Evolution in Electrical and Electronic Engineering Vol. 4 No. 1 (2023) 244-250

EEEE

Homepage: http://publisher.uthm.edu.my/periodicals/index.php/eeee
e-ISSN : 2756-8458

Smart Home Switch System Using IoT

Khairul Aimi Ab Rahim[1], **Jabbar Al-Fattah Yahaya**[1]*

[1]Department of Electrical Engineering, Faculty of Electrical and Electronic Engineering,
Universiti Tun Hussein Onn Malaysia, Batu Pahat, 86400, MALAYSIA

*Corresponding Author Designation

DOI: https://doi.org/10.30880/eeee.2023.04.01.029
Received 16 January 2023; Accepted 19 February 2023; Available online 30 April 2023

Abstract: This work aims to design and develop a smart home system integrating the Blynk application using the ESP32 microcontroller with multiple sensors such as current sensor (ACS712), temperature and humidity sensor and relays (DHT11). This system is designed to monitor and control various electrical appliances and devices in the home through a smartphone application. The current sensor (ACS712) is used to measure the current consumption of the appliances, while the DHT11 sensor is used to monitor the temperature and humidity in the room. The relays are used to control the power supply to the appliances, and the Blynk application is used to provide a user-friendly interface for controlling the system. The automation feature of the system allows for the scheduling and control of the appliances based on the user's preferences and the current conditions in the room. Overall, the smart home switch system SHSS provides a convenient and energy-efficient solution for managing and controlling electrical appliances in the home.

Keywords: Smart Home, Blynk, ESP32, Home-Automation, Smart Home Project

1. Introduction

Due to its ability to improve convenience and satisfaction in daily living, smart home systems have been more popular over the last several decades [1]. The notion of interconnecting electronic devices in the home was first promoted under the banner of "Smart Home" and "Intelligent Home." By installing a Smart Home Switch System (SHSS), homeowners may remotely monitor and adjust their home's lights, security, and other amenities. Reduced energy consumption, increased safety, and a more pleasant experience for the user are all benefits of this technology. The new market for SHSS is growing rapidly as its popularity grows. Because of its high price and complicated nature, the system has not yet gained widespread acceptance among users [2]. Daily routines of a household's inhabitants may be profiled by examining how those individuals utilise electric power equipment at home. Our everyday tasks in the home and business are becoming more sophisticated as a result of technological improvements. Smart apps built on platforms like Android and microcontrollers are crucial in this respect [3]. By use of a wireless network, home systems may be managed and monitored through an app on a user's smartphone. Solutions are investigated for increasing computation power, storage space,

*Corresponding author: jabbar@uthm.edu.my

and data exchange efficiency; incorporating intelligence into sensors and actuators; networking smart things using corresponding technology; facilitating interactions with smart things using cloud computing for easy access from different locations; and more.

The purpose of a smart home switching system project is to automate and control various electrical devices and appliances in a home using a centralized system, typically through a smartphone or other web-enabled device. The goal is to improve convenience, energy efficiency, and security by allowing users to remotely control and monitor their devices and systems.

2. Methodology

2.1 Materials

The main component is ESP32 microcontroller and Blynk application. Table 1 shows the required hardware and Table 2 shows the software used for the project.

Table 1: Hardware Used

Hardware	Description
ESP32	The ESP32 is designed to be used in low-power IoT devices. It's suitable for most portable IoT devices [4] because to its powerful processing capability, in-built Wi-Fi and Bluetooth, and deep sleep characteristics.
Relay	Relays are switches for shutting and opening circuits as well as electromechanically. It regulates the opening and shutting of electrical circuit connections. When the relay contact is open (NO), the relay does not energize with open contact [5].
DHT11	The DHT11 is a simple, low-cost digital sensor for measuring both temperature and humidity. Taking readings from a capacitive humidity sensor and a thermistor, it outputs a digital signal on the data pin (no analogue input pins are needed). It is easy to operate, but precise timing is essential for data collection [6].
ACS712	The ACS712 is an isolated linear current sensor that uses a hall effect and has a low resistance current conductor built right in. It has a voltage isolation of 2.1kVRMS. If we ignore the technical jargon, we may think of it as a current sensor, which utilizes its conductor to determine and measure the amount of current flowing through it [7].

1-way Switch	Unlike two-terminal switches, which enable current to flow in both directions, one-terminal switches only allow current to flow in one direction. A one-way switch, therefore, uses two terminals to either complete or cut off an electrical circuit.
Bulb	A lightbulb generates electrical light. In addition to illuminate a dark room, an electronic gadget may be displayed, utilized to guide traffic, heat, and for many other uses.

Table 2: Software Used

Software	Description
Arduino IDE	The Arduino IDE is a multi-platform, C and C++-capable application. In addition to being used to build and upload program to Arduino-compatible boards, it may also be used to write and upload programs to boards from other vendors' development kits by using third-party cores [8].
Blynk	Blynk is an app that may be used to manage your Arduino, Raspberry Pi, and other Internet-connected devices from your mobile device. It's an online dashboard that lets you quickly build a custom UI for your project using drag-and-drop widgets.

2.2 Block Diagram

Figure 1 shows the smart home switch system block diagram flow. The ESP32 has 39 digital pins, 34 of which are GPIO and the rest input-only. It has 16 PWM channels and ten capacitive touch GPIO pins. Multiplexing lets programmers set up any GPIO pin for PWM or serial communication on the ESP32. The eight-channel relay module uses fewer components and connections to connect to a microcontroller or sensor. It has eight 5V relays and related switching and isolating components. When 5V is applied across the coil, the module's eight relays activate. As shown on the relay body, each relay's contacts are 250VAC, 30VDC, and 10A. Switching transistors buffer high-current relay coils and low-current inputs. They amplify input signals to drive relay coils.

Switching transistors buffer the relay coils' large currents from the inputs' small currents. They magnify input signals to drive coils and activate relays. The freewheeling diodes prevent transistor voltage spikes when the relay is off because the coils are an inductive load. The indicator LEDs light up when the relay coil is powered. An optocoupler separates the switched load from the inputs. The board's VCC selector jumper can enable or disable isolation. The input jumper can connect to the primary voltage supply, ground, and input pins with jumper wires.

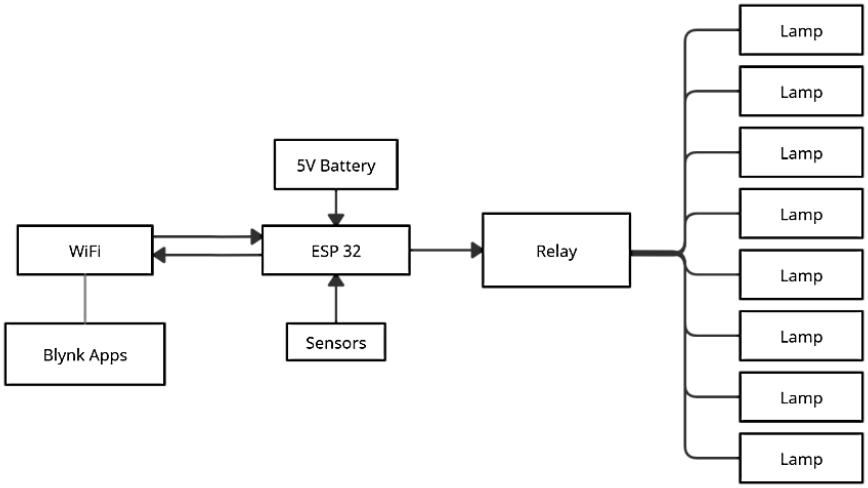

Figure 1: System Block Diagram

2.3 Flowcharts

Figure 2 shows how hardware and software work together to build the system. At system start, the ESP32 is defined and initialized for the attached pins. Device input will be calibrated for all pin modes. Since Blynk operates online, a Wi-Fi connection is created. Blynk servers manage smartphone-device connections for the selected hardware. Users can then connect to the server and process all incoming and outgoing instructions. Choose from a list of control panel buttons. Next, user can choose to trigger the desired function into the system or change the automation in the Blynk apps in the control panel. User selection sends Blynk-driven data to ESP32. Linked pins process serial data. Thus, the output functions the external device.

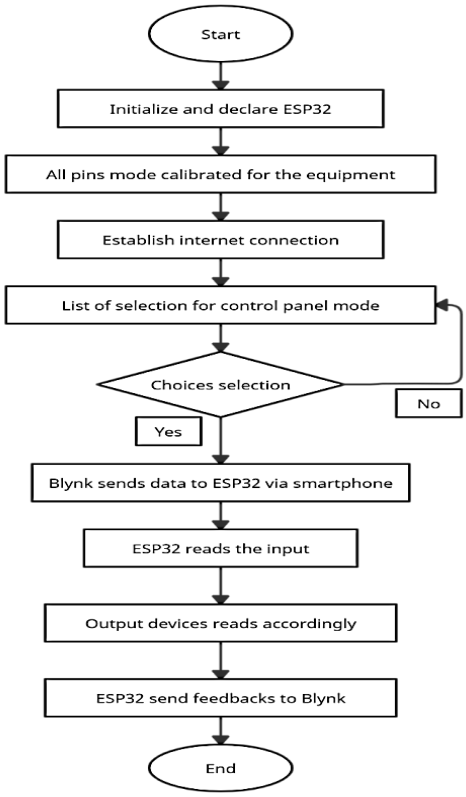

Figure 2: System Flowchart

3. Results and Discussion

3.1 Results

Figure 3 shows the ESP32, ACS712 current sensor, DHT11 temperature/humidity sensor, bulbs, and switches connected. The circuit and signal must be properly connected for electrical appliances to work. When the ESP32's blue LED indicates Wi-Fi connectivity. Thus, Blynk apps can control the relay to control current to the bulbs, and Arduino IDE and Blynk apps can display sensor results in serial monitor.

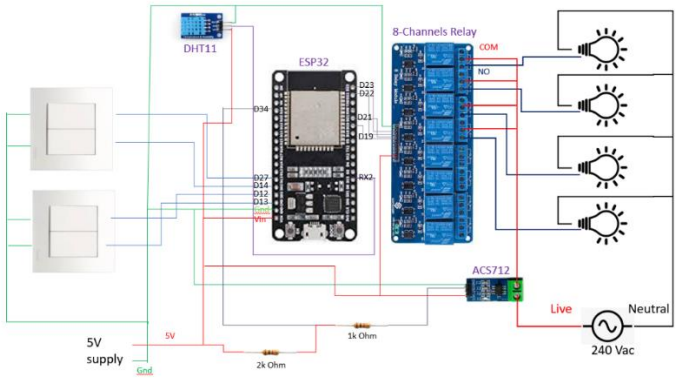

Figure 3: Schematic diagram of the project full connection

Figure 4 shows the Blynk apps' website and smartphone results. Blynk controls all four loads. One pushbutton turns off all loads. Blynk displays DHT11 temperature and humidity sensor data. The ACS712 5A current sensor module detects current and outputs voltage based on sensor sensitivity. Thus, Blynk apps display current and power values calculated. Power output is estimated using a constant 240VAC supply. Finally, Blynk apps can control loads from anywhere with an ESP32 module connected to WIFI.

Figure 4: Blynk console in smartphone apps.

3.2 Discussions

The Smart Home Switch System's (SHSS) system performance has been segmented and analysed in detail. The ESP32 microcontroller with the WIFI module, which is connected to the DHT11 and the ACS712 current sensor, gives the user the ability to control and monitor the state of the household appliances that are being utilised. It has been demonstrated that by utilising the Blynk application, the safety features of the Internet of Things (IoT) to remotely control the appliances in one's home are

secured through the utilisation of the authentication token that has been provided by the application. It has been demonstrated to be a useful convenience to have the capability of controlling appliances from an endless distance away from the device being used.

The Contribution of the smart home switch system project using ESP32, ACS712, relay, bulbs, DHT11 and switches is significant in terms of household automation and energy efficiency. ESP32 is an efficient microcontroller that allows for remote control and monitoring of the smart home switch system. The ACS712 current sensor provides real-time monitoring of energy usage, enabling energy-saving options such as setting schedules or turning off devices when not in use. The relay and switches act as the intermediary between the ESP32 and the connected devices, enabling the control of devices such as lights and fans. The use of energy-efficient bulbs further contributes to energy savings. The DHT11 temperature and humidity sensor provides real-time temperature and humidity data, enabling the ESP32 to adjust the temperature and humidity levels in the home for maximum comfort and energy efficiency. This smart home switch system project ultimately leads to a more sustainable and cost-effective household.

4. Conclusion

By connecting the Blynk apps to the ESP32, the current flow to the load can be accessed remotely from anywhere by controlling the relay switches. Next, the condition of the loads can be monitored in the Blynk application. The DHT11 and ACS712 sensors connected to the ESP32 allow the temperature in a certain room and the current and power usage can be monitored in the Blynk apps. The sensors used also allow the usage of automation to control the state of the loads automatically based on a desired condition by the user. This automation system can protect the devices from overcurrent and alert the user of the condition of the system. For the security of the IoT system, an authentication token is provided and sent into user's email. Thus, the person that can control the system is only for those that have access to the auth token from the Blynk apps.

Acknowledgement

The authors would like to thank the Faculty of Electrical and Electronic Engineering, Universiti Tun Hussein Onn Malaysia for its support.

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