

IoT BASED ESP8266 SWITCHING USING GOOGLE ASSISTANT, ALEXA & CADIO

A Product Synopsis

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Introduction

The history of automation can be traced back to the early 20th century when inventive minds began envisioning ways to streamline domestic tasks through technological innovation. However, it wasn't until the late 20th century that significant progress was made. The 1970s marked the emergence of X10, a communication protocol that allowed devices to communicate over existing electrical wiring, enabling rudimentary remote control of appliances. The 1990s saw advancements with the integration of computers and the internet, as well as the introduction of smart home technologies like thermostats and lighting control.^[1] The 21st century witnessed an exponential growth in the field, with the proliferation of smartphones leading to the development of mobile app-controlled devices and systems. The introduction of voice assistants further revolutionized home automation, allowing users to control various aspects of their homes through voice commands.

Automation has entered a new era with the integration of IoT-based devices like the ESP8266 and voice command technology such as Amazon's Alexa. The ESP8266, a versatile microcontroller with Wi-Fi capabilities, forms the backbone of smart home systems, enabling seamless connectivity and control. By leveraging Alexa's voice recognition and natural language processing, users can effortlessly manage various smart devices within their homes.^[2] From adjusting lights and thermostats to controlling entertainment systems, this synergy between IoT and voice command exemplifies the remarkable strides made in creating intuitive and interconnected living spaces.

Here we have made a simple IoT based esp8266 switching using Cadio. To make this project, we don't have to write any code, we just need to upload the Cadio format on Esp8266, then configure it through their mobile App. After that we can control all our appliance through Cadio & voice command even if there is no internet connection. We have used Esp8266 because it is a versatile microcontroller renowned for its compact size and impressive. Its low-power modes optimize energy consumption, making it ideal for various applications. This microcontroller operates between 3.0V and 3.6V, simplifying integration with different power sources. It can be programmed using popular development environments like Arduino IDE and supports multiple operating modes.

Block Diagram

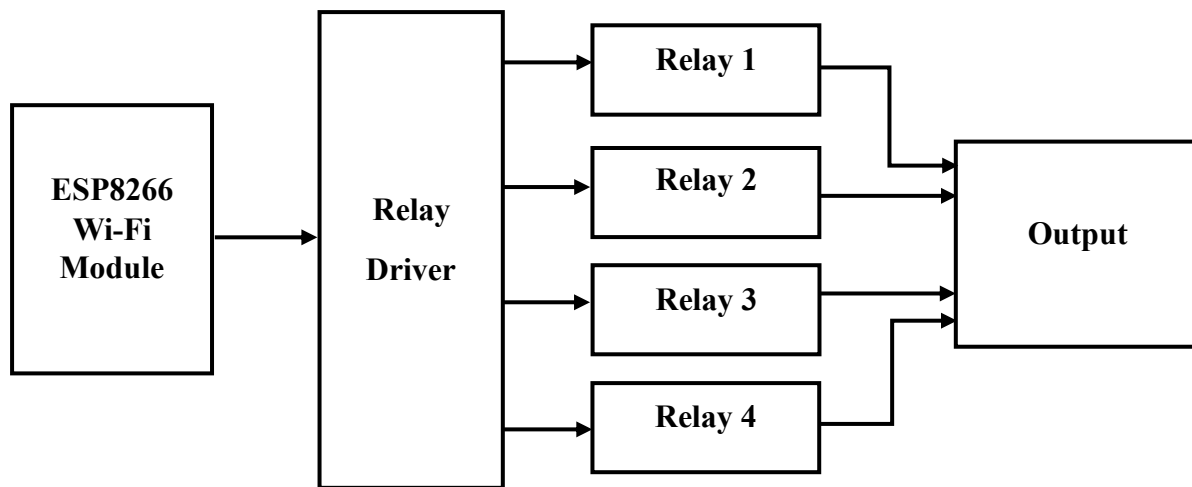


Fig.1 Block Diagram of IoT based ESP8266 Switching

Here we have used ESP8266 Wi-Fi module as it is compact yet potent module integrates seamlessly into various projects, because of its 32-bit microcontroller clocked at up to 160 MHz Its standout feature is the built-in Wi-Fi support, catering to 2.4 GHz IEEE 802.11 b/g/n standards, empowering easy integration into the Internet of Things (IoT) landscape. With memory configurations spanning from 512KB to 4MB of flash memory and approximately 80KB of RAM, it adeptly manages storage and processing demands. Coupled with low-power modes, the ESP8266 module strikes an impressive balance between functionality and energy efficiency. Its programmability through platforms like Arduino IDE and its support for multiple operating modes.^[3]

A relay driver is used as it serves as a crucial link between the low-voltage, low-current control signals from microcontrollers or logic circuits and the high-voltage, high-current loads such as motors, lights, or appliances. It utilizes amplification techniques, typically using transistors or dedicated integrated circuits, to effectively switch the electromechanical relays that control these loads. By providing electrical isolation and ensuring the proper translation of signals, relay drivers enhance safety and reliability in applications ranging from industrial automation to home electronics, enabling seamless and controlled interaction.

There are total 4 relays connected to relay driver and in output we have all the electrical appliances connected to the real output.

Circuit Diagram

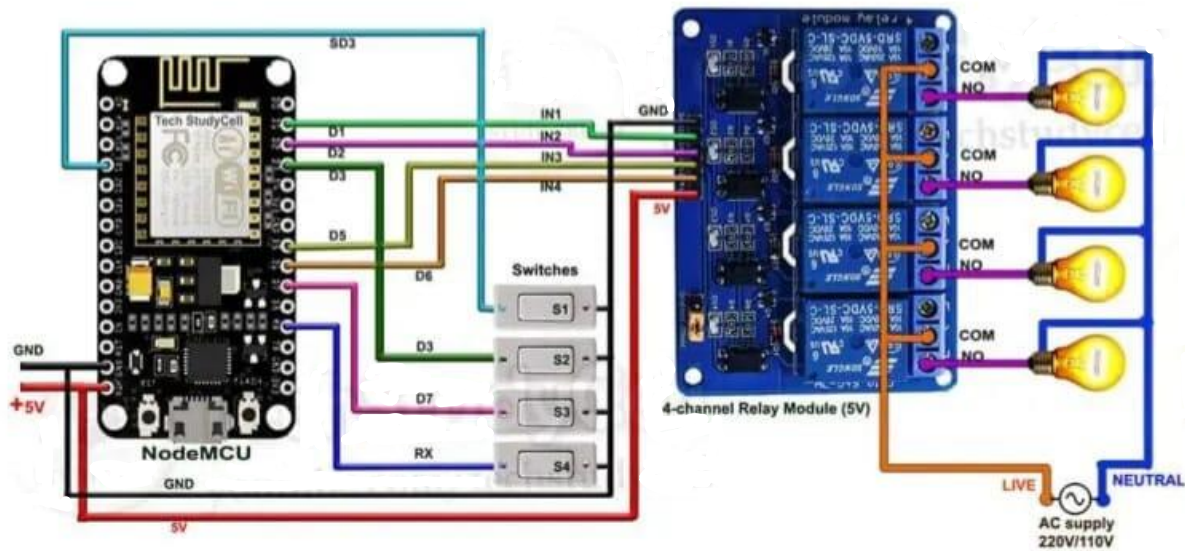


Fig.2 Circuit Diagram of IoT based ESP8266 Switching^[4]

This is the complete circuit diagram for this IoT based Esp8266 switching. We have used the GPIO pins D1 (GPIO-5), D2 (GPIO-4), D5 (GPIO-14), and D6 (GPIO-12) to control the 4 relays. And the GPIO pins SD3 (GPIO-10), D3 (GPIO-0), D7 (GPIO-13), and RX (GPIO-3) are connected with pushbuttons to control the 4 relays manually. The INPUT_PULLUP function in Arduino IDE instead of using the pull-up resistors and a 5V mobile charger to supply the smart relay module.

Component Required

Serial No.	Component Name	Specifications
1	ESP8266	ESP8266 Wi-Fi Module with NodeMCU
2	Relay	4-Channel 5V SPDT Relay Module

3	Switches	Simple ON/OFF Switches
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ESP8266 NodeMCU

The ESP8266 is a highly integrated chip/module designed for wireless communication and microcontroller applications. It was developed by Espressif Systems, a Chinese semiconductor company. The module gained prominence for its ability to provide Wi-Fi connectivity to various electronic devices at an affordable cost. It can control appliances with the voice command using Google Assistant, with the voice command using Alexa and with the Cadio app. It can also control home appliances manually without internet. It monitors real-time feedback in the Cadio, Google Home, and Amazon Alexa App and set timer to control the devices automatically.

Relay Module

A relay module is an electronic component designed to control electrical circuits by using an electromagnetically operated switch. It acts as a bridge between low-power control signals, such as those from microcontrollers, and high-power devices like motors, lights, or appliances. When the module receives a control signal, the relay's internal switch is toggled, either connecting or disconnecting the controlled circuit. This allows for safe and efficient remote control of devices, making relay modules invaluable in applications ranging from home automation to industrial machinery and beyond.

Switches

In IoT-based home automation systems, switches play a pivotal role in providing user-friendly control over various smart devices and appliances. They serve as the interface between users and the interconnected devices, enabling seamless interaction and automation. In IoT-based home automation systems, switches play a pivotal role in providing user-friendly control over various smart devices and appliances. They provide an intuitive and interactive means for users to control and automate their smart devices, enhancing comfort, convenience, energy efficiency, and security within the home environment.

Applications

The ESP8266 is a popular and versatile microcontroller with built-in Wi-Fi capabilities, making it a common choice for Internet of Things (IoT) applications. One of the common use cases for the ESP8266 is remote switching and control. Here are some applications of IoT-based ESP8266 switching:

Home Automation

ESP8266 can be used to control various home appliances such as lights, fans, air conditioners, and more. Through a mobile app or a web interface, users can remotely switch these devices on or off, and even schedule their operation based on time or environmental conditions.

Security Systems

ESP8266 can be integrated into security systems to control cameras, alarms, door locks, and more. Users can receive notifications and monitor their premises remotely, enhancing the security of their property.

Industrial Automation

In industrial settings, the ESP8266 can control and monitor machines, motors, and other equipment remotely. This can help streamline operations, improve efficiency, and reduce downtime.

Remote Access Control

The ESP8266 can be used for remote access control systems, such as opening doors, gates, or garage doors via a mobile app or web interface.

These applications are just a few examples of how the ESP8266 can be used for IoT-based switching and control. Its versatility, affordability, and ease of use make it a popular choice for hobbyists, makers, and professionals alike to create innovative IoT solutions.

Summary and Future Scope

We successfully IoT based Esp8266 switching using Cadio. Home automation using IoT-based ESP8266 modules presents several challenges. Security vulnerabilities can arise due to increased connectivity, requiring robust encryption and authentication measures to safeguard against unauthorized access. Reliability issues might emerge due to network instability or device malfunctions, necessitating reliable fail-safe mechanisms to prevent disruptions in automated processes. Lastly, managing power consumption efficiently in a network of connected devices is essential to maintain sustainability and avoid energy wastage. IoT-based home automation revolutionizes the way we interact with our living spaces. It involves integrating a variety of smart devices, sensors, and appliances into a network that can be controlled, monitored, and automated remotely through the internet. This technology enhances comfort, convenience, energy efficiency, and security within homes. From lighting and climate control to security systems and entertainment, IoT-based home automation empowers users to customize their living environments and simplify daily routines.^[5] It offers the ability to create personalized scenes, control devices through mobile apps or voice commands, and receive real-time alerts, making homes smarter, more efficient, and responsive to users' needs.

Future Scope of IoT-Based ESP8266 Switching:

The future scope of IoT-based ESP8266 switching is quite promising, as the field of IoT continues to evolve and expand. Here are some potential directions and advancements that could shape the future of ESP8266-based switching applications:

Increased Connectivity and Interoperability

The ESP8266's connectivity capabilities are likely to improve, allowing for easier integration with other IoT devices and platforms. This could lead to more seamless interactions between different devices and systems.

Edge Computing and AI Integration

As IoT devices become more powerful, they could handle more data processing tasks locally. The ESP8266 might integrate more advanced AI and machine learning capabilities for real-time data analysis and decision-making at the edge, reducing the need for constant cloud communication.

Energy Efficiency and Sustainability

Future iterations of the ESP8266 might focus on optimizing energy consumption, extending battery life, and improving overall efficiency. This would be crucial for IoT devices deployed in remote or battery-powered scenarios.

Security Enhancements

With the growing concern for IoT security, future versions of the ESP8266 might include enhanced security features to protect against data breaches, hacking, and unauthorized access. This could involve hardware-level security measures and more advanced encryption protocols.

5G and Low-latency Communication

As 5G networks become more widespread, IoT devices like the ESP8266 could benefit from faster and more reliable connectivity, enabling near-instantaneous data transfer and response times.

Healthcare and Medical Applications

With the growing importance of telemedicine and remote patient monitoring, the ESP8266 could find applications in medical devices and healthcare solutions, enabling better patient care and data collection.

Smart Cities and Infrastructure

The ESP8266 could play a role in the development of smart city infrastructure, aiding in systems such as smart street lighting, waste management, traffic control, and environmental monitoring.

Overall, the future scope of IoT-based ESP8266 switching is vast and dynamic. As technology advances and more industries recognize the potential of IoT solutions, the ESP8266 is likely to continue playing a significant role in shaping the way we interact with and control our environment.

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