ДОДАТОК А

Апробація результатів кваліфікаційної роботи

Міністерство освіти і науки України

Харківський національний університет радіоелектроніки

Кафедра комп'ютерно-інтегрованих технологій, автоматизації та робототехніки

VIII Міжнародна Конференція
ВИРОБНИЦТВО
&
МЕХАТРОННІ СИСТЕМИ 2024

VIII International Conference
MANUFACTURING
&
MECHATRONIC SYSTEMS 2024

M&MS
2024
VII International Conference
25-26 October
Kharkiv

Рисунок А.1 – Титульний аркуш

УДК: 005:004.896:62-65:338.3

Виробництво & Мехатронні Системи 2024: матеріали VIII-ої Міжнародної конференції, Харків, 25-26 жовтня 2024 р.: тези доповідей / [редкол. І.Ш. Невлюдов (відповідальний редактор)].-Харків: [електронний друк], 2024. – 135 с.

У збірник включені тези доповідей, які присвячені сучасним тенденціям розвитку технологій та засобів виробництва та мехатронних систем, передовому досвіду та впровадженню їх в галузях систем промислової автоматизації та керування виробництвом; системній інженерії; CAD/CAM/CAE системах; мехатроніці (електро-механічних системах, електронних інструментах систем керування, механічних CAD системах); робототехніці та засобахм інтелектуалізації; MEMS (сучасних матеріалів та технологіях виготовлення MEMS) та компонентах і технологіях автоматизації видобутку, переробки та транспортування нафти та газу.

Редакційна колегія: І.Ш. Невлюдов, В.В. Євсєєв.

Manufacturing & Mechatronic Systems 2024: Proceedings of VIII st International Conference, Kharkiv, October 25-26, 2024: Thesises of Reports / [Ed. I.Sh. Nevlyudov (chief editor).] .- Kharkiv .: [electronic version], 2024. - 135 p.

The collection includes the thesises of reports on modern trends in the development of technologies and means of production and mechatronic systems, top experience and implementation of them in fields of: industrial automation and production management systems; systems engineering; CAD/CAM/CAE systems; mechatronics (electrical and mechanical systems, electronic control tools, mechanical CAD systems); robotics and intellectual toolls; MEMS (modern materials and manufacturing technologies MEMS) and components and technologies for the automation of oil, gas and oil extraction, processing and transportation.

Editorial board: Igor.Sh. Nevludov, Vladyslav.V. Yevsieiev

M&MS 2024, 25-26 October, Kharkiv, Ukraine

Рисунок А.2 – Посвячення

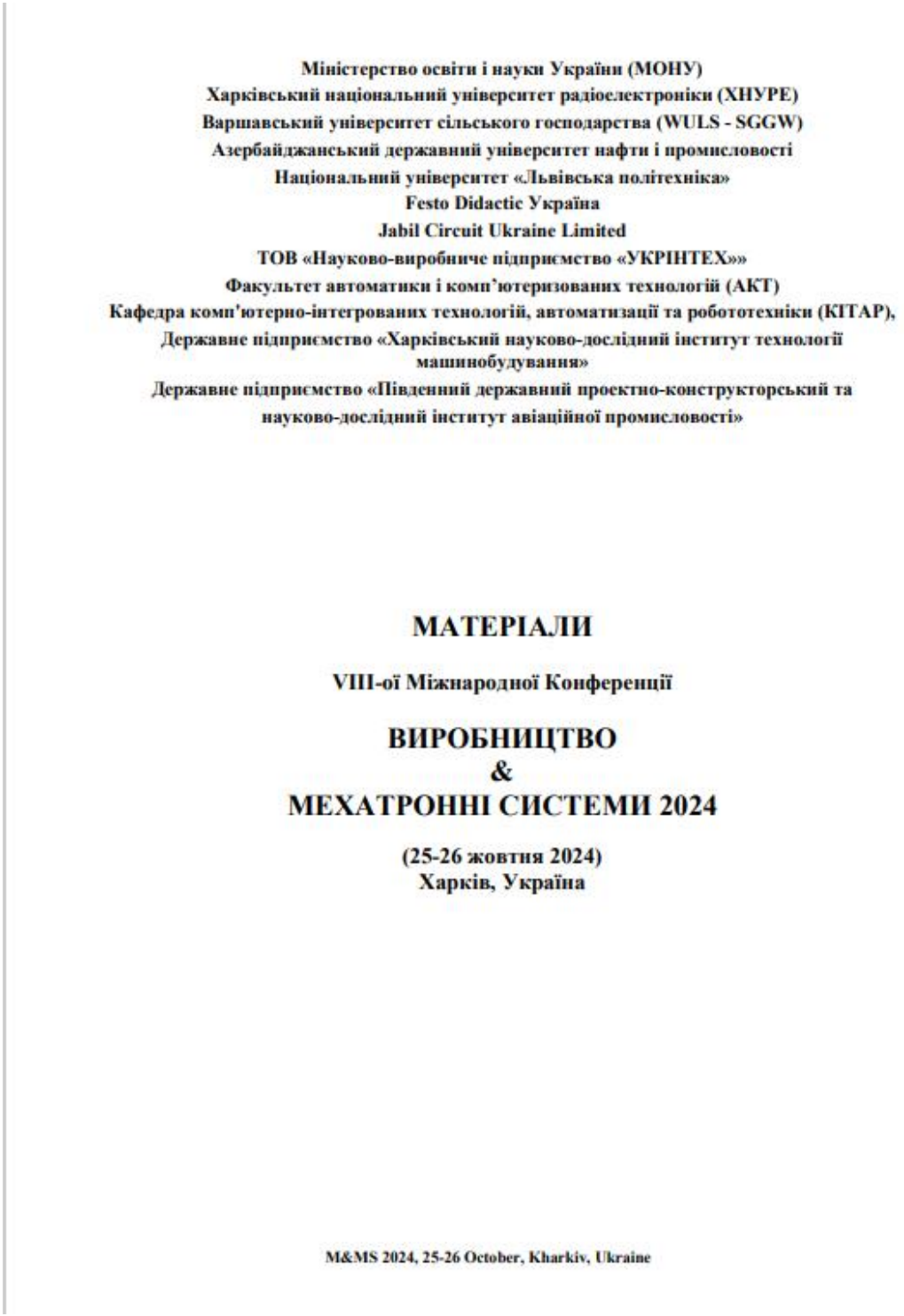

Рисунок А.3 – Інформаційний аркуш

ЗМІСТ

Рисунок А.4 – Зміст

Рисунок А.5 – Продовження змісту

24

Analysis of electronic locks existing systems

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Anotation: The aim of this work is to develop locking device control system that includes personalization function. Such solution is especially relevant for managers who want to conveniently control attendance of workspaces or restricted areas. Owners of warehouses, archives, laboratories, or ordinary offices often need information about who visits these premises and when, but do not always have ability to obtain such data promptly.

The proposed system not only provides this opportunity, but also ensures convenient control through use of modern technologies. This project has created system that, although it has analogues on market, is easy to use and affordable. The study focused on introduction of personalization technology and replacement of traditional keys to open doors using radio frequency identification (RFID), which is already widely used in modern world.

Key words: Radio Frequency IDentification, door lock, optimizing, information.

I. INTRODUCTION

In today's digital age, security and access control issues are becoming increasingly important [1-5]. As number of users and their needs increase, modern electronic locks are becoming increasingly complex, which poses new challenges for developers of such systems, particularly in context of ensuring reliability, security, and ease of use.

One of areas of development of electronic locks is integration of intelligent tools, such as artificial intelligence, machine learning, and natural language processing, which are becoming prerequisite for optimizing these systems. The use of such technologies makes it possible to create automated access control systems that significantly increase work efficiency, minimizing impact of human factor and reducing risk of errors.

Automation of lock management processes can increase speed of response to user requests and reduce time spent on their maintenance. Robotic solutions, in turn, contribute to development of autonomous systems capable of performing complex access control tasks in real time. The integration of these technologies creates new, more adaptive and flexible electronic lock systems that not only perform task of opening or closing doors, but are also able to anticipate user needs based on analysis of their behavior and context of use.

It's also worth noting that automation itself is key trend in modern technology that can significantly improve management of electronic locks. The use of automated solutions helps to reduce cost of operation and maintenance, while increasing level of security and system performance [6-10]. Automation makes it possible to efficiently manage large networks of locks, coordinate their operation, and provide instant access to system status data, which makes lock management more transparent and controlled.

Therefore, in face of increasing security and automation requirements, relevance of analyzing existing electronic lock systems becomes obvious. The integration of intelligent tools, automation, and robotics opens up new horizons for increasing reliability, speed, and efficiency of electronic locks while providing maximum user convenience.

II. ANALYSIS OF PRINCIPLES OF OPERATION OF ELECTRIC LOCKS

At its core, electric lock is executive element of access control and management system (ACS), which is designed to prevent unauthorized persons from entering premises. In general, electric lock is almost no different from regular one. Suffice it to say that electric locks can also be mortise and padlocks, can be operated with push or fixed handles, and can be opened with key. Most of these devices have popular dimensions of conventional mechanical locks – backsets, center spacing, and bar sizes. The main difference is additional control method.

To operate electrical part, lock must be supplied with power source, which is connected to control device on other side. These devices can be various elements of access control system that person interacts with to get into room: magnetic card reader, biometric sensor, code-entry keyboard, key fob, button, or even remote control with smartphone. The lock opens or closes when electric current is applied or turned off. This creates main advantage and reason why such locks are used – they allow you to open door remotely and without using mechanical key. The principle of electric locks operation in Fig. 1.

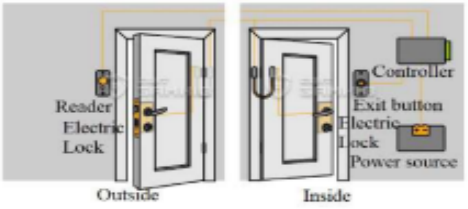

Fig. 1. Principle of electric locks operation

The main thing you need to know about operation of electric locks depending on power supply or removal is that they are divided into "normally closed", "normally open" and "universal".

Normally closed means that lock is unlocked when electrical signal is applied. In its absence, lock is closed.

Normally unlocked. When electrical signal is present, lock remains closed, and when signal is stopped, it opens.

Рисунок А.6 – Перший аркуш

Universal. Such devices havea switch that allows you to independently set desired operating mode.

III. INSTALLATION FEATURES OF ELECTRIC LOCKS

When installing electronic locks, it is important not only to choose reliable system, but also to perform installation work correctly. The quality of installation directly affects functionality and durability of lock, as well as its security and ease of use. Failure to comply with technological requirements during installation can lead to system malfunctions, reduced security, or premature equipment wear. In this section, we'll look at key features of installing electric locks that will ensure optimal operation of access control system and avoid common mistakes.

To begin with, let's consider first option, Scheme 1 – simplest electromechanical lock switching scheme, which can be used to provide remote door opening (Fig. 2) [11-13]. Among peculiarities, it should be noted that sufficiently powerful power supply is required for stable operation. Also note that long press on button (more than 3-5 seconds) will in most cases cause lock's retraction relay to burn out.

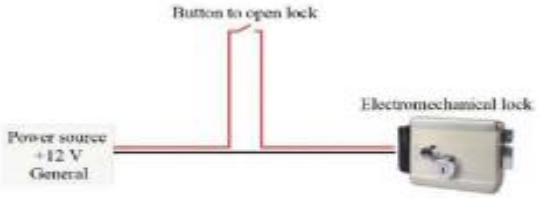

Fig. 2. Connecting electromechanical lock using power supply unit for remote door opening

Next, let's review Scheme 2 for electromechanical lock in more correct version, using lock control unit (LCU) (Fig. 3) [11-13]. This option allows you to use conventional power supply, and also limits duration of voltage supply to lock itself. In this case, lock control unit is placed in lock body or in close proximity to it. Among disadvantages of this installation is failure of security lock, which is common due to their low cost and quality of assembly, which, however, depends on delivery batch.

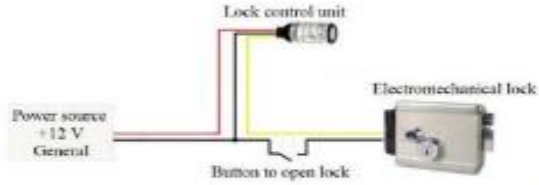

Fig. 3. Connecting electromechanical lock using power supply unit and remote control unit for remote door opening

The third option is Figure 3, and here you can see "classic" (and already outdated) connection scheme for video intercom and electromechanical lock (Fig. 4) [11-13]. This type of connection was widely used before appearance of lock control units (LCUs) on market, and it has same design flaws as option shown in Scheme (Fig. 2) [11-13]. It should be noted that most modern intercom systems control lock using call panel.

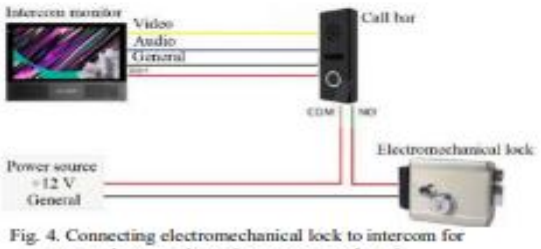

Fig. 4. Connecting electromechanical lock to intercom for remote door opening using power supply unit

The fourth option – Scheme 4 reflects modern (and most correct) option for connecting video intercom and electromechanical lock (Fig. 5).

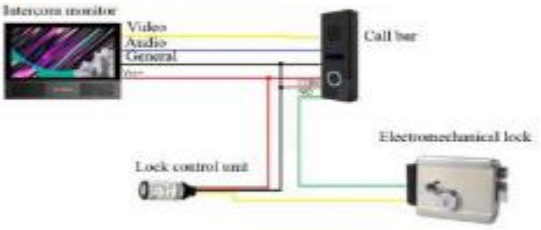

Fig. 5. Connecting electromechanical lock to intercom for remote opening of door using LCU

The advantage of this scheme, in addition to those described in explanation to scheme 2, is that there is no need to lay additional cable from intercom to call panel – to provide power to lock.

IV. OVERVIEW OF TYPES OF ELECTRONIC LOCKS

In modern access control systems, electronic locks play key role, offering wide range of solutions for different needs. The choice of appropriate type of lock depends on many factors, such as security requirements, type of room, and features of use.

There are several main types of electronic locks, each of which has its own advantages and scope of application.

So, let's review most common types of electronic locks to determine their functionality and capabilities, as well as analyze which of them are most suitable for specific operating conditions.

One of the most common types of electronic locks are combination locks (Fig. 6) [14, 15]. They work on basis of entering pre-set code. This is fairly easy-to-use option,

Рисунок А.7 – Другий аркуш

as user doesn't need to carry physical key or other media to access. For most part, these locks are used in buildings where speed and ease of access are important, such as apartment buildings or offices with large number of users. However, combination locks also have their drawbacks. For example, there is risk that attackers may pick up code or otherwise obtain it, so it's important to change codes regularly to provide additional protection.

Fig. 6. Code lock

Another type of electronic locks are systems that use radio frequency identification (RFID) or magnetic cards (Fig. 7). In this case, user attaches card or key fob to special reader to open lock. This approach is very popular in hotels, offices, and facilities with large number of people. RFID-based locks are convenient because they provide quick access and can be configured for specific duration of card, for example, for guest access. However, these systems also have their drawbacks, including risk of losing or copying card, which can pose threat to security of facility.

Fig. 7. RFID lock

One of most modern and secure options for electronic locks is biometric systems (Fig. 8). They work based on recognition of person's unique characteristics, such as fingerprints, face, or iris. The main advantage of such locks is high security, since biometric data cannot be lost or copied, as is case with cards or keys. In addition, such systems are often used in conjunction with other access methods, such as passwords or RFID cards, which increases overall level of protection. However, biometric locks are more expensive than traditional electronic systems and may have limitations due to recognition errors, such as skin damagor change in user's appearance.

Fig. 8. Biometrical lock

In recent years, smart locks (Fig. 9), which work through mobile applications using Bluetooth or Wi-Fi technologies, have become very popular. Such locks allow user to remotely control access to room via smartphone, which is especially convenient in cases where it is necessary to grant access to another person or track use of lock in real time. Smart locks integrate into smart home systems, ensuring synchronization with other devices such as surveillance cameras or alarm systems. However, they also have their weaknesses, as they need constant access to Internet or battery power to work correctly, which can lead to temporary loss of access due to technical failures or exhaustion. Additionally, these systems can be targeted by hackers, making them vulnerable to cyberattacks.

Fig. 9. Wi-fi lock

In addition to basic types of locks, there are combined systems that combine several authentication methods, such as entering code, attaching card, or using biometric data. Such solutions allow for increased security, as users

Рисунок А.8 – Третій аркуш

need to go through several layers of protection to gain access to premises. These systems are most often used in facilities with increased security requirements, such as banks, government agencies, or large corporate offices.

In general, choice of electronic lock system depends on specifics of object, security needs, and ease of use. Each type of lock has its own advantages and disadvantages, and final solution must consider balance between cost, convenience, and level of protection required for particular situation.

V. CONCLUSIONS

In this analysis, principles of operation and features of installation of electric locks were considered, as well as overview of different types of electronic locks was provided. This comprehensive review serves several important purposes. Firstly, it helps to understand basic mechanisms and advantages of electric locks in access control systems. Second, it highlights critical installation considerations to ensure optimal functionality, safety, and longevity of these systems. Finally, by researching different types of electronic locks – from combination and RFID locks to biometric and smart lock systems – we have provided framework for selecting most suitable lock based on specific security needs, usage scenarios, and technological preferences. This research is critical to making informed decisions in implementing efficient and effective access control solutions in variety of applications, from residential to commercial high-security environments.

Additionally, this study emphasizes importance of balancing security, convenience, and cost when implementing electronic lock systems. We've discussed how different types of locks can be integrated into broader security ecosystems, such as video intercoms and smart home networks, showcasing versatility and adaptability of modern access control solutions. The analysis of installation schemes and common pitfalls serves as practical guide for professionals in field, helping to avoid potential issues and ensure reliable system performance.

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Рисунок А.9 – Четвертий аркуш

ДОДАТОК Б
Демонстраційний матеріал у вигляді презентації

№	Позначення	Найменування	Дод. відомості
		Текстові документи	
1	ГЮІК. 443221.014 ПЗ	Пояснювальна записка	53 с., ф. А4
2		Додаткові матеріали	
		Демонстраційний матеріал у вигляді презентації	у форматі 12 с ., ф. А4

Змін	Арк	№ документа	Підп.	Дата	ГЮІК. 443221.014 ПЗ			
Розроб.		Львов А.А.			Розроблення комп'ютеризованої системи управління складним електронним замком на базі Arduino з використанням штучного інтелекту	Літ.	Аркуш	Аркушів
Перевір.		Сотник С.В.						
Н. контр.		Стародубцев М.Г.				ХНУРЕ Кафедра КІТАР		
Затвер.		Невлюдов І.Ш.						