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Program Algorithm for Monitoring System Development

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Abstract:

In our time, the development of a system for monitoring the parameters of the production environment is of great relevance and importance in the current industrial environment for several reasons. First of all, the measurement and analysis of the parameters of the vibrational medium make it possible to ensure the safety of workers and avoid possible accidents and unsafe situations. In other words, monitoring systems allow you to optimize industrial processes by continuously monitoring parameters in real time. This allows you to detect possible malfunctions or anomalies in the plant and immediately respond to them, so as to avoid wasting time and resources. In this article authors propose a program algorithm for parameters of industrial premises monitoring system.

Key words: Monitoring system, Industrial premise, Algorithm, Manufacturing Innovation, Industrial Innovation.

Introduction

The development of industry 4.0 and the integration of digital technologies in manufacturing creates a need for effective and intelligent monitoring systems that can automate the processes of collecting, processing and analyzing data [1]-[12].

This helps companies increase productivity, reduce costs and improve product Quality [13]-[27]. Various methods and approaches can be used here [28]-[33].

Monitoring of production process parameters is a system that provides constant control over key parameters and conditions that affect the efficiency and safety of the production process. Given the constant pressure to increase productivity and reduce costs, monitoring the parameters of the production process becomes extremely relevant, it allows manufacturers and employees to quickly respond to changes in the production environment and ensure stable product quality.

A monitoring system usually consists of sensors that measure various parameters such as temperature, pressure, humidity, resource level (such as electricity or fluids),

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material flow rate, vibration, noise level, etc. This data is usually collected in real time and transmitted to a central system for analysis. The main purpose of monitoring the parameters of the production process is to ensure the stability and efficiency of the production environment. This includes identifying deviations from the norm, hazardous conditions, malfunctions in equipment or processes, and optimizing the efficiency of the production process.

In manufacturing, where automation plays a key role, parameter monitoring becomes even more important. It allows automatic control systems to quickly respond to any changes in the production process and avoid problems or emergency situations. Modern monitoring systems use advanced technologies such as the Internet of Things, artificial intelligence, real-time analytics, and cloud solutions. This allows for more accurate and effective monitoring, and also increases the possibilities of forecasting and optimization of the production process.

In today's production conditions, when the industry is rapidly developing and becoming more and more automated, the integration of monitoring systems is becoming more and more relevant. It allows automatic control systems to quickly respond to changes in the production environment, optimize processes and ensure high product quality. Integration between monitoring systems and automatic control systems requires standardization of data exchange protocols, compatibility between hardware and software, and reliable real-time data transmission and processing. The main task of integration is to ensure the joint operation of monitoring and control systems to achieve common production goals. This includes automatically responding to detected deviations in parameters, optimizing the operation of equipment and processes, ensuring safety and reducing costs. Integration may require the development of specialized application programming interfaces to enable interoperability between systems. It is also important to ensure protection against unauthorized access to data and reliable transmission of information over the network. The integration of monitoring and control systems makes it possible to increase the automation and efficiency of production processes, reduce energy and resource costs, improve product quality and ensure employee safety.

Related works

The development of monitoring systems is becoming increasingly relevant, especially for those enterprises that want to move to the next level in accordance with

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the principles of Industry 4.0. And it is not surprising that many scientists write various works on this topic. Let's look at a few recent works.

Marquès, J. M., and co-authors [34] propose a notification, recommendation and monitoring system which is integrated into an automatic assessment tool with the aim to enhance the learning process in virtual classrooms.

Group of authors in [35] notes that due to long process cycle time and arc-based deposition, defect monitoring, process stability and control are critical for the wire arc additive manufacturing technology system to be used in the industry. Although major progress has been made in process development, path slicing and programming, and material analysis, a comprehensive process monitoring, and control system are yet to be developed. They analyze sensing and control design suitable for a wire arc additive manufacturing system, including technologies developed for the generic Arc Welding process, the Wire Arc Additive Manufacturing process and laser Additive Manufacturing.

Researchers in [36] tell us that operational pollen monitoring networks have developed across Europe, and the world more generally, in response to the increasing prevalence of pollen allergy and asthma. his paper describes the rationale behind the EUMETNET AutoPollen programme, which aims to develop a prototype automatic pollen monitoring network across Europe.

The paper [37] addresses the issue of substantiating a methodological approach to evaluating the efficiency of automated information and telecommunication systems for vehicle traffic monitoring, which allows us to quantify the efficiency of their application.

Guo, Y., & et al. [38] note that computer numerical control machine tools are the core manufacturing equipment in discrete manufacturing enterprises, collecting and monitoring the data is an important part of intelligent manufacturing workshops.

Scientists in [39] present the design and development of a framework for the remote monitoring of refrigerator and cold storage systems based on the implementation of a wireless sensor network for data acquisition, and intelligent algorithms for Predictive Maintenance.

In the study [40], an industrial IoT algorithm with an associated hardware prototype is proposed to monitor the condition of wind energy conversion system in the real-time environment.

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So, we see how diverse monitoring systems can be. Further in this article we will consider the algorithm of the program for a system for monitoring the climatic parameters of industrial premises.

Development of the algorithm of the program of the monitoring system of the parameters of industrial premises

The use of systems for monitoring the production premises parameters is critically important for increasing the efficiency and safety of the production process. These systems allow you to monitor production parameters in real time, detect anomalies and warn of possible malfunctions, which helps prevent accidents and product losses. By analyzing data, these systems help to optimize the use of resources, reduce costs and improve product quality. Personnel training and regular maintenance are important elements in the successful implementation and operation of monitoring systems. Overall, these systems are an essential tool for modern manufacturing, helping to maintain high levels of productivity, safety and competitiveness.

One of the important components of the production process monitoring system, which is aimed at preventing potential problems and emergency situations by detecting deviations from the norm or changes that may indicate malfunctions in the production environment, is the detection of anomalies and warning of system malfunctions. Having considered the detection of anomalies and warning of malfunctions in the monitoring system of the parameters of the production process, it can be emphasized its importance in preventing potential problems in the production environment. This aspect includes real-time monitoring, data analysis to detect deviations, setting thresholds, alert systems and automatic actions, as well as the ability to predict and prevent future problems. This approach helps to ensure the safety, stability and efficiency of the production process.

The system for monitoring the parameters of production premises should provide information in real time. Real-time display of data and their analysis are key elements for effective management and control of the production process. This allows operators and production managers to see the current status of the process without delays. This allows them to quickly respond to any changes, identify problems and take the necessary measures to solve them. Quick access to up-to-date data allows you to assess performance in real time. This allows you to identify weak points in the production process and quickly react to them to increase efficiency. Real-time data analysis also allows you to identify opportunities to optimize production processes. By identifying

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and analyzing different execution options, you can find ways to increase productivity, reduce costs, and improve product quality.

The development of the algorithm of the program for monitoring the parameters of industrial premises is key to ensuring its efficiency and reliability. The algorithm allows you to optimize the use of resources, such as electricity and network traffic, ensuring the efficient operation of the system. It also determines how the system reacts to events such as the detection of excessive temperature or humidity, allowing appropriate measures to be taken to resolve them. A well-developed algorithm ensures stable operation of the system even in difficult environmental conditions. It can also include parameter monitoring and reporting functions, allowing operators and administrators to respond to any problems or anomalies in a timely manner. In addition, the algorithm may include security measures to help prevent unauthorized access and protect data. A well-designed algorithm is also scalable and can be easily extended to include new features or expand system functionality in the future. The general algorithm of the program of the system for monitoring the parameters of production premises is presented in Figure 1.

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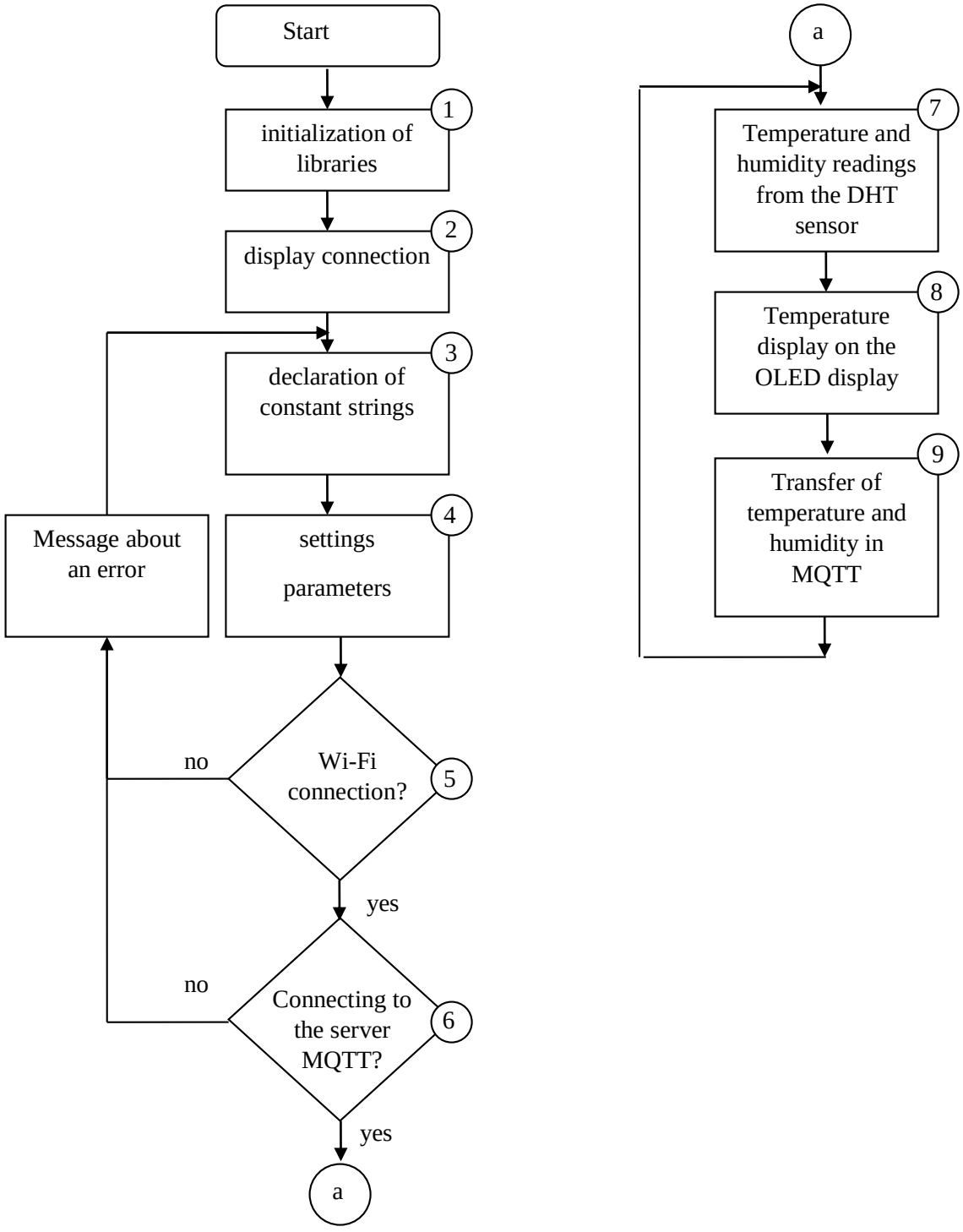

Figure 1: The general algorithm of the program for monitoring the parameters of industrial premises

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Let us present a brief description of each block of the general algorithm of the program for monitoring the parameters of industrial premises:

1 – this block of code is used to connect and initialize the various libraries required for the application to run. For example, the initialization of the ESP8266WiFi.h library allows you to connect to a Wi-Fi network, and the initialization of PubSubClient.h allows you to interact with the MQTT server for data transfer;

2 – the display connection block in the algorithm is used to initialize and configure the connection between the microcontroller and the display. This includes setting communication parameters (such as interface type and display address), preparing the display for operation (cleaning, setting text colors, etc.), and maintaining communication between the microcontroller and the display while displaying data;

3 – the declaration block of constant lines in the algorithm is used to store values that remain constant during the execution of the program. This may include identification data such as Wi-Fi network names or MQTT server addresses, which allows for convenient management of communication parameters and application settings without the need to change the application code itself;

4 – this block of code is designed to configure the display parameters on the OLED display. It sets the power mode of the display, the address of the display on the I2C bus, performs the first initialization of the display, sets the size of the text, the color of the text and other parameters affecting its display;

5 – a cycle of checking the connection to a local wireless network based on Wi-Fi technologies;

6 – cycle of checking the connection to the MQTT server;

7 – this code block is designed to read temperature and humidity values from the DHT sensor. It reads data from the sensor and stores it in the appropriate variables. If the read data is incorrect, the program displays an error message;

8 – this block of code is responsible for displaying the temperature value on the OLED display. It clears the display, sets the text size and color, and outputs the temperature value to the display;

9 – this block in the algorithm is responsible for publishing temperature and humidity values to the MQTT broker. It converts temperature and humidity values to strings and uses the publish function to send these values to the appropriate MQTT topics so they can be processed and visualized on the server.

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The developed algorithm of the program for monitoring the parameters of industrial premises has several advantages. First, it provides reliable collection and transmission of data from temperature, humidity, motion and gas level sensors to the server using Wi-Fi and the MQTT protocol. This allows you to monitor the state of parameters in the production room in real time. Secondly, thanks to the use of an OLED display, local temperature visualization is possible on the spot without the need to connect to a server. In addition, the implemented Wi-Fi and MQTT connection system allows you to easily configure and control the system from any device that supports these technologies. This approach makes the system quite flexible and easy to use for production needs.

Conclusion

Developing a program algorithm for a monitoring system for industrial premises brings significant benefits by improving comfort, safety, energy efficiency. This article describes the purpose of the system for monitoring the parameters of industrial premises. The basic requirements that such a system must satisfy are described. Particular attention is paid to the need for a real-time monitoring process.

A generalized program algorithm has been developed for a system for monitoring the parameters of production premises.

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