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DORMITORY AS A CLUSTER OF A SMART HOUSE

Abstract. *The article considers the concept of a smart city, which uses a variety of information technologies for more efficient operation and compliance with the needs of its inhabitants. The concept is considered on the example of a smart dormitory, where one of the components of the system is the technology of the Internet of Things, in which various gadgets that are connected to the Internet interact with each other.*

The paper analyzes the existing channels and methods of data transmission from sensors for the collection and accumulation of information flows of the dormitory ecosystem.. Based on the obtained data, the logic of operation of monitoring modules with different types of sensors and their communication protocols was implemented and a monitoring system with a user interface with a chatbot was built.

To implement the software development of the system, various tools and components of development were used, namely: open programming language Processing; software development environment for Arduino IDE microcontrollers and ESP8266 microcontroller (MC); developed structural elements of the subsystem and program code on the example of the board for the sensor.

Keywords*: software; smart city; sensors; interface; chatbot**;** IoT.*

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ГУРТОЖИТОК, ЯК КЛАСТЕР РОЗУМНОГО БУДИНКУ

Анотація. *В статті розглядається концепція розумного міста, яка використовує різноманітні інформаційні технології задля більш ефективного функціонування та відповідності потреб його жителів. Концепція розглядається на прикладі розумного гуртожитку, де одним із компонентів системи є технологія Інтернету речей, в якій різні гаджети, які підключені до Інтернету, взаємодіють один з одним.*

В роботі були проаналізовані існуючи канали та методи передачі даних від датчиків для збору та накопичення інформаційних потоків екосистеми гуртожитку. На основі отриманих даних була реалізована логіка роботи модулів моніторингу з різними типами датчиків і їх протоколами зв'язку та побудована система моніторингу з інтерфейсом взаємодії з користувачем через чат-бот.

Для реалізації розробки програмного забезпечення системи були використані різноманітні засоби та компоненти розробки, а саме: відкрита мова програмування Processing; середовище розробки програмного забезпечення для мікроконтролерів Arduino IDE та мікроконтролера (МК) ESP8266; розроблені структурні елементи підсистеми та програмний код на прикладі плати для датчика.

Ключові слова*: програмне забезпечення; розумне місто; датчики; інтерфейс; чат-бот; IoT.*

Introduction. A smart city is a concept based on a city that uses a variety of information technologies to operate more efficiently and meet the needs of its residents. The concept of a smart city is somewhat reminiscent of the concept of a smart home, in which different gadgets interact with each other, but in the city things happen on a more global scale. The idea of a smart city is that by collecting real-time information productive. This allows you to save money, act more efficiently and improve living standards. Build a city that will be as comfortable as possible for its inhabitants, it is necessary to create certain conditions.

The driving force in building a smart city is the collection and processing of large amounts of data, which are updated every second and come from a variety of sensors, sensors, cameras, systems, devices and, ultimately, the citizens themselves, medical services, utilities, landscaping. Data sources are video cameras, various sensors, sensors, information systems that are implemented in everyday life

Modern information technologies perform three important tasks in a "smart city":

1. Provide fast communication channels of information transfer.

2. Carry out the collection and transmission of the necessary data to the municipal services.

3. Perform the role of a means of feedback between the city administration and its inhabitants.

Let's move on to the components and technologies used in a smart city.

The main component of such a system is the Internet of Things.

he Internet of Things, along with artificial intelligence and neural networks, is becoming one of the most relevant topics of 2020. Examples of the Internet of Things include many gadgets connected to the Internet.

The concept of the Internet of Things (IoT) was introduced when the number of things and objects connected to the Internet exceeded the number of people. The Internet of Things can be defined as a collection of intelligent objects that can respond to the environment and process information, as well as send it to other objects (and users) using Internet protocols.

It is a concept that allows physical objects ("things") to interact with each other or with the outside world, partially or completely without human intervention. In fact, this means that the things around us in everyday life, from the simplest, such as a coffee maker, to a car, can transmit the necessary data to each other, providing maximum comfort for the person without his intervention and management.

Modern Smart Home (smart home) in its concept has become part of the Internet of Things. Smart Home means not only safety management – it includes climate control systems (air conditioners, fans, boilers), lighting (for example, turning on the chandelier at 18:00), control of smart appliances (for example, a coffee maker, which brews coffee exactly at 07:00; refrigerator, which signals the lack of milk).

In a "smart" house, the meters themselves record how much energy was spent this month – you do not need to record the indicators. Some technologies for such a house will even be able to show how much a particular light bulb or household appliance connected to the network consumes.

The paper considers this concept on the example of a "smart" dormitory in which different gadgets interact with each other.

Setting objectives. The purpose and task of the study is to analyze the existing channels and methods of data transmission from sensors for the collection and accumulation of information flows of the dormitory ecosystem. Based on the obtained data, it was necessary to implement the logic of monitoring modules with different types of sensors and their communication protocols and to build a monitoring system with a user interface through a chatbot.

The main four basic technological layers involved in the work of the Internet of Things were analyzed:

1. Device hardware. Devices are objects that actually make up "things" on the Internet of Things. Interface between the real and digital worlds, they can take different sizes, shapes and levels of technological complexity depending on the task they need to perform in a particular IoT deployment.

2. Device software. This is what really makes connected devices "smart." The software is responsible for cloud communication, data collection, device integration, and real-time data analysis on the IoT network. Moreover, it is a device software that also enables users at the data visualization level to interact with the IoT system.

3. Communications. It is the hardware and software of a device that provides intelligent objects in ways and means of exchanging information with the rest of the IoT world. Choosing the right communication solution is one of the vital parts of building every IoT technology stack. The chosen technology will determine not only how to send / receive data from the cloud, but also how to control devices and how to interact with third-party devices.

4. Platform. Thanks to "smart" hardware and installed software, the device is able to sense, what is happening around, and report it to the user through a certain communication channel. The IoT platform is a place where all this data is collected, managed, processed, analyzed and presented in a user-friendly form.

Here are many IoT platforms on the market, the choice of which depends on the requirements of a particular IoT project and factors such as architecture and stack of IoT technologies, reliability, configuration properties, protocols used, equipment agnosticism, security and cost. efficiency. It is also worth mentioning that the platforms can be installed both locally and on a cloud basis.

To implement the task of developing software for IoT technology in the concept of smart dormitory, various tools and components of development were used, namely:

1. Open programming language Processing (programming language based on Java).

2. Software development environment for Arduino IDE microcontrollers and ESP8266 microcontroller (MC).

3. Developed structural elements of the subsystem and program code on the example of the board for the sensor.

The Arduino IDE development environment with the Arduino IDE for ESP8266 package installed is used to program these boards. The ESP8266 is the best option, as it has the advantage of high speed, large amount of memory available for programs, support for a large number of popular interfaces.

Boards based on the ESP8266 microcontroller allow the use of a significant number of microcontroller pins in external circuits. For example, the ESP8266 ESP-12E has 10 I / O inputs that can be used to connect a variety of sensors and other components and systems.

MK ESP8266 is currently one of the most integrated solutions for working with WiFi, because it contains many elements on the chip, which in other systems are unsoldered on the board, which in turn increases their cost.

The creation of modern concepts of an automated database for storing information system data involves the development of a number of components and modules needed to implement their functions, which are determined by the needs of their target audience. The selection of the necessary components and modules is one of the important stages of the product creation process.

Without functional components and modules, the concept of an automated database will not be able to provide all the necessary information to its users.

TelegramBot was chosen as the interface for the concepts of the automated database for data storage of the information system.

Research results. For the practical implementation of the concept of the information system "Smart Dormitory" as a development environment was chosen Arduino IDE and as a hardware platform – a system on a chip with a microcontroller ESP8266 ESP-12E.

The most popular version of ESP8266 at the moment is ESP-12E. It has a large amount of Flash memory, which allows you to connect a large number of data sensors and various other

components. The connection to the network is made to the home / office local network with Internet access through the router. The owner of the device can control it using a tablet or computer via its local network or remotely, via the Internet.

The monitoring module, as a set of sensors, is represented by two sensors: one (digital) for measuring temperature and humidity and atmospheric pressure from Bosch BME280; the other sensor is analog, which outputs an output signal, and later in the code we can operate with the values we need.

A user-friendly interface is required for the full operation of any automated database. TelegramBot was chosen as the interface for storing information system data.

Telegram Bot is a program that behaves like a regular chat partner with additional features. It performs predefined tasks independently and without user intervention. An important function of the Telegram bot is the ability to execute commands in the Telegram chat, which then directly trigger actions or request information.

Node-RED was chosen as a programming tool for connecting hardware devices, APIs and Internet services. The RedBot package for NodeRED was used to write the bot. Node-RED provides a browser-based thread editor that simplifies thread connections using a wide range of nodes in the palette. Threads can be deployed in the runtime with a single click.

Most of the functionality is written through Function Node.Function Node are elements that allow you to insert custom program code and thus expand the capabilities of the tools built into the package.

Testing of the main functions of the system should begin with checking the system to create an access point (see Fig. 1). This function is primary and gives the user access to the system. The created access point is password protected to ensure security settings of the subsystem and avoid changing settings thet no access was granted.

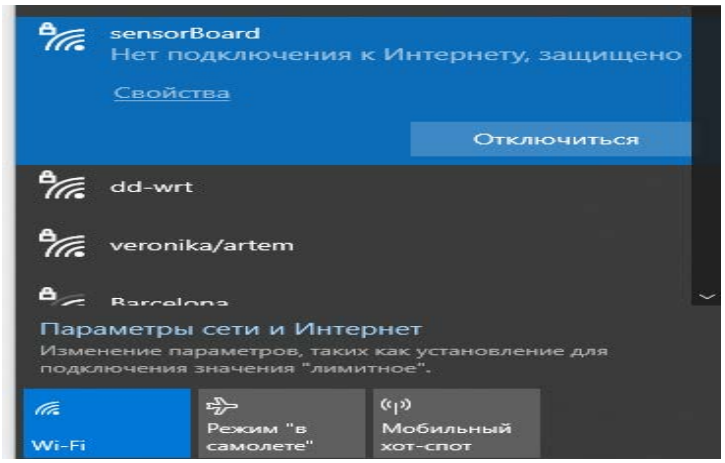

Figure 1. **A wireless access point is created**

Next, you need to log in to the web interface and enter the data:

1. Name and password of the wifi network to which the monitoring module should be connected.
2. Server for sending data.
3. Dormitory number and the room to which the module with sensors will be attached.
4. Interval of data exchange.

Upon successful connection to the wifi network with Internet access, the monitoring module will stop creating an access point for configuration and will become invisible in the list of available connection points and will start sending data to the specified server at a specified interval.The format of communication with the JSON server is formed into a data packet.

All information from the monitoring module, in particular, location data and readings from sensors, are formed into a data packet and sent to the address specified in the settings. The format of communication with the JSON server is formed into a data packet. On the Node-RED side, HTTP codes and a block of user code are used to process this data and store / send notifications to users.

After creating a wireless access point and successfully initializing the monitoring module, to start communication with the bot you need to press / start, then the user receives a message in which you can actually see what can be useful for this bot. Each subsequent step is described in detail in the pop-up messages, after selecting the command that the user wants to execute.

In order to view the state of the room ecosystem, you need to click on "View indicators" and then the student will receive all the data that are studied in the room: air temperature, humidity level in the room, CO2 level, air quality, etc (see Fig. 2).

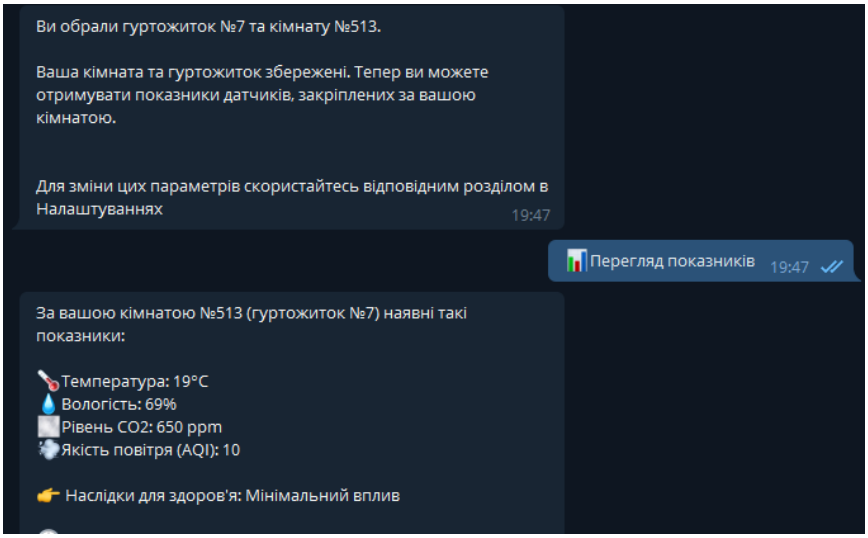

Figure 2. **View the indicators of the ecosystem of the room**

Also, for convenience, you can turn on notifications of changes or exceedances of certain indicators to protect yourself and your health from the effects of negative factors (see Fig. 3).

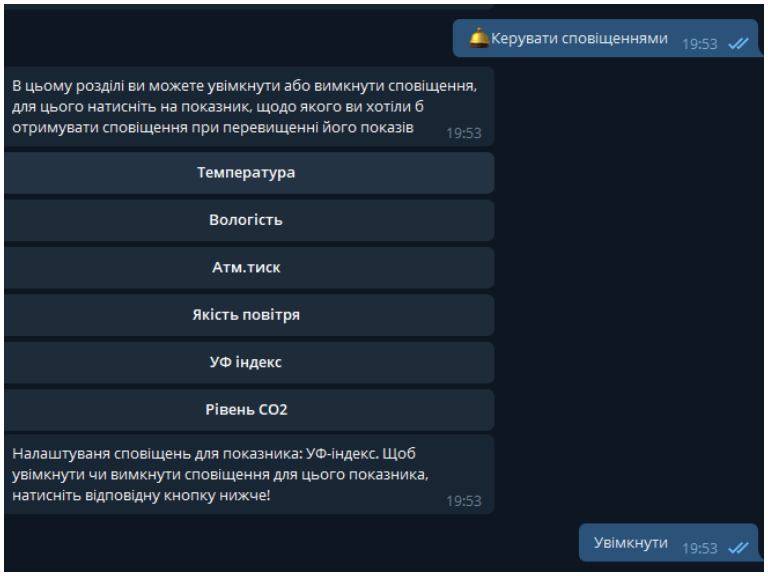

Figure 3. **Enable metric change notifications**

There should be no difficulties when using the bot, as it has a clear and accessible interface and functionality for everyone.

Conclusion.

The purpose of this work was to implement the logic of monitoring modules with different types of sensors and their communication protocols and to build a monitoring system with a user interface with a chatbot.

The system allows you to use information to analyze the temperature in the room, the amount of ultraviolet rays, the level of gas in the kitchen, atmospheric pressure, air quality. In winter, it is especially important to monitor changes in the temperature in the dormitory rooms to avoid unauthorized use of heaters and other devices that could lead to a fire situation.

The system will allow tracking data in the dormitory room where the user lives and will send notifications of their excess or deviation from the norm and promptly respond to dangerous situations. This will improve the lives of students in the dormitory

The system was tested and tested on the data obtained in the dormitory № 3 of the faculty of MKT KNUTD.

Hosting for this environment was deployed on Amazon Web Services (AWS) EC2, as part of a free tariff, for a period of one year.

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