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RADAR-DRIVEN AUTOMATION

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ABSTRACT:
Generally we control Electrical appliances like light,fans using switches directly by switching ON or OFF.This research paper explores about the designing a controller by merging IoT Technology, advanced sensors, and Aurdino-based automation. Now, the Internet of Things integration into modern automation has transformed home and industrial systems. This project is aimed at developing a smart automation of loads using NodeMCU, WiFi dashboard, Blynk application, and relay modules. This system allows users to control electrical appliances remotely using a smartphone or web interface due to its ability to enhance ease of use, energy efficiency, and user control. The NodeMCU, an inexpensive microcontroller with an integrated WiFi module, is the central unit and reports to the Blynk IoT platform. The Blynk dashboard represents an easy-to-use interface that features real-time monitoring and operation of numerous devices. The relay modules interfaced NodeMCU act as electronic switches in which the light, fan, or motor would be controlled.
Keyword: Node-MCU, load automation, IoT, remote control.

INTRODUCTION:

Automation will change the way that we interact with the environment.Loads automation is one of the other activities under this and apparently becomes the most important application as now possible control of electrical appliances such as lights, fans, etc.
Automation is changing our way of interacting with the environment, and we really make life easy, efficient, and controlled. In the era of changing, loads automation are among some of the applications wherein electricity using devices like lights, fans, etc. may be managed easily by using a microcontroller with Wi-Fi integrated in it along with a user-friendly Wi-Fi dashboard.
Among those, NodeMCU and Blynk are good and have filled a perfect combination in the automation of loads. NodeMCU provides very flexible, versatile, low-cost, and highly cost-effective IoT hardware solution, while Blynk is a user-friendly application used to create customized dashboards. Together, they allow users to control electrical loads like lights, fans, and appliances remotely with full seamless controls.

METHODOLOGY:

The methodology shows about the complete scenario of the project. In this we can see at starting the electrical loads like fans, lights etc. Those loads are given to the NodeMCU through the wifi control in this NodeMCU we dump the Arduino code that is uploaded in the NodeMCU. That will sent to the Cloud platform means like IOT there we can control it manually or remotely.

HARDWARE COMPONENTS :

a. Node-MCU(ESP32)

- It is an open-source platform built on the ESP32 Wi-Fi module for applications developed based on IOT.
- The Node-MCU enables development of Wi-Fi devices, and it is also compatible with popular development tools, such as the Arduino IDE.
- This makes Node-MCU an affordable and versatile solution for building connected projects supported by resources and collaboration in a community.

b. Relays

- A relay is an electromechanical switch.
- A relay can provide high-power circuit operation and it brings low isolation circuit isolation and safety, it is widely employed in domestic automation as well as within industrial structures.
- It acts like a 'bridge' between sensitive manage circuits and excessive-modern-day devices in using a magnetic area to open or close the circuit.

c. IOT

- IoT, or net of factors, refers to bodily gadgets, motors, home equipment, and different matters that are embedded with sensors, software, and connectivity features.
- Those linked gadgets may acquire percentage records that let in you talk with others or customers.
- The intention is to create, smart surroundings and streamline processes by automating tasks and presenting treasured insights primarily based on accumulated data.

d. 5V AC to DC converter

- A 5V AC to DC converter is a current input-to-stable-DC-output volt device mainly used to power up the microcontrollers, sensors, and other electronic devices.
- This AC to DC converter was used for converting an input of 100 - 230v to 5v.

e. RCWL-0516 RADAR SENSOR

- RCWL-0516 is one of the most widely used low-cost microwave motion detection devices.sensors in DIY electronics.
- The sensor functions by transmitting microwave signals at a frequency of 3.2 GHz to Back- scattered signal difference from moving subjects Calculate and compare it with usual PIR
  motion.
- Among the versatile advantages of sensors, its ability to detect motion with thin non-metallic materials stands out.

f. Capacitors

- The aluminium electrolytic capacitor is one of those types of capacitors using an aluminium oxide layer as the dielectric and relies on an electrolytic solution to achieve high capacitance values in a relatively small volume.

- They are probably the most widely used capacitors in power supplies, and other electronic circuits because of large capacitance value and the ability to have withstanding high voltage and current.
- In this project we use this capacitors to stabilize the current.

g. PCB(printed circuit board)

- A PCB(printed circuit board) is a fundamental component. It offers both mechanical support and electrical connections for components such as resistors, capacitors, ICs or Integrated Circuits, and other electronic components.
- Therefore, PCBs are very essential in the organization as well as connecting parts in a circuit to be functional. In the following circuit board we connected the capacitors, NodeMCU, etc.

BLOCK DIAGRAM:

The block diagram shown represents a smart lab automation system using IoT technology. At the core of the system is the NodeMCU, a microcontroller with built-in Wi-Fi capabilities that enables wireless communication between the electrical devices and the cloud platform. The system begins with various electrical loads in the lab such as lights, fans, or any other appliances that are to be controlled remotely. These loads are connected to the NodeMCU, which receives control signals via Wi-Fi. Data from the lab environment is also collected through sensors (for example, temperature or motion sensors). This sensor data is sent to the NodeMCU, which acts as the central processing unit. It processes the data and makes decisions on whether to switch devices on or off. The NodeMCU is programmed to communicate with a cloud platform using the MQTT protocol, which is a lightweight messaging protocol ideal for IoT applications. Once the data is uploaded to the cloud, users can access it from anywhere through a mobile app or web interface. They can monitor real-time sensor readings and also control lab devices remotely. This setup ensures efficient and smart management of lab resources, enabling automation, energy saving, and ease of control, all through a seamless integration of hardware and software over the internet.

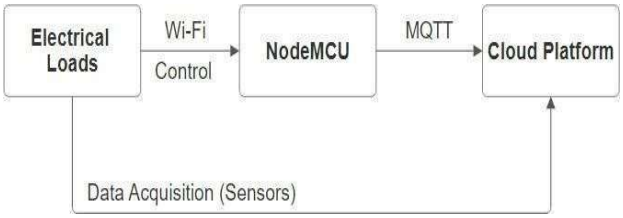

Fig3.1.Block Diagram

PARAMETERS AND SPECIFICATIONS OF THE INVERTER:

- Microcontroller Used: NodeMCU (ESP32)
- Operating Voltage (NodeMCU): 3.3V
- Wi-Fi Frequency: 2.4 GHz
- Relay Module Control Voltage: 5V
- Load Voltage Support (Relay Output): Up to 230V AC
- Radar Sensor Used: RCWL-0516
- Radar Sensor Frequency: 3.2 GHz

- Power Supply Input: 100V – 230V AC
- Converted Output Voltage: 5V DC
- Cloud Platform: Blynk / Adafruit IO
- Programming Platform: Arduino IDE, VS Code
- Control Method: Manual or Motion-based (Radar Sensor)
- Communication Protocol: Wi-Fi (HTTP / MQTT in Blynk)
- Number of Loads Controlled: 1 or more (bulb, fan)
- Dashboard Access: Smartphone or Web-based Interface
- Response Time: < 1 second (real-time switching)
- Capacitor Type: Aluminium Electrolytic Capacitor
- PCB: Used to mount NodeMCU, radar sensor, and relays

RESULTS AND DISCUSSION :

After a successful implementation, users log right into a comprehensive internet dashboard hosted by way of VS Code.This dashboard presentations the status and overall performance metrics of all connected devices in actual-time. similarly, remote users can manage the operating status of each tool through the built-in control panel interface, giving them unparalleled control over their home surroundings from everywhere with an internet connection.

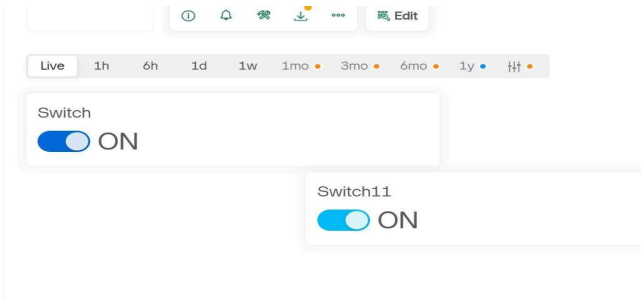

Fig.4.1: Operations using Blynk

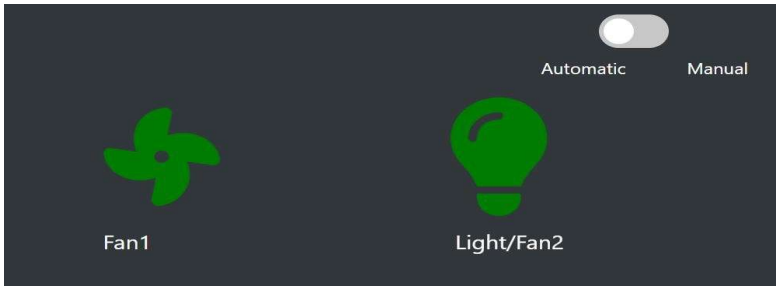

Fig.4.2: Dashboard

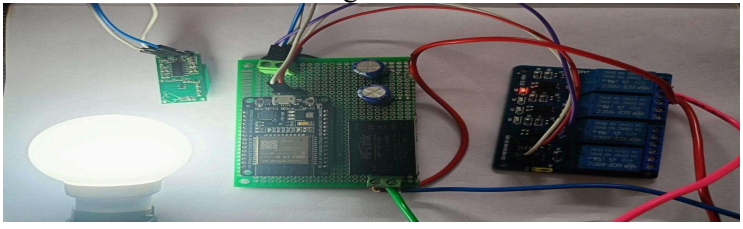

Fig.4.3: Automation in working condition

CONCLUSION:

In this study, we delved deeply into the field of load automation and examined its theories, practices, and applications across a range of sectors. The results demonstrated the straightforward advantages of implementing computerized structures, such as improved accuracy, lower operating costs, and better efficiency. One of the main conclusions is that, when computerized structures are properly integrated, there is a significant decrease in human error and an increase in high-quality products. Furthermore, it has been established that these frameworks' scalability and adaptability are essential components that enable businesses to quickly respond to shifting market demands and technology breakthroughs. Although the benefits are evident, it is impossible to overlook the difficulties, which include initial setup expenses, integration complexity, and loss of ability activities. Addressing these issues calls for a well-rounded approach that incorporates technology.

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