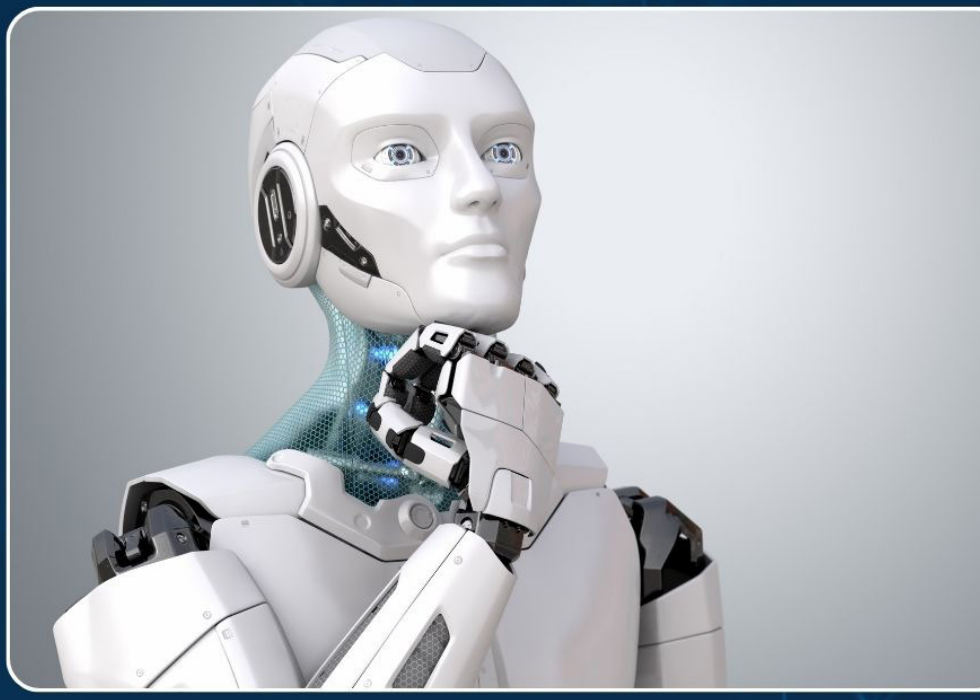
MUHANDISLIK & IQTISODIYOT

№4

*ijtimoiy-iqtisodiy, innovatsion texnik,
fan va ta'limga oid ilmiy-amaliy jurnal*

2025
APREL



Milliy nashrlar

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05.00.00 - Texnika fanlari
08.00.00 - Iqtisodiyot fanlar

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РЭУ.РФ РОССИЙСКИЙ ЭКОНОМИЧЕСКИЙ УНИВЕРСИТЕТ ИМЕНИ Г.В. ПЛЕХАНОВА ТАШКЕНТСКИЙ ФИЛИАЛ · TOSHKENT DAVLAT TRANSPORT UNIVERSITETI · TOSHKENT ARXITEKTURA-QURILISH UNIVERSITETI · TOSHKENT KIMYO-TEXNOLOGIYA INSTITUTI · JIZPI

Elektron nashr,
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MUHANDISLIK & IQTISODIYOT

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ijtimoiy-iqtisodiy, innovatsion texnik, fan va ta'limga oid ilmiy-amaliy jurnal

05.01.00 – Axborot texnologiyalari, boshqaruv va kompyuter grafikasi
05.01.01 – Muhandislik geometriyasi va kompyuter grafikasi. Audio va video texnologiyalari
05.01.02 – Tizimli tahlil, boshqaruv va axborotni qayta ishlash
05.01.03 – Informatikaning nazariy asoslari
05.01.04 – Hisoblash mashinalari, majmualari va kompyuter tarmoqlarining matematik va dasturiy ta'minoti
05.01.05 – Axborotlarni himoyalash usullari va tizimlari. Axborot xavfsizligi
05.01.06 – Hisoblash texnikasi va boshqaruv tizimlarining elementlari va qurilmalari
05.01.07 – Matematik modellashtirish
05.01.11 – Raqamli texnologiyalar va sun'iy intellekt
05.02.00 – Mashinasozlik va mashinashunoslik
05.02.08 – Yer usti majmualari va uchish apparatlari
05.03.02 – Metrologiya va metrologiya ta'minoti
05.04.01 – Telekommunikasiya va kompyuter tizimlari, telekommunikasiya tarmoqlari va qurilmalari. Axborotlarni taqsimlash
05.05.03 – Yorug'lik texnikasi. Maxsus yoritish texnologiyasi
05.05.05 – Issiqlik texnikasining nazariy asoslari
05.05.06 – Qayta tiklanadigan energiya turlari asosidagi energiya qurilmalari
05.06.01 – To'qimachilik va yengil sanoat ishlab chiqarishlari materialshunosligi
05.08.03 – Temir yo'l transportini ishlatish
05.09.01 – Qurilish konstruksiyalari, bino va inshootlar
05.09.04 – Suv ta'minoti. Kanalizatsiya. Suv havzalarini muhofazalovchi qurilish tizimlari
10.00.06 – Qiyosiy adabiyotshunoslik, chog'ishtirma tilshunoslik va tarjimashunoslik
10.00.04 – Yevropa, Amerika va Avstraliya xalqlari tili va adabiyoti

08.00.01 - Iqtisodiyot nazariyasi
08.00.02 - Makroiqtisodiyot
08.00.03 - Sanoat iqtisodiyoti
08.00.04 - Qishloq xo'jaligi iqtisodiyoti
08.00.05 - Xizmat ko'rsatish tarmoqlari iqtisodiyoti
08.00.06 - Ekonometrika va statistika
08.00.07 - Moliya, pul muomalasi va kredit
08.00.08 - Buxgalteriya hisobi, iqtisodiy tahlil va audit
08.00.09 - Jahon iqtisodiyoti
08.00.10 - Demografiya. Mehnat iqtisodiyoti
08.00.11 - Marketing
08.00.12 - Mintaqaviy iqtisodiyot
08.00.13 - Menejment
08.00.14 - Iqtisodiyotda axborot tizimlari va texnologiyalari
08.00.15 - Tadbirkorlik va kichik biznes iqtisodiyoti
08.00.16 - Raqamli iqtisodiyot va xalqaro raqamli integratsiya
08.00.17 - Turizm va mehmonxona faoliyati

Ma'lumot uchun, OAK
Rayosatining 2024-yil 28-avgustdagi 360/5-son qarori bilan
"Dissertatsiyalar asosiy ilmiy natijalarini chop etishga tavsiya etilgan milliy ilmiy nashrlar ro'yxati"ga texnika va iqtisodiyot fanlari bo'yicha "Muhandislik va iqtisodiyot" jurnali ro'yxatga kiritilgan.

Muassis: "Tadbirkor va ishbilarmon" MChJ
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1. Toshkent shahridagi G.V.Plexanov nomidagi Rossiya iqtisodiyot universiteti
2. Toshkent davlat iqtisodiyot universiteti
3. Toshkent irrigatsiya va qishloq xo'jaligini mexanizatsiyalash muhandislari instituti" milliy tadqiqot universiteti
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MUNDARIJA

MUNDARIJA СОДЕРЖАНИЕ CONTENTS

MUNDARIJA СОДЕРЖАНИЕ CONTENTS

MUNDARIJA СОДЕРЖАНИЕ CONTENTS

MUNDARIJA СОДЕРЖАНИЕ CONTENTS

MUNDARIJA СОДЕРЖАНИЕ CONTENTS

INFORMATION EXCHANGE ACCELERATION IN EMERGENCY MODES OF INTELLIGENT CONTROL SYSTEMS

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Abstract: The acceleration of information exchange in emergency modes of intelligent control systems is a critical technological challenge. This article analyzes methods for improving communication efficiency through real-time synchronization of data flows, minimizing delays, optimizing automated decision-making, and maintaining uninterrupted monitoring. Solutions based on neural networks, differential signal protocols, and adaptive bandwidth management are discussed and illustrated with practical examples.

Keywords: intelligent control systems, emergency mode, information exchange, delay minimization, neural networks, automation.

Annotatsiya: Intellektual boshqaruv tizimlarining favqulodda holatlarida ma’lumot almashinuvini tezlashtirish muhim texnologik muammolardan biri sanaladi. Mazkur maqolada ma’lumotlar oqimini real vaqtda muvofiqlashtirish, kechikishlarni minimallashtirish, uzluksiz monitoring va avtomatik qaror qabul qilish mexanizmlarini optimallashtirish orqali favqulodda vaziyatlarda axborot almashinuvi samaradorligini oshirish usullari tahlil qilinadi. Shuningdek, neyron tarmoqlar, differensial signal protokollari va tarmoqli kengligi boshqaruvi asosida taklif etilayotgan yechimlar amaliy misollar bilan asoslab berilgan.

Kalit so‘zlar: intellektual boshqaruv tizimi, favqulodda holat, ma’lumotlar almashinuvi, kechikishlarni kamaytirish, neyron tarmoqlar, avtomatlashtirish.

Аннотация: Ускорение обмена информацией в аварийных режимах интеллектуальных систем управления является актуальной технологической задачей. В статье рассматриваются методы повышения эффективности передачи данных за счёт синхронизации потоков в реальном времени, минимизации задержек, оптимизации механизмов автоматического принятия решений и обеспечения непрерывного мониторинга. Также приведены практические решения, основанные на нейронных сетях, дифференциальных протоколах и адаптивном управлении пропускной способностью.

Ключевые слова: интеллектуальные системы управления, аварийный режим, обмен информацией, минимизация задержек, нейронные сети, автоматизация.

INTRODUCTION

From the assembly lines in manufacturing plants to the precision agriculture fields, automation technology has revolutionized traditional industries. Robots and automated systems enhance production efficiency, reduce human error, and perform tasks that are hazardous or tedious for humans. In countries like Japan and Germany, automation has been pivotal in maintaining competitive industrial sectors despite demographic challenges.

The global healthcare sector has witnessed remarkable advancements due to automation. Automated diagnostic tools, robotic surgical systems, and AI-driven patient management systems are improving outcomes and accessibility. In regions with limited medical personnel, such technologies are vital in bridging the gap between healthcare demands and available services.

ANALYSIS OF LITERATURE ON THE TOPIC

The challenge of ensuring high-speed and reliable information exchange in emergency modes of intelligent control systems has been addressed by numerous researchers across disciplines such as automation, control engineering, and computer science. A foundational understanding of intelligent systems and their adaptive capabilities in uncertain environments was offered by Zadeh through the concept of fuzzy logic, which remains relevant for decision-making under limited data transmission times.

In the domain of industrial automation, the work of Kevin Warwick highlights the importance of real-time signal processing and the integration of artificial intelligence in safety-critical systems. His studies underscore the necessity of self-correcting algorithms and neural feedback loops to mitigate failure risks during abrupt transitions or overloads.

Regarding the architecture of intelligent systems, Peter Norvig and Stuart Russell provide in their seminal work *Artificial Intelligence: A Modern Approach* a broad overview of communication strategies between agents in dynamic environments, particularly emphasizing search efficiency and learning adaptation in response to unexpected scenarios.

A significant contribution to the field of intelligent control in emergency scenarios is made by Katsuhiko Ogata, whose work on modern control engineering explains how state-space methods and transfer functions can be adapted to respond faster and more precisely during failure conditions. His models are particularly useful in analyzing system stability and latency under emergency switching.

Additionally, recent advancements in neural networks for industrial automation, such as those discussed in the studies by Yann LeCun, focus on the application of deep learning in predictive maintenance and fault detection, which directly supports fast information routing and decision-making when systems face anomalies.

Practical insights into the networking and protocol optimization necessary for emergency communication are offered in the works of Andrew S. Tanenbaum. His discussions on network layers and congestion control strategies align with the need to accelerate data flow while maintaining system integrity under stress conditions.

Together, these scholarly works provide a strong theoretical and technical foundation for exploring new models and implementations aimed at improving the responsiveness and resilience of intelligent control systems in critical scenarios.

RESEARCH METHODOLOGY

The research methodology involves the collection of empirical data from simulated emergency scenarios within intelligent control systems using real-time monitoring tools. Data analysis is performed through comparative evaluation of response times, signal transmission efficiency, and fault recovery rates, employing statistical methods and neural network-based modeling to validate system performance improvements.

ANALYSIS AND RESULTS

Automation technology has also transformed the service industry. AI and machine learning algorithms now personalize customer experiences in sectors ranging from retail to banking. Automated chatbots and virtual assistants provide 24/7 support to a global clientele, significantly improving the efficiency and quality of customer service.

In the agricultural sector, automated drones and machinery are revolutionizing farming practices around the world – from the vast cornfields of the United States to the rice paddies of Asia. These

technologies enable precision farming, which optimizes resource use and increases yields – a crucial factor for feeding a growing global population.

While the rapid expansion of automation technology offers numerous benefits, it also poses several challenges, such as potential job displacement and the urgent need for workforce reskilling. Nevertheless, it opens new avenues for employment in technology-driven sectors and underscores the importance of adapting educational systems to prepare individuals for an increasingly automated future (table 1).

Table 1. Sectoral impact of automation: global examples and future prospects.

Sector	Impact of Automation	Global Examples
Industry	Enhances production efficiency, reduces human error, handles hazardous tasks	Japan and Germany's competitive manufacturing sectors
Healthcare	Improves outcomes with automated diagnostics and robotic surgeries, enhances accessibility	Robotic surgical systems in the US, AI-driven patient management in remote areas
Service	Personalizes customer experiences through AI and ML, provides 24/7 support with automated systems	Global retail and banking sectors' use of chatbots and virtual assistants
Agriculture	Revolutionizes farming with drones and machinery for precision farming, optimizes resource use	Precision farming in the US, automated drones in Asian rice paddies
Challenges and Opportunities	Potential for job displacement, necessity for workforce reskilling, new job creation in tech-driven sectors, educational system adaptation	Global workforce and educational institutions

The course "Technical Automation Tools" is aimed at exploring the fundamental components that constitute automated process control systems. It begins by introducing the essential terminology and foundational definitions relevant to the field.

A system element (or device) is defined as a structurally complete and functionally autonomous technical unit that performs designated roles within an automation infrastructure. These roles typically include the measurement of physical quantities, signal transmission, data retention, information processing, and the generation or execution of control commands.

An Automatic Control System (ACS) refers to a cohesive ensemble of technical components and software–hardware complexes that interact in a coordinated manner to fulfill a predetermined control law or operational algorithm.

An Automated Process Control System (APCS) represents an integrated human–machine system engineered for the real-time monitoring, analysis, and regulation of technological processes. It ensures the automated collection, processing, and application of operational data for managing a specific technological object, while adhering to a set of predefined performance indicators–spanning technical reliability, process efficiency, and economic viability (fig. 1).

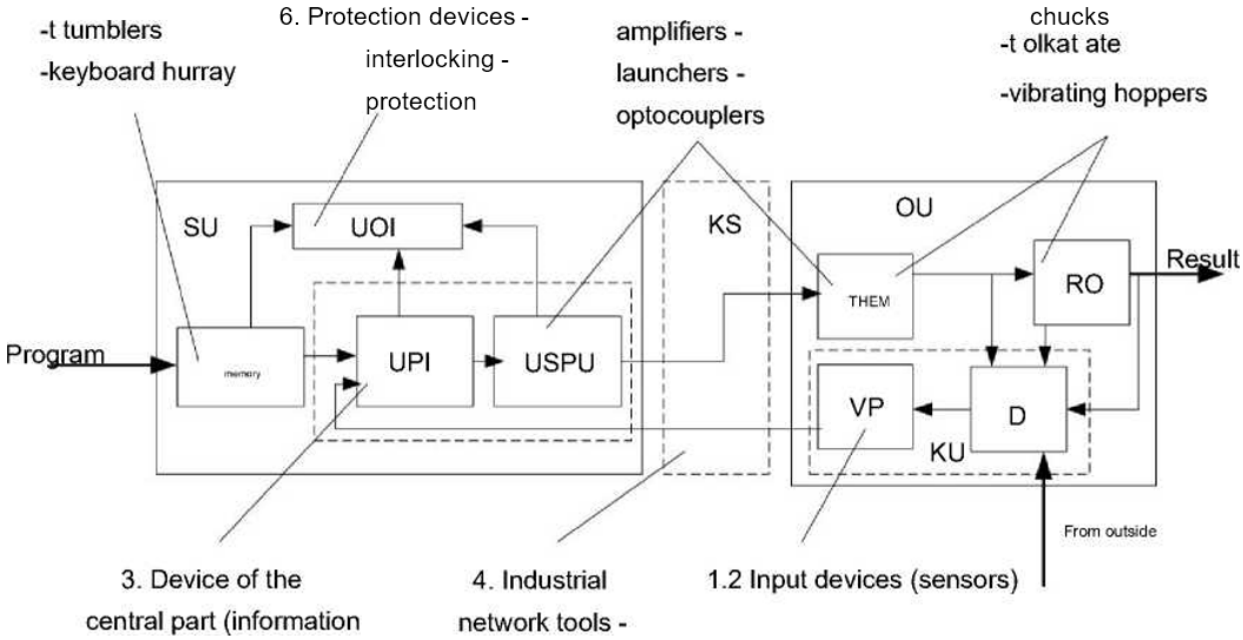


Figure 1. Functional structure of an automated industrial control system.

A *technological control object (TOU)* is a set of technological equipment and the technological process implemented on it in accordance with relevant instructions and regulations.

In the evolution of modern automated process control systems (APCS), a distinct tendency has emerged toward the standardization and interoperability of technical solutions on a global scale. One of the defining characteristics of contemporary automation systems is their openness – the clear definition and documentation of data structures and procedural interfaces. This architectural principle ensures seamless integration with independently developed external devices and systems, enhancing the scalability and adaptability of industrial automation frameworks.

In recent decades, particularly since the 1990s, the landscape of the technical control automation (TCA) industry has undergone a fundamental transformation. A notable increase in domestic manufacturers has been observed, with many enterprises producing competitive automation components and systems. Simultaneously, system integrators have gained strategic significance, bridging the gap between hardware, software, and industry-specific needs. Parallel to this, international leaders in automation technologies have penetrated the markets of the CIS region by establishing representative offices, forming joint ventures, and developing robust dealer networks.

This dynamic market environment has fueled a growing need for structured and comprehensive educational resources that reflect the current state of the TCA industry. However, up-to-date information on both domestic and foreign automation solutions is often fragmented, residing primarily in specialized periodicals or on digital platforms such as www.asutp.ru, www.mka.ru, and www.industrialauto.ru.

The objective of these lecture materials is to provide a coherent and systematized overview of the key components and industrial subsystems within the field of *Technical Automation Tools (TSA)*. This content is specifically tailored for students majoring in *Automation of Technological Processes and Production*, serving as a foundational guide to the subject area.

As per GOST 12997–84, the diverse range of TSA elements utilized in self-propelled automation systems is categorized into seven major groups (refer to Fig. 1), each based on its functional purpose.

Expansion of Functional Capabilities:

Control Functions: From basic commands like start/stop and reverse operations to advanced forms such as cyclic sequencing, numeric programming, and adaptive control systems.

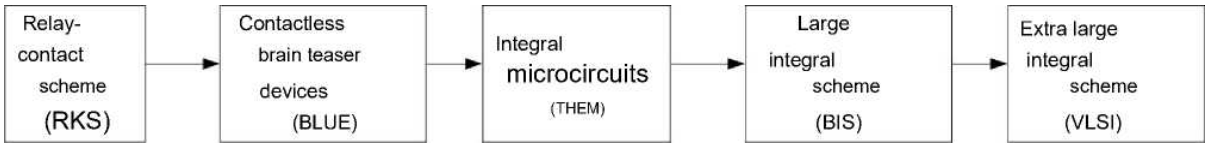
Alarm Functions: Evolution from simple indicator lamps to complex visual interfaces including textual and graphic visualization.

Diagnostic Functions: Transition from elementary fault detection (e.g., open circuit) to comprehensive software-assisted diagnostics of system components.

Communication Functions: Shift from conventional wired connectivity to fully integrated industrial network infrastructures with high-speed data transmission.

Advancement of the Element Base:

This trend marks the transition from electromechanical relay-contact systems to solid-state devices based on discrete semiconductor elements. The trajectory continues toward the deployment of integrated circuits (ICs), including those with high and ultra-high levels of functional integration (Fig. 2).



Rice. 2. Stages of development of electric vehicles.

Transition from manual (intuitive) TSA design methods to scientifically based machine- and computer-aided design (CAD) systems.

TCA Imaging Methods. In the process of studying this course, various methods of depicting and presenting TCAs and their components can be used. The most commonly used are the following:

The constructive method involves depicting instruments and devices using mechanical engineering drawing techniques in the form of technical drawings, layouts, general views, projections (including axonometric ones), sections, and so on.

The circuit method involves, in accordance with GOST ESKD, representing the TSA with circuits of various kinds (electrical, pneumatic, hydraulic, kinematic) and types (structural, functional, fundamental, installation, etc.).

The mathematical model is used more often for software-implemented TSA and may be represented as:

– transfer functions of typical dynamic links;
– differential equations of ongoing processes;
– logical functions for controlling outputs and transitions;
– state graphs, cyclograms, timing diagrams;
– block diagrams of functional algorithms (Fig. 40), etc.

The design and implementation of modern automated process control systems necessitate the integration of a wide spectrum of technical elements and devices. Attempting to satisfy the varied demands of control systems–ranging in complexity and precision–through entirely bespoke automation equipment would be highly impractical. Such an approach would result in an excessively broad and fragmented array of instrumentation and automation solutions, complicating both standardization and maintenance practices.

To address this challenge, a decisive shift occurred in the late 1950s in the USSR, where a strategic initiative was launched to establish a unified State System for Industrial Instruments and Automation Equipment (GSP). This system was designed as a coherent, rationally structured collection of instrumentation conforming to the principles of typification, unification, and aggregation. Its goal was to facilitate the scalable construction of automated systems for measurement, monitoring, regulation, and control across diverse industrial sectors. From the 1970s onward, the GSP framework was also extended to encompass non-industrial domains such as scientific research, healthcare, and experimental testing.

Typification involves the deliberate reduction of the diversity of devices and equipment to a limited set of optimal models. These standard solutions are characterized by superior functional and technical properties. Through typification, prototype designs are formulated that embed essential functional parameters, serving as universal templates across product lines. This process promotes efficiency by clustering functionally similar devices under a common design umbrella, streamlining manufacturing and maintenance.

CONCLUSION AND SUGGESTIONS

Unification represents the standardization of product designs, sizes, configurations, and production methods. It aims to eliminate excessive variability in devices that fulfill similar functions, thereby introducing uniform design parameters across various components of TCA. Unification allows devices, their modules, and structural blocks to be designed from a shared design base, regardless of their functional variations, forming coherent series that improve compatibility and interchangeability.

Aggregation refers to the systematic construction of automation systems using modular and standardized components, such as blocks, units, and subsystems. This principle enables the flexible configuration of complex control systems tailored to specific industrial tasks while maintaining a consistent technical foundation. Aggregation supports the creation of diverse system variants based on a unified set of modules, enabling both product customization and production scalability. It is widely adopted across technological domains–from modular machine tools and industrial robots in mechanical engineering to IB**M-compatible computing systems** in digital control and information processing.

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Musahhih: Zokir Alibekov

Sahifalovchi va dizayner: Oloviddin Sobir o'g'li

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