Monitoring and analysis of air indicators from sensors of various types in the cyberphysical system " Smart home"

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The problem of the choice of technology, on the basis of which can be developed, is considered system of processing and display air indicators in indoors. The advantages of selected technologies are considered and technology is proposed for solving the problem

Key words - Internet of Things, client-server system, temperature indicators.

Introduction

The system for processing and displaying indicators in the building at this moment is the best option for remote monitoring of the premises.

More recently, the notion of IoT (Internet of Things) has emerged - a network concept consisting of interconnected physical devices with built-in sensors, as well as software that allows the transmission and data exchanging between the physical world and computer systems, using standard communication protocols. The prospect of development of this concept is enormous, since the system built on the basis of the IoT, allows remote monitoring of various indices in the room, which in turn allows quick detection of possible problems.

Condition of the problem

The world of technology doesn't stand on the spot, which means that you always need to improve your product. There are several details that need to be improved in building IoT systems that are popular nowadays: the ability to track all data in real-time, the timely notification of users about the exceeding of a particular parameter over the allowed range, and the development of a more user-friendly interface.

In the XXI century, this topic is very relevant, because such systems contribute to increasing the safety of people in the building, and significant cost savings, due to the possible problems rapid detection.

The aim of the work is to develop a system for processing and displaying building indicators, which will be convenient for use and will contain the necessary functionality.

Formulation of the problem

Choose the technology that is most suitable for the processing and display of air indicators of a various type. Consider the trends of the chosen technology and suggest a possible implementation.

Solving the problem

Comparison of technologies for the processing and display of temperature indicators. One of the most popular room monitoring systems is Microsoft Azure. Users of this system can monitor the different sensors state in real-time, or for a certain time range. Monitoring becomes possible after authorizing the Azure system, and creating your own review page. The main advantage of such services is the possibility of remote control over the entire premises, and therefore, the prevention of possible breakdowns or failures in the system of heat supply, power supply, and others.

Microsoft Azure is a cloud-based platform and Microsoft infrastructure designed for cloud computing applications developers and designed to simplify the process of creating online applications.

The concept of cloud computing is using computing power, disk space and communication channels "computing cloud" for the implementation of laborious tasks. The load between the computers in this cloud is distributed automatically. Most cloud applications work in the browser. The main advantages of such approach are: user-friendly interface, ability to create a project page for monitoring the premises and select indicators to be monitored.

1. The concept of the Internet of things. Internet of Things - One of the most popular concepts in modern futurology. And moreover, one of those few who are no longer concepts and are embodied in life.

According to the most widespread formulation, Internet of things are the concept of a computer network of physical objects (that is, things, actually) that are equipped with such technologies to interact with each other.

The concept suggests that Internet of things can seriously affect society life, since it allows automating a lot of processes. Internet of Things (IoT) is a global network of physical devices connected to the Internet - "things" that are equipped with sensors, sensors and data communication devices. These devices are united by connecting to information control and processing centers. In a separate direction, IoT, apparently, stands out in the middle of zero when the number of devices connected to the World Wide Web exceeded the number of users.

IoT combines real things into virtual systems that are capable of solving completely different tasks. The key idea of the concept is to connect all the objects that can be connected to network.

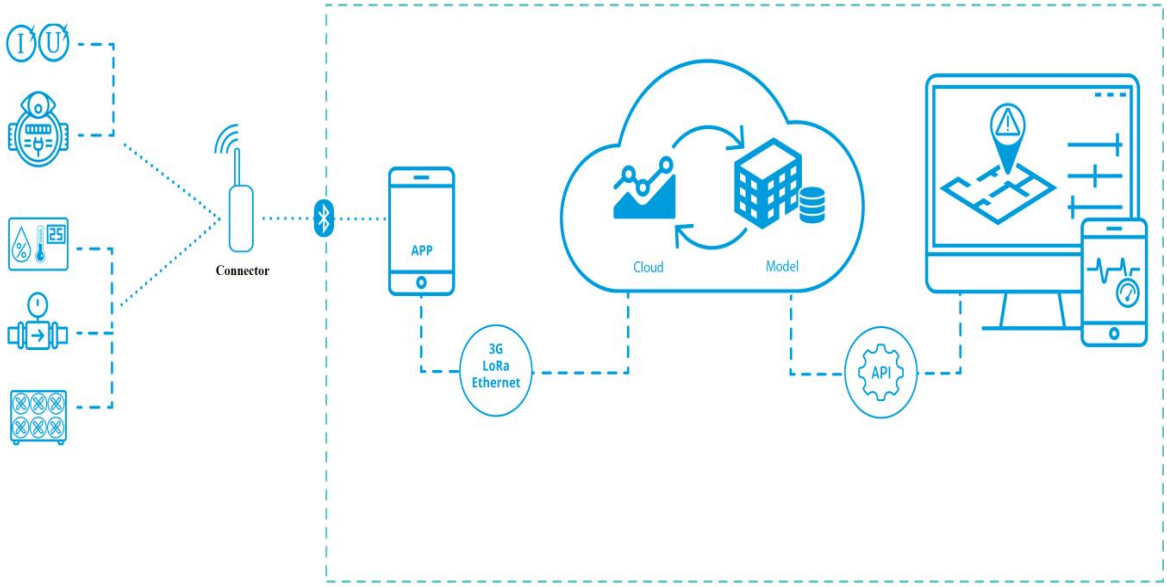

Fig.1. IoT system

The advantages of such system can be considered to be that due to automation, people will have more free time. Connected devices on the Internet will also give people more opportunities for rational resource management. Already today, they help to optimally spend heat, water, light and save on payment of utilities. It is important to note that not only the lives of individuals, but also entire industries will change. One of the most susceptible industries to change will probably

be a telecom, as mobile operators will gradually change their business models from network providers to smart service providers and applications.

2. Principles of functioning. To implement IoT requires an ecosystem that would include "smart things" - various devices equipped with sensors; access network and information transmission (mobile or fixed - not important); as well as platforms for managing the network, devices and applications.

Today, there are several specialized standards for data transmitting between "smart" devices. The eMTC (enhanced Machine-Type Communication) standard is deployed on the basis of mobile LTE networks, and the EC-GSM-IoT (Extended Coverage - GSM - Internet of Things) runs over the GSM network. But the most popular is the standard NB-IoT (Narrowband IoT). Its feature is that it can be deployed, either on GSM or LTE networks, and independently, on a separate network.

You can conventionally divide all IoT projects into two groups, depending on the type of device communication: massive (Massive MTC) and critical (Critical MTC). Each type has its own tasks, and each of them has its own requirements for the network. Massive IoT projects are "smart" homes, counters, solutions for tracking freight or agriculture, and so on.

Such solutions involve the transfer of a small amount of data from a large number of sensors. Also, these decisions are characterized by the uncertainty of the guaranteed transmission-receiving information. Losing some parts of information from the counter is not critical, because the data will be updated during the next session.

The basic requirements here are the low cost of devices and their minimum power consumption. Partly these projects can be implemented on the basis of GSM networks, but most truly massive solutions are built on the basis of LTE infrastructure. With regard to solutions based on "critical" machine communications, they have completely different inquiries. First of all, it is ultra-low signal transmission delay (less than 5 mili-seconds) and ultra-high reliability of the network.

Not for nothing, such applications are called "critical", because they are dependent from the work of the network, what could have influence the safety and even the people life. Examples of such applications can be autonomous cars, traffic management, remote surgery or industrial equipment management. These solutions still exist in the form of prototypes or test samples, since they require the next generation networks of 5G to implement them.

3. Technologies used for realization.

To combine everyday things with the network the following should be taken into account:

- Object identification. Only unique identification system can provide correct collecting and accumulating information about a particular object in the network.

- Data processing. For sensors data processing and accumulation, a built-in processor(computer) (such as Raspberry Pi, Intel Edison) should be used.

- Data transmission without wired connection. Wireless technology (Wi-Fi, Bluetooth, ZigBee, 6LoWPAN) can be used to exchange information between devices which are mobile and autonomous.

An important element in building the Internet of things is also an architectural template. To solve this problem, the best architectural template is Model-View-Controller (MVC). It is an architectural template that is used when designing and developing software.

This template involves dividing the system into three interrelated parts: a data model, a view (user interface), and a control module. It is used to separate data (models) from the user

interface (view) so that changes to the user interface minimally affect the operation of data, and changes in the data model could be carried out without changing the user interface.

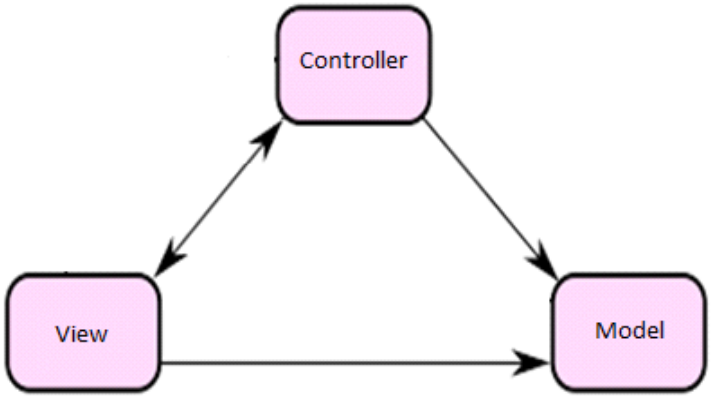

Fig.2. MVC pattern

Client-server architecture. This architecture is the dominant concept in creating distributed network applications and involves interaction and sharing of data between them.

This architecture includes the following main components:

• a set of servers that provide information;

• a set of clients who use services provided to servers;

• Network - provides interaction between clients and servers.

Servers are independent of each other. Customers also function in parallel with each other. One server can process queries simultaneously from different clients.

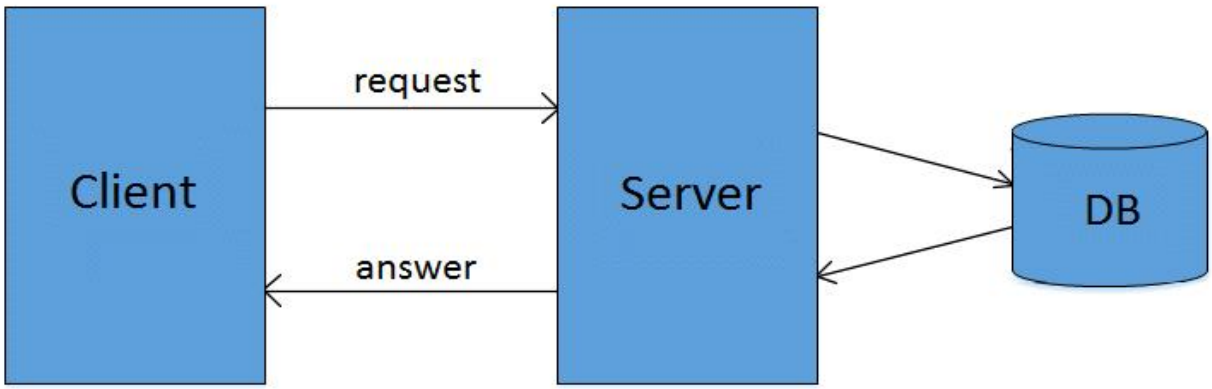

Fig.3. Client-server model

Description of the system

The system must collect data from sensors of various types. After receiving an array of data, the system must process them by generating the input data that must be submitted to the graphs. After the graph is drawn, it is necessary to specify units of measurement, which also come in the array.

Graph - is graphic display of indicators from different types of sensors. It is also need to implement the ability to view metrics in online mode with the help of WebSocket. The system should also be able to analyze the data obtained. For example, if the room temperature has started to drop sharply, it is necessary to notice it on time, and do it programmatically (without human help) by including an additional heater. For this, it is necessary to make possibility to set

the minimum and maximum range of the sensor values. Also, when sensor exit a certain figure for a valid range, system must inform the user (using SMS / mail/ message on user interface).

Conclusion

The concept of the Internet of things, principles of functioning and technology for its construction were considered and chosen as technology for implementing processing and displaying air indices in a building system. Microsoft Azure cloud was chosen as central part of the system for data processing and user informing. The architecture of the client-server, the kind of system use is considered.

References

[1] The Internet of Things (MIT Press Essential Knowledge series) Paperback – March 20, 2015.

[2] The Second Machine Age – Work, Progress, and Prosperity in a Time of Brilliant Technologies Hardcover – 18 Feb 2014.

[3] Getting Started With The Internet Of Things: Connecting Sensors and Microcontrollers to the Cloud Paperback – 2011.

[4] Learning Internet of Things Paperback – Import, 27 Jan 2015.