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DEVELOPMENT AND IMPLEMENTATION OF THE DATA STRUCTURE AND ANALYTICAL APPLICATIONS OF THE SYSTEM “ZIYRAK”

Khamdamov R.Kh.[1], Sakiev T.R.[1], Rakhmanov Kh.E.[2]

[1] Digital technologies and artificial intelligence research institute, Tashkent, Uzbekistan
[2] Samarkand branch of Tashkent university of information technologies named after Muhammad al-Khwarizmi, Samarkand, Uzbekistan
r.hamdamov@mail.ru, temur.sakiev@gmail.com, hoshimrahmonov@gmail.com

Abstract. *Fires are one of the most serious and destructive natural and man-made disasters, having dangerous consequences for human life, property and the environment. This article presents the general structure of a hardware and software complex that detects smoke and fire from video images received from CCTV cameras. The structure of the database and mobile application of the intelligent system is also described. An intelligent system capable of automatically detecting fires in the early stages, as well as providing prompt alerts to users on their mobile phone, facilitating more effective emergency response.*

Keywords: *fire detection, smoke detection, alarm system, data structure.*

I. INTRODUCTION

The modern world is characterized by the intensive development of cities and industry. This leads to an increase in the number of people and property concentrated in limited areas. In such an environment, the risk of starting and spreading fires increases significantly. Smart smoke and fire detection systems are able to quickly detect a fire at an early stage, which allows you to take timely measures to extinguish it and prevent possible disasters [1-3].

Smoke and fire detection systems, using heat and chemical sensors, are an important safety measure against fires. However, such methods have their drawbacks, which limit their effectiveness and reliability.

Heat sensors usually respond to an increase in ambient temperature. They may not immediately detect a small fire that is just starting, as the temperature can rise to a certain level before the sensor trips. This can result in a delay in detecting a fire in its early stages, when a quick response is critical to preventing it from spreading [4-6].

Heat sensors focus on detecting rising temperatures and therefore may not be effective at detecting fires that are not accompanied by intense heat. Also, chemical sensors can react not only to combustion products, but also to other chemical compounds present in the environment. This can lead to false alarms when the sensor reacts to non-fire chemical vapors. This can cause dissatisfaction and even ignoring the detection signals on the part of the personnel.

Heat and chemical sensors can detect fires at specific points or areas. They are not always able to provide complete spatial information about the location of the fire. This can make it difficult to quickly respond and extinguish a fire, especially in large areas or in complex structures.

Modern technologies such as optical sensors, infrared cameras and machine vision systems provide highly accurate smoke and fire detection. These systems are able to detect even the smallest changes in the environment, avoiding false alarms and providing reliable detection of real fires. What's more, smart systems react instantly, which helps to quickly activate emergency systems and call rescue services [7-8].

With the constant growth of cities and industry, the likelihood of fires increases. However, traditional fire detection methods may not be effective, especially in remote or hard-to-reach areas. In light of the rapid development of information technology and artificial intelligence, the use of neural networks for fire detection is becoming an increasingly relevant and promising approach [9-12].

II. INTELLIGENT FIRE DETECTION AND WARNING SYSTEMS

Intelligent fire detection and warning systems are an important part of modern security systems. They are designed for early detection of fires and instant notification of people and security services about the emerging threat. These systems combine a variety of technologies and sensors to provide a reliable and fast response to fire situations.

The main components of intelligent fire detection and alarm systems include:

Smoke and heat sensors: These sensors are designed to detect changes in the environment that indicate a possible fire, such as the presence of smoke or a sudden increase in temperature.

Video cameras and image processing: Some systems use video cameras and image processing algorithms to further check for flames or smoke, and to account for the characteristics and spread of fire.

Smart Algorithms: These systems often include algorithms and artificial intelligence to analyze data from sensors. They are able to distinguish normal from suspicious changes and quickly respond to potential fires.

Warning Systems: When a fire is detected, the system will activate sirens, flashing lights, alerts to mobile devices, and even automatic calls to the fire department.

Communication with a central monitoring system: Many intelligent systems are connected to a central monitoring system, which allows operators to monitor the status of the system, as well as intervene if necessary.

The benefits of intelligent fire detection and alert systems include faster response to fires, fewer false alarms with more accurate algorithms, and the ability to be monitored and controlled remotely. These systems contribute to increased safety in buildings and structures, minimizing risks to life and property.

III. INTELLIGENT SYSTEM “ZIYRAK”

The goal of the system “Ziyrak” is to provide a highly efficient and reliable fire detection and warning system through CCTV cameras using advanced neural network technology. This system aims to prevent the occurrence and spread of fires, as well as to minimize potential damage and threats to life, property and the environment. The main objectives of the system “Ziyrak” include:

Early Fire Detection: The system “Ziyrak” seeks to detect fires at the earliest stage when they are just starting. This allows you to quickly respond and take the necessary measures to extinguish and prevent the spread of fire.

High Detection Accuracy: The aim of the system is to provide high accuracy in fire detection. The use of neural networks allows the System «Ziyrak» to highlight unique visual signs of smoke and flames, which reduces the likelihood of false positives.

Fast response and notification: The system aims for instant response and notification of the competent services and fire detection persons. This allows you to quickly coordinate efforts to extinguish and evacuate, reducing the risks and consequences.

Integration and scalability: The system «Ziyrak» is focused on integration with existing security and monitoring systems. It is also designed with scalability in mind to be applicable to facilities of various sizes and types.

"Ziyrak" is an intelligent system developed using advanced neural network technology for fire detection and alerting. The name "Ziyrak" comes from the Uzbek language and translates as "smart". This name reflects the main mission of the system - to provide protection and safety from fires. The general structure of the hardware and software complex is shown in Figure 1.

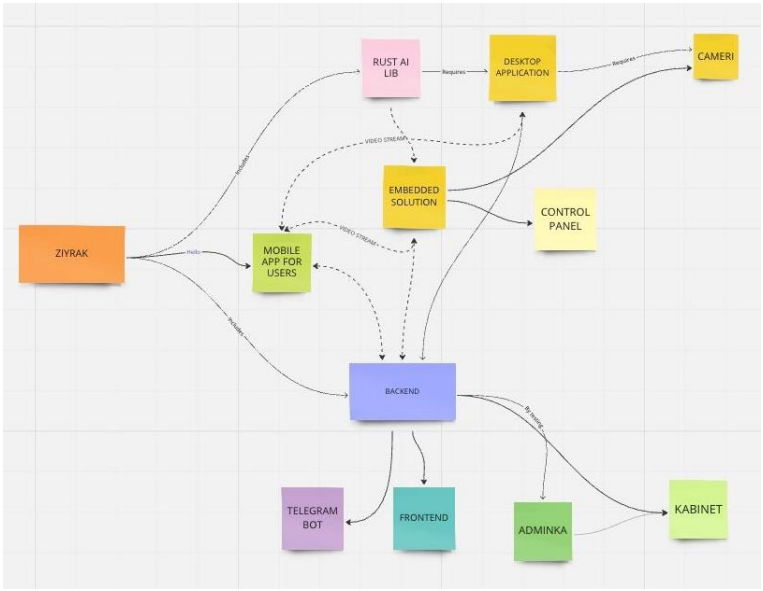


Fig.1. The structure of the hardware and software complex.

The database structure of an intelligent fire detection and notification system based on CCTV cameras can include the following main components:

Table "Camera": Contains information about the surveillance cameras installed on the site. Each entry can include fields such as camera ID, location, description, and IP address.

Table "Photo": This table stores information about photos associated with events and system status.

Table "Notification": Contains information about notifications sent to users or system operators. Details about the alert time, event type, recipient, and status (read/unread) are stored here.

Table "Users": Contains information about system users. Each user can have their own credentials, roles (administrator, operator, analyst, etc.) and alert settings.

Table "Video": If the system supports video recording when events occur, this table may contain links to saved videos associated with certain events.

Table "Device": This table stores information about all devices, including their type, name, location, IP address (if applicable), current status, and last connection information.

Table "Organization": designed to store information about various organizations that can be associated with a fire detection and notification system based on video surveillance cameras.

Table "Organization": Here you can store information about the name of the branch, its address, telephone number and e-mail. This will help to effectively manage information about the various locations where the system is used.

Table "Detection zones": If the system supports the division of areas on the camera image for more accurate detection of events, information about the zones and their parameters can be stored here.

Table "Logs": This table can be used to record all events related to the system: alerts, camera state changes, operator actions, etc. Logs help you track activities and analyze what happened in the system.

Table "Settings": General system settings are stored here, such as sensor sensitivity, notification methods, thresholds for triggering events, and other parameters.

Table "Messages": This table can be used to exchange messages between users of the system and to store the history of messages.

This is only a basic structure, which can be supplemented depending on the specific requirements and functionality of an intelligent fire detection and warning system based on video surveillance cameras. The structure of the database is shown in Figure 2.

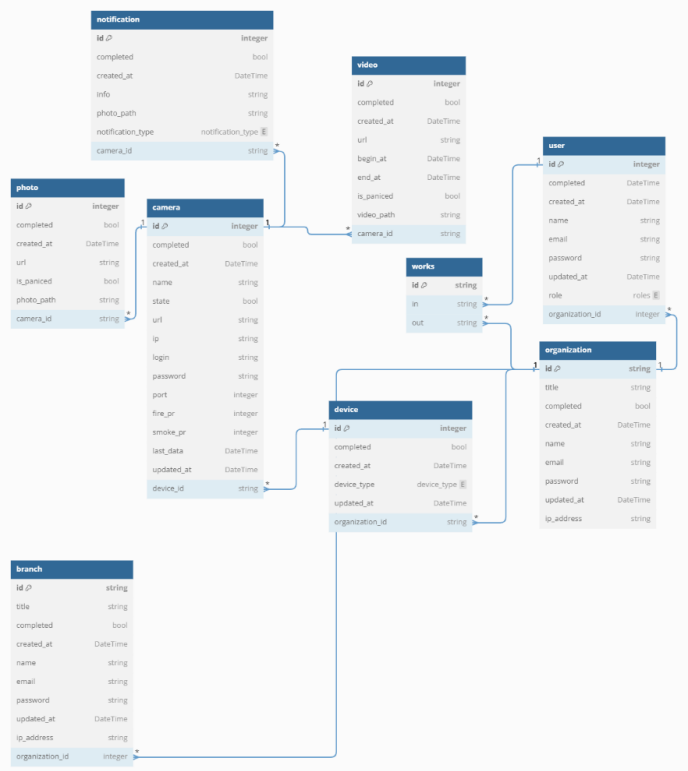


Fig.2. Database structure of the system "Ziyrak".

A mobile application of the intellectual system "Ziyrak" was also developed in the Rust programming language.

The mobile application of the intelligent fire detection and alarm system based on CCTV cameras provides users

with a convenient way to monitor and control the system.

Below are some of the features and components of the mobile app:

1. Authorization and Profile:
- Login to the application through credentials or biometrics.
- Personal user profile with settings and contact information.

2. View Cameras:
- Online viewing of video streams from installed cameras.
- Ability to switch between different cameras.

3. Fire detection:
- Receive alerts for fire or smoke detection events.
- Visualization of events using photos or videos.

4. Device Management:
- Enable and disable surveillance cameras.
- Manage settings of sensors and devices.

5. Event History:
- View the event log, including fire alerts and other events.

6. Alert Settings:
- Manage notification methods (push notifications, email, etc.).
- Setting the sensitivity of sensors to trigger alerts.

7. Object Map:
- Displaying the location of cameras on the site map.
- Ability to quickly jump to a specific camera through the map.

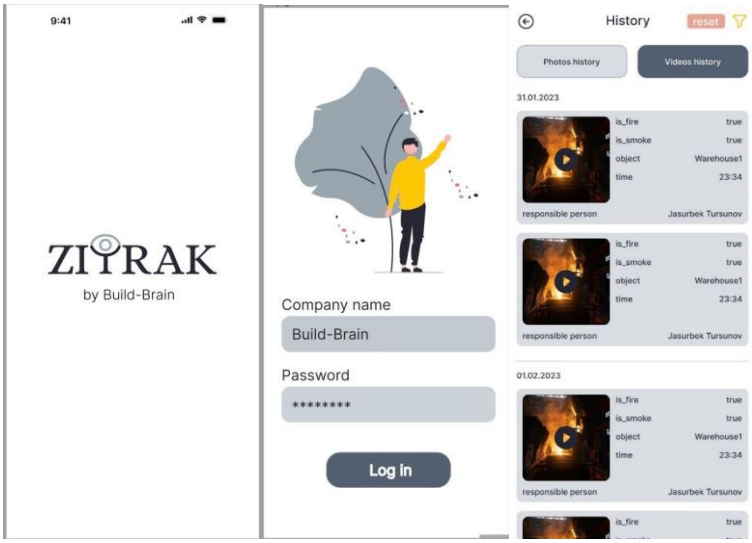
8. Communication with Support:
- Ability to contact technical support to solve problems.

9. Share Events:
- Ability to send a specific event (for example, a photo of a fire) via instant messengers or email.

10. Profile Settings:
- Change password, personal data and preferences.

11. Alarm Alert:
- Playing an audible signal or vibration in case of a fire alarm.

This is just a general overview of the functionality that can be included in the mobile application for the “Ziyrak” system. Specific features and functions of the application can be adapted to the requirements and needs of users. In Figure 3. some fragments of the application are presented.



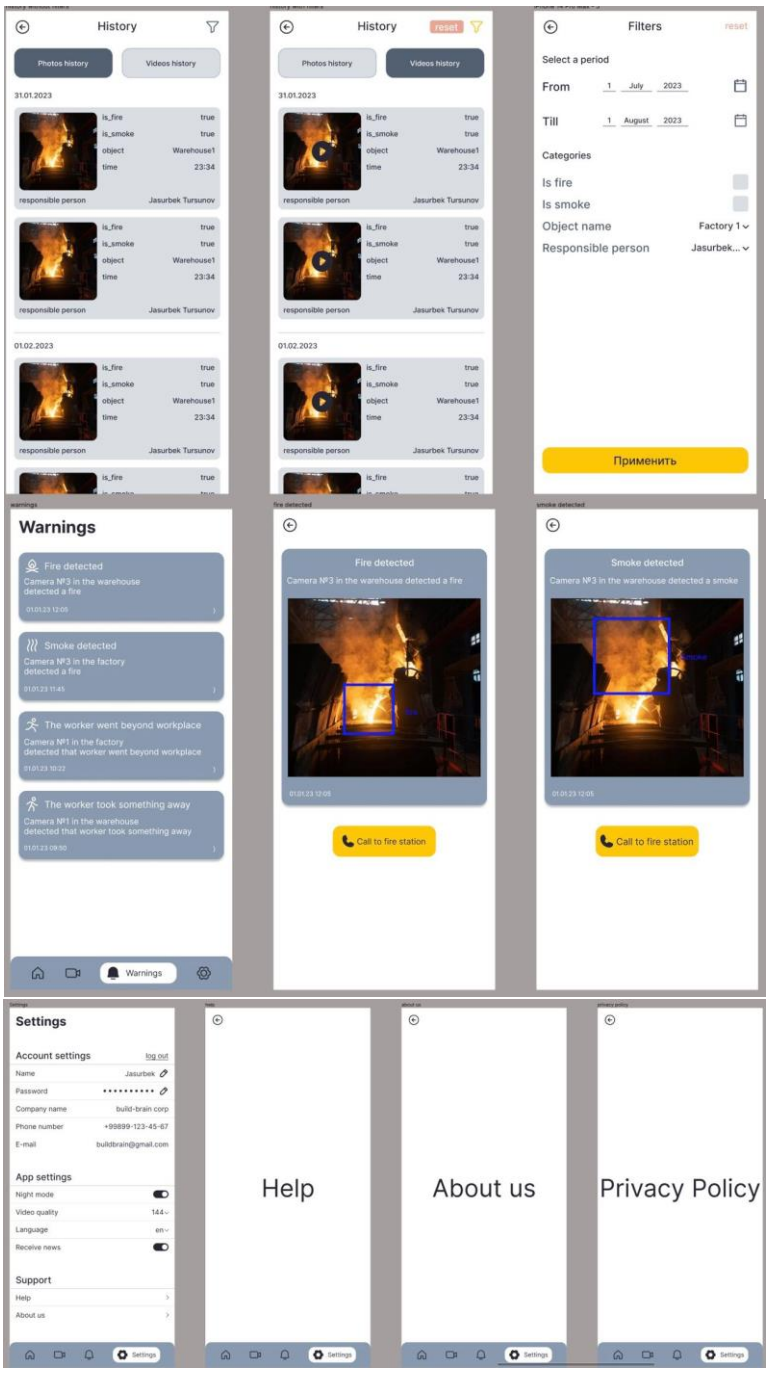


Fig.3. Mobile application of the system “Ziyrak”.

Advantages of the Intelligent System.

An intelligent fire detection and alarm system based on CCTV cameras provides many benefits that contribute to improving the safety of facilities and rapid response to emergencies:

Early Fire Detection: Thanks to the CCTV-based detection system, fires can be detected at an early stage when they can still be effectively extinguished.

Real-Time Alert: The mobile application allows users to receive real-time event alerts, allowing them to quickly respond to emergencies.

Remote Control: Users can remotely control devices and cameras through the mobile app, which is especially useful when out of the office.

Informed Decisions: Event history and analytics allow users to analyze past events and make informed decisions to improve security.

Efficient Resource Allocation: The system allows you to allocate resources more efficiently, directing them to where they are really needed.

Scalability: Due to the modular structure, the system can be easily scaled up by adding new cameras and devices as needed.

IV. CONCLUSION

The development and implementation of an intelligent fire detection and alarm system based on CCTV cameras is a complex but important process that includes the design of a database structure and the development of a mobile application. Careful planning, user customization, and effective interaction between the database and the mobile application provide a reliable and functional system that can quickly respond to potentially dangerous situations and ensure security.

An intelligent fire detection and alarm system based on CCTV cameras is a complex but incredibly important step in ensuring security. Pairing a well-designed database with a user-friendly mobile application creates a powerful system that can respond to emergencies and prevent potential threats.

Such a system can be implemented at various sites: from residential buildings to commercial and industrial complexes. It gives users the ability to control the situation, receive real-time information and take action in case of emergency.

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РАЗРАБОТКА И ВНЕДРЕНИЕ СТРУКТУРЫ ДАННЫХ И АНАЛИТИЧЕСКИХ ПРИЛОЖЕНИЙ СИСТЕМЫ «ЗИЙРАК»

Хамдамов Р.Х.[1], *Сакиев Т.Р.*[1], *Рахманов Х.Э.*[2]

[1] НИИ Развития цифровых технологий и искусственного интеллекта, Ташкент, Узбекистан

[2] Самаркандский филиал Ташкентского университета информационных технологий имени Мухаммада ал-Хорезми, Самарканд, Узбекистан

r.hamdamov@mail.ru, temur.sakiev@gmail.com, hoshimrahmonov@gmail.com

Аннотация. *Пожары являются одним из наиболее серьезных и разрушительных природных и техногенных бедствий, имеющих опасные последствия для жизни людей, имущества и окружающей среды. В данной статье представлена общая структура аппаратно программного комплекса которая обнаруживает дым и огонь по видеоизображениям полученных с камер видеонаблюдения. Также описана структура базы данных и мобильного приложения интеллектуальной системы. Интеллектуальная система, способная автоматически обнаруживать пожары на ранних стадиях, а также предоставлять оперативное оповещение пользователям на мобильный телефон, что способствует более эффективному реагированию на чрезвычайные ситуации.*

Ключевые слова: *обнаружение пожара, обнаружение дыма, система сигнализации, структура данных.*