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NodeMCU Based Switching Control Using Arduino IoT Cloud Platform

Mr. Arvind
arvindsran32@gmail.com
M. Tech Scholar, Department of Electrical & Electronics Engineering, BRCM CET, Bahal, (Haryana), India
Mr. Sandeep Kumar
sjakhar1989@gmail.com
Assistant Professor, Department of Electrical & Electronics Engineering, BRCM CET, Bahal, (Haryana), India

ABSTRACT

In this work a system has been proposedto monitor and control the switching of electrical appliances via relays in an IoT enabled environment. In this paper it has been demonstrated that how a problem statement is being formulated by considering the inferences drawn out of literature survey and the gaps identified in the existing systems proposed so far and reported. NodeMCU is an IoT enabled development board for rapid prototyping with on chip Wi-Fi chipset by Espressif. The hardware set-up along with the establishedconnectivity provides a distributed network and 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.

Keywords:NodeMCU, ESP8266, IoT, Arduino IoT Cloud,Monitoring and Control

INTRODUCTION

A cheap open - source software IoT platform is Node MCU. Open-source prototype board designs have been developed for this open-source firmware. Node and MCU are combined to form the moniker "Node MCU" (micro-controller unit). It is powered by Espressif Systems' Micro - controller Wi-Fi SoC (System on Chip). The designs for the prototype boards and firmware are also open source. The ESP-12F Wi-Fi module houses an ESP8266 core CPU in a smaller-sized module. Tensilica L106 blends an industry-leading 32-bit MCU micro with ultra-low power consumption, 16-bit short mode, support for RTOS, and an incorporated Wi-Fi on-board antenna. The module supports the whole TCP/IP protocol stack and IEEE802.11 b/g/n standard compliance. With the least amount of money and space needed, it offers unmatched versatility to integrate Wi-Fi features into other systems or run as an independent program. The ESP8266EX provides a comprehensive and self-contained Wi-Fi information through social. Alternatively, any microcontroller-based design with straightforward connection (SPI/SDIO or I2C/UART interface) may be enhanced with wireless internet access by acting as a Wi-Fi adaptor. Through its GPIOs, the ESP8266EX frequently integrates with different sensors and other application-specific devices.The problem statement has been analyzed and the after going through the rigorous study and referring a lot of literature reported so far it is inferred that the architecture of the proposed system must be having a Node MCU development board which is considered as the most suitable boards for implementing such kind of applications at zero level.The 17 Peripheral devices of the ESP8266EX may very well be reprogrammed with a wide range of purposes using the proper registers. Any GPIO can be designed with internal move or knock, or set to differential amplifier. The IO pads, which contain input and output buffers with tri-state control inputs, are bi-directional, non-inverting, and tri-state in summary. Other functionalities, including such I2C, Serial peripheral, UART, PWM, IR Bluetooth Enabled, LED Light and Button, etc., can be overlapped with these pins. The GPIOs can also be adjusted to retain their state for low power tasks. If needed, the IO can be constructed with alternative hold ability. Positive feedback is introduced to the pad through the hold functionality. In order to drive the pad, the external driver ought to be more powerful than to the positive feedback. The connectivity, networking and communication

protocols used with these web-enabled devices largely depend on the specific IoT applications deployed.

EXPERIMENTAL SET-UP

The experimental set-up was developed for the implementation of proposed work as shown below. The system is built around NodeMCU which is an IoT enabled development board with WiFi connectivity. The system uses user's WiFi hotspot credentials in the form of SSID and password provided in the code. Using Arduino IoT Cloud a dashboard is formed using widgets to control the switching of electrical appliances remotely.

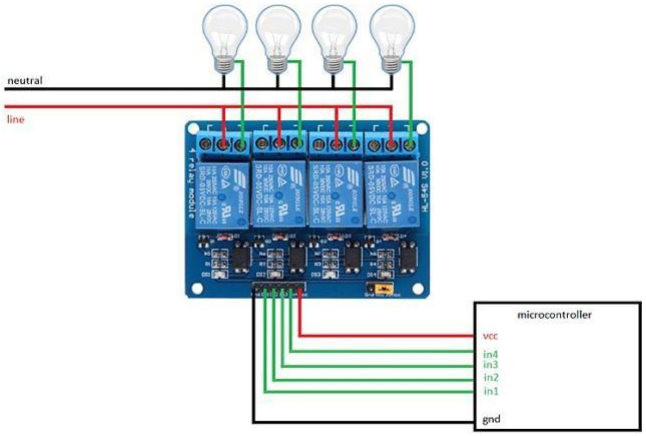

Figure-1. NodeMCU-Relay Interfacing Section

SPDT relay was interfaced to one of the digital I/O pins of the NodeMCU. The SPDT relay acted as an output device and was connected on pin D0 of the NodeMCU. The relay acted as an electromagnetic switch and was used here to switch 220V AC load connected, bulb in this case. Here as the relay power consumption was more so the system was fed with a higher power source 5V/ 1A.With an intuitive user interface and an all-in-one solution for configuration, coding, uploading, and visualization, the Arduino IoT Cloud is a platform that anybody can use to develop IoT projects. One can design, deploy, and monitor IoT projects with ease using the Arduino IoT Cloud, an online platform. Before begin using this IoT cloud platform first we need to get a fast rundown of the supported boards, the API, configuration, Things, variables, and dashboards while learning how to set up the Arduino Cloud IoT.

FIRMWARE

First of all at the initial stage we downloaded and installed all the required libraries and also included those in the source code. These libraries were:

1. painlessMesh.h
2. ArduinoJson.h
3. SPI.h
4. Wire.h
5. Adafruit_GFX.h
6. Adafruit_SSD1306.h

Then we defined the Wi-Fi Credentials including the SSID, Password and Port. These Wi-Fi credentials remained same for each and every board which we wanted to communicate between each other.

Sending Part of the Code:

First of all we read the button status and if the button status was low then we just toggled the button status variable. So, whenever the button was pressed the button status variable would change from one to zero or from zero to one according to the last variable saved in that variable. After saving the button status then was the time to send that and for sending that we used the JSON Format. JSON (Java Script Object Notation) is just an object notation or we can say a syntax in which a data is represented. It is very popular in sending and receiving data may be over the internet or may be between the hardware.

JSON Code Part:

First of all a JSON object was created in which there would be two values Relay1 and Relay2 and their keys were button1_status and button2_status respectively. So this was how JSON syntax looked like. Likewise we could create many values and assign them respective keys and this data was converted into string format by using the function in the code called as

serializeJson(doc,msg);

So then that JSON format data was saved in string called *msg.*

"Relay1":true,
"Relay2":false,
"Relay3":true,
"Relay4":true,
"Relay5":false

Where "Relayx" were known as 'Values' and true/false were called 'Keys'. Data transmitted in JSON Format appeared in the serial monitor window like this:

{"Relay1":false, "Relay2":false}
{"Relay1":true, "Relay2":false}

Then on the receiver side it was very easy to deserialize that string and just extract that particular data which we wanted out of that whole string.

Code Part at the Receiver Side:

On the receiver side if we wanted the data of Relay1 particularly so first of all we deserialized it

DeserializationError error = deserializeJson(doc, json);

and then

write relay1_status =doc["Relay1"];

which was the name of our value which data we wanted and we got the key of this value easily

digitalWrite(Relay1, relay1_status);

and we could easily turn on and off the relay by using this variable. So, this was the simplest and practical explanation of how we transmitted and received data using JSON. Here we just serialized the push button data sending it after every second. Then that data was broadcasted to all the devices under same network under same port number. Then, talking about the receiving part of the code, after receiving the data we first deserialized the JSON and saved different data into different string.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.

Figure 2 Arduino IoT Cloud Dashboard for Mobile

CONCLUSION

Here In this research work the Arduino IoT Cloud platform has been utilized to design, develop and demonstrate the connectivity and control between the microcontroller. Arduino IoT Cloud is a platform open for user to access and control the devices data obtained from some inputs like sensors, buttons specifically for IoT applications. Here a hardware-based demonstration was made for the implementation of Arduino IoT Cloud platform-based switching system to establish connectivity between multiple relays with the Cloud based GUI dashboard using Wi-Fi enabled NodeMCU device for the transfer of data. The Arduino IoT Cloud platform provides flexibility to users to create their own dashboard using widgets as per the application. It was observed that the system was capable of establishing connectivity with the main node automatically by making use of user's ssid, password and with the Arduino IoT Cloud dashboard.

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