'Blynk' Cloud Server based Monitoring and Control using 'NodeMCU'

Ms. Priya Sharma[1], Mr. Parveen Kantha[2]

[1]*M.Tech. Scholar, Dept. of Computer Science Engineering, B.R.C.M.C.E.T., Bahal, Haryana, India*
[2]*Assistant Professor & Head, Dept. of Computer Science Engineering, B.R.C.M.C.E.T., Bahal, Haryana, India*

---***---

Abstract - *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. 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. The 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.*

Key Words: NodeMCU, WiFi, IoT, Cloud, ESP8266, Blynk, Wireless Multi Sensor Network, Surveillance, etc.

1. INTRODUCTION

1.1 IoT Ecosystem

The Internet of Things, or IoT, is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers (UIDs) and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction. An IoT ecosystem consists of web-enabled smart devices that use embedded systems, such as processors, sensors and communication hardware, to collect, send and act on data they acquire from their environments. IoT devices share the sensor data they collect by connecting to an IoT gateway or other edge device where data is either sent to the cloud to be analyzed or analyzed locally. Sometimes, these devices communicate with other related devices and act on the information they get from one another. The devices do most of the work without human intervention, although people can interact with the devices -- for instance, to set them up, give them instructions or access the data. The connectivity, networking and communication protocols used with these web-enabled devices largely depend on the specific IoT applications deployed. IoT can also make use of artificial intelligence (AI) and machine learning to aid in making data collecting processes easier and more dynamic. In addition to offering smart devices to automate homes, IoT is essential to business. IoT enables companies to automate processes and reduce labor costs. Generally, IoT is most abundant in manufacturing, transportation and utility organizations, making use of sensors and other IoT devices; however, it has also found use cases for organizations within the agriculture, infrastructure and home automation industries, leading some organizations toward digital transformation.

1.2 Cloud Computing

The essential aspects of Cloud computing have been reported in the definition provided by the National Institute of Standard and Technologies (NIST): "Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction". The availability of virtually unlimited storage and processing capabilities at low cost enabled the realization of a new computing model, in which virtualized resources can be leased in an on-demand fashion, being provided as general utilities. Large companies (like Amazon, Google, Facebook, etc.) widely adopted this paradigm for delivering services over the Internet, gaining both economical and technical benefits. Specific issues have been identified for each service models, which are mainly related to security (e.g., data security and integrity, network security), privacy (e.g., data confidentiality), and service-level agreements, which could scare away part of potential users. Moreover, the lack of standard APIs prevents customers to easily extract code and data from a site to run on another. Cloud computing model is attractive since it frees the business owner from the need to invest in the infrastructure, renting resources according to needs and only paying for the usage. Moreover, it allows decreasing operating costs.

1.3 Cloud and IoT: Factors for their Integration

Their characteristics are often complementary, as Table 1 shows. Such complementarity is the main reason why many researchers have proposed and are proposing their integration, generally to obtain benefits in specific application scenarios. In general, IoT can benefit from the virtually unlimited capabilities and resources of Cloud to compensate its technological constraints (e.g., storage, processing, communication). On the other hand, Cloud can benefit from IoT by extending its scope to deal with real world things in a more distributed and dynamic manner, and for delivering new services in a large number of real life scenarios. Being IoT characterized by a very high heterogeneity of devices, technologies, and protocols, it lacks different important properties such as scalability, interoperability, flexibility, reliability, efficiency, availability, and security.

	IoT	Cloud
Displacement	Pervasive	Centralized
Reachability	Limited	Ubiquitous
Components	Real world things	Virtual resources
Computational capabilities	Limited	Virtually unlimited
Storage	Limited or none	Virtually unlimited
Role of the Internet	Point of convergence	Means for delivering services
Big data	Source	Means to manage

Table 1: Complementary Aspects of Cloud and IoT

Cloud facilitates the flow between IoT data collection and data processing, and enables rapid setup and integration of new things, while maintaining low costs for deployment and for complex data processing. Automation can be applied to both data collection and distribution at low cost. Cloud offers an effective and cheap solution to connect, track, and manage anything from anywhere at any time by using customized portals and built-in apps. The availability of high speed networks enables effective monitoring and control of remote things, their coordination, their communications, and real-time access to the produced data. IoT involves by definition a large amount of information sources (i.e., the things), which produce a huge amount of non-structured or semi-structured data, which also have the three characteristics typical of Big Data: volume (i.e., data size), variety (i.e., data types), and velocity (i.e., data generation frequency). Large-scale and long-lived storage, possible thanks to the virtually unlimited, low-cost, and on-demand storage capacity provided by Cloud, represents an important CloudIoT driver. Cloud is the most convenient and cost effective solution to deal with data produced by IoT and, in this respect, it generates new opportunities for data aggregation, integration, and sharing with third parties. Once into Cloud, data can be treated as homogeneous through well-defined APIs, can be protected by applying top-level security, and can be directly accessed and visualized from any place. Collected data is usually transmitted to more powerful nodes where aggregation and processing is possible, but scalability is challenging to achieve without a proper infrastructure. Cloud offers virtually unlimited processing capabilities and an on-demand usage model. This represents another important CloudIoT driver: IoT processing needs can be properly satisfied for performing real-time data analysis (on-the-fly), for implementing scalable, real-time, collaborative, sensor-centric applications, for managing complex events, and for supporting task offloading for energy saving.

1.4 NodeMCU Board

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 in smaller sizes of the module encapsulates Tensilica L106 integrates industry-leading 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.

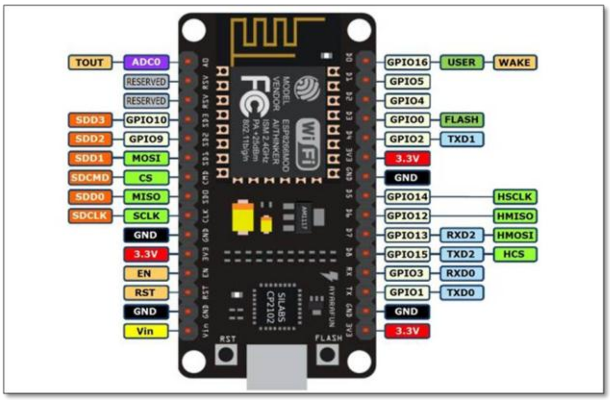

Fig.-3.10: NodeMCU Pin Configuration

2. OBJECTIVE

Here the objective of the work was to make an attempt to integrate two technologies having complementary characteristics relative to each other. One of these technologies is well known Internet of Things and other one is the Cloud Computing. Each technology has its own set of advantages and disadvantages so the integration of both could compensate for the shortcoming of each other. For this purpose an IoT system was designed and developed around a high performance computational platform i.e. NodeMCU. The objective was to implement an IoT system for the purpose of real-time remote surveillance of multi-sensor network and also enable the user to control the switching of multiple electrical appliances remotely via a smart-phone using a cloud server. The system was expected to acquire both types of signals analog and digital from the sensors. 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 a cloud server application 'Blynk'. 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. Hardware prototype should be capable enough to validate the work.

3. PROBLEM FORMULATION

Recent technological advances in low power integrated circuits and wireless communications have made available efficient, low cost, low power miniature devices for use in remote sensing applications. The combination of these factors has improved the viability of utilizing a sensor network consisting of a large number of intelligent sensors, enabling the collection, processing, analysis and dissemination of valuable information, gathered in a variety of environments.

Developing WSN hardware: Typically a node (WSN core hardware) contains sensor interfaces, processing units, transceiver units and power supply. Almost always, they comprise of Digital inputs/outputs and A/D converters for analog and digital sensor interfacing and these sensor nodes have the ability to communicate using one frequency band making them more versatile.

Developing IoT System: Here an IoT system need to be realized that must be having three basic components which enable seamless prospects for the user: (a) Hardware—made up of sensors, actuators and embedded communication hardware (b) Middleware—on demand storage and computing tools for data analytics (c) Presentation—novel easy to understand visualization and interpretation tools which can be widely accessed on different platforms and which can be designed for different applications.

Data Storage: The data needs to be stored and used intelligently for smart monitoring and actuation.

Modular Design: The system should have a modular architecture both in terms of hardware system design as well as software development and it should be very well-suited for IoT applications.

Personal Utility: The sensor information collected was to be used only by the individual who directly owns the network. So, here Wi-Fi was to be used as the backbone enabling data transfer.

Visualization: Visualization is critical for an IoT application as this allows the interaction of the userwith the environment. A Smartphone can be used for visualization and communication along with several interfaces like Bluetooth, Wi-Fi for interfacing sensors measuring physiological parameters. So far, there are several applications available for Apple iOS, Google Android and Windows Phone operating systems that measure various parameters.

Control: Control of home equipment such as air conditioners, refrigerators, washing machines etc., would allow better home and energy management.

Cloud Server Platform: A cloud server platform was required to integrate IoT network with the cloud network.

4. Getting Started With the Blynk App

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.

1. Create a Blynk Account

After downloading the Blynk App, the user needs to create a New Blynk account with a valid email address.

Why do the users need to create an account?

- An account is required to save user's projects and have access to them from multiple devices from anywhere in the world
- It's also a security measure
- The users can always set up their own Private Blynk Server and have full control

2. Create a New Project

After successfully logged into the account, the next step is to start by creating a new project.

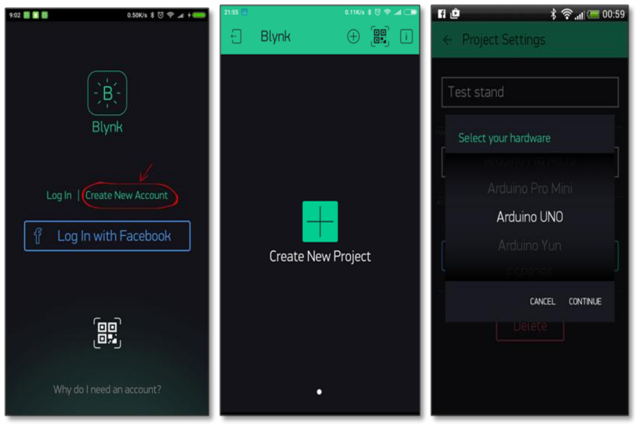

Figure 1: Getting Started with Blynk

3. Choose Hardware

User need to select the hardware model to be used. Blynk supports more than 400 boards already, including support for Arduino, ESP8266 (Generic, NodeMCU, Witty Cloud, Huzzah, WeMos D1, Seeed Wio Link, etc.), ESP32 (WiFi, BLE), Raspberry Pi, BeagleBone Black, Particle, ARM mbed, TI Energia, MicroPython, Node.js, OpenWRT and many Single Board Computers.

4. Auth Token

Auth Token is a unique identifier for the user which is needed to connect their hardware to their smartphone. Every new project a user creates will have its own Auth Token. Users will get Auth Token automatically on their email after project creation. They can also copy it manually. Click on devices section and selected required device:

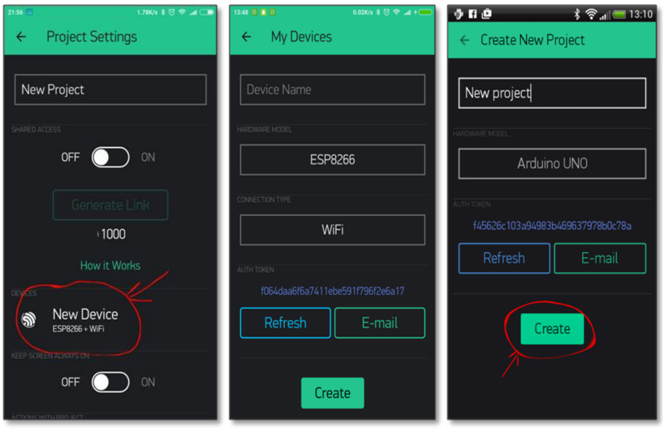

Figure 2: Getting Started with Blynk

5. Add a Widget

User will find the project canvas empty and thus required to add widgets or blocks to their project. For that purpose user needs to tap anywhere on the canvas to open up the widget box. All the available widgets are located here. Users need to pick and place the widget of their choice.

- Drag-n-Drop – User need to tap and hold the Widget to drag it to the new position
- Widget Settings - Each Widget has its own settings and user need to tap on the widget to get to them

The most important parameter to set is PIN. The list of pins reflects physical pins defined by the user's hardware. If the LED is connected to Digital Pin 8, then select D8 where D means Digital.

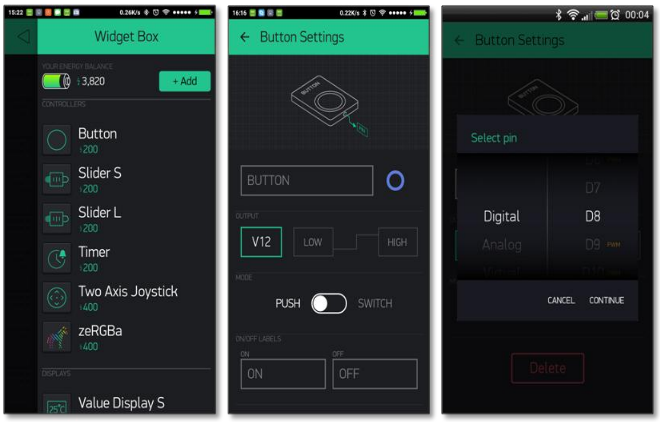

Figure 3: Getting Started with Blynk

6. Run the Project

After done with the Settings the user need to press the PLAY button. This will switch the project from EDIT mode to PLAY mode where the user can interact with the hardware. While in PLAY mode, it will never allow the user to drag or set up new widgets, press STOP and get back to EDIT mode if required. When the connection will establish the Blynk dashboard will show a message "Arduino UNO is online" otherwise user will get a message saying "Arduino UNO is offline".

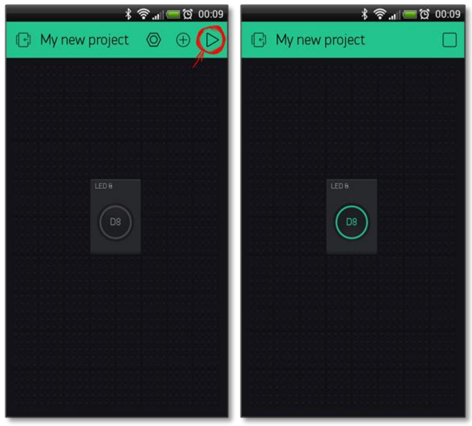

Figure 4: Getting Started with Blynk

7. CONCLUSIONS

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.

REFERENCES

[1] Mona Kumari; Ajitesh Kumar; Ritu Singhal, "Design and Analysis of IoT-Based Intelligent Robot for Real-Time Monitoring and Control", 2020 International Conference on Power Electronics & IoT Applications in Renewable Energy and its Control (PARC), IEEE.
[2] Dilip Kumar Sharma; Neeraj Baghel; Siddhant Agarwal, "Multiple Degree Authentication in Sensible Homes basedon IoT Device Vulnerability",

2020 International Conference on Power Electronics & IoT Applications in Renewable Energy and its Control (PARC), IEEE.

[3] Harsh Kumar Singh; Saurabh Verma; Shashank Pal; Kavita Pandey, "A step towards Home Automation using IOT", 2019 Twelfth International Conference on Contemporary Computing (IC3), IEEE.

[4] Fan Wu; Taiyang Wu; Mehmet Rasit Yuce, "Design and Implementation of a Wearable Sensor Network System for IoT-Connected Safety and Health Applications", 2019 IEEE 5th World Forum on Internet of Things (WF-IoT), IEEE.

[5] Satyendra K. Vishwakarma; Prashant Upadhyaya; Babita Kumari; Arun Kumar Mishra, "Smart Energy Efficient Home Automation System Using IoT", 2019 4th International Conference on Internet of Things: Smart Innovation and Usages (IoT-SIU), IEEE.

[6] Kabita Agarwal; Arun Agarwal; Gourav Misra, "Review and Performance Analysis on Wireless Smart Home and Home Automation using IoT", 2019 Third International conference on I-SMAC (IoT in Social, Mobile, Analytics and Cloud) (I-SMAC), IEEE.

[7] Tushar Chaurasia; Prashant Kumar Jain, "Enhanced Smart Home Automation System based on Internet of Things", 2019 Third International conference on I-SMAC (IoT in Social, Mobile, Analytics and Cloud) (I-SMAC), IEEE.

[8] Tui-Yi Yang; Chu-Sing Yang; Tien-Wen Sung, "A Dynamic Distributed Energy Management Algorithm of Home Sensor Network for Home Automation System", 2016 Third International Conference on Computing Measurement Control and Sensor Network (CMCSN), IEEE.

[9] Waheb A. Jabbar; Mohammed Hayyan Alsibai; Nur Syaira S. Amran; Samiah K. Mahanadi, "Design and Implementation of IoT-Based Automation System for Smart Home", 2018 International Symposium on Networks, Computers and Communications (ISNCC), IEEE.

[10] Shradha Somani; Parikshit Solunke; Shaunak Oke; Parth Medhi; P.P. Laturkar, "IoT Based Smart Security and Home Automation", 2018 Fourth International Conference on Computing Communication Control and Automation (ICCUBEA), IEEE.