ESP8266 Based Switching Control using Web Server

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ABSTRACT

In this work the proposed system has been implemented around the NodeMCU IoT enabled development board with on chip Wi-Fi chipset by Espressif. The hardware set-up along with the web-server dashboard will collectively fulfil the purpose. This is an experimental work and the developed prototype has validated the research work reported here in this dissertation work. Solution has been provided for each problem statement that has been discussed and the research has been carried out in a phased manner. The output of these relay modules was further extended to switch the ac load. For ac load four LED bulbs were used here for the demonstration purpose only.

Keywords: IoT, Web server, NodeMCU, Home Automation

INTRODUCTION

Servers, clients, and the infrastructure that connects them are still the foundation of the Internet. Viewers send the request to sites, which react. Cloud computing differs from this method in that virtual machines do more than simply respond to requests; they also run programs and process data on behalf of clients.As more computer activities shifted to this server-and-infrastructure sector of the Internet, people refer to "the cloud" as nothing more than a shorthand way of describing where other computing procedures were taking place. The term "cloud computing" is now widely used to characterize this sort of computing.NodeMCU is a reduced open-source IoT platform. It is open-source firmware with accessible prototyping board designs. The phrase "NodeMCU" is an abbreviation again for the terms "node" and "microcontroller" (micro-controller unit). It is built by the ESP8266 Wi-Fi SoC from Express if Systems (System on Chip). The firmware as well as the experimental board designs are free to the source. The ESP-12F Wi-Fi device has an ESP8266 core processor in smaller module sizes. Tensilica L106 has an industry-leading 32-bit MCU micro with a 16-bit short form, clock frequencies of 80 MHz and 160 MHz, RTOS compatibility, as well as and an embedded Wi-Fi on-board antenna. The module complies the with IEEE802.11 b/g/n standard and the whole TCP/IP protocol stack. It provides unequalled versatility in incorporating Wi-Fi abilities into other systems or serving as a stand-alone application at the lowest possible cost and with the least amount of room necessary. The ESP8266EX provides a complete and ego Wi-Fi network of social; it may host the program or offload Wi-Fi networking activities from some other application processor. The ESP8266EX is commonly connected to external sensors as well as other implementation devices through its GPIOs.

Here in this work, the methodologies followed to design and implement this system using different hardware and software tools were discussed. A brief description of the complete development cycle of this IoT-based system was provided here. First of all, a briefing was done about the designing of schematic using a CAD tool by giving due consideration to the objectives of our work; then the PCB layout designing for hardware prototyping was demonstrated and discussed; then the bill-of-material required to assemble the hardware was given. Also, the algorithm design and firmware components used to drive this system were discussed here.

The hardware prototype board for the proposed system was designed in the EAGLE CAD tool. EAGLE is an Easily Applicable Graphical Layout Editor by Autodesk. It is the worldwide most widely used PCB design tool. In this work, the methodology was adopted to design and validate the schematic first and then the layout was designed as per the schematic. Finally, we used the PCB layout design to fabricate the PCB. Afterward, the hole drilling process was carried out followed by the component placement and soldering process. Finally, we obtained the hardware prototype for the proposed system in the form of a self-designed PCB card. The schematic and board layout details could be accessed in the upcoming subsections.

EXPERIMENTAL SET-UP

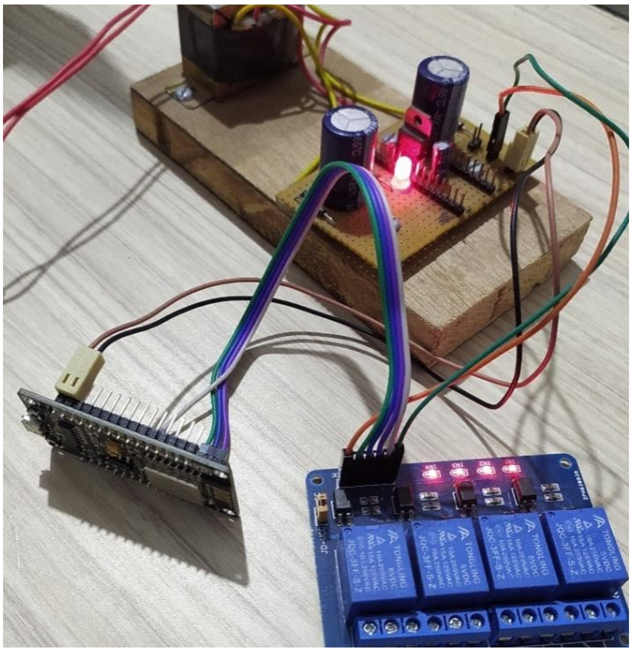

Figure-1: Experimental Set-up

The proposed system has been implemented around the NodeMCU IoT enabled development board with on chip Wi-Fi chipset by Espressif. The hardware set-up along with the web-server dashboard will collectively fulfil the purpose. This is an experimental work and the developed prototype has validated the research work reported here in this dissertation work. Solution has been provided for each problem statement that has been discussed and the research has been carried out in a phased manner. The output of these relay modules was further extended to switch the ac load. For ac load four LED bulbs were used here for the demonstration purpose only. Otherwise, any single-phase ac electrical appliance could be connected with relay outputs.The IP address for establishing the connectivity with your network can be obtained over the serial monitor window available in the Arduino IDE. This IP address can be used as a URL to open a web-page in the format of a dashboard with caption-1 "ESP8266 Web Server Home Automation" and caption-2 "Aashish MTech BRCM-CET".

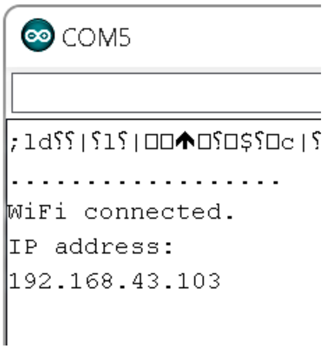

Figure-2: Wi-Fi IP Address in Arduino Serial COM Port

There can be seen four buttons on this web-server dashboard intended to display the status of device ON or OFF. As this is an HTML based design the user can easily change it as per his/ her requirement by editing some lines of the code. The user can directly give a command to trigger the remotely connected relays just by clicking on these buttons by tapping over the phone or by using mouse over the laptop screen.

RESULTS & DISCUSSION

The final prototype board's results were viewed on a smartphone application called Blynk. Blynk was downloaded directly on the user's device, and an account was established by inputting the necessary user credentials. The user was granted an authentication token ID by e-mail, which was then inserted into the firmware before it was uploaded to the NodeMCU. In the Blynk App's graphical user interface window, a new project was formed by picking certain widgets

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from its extensive library and configuring those widgets by the system hardware and firmware. All of the sensors and relay board, as well as the NodeMCU, were carefully linked and powered by a DC power supply. The Wi-Fi hotspot network was used to connect the NodeMCU-based hardware and the Blynk over the mobile device. Individual sensor outputs may be easily checked on the Blynk project screen in real-time. This platform was also used to remotely activate the relays. A four-channel relay module was connected to the NodeMCU, which ran on 5V dc only. All four relay outputs were linked to the alternating current load, and LED lamps were utilized as a demonstration. Otherwise, any single-phase alternating current demand might be connected to the separate relay outputs. The user should keep in mind that the wireless communication network established here for the system was a local network only, and therefore system functionality was restricted to the bounds of the local Wi-Fi hotspot utilized by the user to establish system connectivity. Other protocols at the firmware level would be necessary to access this system from anywhere in the world. As a result, the work was tested and confirmed using the produced hardware as well as the Blynk App on a mobile phone.

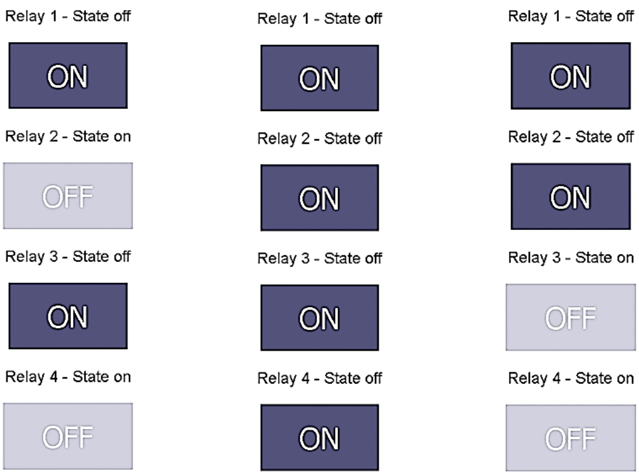

Figure-3: Status of Relays Demonstrated on Web Dashboard

The hardware set-up was initially assembled over a breadboard only and with the help of jumper wires all the sensors and the four-channel relay module were interfaced to the NodeMCU board and the power source. Initially, the NodeMCU interfacing with each sensor was carried out individually, and then at a later stage, all the sensors were integrated into a single system along with the controlling relays. The firmware was uploaded to the NodeMCU and the system response was checked for the desired results. There was a power drop issue in the circuit and the reason was because of the significant amount of power drain by the system as all the sensors, relay, and NodeMCU were connected at a single time and power demand increased. Hence, the power source rating was increased to meet the system demand. Multiple iterations were carried out to calibrate the system. The firmware was edited, compiled, and tested on Arduino IDE and multiple libraries were included to make the system run. The output response of the system was checked on the serial monitor at each stage. To establish communication between the user and the developed IoT system various credentials were required from the user to be included at the firmware level only. The system access was limited to the Wi-Fi hotspot-based local area network only. Multiple iterations were carried out to debug the firmware to get the desired results. After we carried out testing on the system for all the desired parameters, a final prototype was designed and developed by assembling a printed circuit board (PCB).

CONCLUSION

As IoT is a vast field and researchers are still struggling hard to explore its potentials in multiple applications. Thus, IoT is still an emerging field and as new sensors and networks are evolving day by day so do the scope of its applications are widening with time. This work may be expanded to demonstrate more complex LAN and WAN communication protocols like LoRA, BLE, Zigbee, Z-waves, AWS cloud platforms, and so on. As IoT is the fastest emerging technology today and is widely accepted and is growing at a much faster pace worldwide. So, prospects for this kind of work are always open. Following effectively completing this project, it was found that the Internet of Things (IoT) constituted a new framework for wireless communication devices. The Internet of Things (IoT) is the development of current networks to handle anything that is or will be present in the future. Items with personas and simulated dispositions that operate in the smart home environment and use a connected device to connect and engage within a social environment and user context.

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