Development of a Cloud-Connected Home Automation System Using Telegram API

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Abstract

This paper presents a Telegram-based home automation system that operates using Wi-Fi connectivity, allowing users to control household appliances through smartphones and laptops. The system is particularly beneficial for elderly individuals, people with physical disabilities, and those who travel frequently, offering them a simple and efficient way to manage their home appliances remotely. Traditional home automation solutions such as Bluetooth suffer from limited range, GSM involves higher operational costs, and Zigbee is constrained by bandwidth and power limitations. The proposed system addresses these issues by integrating the Telegram messaging platform with a Wi-Fi-enabled microcontroller, specifically the NodeMCU with ESP8266. Through this setup, users can send commands via Telegram, enabling real-time control and synchronization of devices like lights, fans, and other appliances connected through relays. The system provides a cost-effective, scalable, and user-friendly solution that enhances accessibility and convenience. It represents a practical approach to modern smart living, aligning with the broader vision of the Internet of Things (IoT).

Keywords: Home Automation, IoT, Telegram App, GSM, Node MCU

1. Introduction

The Internet of Things (IoT) has emerged as a revolutionary technology that significantly enhances internet-based communication and connectivity. It enables seamless interaction between people and devices, facilitating connections at any time, from any location, across various networks, and through numerous services. This technology forms the backbone of modern automation systems, especially in the context of smart homes. The current project explores an innovative concept in home automation that relies on message-based communication for controlling household appliances. It specifically utilizes the ESP8266 microcontroller, a Wi-Fi-enabled chipset, to develop a working prototype capable of managing both smart and conventional (non-smart) appliances through the IoT framework.

This system is particularly designed to benefit elderly individuals and those with physical disabilities, especially people who live alone, by offering a convenient and remote

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method to manage household functions. Home automation, often referred to as a residential extension of building automation, encompasses the control of essential systems such as lighting, air conditioning, ventilation, and security. Additionally, it allows the monitoring and management of everyday appliances like ovens, washing machines, and refrigerators through internet-enabled devices. With the rapid advancement of mobile device processing power and the growing affordability of smart technologies, the concept of smart living—encompassing smart homes, smart cities, and smart schools—is becoming more accessible and practical for everyday life.

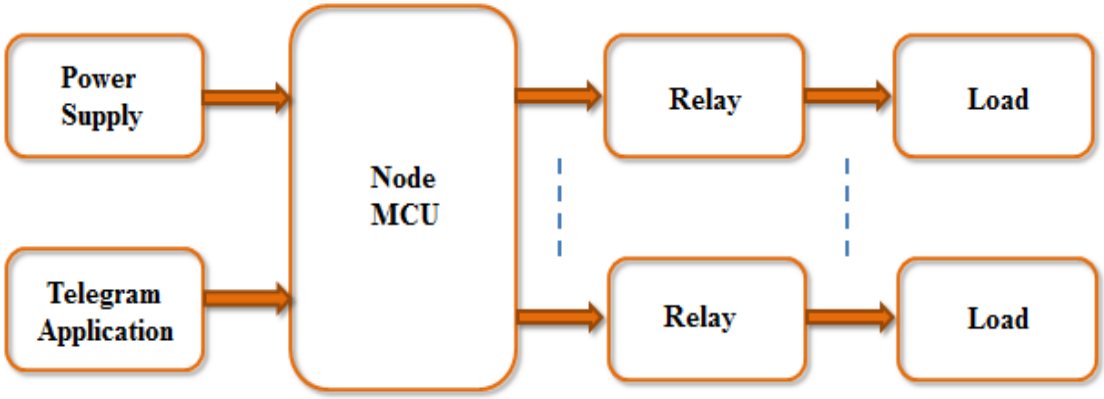

Figure 1: Block diagram

2. Internet of Things (IoT)

The Internet of Things (IoT) represents a transformative paradigm in modern technology, referring to an interconnected network of physical objects-such as household appliances, vehicles, and other electronic devices-embedded with sensors, software, and network capabilities. These components enable devices to gather, process, and share data with minimal human interaction, thereby fostering automation and intelligent decision-making. In the context of Telegram-based home automation, IoT plays a pivotal role in establishing a reliable and efficient system composed of interconnected elements, including sensors, microcontrollers, and control units. These devices collaboratively collect real-time data, transmit it over a wireless network, and execute actions based on received commands.

IoT has become increasingly ubiquitous in the field of engineering and is widely recognized as a foundational technology for applications such as smart homes. It facilitates seamless communication and interoperability among devices via the internet, enabling centralized or remote control of various systems.

In this automation model, the Telegram messaging platform serves as a communication interface, allowing users to issue commands and receive status updates regarding home appliances. This approach provides a cost-effective, scalable, and user-centric

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solution for remote home management, particularly useful for enhancing convenience, security, and accessibility in everyday living environments.

3. Home Automation

A Telegram-based home automation system is an innovative application of modern communication and IoT technologies, designed to facilitate the remote monitoring and control of household appliances via the Telegram messaging platform. This system is composed of several integral components, including sensors, microcontrollers, communication modules, and notification mechanisms. Environmental sensors such as motion detectors, temperature sensors, and light sensors are used to continuously monitor the home environment. These sensors transmit data to microcontroller units—commonly ESP8266-based NodeMCU boards or Arduino modules like the Arduino Nano—which process the collected information and execute control logic accordingly.

The NodeMCU, equipped with Wi-Fi capabilities, plays a critical role in establishing internet connectivity, thereby enabling seamless communication with the Telegram Bot API. Through this integration, users can interact with the system by sending simple text commands or messages via Telegram to control appliances, request real-time status updates, or receive automated alerts. The system is also capable of sending push notifications to inform users of abnormal conditions, such as unauthorized access or device malfunction, enhancing home security and responsiveness.

This combination of IoT and Telegram not only ensures remote accessibility and convenience but also promotes energy efficiency and smarter living. It offers an intuitive, cost-effective solution ideal for implementing intelligent, connected home environments.

4. Existing System

In earlier times, home automation technologies were non-existent, and individuals had to manually operate all household appliances. This required significant human effort, led to higher energy consumption, and offered little to no security or convenience. The advent of home automation has brought numerous advantages, including reduced manual effort, enhanced safety and security, and improved energy efficiency. Various technologies have emerged to facilitate automation, such as Bluetooth-based systems, Internet of Things (IoT) platforms, and microcontroller-based solutions like Raspberry Pi.

Among these, IoT-based systems have proven to be particularly effective due to their capability for long-range communication. Unlike Bluetooth, which is limited to a range of approximately 150 meters and is thus suitable only for local control, IoT allows users to manage home appliances from virtually any location with internet access. For instance, in the past, if someone went on a week-long trip and forgot to turn off the lights, it would result in unnecessary energy wastage. With IoT-enabled devices such as the

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NodeMCU microcontroller, users can now remotely switch off lights and other appliances, significantly reducing power consumption and enhancing convenience. This illustrates how IoT technology addresses the limitations of earlier systems and provides a more flexible, scalable solution for modern home automation needs.

5. Proposed Method

The proposed system is based on the ESP8266EX, a compact and highly integrated Wi-Fi SoC widely used in IoT applications. It offers efficient power usage, reliable design, and solid performance, providing a strong foundation for end-point IoT solutions.

This system allows users to remotely control and monitor home appliances using an internet-connected device. With the help of the ESP8266 module, users can easily perform ON/OFF operations of various electronic devices at home through a wireless connection.

Once all components are properly connected—such as the microcontroller, relays, and other supporting hardware—the user interacts with the system via an Android application. Commands are sent in the form of text messages through the app, which are received and processed by the ESP8266. This setup enables the user to control appliances from any location and also monitor their current status efficiently.

6. Software Employed

In a Telegram-based home automation system utilizing IoT and NodeMCU, the Arduino IDE is commonly used to program the NodeMCU module. Core libraries such as *ESP8266WiFi* are implemented to establish Wi-Fi connectivity, while the *UniversalTelegramBot* library facilitates interaction with the Telegram Bot API. Through this setup, users send commands via Telegram messages, which are received and processed by the NodeMCU to control household appliances like fans or lights through relay modules.

For additional features, optional platforms like Blynk can be used to create a graphical mobile interface, and MQTT can be integrated to enable real-time communication, making the system scalable for larger IoT deployments. Advanced configurations may also incorporate Home Assistant to define automated responses or custom triggers based on Telegram inputs.

To support internet connectivity and data communication, the ESP8266 library is essential. It provides the functions necessary to program the ESP8266-based NodeMCU, a cost-effective microcontroller with built-in Wi-Fi and TCP/IP capabilities. With this library, the NodeMCU can connect to wireless networks and transmit data to cloud services like AWS IoT. This enables remote device monitoring and control, allowing users to manage

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appliance statuses and functionality from anywhere. Telegram serves as the user interface, enhancing convenience through simple text-based commands.

7. Results and Discussions

The setup process begins by connecting the NodeMCU and relay modules using a PCB board. After completing the on-board wiring, connect the electrical loads—such as lights, fans, or motors—to the relay outputs. Then, connect an adapter to the NodeMCU to provide power, and ensure the loads also receive the necessary power supply. Before turning on the power, upload the source code to the NodeMCU using a USB cable and the Arduino IDE. The NodeMCU should also be linked to a Telegram account where a Telegram bot has been created for appliance control.

Once both the software and hardware configurations are in place, the system can be powered on for operation.

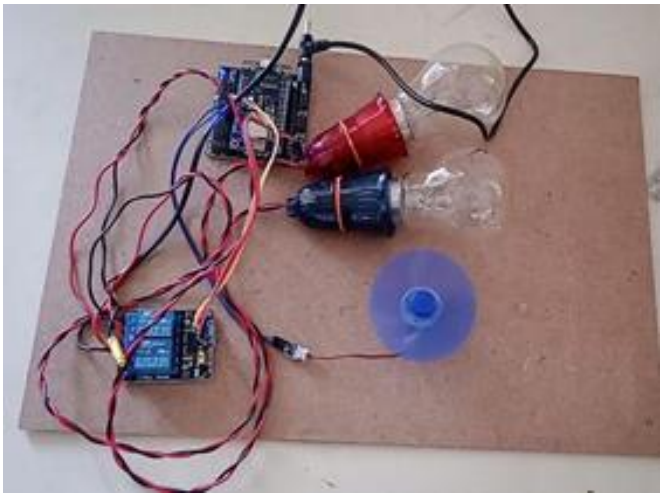

Figure 2: Experimental Setup

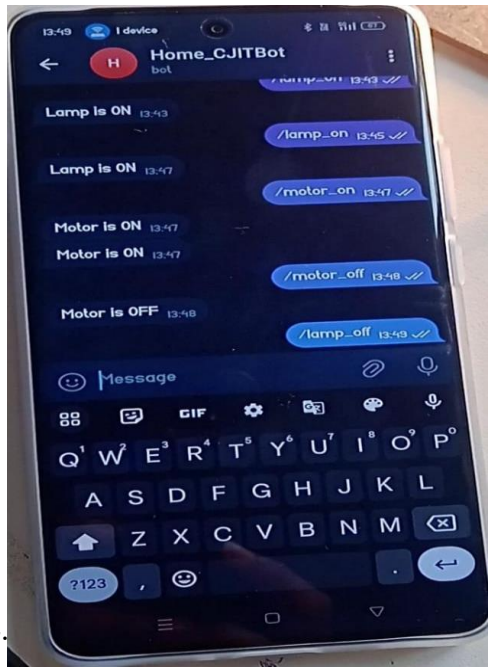

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Figure 3: Text Commands given in Telegram App

Text commands are entered in the Telegram application on an Android device. These commands are received by the NodeMCU, which then sends the appropriate signals to the relays. Based on the command, the corresponding load connected to the relay—such as a light or fan—is turned ON or OFF accordingly.

This setup demonstrates that home appliances can be controlled remotely through text commands sent via the Telegram app installed on a smartphone, enabling control from any location with internet access.

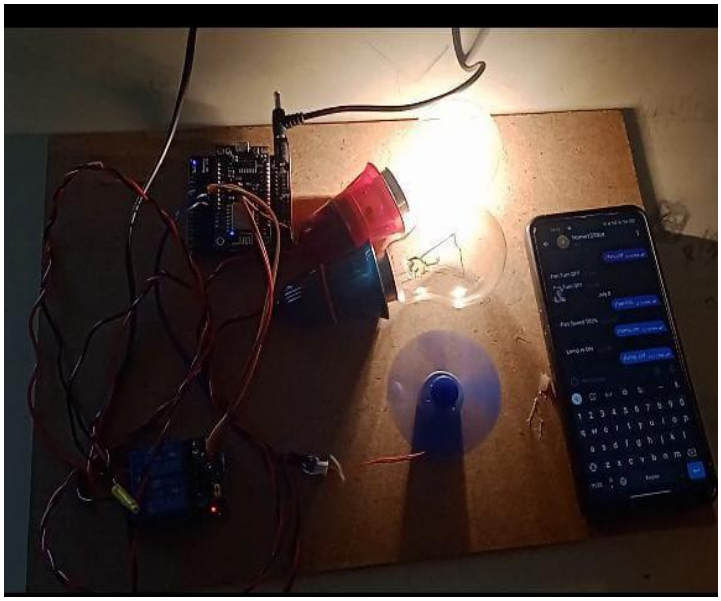

Figure 4: Experimental Result

7. Conclusion

The Telegram-based Home Automation System highlights the effective integration of Internet of Things (IoT) technology with messaging platforms like Telegram for remotely managing household appliances. This system proved to be intuitive, adaptable, and capable of real-time appliance monitoring, offering users increased convenience, improved energy efficiency, and enhanced home security. Despite challenges such as reliance on stable internet connectivity and potential security vulnerabilities, the system performed efficiently and demonstrated strong potential in automating and supervising

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smart home environments. It serves as a stepping stone toward the development of more advanced automation systems that could include features like voice control, machine learning for intelligent automation, and broader integration with other IoT ecosystems.

This paper presented an approach to home automation where users can control appliances by sending commands to a Telegram bot using IoT-enabled technology. This method allows seamless control over household devices through any internet-enabled device, such as a smartphone or laptop. Users can operate appliances remotely with a single command, making home management more accessible and efficient from virtually any location.

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