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Automated Monitoring System Development

Andrii Bondariev[1], Svitlana Maksymova[1],

1. CITAM Department, Kharkiv National University of Radio Electronics, UKRAINE,
Kharkiv, Nauki Ave. 14., e-mail: andrii.bondariev@nure.ua

Abstract - The relevance of the topic of monitoring and its impact on the production efficiency of the enterprise is given. Data transmission standards of both hardware and software parts of the system, as well as transmission over the Internet, were analyzed. An analysis of the impact of the lack of monitoring, as well as the situation of non-compliance with the operating conditions of the sensors, was carried out. Modern automated monitoring systems were considered and analyzed. The development prospects of the development of an automated monitoring system in production are described.

***Keywords*:** Automated System, Monitoring, Sensors and Sensors, Arduino Microcontroller, Web Service Amazon Web Services, Web Technologies, IoT.

I. Introduction

Monitoring of information technology systems is a component of the management of the information infrastructure of the enterprise, which consists in the constant observation and periodic analysis of the components of the work processes with the tracking of the dynamics of the changes that occur with it. The key task of monitoring systems is to receive, save and analyze information about the state of controlled elements of the company's structure. The development web application allows you to quickly react to a problem in the operation of services, as well as effectively prevent the occurrence of problems [1]. That is why the idea was put forward to create a similar system, which will be an automated system for monitoring and managing work processes in production.

Today, in various companies with production, the need for self-monitoring of components used in work processes during the performance of important tasks is growing. The need to find methods of detecting problems in production during the execution of work processes is an important component and indicator of the productivity of the business structure. For the necessary effectiveness, it is necessary to be able to notice and solve such problems in a timely manner, so that they do not allow negative perspectives, critical incidents and do not involve material losses in the company. The relevance of the topic of monitoring in the technological sphere is especially relevant, because poor-quality use of production capacity or materials can entail a tendency for negative production efficiency and its unprofitability in the distant possible forecast. While having even the simplest monitoring can prevent these bad consequences.

The key task of monitoring systems is to receive, save and analyze information about the state of controlled elements of the company's structure, and the AWS cloud web service copes well with this task. For more than 15 years, Amazon Web Services has been the most complete and widely used cloud service in the world[2]. AWS is constantly expanding its technologies to support almost any cloud solution. Today, it has more than 200 full-featured services for computing, storage, databases, networking, analytics, machine learning and artificial intelligence (AI), Internet of Things (IoT), mobile devices, security, hybrid, virtual and augmented reality (VR and AR), media, the entire application development cycle. The listed services cover 81 availability zones in 25 geographic regions. Millions of customers, including the fastest-growing startups, corporations, and leading government agencies, trust AWS to transform their infrastructure to become more elastic and lower costs.

II. Design and Formation of Automated Monitoring System

The purpose of this work is to create an automated system for monitoring important indicators during work processes in production with the help of sensors and modern information and technical technologies. Work processes mean the creation of a material product necessary for the existence and development of production as a business structure, and monitoring is a necessary part of improving the efficiency of the creation of this product.

For example, you can consider an enterprise that produces a material product, and for which it is important to observe the temperature regime for materials of various kinds - these can be products of the chemical industry, with electrical conductivity. Violation of the climatic regime during the processing and production of such goods can lead to a significant defect rate in the final version. To prevent this, monitoring based on a humidity and temperature sensor can be set up in the working areas, which will transmit the indicators to the appropriate directory. There can be as many such sensors as necessary, and this need is calculated using the same indicators that can affect the quality of the manufactured product.

An urgent task is to create an automated system for monitoring lighting, temperature and humidity, noise and vibration - important indicators during work processes in production using sensors and modern IT technologies using AWS. Work processes mean the creation of a material product necessary for the existence and development of production as a business structure, and monitoring is a necessary part of improving the efficiency of the creation of this product[3]. At that time, AWS is an important part of this system because it is in the web cloud that the deployment of the completed application will take place. In addition to the fact that the AWS web service performs its task well, it is also worth considering the best aspects of this cloud provider:

The cloud gives an easy access to a wide range of technologies so you can innovate faster and create almost

anything you can imagine. From infrastructure services such as compute, storage, and databases to IoT, machine learning, data analytics, and more, you can quickly scale resources as needed. Thanks to the capabilities of AWS, the implementation is several orders of magnitude faster than before and it gives the freedom to experiment, test new ideas to differentiate the customer experience and transform your business.

AWS is designed to be the most flexible and secure cloud computing available today[2]. The AWS core infrastructure is designed to meet the security requirements of the military, global banks, and other highly sensitive organizations. This is supported by a comprehensive set of cloud security tools with 230 services and features for security, compliance and management. AWS supports 90 security standards and compliance certificates, and all 117 AWS services that store customer data offer the ability to encrypt that data. This suggests that using AWS will make the development monitoring system more secure.

In order to comply with technological norms during the production of a material product, optimal indicators that can contribute to production efficiency must be maintained. The work will consider sensors that can provide information to the monitoring system, namely:

- light sensor;
- temperature and humidity sensor;
- noise sensor;
- vibration sensor.

The question arises as to the use of the system, which will be the process of interaction of a microcontroller based on a microcontroller with sensors, from where information will be displayed in software using a cloud web service and wireless technologies. This work will describe the creation of a similar automated monitoring system at the production site, which can be seen in Fig. 1

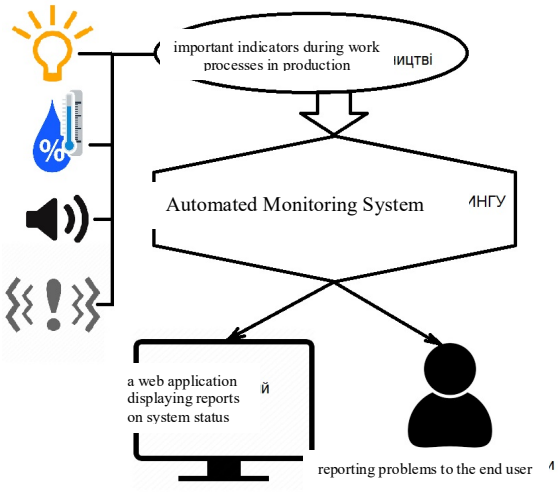

Figure1. Automated Monitoring System Functions

Of course, it would be possible to do without a complex system and choose instruments for measuring indicators that would immediately provide information. And after a person would have received information about the indicators, he would write them down in a regular journal with a pen, and that journal had to be kept manually every day. Of course, it is simpler and maybe even cheaper, but here you still need to take into account the presence of the human factor, which will be reflected in the incomplete radius and inaccuracy of the calculations, since a person cannot physically fit where an electric sensor can. Manual logging, because of its inconvenience, will have consequences in the transfer and exchange of information, as well as in the ability to back it up.

Thus, it becomes relevant to create an automated monitoring system that will allow control without human intervention, and all information will be collected digitally, which will simplify transfer, processing, storage and interaction with data.

AWS offers Internet of Things (IoT) services and solutions to connect and manage billions of devices. These cloud services connect your IoT devices to other devices and AWS cloud services[2]. AWS IoT provides device software that can help you integrate your IoT devices into AWS IoT-based solutions. If your devices can connect to AWS IoT, AWS IoT can connect them to cloud services provided by AWS (Figure 2).

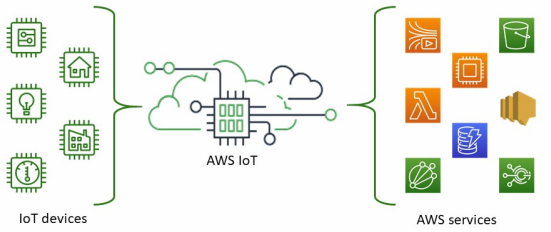

Figure 2. Work Scheme AWS IoT

Also as a practical example of the use of the AWS infrastructure and, as a result, trust among public authorities, you can consider how on July 15, in London, the Minister of Digital Transformation Mykhailo Fedorov and the Director of Digital Transformations in the Public Sector Amazon Web Services (AWS) Liam Maxwell signed a Memorandum on mutual understanding regarding acceleration of digital transformation and implementation of innovations in Ukraine[4]. "For many years, Amazon (AWS) has had a strong, loyal and growing customer community in Ukraine. We welcome the signing of this Memorandum of Understanding with the Ukrainian Government and look forward to working together in the direction of the digital development of the state," — Liam Maxwell, Director of Digital Transformation in the Public Sector, Amazon Web Services in Europe.

III. Sequence and Principles of System Operation

For the automated processing of data from indicators of noise, lighting, temperature and humidity and vibration sensors, it is proposed to create a system that will take into account and solve the shortcomings of existing popular

analogues, taking existing components as a basis, and improving efficiency.

It is proposed to include the following elements [5] (Fig. 3) in the composition of the proposed system for the automation of control and accounting of indicators:

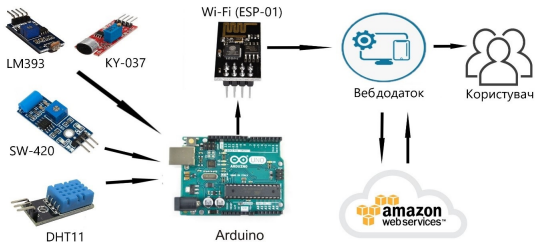

Figure 3. General Scheme of Automated Monitoring System Operation

Wi-Fi module ESP-01 is the most popular module of the ESP8266 series. The controller communicates with the ESP8266 via UART (Serial port) using a set of AT commands. Work on receiving and transmitting data looks like interaction with a TCP socket or with a serial port of a computer. You can program and download firmware through the Arduino IDE [6], just like when working with Arduino. The reaction to AT commands is simply a function of the standard firmware installed at the factory. Since there are 2 input/output ports on the board, after the firmware you can do without an additional controller by connecting the peripherals directly to the module. To flash the module, you will need an ordinary programmer, as well as for some Arduino boards. The PCB antenna of the module provides a communication range of up to 400m in open space. Using the Wi-Fi module ESP-01 is possible thanks to the existing and booming software. The ESP-01 module is successfully used in stationary and mobile devices as part of smart home systems, mobile and wearable devices. Thanks to the use of ESP-01, modern household appliances become an ecosystem of the Internet of Things. Wi-Fi wireless communication and the function of reducing power consumption are especially relevant in robotic complexes that move, with power from chemical sources of current or from solar batteries. This module is ideal for solving the problem of processing information from a microcontroller to a web application based on the AWS cloud web service.

The LM393[7] sensor is able to determine the distance to objects and obstacles, as well as the level of illumination in Lux. The sensor module includes: an IR LED with a programmable driver, two photodiodes for determining total illumination (Ch0) and illumination in the IR range (Ch1), amplifiers with programmable gain, MC, ALU, ADC, RAM, I2C bus controller (contacts SDA and SCL). The illumination and proximity sensor can be used in Arduino projects to implement mechanisms for changing the brightness of screens depending on the illumination or the approach-removal of objects.

The DHT11 is a digital humidity and temperature sensor consisting of a thermistor and a capacitive humidity sensor. The sensor also contains an ADC for converting analog values of humidity and temperature. The DHT11 sensor does not have high speed and accuracy, but it is simple, inexpensive and excellent for training and indoor humidity control.

The KY-037 sensor is characterized by high energy efficiency in operation mode (consumes from 3.1 to 6 mA) and automatic noise control. The last advantage manifests itself well when working with borderline sounds in the noise range (quiet sounds are amplified, and loud sounds are amplified). The built-in electric microphone is sensitive to sounds in the frequency range from 22 Hz to 22 kHz. The standard connection of the module to the controller (for example, the Arduino board) is performed via three contacts: Vdd ("+"), GND ("-"), OUT (to the analog input). Using the GAIN contact, you can control the value of the maximum volume gain (by 40 dB, 50 dB, or by 60 dB). The AR contact is used to set the trigger time.

The SW-420 vibration sensor is designed to capture vibrations in Arduino-based systems. The module is widely used from anti-theft systems to the creation of earthquake detectors. The SW-420 vibration sensor responds to shocks and vibrations. The sensitivity of the module can be adjusted using a tuning resistor. The sensor has small dimensions, but is equipped with two LEDs, one of which allows you to monitor the presence of power, and the second turns on when triggered. Unlike other analogues, this sensor is not triggered by constant vibration - one push is enough.

On the basis of the sensors described above, the solution of the task will be performed to automate the data processing of the indicators selected for the task and create a system that will work on the basis of the Arduino microcontroller and informative graphs will be built in real time based on the output data. The image will be displayed in the windows of the software, which in turn will be deployed through the AWS web service. Monitoring will be available through the web version in the secure environment of the cloud provider, so it will not be necessary to install new computers or other digital devices, it will only be enough to have access to the web version and conveniently use an effective system that will help the company monitor its own important work processes.

With cloud computing, you don't have to allocate extra resources up front to handle future peak levels of business activity. Instead, you provide the required amount of resources. You can scale these resources up or down to instantly increase and decrease capacity as your business needs change. For example, AWS container and orchestration services make it easy to manage the underlying infrastructure, both on-premises and in the cloud. This allows you to focus on innovation and the needs of your business. Nearly 80 percent of all containers in the cloud today run on AWS. Customers like Samsung, Expedia, GoDaddy, and Snap choose to run their containers on AWS for security, reliability, and scalability.

AWS IoT allows you to choose the most appropriate and modern technologies for your solution. To help you manage and support your IoT devices in the field, AWS IoT Core supports the following protocols:

- MQTT (message queue and telemetry transport)
- MQTT via WSS (Websockets Secure)
- HTTPS (hypertext transfer protocol - secure)
- LoRaWAN (global long-range network)

In Fig. 4, you can familiarize yourself with the operation scheme of the Arduino microcontroller in the cloud computing system using the services of the AWS platform and the third-party monitoring service Grafana.

Grafana will help to visualize the metrics that the system will provide during operation, and with the help of this service, it will be possible to evaluate the system's performance more comfortably and efficiently. It is also well integrated with the AWS platform, which makes the use of Grafana an effective way of implementing a monitoring system.

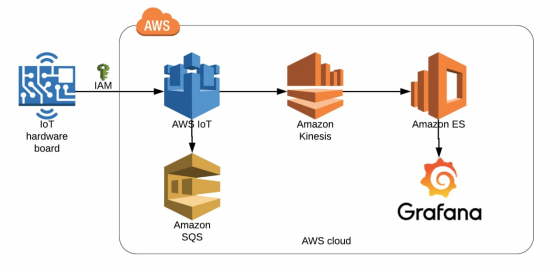

Figure4. Scheme of Automated Monitoring System Operation

IV. Conclusion

The topic of motion or presence sensors was touched upon in this work. Their analysis was carried out, their role in human life, and a new device was proposed that performs the same tasks, but without the sensor itself, namely an automated information processing module. Thanks to the listed sensors, it will be possible to monitor the necessary lighting, temperature and humidity, noise and vibration. Controlling these indicators will help keep production in an efficient and fault-tolerant state. The automated monitoring system covers important indicators during work processes in production and deals with the processing of data from indicators with the help of sensors and modern information and technical technologies to stabilize and improve the efficiency of creating a material product, which is necessary for the existence and development of production as a business structure.

Thanks to the use of the proposed automated monitoring system using the AWS cloud web service, it will be possible to monitor the necessary lighting, temperature and humidity, noise and vibration. Controlling these indicators will help keep production in an efficient and fault-tolerant state. The automated monitoring system covers important indicators during work processes in production and deals with the processing of data from indicators with the help of sensors and modern information and technical technologies to stabilize and improve the efficiency of creating a material product, which is necessary for the existence and development of production as a business structure. Also, thanks to the use of cloud technologies of the AWS web provider, the development system will be more protected by the encryption and security methods of the cloud provider's infrastructure and more flexible in completing functions and introducing new capabilities.

Thus, the automation of the process of monitoring indicators will increase the speed of response to problems during production, will allow quality analysis of conditions and will prevent critical situations at the enterprise.

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