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Real Time Implementation of Google Assistant Based Home Automation System

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ABSTRACT

The implementation of Google Assistant in home automation provides an intelligent and interactive way for users to control various devices and appliances within their homes. This paper focuses on the real-time implementation of Google Assistant in home automation, outlining the challenges and benefits of integrating the technology into a smart home system. The paper also discusses the various components involved in the implementation, including the hardware and software requirements. Additionally, the paper explores the potential applications of Google Assistant in home automation, such as energy management, security monitoring, and smart entertainment systems. Overall, this paper provides insights into the real-time implementation of Google Assistant in home automation and its potential to transform the way we interact with our living spaces.

Keywords: Google assistant; Home automation; Smart home system; Challenges and benefits.

1. Introduction

The emergence of smart home technology has brought about a significant transformation in the manner in which we engage with our domestic environments, providing us with the ability to regulate a diverse range of devices and appliances through the utilisation of voice-activated commands or mobile applications [1]. Google Assistant is a widely utilised voice assistant for home automation that offers users an intuitive and seamless means of managing their smart home devices. In recent times, there has been an increasing inclination towards the instantaneous integration of Google Assistant in domestic automation, thereby facilitating users to exercise control over their devices and appliances in real-time and obtain prompt responses [2]. This paper focuses on the real-time implementation of Google Assistant in home automation, outlining the challenges and benefits of integrating the technology into a smart home system [3].

The incorporation of Google Assistant into home automation systems in real-time is closely associated with the notion of the Internet of Things (IoT), which refers to the interconnectivity of various devices and objects through the internet [4]. The Internet of Things (IoT) has facilitated the development of intelligent domiciles, wherein various devices and appliances can establish communication with one another [5], exchange information, and function in a synchronized manner. Google Assistant, as a voice assistant, provides a natural interface to control IoT devices in a smart home environment, enabling users to interact with their devices using natural language commands [6].

The real-time implementation of Google Assistant in home automation takes this integration a step further, allowing for instantaneous control and feedback [7]. For example, a user can use Google Assistant to turn on the lights in a room, and receive feedback from the system that the lights have been turned on in real-time. This real-time feedback allows for a more seamless and intuitive user experience, enhancing the overall functionality and usability of the smart home system [8]. However, implementing real-time Google Assistant-based home automation requires a complex infrastructure of hardware, software, and communication protocols [9],[10]. This paper delves into the details of this infrastructure and provides insights into the challenges and benefits of implementing real-time Google Assistant-based home automation, with a focus on the IoT-related aspects of the technology.

2. Existing Systems

The current investigation puts forth a home automation framework that employs Bluetooth technology and mobile devices [11]. The system entails the linkage of household appliances to an Arduino BT board through relays at both input and output ports. The Arduino BT board is based on a programming paradigm that utilises a high-level interactive C language that is specifically tailored for microcontrollers [12]. The process of establishing the connection is facilitated by employing Bluetooth technology. The incorporation of password protection guarantees that only authorised users are able to gain entry to the devices. The facilitation of wireless communication is achieved by establishing a Bluetooth connection between the Arduino BT board and a mobile device. The current system utilises a Python script that exhibits portability, enabling it to be installed on any Symbian OS environment [13]. A circuit has been designed and implemented to obtain feedback from the mobile device, indicating its operational status.

The current investigation delineates the creation and execution of a domicile automation mechanism that employs Zigbee technology to oversee and regulate domestic devices. The design of the system is intended to ensure compatibility with cellular devices. The device's performance is documented and archived by network coordinators [14]. For this purpose, the standard wireless ADSL modem router with four switch ports is utilised to implement the Wi-Fi network. The implementation of preconfigured network SSID and Wi-Fi security parameters has been executed. The security protocol encompasses the primary message processing by the virtual home algorithm, which subsequently authenticates its safety before re-encrypting and transmitting it to the genuine network device of the home [15]. The transmission of messages from the Zigbee controller to the endpoint was facilitated through the utilisation of the Zigbee network. The algorithm for virtual home guarantees the protection and confidentiality of all incoming messages. The utilisation of Zigbee communication can offer benefits in terms of cost reduction and decreased intrusiveness during system installation [16].

The amalgamation of mobile phone and Global System for Mobile Communications (GSM) technology has rendered GSM-based home automation systems a compelling domain of scholarly inquiry [17]. The communication alternatives that were predominantly evaluated for GSM encompass SMS-oriented, GPRS-oriented, and dual-tone multi-frequency (DTMF)-oriented home automation. This presents a logical diagram that illustrates the operational framework of Alheraish's work [18]. The diagram showcases the interplay between home sensors and devices within the home network, and their communication through GSM and SIM (subscriber identity module). The mechanism utilises transducers to transform physical actions into electrical impulses, which are then conveyed to a microcontroller [19]. The sensors of the system exhibit the ability to transform physical characteristics, such as sound, temperature, and humidity, into an alternative form of quantification, such as voltage. The microcontroller is responsible for signal processing and translation into commands that are intelligible to the GSM module. The determination of a suitable mode of communication, specifically SMS, GPRS, or DTFC, is dependent on the instruction received by the GSM module.

The implementation of home automation through the utilisation of RF module technology. The primary objective of the Home Automation System is to construct a home automation system that utilises a remote controlled by RF technology [20]. The pace of technological advancement has led to a corresponding increase in the intelligence of residential dwellings. Contemporary residential dwellings are intentionally transitioning from conventional light switches to a centralised control mechanism, which encompasses radio frequency operated switches. Currently, conventional wall switches located throughout a residence require significant effort on the part of the user to physically approach and manipulate them for control and operation. Moreover, it becomes increasingly challenging for elderly individuals or those with physical disabilities to engage in such activities. The implementation of RF technology in home automation utilising remote devices presents a simplified solution [21]. To achieve this objective, a radio frequency (RF) remote is integrated with the microcontroller on the transmitter end to transmit ON/OFF signals to the receiver, which is connected to the devices. The loads can be activated or deactivated through wireless means by utilising the remote switch located on the transmitter [22].

The topic of interest pertains to home automation that is controlled by Google Assistant. The extant protocol comprises three primary stages, namely: configuring Adafruit IO, establishing a link with the ESP8266, and interfacing with Google Assistant via IFTTT. Adafruit IO is an online platform utilised for generating simulated switches that can be activated or deactivated based on the instructions issued to Google Assistant [23]. The ESP8266 is a wireless communication module utilised for facilitating internet-based communication between a smartphone and the Node MCU via Wi-Fi. The IFTTT platform is utilised for generating a series of uncomplicated conditional statements, commonly referred to as applets. The system's hardware architecture comprises of a Node MCU and a smartphone, which communicate wirelessly over the internet [24]. The Google Assistant is an integrated voice recognition feature within the Android operating system. It has been utilised to create a mobile application that enables users to command home appliances through vocal instructions. The aforementioned software programme facilitates the conversion of vocal commands issued by the user into textual format. Subsequently, the transcribed text is relayed to Adafruit libraries that are integrated with Node MCU via IFTTT. The system incorporates a temperature and humidity sensor module for regulating the air, and a home automation system based on voice recognition was suggested and executed.

2.1. Disadvantage of Existing System

a. Misbehavior during heavy network traffic

The ESP8266 microcontroller, which is responsible for decoding the voice commands received from Google Assistant and controlling the relays, may misbehave when heavy network traffic occurs. This is because the ESP8266 relies on Wi-Fi communication to receive commands from Google Assistant and send control signals to the relay modules. During heavy network traffic, the Wi-Fi connection may become unstable, leading to delays or lost data packets, which can cause the ESP8266 to misbehave.

Irish Interdisciplinary Journal of Science & Research (IIJSR)
Volume 7, Issue 2, Pages 63-70, April-June 2023

b. Leakage voltage in digital pins

Another disadvantage of the system is that small leakage voltage is experienced in the digital pins. This can be problematic if the leakage voltage is sufficient to cause the relay modules to turn on or off unintentionally, even when there is no voice command issued. Leakage voltage can occur due to a variety of factors, such as signal interference or poor electrical grounding.

3. Proposed System

The updated methodology for the real-time implementation of Google Assistant-based home automation with the inclusion of Arduino UNO board as an intermediary between the ESP8266 and the relay modules involves setting up the hardware, configuring the software, integrating voice commands, controlling the relay modules, managing network traffic, and testing and debugging the system. By adding an Arduino UNO board to the system, the issues of network traffic and voltage leakage can be addressed, which can improve the reliability and stability of the system. The ESP8266 and Arduino UNO board work together to manage network traffic, while the Arduino UNO board provides stable power to the relay modules to prevent any voltage leakage issues.

3.1. Methodology

a. Hardware Setup

The first step is to set up the hardware. In addition to the existing components used in the original project, an Arduino UNO board is added as an intermediary between the ESP8266 and the relay modules. The ESP8266 is connected to the Arduino UNO board using UART communication, while the relay modules are connected to the Arduino UNO board's digital pins. The power supply for the relay modules and the Arduino UNO board is provided using a 5V power supply.

b. Software Configuration

Subsequently, it is imperative to set up the software. The ESP8266 microcontroller is programmed through utilisation of the Arduino Integrated Development Environment (IDE) and the Adafruit Message Queuing Telemetry Transport (MQTT) library. The programming of the Arduino UNO board is facilitated through utilisation of the Arduino Integrated Development Environment (IDE). The ESP8266 and Arduino UNO board's software is tasked with deciphering voice commands transmitted from Google Assistant via IFTTT and subsequently regulating the relay modules.

c. Voice Command Integration

The voice commands are added through the IFTTT website and linked to the Adafruit account, as in the original project. The commands are then sent to the ESP8266 using MQTT communication. The ESP8266 decodes the commands and sends them to the Arduino UNO board using UART communication.

d. Relay Control

The Arduino UNO board receives the commands from the ESP8266 and controls the relay modules accordingly. The relay modules turn on or off the respective devices according to the user's request. The Arduino UNO board is

Irish Interdisciplinary Journal of Science & Research (IIJSR)
Volume 7, Issue 2, Pages 63-70, April-June 2023

equipped with a voltage regulator and is able to provide stable power to the relay modules, which helps to prevent any voltage leakage issues.

e. Network Traffic Management

The ESP8266 and Arduino UNO board work in tandem to manage network traffic. The ESP8266 is responsible for receiving the voice commands from Google Assistant and decoding them. Once the commands are decoded, they are sent to the Arduino UNO board for relay control. The Arduino UNO board is capable of buffering incoming data packets and processing them at a slower pace to prevent the system from becoming overloaded. This helps to ensure that the system remains stable even during heavy network traffic.

f. Testing and Debugging

The final step is to test the system and debug any issues. The system can be tested by issuing voice commands through Google Assistant and verifying that the devices are turning on or off as expected. Any issues that arise during testing can be addressed through debugging and refinement of the software and hardware components.

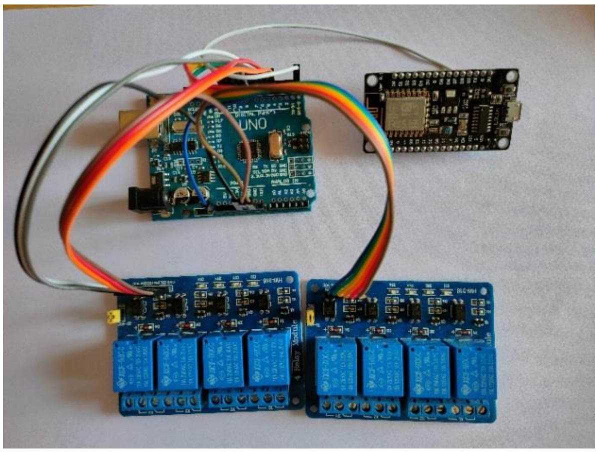

Figure 1. Hardware setup – Arduino UNO, ESP8266, 4 channel relay modules

3.2. Advantages

a. Improved Stability

The addition of an Arduino UNO board to the system can help to improve the stability of the system. The Arduino UNO board can buffer incoming data packets and process them at a slower pace, which can help to prevent the system from becoming overloaded during heavy network traffic.

b. Reduced Voltage Leakage

The Arduino UNO board is equipped with a voltage regulator, which can provide stable power to the relay modules and prevent any voltage leakage issues. This can help to improve the safety of the system.

c. Better Integration with Other Devices

The Arduino UNO board is a widely used microcontroller board with a large community of developers, which means that there are many resources available for integrating it with other devices. This can make it easier to extend the functionality of the system and integrate it with other IoT devices.

Irish Interdisciplinary Journal of Science & Research (IIJSR)
Volume 7, Issue 2, Pages 63-70, April-June 2023

d. More Processing Power

The Arduino UNO board has a more powerful microcontroller than the ESP8266, which can provide more processing power for the system. This can make the system more responsive and allow for more complex control logic. Overall, the new system that utilizes both the ESP8266 and Arduino UNO board can help to improve the stability, safety, and flexibility of the system, which can make it more reliable and easier to integrate with other IoT devices.

4. Conclusion and Future Scope

In conclusion, the real-time implementation of Google Assistant-based home automation using both the ESP8266 and Arduino UNO board provides a stable and reliable system for controlling home devices with voice commands. By addressing the issues of network traffic and voltage leakage, the system can offer a safer and more responsive experience for users. Additionally, the integration of the Arduino UNO board offers a more powerful microcontroller and better integration with other devices, which can allow for more complex control logic and easier extension of the system's functionality.

Looking towards the future, there are several possible avenues for further development of this project. One possible future scope is the integration of a LoRa system to provide a long-range, low-power wireless communication solution for IoT devices. This would allow the system to communicate with devices located outside of the home or in remote locations, providing greater flexibility and control for the user. Additionally, the system could be expanded to include more home devices or integrate with other IoT devices to provide a more comprehensive smart home experience. The voice command integration could also be improved to provide more natural language processing and allow for more complex commands. Overall, the real-time implementation of Google Assistant-based home automation has a lot of potential for future development and offers an exciting opportunity to create a more convenient and efficient smart home.

Declarations

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Competing Interests Statement

The authors declare no competing financial, professional, or personal interests.

Consent for publication

The authors declare that they consented to the publication of this research work.

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