlantirishda soliqqa tortish tizimining samaradorligini oshirish va iqtisodiyotni barqaror rivojlantirishda muhim qadam bo'lib xizmat qilishi mumkin.



Adabiyotlar

1. O'zbekiston Respublikasi Soliq kodeksi (2019 yilgi yangi tahriri).
2. O'zbekiston Respublikasi Prezidentining "Kichik va o'рта biznesni rivojlantirish to'g'risida"gi farmonlari va qarorlari.
3. O'zbekiston Respublikasi Davlat statistika qo'mitasi (2023). O'zbekiston iqtisodiyotida kichik va o'рта biznesning roli. [Statistik hisobotlar].
4. O'zbekiston Soliq qo'mitasi (2023). Soliq to'lovlari va soliqqa oid statistik ma'lumotlar. [Rasmiy hisobotlar].
5. Jahon banki (2023). O'zbekiston: Iqtisodiy o'sish va rivojlanish strategiyalari. [Hisobot].
6. Xalqaro Valyuta Jamg'armasi (2023). O'zbekiston iqtisodiy ko'rsatkichlari va soliqqa oid islohotlar. [Hisobot].
7. Kichik va o'рта biznesni qo'llab-quvvatlash markazi (2022). Kichik biznes uchun soliq imtiyozlari. [Tadqiqot].
8. Turkiya Respublikasi Soliq Boshqarmasi (2021). Kichik va o'рта biznesni rivojlantirishda soliq siyosati. [Hisobot].
9. Janubiy Koreya Respublikasi Soliq Boshqarmasi (2020). Soliqqa tortish tizimi va kichik biznesni rivojlantirish. [Hisobot].
10. Polsha Respublikasi Soliq Boshqarmasi (2022). Kichik va o'рта biznesga soliq imtiyozlari. [Tadqiqot].
11. Mustaqil tadqiqotchilar tomonidan o'tkazilgan so'rovnoma natijalari (2023).
12. Rasulov, A. (2021). O'zbekistonning iqtisodiy rivojlanishida kichik va o'рта biznesning roli. O'zbekiston iqtisodiyoti jurnali.
13. Abdullaeva, N. (2022). Soliqqa tortish tizimidagi islohotlar: amaliy va nazariy yondashuvlar. O'zbekiston moliya va soliq jurnali.



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OBJECTIVES, TYPES AND METHODOLOGY OF CRM SYSTEM SELECTION

Abstract: Customer Relationship Management (CRM) systems play a pivotal role in fostering customer engagement, improving sales, and enhancing overall business performance. The objectives of CRM system selection focus on aligning the system's functionality with business goals, optimizing customer interactions, and ensuring scalability and integration with existing infrastructure. The types of CRM systems, including operational, analytical, and collaborative CRMs, are examined to provide a comprehensive understanding of their specific use cases and benefits.

Keywords: CRM, methodology, digital technologies, digital marketing, marketing, online shopping, business.



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Introduction

Trading and Retailing has the opportunity to be client arranged since retailers lock in in individual contact with clients. Be that as it may, sellers and retailers have been moderate in taking advantage of their closeness to the client as they have set the most elevated needs on buying choices, operational concerns and marketing tools, not client administration. In common, most sellers and retailers are exceptionally item arranged as they endeavor to oversee combination of stock in a productive way. This introduction is changing since of the accessibility of databases on the buys of person clients. Such databases permit sellers and retailers to conduct coordinates approach to promoting that methodically ties marketing hones to client buying behavior. In a world of coordinates retailing, retailers will be less concerned with the benefit of things in stock and more concerned with the benefit of the clients within the store.

As delineated in Fig. 1, coordinates approach to trading and retailing includes analyzing client databases to assess the display and potential esteem of person clients, deciding how clients react to retail promoting factors, and apportioning promoting assets to person clients in like manner

An Integrated Approach to Retailing

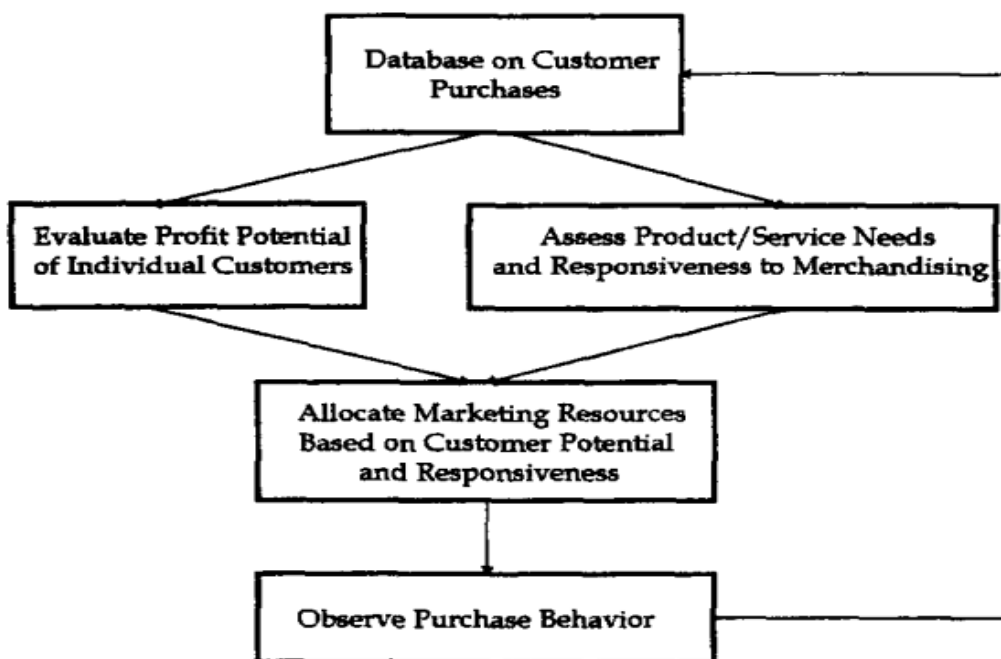


Figure 1. An integrated approach to retailing (Source: Blattberg and Glazer, 1994)

Client administration is made conceivable by databases on person buys, and can possibly be actualized by marketers at all levels, not fair retailing (Blattberg and Glazer, 1994). In any case, sellers and retailers, like other large-scale benefit providers, stand to pick up the foremost from database driven client administration hones since retailers control colossal amounts of tall quality buy information, and the dominance of retail benefits stem from a little parcel of the client base.

The rise of marketing has forced today's marketing executives to base their strategic decisions

more on the needs of the market, necessitating a formalized method of gathering precise and timely information about their target market, their products, the competitive landscape, and their overall environment. The practice of using the Internet to market and sell products or services is known as internet marketing. Internet marketing makes use of the potential of digital trade to market and sell goods. Electronic commerce refers to any market conducted online. Online trading, buying, and selling of products and services are made possible by electronic commerce. Internet marketing includes the subcategory of electronic commerce. Due to the rise in internet usage, online marketing has begun to gain significant traction.

It is stated that text-only websites that provided product information were the Ajoyib to offer Internet marketing services in the start of 1990. With the expansion of the internet, there is now more to it than only the sale of goods; there is now information about goods, advertising space, software, auctions, stock trading, and matchmaking. A few businesses, including Google, Yahoo, Amazon, Alibaba, and Youtube, have transformed how the internet may be utilized for marketing. The definition of internet marketing is as follows: "Achieving marketing objectives through the application of digital technologies." By satisfying their needs, using technology to help marketing initiatives improves customer knowledge. Digital marketing is the term for this. Businesses in developed countries have realized the value of digital marketing.

Businesses that want to succeed will need to combine traditional procedures with online ones in order to better serve their customers' requirements. The introduction of new technologies has given marketers new business opportunities to manage their websites and accomplish their corporate goals. For businesses to succeed, online advertising is a potent marketing tool for establishing brands and boosting visitors

In the business world of today, the adage "The customer is always right" might apply. Without clients, a business will not remain in business. Knowing what customers desire is crucial for this reason. CRM systems are a tool that will assist businesses in understanding their customers. In their definition of CRM systems, Kenneth C. Laudon and Jane P. Laudon said that these systems "capture and integrate customer data from across the organization, consolidate the data, analyses the data, and then distribute the results to various systems and customer touch points throughout the enterprise." 2012 [Laudon and Laudon]. In order to clearly grow their markets, businesses have recently purchased Customer Relationship Management (CRM) technologies. In order to accomplish business excellence and the main goal of obtaining devoted customers, the CRM technology brings with it the creation of marketing possibilities, the rise in customer value, and the improvement of customer happiness [Fardoie and Monfared, 2008].

What kind of information is required to establish a solid, trustworthy, and enduring relationship with the clients is the key question? The businesses needed to know who their clients were, what their interests were, and how to get in touch with them.

The makers of CRM software offer remedies for three primary areas:

- The use of automated technologies to assist salespeople and sales management in achieving their professional goals is known as sales force automation. Brettle (2009)
- Marketing automation is the use of computerised technology to assist marketers and

marketing management in achieving their professional goals. Brettle (2009)

- Customer service: "Provide knowledge and resources to enable contact centres, help desks, and customer support workers operate more effectively. They are equipped to manage and assign customer service requests. 2012 [Laudon and Laudon]

There are various types of CRM systems available today. To choose one of them to work at a specific object, we start by looking at the general quality attributes of the IS (Fig. 2).

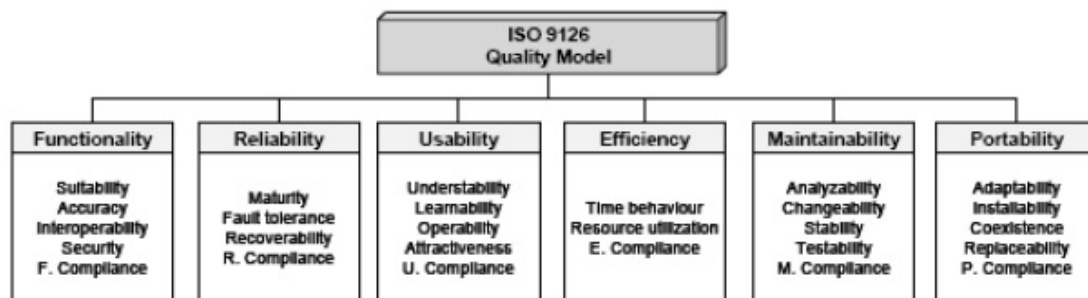


Figure 2. ISO 9126 Standard model (Source: ISO 2001)

- Functionality is the capacity of a software product to fulfil explicit and implicit needs when employed under predetermined circumstances.
- Reliability is defined as "the capacity of the software product to sustain a defined level of performance when employed in a defined environment.
- Usability is the ability of a software product to be comprehended, learnt, used, and appealing to the user when used in a particular way.
- Efficiency is the ability of a software product to deliver appropriate performance in relation to the quantity of resources used, under specified circumstances.
- Maintainability: "The software product's ability to be modified."
- Transferability: "The ability of the software product to operate in different environments." (ISO, 2001)

It will be defined the CRM system for a certain organization after determining the characteristics of the IS. The graphic below shows the selection of systems in order (Fig.3).

The three main technological components of the CRMs are:

- Collaborative technologies: These are the points of contact with customers. In other words, the various channels that customers use to communicate, such as email, phone calls, and faxes, are the collaborative technologies, website pages, and so on.
- Operational innovations: are all the forms and capacities related to the three major regions: deals (account administration, region administration and others), showcasing (campaign administration, mail showcasing and others) and client bolster (case administration, contact center

and other).

- Explanatory innovations: compares to the preparing of the data of the deals, promoting and client back and its change in data for reports and analytics. This could be utilized, for case, a conclusion of client relationship administration. [Fardoie and Monfared, 2008].

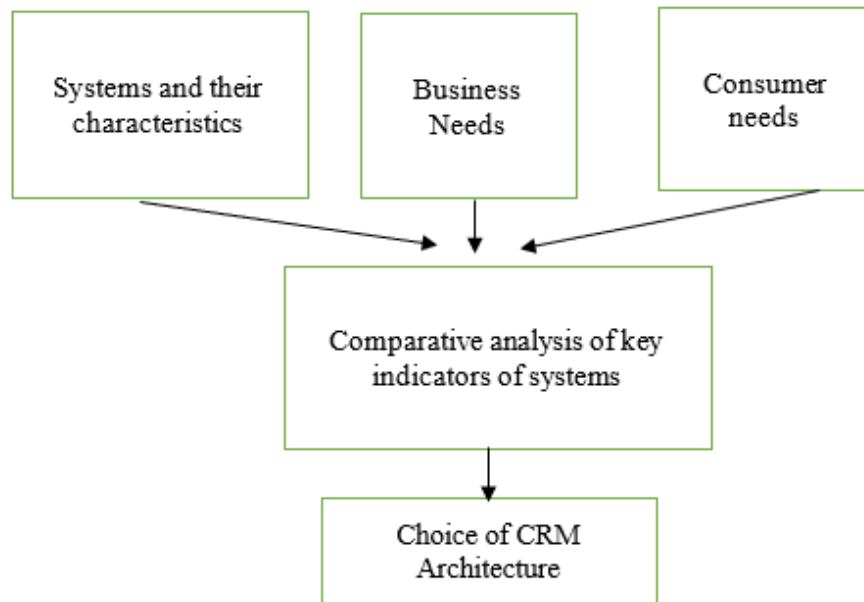


Figure 3. System selection procedure

Among these three advances for us, the most noteworthy intrigued in terms of usefulness is Operational innovation. Subsequently, let us consider in more detail the engineering of this CRM framework innovation. Presently we offer an outline on what a CRM framework is, by displaying the concept proposed by Buttle [2009], that states:” CRM is the center commerce procedure that coordinating inner forms and functions, and outside systems, to make and provide esteem to focused on clients at a benefit. It is grounded on tall quality customer related information and empowered by data technology.” Within the taking after segment, we show a few CRM engineering models. In this area, we display a few models of CRM designs, which deliver us an understanding into what most of CRM models have. We consider the taking after CRM models: The Sugar CRM (Siebel) show [Fardoie and Monfared, 2008], Microsoft Elements demonstrate and Sage show (Fig.20,21,22).



Figure 4. Sugar CRM architecture model from www.marketing.com

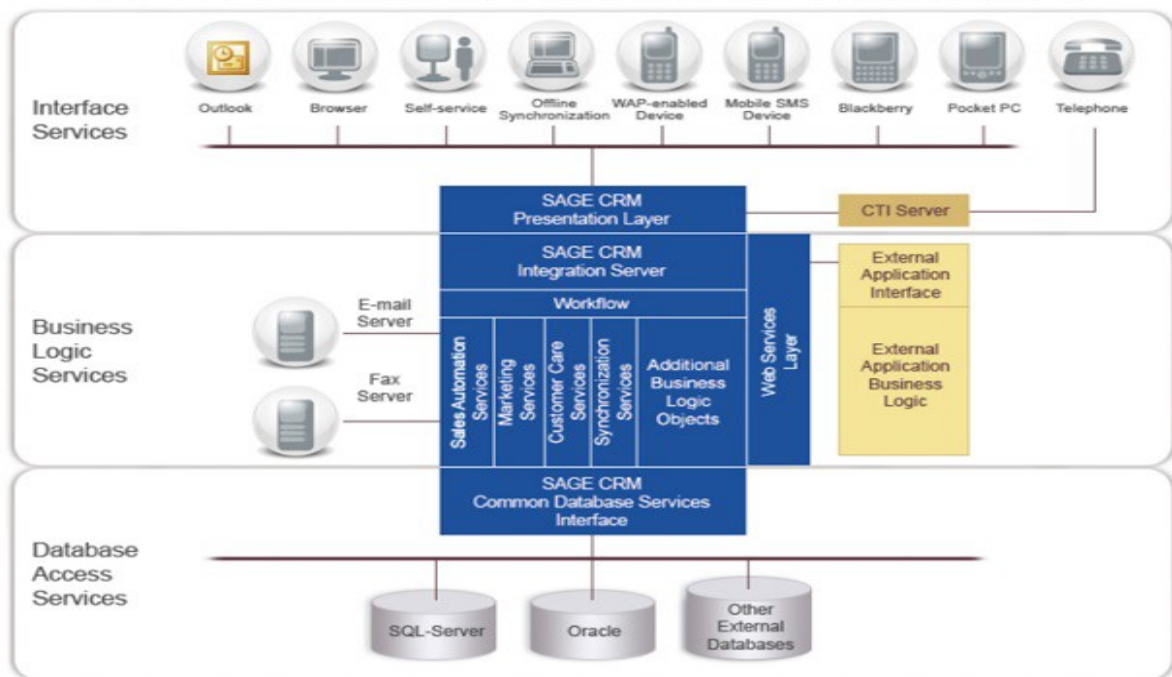


Figure 5. Sage CRM architecture model from

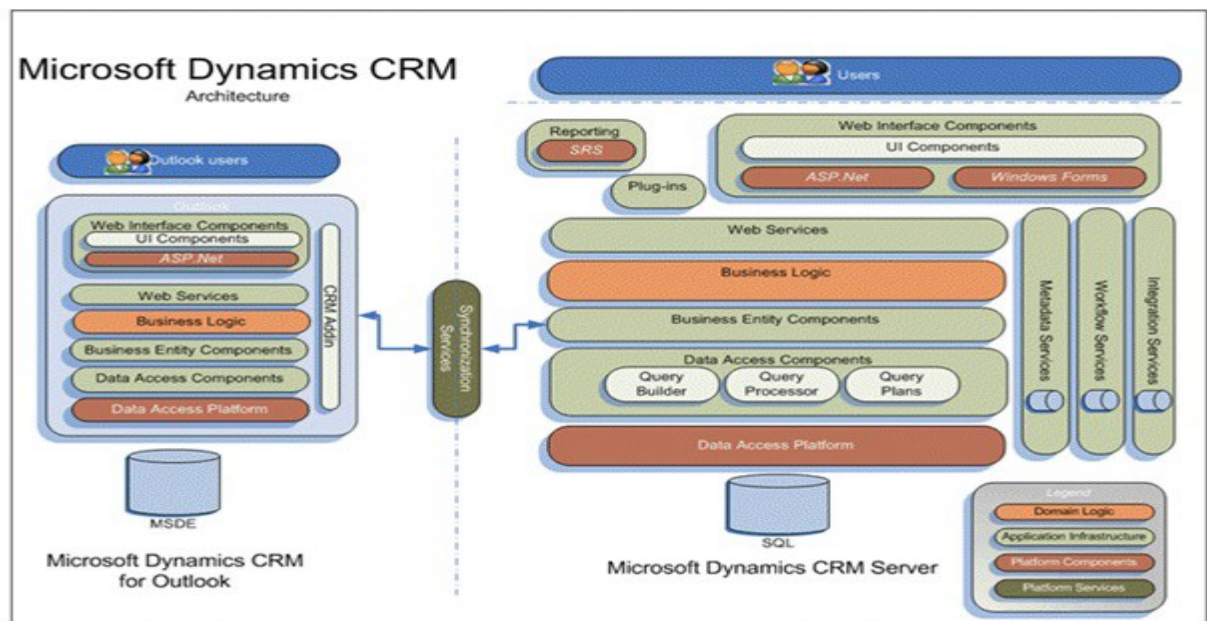


Figure 6. Microsoft Flow CRM engineering

In these models, we distinguish common components between them, that provide us a thought on what composes a CRM:

- Interface/Channel: show in Sugar CRM, Microsoft CRM and Sage CRM.
- Introduction layer: show in Microsoft CRM, Sage CRM.
- Web administrations: display in Sage CRM and Microsoft CRM
- Trade rationale: display in Microsoft CRM, and Sage CRM.
- Detailing and Investigation: show in Sugar CRM and Microsoft CRM.
- Information layer: show in Microsoft CRM and Sage CRM.
- Integration administrations: show in Microsoft CRM and Sage CRM.
- Workflow computerization: show in Microsoft CRM, Sage CRM and Sugar CRM.

Conclusion

In conclusion, a well-structured approach to CRM system selection empowers organizations to optimize customer experiences, improve decision-making through data-driven insights, and foster stronger customer relationships. Careful evaluation and alignment with organizational needs will maximize the CRM's value, contributing to long-term success.

By understanding the different types of CRM systems—operational, analytical, and collaborative—organizations can choose the one that best fits their customer engagement model and business processes. The selection methodology, which involves assessing functional requirements, evaluating vendor offerings, and considering integration capabilities, ensures that the chosen CRM system not only meets the technical specifications but also aligns with business goals.



References

1. Abdulakhatov M.M, “Models and methodologies software development” Scientific electronic journal of Management and Future Technologies Volume 1, Issue 2, June, 2024.
2. Abdulakhatov M.M, “The application of digital marketing strategies” Scientific electronic journal of Management and Future Technologies Volume 1, Issue 1, April 2024
3. Abdulakhatov M.M, “The main impacts of digital transformation on small to medium-sized business enterprises” Scientific electronic journal of Digital Economy and Information Technologies No. 2, 2022
4. Abdulakhatov M.M “The digital economy is the basis for economic development” Scientific journal of Economy and Society No. 10, October 7, 2022
5. Kobilov A.U, Abdulakhatov M.M, Rajabov Sh.B, “Artificial intelligence as a technological innovation for economic development of the republic of Uzbekistan” ICFNDS '22, December 15, 2022, Tashkent, TAS, Uzbekistan.
6. N. Ashrafi, The impact of software process improvement on quality: in theory and practice, Information & Management, 2003. 40(7): pp. 677-690.



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ОБ ОДНОМ АЛГОРИТМЕ ЧИСЛЕННОГО РЕШЕНИЯ КРАЕВЫХ ЗАДАЧ УПРУГО- ПЛАСТИЧНОСТИ

Аннотация: В статье рассмотрен эффективный численный метод решения двумерных упругопластических краевых задач для изотропных тел. Дискретные уравнения составлены конечно-разностным методом. Суть предложенного метода состоит в разрешении конечно-разностных уравнений относительно центральных узловых точек искомой функции перемещений и деформаций, отдельно для внутренних и граничных точек и организации итерационного процесса.

Ключевые слово: эластичность, краевая задача, деформация, перемещение, напряжение.



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ALGORITHM FOR NUMERICAL SOLUTION OF BOUNDARY VALUE PROBLEMS OF ELASTICITY- PLASTICITY

Abstract: The article considers an effective numerical method for solving two-dimensional elastic-plastic boundary value problems for isotropic bodies. Discrete equations are composed by a finite-difference method. The essence of the proposed method consists in solving finite-difference equations with respect to the central nodal points of the sought-for displacement and deformation function, separately for internal and boundary points and organizing the iteration process.

Keywords: elasticity, boundary value problem, deformation, displacement, stress.



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Постановка задачи

Обычно, модельные уравнения, описывающие процесса линейного деформирования твердых тел, состоит из [1]:

уравнения равновесия

$$\sum_{j=1}^3 \sigma_{ij,j} + X_i = 0, \quad x_i \in V, \quad i = 1, 2, 3. \quad (1)$$

закона Гука

$$\sigma_{ij} = \lambda \theta \delta_{ij} + 2\mu \varepsilon_{ij}, \quad (2)$$

соотношения Коши

$$\varepsilon_{ij} = \frac{1}{2} \left(\frac{\partial u_i}{\partial x_j} + \frac{\partial u_j}{\partial x_i} \right), \quad (3)$$

и граничных условий

$$u_i|_{\Sigma_1} = u_i^o, \quad \sum_{j=1}^3 \sigma_{ij} n_j|_{\Sigma_2} = S_i^o, \quad i = 1, 2, 3. \quad (4)$$

где σ_{ij} – тензор напряжений, ε_{ij} – тензор деформаций, u_i – компоненты перемещений, X_i – объёмные силы, λ, μ – упругие постоянные Ламе, $\theta = \varepsilon_{11} + \varepsilon_{22} + \varepsilon_{33}$ шаровая часть тензора деформаций, δ_{ij} – символ Кронекера, n_j – внешняя нормаль к поверхности Σ_1, Σ_2 , S_1^o, S_2^o, S_3^o – компоненты вектора внешней нагрузки.

В краевой задаче (1-4), можно рассматривать вместо соотношения (2) следующую нелинейную связь между тензором напряжений и деформаций, так называемую деформационную теорию пластичности Ильюшина [1]

$$\sigma_{ij} = \sigma \delta_{ij} + \frac{\sigma_u}{\varepsilon_u} e_{ij}, \quad (5)$$

где

$$\sigma = K\theta, \quad K = \lambda + \frac{2}{3}\mu, \quad (6)$$

$$\sigma_u = \sigma_u(\varepsilon_u), \quad (7)$$

где σ_u, ε_u – интенсивности тензора напряжений и деформации, соответственно, e_{ij} – девиатор тензора деформаций

$$e_{ij} = \varepsilon_{ij} - \frac{\theta}{3}, \quad \theta = \varepsilon_{11} + \varepsilon_{22} + \varepsilon_{33}, \quad (8)$$

$$\varepsilon_{ij} = \frac{1}{2} \left(\frac{\partial u_i}{\partial x_j} + \frac{\partial u_j}{\partial x_i} \right). \quad (9)$$

При соотношениях (9), деформационную теорию пластичности (4-7), иногда называют теорией малых упругопластических деформаций Ильюшина [1]. Известно, что соотношение (7) может быть представлено в следующем виде [1,3]

$$\sigma_u = \begin{cases} 2\mu\varepsilon_u & \text{при } \varepsilon_u < \varepsilon_u^*, \\ 2\mu\varepsilon_u^* + 2\mu'(\varepsilon_u - \varepsilon_u^*) & \text{при } \varepsilon_u \geq \varepsilon_u^*, \end{cases} \quad (10)$$

где ε_u^* – предел упругости [1].

Соотношение (10) при $\varepsilon_u \geq \varepsilon_u^*$ может быть записано в следующем виде [3]

$$\sigma_u = 2\mu\varepsilon_u + 2(\mu - \mu')(\varepsilon_u - \varepsilon_u^*) \quad \text{при } \varepsilon_u \geq \varepsilon_u^*. \quad (11)$$

Подставляя соотношения (11) в (5), можно найти определяющее соотношение деформационной теории в случае кусочно-линейной диаграммы деформирования т.е.

$$\sigma_{ij} = \begin{cases} \lambda\theta\delta_{ij} + 2\mu\varepsilon_{ij} & \text{при } \varepsilon_u < \varepsilon_u^*, \\ \lambda\theta\delta_{ij} + 2\mu\varepsilon_{ij} - 2(\mu - \mu')\left(1 - \frac{\varepsilon_u^*}{\varepsilon_u}\right)e_{ij} & \text{при } \varepsilon_u \geq \varepsilon_u^*. \end{cases} \quad (12)$$

Таким образом, в краевой задаче (1-4), вместо (6) рассматривая (12) получим нелинейную модельное уравнение, описывающее нелинейный процесс деформирования твердых тел [4]:

$$\sum_{j=1}^3 \sigma_{ij,j} + X_i = 0, \quad x_i \in V, \quad i = 1, 2, 3. \quad (13)$$

$$\sigma_{ij} = \begin{cases} \lambda\theta\delta_{ij} + 2\mu\varepsilon_{ij} & \text{при } \varepsilon_u < \varepsilon_u^*, \\ \lambda\theta\delta_{ij} + 2\mu\varepsilon_{ij} - 2(\mu - \mu')\left(1 - \frac{\varepsilon_u^*}{\varepsilon_u}\right)e_{ij} & \text{при } \varepsilon_u \geq \varepsilon_u^*, \end{cases} \quad (14)$$

$$\varepsilon_{ij} = \frac{1}{2} \left(\frac{\partial u_i}{\partial x_j} + \frac{\partial u_j}{\partial x_i} \right), \quad (15)$$

$$u_i|_{\Sigma_1} = u_i^o, \quad \sum_{j=1}^3 \sigma_{ij} n_j|_{\Sigma_2} = S_i^o, \quad x_i \in \Sigma_2. \quad (16)$$

Модельные уравнения, основанные деформационной теории Ильюшина (13-16) могут быть записаны относительно перемещений в двумерном случае имеет вид т.е. [1]

$$\begin{aligned} (\lambda + 2\mu) \frac{\partial^2 u}{\partial x^2} + \mu \frac{\partial^2 u}{\partial y^2} + (\lambda + \mu) \frac{\partial^2 v}{\partial x \partial y} - f_1 &= 0, \\ (\lambda + 2\mu) \frac{\partial^2 v}{\partial y^2} + \mu \frac{\partial^2 v}{\partial x^2} + (\lambda + \mu) \frac{\partial^2 u}{\partial x \partial y} - f_2 &= 0, \end{aligned} \quad (17)$$

где

$$f_i = 2(\mu - \mu')(1 - \frac{\varepsilon_u^*}{\varepsilon_u}) \frac{\partial e_{ij}}{\partial x_j} \quad \text{при } \varepsilon_u \geq \varepsilon_u^* \quad (18)$$

граничные условия относительно перемещений:

$$\begin{aligned} u(x, y)|_{x=0} = u_0, \quad u(x, y)|_{x=l_1} = \bar{u}_0, \quad u(x, y)|_{y=0} = u'_0, \quad u(x, y)|_{y=l_2} = \bar{u}'_0, \\ v(x, y)|_{x=0} = v_0, \quad v(x, y)|_{x=l_1} = \bar{v}_0, \quad v(x, y)|_{y=0} = v'_0, \quad v(x, y)|_{y=l_2} = \bar{v}'_0. \end{aligned} \quad (19)$$

f_i – представляет собой нелинейную часть дифференциальных уравнений, u, v, w – перемещения, $\varepsilon_u = \sqrt{\frac{1}{2} e_{ij} e_{ij}}$ – интенсивность тензора деформаций.

Сравнение численных результатов

Этот параграф посвящен численному решению краевых задач сформулированных относительно перемещений и деформаций и сравнению результатов между собой, а также с известным решением Тимошенко-Гудьера [2]. Пусть прямоугольная пластина размером $(2a, 2b)$ находится под действием одноосной нагрузки параболической формы приложенных на противоположных сторонах перпендикулярных к оси OX [2]. Остальные грани свободны от нагрузок т.е.

$$\text{при } x = \pm a: \sigma_{11} = S_0(1 - \frac{y^2}{a^2}), \quad \sigma_{12} = 0, \quad (20)$$

$$\text{при } y = \pm b: \sigma_{22} = 0, \quad \sigma_{21} = 0. \quad (21)$$

Для рассматриваемой задачи, в работе Тимошенко-Гудьера [2], на основе условия минимизации энергии деформации с использованием функции напряжений Эри, были найдены следующие выражения для компонентов тензора напряжений

$$\begin{aligned} \sigma_{11} &= S(1 - \frac{y^2}{a^2}) - 0.1702S(1 - \frac{3y^2}{a^2})(1 - \frac{x^2}{a^2})^2, \\ \sigma_{22} &= -0.1702S(1 - \frac{3x^2}{a^2})(1 - \frac{y^2}{a^2})^2, \\ \sigma_{12} &= -0.6805S \frac{xy}{a^2} (1 - \frac{x^2}{a^2})(1 - \frac{y^2}{a^2}). \end{aligned} \quad (22)$$

Исходные данные имеет следующие безразмерные значения:

$$\lambda = 0.8, \quad \mu = 0.5, \quad l_1 = 2a, \quad l_2 = 2b, \quad a = b = 1, \quad N_1 = N_2 = 10, \quad \mu' = 0.3, \quad \varepsilon_u^* = 0.32, \quad S = 1.$$

В таблице 1 приведены и сравнены значения напряжений σ_{11} , в средине пластины полученные относительно перемещений, деформаций и результаты Тимошенко-Гудьера [2] при $\varepsilon_u < \varepsilon_u^*$

Таблица 1. Сравнение тензора напряжений σ_{11} при $y=0$

Задачи	$x=-1$	$x=-0.8$	$x=-0.6$	$x=-0.4$	$x=-0.2$	$x=0$
Результаты Тимошенко-Гудьера	1.0000	0.9779	0.9303	0.8788	0.8431	0.8298
Результаты относительно перемещений	0.9925	0.8791	0.8538	0.8214	0.7963	0.8214
Результаты относительно деформаций	1.0000	0.9818	0.9818	0.9818	0.9818	0.9818

Сравнения напряжений σ_{11} показывают, что численные результаты, полученные по итерационному относительно перемещений методу прогонки относительно деформаций очень близки, чем обеспечивается справедливость сформулированных краевых задач, а также достоверность полученных численных результатов.

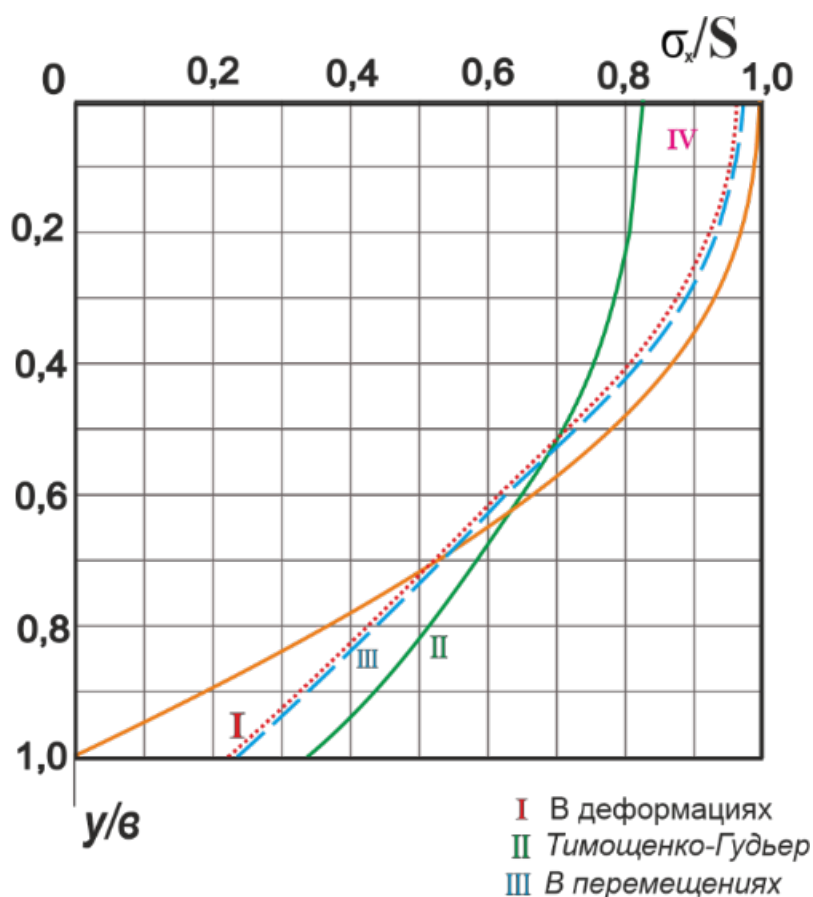


Рис.1. Распределение напряжений σ_{11} по результатам краевых задач о сжатии прямоугольной пластины под действием нагрузки параболической формы относительно деформаций(I) и перемещениях (III), а также согласно результатам Тимошенко-Гудьера (II).

Теперь рассмотрим данную задачу с учётом нелинейных частей при $\epsilon_{ii} \geq \epsilon_{ii}^*$.

Таблица 2. Сравнение тензора напряжений σ_{11} при $y=0$

Задачи	$x=-1$	$x=-0.8$	$x=-0.6$	$x=-0.4$	$x=-0.2$	$x=0$
Результаты относительно перемещений	0.9919	0.8339	0.7827	0.7417	0.7145	0.7051
Результаты относительно деформаций	1.0000	0.9457	0.9275	0.9229	0.9220	0.9221

Заключение

Сформулирована краевая задача упруго-пластичности в для прямоугольнике в случае плоской деформации. Дискретные уравнения составлены конечно-разностным методом и решена итерационным методом. С помощью уравнение Ламе и условий Сен Венана данная задача сформулирована относительно деформаций и решена по методу переменных направлений согласно методу прогонки по соответствующим направлениям. Разработаны численные алгоритмы и соответствующее программное обеспечение для решения двумерных упруго-пластических краевых задач.



Литература

1. Pobedrya B.E. New formulation of the problem of mechanics of a deformable solid body in stresses. Report of the Academy of Sciences of the USSR, vol. 253, 2, 1980, pp. 295-297.
2. Timoshenko, S. P., Goodier, J. N. (1970). Theory of Elasticity. McGraw-Hill.
3. Khaldjigitov A.A., Djumayozov U.Z. Numerical solution of the problem of the theory of elasticity in deformations. Uzbek Journal of Problems of Mechanics, No. 3, 2022, 56-65 pp.
4. Khaldjigitov A.A., Djumayozov U.Z. Numerical Solution of the Two-Dimensional Elasticity Problem in Strains. Mathematics and Statistics. №5, Vol 10, 2022, pp. 1081-1088. <https://doi.org/10.13189/ms.2022.100518>



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РОЛЬ ПРИМЕНЕНИЯ ЗАКОНОВ РАСПРЕДЕЛЕНИЯ В ОБСЛУЖИВАНИИ РАЗНОРОДНОГО ТРАФИКА В СЕТЯХ 5G

Аннотация: В данной работе приведены некоторые законы распределения, применяемые в обслуживании разнородного трафика в сетях 5G, а также рассмотрены виды трафика в сетях 5G. Проведен обзор законов распределения и даны предложения на будущие исследования.

Ключевые слова: Технология, трафик, пропускная способность, законы распределения, сеть, обслуживание, планирование, модель.



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THE ROLE OF APPLICATION OF DISTRIBUTION LAWS IN SERVING DIFFERENT TRAFFIC IN 5G NETWORKS

Abstract: This paper presents some distribution laws applied in serving heterogeneous traffic in 5G networks, and also considers the types of traffic in 5G networks. A review of distribution laws is provided and suggestions for future research are given.

Keywords: Technology, traffic, throughput, distribution laws, network, service, planning, model.



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Введение

Появление технологии 5G привело к значительному прогрессу в телекоммуникационных системах, обещая более высокую скорость передачи данных, меньшую задержку, повышенную надежность и широкие возможности подключения устройств. Ожидается, что с распространением разнообразных приложений, таких как умные города, автономные транспортные средства, Интернет вещей (IoT – Internet of Things) и дополненная реальность, сети 5G будут поддерживать широкий спектр разнородных (гетерогенных) типов трафика. К ним относятся улучшенная мобильная широкополосная связь (**eMBB - enhanced Mobile Broadband**), сверхнадежная связь с малой задержкой (**URLLC - Ultra-Reliable Low-Latency Communications**) и массовая машинная связь (**mMTC - massive Machine Type Communications**). В результате эффективное обслуживание таких разнородных типов трафика в сетях 5G представляет собой сложную и трудную задачу [1, 2, 3].

Материалы и методы

Мотивация для этой работы проистекает из острой необходимости разработки моделей и алгоритмов, способных эффективно управлять и обслуживать требования к разнородному трафику в сетях 5G. Разнообразная природа типов трафика, каждый из которых имеет уникальные требования к качеству обслуживания (**QoS – Quality of Service**), требует разработки интеллектуальных и адаптивных механизмов распределения ресурсов, планирования и управления трафиком внутри сети. Кроме того, оптимизация производительности сети для обеспечения эффективного использования ресурсов и предоставления надежных услуг с низкой задержкой для различных типов трафика имеет решающее значение для успешного развертывания и эксплуатации сетей 5G [4, 5, 6].

Понимание и решение этих проблем не только способствует развитию технологии 5G, но и закладывает основу для будущих поколений систем беспроводной связи. Сосредоточив внимание на разработке моделей и алгоритмов, адаптированных к динамичному и разнообразному характеру трафика 5G, это исследование направлено на то, чтобы внести существенный вклад в оптимизацию и эффективную работу сотовых сетей следующего поколения [7].

Технология 5G включает различные типы трафика, которые позволяют достигать высокой пропускной способности, низкой задержки и повышенной надежности связи. Основные виды трафика, используемые в сетях 5G, включают [8, 9]:

1. **Трафик eMBB:** Этот тип трафика предназначен для обеспечения высокой скорости передачи данных и большой пропускной способности для приложений, таких как потоковое видео высокого разрешения, онлайн-игры с высокими требованиями к пропускной способности и загрузки файлов большого объема.

2. **Трафик URLLC:** Этот тип трафика призван обеспечить низкую задержку и высокую надежность связи для критически важных приложений, таких как удаленное управление медицинскими устройствами, автономные транспортные системы и промышленное

оборудование, где даже небольшая задержка может быть недопустима.

3. **Трафик mMTC:** Этот тип трафика предназначен для обеспечения связи с большим количеством устройств, работающих в сети Интернет вещей (IoT), таких как смарт-датчики, умные счетчики и другие устройства, которые требуют низкого энергопотребления, низкой стоимости и низкой сложности связи (рис. 1).



Рис. 1. Разнородный трафик в сетях 5G.

Математическое моделирование дискретных систем со стохастическим характером функционирования предполагает использование моделей массового обслуживания, описываемых в терминах аппарата теории вероятностей.

Математическое описание случайных величин предполагает задание закона распределения, устанавливающего соответствие между значениями случайной величины и вероятностью их появления. Рассмотрим дискретную случайную величину X , принимающую значения x_1, x_2, \dots, x_n . Величина X может принять каждое из этих значений с некоторой вероятностью. Обозначим через $p_i (i = \overline{1, N})$ вероятность того, что случайная величина X примет значение x_i : $p_i = P(X = x_i)$. Если в результате опыта величина X принимает только одно из этих значений, то имеем полную группу несовместных событий и сумма вероятностей всех возможных значений случайной величины равна единице:

$$\sum_{i=1}^n p_i = 1$$

Эта суммарная вероятность каким-то образом распределена между отдельными значениями. Случайная величина будет полностью описана с вероятностной точки зрения, если мы зададим это распределение, т.е. установим так называемый **закон распределения**.

Законом распределения случайной величины называется всякое соотношение, устанавливающее связь между возможными значениями случайной величины и соответствующими им вероятностями. Про случайную величину говорят, что она подчинена данному закону распределения.

Моделирование технических систем с дискретным характером функционирования предполагает применение разных законов распределений, как дискретных, так и непрерывных случайных величин. В качестве законов распределений дискретных случайных величин наиболее широко используются:

- распределение Пуассона;
- геометрическое распределение.

Поскольку в математических моделях массового обслуживания непрерывной случайной величиной обычно является время, наибольший интерес представляют законы распределений непрерывных случайных величин, определенных в области положительных значений: равномерный; экспоненциальный; Эрланга; Эрланга нормированный; гиперэкспоненциальный; гиперэрланговский [10, 11].

В создании математической модели выбор законов распределений считается одним из основных задач.

Результаты

В качестве результата можно привести следующие сведения анализа на основе работ [12-20]:

1. В eMBB (enhanced Mobile Broadband) для распределения данных часто используются различные статистические распределения в зависимости от характеристик трафика и приложений. Вот несколько распределений, которые могут быть использованы:

- **распределение Пуассона:** Это одно из самых распространенных распределений для моделирования случайного процесса, такого как поступление пакетов данных в сети. В eMBB, где множество пользователей скачивают данные или просматривают видео, распределение Пуассона может использоваться для моделирования потоков трафика;

- **распределение Гаусса (нормальное распределение):** Это распределение широко используется для моделирования различных параметров в сетях связи, таких как скорость передачи данных, задержки и т.д. В eMBB оно может быть использовано для моделирования



скорости передачи данных различными пользователями или устройствами;

- **экспоненциальное распределение:** Это распределение часто используется для моделирования временных интервалов между событиями. В контексте eMBB, экспоненциальное распределение может быть применено для моделирования времени между запросами данных от пользователей или времени между пакетами данных в передаче потокового видео;

- **логнормальное распределение:** Это распределение, которое может использоваться для моделирования параметров с положительным диапазоном значений, таких как скорость передачи данных или размер файлов. В eMBB оно может быть полезно для моделирования размера загружаемых или передаваемых файлов.

2. URLLC (Ultra-Reliable Low-Latency Communications) обычно предполагает высокую надежность и низкую задержку передачи данных, что требует специфического подхода к распределению данных. Ниже приведены несколько распределений, которые могут быть применены в URLLC:

- **биномиальное распределение:** Это распределение может использоваться для моделирования событий с двумя возможными исходами (успех/неудача), что может быть полезно при моделировании успешных и неуспешных передач данных с высокой надежностью;

- **распределение Бернулли:** Это частный случай биномиального распределения, который подходит для моделирования бинарных событий (например, успешная/неуспешная передача пакета данных);

- **экспоненциальное распределение:** Это распределение может быть полезно для моделирования времени между событиями с низкой вероятностью, таких как появление критических сообщений или запросов на передачу данных в сети URLLC;

- **нормальное распределение:** В URLLC, где важна низкая задержка, нормальное распределение может использоваться для моделирования времени передачи данных, которое должно быть близко к определенному значению с небольшими отклонениями;

- **распределение Пуассона:** Может быть применено для моделирования событий, происходящих с низкой интенсивностью, например, появление критических уведомлений или запросов от удаленных устройств.

3. В mMTC (massive Machine Type Communications) обычно предполагается большое количество устройств, работающих в сети Интернета вещей (IoT), что требует особых подходов к распределению данных. Ниже приведены несколько распределений, которые могут быть применены в mMTC:

- **распределение Пуассона:** Это распределение может использоваться для моделирования случайных процессов, таких как появление сообщений или событий от множества устройств IoT;

- **геометрическое распределение:** Это распределение может использоваться для

моделирования времени между последовательными событиями от одного устройства IoT, так как оно описывает количество попыток, необходимых для появления первого успеха;

- **распределение Лапласа (двойное экспоненциальное распределение):** Это распределение может быть применено для моделирования данных с тяжелыми хвостами, что может быть типично для данных, генерируемых множеством устройств IoT с различными характеристиками передачи;

- **распределение Бернулли:** Возможно использование биномиального или распределения Бернулли для моделирования бинарных событий, таких как наличие или отсутствие данных от конкретного устройства IoT в определенный момент времени;

- **экспоненциальное распределение:** Это распределение может использоваться для моделирования интервалов времени между событиями от множества устройств IoT.

Обсуждение

Обсуждая полученные сведения, можем отметить, что фактический выбор закона распределения для разработки моделей и алгоритмов обслуживания разнородного трафика в сетях 5G зависит:

- от конкретных характеристик трафика и приложений, а также требований к моделированию конкретных сценариев использования для eMBB;

- от характеристик конкретного приложения, таких как частота событий, требования к надежности и задержке передачи данных для URLLC;

- от характеристик трафика в конкретном сценарии, таких как тип сообщений, частота передачи данных и особенности устройства IoT для mMTC.

Исходя из выше полученных сведений, мы можем классифицировать соответствующие законы распределения по их широкому применению в обслуживании разных видов трафика согласно табл. 1.

Таблица 1. Классификация законов распределения по их применению.

Законы распределения	Виды услуг (трафик) в сетях 5G		
	eMBB	URLLC	mMTC
Распределение Пуассона	+	+	+
Распределение Гаусса (нормальное распределение)	+	+	
Экспоненциальное распределение	+	+	+
Логнормальное распределение	+		
Биномиальное распределение		+	
Распределение Бернулли		+	+



Геометрическое распределение			+
Распределение Лапласа (двойное экспоненциальное распределение)			+

Выводы

Анализируя полученные результаты и учитывая различия требований на разные характеристики трафика в сетях 5G, в заключении можно сказать, что выбор конкретных законов распределения для разработки моделей и алгоритмов обслуживания разнородного трафика в сетях 5G считается актуальной задачей и в будущих исследованиях мы планируем уделить особое внимание для решения этой задачи.

Литература

1. S.Sirotkin. 5G Radio Access Network Architecture. – John Wiley& Sons, 2021, 408 page.
2. H.Venkataraman, R.Trestian. 5G Radio Access Networks. – Taylor&Francis Group, 2017, 295 page.
3. Жан Вальран, Шьям Парех. Коммуникационные сети: краткое сведение / пер. с англ. К.В. Петровичевой – М.: ДМК Пресс, 2023. – 268 с.: ил.
4. Тихвинский В.О., Терентьев С.В., Коваль В.А., Девяткин Е.Е. Развитие сетей мобильной связи от 5G Advanced к 6G: проекты, технологии, архитектура. - Москва: ТЕХНОСФЕРА, 2023. – 528 с.
5. Б.К. Турумбетов. Тенденции развития услуг на базе сети 5G. International Scientific and Technical Conference “DIGITAL TECHNOLOGIES: PROBLEMS AND SOLUTIONS OF PRACTICAL IMPLEMENTATION IN THE SPHERES. Tashkent, TUIT, April 27-28, 2023. p. 472-474.
6. S.Tanwar, H.Khujamatov, B.Turumbetov, E.Reypnazarov, Z.Allamuratova. Designing and Calculating Bandwidth of the LTE Network for Rural Areas. Международный журнал «International Journal on Advanced Science, Engineering and Information Technology», Индонезия, 2022 год, Vol. 12 (2022) № 2. ISSN: 2088-5334, стр. 437-445.
7. Б.К. Турумбетов. Обзор моделей и алгоритмов обслуживания разнородного трафика в сетях 5G. «Muhammad Al-Xorazmiy Avlodlari» Ilmiy-Amaliy Va Axborot-Tahliliy Jurnal, Tatu, 2023 Yil, 4-Son.



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