IOT Industrial automation using raspberry Pi

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Abstract: The Industrial Internet of Things (IIoT) has emerged as a powerful technology for enhancing industrial monitoring, automation, and worker safety. This paper presents an IoT-based Industrial Automation System using Raspberry Pi that continuously monitors critical industrial parameters such as temperature, humidity, gas leakage, fire incidents, and air quality. The system utilizes various sensors connected to a Raspberry Pi with built-in Wi-Fi for real-time data acquisition and cloud communication. In addition, an RFID-based attendance system and a camera monitoring module are incorporated to improve security and workforce management. Alerts are sent through Telegram whenever abnormal conditions are detected. The proposed system provides a low-cost, reliable, and efficient solution for industrial monitoring and automation.

KEYWORDS- Internet of Things (IoT), Industrial Automation, Raspberry Pi, RFID, Temperature Sensor, Humidity Sensor, Gas Sensor, Fire Sensor, Air Quality Monitoring, Cloud Computing.

INTRODUCTION

Industrial automation plays a crucial role in improving productivity, safety, and operational efficiency in modern industries. Continuous monitoring of industrial parameters such as temperature, humidity, gas concentration, fire conditions, and air quality is essential to prevent accidents and ensure worker safety. Traditional monitoring methods often require manual supervision and may not provide real-time responses during emergencies. The advancement of IoT technology enables industries to monitor equipment and environmental conditions remotely through smart sensors and cloud platforms. The proposed IoT-based industrial automation system utilizes

Raspberry Pi as the central controller to collect sensor data, monitor industrial conditions, maintain attendance records using RFID technology, and provide real-time alerts through cloud communication. This approach enhances industrial safety, reduces human intervention, and supports efficient decision-making.

RELATED WORK

Many industrial monitoring systems have been developed using wireless communication technologies, sensors, and cloud platforms. Existing systems focus on monitoring individual parameters such as temperature, gas leakage, fire detection, or equipment status. Some solutions utilize GSM communication for alert generation, while others employ web servers and cloud services for remote monitoring. Although these systems provide effective monitoring capabilities, they often lack comprehensive integration of multiple sensing technologies, attendance management, and real-time cloud-based analytics. Therefore, a unified industrial automation platform capable of monitoring several industrial parameters simultaneously is required to improve safety and operational efficiency.

LITERATURE SURVEY

Several researchers have contributed to the development of IoT-based industrial monitoring and automation systems. Shivaji Kulkarni and Amogh Darekar presented a survey on Li-Fi communication technology, highlighting its advantages in terms of bandwidth, efficiency, and high-speed data transmission. Mahesh S. Kholgade and his team proposed a gas leakage detection system using an MQ6 gas sensor and microcontroller to monitor hazardous gas leaks and activate alarms and exhaust fans. Sarguna Priya and co-authors developed an industrial parameter monitoring system using sensors such as temperature, pressure, current, and level sensors with CAN Bus communication for industrial applications. S. W. Mohod and Rohit S. Deshmukh introduced an IoT-based industrial monitoring and control system that integrated sensors with GSM and GPRS communication for remote monitoring. Jadhav Sunny and colleagues proposed an industrial parameter monitoring and control system utilizing GSM communication and web servers to ensure continuous monitoring and alert generation. These studies demonstrate the growing importance of IoT and wireless technologies in industrial monitoring, while emphasizing the need for integrated systems capable of monitoring multiple parameters simultaneously.

EXISTING METHOD

Existing industrial monitoring systems generally employ separate devices for gas leakage detection, fire detection, attendance management, and environmental monitoring. These systems often require dedicated hardware setups and manual supervision for data collection and analysis. Most traditional solutions are limited to local monitoring and may not provide reliable real-time alerts or centralized cloud-based data management. Additionally, maintaining separate systems increases operational complexity, space requirements, and maintenance costs, reducing overall efficiency in industrial environments.

PROPOSED METHOD

The proposed IoT-based Industrial Automation System utilizes Raspberry Pi as the central processing and communication unit. Various sensors including temperature and humidity sensors, gas sensors, fire sensors, and air quality sensors continuously monitor industrial conditions and upload the collected data to the cloud. A Raspberry Pi camera provides live monitoring of industrial premises, while an RFID module automates employee attendance management. In the event of abnormal conditions such as fire outbreaks, gas leakage, or unsafe environmental conditions, the system immediately generates alerts through Telegram notifications. The cloud-based architecture enables remote access to real-time data from any location, reducing manual effort and enhancing industrial safety and productivity.

SYSTEM ARCHITECTURE

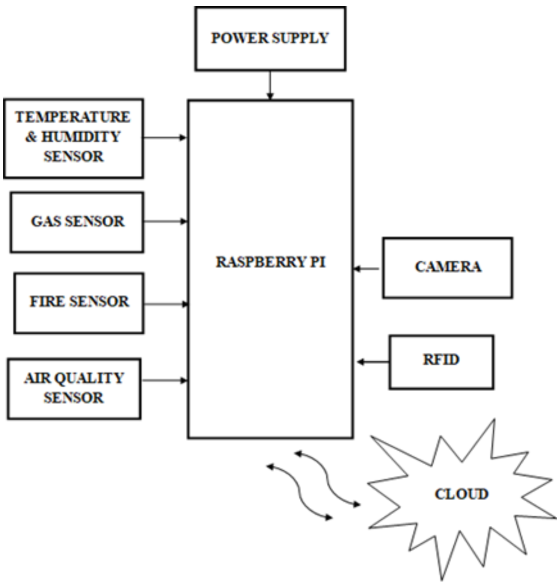

Fig.1 System Architecture

MODULE DESCRIPTION

Raspberry Pi Controller Module: The Raspberry Pi serves as the central controller of the system. It collects sensor data, processes information, communicates with cloud services, and manages all monitoring operations. The built-in Wi-Fi feature enables seamless internet connectivity for real-time monitoring.

Temperature and Humidity Monitoring Module: The DHT11 sensor continuously measures temperature and humidity levels within the industrial environment. The collected data helps maintain suitable working conditions and prevents equipment damage caused by environmental variations.

Gas Detection Module: The gas sensor monitors the presence of harmful gases and smoke in the industrial environment. Whenever hazardous gas concentrations exceed safe limits, the system immediately generates warning alerts to prevent accidents.

Fire Detection Module: The fire sensor continuously monitors the environment for fire and abnormal heat conditions. Upon detection, alert messages are sent to authorized personnel, enabling rapid emergency response and minimizing damage.

Air Quality Monitoring Module: The air quality sensor evaluates the quality of air within industrial premises by detecting pollutants and contaminants. This module helps maintain a healthy and safe working environment for employees.

Camera Surveillance Module: The Raspberry Pi camera provides real-time visual monitoring of industrial activities. It helps identify unauthorized access, monitor operations, and improve overall security within the workplace.

RFID Attendance Management Module: The RFID module automates employee attendance recording. Workers can register their attendance using RFID cards, and the information is stored digitally for easy access and management.

Cloud Storage and Monitoring Module: This module stores sensor data and attendance records in the cloud. It allows authorized users to access real-time and historical data from any location through an internet connection.

Telegram Alert Module: The Telegram notification system sends instant alerts to registered users whenever abnormal industrial conditions such as gas leakage, fire incidents, or unsafe environmental parameters are detected.

RESULTS AND DISCUSSION

The proposed IoT-based industrial automation system successfully monitored temperature, humidity, gas leakage, fire conditions, air quality, and employee attendance in real time. The Raspberry Pi effectively communicated with cloud services and provided continuous data updates through the web interface. The Telegram alert mechanism accurately notified users whenever abnormal conditions were detected, improving response time and industrial safety. Experimental observations demonstrated that the system reduced manual monitoring efforts, enhanced operational efficiency, and provided a cost-effective solution for industrial automation and monitoring.

CONCLSUION AND FUTURE SCOPE

The proposed IoT-based Industrial Automation System using Raspberry Pi provides an efficient and reliable platform for monitoring industrial environments. By integrating multiple sensors, cloud storage, RFID attendance management, and real-time alert mechanisms, the system significantly improves industrial safety, security, and operational efficiency. The cloud-based architecture enables remote monitoring and data accessibility from any location. In the future, artificial intelligence-based predictive maintenance, machine learning analytics, automated control mechanisms, and advanced industrial robotics can be integrated to further enhance automation capabilities and smart industry applications.

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