IoT Based Home Appliances Controlling System

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ABSTRACT
In this work, an IoT Home appliances controlling system is developed. The aim is to eliminate the inconveniences associated with manual switching of home appliances. This smart device consists of two-parts: the server (Sinric Pro web server), which helps the users and administrators to remotely controls and monitors the activities in the home. A system code using Sinric Pro interfaces this smart device and the controller for effective functioning. There is also an hardware interface module provides appropriate interface relays of home automation system. A Smart phone is the command sender while the IoT controller executes the command from the smart phone through the Wi-Fi, while the relay in the controller actuates the load for appropriate response. When the Smart Phone sends the command to turn ON, the load comes ON and remains ON until another command to turn off is received. This system supports a wide range of home automation devices like power management and security. This smart device is easy to operate and of good quality in terms of robustness, durability, cost effectiveness and components availability for ease of repair and maintenance.
KEYWORDS: *Internet of Things, WiFi Module, Home Automation, Relay*

I. INTRODUCTION

Over the years, the emergence of electronics devices in different complexity, paves way for a need to control them remotely without manual switching on/off of such devices [1] , [2] , [3]. This work employs IoT based controller to remotely control devices from a far distance thereby saves time required to move about for manual control of such and circumvent the mandatory line of sight operation of the home appliances. Some home appliances where this smart device becomes handy are in the controlling of Television sets, wired mobile phones and ringing bells [4], [5], [6], [7]. The emergence of Wi-Fi modules and the quest for wireless communication became so alarming in the recent times such that practically most appliance in the markets runs on internet module, radio frequency protocols and other means that could ease man in other to control devices remotely [8], [9], [10]. A communication link between the IoT controller and appliances to be controlled is established in this work. The resulted smart device comprises hardware and software sections. The hardware section includes the Wi-Fi wireless communication module to pair up and establish a connection between the web server and the controller, together with the Relay that performs the switching operation [11], [12] . The software which is the web server is the main tool for controlling the entire system. It serves as responsive software responsible for sending an encoded signal via the internet to the physical hardware, while the user provides the necessary input to control the device which will in-turn control the load connected to the device [13], [14], [15].

II. RELATED WORKS

Attention is given to home automation by researchers using different technologies in the recent times. The authors in [9] proposed an Home Automation System (HAS) using Intel Galileo that employs the integration of cloud networking and wireless communication to provide the user with remote control of various lights, fans, and appliances within their home and storing the data in the cloud. The system will automatically change on the basis of sensors' data. This system is designed to be low cost and expandable allowing a variety of devices to be controlled [16], [17]. In another vein, [17] discussed the different intelligent home automation systems and technologies from a various features standpoint. The effort targeted on the home automation concept of where the controlling and monitoring operations are expediting through smart devices. Wide-ranging home automation systems and technologies were reviewed in the work with central controller based (Arduino or Raspberry pi), cloud-based, Bluetooth-based, SMS based, ZigBee based, mobile-based, RF Module based, web based [18], [19], [20], [21]. A home automation system with a four-button key fob transmitter by using RF (Radio Frequency) technology was proposed by [22]. The work reveals that houses are gradually shifting from normal switches to centralized control system that involves a remote-control transmitter. This technology being not only easy to use but also helps to prevent misuse of energy. Remote control (key fob) transmitter is small

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and very light weight, which will work from a decent distance. In order to achieve this, a RF remote (Keyfob) is interfaced to the microcontroller on transmitter side which sends ON/OFF commands to the receiver where loads are connected. By operating the specified remote switch on the transmitter, the loads can be turned ON/OFF remotely through wireless technology. Arduino IDE software was used to compile some programs related to the microcontroller ATmega328. Design of an advanced home automation system using normal Web Server and Wi-Fi technology was conducted by [23]. The author made use of Arduino wifi module ESP8266 for the Home automation system.

III. SYSTEM ARCHITECTURE

The designed smart device in this work controls home appliances such as Television, Fan, Bulb, Motor, Refrigerator etc when connected to Relay driven by NodeMCU using the Sinric Pro Application.. The NodeMCU Wifi moduleESP8266 through wireless connection, receives messages published from the webpage to drive the relay modules for various appliances. The encoded signal to be transmitted to both the server and the ESP8266 for the control of the appliances are done in IoT platform environment. Internet connectivity is required for the operation of the device).The ubiquitous accessibility of the server and its components requires its hosting in the internet. Together with the IoT mobile application is the web based control panel where the switching control of the connected home appliances is done, the state of the appliances can also be monitored from this panel by the operators [24], [25]. User can access the control panel web page from his smart phone or computer, using its LAN IP address.
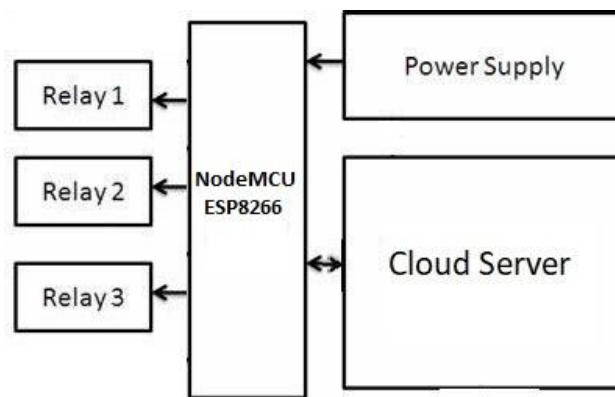

Fig 1: System Block Diagram of the IoT based Controller Home Appliances Automation

i.   NodeMCU ESP8266 Wifi Module

The hardware design incorporate the NodeMCU   called ESP8266developed in 2013 by a Chinese company named Espressif. NodeMCU being an IoT platform that uses the Lua programming language is . programmed in this work using Arduino IDE so it can run the libraries used by arduino. NodeMCU. The choice of this microcontroller is based on its low price and high support receives by the community.. The NodeMCU and its pin diagram is shown in Fig 2
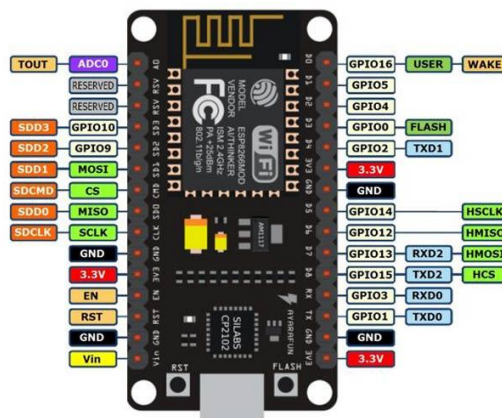.

Fig 2: NodeMCU ESP8266 and its pin

The software design of this work uses arduino developer develop program for arduino controller. The flow chart of the whole system is shown in Fig 3
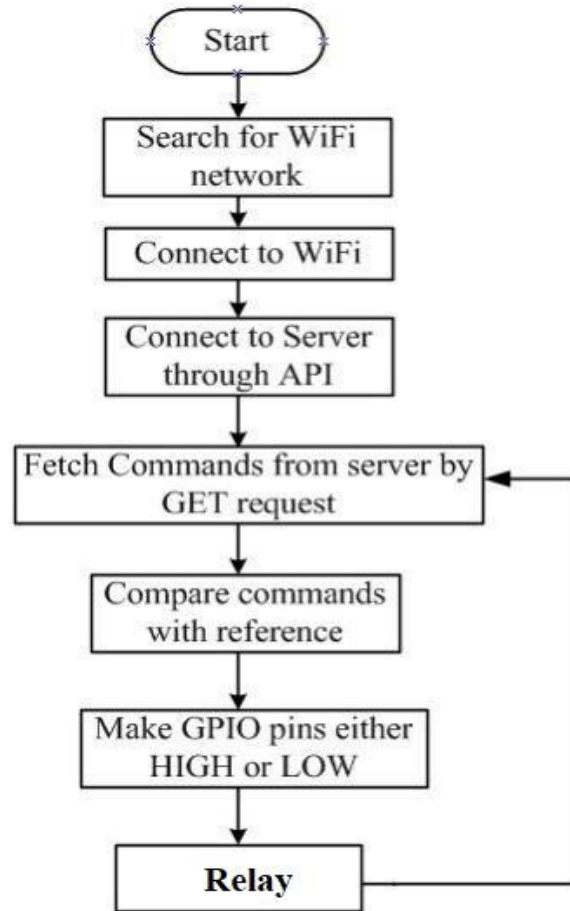

Fig 3: System Flowchart of the smart device for home appliances control automation
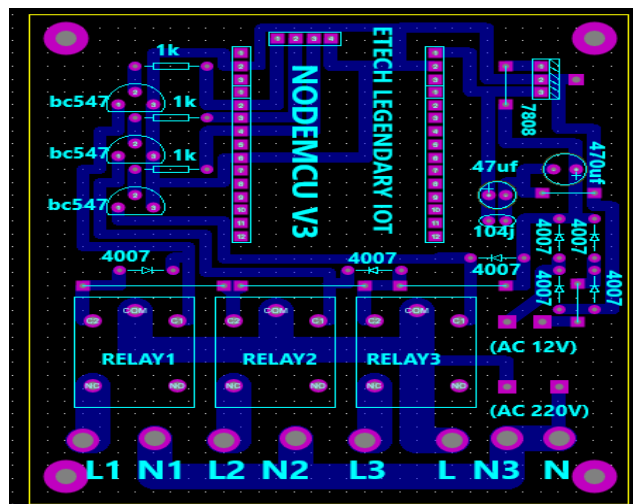

Fig 4**:** PCB Layout of IoT Based Controller

IV.   RESULTS AND DISCUSSION

The experimental model was made according to the circuit diagram and the results were as expected. The loads are switched on when the NODEMCU receives a wireless signal from the Sinric pro application and it drives the particular load relay in turn. The loads are switched off only when the NODEMCU receives another wireless OFF signal from the mobile app (Sinric pro) being operated by the user. The diagrams of construction stages of the smart device are shown in Fig 5-10
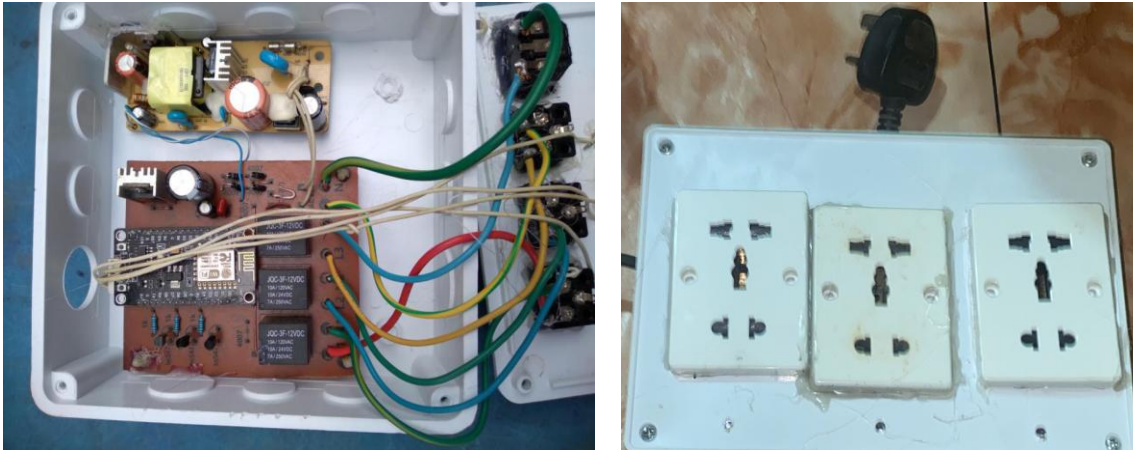
Fig 5: IoT Controller smart device for home appliances automation under construction

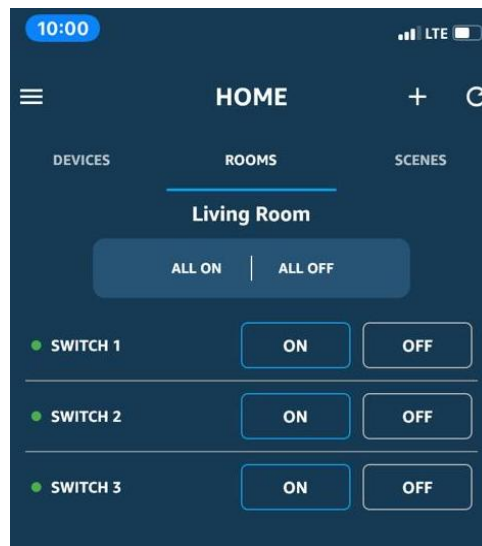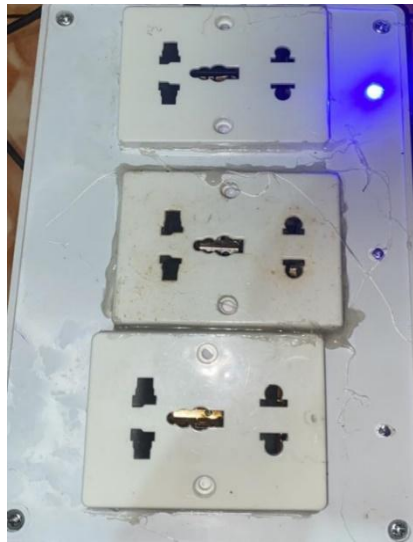Fig 6:   Complete IoT Controller smart device for home appliances automation.

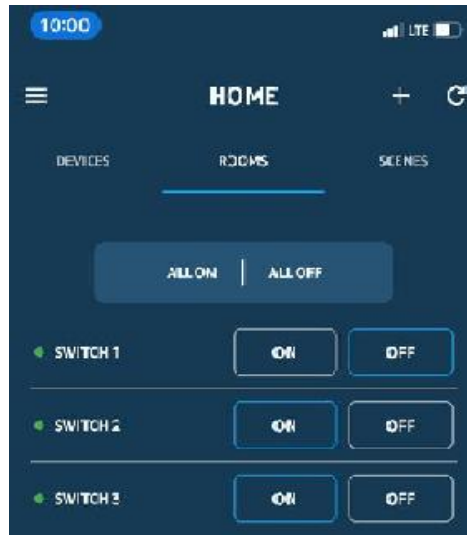Fig 7: Application Interface showing all outlets ON.

Different cases scenarios are explained as shown through the Fig 8-10.
Case One
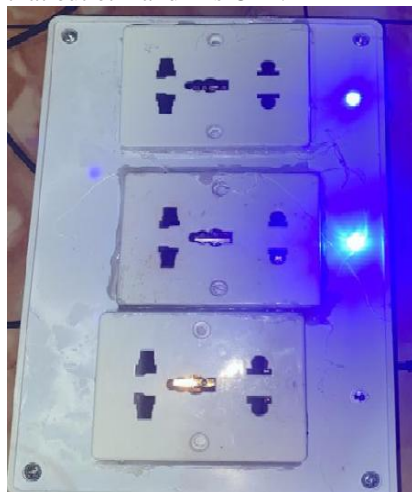This case shows that outlet 1 is OFF

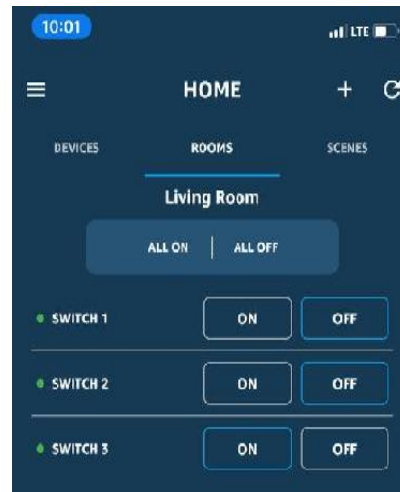(a)   (b)

Fig 8: **(a)** IoT Controller showing outlet 1 OFF (b) Application Interface showing outlet 1 OFF

Case Two
This case shows that outlet 1 and 2 is OFF.

(a)   (b)

Fig 9: (a) IoT Controller showing outlet 1 and 2 OFF (b) Application Interface showing outlet 1 and 2 OFF.

Case Three
This case shows that outlet 1, 2 and 3 is OFF
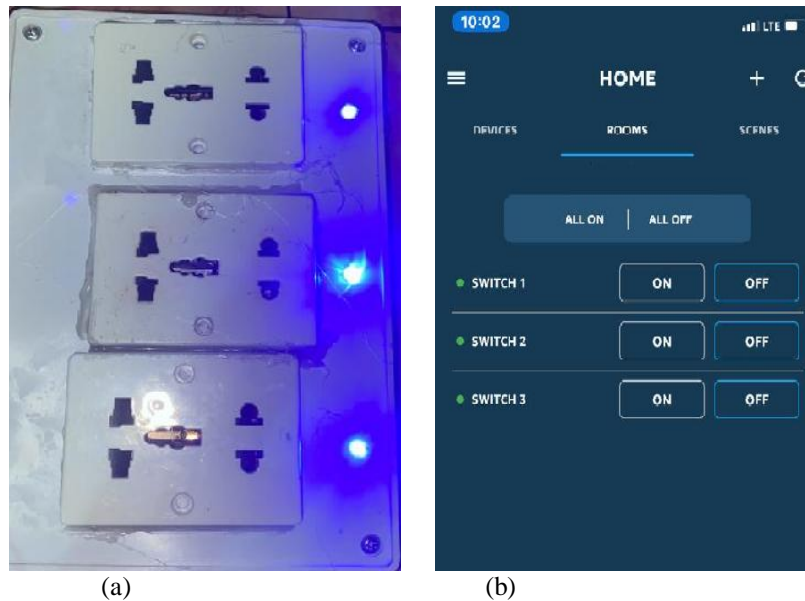
(a)   (b)

Fig 10: (a) IoT Controller showing all outlets OFF (b) Application Interface showing all outlets OFF.

V. CONCLUSION

In this work, the development of an IoT based controller which has the advantage of low cost and flexible control using a smartphone is presented. The proposed solution relies on a single Wi-Fi module for performing communication between the remote user and the household appliances. The developed controller is fast, reliable and the switching speed is about 10secs depending on the data rate of the wireless network.

ACKNOWLEDGMENT

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