

Home Automation using BLYNK Application and ESP8266NodeMCU Home Automation System (HAS)

Mohd Shahur Sheikh¹, Manasi Daph², Anjali Chauhan³, Guneshwari Warturkar⁴

Vaishnavi Mohurle⁵, Prof. Anand D. G. Donald⁶

UG Students, Department of Computer Science and Engineering^{1,2,3,4,5}

Guide, Department of Computer Science and Engineering⁶

Rajiv Gandhi College of Engineering Research and Technology, Chandrapur, Maharashtra, India

Abstract: *The phrase "smart home system" refers to the intelligent management of various home equipment to create a smart, secure, and pleasant home environment. We can operate household items like the TV, refrigerator, air conditioner, and fans thanks to home automation. In addition to reducing human effort, home automation is essential for preserving time and energy. Home automation's primary goal is to assist the elderly and handicapped by making it easier for them to use household equipment. The Android operating system now reigns supreme in the smart phone market. Smart phone features are designed to connect to any other Bluetooth-enabled devices. Millions of goods, including autos and mobile devices, include Bluetooth wireless technology.*

Keywords: Smart home system, Home Automation, Wi-Fi Controller, Wi-Fi Module, ESP8266NodeMCU, Smart Phone.

I. INTRODUCTION

In today's fast-paced world, technology has become an integral part of our lives, transforming the way we live, work, and interact with our surroundings. One significant technological advancement that has gained immense popularity is the Internet of Things (IoT). IoT refers to a network of interconnected devices embedded with sensors, software, and connectivity, enabling them to collect and exchange data. One area where IoT has made a significant impact is home automation.

Home automation, powered by IoT, revolutionizes the way we manage and control various aspects of our homes. It involves connecting and integrating smart devices, appliances, and systems within a home, enabling them to communicate with each other and be controlled remotely through a centralized platform such as a smartphone, tablet, or voice assistant.

The need for home automation arises from several factors such as,

- Convenience
- Energy Efficiency
- Security
- Improved Quality of Life

Smart phones have an in-built function and can be made to communicate to any other devices in a network with a connectivity option like Bluetooth [1].

II. SYSTEM ARCHITECTURE

Home automation, powered by advanced technologies, has transformed the way we interact with our homes. At the heart of this transformation lies the system architecture that orchestrates the various components and devices to create a seamless and integrated home automation experience.

The system architecture of a home automation setup encompasses the hardware, software, and communication protocols that enable devices to connect, communicate, and perform desired actions. It provides a structured framework

for managing the different elements involved in home automation, including sensors, actuators, controllers, and user interfaces.

Let's explore the key components of a typical home automation system architecture:

- **Devices and Sensors:** Home automation systems consist of a variety of devices and sensors that collect data and interact with the physical environment. These can include smart thermostats, lighting systems, security cameras, motion sensors, door/window sensors, smart locks, and more. These devices act as input sources and provide real-time information about the home environment. [2]
- **Controllers and Gateways:** Controllers are the central brain of the home automation system. They process data from sensors, analyze it, and trigger actions based on predefined rules or user commands. Controllers can be in the form of dedicated hubs, smart speakers, or even software-based controllers running on smartphones or computers. Gateways act as intermediaries, facilitating communication between different devices and protocols, ensuring compatibility and interoperability. [2]
- **Communication Protocols:** To enable seamless communication between devices, home automation systems rely on various communication protocols. Common protocols include Wi-Fi, Zigbee, Z-Wave, Bluetooth, and Thread. Each protocol has its strengths and specific use cases. Wi-Fi, for instance, offers high data transfer rates, while Zigbee and Z-Wave are designed for low-power and mesh networking. [2]
- **Cloud Services:** Cloud computing plays a crucial role in modern home automation systems. By connecting to the cloud, devices can access remote services, store data, and enable remote control and monitoring. Cloud services also offer features like data analytics, machine learning algorithms, and voice assistants, enhancing the capabilities of home automation systems. [2]
- **User Interfaces:** User interfaces provide a means for homeowners to interact with the home automation system. These can be mobile applications, web interfaces, dedicated control panels, or voice-based assistants. User interfaces allow users

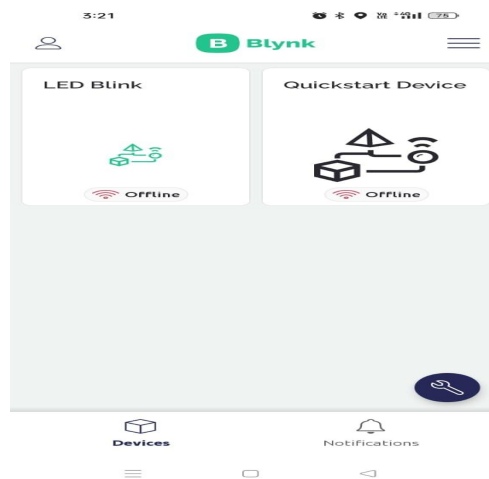
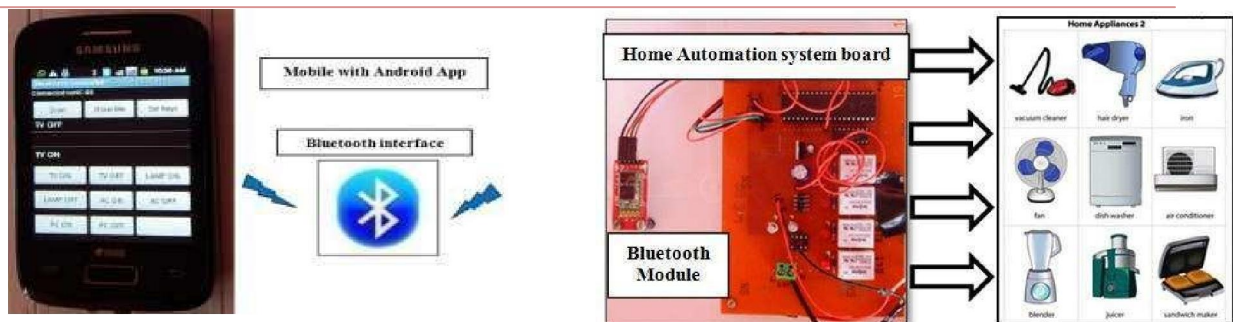


Figure.1 User Interface

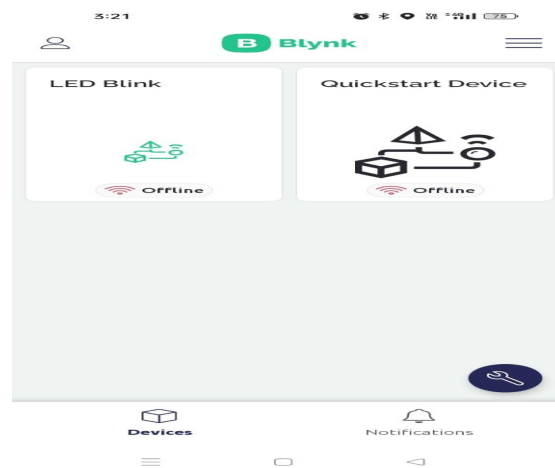
- **Security and Privacy:** As home automation systems become more prevalent, ensuring security and privacy is of paramount importance. System architecture incorporates robust security measures such as encrypted communication, user authentication, and secure access controls to protect against

III. DEVELOPMENT PLATFORM

The technologies utilized to create the home automation system's mobile phone application are discussed in this section. The technologies described in this paper's presentation of the creation of mobile phone applications are: Bluetooth [1], Android [3]. Android is a platform for creating and delivering apps for mobile platforms that support it. As a wireless technology for short-range communication, Bluetooth has its own benchmark and enables the development of Android-based mobile applications.

Android Application

An open-source operating system is Android. Figure 1 depicts the Android application for a Bluetooth controller. The same has been downloaded and installed on the Realme C15 mobile which is having android version of Android 10. The embedded system board's input/output ports are connected to the household appliances, and a microcontroller is wirelessly connected to an Android application using Bluetooth Controller through an HC-05 Bluetooth Module.



Wi-Fi Module

Wi-Fi, short for Wireless Fidelity, is a wireless communication technology that has revolutionized the way we connect to the internet and communicate with devices. It enables wireless data transfer between devices, allowing for seamless connectivity and mobility within a local area.

Wi-Fi operates using radio frequency signals to establish connections between devices and a wireless access point, such as a router. It leverages the 2.4 GHz and 5 GHz frequency bands to transmit and receive data, offering high-speed and reliable wireless communication.

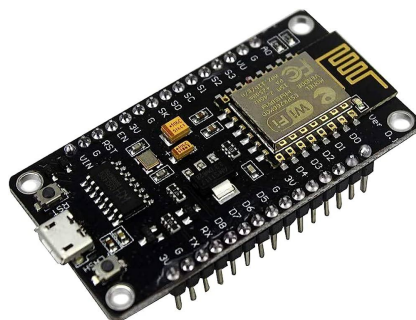


Figure 3 Wi-Fi Module

The Wi-Fi Module is seen in Figure 3. You may wirelessly transmit and receive serial data with this module. It enables transparent two-way data transfer and serves as a drop-in substitute for wired serial connections. It may be used to simply create a connection between an MCU or other embedded project and a PC for data transfer in place of a serial port. The Bluetooth Serial Port Profile is the Bluetooth profile used in the Android app for the Home Automation System (HAS).

Arduino IED

The Arduino Integrated Development Environment (IDE) is a software platform that plays a central role in the world of electronics and microcontroller programming. It provides a user-friendly interface and a set of powerful tools for creating and uploading code to Arduino microcontrollers.

Arduino, an open-source electronics platform, offers a range of microcontrollers and development boards that are designed to be accessible and easy to use for both beginners and experienced electronics enthusiasts. The Arduino IDE serves as the primary programming environment for writing code that controls these Arduino boards.

BLYNK IoT

The Blynk app is a powerful mobile application that allows users to control and monitor their Internet of Things (IoT) projects effortlessly. It provides a user-friendly interface and a range of features that make it easy for both beginners and experienced IoT enthusiasts to build interactive and responsive IoT applications.

Blynk acts as a bridge between hardware devices and mobile devices, enabling users to remotely control and monitor their IoT projects from anywhere in the world. With Blynk, users can create custom dashboards, design intuitive interfaces, and control a wide range of IoT devices and sensors with just a few taps on their smartphones or tablets.[4]

One of the key features of the Blynk app is its drag-and-drop interface builder. Users can easily design their own custom interfaces by adding widgets such as buttons, sliders, graphs, and displays. These widgets can be linked to various IoT hardware platforms, including Arduino, Raspberry Pi, ESP8266, and more, allowing users to control and monitor their connected devices effortlessly.

IV. HARDWARE IMPLEMENTATION

The client component of a home automation system is home automation hardware. Home automation system block diagram which is shown in figure 4 home Automation control board comprises of ESP8266NODEMCU, Serial Bluetooth Module, Relay driver and a few discrete components

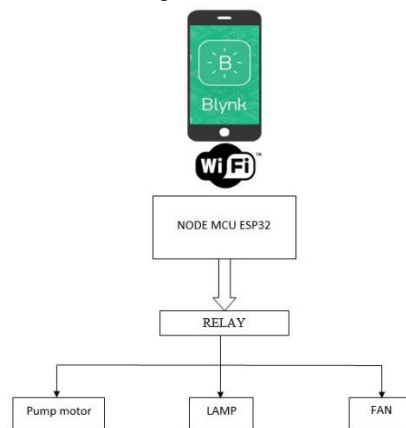


Figure 4 Home Automation Block Diagram

ESP8266NODEMCU

The ESP8266 NodeMCU is a versatile and popular development board that combines the power of the ESP8266 Wi-Fi module with the convenience of an integrated microcontroller unit (MCU). It has gained immense popularity in the world of Internet of Things (IoT) due to its compact size, low cost, and exceptional capabilities.

The ESP8266NODEMCU board is built around the ESP8266 Wi-Fi module, which provides seamless connectivity to Wi-Fi networks. With this board, users can connect their projects to the internet, enabling remote control, data exchange, and real-time monitoring capabilities.

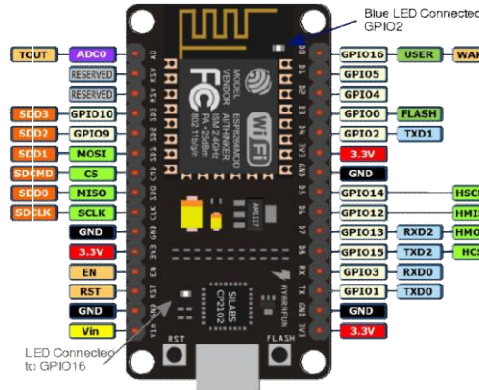


Figure.5 Block Diagram of ESP8266NODEMCU

NodeMCU Program

NODMCU program is written in C language using the Arduino IED. Header files beginning with "# include <stdio.h>" are used to begin programming. The '# define' function is used to define the pins on the microcontroller port that are used to interface with the surrounding peripherals. By pressing a key on the home automation system's GUI Application software created for Android that is loaded on a mobile device will send ASCII characters serially via Wi-Fi, and on the receiving end, a microcontroller will receive data serially on an Rx D Port Pin. The "UDR register" will save these ASCII characters as their corresponding value, and the microcontroller will then behave in accordance with the C program and the information obtained from the Wi-Fi module. The Port A serves as an output port for relay switching, which turns on and off the appliances.

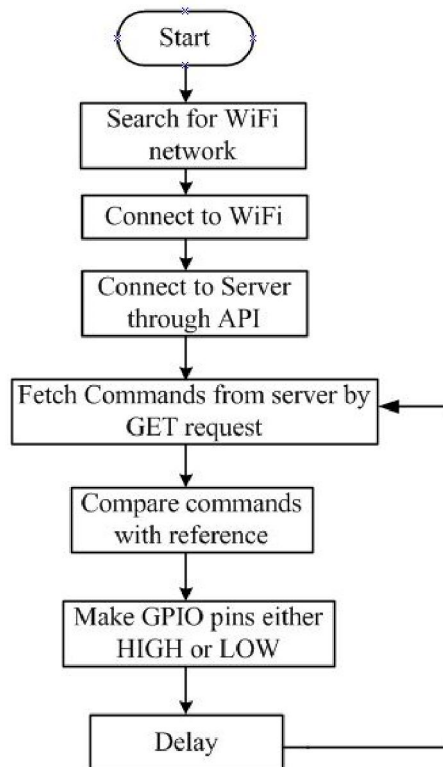


Figure.6 Program Flow Chart

V. TESTING & RESULTS

On powering up the hardware ESP8266NODEMCU Module make the Green LED flicker quickly. It indicates the module is power up and this can be paired.

Open the BLYNK application on mobile phone after that you will be asked for turning on the Wi-Fi, Press Allow to continue further.

Using scan key you can connect to ESP8266NODEMCU Module. On pairing with Wi-Fi Module the application appears with message “Connected to NODMCU”.

Now pressing the keys you can control the home appliances as per your requirement. On pressing “LED ON” key (here for sake of feasibility LED is connected) LED (Load) turned ON and feedback from controller is received i.e. LED ON.



Figure.7 LED ON

On pressing “LED OFF” key (here for sake of feasibility LED is connected) LED (Load) turned OFF and feedback from controller is received i.e. LED OFF.



Figure.7 LED OFF

VI. CONCLUSION

In conclusion, the research conducted on the home automation system using ESP8266 NodeMCU demonstrates the significant potential and benefits of this technology. The ESP8266 NodeMCU, with its built-in Wi-Fi capabilities and powerful microcontroller, offers a versatile platform for designing and implementing home automation systems.

Throughout the research, it was evident that the ESP8266 NodeMCU provides a reliable and cost-effective solution for controlling various household devices remotely. Its ability to connect to the internet allows users to monitor and control their homes from anywhere in the world using a smartphone or a web-based interface.

The research findings highlight the ease of integration of the ESP8266 NodeMCU with existing home appliances, making it an ideal choice for retrofitting automation features into conventional homes. By leveraging the extensive library support and flexible programming options, researchers were able to develop custom applications to control lighting, temperature, security systems, and other aspects of home automation.

Furthermore, the ESP8266 NodeMCU's compatibility with popular platforms such as Arduino and the Arduino IDE simplifies the development process, enabling even individuals with limited programming experience to create their own home automation projects

REFERENCES

- [1] J. Haartsen, "BLUETOOTH—The universal radio interface for ad hoc, wireless connectivity", Ericsson Review No. 3, pp. 110-117, 1998.
- [2] Home Automation System By google.com
- [3] Why Android ?, <http://www.android.com/about/>, last seen on October 2013.
- [4] <https://play.google.com/store/apps/details>.