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IOT and Cloud Based Healthcare Monitoring System

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ABSTRACT:

The Voice Controlled Home Automation Using Node MCU project is designed to bring convenience, efficiency, and modern technology into everyday home environments through the use of voice commands. By leveraging the power of the Node MCU microcontroller and integrating it with Internet of Things (IoT) platforms such as Adafruit IO and IFTTT, this system allows users to control household appliances like a bulb, DC motor, and CPU fan simply by speaking to Google Assistant. This setup eliminates the need for manual switches, enabling remote and hands-free operation of devices via wireless communication. The Node MCU acts as the core controller, receiving commands and operating relays to switch devices on or off. This solution not only enhances the user's comfort and accessibility but also promotes energy efficiency and supports the growing demand for smart home technology. The project demonstrates the practical application of embedded systems and IoT in creating a scalable, cost-effective, and user-friendly smart home environment.

Keywords: IoT, Cloud Computing, NodeMCU, MSSQL, Healthcare Monitoring, Wearable Sensors, Real-Time Data, Hierarchical Clustering, Python Web Application, Scalability, Automation.

1. Introduction:

Internet of Things (IoT) was introduced in the late 1990s and early 2000s. However, it gained significant attention and traction around the mid-2000s as advancements in technology, particularly in connectivity and miniaturization, enabled the widespread deployment of IoT devices. The term "Internet of Things" was popularized by Kevin Ashton, a British technology pioneer, in 1999 while working at Procter & Gamble. Since then, IoT has evolved rapidly, with increasing adoption across various industries and domains, transforming the way we interact with technology and our surroundings.

The IoT domain involves connecting everyday objects to the internet, enabling them to collect and share data. These objects, equipped with sensors and internet connectivity, can communicate with each other and with central systems to perform various tasks and provide valuable insights. From smart home devices like thermostats and security cameras to industrial sensors monitoring machinery, IoT is revolutionizing how we interact with our environment. This interconnected network of devices has applications across industries, from healthcare and agriculture to manufacturing and transportation. However, ensuring security and privacy in IoT systems, as well as addressing interoperability issues, are ongoing challenges in this domain. Despite these challenges, IoT continues to evolve and expand, offering tremendous opportunities for innovation and efficiency improvements in diverse fields.

2. Literature Review:

[1]. WIRED HOME AUTOMATION SYSTEMS

Traditional home automation systems typically relied on wired infrastructures, requiring physical connections between the control units and appliances. Such systems were reliable but involved significant installation costs and were challenging to modify or upgrade. According to Patel et al. (2014), wired automation provided robust control, especially in large-scale applications like commercial buildings, but lacked flexibility and required professional installation, making it less suitable for homes with evolving needs. The cost and labor-intensive nature of these systems also limited their accessibility for average homeowners

[2].REMOTE-CONTROLLED AUTOMATION

Before the advent of IoT, remote-controlled automation using infrared (IR) or radio frequency (RF) technology was a popular method for controlling devices such as lights and fans. As noted by Singh and Gupta (2013), while these systems offered ease of use and did not require complex wiring, they were limited by the range of the remote control and often only supported basic on/off functions. Additionally, the lack of internet connectivity restricted the potential for remote access or smart scheduling, making them less efficient than modern systems (Singh & Gupta, 2013).

[3]. PROGRAMMABLE LOGIC CONTROLLERS (PLC)

PLC-based home automation was another conventional method, widely used for its robustness and reliability in controlling electrical devices. As Ravindran et al. (2012) highlight, PLCs offered programmable control over appliances and were particularly suited to industrial applications. However, in residential settings, the complexity of programming and the high cost of PLC systems often made them impractical for homeowners. The need for expert knowledge in programming further restricted their use in typical home environments (Ravindran et al., 2012).

[4]. ZIGBEE AND Z-WAVE TECHNOLOGY

As home automation evolved, wireless technologies such as Zigbee and Z-Wave became more prevalent. Kumar and Verma (2016) reviewed these technologies as a step forward from conventional wired systems, offering better flexibility, scalability, and ease of installation. However, they still had limitations regarding interoperability and required dedicated hubs for device communication. Despite their improvements over earlier methods, the costs associated with proprietary hubs and devices presented barriers to widespread adoption, particularly in smaller homes (Kumar & Verma, 2016).

2.Voice Controlled Home Automation Using NodeMCU Using Adafruit IO

This project integrates voice commands with IoT using the NodeMCU microcontroller and Adafruit IO platform. Users can control home appliances such as lights, fans, and motors by speaking to Google Assistant. The spoken commands are processed via IFTTT and sent to Adafruit IO, which communicates with the NodeMCU over Wi-Fi to toggle relays that control appliances, offering a seamless, wireless smart home experience.

3.Design and Development of Voice Controlled Home Automation Using NodeMCU

The project involves the complete design and development process of a voice-controlled smart home system. It uses the NodeMCU microcontroller to receive commands through Wi-Fi from platforms like Ad fruit IO and IFTTT, triggered by Google Assistant. The design includes modules for user authentication, voice command interpretation, cloud communication, and device control. The system is built for scalability, ease of use, and efficient operation.

4.Voice Controlled Home Automation Using NodeMCU Using NodeMCU

This emphasizes the central role of the NodeMCU microcontroller in both the control logic and connectivity of the home automation system. NodeMCU not only connects to the internet via Wi-Fi but also processes voice-triggered commands to manage appliances through relay circuits. It acts as the core component that enables smart, voice-activated home control without the need for physical switches.

3. Methodology:

3.1 System Overview:

It is a process of planning a new business system or replacing an existing system by defining its components or modules to satisfy the specific requirements. Before planning, you need to understand the old system thoroughly and determine how computers can best be used in order to operate efficiently. Project layout is Unified Modeling Language (UML) which related in the context of software development, where UML is a visual modeling language used to represent the design and structure of a system and to how the files and components of a software project are organized and structured.

3.2 Hardware Design:

The Voice Controlled Home Automation system include essential components such as a Node MCU (ESP8266) microcontroller, which serves as the central processing unit with built-in Wi-Fi capabilities. Additional hardware includes relay modules to switch household devices, a DC motor, a CPU fan, and a bulb to demonstrate appliance control. A regulated power supply with components like transformers, rectifiers, capacitors, and voltage regulators (7805/7812) ensures stable voltage delivery to the system.

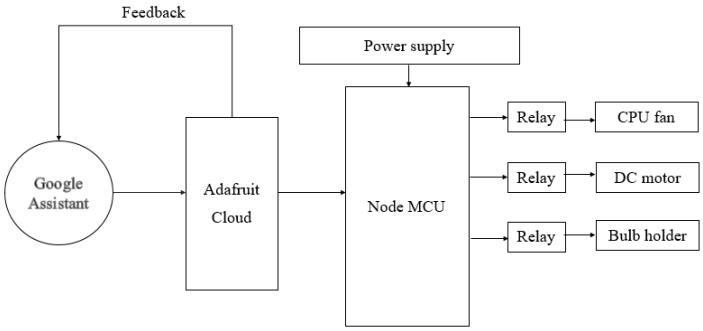

Fig 1: Block Diagram

The block diagram illustrates a voice-controlled home automation system using NodeMCU. Voice commands given to Google Assistant are sent to the Adafruit Cloud, which communicates with the NodeMCU microcontroller. The NodeMCU processes these commands and controls connected appliances through relay modules. Each relay operates a specific device, such as a CPU fan, a DC motor, or a bulb holder. The system is powered by a dedicated power supply, and feedback is provided from the Adafruit Cloud to Google Assistant to confirm command execution, enabling efficient and interactive control of home appliances.

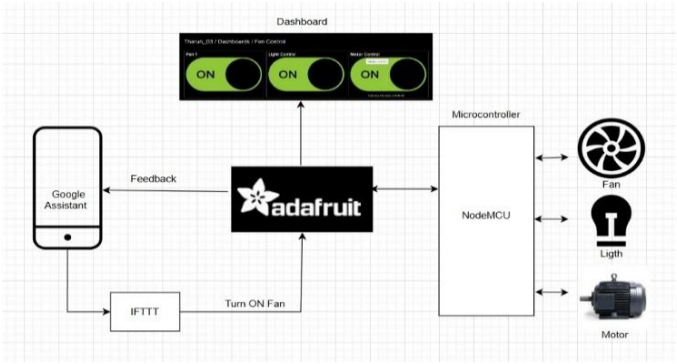

Fig 2: System Architecture

The system architecture depicted in the diagram represents a smart home automation system that enables users to control electrical appliances (such as a fan, light, and motor) using Google Assistant and Adafruit IO.

4. Implementation:

The implementation of the Voice Controlled Home Automation system combines both software and hardware components to enable hands-free operation of household appliances. At the core of the setup is the NodeMCU microcontroller, which has built-in Wi-Fi capability and serves as the central control unit. It connects to the internet and communicates with Adafruit IO, a cloud-based IoT platform, using the MQTT protocol. Voice commands are issued by the user through Google Assistant, which are then passed to IFTTT. IFTTT acts as a middleware that translates these commands into actions that can be understood by Adafruit IO and sent to the NodeMCU.

On the software side, the system is programmed using Embedded C through the Arduino IDE. The code configures the GPIO pins of the NodeMCU to control relay modules connected to devices like a light bulb, CPU fan, and DC motor. The relays act as electronic switches, turning appliances ON or OFF based on the received command. Additionally, the Adafruit IO dashboard is used to create data feeds and monitor device states in real-time, offering feedback and control through a simple, interactive interface.

INTERFACING SENSORS

In the initial setup, sensors are interfaced with the NodeMCU to ensure continuous data collection, as shown in **Fig. 3**. The MAX30100 sensor is used to measure heart rate and oxygen levels, and a temperature sensor may be added to monitor body temperature. These sensors transmit the data via I2C communication protocols to the NodeMCU for processing.

Fig. 3: Connecting sensors

The interfacing of sensors with the Arduino enables real-time data collection for vehicle monitoring and accident detection. The system integrates an accelerometer, vibration sensor, and microphone to detect shocks, sudden movements, and record surrounding sounds. A GPS module is connected via serial communication to track the vehicle's location accurately.

Additionally, the system includes a Wi-Fi module (ESP8266) to transmit data to the cloud, ensuring remote access and secure storage. Instead of a camera, a microphone module records audio for incident analysis while maintaining privacy. In case of an accident, the system captures impact force, vehicle position, and ambient sounds, issuing an emergency alert based on the recorded data. This IoT-powered black box enhances vehicle safety by providing secure data storage and rapid emergency response, helping in accident analysis and improving road safety

5.RESULTS:

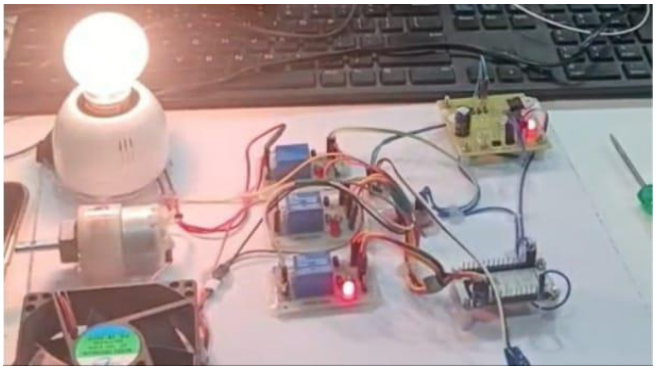

Fig. 4: Sensor Reading

Fig. 5: Adafruit IO Dashboard

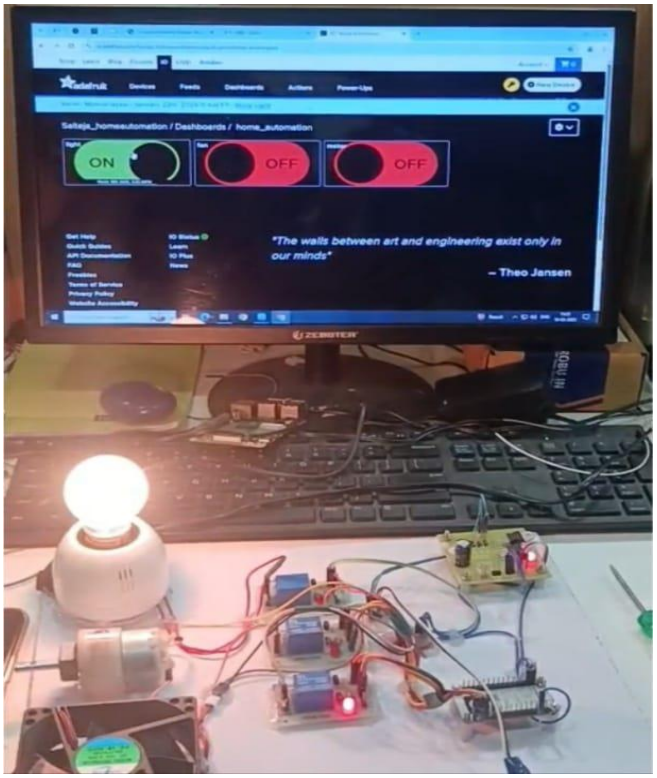

Figure 6: Ligth is Turn On

6. CONCLUSION:

The voice controlled home automation system using NodeMCU presents a highly effective and convenient approach to integrating smart technology into daily life. By leveraging NodeMCU for device control, Adafruit IO for real-time data management, and IFTTT for seamless automation, the system enables effortless interaction with household appliances through a voice interface powered by Google Assistant. This innovative setup not only simplifies home automation but also enhances accessibility for individuals with mobility challenges, making smart living more inclusive.

Additionally, the system contributes to energy efficiency by allowing users to optimize appliance usage, reducing unnecessary power consumption. The integration of cloud-based platforms ensures remote control capabilities, enabling users to operate their devices from anywhere. With its scalability and ease of implementation, this project serves as a foundation for future advancements in home automation, paving the way for a more connected and intelligent living environment.

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