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Факультет аеронавігації, електроніки та телекомунікацій
Кафедра авіаційних комп'ютерно-інтегрованих комплексів

ДОПУСТИТИ ДО ЗАХИСТУ
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_____ Віктор СИНЄГЛАЗОВ
" ____ " _____2023 р.

КВАЛІФІКАЦІЙНА РОБОТА
(ПОЯСНЮВАЛЬНА ЗАПИСКА)

ВИПУСКНИКА ОСВІТНЬОГО СТУПЕНЯ
"БАКАЛАВР"

Спеціальність 151 "Автоматизація та комп'ютерно-інтегровані технології "
Освітньо-професійна програма "Комп'ютерно-інтегровані технологічні процеси і виробництва"

Тема: "Система забезпечення безпеки житлового приміщення"

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Київ - 2023

MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE

NATIONAL AVIATION UNIVERSITY

Faculty of Aeronautics, Electronics and Telecommunications

Department of aviation computer-integrated complexes

ADMIT TO DEFENSE

Head of the graduation department

_____ Viktor SINEGLAZOV

"____" _____2023

QUALIFICATION WORK

(EXPLANATORY NOTE)

GRADUATE DEGREE OF EDUCATION

"BACHELOR"

Specialty 151 "Automation and computer-integrated technologies"

Educational and professional program "Computer-integrated technological processes and production"

Theme: "Security system of the residential premises"

Executor: _____ student of group KP-404Ba Alina ZAHORNA

Supervisor: _____ senior teacher Mykola VASYLENKO

Normocontroller: _____ Mykola FILIASHKIN

Kyiv - 2023

НАЦІОНАЛЬНИЙ АВІАЦІЙНИЙ УНІВЕРСИТЕТ

Факультет аеронавігації, електроніки та телекомунікацій

Кафедра авіаційних комп’ютерно-інтегрованих комплексів

Освітній ступінь: бакалавр

Спеціальність 151 «Автоматизація та комп'ютерно-інтегровані технології»

Освітньо-професійна програма «Комп’ютерно-інтегровані технологічні процеси і виробництва»

ЗАТВЕРДЖУЮ

Завідувач кафедри

_____Віктор СИНЄГЛАЗОВ

“ ____ ” _____2023 р.

ЗАВДАННЯ

на виконання кваліфікаційної роботи студента

Загорної Аліни Романівни

1. Тема роботи: “Система забезпечення безпеки житлового приміщення”.

2. Термін виконання роботи: з 22.05.2023р. по 15.06.2023р.

3. Вихідні дані до роботи: Типи датчиків охоронних систем, тип та площа приміщення що охороняється, режими роботи охоронної системи.

4. Зміст пояснювальної записки (перелік питань, що підлягають розробці): Теоретико-методичні засади та актуальність системи забезпечення безпеки; Сучасні системи безпеки; Типове охоронне обладнання; Система охоронної сигналізації.

5. Перелік обов’язкового графічного матеріалу: Структура охоронної системи, розміщення елементів охоронної системи, алгоритми роботи охоронної системи.

6. Календарний план-графік:

№	Завдання	Термін виконання	Відмітка про виконання
1.	Отримання завдання	22.05.2023–23.05.2023	
2.	Формування мети та основних завдань дослідження	23.05.2023–25.05.2023	
3.	Теоретико-методичні засади та актуальність системи забезпечення безпеки	25.05.2023–27.05.2023	
4.	Сучасні системи безпеки	27.05.2023–29.05.2023	
5.	Типове охоронне обладнання	29.05.2023–31.05.2023	
6.	Система охоронної сигналізаці	31.05.2023–09.06.2023	
7.	Оформлення пояснювальної записки	09.06.2023–11.06.2023	
8.	Підготовка презентації та роздаткового матеріалу	11.06.2023–15.06.2023	

7. Дата видачі завдання:

Керівник: _____ Микола ВАСИЛЕНКО

Завдання прийняв до виконання: _____ Аліна ЗАГОРНА

NATIONAL AVIATION UNIVERSITY

Faculty of Aeronautics, Electronics and Telecommunications

Department of aviation computer-integrated complexes

Educational degree: Bachelor

Specialty 151 "Automation and computer-integrated technologies"

Educational and professional program "Computer-integrated technological processes and production"

APPROVED

Head of Department

_____ Viktor SINEGLAZOV

"____" _____2023

TASK

For the student's qualification work

Zahorna Alina Romanivna

1. The thesis title: "Security system of the residential premises".

2. The term of the project: from 22.05.2023 until 15.06.2023

3. Output data to the project: Types of sensors of security systems, type and area of the protected premises, modes of operation of the security system.

4. Contents of the explanatory note: Theoretical and methodological principles and relevance of the security system; Modern security systems; Typical protective equipment; Security alarm system.

5. List of required illustrative material: The structure of the security system, the placement of security system elements, the security system's work algorithms.

6. Planned schedule.

№	Task	Execution term	Execution mark
1.	Getting the task	22.05.2023–23.05.2023	
2.	Formation of the purpose and ma objectives of the study	23.05.2023–25.05.2023	
3.	Theoretical and methodological principles and relevance of the security system	25.05.2023–27.05.2023	
4.	Modern security systems	27.05.2023–29.05.2023	
5.	Typical protective equipment	29.05.2023–31.05.2023	
6.	Security alarm system	31.05.2023–09.06.2023	
7.	Preparation of an explanatory not	09.06.2023–11.06.2023	
8.	Preparation of presentation and handouts	11.06.2023–15.06.2023	

7. Issue date of the task

Supervisor: _____ Mykola VASYLENKO

The task was accepted by: _____ Alina ZAHORNA

РЕФЕРАТ

Пояснювальна записка до дипломного проекту “Система забезпечення безпеки житлового приміщення”: сторінок - 60 , рисунків - 16 , таблиць - 5, джерел посилань - 10 .

Об'єкт дослідження:

Технології охоронних систем житлових приміщень.

Предмет дослідження:

Система охорони приміщень.

Мета дослідження:

Аналіз існуючих охоронних систем та розробка охоронної системи приватного будинку з додатковим функціоналом.

Ключові слова:

Система охоронної сигналізації, безпека, захист, контроль та управління доступом, охоронне відеоспостереження, інженерно-технічне укріплення.

ABSTRACT

Explanatory note to the diploma project "Security system of the residential premises": pages - 60, figures - 16, tables - 5 , reference sources - 10.

Object of research:

Technologies of residential security systems.

Subject of research:

Premises security system.

Purpose of the work:

Analysis of existing security systems and development of a security alarm system for a private house with additional functionality.

Keywords:

Security alarm system, security, protection, access control and management, security video surveillance, engineering and technical fortification.

CONTENT

LIST OF TERMS, ABBREVIATIONS, TERMS

SAS - security and alarm system

ACMS - access control and management system

SVSS - security video surveillance system

SETF - system of engineering and technical fortification

IR - infrared

SPU - signal processing unit

GSR - glass break sensor

AE - acoustic emitter

AR - acoustic receiver

PIR - passive infrared

INTRODUCTION

The modern period is characterized by a significant deterioration of the criminal situation in our country, which is due to the difficult financial situation in the country and in the world in general. Most of the crimes are cases of encroachment on property. In such circumstances, people have to take care of their own safety and the safety of their property, since it is impossible to count on the efficiency and competence of law enforcement agencies. However, in our country there are a number of professional organizations that specialize in security systems and measures of any level and specificity. Thanks to timely information, you can minimize the consequences of emergency situations and save people's lives and their property. This is achieved with the help of security systems, in particular security alarm systems.

To ensure personal, home and business security, there is a wide selection of modern devices on the market that reliably protect against uninvited guests, be it a house, office, garage or other objects. However, even if highly effective technical means are used, improper installation will not be able to provide adequate property protection. Therefore, for full security, it is necessary to follow certain measures and rules in everyday life, which are not complicated. In addition, the installation of security alarms should be entrusted to professionals in this field.

Today, technologies are rapidly developing, which allow creating more and more systems that provide early warning of adverse events. There are many life situations that do not always cause joy. To avoid negative consequences, a person must be informed in a timely manner.

When developing any security system, all technical solutions must comply with environmental, sanitary-technical, fire-fighting and other regulations in force on the territory of Ukraine, and ensure safe operation of the object, which does not threaten the life and health of people.

In our world, it is extremely important to have an alert system for various natural disasters. But the next important notification is about trespassing on private property. Property is valuable for a person, so he prioritizes its protection.

CHAPTER 1. THEORETICAL AND METHODOLOGICAL PRINCIPLES AND RELEVANCE OF THE SECURITY SYSTEM

1.1 The concept of a security system

The security system is a complex of interrelated technical, organizational and legal measures aimed at ensuring the security of an object, such as a residential premises. It includes a variety of components and systems that work together to reduce hazard risk and protect occupants and property.

The main goal of the security system is to prevent unwanted events that may threaten the life, health or property of people, as well as to improve the speed and efficiency of responding to unforeseen situations. Such a system may include the following elements:

Physical Security: This includes a variety of measures and devices to physically protect the living space, such as alarms, locks, access control systems, window bars, fences, and other means to prevent unauthorized entry.

Fire protection: Includes fire detection systems, smoke detectors, fire detectors, automatic circuit breakers, fire sound and warning systems, fire extinguishers and other means of preventing and extinguishing fires.

Video surveillance: It is used to ensure control over the object and detect unwanted events. It includes the installation of surveillance cameras, video recording, real-time monitoring and the ability to preserve the evidence base.

Alarm systems: These are designed to detect unwanted events such as intrusion, fire, flooding or other emergency situations. Alarm systems can include motion sensors, door and window opening sensors, water flow sensors, etc. When the alarm system is triggered, an alarm is activated, which notifies residents and relevant services.

Communication Systems: Include communication systems that allow residents to quickly and effectively communicate with security services, police, fire or medical personnel in the event of an emergency.

Access control: Access control systems allow you to limit the possibility of entering a living space. These may include access cards, biometric systems, combination locks, or other technologies that verify an individual and their authorization to enter.

Automated management systems: The use of modern technologies and automation systems allows for more effective management of the security system, providing automatic response to certain events and setting up predictable scenarios.

The relevance of the residential security system stems from the need to protect life and property, reduce the risk of criminal activity, and ensure the comfort and peace of residents. Thanks to the constant development of technology and increased security awareness, security systems are becoming more accessible, efficient and integrated. They play an important role in creating a safe environment, preventing and responding to emergency situations, as well as providing control and protection of the facility.

1.2 Functions of the security system

The functions of a residential security system include a variety of tasks and objectives aimed at ensuring the safety of residents and property. The main functions of the security system include:

Detection: The function of detection is to detect potential threats and hazards in the living space. This can be the movement of people, a break-in, a gas leak, a fire or other dangerous situations. The detection system uses different types of sensors and devices to monitor and observe the environment.

Notification: The notification function provides for quick and efficient transmission of information about detected danger to residents and relevant security services. This can be an audible or visual alarm, a mobile device alert, an automatic call to emergency services, or other notification methods.

Prevention: The function of prevention aims to prevent risks and hazards by taking preventive measures and safety measures. This may include access control, use

of video surveillance cameras, automatic shutdown of electrical appliances, detection of gas or water leaks, etc.

Response: The response function provides a quick response to identified hazards and immediate measures to neutralize them or minimize their consequences. This may include automatic activation of the fire alarm, calling of emergency services, disconnection of power supply systems, activation of emergency lighting systems and other measures.

Monitoring: The monitoring function involves constant control and monitoring of security systems, their performance and condition. This may include checking the operation of sensors, video surveillance cameras, batteries, alarm systems and other equipment.

Data recording and storage: The data recording and storage function allows you to record events that occur in the living space for further analysis and use. This can be video recording from video surveillance cameras, audio recording, event logs and other data that can be useful for determining the causes of incidents and taking appropriate measures.

1.3 Types of security systems

There is a wide range of different types of security systems that can be used in residential premises. Below are some of the main types of such systems:

Video surveillance systems: They use video surveillance cameras to monitor and record events in the living space. These systems allow residents to monitor exterior spaces, front doors, hallways, and other sensitive areas, which can provide a sense of security and detect unusual activity.

Access control systems: These include the use of access cards, biometric identifiers (such as fingerprints or eye scanners) or combination locks to restrict access to a residential area. This allows only authorized persons to enter the house or apartment, preventing unauthorized access.

Alarm systems: These are used to notify when a danger or intrusion is detected. These can be sound or visual signals that immediately attract the attention of residents and surrounding people. Some alarm systems can also automatically send messages to mobile devices or call emergency services.

Gas and smoke detection systems: These systems use special sensors to detect gas leaks or the presence of smoke, which may indicate a fire or other danger. When the sensor is triggered, the system automatically notifies the occupants and activates the alarm systems, allowing timely response to the danger.

Automatic appliance shut-off systems: These systems turn off electrical appliances such as stoves, irons or heaters if they are left unattended for a long period of time or if suspicious changes in energy consumption are detected. This can prevent fires caused by carelessness or faulty electrical appliances.

Automatic lighting systems: These systems include automatic lighting when motion is detected or light changes are detected. They can be particularly useful in corridors, stairwells or driveways, providing safety and comfort when moving around in the dark.

Fire safety systems: These systems include smoke detectors, fire extinguishers, automatic sprinkler systems or fire alarm buttons. They are designed to detect fire early and respond immediately, helping to prevent fire from spreading and endangering residents.

These different types of security systems interact with each other, forming a complex security system that provides protection for residential premises and their residents. The combination of different types of security systems allows you to effectively detect, notify and respond to potential threats, ensuring a high level of security in residential premises.

1.4 Approaches to the analysis of security systems

Various approaches can be used to analyze security systems, depending on the purpose of the analysis. Here are some possible approaches to analyzing security systems:

Technical approach: The analysis focuses on the technical aspects of the security system, such as the use of devices, technologies, hardware and software. The efficiency, reliability and functionality of the system are evaluated.

Physical approach: The physical environment of the living space is analyzed, including architectural features, the location of entrances, windows, and exterior spaces. It determines how these factors affect security and how physical protection can be improved.

Organizational approach: The organization and management of the security system is analyzed. Includes security policies, procedures, staff training and communication processes. The efficiency of the system is evaluated taking into account the human factor.

Information approach: The collection, processing and transmission of information in the security system is analyzed. Includes evaluation of data collection tools, monitoring, analysis and notification systems. Protection of information against unauthorized access is also analyzed.

Risk-oriented approach: Analyzes potential threats and security risks for the living space. The probability of occurrence of events, their impact and possible consequences is determined. Strategies and measures are being developed to reduce risks.

Social approach: The interaction between the security system and the residents of the residential premises is analyzed. The degree of participation and interaction of residents with the security system, as well as their perception and behavior regarding security, is determined.

These approaches to the analysis of security systems help to understand various aspects of their functioning and effectiveness. Comprehensive analysis provides the

opportunity to identify potential problems and develop effective strategies to improve security in residential premises.

1.5 Conclusion

Therefore, the theoretical and methodological principles of the security system are the fundamental principles that support security in the modern world. The relevance of this system lies in its ability to adapt to changing threats and provide protection against modern security challenges.

The security system must adapt to constant changes in society, to technological progress and the emergence of new threats, use new technologies, develop effective techniques for countering threats, and provide reliable protection. This covers aspects such as cyber security, information protection, physical security, network security, counter-terrorism and many others.

CHAPTER 2. MODERN SECURITY SYSTEMS

2.1 Security and alarm system

With the help of a security and alarm system, it is possible to carry out round-the-clock monitoring of any object - an apartment, a cottage, an office, a warehouse, etc. SAS is a reliable way to protect the protected object from intrusion.

SAS is divided into two types:

Active security system: This type of system is designed to actively intervene and prevent illegal entry. It includes devices that directly affect potential attackers or create obstacles and delays for their actions. Examples of active security systems include real-time video surveillance, access control systems using access cards or biometric identification, security alarms with direct notification of security services or law enforcement, and electronic locking systems or panic buttons.

Passive security system: This type of system is designed to detect and warn of potential threats or intrusions, but does not take active measures to prevent them. It includes devices and security measures that create barriers or serve as indicators to deter intruders and provide warning. Examples of passive security systems include the installation of video surveillance cameras, motion sensors, door and window sensors, security lighting, fences and locks, as well as signs about the presence of a security system.

Examples of active SASs include:

Alarm systems: This includes panic buttons or control panels that allow you to activate an alarm in the event of an emergency. Alarms can be directed to a place where guards or security services are located for quick response.

Motion sensors with automatic actions: When motion is detected, sensors can activate automatic actions such as turning on lights, closing doors, starting a video recording system or sounding warnings. This can help deter trespassers and prevent further entry.

Automatic access blocking: This includes systems that automatically block access to certain areas or premises in the event of a danger or alarm situation. This can be achieved, for example, by closing automatic doors, activating electromagnetic locks or controlling access control systems.

Video surveillance systems with automatic analysis: An additional function of active video surveillance systems can be the use of computer vision algorithms for automatic video analysis and detection of suspicious actions or situations. For example, the system can automatically recognize moving objects or certain patterns of behavior and trigger an alarm or take other appropriate actions.

Use of physical barriers or obstructions: An active security system may include the installation of barriers such as spikes, barriers, or barriers that are activated to prevent intrusion or restricting access to the object.

Examples of passive SAS include:

Video surveillance: Installation of surveillance video cameras allows you to monitor and record what is happening at the object. They can be placed in prominent places to deter potential intruders and warn of the presence of a security system.

Motion sensors: Motion sensors detect the presence of movement in a given area and can activate alarms or lighting devices. They can be installed at entrances, windows or other vulnerable places.

Door and window opening sensors: Opening sensors detect when doors or windows are opened or closed. They can activate the alarm or report it through the access control system.

Security lighting: Installing special lighting, such as floodlights or moving light sensors, can deter intruders and make it easier to detect suspicious activity.

Fencing and locks: Physical barriers such as fences, bars, shutters or strong locks create additional barriers to illegal entry and can deter potential intruders.

Signs about the presence of a security system: Placing signs about the presence of a security system in prominent places can serve as a warning and deter potential intruders.

As a rule, these two types of security systems are used in combination to provide the best level of security. Passive systems detect and signal potential threats, and active systems take measures to immediately prevent and respond to them.

2.2 Access control and management system

An access control and management system is an active security system used to restrict and control access to certain areas, premises or resources. It provides authorized persons with access to protected areas and at the same time prevents unauthorized access.

The main components of ACMS include:

Identification devices: These can be access cards, key fobs, biometric readers (fingerprints, retina scanners, facial recognition, etc.) or coded keypads. They allow users to pass through checkpoints.

Readers: These are devices that read information from identification devices and transmit it to the access control system for authentication.

Access controllers: These are central devices that manage the access control process and make decisions about whether to allow or deny access. They process information from readers and are connected to the management system.

Locks and door opening mechanisms: ACMS can be integrated with electromagnetic locks, electromechanical locks, electric drives or other devices that provide controlled access to the area.

Management software: The access control and management system runs on special software that manages all components and provides access rights settings, event recording and system monitoring.

ACMS allows organizations to effectively manage access of employees, visitors and third parties, ensuring facility security and protection of confidential information. It also allows you to log access events, create reports, and analyze data for security and management purposes.

2.3 Security video surveillance system

The security video surveillance system provides surveillance of the object with the help of video cameras. Moreover, it is possible to observe several points at the same time: for example, the main and additional entrances to the house, the gate, the perimeter and individual rooms.

The main components of SVSS include:

Surveillance cameras: Installed in strategic locations to capture video images. Cameras can be of various types, including fixed, panning, close-up, and hidden cameras. They record everything that happens at the facility and transmit the video signal to other devices for viewing and archiving.

Monitors: Used to view the video signal from the camera. They can be installed at the place of observation, as well as in other places for centralized control and monitoring.

Video recorders: designed to record and store video data received from cameras. Video recorders provide the ability to save video on a hard disk or other media, as well as to play it back as needed.

Network devices: Includes switches, routers and other network equipment that provides video data transmission over the network, as well as the possibility of remote access to the video surveillance system.

Software: Used to control and monitor the SVSS. It allows you to view videos, adjust the parameters of cameras and video recorders, as well as perform analytical functions such as motion detection, face recognition, and others.

The main task of the SVSS is to ensure the safety of the object by means of visual observation and obtaining visual information about the situation at the object. In addition to up-to-date information, SVSS provides an opportunity to analyze events that have already taken place, as all information from the cameras is usually recorded and can be viewed at any time.

Today there are several types of video surveillance - home, street, hidden. According to the method of signal processing, the systems are divided into analog,

combined and digital. The latter are the most advanced and necessary, as they provide high image quality, high speed access to the archive, the possibility of remote viewing and integration with other security systems.

According to the method of transmitting the video signal, SVSSs can be wired or wireless. Wireless systems can be installed in hard-to-reach places, but wired systems are more reliable and cheaper.

2.4 System of engineering and technical fortification

The system of engineering and technical fortification is a complex of measures and structures designed to ensure the protection and strengthening of the territory, objects and structures from various threats and dangers. It includes various engineering and technical solutions aimed at creating barriers to potential attacks, intrusions or adverse impacts.

Ideally, each SETF should have 5 protected zones:

- territory perimeter;
- building perimeter;
- premises available to visitors;
- premises available only to the owners of the house;
- premises with the most limited access - weapons, safes.

SETF includes various elements to ensure security and protection of protected areas and objects. Such as:

Barriers and fences: These are physical barriers, such as fences, enclosures, walls, gratings and barriers, that create barriers to unauthorized access to a protected area or facility. They can be made of various materials, including metal, concrete, wood and others.

Video surveillance: Video surveillance systems, including cameras and video recorders, are used to monitor and control the protected area. They can be installed in strategic locations to capture video and record the actions of violators.

Sensors and alarms: Motion sensors, intrusion sensors, intrusion sensors, heat sensors and other devices are used to detect illegal access or dangerous situations. They can be connected to alarm systems that are activated when certain events occur.

Lighting: Good lighting plays an important role in ensuring safety. Lighting devices can be installed in the protected area to provide sufficient visibility and deter potential trespassers.

Access control: Access control systems such as electronic locks, access cards, biometric systems and others are used to restrict and regulate access to a protected area or inside facilities.

Alerting and communication systems: In the event of a threat or emergency, it is important to have alerting and communication systems to quickly inform security, security services or other responsible persons. It can be emergency communication systems, loudspeakers, warning devices, etc.

The purpose of the system of engineering and technical fortification is to create obstacles, detect and prevent threats, as well as to ensure control and response to possible dangers. It helps ensure the safety and protection of protected objects, territories and people.

2.5 Conclusion

In general, to ensure complete home security, it is recommended to combine different types of security systems. For example, a combination of Security and alarm systems, Access control and management system, Security video surveillance system, and System of engineering and technical fortification can provide comprehensive protection that allows you to control access, detect potential incidents, provide visual data, and create physical barriers for potential attackers. The specific choice of security systems depends on the individual needs and characteristics of each specific home.

CHAPTER 3. TYPICAL PROTECTIVE EQUIPMENT

3.1 Standards of security systems

Since 2010, Ukraine has been developing its own series of standards on the basis of the European group of standards EN 50131, and it is called, accordingly, DSTU EN 50131. At the moment, in open sources it was possible to find two adapted, officially accepted and translated into Ukrainian standards, these are DSTU EN 50131-1 Alarm systems. Security alarm systems. "General requirements" and DSTU EN 50131-6 Alarm systems. Security alarm systems. Power sources. Moreover, the same standard for power sources, DSTU EN50131-6, was adopted in 2014 and entered into force only in 2016, canceling the Soviet GOST 26342-84 and GOST 27990-88. There are references to other standards related to detectors in regulatory documents, and apparently they are even officially adopted in Ukraine, but there are only English-language versions on the Internet.

The standard used by security alarm manufacturers in the past was called BS (British Standards) 4737 or 7042 for enhanced security and BS 6799 for wireless systems. These standards have been replaced by the European Standard, series EN 50131. It contains a set of European standards, according to which companies engaged in the installation of security systems can inspect, install and maintain facilities. European Standards currently have a document called PD 6662 which shows the part of the British Standards where the European Standards are not applicable. European standards have been adopted by the Insurance Industry and the Association of British Insurers is now pushing for companies to follow them too. The Association of British Insurers believes that because European standards are "risk-based", they form a better framework for the technical design of safety systems.

The main differences between EN 50131 and BS 4737 are:

1) Structured standards

2) Classification of systems

3) Equipment classification

4) Risk-based

This provides a structured approach to building security systems:

1) Risk assessment

2) Technical review

3) System design

4) Installation of the system according to the agreed specification

5) Installation of equipment in accordance with the manufacturer's recommendations

A significant advantage for insurers and installers applying European standards to security systems is the specification of levels corresponding to a certain risk. One of the main differences in the European Standards is the Classification of Systems, which is not characteristic of BS 4737.

System classification based on structured risk analysis determines:

1. System size

2. Transmission of signals

3. Security in case of intervention

There are four levels of security in the new European Standards:

Grade 1. The simplest alarm. The equipment is cheap but performs its functions. Obvious ways of penetration, such as doors and windows, should be blocked by sensors. The system should protect the premises from inexperienced attackers. Suitable for protecting objects with a minimal risk of robbery.

Grade 2. More complex equipment, various types of sensors that can duplicate or complement each other. The alarm must perform its functions of protection against experienced intruders who can use special equipment. Grade 2 - the most common class, excellent for the protection of apartments, houses, offices, shops.

Grade 3. The alarm must resist intruders, have professional skills, special equipment for bypassing security systems, and must be protected from sabotage. Sensors should block not only obvious ways of entering the premises, but also hypothetical ones, such as ceilings, passages from basements, technical and

communication hatches. Such a system is designed to protect large financial institutions, such as shopping centers, bank branches, jewelry stores, etc.

Grade 4. The system must withstand professional groups or even terrorist attacks. The category of protected objects can include money vaults, mints, and state institutions connected with special services. Grade 4 is practically never applied to ordinary objects, because the requirements are very strict and specific.

Depending on the system level, the number of maintenance visits will be:

Level 1 — 1 visit per year

Level 2x — 1 visit per year

Level 2 and 3 — 2 visits per year, or 1 visit + 1 remote

Level 4 — 2 visits per year

Further inclusion in the European Standards is the classification of components used to install a security alarm system. They are classified depending on where they will be mounted.

There are four classifications of components:

Class 1= Indoors where the temperature is controlled

Class 2= Indoors where the temperature is not controlled

Class 3= Outdoors, protected

Class 4= Outdoors, not protected

In order to obtain information about an alarming situation at the object, the alarm system includes detectors that differ from each other in the type of controlled physical parameter, the principle of operation and the method of information transmission. Each type of detector has its own list of main unique technical characteristics defined by the relevant standards. The market of modern technologies is quite saturated with a variety of technical solutions, at the same time, even sensors of the same type differ in the design features of their components, ease of use, reliability, and level of design, which is taken into account when choosing a particular device or manufacturer.

3.2 Detectors of security systems

The level of reliability of any security system and its operation as a whole depend on what sensors and detectors are used in them, where they are placed in the protected area.

It is customary to understand sensors as detectors that convert physical values and characteristics (for example: heat, light, sound, physical movements, vibrations, shocks) into an electrical signal.

There are different types of sensors. Electrical contact sensors that work to open or close contacts, sensors made of thin wire or foil that break when mechanically affected (ohmic detectors) have been known for a long time.

In modern systems, more and more preference is given to non-contact sensors and detectors. These include passive and active IR motion detectors, radio wave detectors, vibration and glass breakage detectors, ultrasonic, magnetic contact and photoelectric sensors. Modern sensors and detectors are made on the basis of the latest achievements of science and technology. They have not only high technical characteristics, but also a beautiful design. Motion detectors allow you to register the occurrence of movement on the protected object.

There are several types of them that differ in the principle of motion registration: ultrasonic detectors, passive and active detectors with an IR sensor, detectors with a radio wave sensor, and their combinations.

Ultrasonic detectors have a fairly high sensitivity. They emit and receive a reflected ultrasonic signal and allow to register even a small air flow. In this connection, there is a problem of immunity, any slight movement or draft of air leads to the activation of the sensor and a false alarm.

Currently, motion detectors based on IR sensors are widely used. They are activated when a moving object emitting heat (for example, a person) hits the sensor's sensitivity zone. IR motion detectors provide reliable protection of a large area, have a modern design that fits well into the interior of an apartment or office.

Sensors can also be classified by their installation location on the object. External sensors for monitoring the perimeters of territories (perimeter sensors) are usually installed in combination with fences made of metal mesh or gratings and react to various influences, such as shaking. For the protection of territories and buildings, hidden sensors installed in the soil or its covering, in walls and building structures are used. Internal sensors are used to protect the perimeters of buildings and premises, to control internal spaces and objects. They act in the same way as external sensors, but differ in design and technological characteristics.

Ohmic, magnetic and shock contact detectors are among the simplest. They are a thin metal conductor specially fixed on the protected object. Any physical action on the protected object leads to a break in the conductor.

Ohmic detectors AL-1-T-0.02x10 "Foil", "Foil-S" are designed to block glass constructions from breaking, which are subject to the influence of vibration and impact interference in rooms where there are no high requirements to the interior (warehouses, industrial and commercial premises).

Blocking with aluminum foil is made by gluing it along the perimeter of the window glass. When protecting slots in glass blocks, the foil must be glued in the middle of each glass block. The foil is glued to the glass with "Kontakt" glue or similar from the inside of the frames (doors) on the side of the protected room. To connect to the security alarm loop, the tape is clamped in a special holder (clamp), which is glued to the same places as the foil.

The ohmic detector "Wire" is designed to protect building structures (doors, hatches, gates, walls, partitions, etc.). A wire with a cross-section of no more than 0.2 mm2 is used. The wire is laid on the inside of the building structures over the entire area. With the open method, the wire is attached directly to the surface of building structures with further protection against accidental (or intentional) damage with plywood sheets, etc. With the hidden method of laying, the wire is laid and fixed in holes with a depth and width of at least two diameters of the wire, followed by puttying of the hole and continuous painting of the surface.

Magnetic contact detectors are designed to block doors, windows, hatches, showcases of other movable structures from opening. The detectors can be used as trap sensors for blocking portable objects (museum exhibits, personal computers, etc.) as well as blocking steel structures (safes, fireproof cabinets, etc.).

The magnetic contact detector consists of a hermetic magnetically controlled contact and a permanent magnet in a plastic or metal non-magnetic case. Detector modules are attached directly to the surface of the object protected from the side of the room. Detectors are fixed on a wooden surface with screws, on a metal surface with screws with a 25-30 mm thick layer of insulating material, and on a glass surface with "Contact" glue. Reed switch and magnet modules are installed on the blocking element parallel to each other (detectors for open installation) — for detectors for hidden installation. Violation of the parallelism of magnetic contact detector nodes, their non-rigid fastening, poor-quality soldering or its replacement with a twisted cable can lead to false activation of the detectors.

Domestic industry produces magnetic contact sensors of the following types: SOMK-1-1 (Fig. 3.1); 3M; 8; 9; SOMK-3-1;4;11; ECMK-7EП;1E; 3E; 5E;

In addition to domestic sensors, SMK sensors from the TANE company are widely used, which supplies sensors of two types: with a standard working gap of 20 mm and with an extended working gap of 30 mm.

Fig. 3.1 Impact contact detector IOZOZ-5 "Window-6" and SOMK-1-1 reed switch

Shock contact detectors IO303-1 "Window-2M", IOZOZ-3 "Window-4", IOZOZ-4 "Window-5", IOZOZ-5 "Window-6" (Fig. 3.3) are designed for blocking glass sheets with an area of up to 20 m2 with memory of alarm notifications.

The detectors consist of a signal processing unit (SPU) and glass break sensors (GSR).

The location of the component parts of the detector (BOS and DRS) is determined by the number, relative location and area of glass sheets that need to be controlled.

Piezoelectric detectors are designed to block building structures against destruction or pressure; they form messages about permeation as a result of the transformation of the energy of elastic waves of the ultrasonic or sound range, which occur when an intruder attempts to destroy a protected structure.

Piezoelectric detectors IO311-1 "Gyurza-050", IO304-5 "Gyurza-050M" (Fig. 3.2) are designed for operation in closed heated rooms.

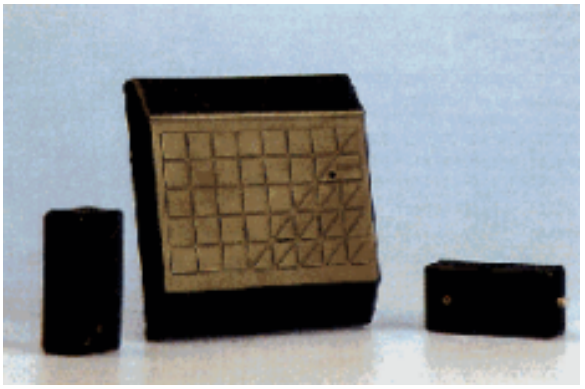

Fig. 3.2 Gyurza-050M piezoelectric detectors

These detectors are used to block historical, artistic and jewelry values, as well as individual building structures.

The principle of operation of the detectors is based on the registration of pressure changes during mechanical impact on objects. Thanks to the ability to adjust the level of sensitivity, the "Gyurza" detector can be used to protect miniature and fairly large objects. Two types of sensors are used in the detector. For mounting the

sensors, the delivery set includes clamps, hooks and a string. It is allowed to connect up to 40 sensors to the signal processing unit (SPU) of the detector.

Piezoelectric detector IO304-3 "Gran-2" is used to detect the destruction of monolithic concrete and brick walls and floors with a thickness of at least 150 mm, wooden structures made of boards with a thickness of 20-40 mm, plywood with a thickness of at least 4 mm and metal safes

The "Gran-2" detector has a block design and consists of a signal processing unit (SPU), seven sensors of vibration signals for detecting vibration that occurs in monolithic structures, three sensors of vibration signals with a sound guide for detecting vibration that occurs in a non-monolithic wooden structure .

Piezoelectric detectors IO313-1 "Sherekh-1", IO313-1A "Sherekh-1-1" are used to detect intentional destruction of building structures: concrete walls and floors, brick and wooden walls, safes and metal cabinets.

Detectors are installed inside the protected object in places protected from mechanical damage and access by outsiders. When choosing a place to install the detector, you need to know the specific features of the room (the shape and size of the room, the location of door and window openings, the thickness and material of walls, ceilings and other structures that are subject to blocking). The detector is installed on the structure using a special screw

Capacitive detectors are designed for blocking metal cabinets, safes, individual objects, and construction of protective fences. Their principle of operation is based on a change in the electric capacity of the antenna in case of approaching or touching the protected object.

Capacitive detector IO305-3 "Peak" (Fig. 3.3) is designed for blocking safes, metal cabinets, and gratings.

Fig. 3.3 Capacitive detector IO305-3 "Peak"

Due to the stepwise adjustment of capacity and sensitivity, the "Peak" detector adapts to the parameters of a specific protected object, which ensures a high detection capability of the detector. Automatic tracking of changes in the capacity of the protected object when environmental conditions change ensures high interference immunity of the detector and reliability of protection. The detector provides automatic control of the integrity and leakage resistance of the connecting wire from the sensitive element.

The "Peak" detector should be placed as close as possible to the protected object so that, with the detector's sensitivity set, access to it is impossible without issuing an alarm.

Capacitive detector IO305-4 "Gradient" is intended for protection of hangars made of light metal structures and weakly reinforced walls by means of blocking on the surface of the hangar. The "Gradient" detector provides flexibility in the formation of a protection zone using a sensitive three-wire element, the ability to protect the shell when carrying out work in a protected room, resistance to air flow, spark discharges, movement of birds.

Sound detectors are designed to block structures when glass is broken. The principle of operation of these emitters is based on a non-contact method of acoustic control of the destruction of glass, which occurs during the propagation of a signal in the sound frequency range that has spread through the air.

Sound detectors IO329-1 "Glass-1", IO329-2 "Glass-2", IO329-2A "Glass-2-1", IO329-4 "Glass-3" are designed to detect the destruction of the glass fabric of window and stained-glass structures.

The detectors are installed on the wall or on the ceiling so that all glazed parts of the structure are within its direct view (viewing angle of the detector 90°). When detectors are placed in the room for the period of protection, all doors, windows, cabins, ventilation, telephones, loudspeakers, and electric bells must be closed.

Surface sound detector IO329-4 "Arfa" is designed for remote (non-contact) detection of the destruction of glass sheets.

The detector is mounted on the inside of the room in a place protected from mechanical damage and access by outsiders at a height of at least 2 m from the floor. When installing the detector, all areas of the glass must be within its direct view.

Of the imported sound detectors, the Z & K Intelli Sense detectors (USA) models FG-1015 / 1025R, Z, Swan GBD-2 are of interest (Fig. 3.4)

Fig. 3.4 Sound alarm Swan GBD-2

These sensors register the sounds that accompany the impact on the glass and occur when it is damaged. The detectors have a modern design and can be installed on the wall, window frame or on the wall of the protected room.

Although non-contact acoustic detectors have recently become very popular, their use in some cases is limited, since these types of detectors react both to sounds generated inside the room and to acoustic vibrations coming from the glass from the street. This refers to a situation where strong noises can occur in the premises, which

lead to false alarms. In such cases, it is advisable to use the acoustic detector model FG 1025Z by Z & K.

This detector registers acoustic vibrations coming from the side of the protected glass. Selectivity is achieved by using two independent microphones with further processing of signals according to the time of arrival from the controlled area. This technology allows you to significantly increase the probability of registering glass breakage, the reliability of the detector as a whole and its ability to cut off false alarms.

Flex Guard model FG-701 glass breakage simulators are used for remote testing of Z & K detectors. The simulator reproduces the sound of glass breaking and can be used to test the functionality of all break sensors.

Ultrasonic detectors are designed for the protection of closed premises and are formed when an intruder enters and the field of elastic waves of the ultrasonic range, caused by the movement of the intruder in the detection zone, is disturbed. The detection zone of the detector has a complex ellipsoid shape.

To ensure stable operation of ultrasonic detectors, the following rules must be followed:

1. Detectors should not be used in rooms with an acoustic noise level above 60 dB;

2. Do not install detectors in shop windows, above heating radiators, on window sills, near window curtains and indoor plants, and also do not allow these objects to fall into the detection zone;

3. During the protection period, it is necessary to lock doors, windows, cabins, hatches, as well as turn off ventilation units, heaters, telephones, bells, loudspeakers, etc.

4. Do not allow animals and birds to be in the premises protected;

5. Do not place two or more detectors in the same room or adjust them in such a way that the detection zones do not overlap at maximum sensitivity.

Ultrasonic detectors IOP308-3 "Echo-2", IO308-1 "Echo-3", IO308-2 "EchoA" are designed to detect the movement of a trespasser in an area protected by means of blocking local areas of the room, that is, places where valuables are concentrated. Detector detection zones are shown in Fig. 3.5.

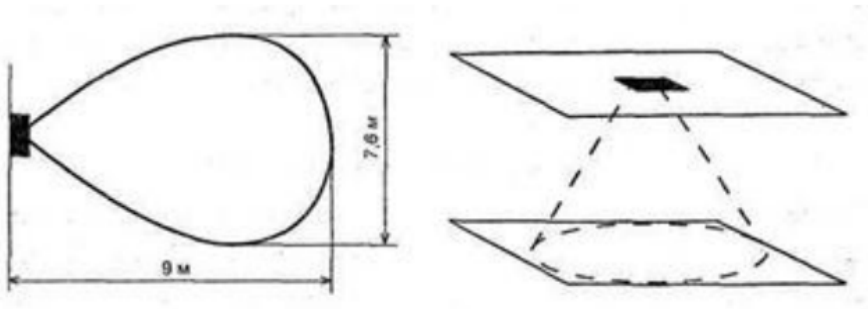

Fig. 3.5 Detection zones of the "Echo-A" detector

The volumetric security ultrasonic detector "Echo-A" is designed for the protection of closed premises and provides blocking of local areas of the premises, places with equipment, etc. When installing the detector on the ceiling, it is possible to protect individual objects located inside large premises, and adjustment sensitivity can be adjusted by smoothly changing the size of the protected zone from 6 to 70 m2.

The ultrasonic detector "Vitryna" is intended for the protection of closed premises, detection of trespassing of a trespasser into the protected area, movement of objects inside it, followed by the issuance of an alarm notification.

The ultrasonic detector consists of a signal processing unit (SPU), an acoustic emitter (AB) and an acoustic receiver (AP). AE and AR are made in the form of plastic cylinders equipped with rotating brackets for spatial orientation. The basis of AE and AR are piezoelectric ultrasonic transducers with mutually agreed parameters. Their action is based on the interference of ultrasonic vibrations. With closed windows and doors, the space controlled by the detector is limited, and a stable interference pattern is formed at the location of the receiver. When an intruder enters the room, the stability of the interference pattern is disturbed and an alarm signal is generated.

Passive infrared motion detectors for the protection of indoor spaces have received the most widespread PIR motion detectors (passive infrared detectors).

The principle of operation of PIR detectors is based on the registration of changes in the intensity of the infrared (IR) spectrum of radiation, which occurs when a thermal object, for example, a person or an animal, moves in the control zone. The sensitive element of such a device is a pyroelement (pyroreceiver), on the surface of which an electric signal is generated under the action of IR radiation from any thermal object. To register the fact of the movement of a thermal object in the detector, a multi-beam directional pattern is formed using a multi-segment mirror, consisting of many detection beams directed at different angles and in different directions.

The crossing of these rays by a thermal object leads to pulses of infrared radiation falling on the pyroelement, and as a result, the formation of the latter electrical pulses takes place. These pulses are amplified and processed by a detector that counts their number and the time intervals between them. The values of these parameters determine the stability of the device and the detection range of the speed of movement of the thermal object (from 3 m/s for a fast-moving person and up to 0.3 m/s for very slow movement). The detection beams form a detection zone that determines the sensitivity of the device. The maximum distance at which a moving object can still be reliably detected. Accurate geometric characteristics (configuration) of the detection zone are provided by multi-segment mirrors and an optical system on Fresnel lenses. The use of different types of lenses allows you to change the configuration of the detection zone depending on the situation. Thanks to this, motion detectors have a universal application and are used to protect premises, places of concentration of values, approaches to them, corridors, internal perimeters, window and door openings, etc.

The world's leading manufacturers of PIR detectors use a pyroreceiver with two or more sensitive areas as sensitive elements, which allows to significantly reduce the probability of false positives under the influence of external factors, for

example, convective air flows, light and radio frequency interference. However, to ensure the stability of the detector's operation, it is not recommended to install it above heating devices; point the detector at warm air fans, spotlights, soffits, bright incandescent lamps, direct sunlight hitting the detector; and it is also not recommended to be in the detection zone of objects (curtains, partitions, cabinets, etc.) capable of forming "dead" zones and animals.

Security PIR detectors of the KS-101 type are developed and supplied by a Ukrainian manufacturer. They are designed to work as part of control panels, such as "Danuy", "Lun", "Orion", etc.

The device is powered by the alarm loop. A double pyrocell is used as a sensor. Due to the use of different types of lenses, the detectors have different detection zones (different directional patterns). The body of the devices is made according to a modern design, which allows them to fit well into the interior of any room.

The detection zone diagram of a passive infrared detector is determined by the optical system.

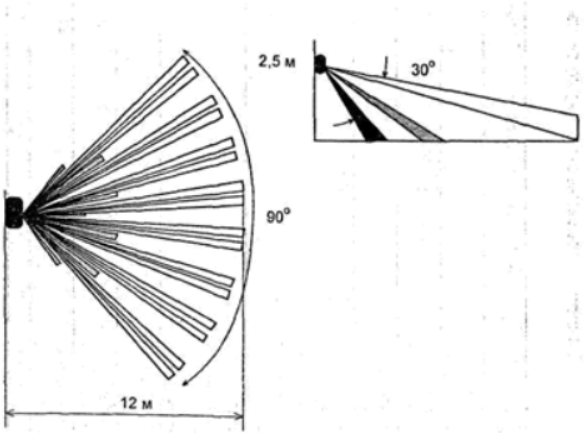

Fig. 3.6 Diagram of the detection zone of a passive infrared detector

In the Ukrainian market, PIR detectors of various foreign manufacturers are widely represented. The devices of SWAN (Swan Quad) companies (Fig. 3.7) DSC (LC-100), as well as ORTECH (France, Germany) models LX-2AU, PIR700E are in the greatest demand.

Fig. 3.7 PIR detector Swan Quad

Active infrared motion detectors are used to protect internal and external perimeters of premises, windows, showcases, and individual objects. They generate an alarm when the reflected flow changes (one-position detectors) or when there is no (change) in the received flow (two-position detectors) of optical radiation energy caused by the movement of the intruder in the detection zone.

The detection zone of the detector has the form of a "beam barrier" formed by one or several parallel, narrowly directed beams.

To ensure stable operation of the detector, it is recommended to follow the following rules:

• Install the emitter and receiver on strong, non-deformable structures;

• Do not allow sun glare and the light of car headlights to hit the receiver;

• Do not allow extraneous objects to be located more than 0.5 m from the space through which the beam passes.

GSN ElectronicPatrol 101 detectors; OptexAX-500Plus (Fig. 3.8); AX650TF; AX-130TN; BX-100PLUS are designed to detect trespassers entering the territory of the protected object. Detectors provide blocking of building structures, window and door openings, corridors, passages, etc.

The perimeter of the object must be equipped with a fence that serves as a mechanical barrier for the violator. From the internal side of the fence, it is necessary to allocate a rejection zone with a width of at least 1 m, which must be free of vegetation and other objects that prevent the passage of rays. Detector units can be

installed on walls, special poles or racks, which ensure the absence of oscillations and vibrations.

Fig. 3.8 Active perimeter detectors OptexAX-500Plus

Radio wave motion detectors are designed to detect and register motion in the protected area. Each detector contains a microwave module, which includes an emitter and a receiver of microwave oscillations. Unlike passive IR detectors, radio wave detectors are active devices, as they continuously emit microwave vibrations into the surrounding space. The principle of operation of these devices is based on the interference of radio waves in the centimeter range or on the Doppler effect (change in the frequency of a signal reflected from a moving object).

Radio wave detectors can be used to protect closed premises, internal and external perimeters, individual objects and building structures. The detection zone has the shape of an ellipsoid of rotation or a teardrop shape. The detection zones of different types of detectors differ only in size. To ensure stable operation of radio wave detectors, detectors cannot be installed on conductive structures. Oscillating or moving objects with a significant reflective surface, as well as large objects capable of creating "dead" zones, should be moved outside the detection zone.

Effective measures in reducing the impact of adverse factors are:

• Fixing objects that can move in the detection zone;

• Selection of the appropriate direction of radiation from the broadcaster, as well as the use of radio-proof screens, for example, in the form of metal meshes in front of objects whose vibrations or movement cannot be eliminated;

• Eliminating the possibility of the detector triggering when small animals and insects appear in the detection zone by choosing the height of the detector suspension and orienting the direction of its radiation parallel to the floor;

• Do not use detectors on objects near which powerful radio transmitters are located.

Radio wave detectors SWAN 1000; DSC LC-151 (Fig. 3.9); DSC LC-171 provides blocking of premises, places of concentration of values, museum and exhibition exhibits, etc. They have continuous three-dimensional detection zones with a maximum area of up to 90 m2 and a controlled volume of up to 200 m2 at a range of 12 - 16 m.

Fig. 3.9 Radio wave detector DSC LC-151

Combined detectors. The principle of operation of combined detectors is a combination of two detection principles. Recently, combined detectors, which include two passive infrared and active radio wave or passive infrared and active ultrasonic detectors, have been increasingly used. These are so-called dual technology detectors.

In such devices, the PIR detector works continuously. When registering the fact of movement of a thermal object in the detection zone, the radio wave (ultrasound) detector is turned on. If the latter confirms the presence of a moving object in the protection zone, the device will generate and issue an alarm message via the alarm loop. This mode of operation of the detectors allows you to ensure a high level of

interference protection of the device and reduce the level of microwave radiation, since the radio wave detector is turned on only for a short period of time.

Combined detectors are used to protect objects with a complex environment with obstacles, where the use of detectors of other categories is impossible or ineffective.

Combined SWAN PGB; Satel Opal; DSC LC-104 (Fig. 3.10) combines two detection channels: infrared (IR) passive and radio wave (RW) active, and also issues an alarm message to the alarm loop when the two channels are activated sequentially (when the RW channel is prioritized).

Fig. 3.10 Combined detector DSC LC-104

The location of the detectors is chosen so that their detection zones overlap the possible directions of movement of the offender.

Ceiling motion detector BV-501GB of DSC company is two independent devices in one case: a passive IR detector and a broken glass detector. The BV-501GB has a circular pattern and is intended for installation on the ceiling of a protected room. It has a modern design and high operational characteristics, which makes it an excellent tool for protecting premises.

The device includes a PIR detector with a circular directional diagram based on a pyroelement with adjustable sensitivity.

It is designed to detect unauthorized entry into the premises. The second detector is a broken glass detector with a range of up to 9 m, designed to register the fact of glass breaking and generate an alarm signal.

Combined ARROWHEAD (USA) motion detectors, which include radio wave PIR sensors, are represented by the 1000 series models. They have a modern design that matches any room interior, and high detection characteristics.

PIRAMID motion detector of the company "Protection Technologies Inc." (USA), supplied to Ukraine, uses dual technology: combined radio wave and dual PIR sensors. It works reliably in a wide range of outdoor conditions and is used for outdoor installation.

The main factor that ensures the reliability of the device is the use of a unique two-channel Doppler radio wave detector. This detector performs its functions much better than a conventional microwave detector, as it ignores such sources of false positives as various vibrations and random movements of objects. This device allows you to measure the distance to a moving object and activate an alarm when the set distance is violated.

The detector is widely used to protect the perimeters of various objects, building roofs, construction sites, parking lots, etc., as the PIRAMID motion detector can be equipped with a built-in video camera and work as part of a video surveillance system.

3.3 Video surveillance cameras

Modern video surveillance systems can be classified according to several criteria. By location, they are divided into domestic, street and hidden.

Home video surveillance: This is video surveillance installed inside or around a residential area. It is used to ensure security in a house, apartment or the surrounding area.

Street video surveillance: This is video surveillance installed in open spaces such as streets, parks, shopping malls and other public places. It allows you to monitor safety on the streets and detect potential crimes.

Hidden video surveillance: This is video surveillance that is carried out using hidden cameras that can be installed in inconspicuous places or in the form of objects

that do not arouse suspicion. It is used for hidden surveillance and unobtrusive security.

According to the method of signal processing, systems are divided into analog, combined and digital.

Analog video surveillance: In this system, the video signal is transmitted by an analog cable from the camera to the monitor or video recorder. Image quality may be limited and depends on resolution and hardware capabilities.

Combined video surveillance: This system combines analog and digital video surveillance. Cameras transmit an analog signal, which is then converted to a digital format for processing and storage. This allows you to use both analog and digital cameras.

Digital video surveillance: This system is based on the transmission and processing of a digital video signal. Cameras record video in digital format, and the data can be transferred and stored on digital media such as hard drives or cloud storage. Digital video surveillance provides better image quality and more functionality, such as remote access and video analytics.

3.4 Conclusion

In order to obtain information about an alarming situation at the object, the alarm system includes detectors that differ from each other in the type of controlled physical parameter, the principle of operation and the method of information transmission. Each type of detector has its own list of main unique technical characteristics defined by the relevant standards. The market of modern technologies is quite saturated with various technical solutions, at the same time, even sensors of the same type differ in the design features of their components, ease of use, reliability, and level of design, which is taken into account when choosing a particular device.

CHAPTER 4. SECURITY ALARM SYSTEM

A private house with a total area of 70 m², which has 5 windows and 1 entrance, was chosen as the object for the construction of the security system.

The main principle of protecting a private house is to block the entrance (windows, doors) with the help of magnetic contact sensors, and the interior space using IR motion sensors.

Thus, the following structure of the security system is proposed to protect the selected building.

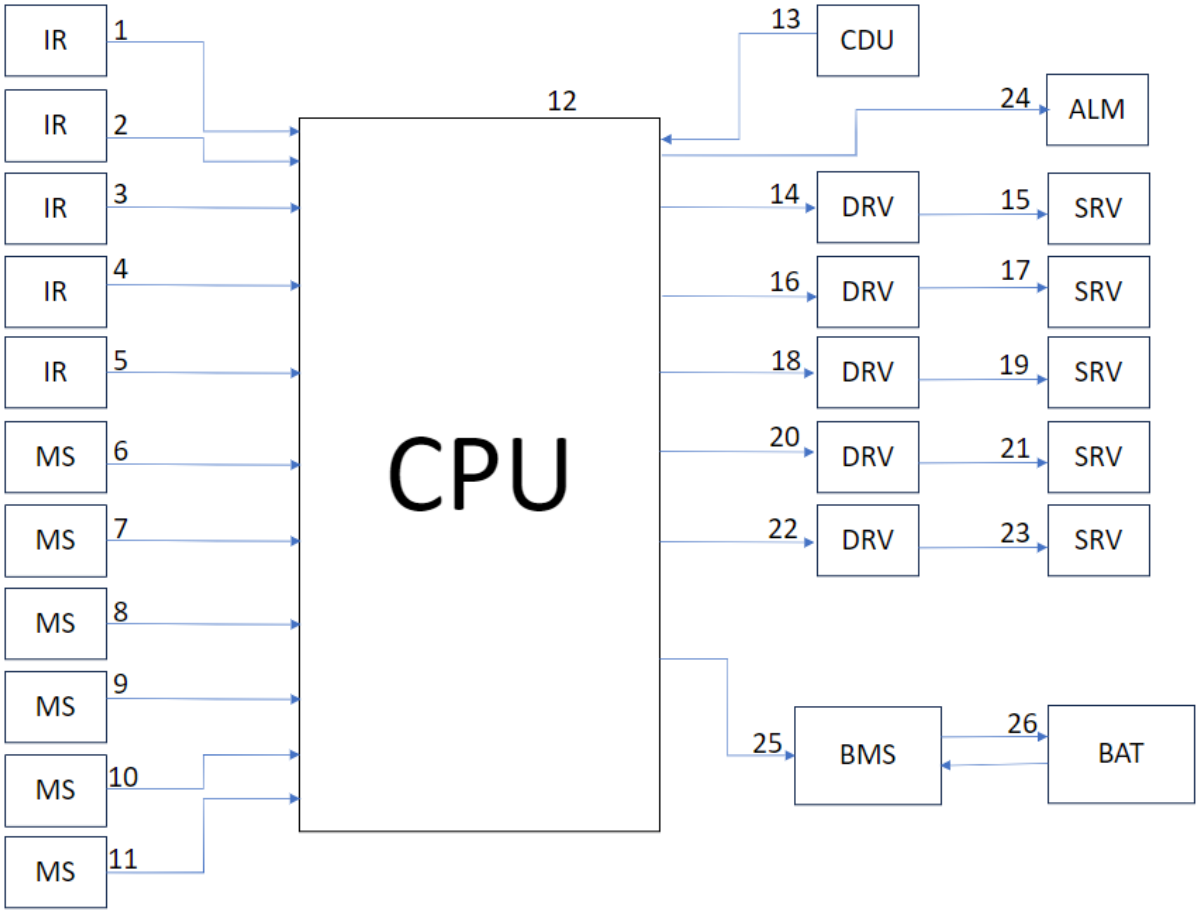

Fig. 4.1. The structure of the security system:

1-5 - Infrared motion sensors; 6-11 - Magnetic contact sensors; 12 - Microprocessor; 13 - Reception-contact device; 14, 16, 18, 20, 22 - Servo control modules; 15, 17, 19, 21, 23 - Servo drives; 24 - Siren; 25 - Battery management system; 26 - Accumulator battery.

4.1 Security system equipment and their placement in a private house

The use of the following equipment is suggested for the development of a security alarm system for a private house:

1. DSC PC-1864 reception and control device

Serves to receive signals from sensors; activation of light and sound alarms; transmission of signals of changes in the status of the protected object (arming/disarming, alarm, etc.) and transmission to the remote control via various communication channels.

Table 4.1

Technical characteristics of DSC PC-1864

Zone on the board:	8
Maximum possible number of zones:	64
Wired zones:	64 (7 x PC-5108)
Wireless zones:	32
Support for keyboard zones:	yes
PGM outputs on the board:	PGM1, 3, 4=50mA, PGM-2=300mA
Expansion of PGM outputs:	8x50mA (PC5208), 4x500mA (PC5204)
Number of supported keyboards:	8
Number of groups:	8
User passwords:	32 and master code
Event buffer:	500 events
Supported batteries:	4Ah 7Ah 14Ah
Siren output:	12V / 700mA

2. Keyboard RP432KP Risco

Features of the RP432KP0000A keyboard:

- Blue backlight display and keyboard

- Information about the state of the system, presented in graphical and textual form
- Call alarms ATTACK, FIRE, MEDICAL from the keypad
- Sound signaling of events< /li>
- Quick control
- Functional buttons
- 4-wire bus
- Protection against unauthorized access

Fig. 4.2 Keyboard

3. Battery Full Energy FEP-127

Table 4.2

Technical characteristics of Battery Full Energy FEP-127

Battery capacity:	7 Ah
Output voltage:	12V DC
Battery Type:	AGM (Lead-Acid)
Temperature range:	-10...+40°C

All security alarm devices must be provided with uninterrupted power supply. As a rule, the network power supply of security alarm control panels is used as the main one, other devices are powered from low-voltage secondary sources of direct

current or from the security alarm loop. In accordance with domestic safety regulations, the security alarm must function without interruption in the event of a power outage at the facility during the day in standby mode and for at least 3 hours in alarm mode. To fulfill this requirement, the alarm system must use a backup power supply system - additional sources or built-in batteries.

4. Infrared motion sensor DSC LC-100

Infrared motion sensor

It is a passive sensor that scans the environment for thermal radiation. From several dozen to several hundred lenses and concave mirrors are installed in the body.

Advantages: The infrared sensor is a budget device. The device does not produce any radiation and is therefore 100% safe for health.

Disadvantages: There is a risk of false activation near heating devices or in heat, when the air temperature approaches the temperature of the human body.

Main features:

- The motion sensor is used to track people's movements in the protected premises;
- The wire sensor is easy to install and remove;
- This sensor is installed indoors;
- Immunity from animals weighing up to 25 kg. The sensor will not respond to them and will not give false alarms;
- Increased range of motion detection – 15 m (instead of the standard 10 m);
- The viewing angle of 90 ° is quite wide and, with proper installation, can cover the entire room (without "blind spots").

Table 4.3

Technical characteristics of the motion sensor DSC LC-100

Type of installation:	Wall, ceiling mounting
Possibility of external application:	None
Motion detection range:	15 m
Immunity from pets:	Up to 25 kg
Installation height:	1.8 m to 3 m
Protection against hacking:	Yes
Connection method:	Wired
Operating voltage:	8.2 - 16 V
Operating temperature range:	-10°C ~ +50°C
Working humidity:	Up to 95%
Dimensions:	92 x 62.5 x 40 mm
Current in idle / alarm mode:	8/10 mA
Weight:	40 g

Fig. 4.3 Infrared motion sensor DSC LC-100

5. SOMK-1-8

The SOMK-1-8 magneto-contact opening sensor is designed to detect unauthorized opening of doors, windows, hatches, etc. and issuing an "Alarm" notification to the receiving and control device.

The detector provides opening of the alarm circuit when doors, windows, hatches are opened or when objects blocked by it are moved.

Fig. 4.4 SOMK-1-8 magneto-contact opening sensor

Design and principle of operation

The magnetic detector consists of a setting element and a reed switch:

- The setting element is a magnet in a plastic case.
- A reed switch is an electromechanical switching device that changes its state under the influence of a magnetic field.

When both elements are at a distance of more than 28 millimeters, the reed switch contacts are open, and when they are closer to 15 millimeters, they are closed. Between 15 and 28 millimeters is the "gray zone". Each reed switch has a trigger threshold in this range, but you will have to determine where exactly.

6. CO 01

The siren is designed to give a light and sound signal in the event of an alarm. With the help of a powerful sound of 110 dB, the siren repels and affects the intruder, and attracts the attention of the surrounding people. Additional impact and attention-grabbing is provided by the light indication built into the siren.

Main features:

- Acoustic signaling: piezoelectric transducer
- Optical signaling: super bright LEDs
- Anti-tamper protection: break from base and discovery

Table 4.4

Technical characteristics of CO 01

Class of environmental protection:	III
Case dimensions:	300×195×97 mm
Operating temperature range:	-35...+55 °C
Nominal supply voltage (±15%):	12 V DC. current
Average current consumption during so signaling:	250 mA
Average current consumption with opti signaling:	35 mA
Weight:	651 g
Sound level:	120 dB

7. Servo drive DA08N24PI

Table 4.5

Technical characteristics of Servo drive DA08N24PI

Power supply:	Voltage: 24B AC/DC Power consumption: 4.5W Frequency: 50/60 Hz
Damper area:	up to 1.6m2
Management:	0(2)-10V/0(4)-20mA
Response time:	30-40s/70-95s/115-160s
Auxiliary switches(S):	3(1.5)A, 230V
Feedback signal:	0(2)-10V/0(4)-20mA
Angle of rotation:	0°-90° 5°-85°(5° Setting)
Mechanical connection:	Round shaft 10-20mm, square shaft 10*10-16*16mm

Electrical connection:	Screw terminals
Degree of protection:	IP54
Conditions:	Operating temperature from -30° to 50° 5°-95° PH, non-condensing. Storage temperature -40° to 70°, 5°-95° PH, non-condensing
Noise level:	<45dB
Weight:	1.08 kg

It was decided to use this particular equipment, based on the ratio of price-quality criteria.

Scheme of placement of security system sensors in a private house is shown in the figure:

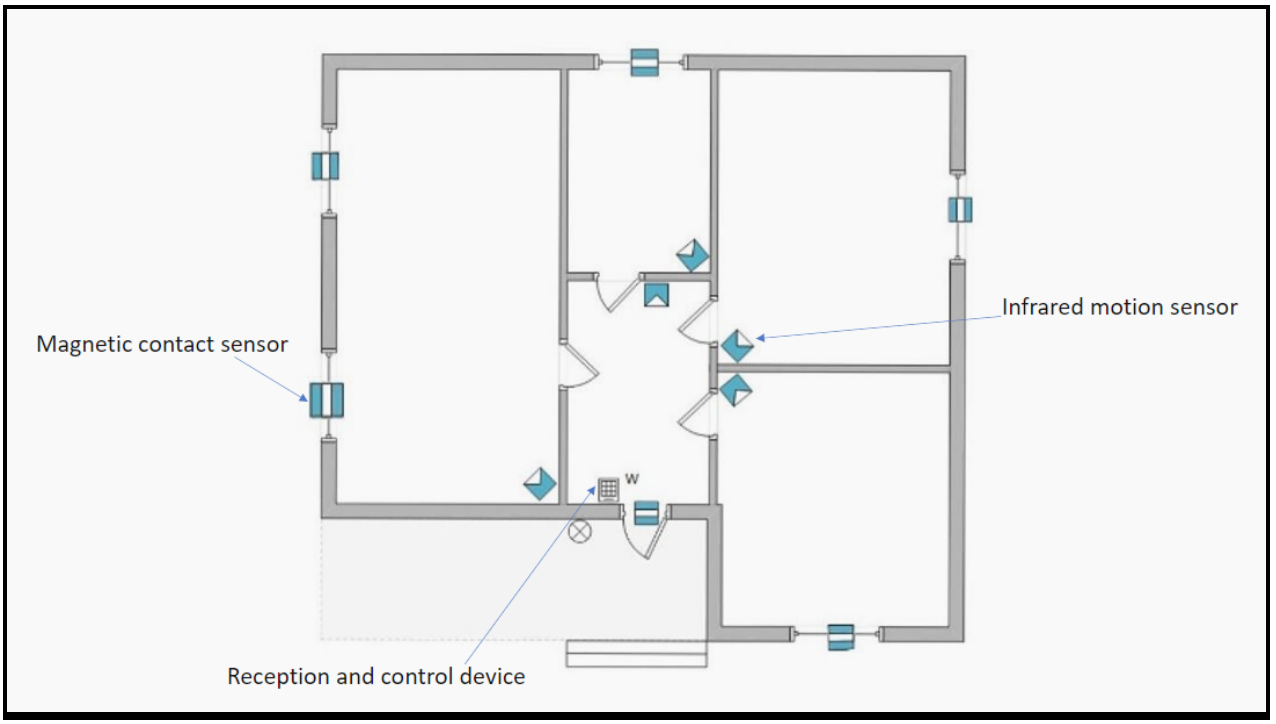

Fig. 4.5 Scheme of placement of security system sensors

In the corners of each room, we install infrared motion sensors, which are attached at an angle of 90°C to the wall surface, at a height of 1.8 m to 3 m.

Magnetic contact sensors are installed on the window frames, one part, an electromechanical switching device (reed switch), is installed on the stationary part of the window, and the second part, a magnet, is installed on the moving part of the window, the placement of sensors is similar to doors.

4.2 Management of the security alarm system

The control of the security alarm system is carried out with the help of a receiver and control panel, which allows you to turn the system on and off, receive information about the status of the sensors and the operating mode, change the system settings and monitor the state and battery charge level.

In case of activation of motion sensors or magnetic contact sensors, the signal from them is processed by a microprocessor, which generates a control signal to the notification device and turns on the corresponding indication on the receiving and control device.

4.3 Functioning of the system

The system is set to working mode using the keyboard of the receiving and control device, which also displays the current state of the system.

At the same time, the system first checks the status of window opening sensors. If all windows are closed, the private house is set on alarm.

If one of the windows is open, the system generates a control signal to the corresponding window servo, which tries to close the window.

If the window closes successfully and a signal is received from the corresponding opening sensor, the private house is armed. If it is not possible to close the window automatically, the control signal is sent to the servo drive, but if after 5 seconds there is no signal from the opening sensor, a corresponding indication is displayed on the receiving and control device, which informs the user about the need to close the corresponding window manually or remove the obstacle that prevents its automatic closing.

When the system is in working mode, the activation of any of the motion sensors or window opening sensors results in activation of the detector and remote transmission of the signal to the security services, if available.

The battery management system monitors the charge level of the batteries both in working mode and in standby mode. But it ensures its automatic recharging when there is power in the network.

When the system is running on battery power, the automatic window closing function is turned off to save battery power. In this case, only the status of the windows is checked, and a corresponding warning is displayed on the receiving and control device.

The graphic interpretation of the algorithm of the system is shown in the figure:

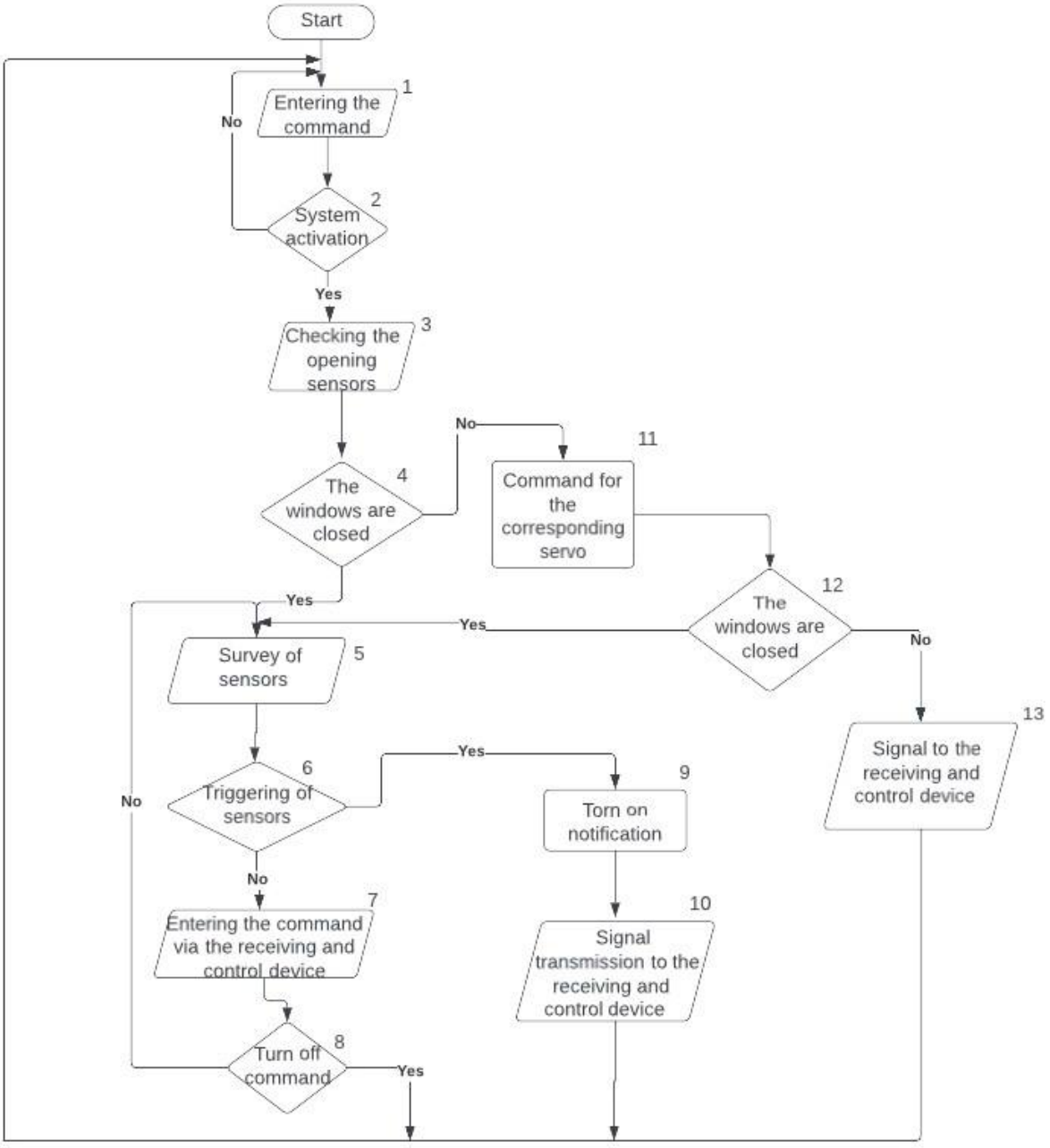

Fig. 4.6 Block diagram of the system operation algorithm

4.4 Conclusion

For my thesis, I chose a private house as an example. A special feature of my system is the use of servo drives to automatically close the windows. Also, when choosing equipment for planning a security alarm system, the economic component and the price-quality ratio were taken into account. The general structure of the

security system has been developed and an illustrated diagram of the placement of sensors in a private house. An algorithm of system operation has been developed.

CONCLUSIONS

With the worsening of the criminal situation and considering that the majority of crimes are encroachment on private property, the urgency of ensuring the security of private property is more critical than ever. To ensure the integrity and safety of private property, it is advisable to use security alarm systems.

In my thesis, I considered modern security systems and decided to develop a typical security alarm system with improvements using servo drives to automatically close windows, which in turn will ensure reliable operation of the security alarm system and protect private property from unauthorized entry. I used the equipment, taking into account the price-quality ratio and arranged it according to the scheme of the house.

In general, the security alarm system can be used both as an independent system for ensuring the security of a private home and as part of a complex system.

For example, a combination of security and alarm systems, access control and management systems, security video surveillance systems, and engineering and technical fortification systems can provide comprehensive protection that allows you to control access, detect potential incidents, provide visual data, and create physical barriers to potential attackers. The specific choice of security systems depends on the individual needs and characteristics of each particular house.

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