Classroom Automation

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ABSTRACT

This project aims to develop an automated lighting and ventilation system using the ESP32 microcontroller, which detects human presence and manages the operation of lights and fans accordingly. The primary objective is to enhance energy efficiency in indoor environments by activating the light and fan only when people are detected, and deactivating them when the space is unoccupied.

The system employs an ultrasonic sensor for accurate people detection, which communicates with the ESP32. When the sensor detects movement, it triggers the lights and fan to turn on; conversely, when no movement is detected for a specified duration, both devices are switched off. Additionally, the system integrates an SMS alert feature that notifies users via a mobile message whenever the lights and fan are activated or deactivated, ensuring remote monitoring of energy usage.

I. INTRODUCTION

In an era where smart home technology is becoming increasingly prevalent, the integration of Internet of Things (IoT) devices can significantly enhance energy efficiency and user convenience. This project leverages the ESP32 microcontroller to create a smart environment that detects human presence and automatically controls the lighting and fan systems accordingly.

Background Information :

The significance of this project lies in its ability to optimize energy consumption in residential and commercial spaces. By utilizing a motion detection system, the ESP32 can determine when a room is occupied. When presence is detected, the system activates the lights and fan, ensuring comfort. Conversely, when no one is present, the lights and fan turn off, conserving energy and reducing electricity costs.

II. LITERATURE SURVEY

Overview of Automation in Smart Classrooms :

Classroom automation is part of the broader trend of smart environments. Smart classrooms integrate various sensors and devices to optimize comfort, energy usage, and overall functionality. This automation enhances learning experiences by creating more responsive environments. Typical smart classroom systems include features like automated lighting, HVAC (Heating, Ventilation, and Air Conditioning) control, multimedia integration, and occupancy detection.

Occupancy Sensing with PIR Sensors :

Passive Infrared (PIR) sensors are commonly used in automation systems to detect human presence through the infrared radiation emitted by body heat. In classroom automation, PIR sensors are employed to detect motion, allowing automatic control of lights and fans. When motion is detected, the lights and fans are turned on, and when no motion is detected for a certain

period, they are turned off, leading to energy conservation.

Temperature-Based Fan Speed Control :

Temperature control is crucial in maintaining comfort in classrooms. In this system, the fan's speed is adjusted based on the ambient temperature measured by a temperature sensor (e.g., DHT11 or LM35). As the temperature rises, the fan speed increases to provide cooling, and as the temperature decreases, the fan speed lowers.

Automation Control through IoT Platforms (Blynk) :

Internet of Things (IoT) platforms like Blynk allow real-time monitoring and control of devices. In classroom automation, Blynk can be used to monitor sensor data (e.g., temperature, motion) and manually control devices like fans and lights through a mobile application or web interface. This ensures that users can manage classroom conditions remotely and access realtime data on environmental conditions.

III. HARDWARE REQUIREMENT

- **PIR Sensor (Passive Infrared Sensor) :** To detect motion and presence in the room.
- **DHT11 Temperature and Humidity Sensor** : To monitor the temperature for controlling the fan speed.
- **ESP32 :** As the microcontroller unit to handle sensor inputs and control the fan, lights, and communication with Blynk.
- **DC Fan/Motor Driver (e.g., L298N) :** If controlling a DC fan for varying speed.
- **AC Fan (Ceiling Fan) :** If an AC fan is used, a TRIAC or SSR (Solid State Relay) may be required to control speed.
- **LED/Bulb or other lighting fixtures :** For turning lights on or off based on motion.
- **Switches (optional) :** For manual override to control the fan and light.
- **Blynk-compatible Wi-Fi Module :** (/ESP32) for communicating with the Blynk cloud and dashboard.
- **Resistors, Capacitors, Diodes :** For circuit design and stability.
- **Breadboard & Jumper Wires :** For prototyping and connections.
- **Power Supply (5V/12V as needed) :** To power the microcontroller and relays.

Software requirement

- **Arduino IDE** : For programming the microcontroller.
- **Blynk App :** To create a dashboard for monitoring and controlling the fan and light via a smartphone.
- **Libraries for Sensors :**
  - **PIR Sensor Library**
  - **DHT11/ Library**
  - **Blynk Library**
  - **PWM Library :** To control the fan speed based on the temperature.

IV. METHODOLOGY

Aim and Objectives

The primary goals of this project are as follows:

1. **Automated Control of Appliances :**

- Develop a system that uses the ESP32 to automatically turn on lights and fans when people are detected in a room.
- Ensure that the lights and fans are turned off when no presence is detected, thereby enhancing energy efficiency.

2. **Real-Time Monitoring and Notifications :**

- Implement a mechanism to send SMS notifications to users when the status

- of the lights and fans changes, ensuring they are informed about their home or office environment.

- Display the on/off status of the lights and fan in real time on the Blynk app, allowing for convenient remote monitoring.

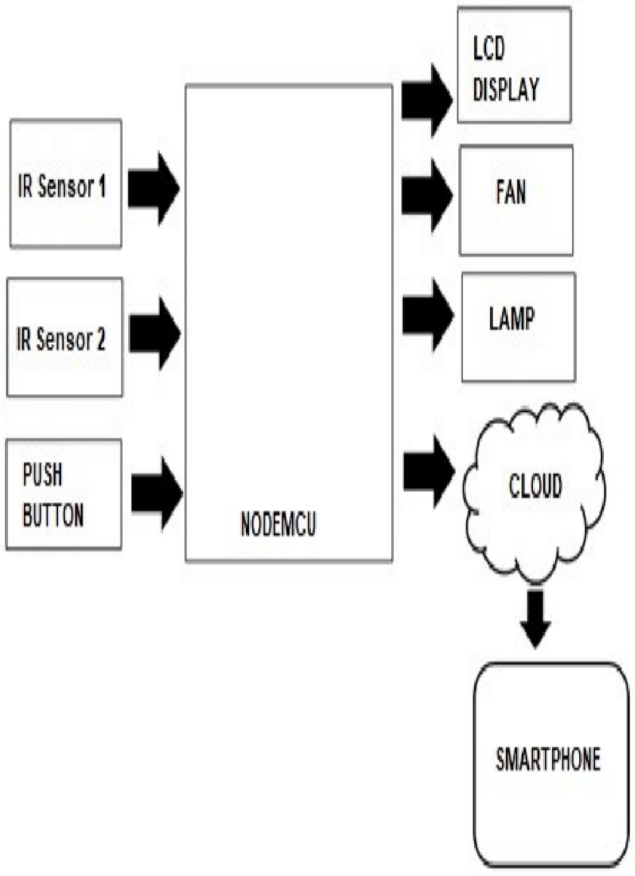
3. **User-Friendly Interface :**

- Design an intuitive interface within the Blynk app that enables users to easily visualize and control the status of their lights and fans.

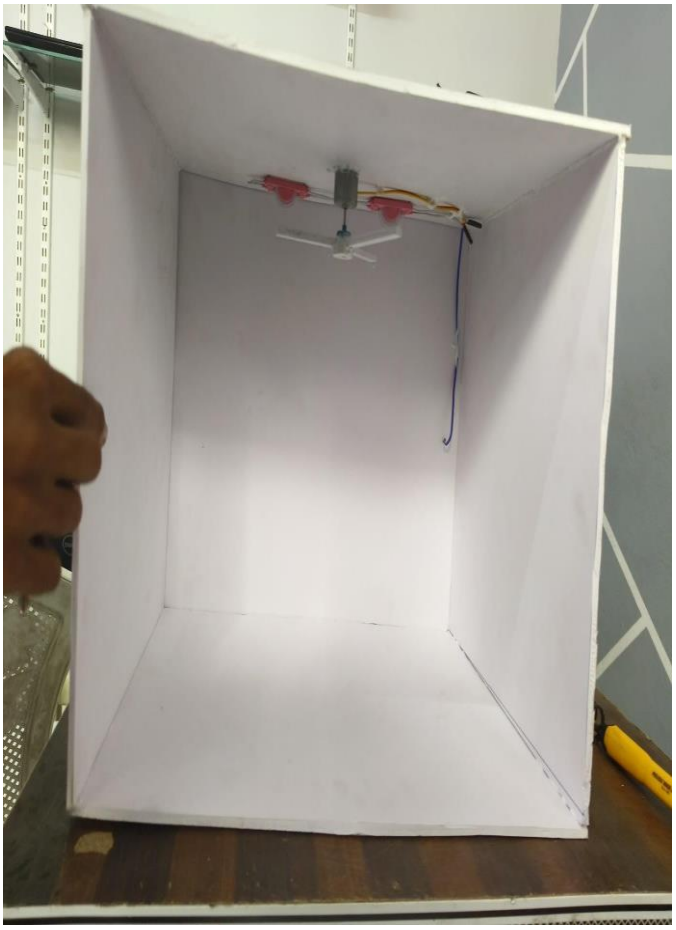
4. **Energy Efficiency and Cost Reduction :**

- Aim to reduce energy consumption and lower electricity bills by ensuring that appliances are only operational when needed.
- Promote awareness of energy usage patterns through the app, encouraging users to adopt more sustainable habits.

Block Diagram :



Project Output :



V. CONCLUSION

In summary, the ESP32-based smart automation system effectively meets the project's objectives by providing an automated, energy-efficient solution for controlling lighting and ventilation based on human presence. The successful integration of real-time monitoring and user-friendly interfaces positions this project as a valuable contribution to the growing field of smart home technology, with significant implications for energy management and user convenience. Future work could explore additional features, such as integration with other smart devices or advanced machine learning algorithms for predictive occupancy detection.

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