IoT Enabled Multi-Sensory Environment for Remote Monitoring & Control

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ABSTRACT

In this work a carefully designed hardware and the real-time supervision of measured sensor outputs as well as the relay on/off status observed over the Blynk App along with the real-time controlling of relays validated the work. As it was a wireless multiple sensor network, it utilizes the Wi-Fi local hotspot network as per the ssid and password credentials entered by the user in the firmware itself. Here in this work efforts were made to exploit the potentials of a cloud based mobile app Blynk which is specifically designed for the IoT based applications. For this purpose, a NodeMCU based IoT system was designed and developed for real-time supervision of the measured outputs from multiple sensors and also enable the user to make decision accordingly to control the electrical load connected to it. There will be icons on the screen dashboard resembling on/off switch and tapping over these buttons would switch the relay states accordingly. The complete system has been implemented using the ESP8266 based NodeMCU development board suitable for IoT applications.

Keywords: NodeMCU, IoT, Cloud, ESP8266, Blynk, Wireless Multi Sensor Network

INTRODUCTION

NodeMCU is a low-cost open source IoT platform. It is an open-source firmware for which open-source prototyping board designs are available. The name "NodeMCU" combines "node" and "MCU" (micro-controller unit). It runs on the ESP8266 Wi-Fi SoC (System on Chip) from Espressif Systems. Both the firmware and prototyping board designs are open source. ESP-12F Wi-Fi module is having a core processor ESP8266 and integrates ultra-low power 32-bit MCU micro, with the 16-bit short mode, Clock speed support 80 MHz, 160 MHz, supports the RTOS, integrated Wi-Fi on-board antenna. The module supports standard IEEE802.11 b/g/n agreement, complete TCP/IP protocol stack. ESP8266EX offers a complete and self-contained Wi-Fi networking solution; it can be used to host the application or to offload Wi-Fi networking functions from another application processor. "The cloud" refers to servers that are accessed over the Internet and the software and databases that run on those servers. Cloud servers are located in data centers all over the world. By using cloud computing, users and companies don't have to manage physical servers themselves or run software applications on their own machines. The cloud enables users to access the same files and applications from almost any device, because the computing and storage takes place on servers in a data center, instead of locally on the user device. This is why a user can log into their Instagram account on a new phone after their old phone breaks and still find their old account in place, with all their photos, videos, and conversation history. For businesses, switching to cloud computing removes some IT costs and overhead: for instance, they no longer need to update and maintain their own servers, as the cloud vendor they are using will do that. This especially makes an impact for small businesses that may not have been able to afford their own internal infrastructure but can outsource

their infrastructure needs affordably via the cloud. The cloud can also make it easier for companies to operate internationally, because employees and customers can access the same files and applications from any location. Blynk is a mobile platform with iOS or Android to control various microcontroller platforms like Arduino, Raspberry Pi, NodeMCU etc. by reading or writing bits wirelessly over the internet. Users can easily create the graphical interfaces for their projects by simply dragging and dropping widgets available in this app. It is a hardware-agnostic IoT platform with white-label mobile apps, private clouds, device management, data analytics, and machine learning.

OBJECTIVE OF RESEARCH

The objective of the study was to implement a cloud-based system for the surveillance of certain parameters in a multisensory environment and that too remotely in real-time over the mobile phone using internet and it should also enable the user to control different electrical appliances remotely over the internet using the same cloud-based application. In context of this statement a versatile system was required to establish communication between the different sensor nodes or clients and the central server node. The central node was expected to enable the user to remotely access the status of sensor parameters in real-time over the mobile using internet. The system was expected to acquire both types of signals analog as well as digital as per the sensor output. The aim was to collect the sensor data from the deployed units and send it to the cloud so that the user could access it remotely in real-time on an open-source cloud platform-based application. Wi-Fi protocol was to be utilized to establish communication between the hardware and the Mobile Application. A local hotspot was to be used to establish connectivity.

IMPLEMENTATION

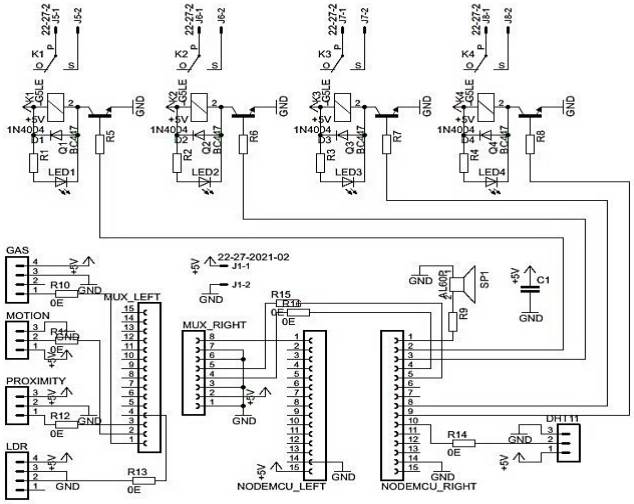

Figure-1: System Architecture

The schematic shown above consisted of a central node i.e. NodeMCU which is an integrated Microcontroller and ESP8266 Wi-Fi module and that supports most of the IoT based applications. There are two types of sensors interfaced to the NodeMCU depending upon their outputs. Some of those were the analog output sensors and others were the digital output sensors. As there were multiple digital input/output pins and only single analog input/output pin available on the NodeMCU board, we had interfaced a 16-Channel Analog Multiplexer to the analog pin of the NodeMCU. This was done to enable NodeMCU to receive the multiple sensor analog-output values one by one and process it. As it was a 16:1 multiplexer, there were four select lines (S3, S2, S1, S0) available for that purpose on-board to select each channel of the multiplexer. We had utilized just four channels of this multiplexer for four different analog output sensors. The digital output sensors and other digital devices were connected directly to the digital input/ output pins of the NodeMCU. The analog sensors used here were Light Dependent Resistor (LDR) module for sensing light intensity, MQ-5 module for sensing gas in the environment, Infrared Proximity sensor module for proximity sensing, Passive Infrared (PIR) sensor module for motion detection. The digital sensors here were DHT11 to sense humidity and temperature levels. The digital devices like buzzer and four-channel relay board were also interfaced to the NodeMCU with appropriate driver circuits. The whole system required +5volt

dc power for its operation.

ALGORITHM DESIGN

First of all before writing the firmware we had installed the required sensor libraries to the Arduino IDE and included those libraries at the initial position while starting to write the firmware. For Example: #include <BlynkSimpleEsp8266.h> and likewise others were required for this project. One can easily find these libraries over the internet. Then we configured the NodeMCU digital as well as analog pins and defined those pins by assigning them appropriate names as per our convenience. Analog pin to read the incoming analog value from different sensors and Digital pins for read/ write purpose. This step was taken to minimize the probability of making errors while using specific pins in the firmware and makes source code easy to understand by anyone else. Next Step was to assign digital pins of NodeMCU dedicatedly for the Selection pins (S0 & S1 in our case) of the multiplexer module. We had used it in our system to switch between different analog sensors and give data over a single available analog channel on the NodeMCU Board. Declare variables and assign appropriate data types. Then we included in our firmware the Unique Authorization Token provided by the Blynk App. One can receive this Authorization Token over his/ her registered e-mail id while signing up in Blynk App for a New Project. This is an important step. Then another important step is to enter your WiFi credentials i.e. your local hotspot ssid and password. Set the password to "" for open networks. There was a function that sends Arduino's up time every second to Virtual Pin (5). In the app, Widget's reading frequency should be set to PUSH. This means that you define how often to send data to Blynk App. One can send any value at any time. Please don't send more that 10 values per second.

RESULTS & DISCUSSION

In this 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 in 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 singe 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.

CONCLUSION

By the end of successful completion of this work it was concluded that the IoT is a new scenario of wireless communication devices. IoT is the development of existing internet facility to manage everything which exists in the world or exists in the future. Things having individualities and the simulated dispositions functioning in smart space using a smart interface to link and connect within the social environment and user context. The IoT also can be considered as global networks which give the communication between things to things, human to things and human to human. As per this work, surveillance is the procedure of close deliberate perception or supervision kept up over an individual, gathering, and so forth particularly one in care or under doubt. For the above mentioned purposes now a day's devices are equipped with various sensors as per application requirements. Sensors are communicating with each other using various topologies in IoT. Data travels locally or remotely from or in by each sensor node. As per application and requirements, sensor nodes may be of same type or different type. For a smart home, it is essential to combine sensor network with internet and intelligent real life objects. Integration of these sensors, smart objects, devices and network is IoT.

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