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Smart Room Monitoring System Using IoT

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Abstract: *The rapid development of the Internet of Things (IoT) technology has transformed the manner in which individuals communicate with machines in their everyday life. The project is aimed at work on a Smart Room Monitoring System based on ESP8266 micro-controller and various sensors like DHT11, PIR, ultrasonic and IR sensors. The system will be created to control the conditions in the rooms in real-time and control appliances according to sensor indicators. The sensor used to monitor temperature and humidity is the DHT11 sensor and the sensor to detect any movement made by a person is the PIR sensor. Distance and object detectors are based on ultrasonic and IR sensors. Electrical appliances are controlled with the help of relay modules and a servo motor is carried out to accomplish mechanical tasks like doors. The system also facilitates remote monitoring with Wi-Fi connectivity. The project is designed to enhance comfort, security, and energy efficiency in interior spaces. The results of the implementation prove that the IoT-based automation can be a reliable, yet cost-effective solution to managing the smart room.*

Keywords: IoT, Smart Room, ESP8266, DHT11, PIR Sensor, Automation, Monitoring System

I. INTRODUCTION

Technology is gaining relevance in day-to-day life and individuals now demand smarter and efficient technology in their homes and work places. The Internet of Things (IoT) contributes significantly to this change as it enables devices to interconnect, communicate, and share information via the internet. One of the widespread applications of IoT is smart room systems where various devices collaborate to enhance comfort, safety, and energy management.

The project is a Smart Room Monitoring System created with the ESP8266 micro-controller and various sensors, which include the DHT11, PIR, ultrasonic, and IR sensors. These sensors capture real time data concerning room temperature, humidity, motion and object detection. Depending on the data that has been received, the system will automatically operate appliances such as lights and fans with relay modules. It also has a servo motor to execute such mechanical tasks as closing and opening doors.

The primary aim of this project is to develop a simple, inexpensive, and effective smart room system that will be able to keep track of environmental conditions and to automate devices without human intervention all the time. The project also shows how the IoT technology can be used to create smart indoor systems that enhance convenience at the expense of unneeded energy wastage.

II. LITERATURE REVIEW

IoT technology has become prevalent in the past few years, with numerous companies developing smart home and room automation systems. Numerous scientists have been busy incorporating sensors and wireless communication modules to come up with systems that can be used in monitoring environmental conditions and automatic control of appliances.

Micro controllers like Arduino and ESP8266 have been used to develop several smart monitoring systems due to their low-cost, ability to program easily, and the ability to communicate wirelessly. They are usually automated and

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monitored using sensors to gather information concerning temperature, humidity and movement which are used to control thermostats remotely.

PIR sensors are typically employed in security systems to identify human traffic whereas DHT11 sensors in most cases are employed to measure environmental conditions like temperature and humidity. Other researchers have covered ultrasonic and IR sensors to distance measurement and object detection to enhance the functionality of the system.

Whereas there are numerous available systems that offer automation and monitoring capabilities, some of them are costly, hard to set up, or only feature a few functions. To enhance such approaches, the proposed Smart Room Monitoring System consolidates a combination of various sensors with ESP8266 microcontroller into one-unit system. The project will be geared toward offering a cost-effective, efficient, user-friendly means that will aid in automation, security, and real-time monitoring.

III. METHODOLOGY

The Smart Room Monitoring System is developed based on an IoT approach, which integrates sensing, processing, communication, and automation. The methodology is geared towards developing a system that would be able to continuously monitor the conditions of rooms and automatically react based on a set of predetermined conditions.

A. System Architecture

The system is separated into three large parts sensing, processing, and application. Sensors in the sensing section include DHT11, PIR, ultrasonic and IR sensors, which capture environmental and motion related sensors. The ESP8266 microcontroller controls the processing part as it receives the received information to process and produce control signals. Application section gives a monitoring and controlling capability of the system using a mobile or web interface.

B. Hardware Implementation

All sensor are attached to the ESP8266 through appropriate input and output pins. The DHT11 sensor detects the temperature and humidity in the room. The PIR sensor line of action is motion sensing and the ultrasonic sensor is a measurement of the distance via trigger and echo signals. The IR sensor is applied to detect nearby objects. Appliances like lights and fans can be attached to relay modules and be automated. It also has a servo motor attached to it to do its tasks such as automatic door movement.

C. Software Implementation

The system is programmed using the Embedded C/C++ at the Arduino IDE. The software is continuous and continuously reads the sensor readings and comparison with set threshold values. The ESP8266 will transmit signals to actuators and relays to carry out automation functions depending on the conditions. The ESP8266 has Wi-Fi that can be utilised towards internet communication and remote monitoring.

D. Working Procedure

Depending on the room environment, sensors are in place to monitor it.
The sensor data is transmitted to ESP8266 microcontroller.
The data is processed by the controller and predefined conditions are checked.
In case a motion is detected, the lights are turned on automatically.
Cooling devices go off when the temperature increases beyond the predetermined value.
To sense the presence of obstacles or prompt actions, ultrasonic and IR sensors are used.
The encoder is a servo motor which carries out mechanical tasks like opening or closing the door.
Information about systems is updated in real time and it may be monitored remotely.

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E. Communication Mechanism

The ESP8266 connects itself to a wifi network and transmits sensor data to an IoT platform, or to a web server. This provides users with the ability to access this information remotely and operate appliances regardless of their location as long as he or she has access to the internet.

F. Pros of the Methodology

The suggested solution is cost-effective, easy to implement and efficient. It integrates both automation, monitoring and security in a single system as well as minimizes manual effort, and enhances energy management.

IV. SYSTEM ARCHITECTURE

The Smart Room Monitoring System adheres to a layered architecture that enables easy communication between the sensors, the microcontroller, and the actuators, and the user interface.

A. Overview of the Architecture

The architecture comprises of sensing, processing, communication and user interface layers. Each layer has a certain work task to complete to make the system work correctly.

B. Sensing Layer

The DHT11, PIR, ultrasonic, and the IR sensors make up the sensing layer. These sensors continuously read real-time information concerning the conditions in the room and transmit it to ESP8266 microcontroller.

C. Processing Layer

ESP8266 serves as a central controller of the system. It processes sensor data, assesses states and creates outputs used to automate processes. It is also in charge of internet communication.

D. Communication Layer

The ESP8266 comes with an in-built Wi-Fi to facilitate wireless connection. The sensor data may be sent to a cloud server/ web application where they may be monitored and controlled remotely.

E. Actuation Layer

The actuation layer has relay modules and a servo motor. Appliances like lights and fans are operated using relay modules and mechanical work like doors are opened and closed is done by the servo motor.

F. User Interface Layer

The system may be interacted with by the users with a web or mobile application. The interface shows sensor readings and has the ability to remotely control connected appliances.

Data Flow

This takes the form of a continuous process using sensors, processing data by the ESP8266, activated actions by the use of actuators and relaying the updated information to the user interface.

V. IMPLEMENTATION

The Smart Room Monitoring System implementation will involve the hardware configuration as well as software software installation to attain automation and real-time monitoring.

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A. Hardware Implementation

The hardware part is based on the ESP8266 microcontroller. The DHT11 sensor will be attached to enable the measurement of temperature and humidity and the PIR sensor will be attached to the sensor to detect motion. The ultrasonic sensor is the sensor that measures the distance and the IR sensor measures objects or obstacles. Electrical devices, including lights and fans, are controlled by relay modules and the servo motor controls the movement of the doors. The system is operated by an 5V steady power supply.

B. Software Implementation

Embedded C/C++ is used to develop the software in Arduino IDE. The ESP8266 is coded to have Wi-Fi connection to the internet. The code does the following tasks:
Programming sensors and pins.
Sensor data constant reading.
Condition checking using threshold values.
Control of relay and servo motors.
Wireless data communication

C. Working Process

Once power is connected, the ESP8266 would boot all the devices.
Sensors will start gathering environmental measurements.
The sensor data are processed by the controller that checks the conditions.
When motion is detected, lights are automatically turned on.
Fans turn on when temperature goes higher than the preset temperature.
Ultrasonic and IR sensors perform functions according to the obstacle detection.
Relay modules are used in switching of the appliances.
Servo motor accomplishes mechanical movements.
Remote monitoring and control transmit its data via Wi-Fi.

D. Integration and Testing

The system was put to test to check sensor readings, automation and communication effectiveness among other conditions. The individual parts were initially tested and then comprehensive testing of the systems.

VI. CONCLUSION

The project provides a practical solution for improving comfort, security, and energy efficiency inside a room. Features such as motion-based lighting, temperature-based fan control, and remote monitoring through Wi-Fi make the system useful for modern smart environments. The integration of a servo motor for mechanical operations further increases the functionality of the system.
During testing, the system showed stable performance and responded correctly to different environmental conditions. The use of low-cost components and simple programming also makes the project affordable and easy to implement for real-world applications.

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