IoT based web-controlled Home Automation

A Project Report

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BONAFIDE CERTIFICATE

Certified that this project report **"IoT based web-controlled home automation"** is the

Bonafide work of **"Shashi Ranjan Mehta, Aastha, Tanmay Toshniwal, Shivam Kumar, Angad Anand"** who carried out the project work under my/our supervision.

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INTERNAL EXAMINER   **EXTERNAL EXAMINER**

Abstract

IoT based web-controlled home automation is a technological advancement that enables homeowners to automate various home appliances and systems, allowing them to control and monitor them remotely through a smartphone or other connected device. This technology can improve energy efficiency, safety, and convenience in the home.

The proposed system consists of two main components; the first part is the server (web server), which presents system core that manages, controls, and monitors users' home.

Servers is manged with the help of nodemcu esp8266 Users and system administrator can locally (LAN) or remotely (internet) manage and control system code. Second part is hardware interface module, which provides appropriate interface to user of home automation system

Overall, a home automation system can provide a high level of convenience, comfort, and security while reducing energy consumption and costs. As technology continues to advance, home automation systems are likely to become even more sophisticated and intuitive, making them an increasingly popular choice for homeowners seeking to improve their living spaces.

CHAPTER 1

INTRODUCTION

1.1.   Identification of Client/ Need/ Relevant Contemporary issue

The need for an automated home system is to provide convenience, comfort, and security to homeowners or tenants. An automated home system can control and manage various household appliances such as lighting, heating, cooling, security systems, and entertainment systems. This technology can reduce energy consumption, save time and effort, and provide a more comfortable living environment.

One relevant contemporary issue related to an automated home system is privacy and security concerns. As these systems become more advanced and connected to the internet, they are vulnerable to cyber-attacks and hacking. The information collected by these systems, such as personal data, usage patterns, and habits, can also be at risk. Therefore, it is crucial to ensure that an automated home system has robust security measures in place to protect against cyber threats and privacy breaches. Additionally, ensuring that the system is up-to-date and regularly maintained can help mitigate the risks of security breaches.

1.2.   Identification of Problem

One of the potential problems with an automated home system is its reliability. Automated home systems rely on multiple interconnected devices and software to work together seamlessly. If any of these component's malfunction, it can affect the entire system and cause inconvenience to the homeowners. For example, if the lighting system fails to turn on or off, it can cause discomfort or even safety hazards. Similarly, if the security system fails to function correctly, it can compromise the safety of the occupants and their property.

Another problem that can arise with an automated home system is the complexity of the system. The more advanced the system, the more complex it becomes, and the more challenging it is to maintain and troubleshoot issues. If the system requires constant maintenance or repairs, it can cause frustration to the homeowners and lead to additional expenses.

Lastly, the cost of an automated home system can be a problem for some homeowners. The installation and maintenance of an automated home system can be expensive, and it may not be feasible for everyone to afford it. Additionally, the cost of repairing or upgrading the system can be significant, especially if it requires specialized expertise. Overall, while automated home systems offer many benefits, they can also present potential problems related to reliability, complexity, and cost.

1.3.   Identification of Tasks-

The overview of the hardware, software and technology we are using in this project-

1.3.1 Hardware specification-

1.NodeMCU (esp8266)- NodeMCU is an open-source development board based on the ESP8266 Wi-Fi module. The ESP8266 is a low-cost Wi-Fi chip with full TCP/IP stack and microcontroller capabilities. NodeMCU provides an easy-to-use firmware for programming the

ESP8266 chip. It allows developers to write Lua scripts or use the Arduino IDE to program the board.

Some features of NodeMCU include:

- Wi-Fi connectivity: NodeMCU can connect to Wi-Fi networks and act as a Wi-Fi access point.
- GPIO pins: NodeMCU has a number of general-purpose input/output (GPIO) pins that can be used for a variety of purposes.
- Analog input: NodeMCU has an analog-to-digital converter (ADC) that can be used to read analog sensors.
- USB interface: NodeMCU can be programmed and powered through a USB interface. NodeMCU is widely used for IoT projects, such as home automation, sensor networks, and robotics. It is a low-cost and versatile platform for prototyping and experimenting with connected devices.

Fig 1.1(nodeMCU)

2. 5 volt 4 channel relay-A 5V 4-channel relay is an electronic module that allows you to control up to 4 high-power devices using a microcontroller or other low-power signal source. Each channel of the relay consists of an electromechanical switch that can be activated by applying a small voltage to its control input.

When the control voltage is applied, the relay switches its contacts, allowing a separate circuit to be connected or disconnected from the main power source. This makes relays useful for controlling high-power devices such as motors, lights, or heaters, using low-power control signals from microcontrollers, sensors, or other electronic devices.

The 5V 4-channel relay module typically includes input and output pins for each channel, as well as a common ground and power supply input. The control signals for each channel are typically provided by separate digital output pins of a microcontroller or other control device, while the high-power devices are connected to the relay's output terminals.

It is important to note that when using relays to control high-power devices, appropriate safety measures must be taken to prevent electrical shock, fire, or other hazards. This may include the use of fuses, circuit breakers, or other protective devices, as well as proper grounding and insulation of all components.
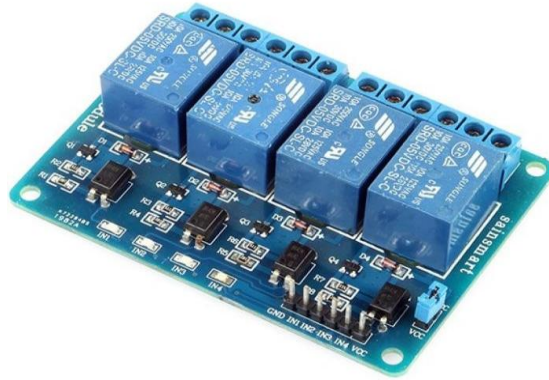
Fig 1.2(relay)

3. Breadboard –A breadboard is a tool used for building and testing electronic circuits without the need for soldering. It consists of a plastic board with a grid of holes arranged in rows and columns. Each hole contains a metal contact, and the contacts in each row and column are connected electrically.
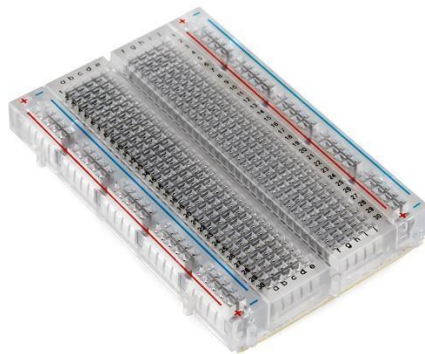

Fig 1.3(Breadboard)

4.LED – LED stands for Light Emitting Diode. It is a semiconductor device that emits light when an electric current passes through it. LEDs are highly efficient at converting electrical energy into light and are therefore used in a wide variety of applications, such as lighting, displays, and electronic devices.

Fig 1.4(LED)

1.3.2 Software specification-

Arduino IDE - Arduino IDE is an Integrated Development Environment (IDE) designed to program Arduino boards. It is a software application that runs on a computer and allows users to write, compile, and upload code to Arduino boards. The Arduino IDE is open-source and freely available for download from the Arduino website.

The Arduino IDE comes with a vast library of pre-written code called sketches that help developers get started quickly. It also supports third-party libraries that can be downloaded and added to the IDE.

One of the key features of the Arduino IDE is the ability to upload code to the Arduino board via a USB connection. The IDE automatically detects the board and its communication port, making it easy to upload code and debug the application.

Overall, the Arduino IDE is an essential tool for anyone interested in developing projects with Arduino boards. It provides a streamlined and user-friendly interface that simplifies the process of programming and uploading code to Arduino boards.

Blynk - The Blynk website is a platform for building mobile and web applications for the Internet of Things (IoT). It provides a range of tools and resources for developers to create and manage projects that integrate with a wide range of hardware and software platforms.

On the Blynk website, you can learn about the Blynk platform and its features, download the Blynk app for iOS or Android, sign up for a Blynk account, and access documentation, tutorials, and support resources.

Android Studio - Android Studio is an integrated development environment (IDE) for creating Android applications.Android Studio also includes support for the latest Android SDKs, allowing developers to easily target a wide range of Android devices with their apps. It supports multiple programming languages, including Java and Kotlin, and offers a range of features to simplify the development process, such as code templates, auto-complete, and real-time error checking.
Some of the key features of Android Studio include:
- Visual layout editor: Allows developers to create and modify the user interface of their apps using a drag-and-drop interface.
- Code editor: Provides a powerful and customizable code editor that supports a range of programming languages.
- Emulator: Allows developers to test their apps on a virtual device that mimics the behaviour of a real Android device.
- Performance profiler: Helps developers identify performance bottlenecks in their apps by providing detailed insights into CPU usage, memory usage, and network activity.
- Gradle build system: Provides a flexible and efficient build system for Android apps, allowing developers to easily manage dependencies and build variants.

Overall, Android Studio is a powerful and comprehensive IDE that is essential for anyone looking to develop Android applications.

GitHub - GitHub is a web-based platform that provides hosting for software development version control using Git. It allows developers to collaborate on code with others and provides tools for version control, bug tracking, and project management.

Gannt chart-
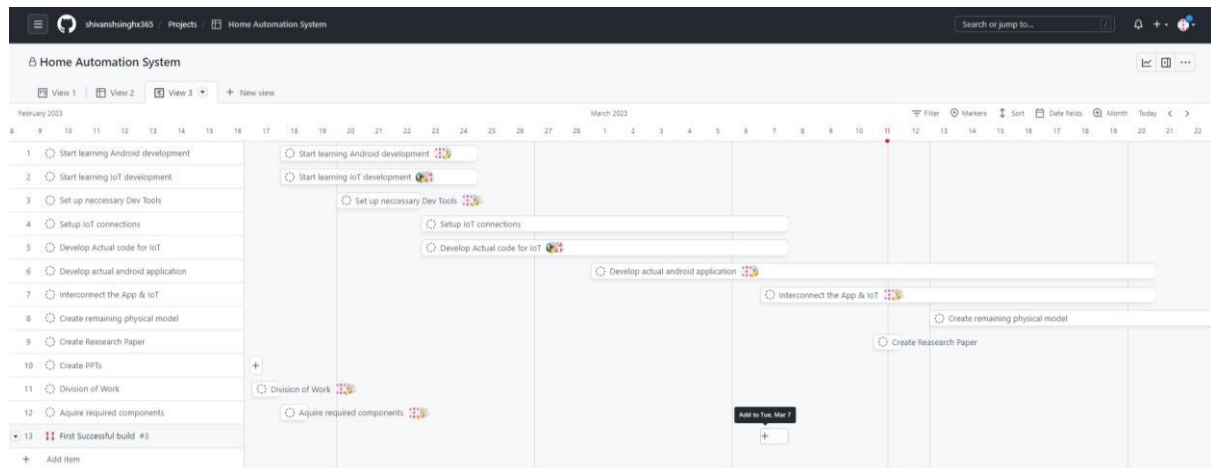
The project is divided into 3 main phases-

IOT Phase- This phase is concerned with setting up the basic IoT systems and making primary electronic connections to get to a working stage, and provide the basic switching functionality via the NodeMCU webserver and a basic web interface. This will serve as a base for all further development.

Application Phase- This is the second phase of the development which deals with creation of an android application to interface with our hardware over the internet. The app aims to provide more functionality over the basic web interface developed in phase 1. These functionalities include ability to control devices via Google Assistant and developing a native app instead of a locally hosted website.

Integration Phase- This is the final phase of the project that deals with interconnecting the application with the hardware and also completing the remaining electronic circuits in order to provide a fully functional and complete home automation system.

CHAPTER 2.
LITERATURE REVIEW/BACKGROUND STUDY

2.1. Timeline of the reported problem

Some major timeline of the project are as follows-

- 2016: The Mirai botnet infects and controls thousands of smart home devices, leading to massive distributed denial-of-service (DDoS) attacks that disrupt internet services across the US and Europe.
- 2018: Researchers at the University of Michigan demonstrate how they can use a simple laser pointer to remotely hijack voice-activated virtual assistants like Amazon Alexa and Google Home.
- 2019: Security researchers discover vulnerabilities in Ring doorbell cameras that allow attackers to access live camera feeds and obtain login credentials.
- 2020: A vulnerability is found in Philips Hue smart bulbs that could allow attackers to take over the bulbs and use them to gain access to a home network.
- 2021: Researchers uncover a flaw in Amazon's Alexa that allows hackers to silently install skills on a user's device, potentially giving them access to sensitive information.
- 2022: A study reveals that many popular smart home devices are susceptible to hacking, with vulnerabilities ranging from weak passwords to unencrypted data transmission.

2.2. Existing solutions

Automated home systems using relay and NodeMCU are a popular solution for controlling home appliances and devices through the internet. Here are some existing solutions that utilize this technology:

- Amazon Alexa: This is a voice-controlled home automation platform that can control a wide range of smart home devices, including lighting, thermostats, and door locks. Alexa can be controlled using voice commands, and it offers a range of advanced features, including the ability to create custom routines and schedules.
- Blynk: This is a mobile app development platform that can be used to create custom dashboards for controlling smart home devices using NodeMCU and relay modules. Blynk supports a variety of hardware platforms, including Arduino, Raspberry Pi, and NodeMCU, and offers a range of widgets for creating custom interfaces.
- ESPHome: This is a powerful framework for building custom firmware for NodeMCU-based devices. ESPHome offers a range of pre-built components for controlling smart home devices, including relay modules, and can be used to create custom integrations with a wide range of smart home protocols.

Overall, automated home systems using relay and NodeMCU offer a flexible and cost-effective solution for controlling smart home devices through the internet. With a range of existing solutions available, it is possible to create custom home automation systems that meet specific needs and requirements.

2.3. Bibliometric analysis

Research on automatic home systems is not only focused on improving energy efficiency, convenience, and security, but also on enhancing accessibility and health. For example, there is a growing interest in developing home automation systems that can support elderly and disabled people to live independently and safely in their own homes. Additionally, there is research being conducted on using automatic home systems to improve indoor air quality and reduce exposure to harmful pollutants, which can have a positive impact on residents' health. As technology continues to advance, there is great potential for automatic home systems to play a significant role in addressing some of the major challenges facing modern society, including climate change, aging populations, and public health.

2.4. Review Summary

Get to know about automation home systems are a rapidly growing field of research and development, focused on improving energy efficiency, convenience, security, accessibility, and health in homes. The field encompasses a wide range of technologies and applications, including home automation systems design, energy management, security and privacy, as well as solutions for elderly and disabled people. The development of automation home systems has the potential to address some of the most pressing challenges facing modern society, including climate change, aging populations, and public health. As technology continues to advance, it is likely that we will see even more innovative and effective solutions for automating homes and improving the quality of life for residents.

A study by Dong et al. (2018) looked into how home automation systems affect energy usage. The study discovered that by automatically altering lighting, heating, and cooling systems based on occupancy and ambient conditions, home automation systems can dramatically lower energy usage and boost energy efficiency.

Hassan, et al. (2019) looked at the effect of home automation systems on user satisfaction and perceived comfort in another study. The study discovered that by enabling individualised control over home appliances, lighting, and temperature, home automation systems can increase consumer pleasure and comfort.

Hwang, et al. (2018)'s third study concentrated on the security features of home automation systems. The study discovered that by incorporating security sensors, cameras, and alarms, home automation systems may considerably increase house security. The study also found that the usage of home automation devices boosted users' perceptions of security and safety.

Also, a 2017 study by Ozcan et al. investigated the efficiency of mobile-based home automation systems in improving the quality of life for senior citizens. According to the study, home automation systems can enhance elderly people's quality of life by giving them voice commands, customised settings, and remote access to household items.

The adoption of home automation systems was examined in a study by Sohail, et al. (2019), which also highlighted critical elements that affect adoption. According to the study, perceived

utility, usability, and social impact were key elements that affected the adoption of home automation systems.

2.5. Problem Definition

The problem definition of automation home system is to address the inefficiencies and limitations of traditional home systems, which rely on manual control and monitoring of various home appliances and systems. These traditional systems are often characterized by high energy consumption, poor energy management, low security, and limited accessibility for elderly and disabled people. The goal of automation home systems is to provide more efficient, convenient, and secure control and monitoring of home appliances and systems through the use of advanced technologies such as sensors, artificial intelligence, and internet of things (IoT) devices. However, the development and implementation of automation home systems also pose several challenges, such as data privacy and security, interoperability of devices from different manufacturers, and affordability for households with limited financial resources. Thus, the problem definition of automation home system includes both the opportunities and challenges of advancing the field to improve the quality of life for residents in homes.

2.6. Goals/Objectives

The goals/objectives of automation home systems are to:

- Improve energy efficiency: Automation home systems aim to reduce energy consumption and improve energy management in homes by automating the control and monitoring of various home appliances and systems.
- Enhance convenience: Automation home systems aim to provide residents with greater convenience by enabling remote control and monitoring of home appliances and systems, as well as allowing for personalized settings and preferences.
- Improve security: Automation home systems aim to enhance home security by providing advanced monitoring and control of security systems, such as smart locks and cameras, and alerting residents of potential security breaches.
- Enhance accessibility: Automation home systems aim to provide greater accessibility for elderly and disabled people by enabling remote control and monitoring of home appliances and systems, as well as providing voice-activated controls and other assistive technologies.
- Improve health: Automation home systems aim to improve indoor air quality and reduce exposure to harmful pollutants, as well as provide advanced monitoring and control of health-related systems such as air purifiers and humidifiers.
- Reduce costs: Automation home systems aim to reduce overall costs associated with home maintenance and energy consumption, as well as reduce the need for professional services such as housekeeping and home security.

Overall, the goals/objectives of automation home systems are to improve the quality of life for residents in homes by providing greater efficiency, convenience, security, accessibility, and health.

CHAPTER 3.
DESIGN FLOW/PROCESS

3.1. Evaluation & Selection of Specifications/Features

- Compatibility: Ensure that the home automation system is compatible with the devices you already have in your home, such as smart appliances, security cameras, and other smart home devices. Make sure that the system can work with a variety of operating systems and platforms to ensure maximum compatibility.
- Scalability: Consider the potential to add more devices to your home automation system in the future. It's important to choose a system that can scale to meet your needs as your home automation setup grows.
- User-friendly interface: Choose a system with an easy-to-use interface that can be controlled from a smartphone, tablet, or other device. The interface should be intuitive and user-friendly, allowing you to easily control all aspects of your home automation setup.
- Security: Security is a critical consideration for any home automation system. Look for a system that has built-in security features, such as data encryption, authentication, and access controls. The system should also allow you to monitor and control access to your smart home devices.
- Integration with other systems: Consider the compatibility of the home automation system with other systems in your home, such as your home entertainment system or your home security system. Integration with these systems can increase convenience and efficiency in controlling all aspects of your home.
- Customization: Choose a home automation system that allows for customization and personalization. You should be able to customize settings and preferences to your liking, including the ability to create custom scenes and routines.
- Energy efficiency: Look for a system with energy-saving features that can help you conserve energy and save on your utility bills. For example, the system could turn off lights or adjust thermostat settings when you're not at home.
- Reliability: Choose a system that is reliable and provides consistent performance. Look for systems that have been well-reviewed and have a proven track record of reliability.
- Cost: The cost of the home automation system should be reasonable and affordable, taking into consideration the value it provides and the long-term savings it can offer. Consider the cost of the initial setup, ongoing maintenance and support, and any additional features or devices you may want to add in the future.

3.2.   Design Constraints
1.1.1. Standards:

- Standards: The system should be designed based on relevant industry standards and guidelines for home automation systems, such as those set by the Home Automation Association or the International Electrotechnical Commission (IEC).
- Regulations: Relevant regulations should be considered, such as energy efficiency regulations, environmental regulations, and safety regulations related to home automation systems.

- Economic: The system should be designed with economic considerations in mind, such as the cost of materials and labor, maintenance costs, and the potential return on investment.
- Environmental: Environmental factors should be taken into account, including the materials used in the system, the energy efficiency of the system, and its potential impact on the environment.
- Health: Health considerations should be considered, especially for systems that may impact the health of individuals or the general public. It is important to ensure that the system is safe and healthy for all users.
- Manufacturability: The manufacturability of the system should be considered, including the ease of manufacturing, assembly, and testing.
- Safety: Safety is a critical concern in any system design, and safety features should be included to protect users from harm. This includes things like fire safety and ensuring that the system cannot be hacked.
- Professional: The design should adhere to professional standards and ethical guidelines, including honesty, integrity, and respect for the privacy of users.
- Ethical: Ethical considerations should be taken into account, including issues related to privacy, data protection, and the potential impact of the system on society as a whole.
- Social & Political Issues: The social and political impact of the system should be considered, including issues related to diversity, inclusion, and accessibility.
- Cost: The cost of the system should be taken into account, including the cost of components, labor, and maintenance, as well as the potential return on investment for the end-user.

3.3.   Analysis of Features and finalization subject to constraints

Analysis of Features:

- Voice control: The system should be able to respond to voice commands to control various devices, such as turning on/off lights or adjusting temperature.
- Remote access: The system should allow for remote access, enabling users to control devices and monitor activity when they are away from home.
- Security: The system should include security features, such as cameras and motion sensors, to provide protection against intruders.
- Energy efficiency: The system should include features that help to conserve energy, such as automated temperature control and the ability to turn off devices when not in use.
- Customization: The system should allow for customization, enabling users to program their own preferences for things like lighting, temperature, and music.
- Integration: The system should be able to integrate with other smart devices in the home, such as smart speakers and TVs, to create a seamless smart home experience.

Finalization subject to constraints:

- Standards and Regulations: The system should be designed and finalized based on relevant industry standards and guidelines for home automation systems, and should comply with any relevant regulations related to safety, security, and energy efficiency.

- Economic and Environmental Constraints: The system should be designed with economic and environmental constraints in mind, to ensure that the cost of materials and labor is reasonable and that the system is energy-efficient and environmentally sustainable.
- Health and Safety Constraints: The system should be designed with health and safety constraints in mind, to ensure that it is safe and healthy for all users, and that it includes appropriate safety features such as fire safety measures.
- Professional and Ethical Constraints: The system should adhere to professional and ethical standards, such as honesty, integrity, and respect for user privacy and data protection.
- Social and Political Constraints: The system should be designed with social and political constraints in mind, to ensure that it is accessible and inclusive for all users, and that it does not perpetuate biases or stereotypes.
- Cost Constraints: The system should be designed with cost constraints in mind, to ensure that it is affordable for the target market and provides a reasonable return on investment.
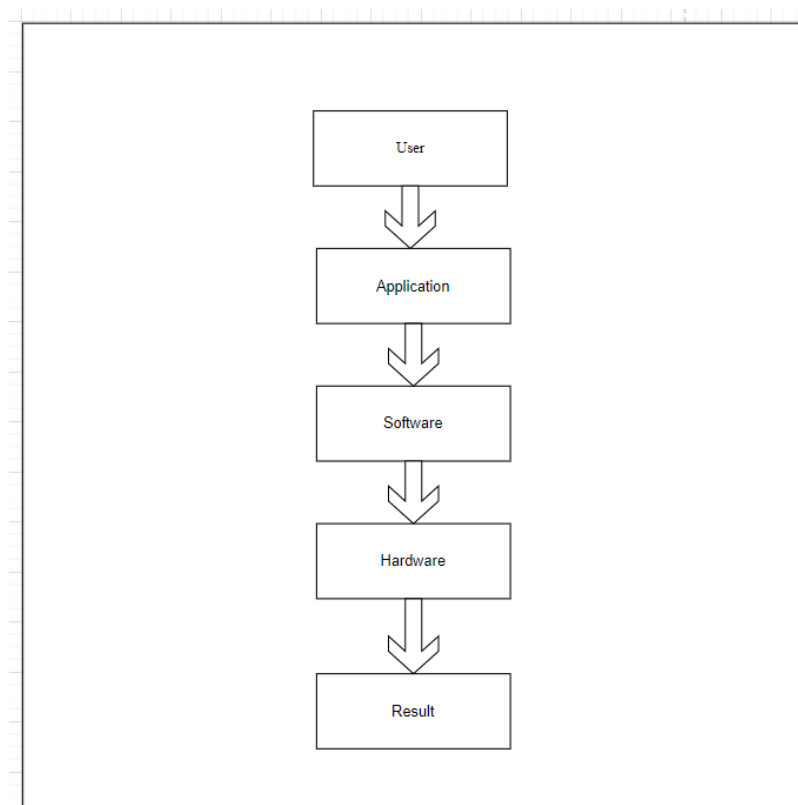
3.4. Design Flow

Fig 3.1(Design Flow)

3.5.   Design selection

Design selection for a home automation system depends on various factors, such as the homeowner's specific needs, preferences, budget, and the complexity of the automation system desired.
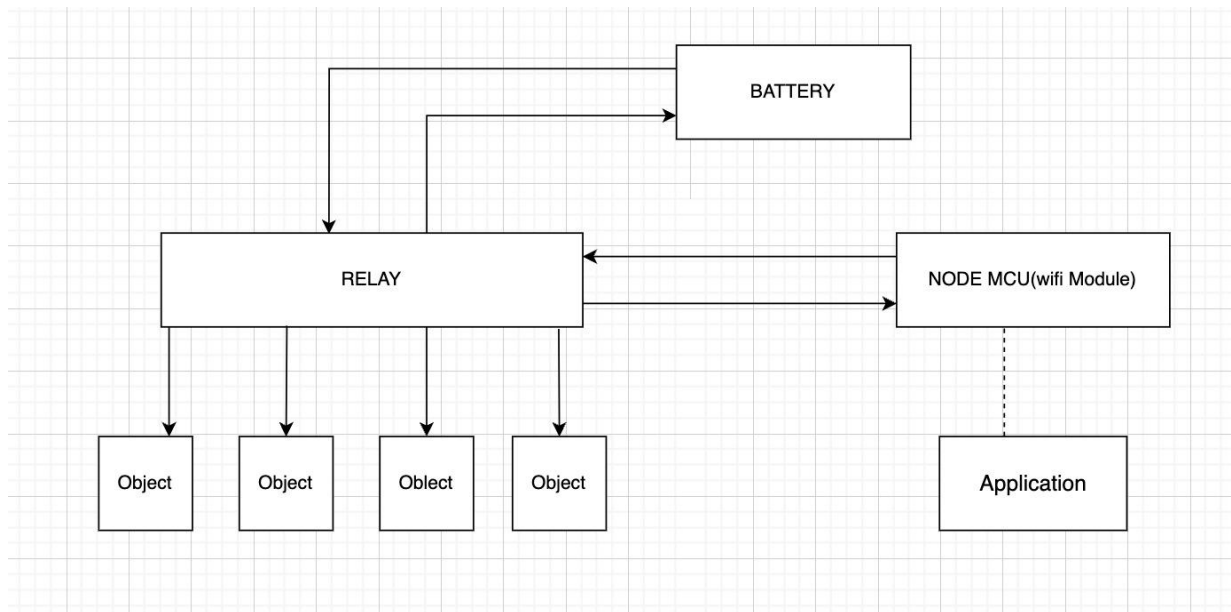

Fig 3.2(Design Selection)

CHAPTER 4.

4.1. Implementation plan/methodology

To connect these components together for a home automation system, we could use the ESP8266 to control the relay, which in turn controls the electronic devices. The battery will used to power the ESP8266 and the relay. The specific wiring diagram will depend on the specific components used and the requirements of the home automation system
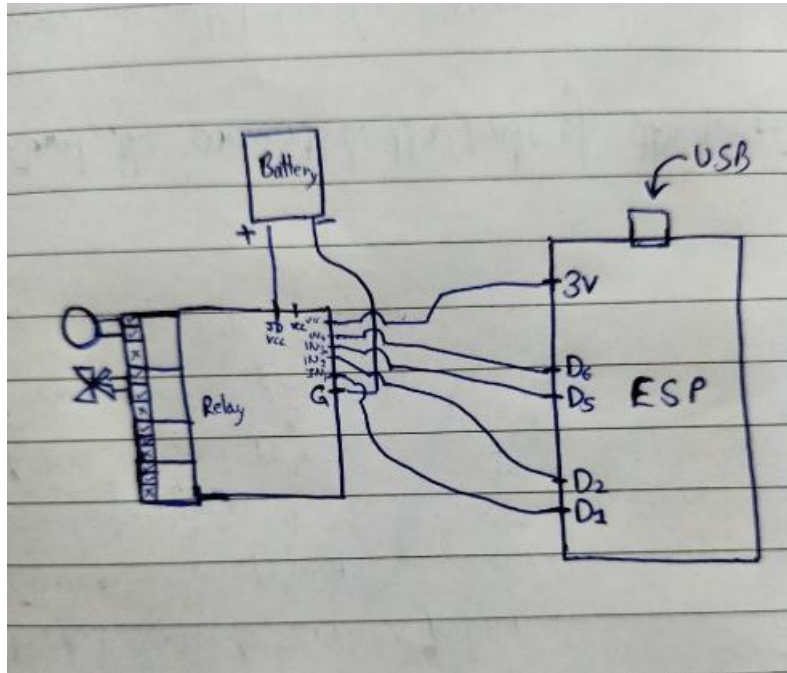

Fig 4.1(circuit Diagram)

Fig 4.4 (structure of model)

CHAPTER 5.

CONCLUSION AND FUTURE WORK

5.1. Conclusion

Home automation systems can bring a lot of convenience and benefits to homeowners. By using various devices such as smart bulbs, smart plugs, smart thermostats, and sensors, a home automation system can help automate and control various aspects of a home, such as lighting, temperature, security, and entertainment.

With the help of a smart hub or voice assistant, users can easily control and customize their home automation system using their smartphone or voice commands. Home automation systems can also provide energy savings and improve home security by allowing users to monitor and control their homes remotely.

However, it's important to consider the cost, compatibility, and complexity of a home automation system before implementing it. Home automation systems can require a significant investment in terms of time and money, and may require technical expertise to install and configure properly. It's also important to ensure that the home automation system is secure and properly maintained to prevent potential security risks or malfunctions.

Overall, a well-designed and implemented home automation system can enhance the comfort, convenience, and security of a home, while also potentially reducing energy costs and increasing property value.

5.2.   Future work

It's difficult to predict the specific future of a project without more information about the project itself. However, in general, the future of a project can be influenced by a number of factors, including changes in technology, user needs and preferences, market trends, and competition.

To ensure the success and longevity of a project, it's important to stay up-to-date on these trends and factors, and to regularly assess and adapt the project's goals and strategies accordingly. This might involve ongoing development and improvement of the project's technology, as well as ongoing market research and user feedback to ensure that the project continues to meet the needs and preferences of its target audience.

It's also important to consider potential challenges and risks that could impact the project's future, such as changes in regulations or legal requirements, shifts in consumer behavior or preferences, or the emergence of new competitors or technologies.

Ultimately, the future of a project will depend on a variety of factors, and will require ongoing monitoring, assessment, and adaptation to ensure its continued success.

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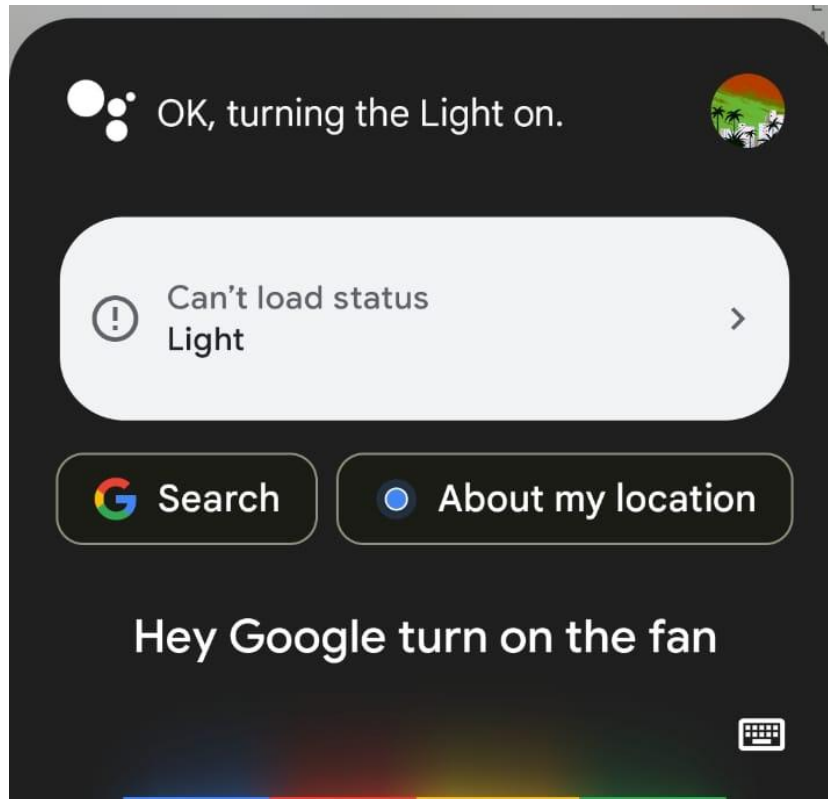Circuit-diy-https://www.circuits-diy.com/iot-home-automation-system-using-blynk-nodemcu-esp8266/

APPENDIX

1. Plagiarism Report

USER MANUAL

Step 1- Open Google Assistant/ Alexa "Say hey Alexa turn on the light/fan /charger/laptop"

Step 2-It will turn on the light/fan /charger/laptop