IOT Based Smart Greenhouse and Poultry Farm Environment Monitoring and Controlling using LAMP Server and Mobile Application

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ABSTRACT

For last few years, challenges of monitoring and control of different environmental parameters accurately has emerged as new field of research. The concept of Internet of Things (IOT) is also emerging very fast where everything around us comes with an internet connectivity for monitoring and control. Monitoring the environmental parameters and initiating a control action from internet is also part of this concept. This environment monitoring system is capable of monitoring and control of environmental parameters like temperature, soil moisture, CO_2,light intensity and humidity for green house and poultry farm. Node-MCU (ESP 8266) is used for node monitoring. Node-MCU collects data from different sensors. I.e. Temperature sensor, humidity sensor, soil-moisture sensor, gas sensor etc. and communicate with base station over Wi-Fi local network. Node is connected to base station using Wi-Fi network created by router. Base station is powered by Raspberry pi. Raspberry pi has on board Wi-Fi chip to connect to the network. Raspberry pi is going to be used as LAMP Server. We are going to develop a logging system, which will allow nodes to log data in to MySQL database. We are also going to develop web based application which will show all logged data on the web page and also providing control action. Controlling action is also initiated by mobile application.

Keyword: - *Internet of Things (IOT), Node MCU (ESP 8266), Wi-Fi, Raspberry pi, LAMP Server, Mobile Application*

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1. INTRODUCTION

Agriculture plays major role in the economy of the country. More than 70% of Indian population relies on agriculture for their sustenance. According to world's agricultural produce, chicken is the most favored produce, since it is a nutrient-rich food providing high protein, low fat and cholesterol, and lower energy than other kinds of poultries. Embedded greenhouse and poultry farm monitoring and control is proposed to provide a highly detailed micro-climate data for plants within a greenhouse environment with an innovative method of growing temperate crops in a tropical environment using microclimatic conditions. The greenhouse was equipped with conventional wired sensors that provide readings of the air temperature, light intensity and nutrient solution temperature in the mixing tank.

In Todays' demand, the utilization of high quality greenhouse is increased for crop production and quality. The increased population demands for large amount of crop production. We can cultivate the crops which need some specific environmental conditions in the greenhouse.

This research has focused on the use of modern technology to help manage animal farming, which means farm management automation in various ways. The demand for the food crops is more in the present scenario. Now a day the cultivation of the crops in the greenhouse under specified conditions which is suitable for the crops is increased.

In the digital world, especially the computer communication starts with sharing data between machine to machine, and it moves to machine to infrastructure, then machine to environment, and machine to people but now internet is everything. The people also want to communicate with all non living things through internet such as home appliances, furniture's, stationeries, cloths etc. The people already have a lot of technologies to interact with living things but IOT enables to communicate with non living things with comfort manner. IOT is a convergence of several technologies like ubiquitous, pervasive computing, Ambient Intelligence, Sensors, Actuators, Communications technologies, Internet Technologies, Embedded systems etc see Fig. 1.

Fig- 1: Architecture of IOT

In the architecture, embedded system, sensors and actuators are the physical components which are directly interacting with the users. The users manipulate the data through these components. ICT, ubiquitous/pervasive computing, Internet protocols used to create communication among the devices and manage high end user interactions.

The IOT applications are boundless, few examples are; smart cities, smart energy and the smart grids, smart transportation and enabling traffic management and control [10].

2. LITERATURE SURVEY

Mohannad Ibrahim, Abdelghafor Elgamri, Sharief Babiker, Ahmed Mohamed Stefan et al [1] describe an approach to build a costeffective standardized environmental monitoring device using the Raspberry-Pi (R-Pi) single-board computer. The system was designed using Python Programming language and can be controlled and accessed remotely through an Internet of Things platform. It takes information about the surrounding environment through sensors and uploads it directly to the internet, where it can be accessed anytime and anywhere through internet. Experimental results demonstrated that the system is able to accurately measure: temperature, humidity, light level and concentrations of the carbon monoxide harmful air pollutant. It's also designed to detect earthquakes through an assembled seismic sensor.

Divyavani Palle, Aruna Kommu, Raghavendra Rao Kanchi et al [3] proposed Measurement and control of humidity and temperature play an important role in different fields like Agriculture, Science, Engineering and Technology. Also, it becomes essential to monitor the real-time weather condition of one place from another place. In this paper, we present the design and development of CC3200-based Cloud IoT for measuring humidity and temperature. CC3200 is the first SimpleLink WiFi internet-on-chip LaunchPad developed by Texas instruments, USA in 2014. The HRT393 sensor is used for measuring humidity and temperature. Measured parameters are sent to the Cloud servers of AT&TM2X Cloud technology (HTTPS). Humidity and temperature measurements made in real-time are shown graphically. The software is developed in Energia integrated development environment (IDE). The measured values are compared with the measurements recorded by the ground station Laboratory set up by

ISRO, India, on the University campus.

Rajalakshmi P., Mrs.S.Devi Mahalakshmi et al [4] presents an approach Internet of Thing sis a shared network of objects or things which can interact with each other provided the internet connection. IOT plays an important role in agriculture industry which can feed 9.6 billion people on the Earth by 2050. Smart Agriculture helps to reduce wastage, effective usage of fertilizer and thereby increase the crop yield. In this work, a system is developed to monitor crop-field using sensors (soil moisture, temperature, humidity, Light) and automate the irrigation system. The data from sensors are sent to web server database using wireless transmission. In server database the data are encoded in JSON format. The irrigation is automated if the moisture and temperature of the field falls below the brink. In greenhouses light intensity control can also be automated in addition to irrigation. The notifications are sent to farmers' mobile periodically. The farmers' can able to monitor the field conditions from anywhere. This system will be more useful in areas where water is in scarce. This system is 92% more efficient than the conventional approach.

Siwakorn Jindarat, Pongpisitt Wuttidittachotti et al [5] propose a new approach to investigate an establishment using an Intelligent System which employed an Embedded System and Smart Phone for chicken farming management and problem solving using Raspberry Pi and Arduino Uno. An experiment and comparative analysis of the intelligent system was applied in a sample chicken farm in this study. The findings of this study found that the system could monitor surrounding weather conditions including humidity, temperature, climate quality, and also the filter fan switch control in the chicken farm. The system was found to be comfortable for farmers to use as they could effectively control the farm anywhere at any time, resulting in cost reduction, asset saving, and productive management in chicken farming.

3. METHODOLOGY

The system is comprised of several subsystems; each will be explained in detail in this section. This project describes the environment monitoring system is capable of monitoring and control of environmental parameters like temperature, soil moisture, CO_2,light intensity and humidity for green house and poultry farm. Node-MCU (ESP 8266) is used for node monitoring. Node-MCU collects data from different sensors. I.e. Temperature sensor, humidity sensor, soil-moisture sensor, gas sensor etc. and communicate with base station over Wi-Fi local network. Node is connected to base station using Wi-Fi network created by router. Base station is powered by Raspberry pi. Raspberry pi has on board Wi-Fi chip to connect to the network. Raspberry pi is going to be used as LAMP Server. We are going to develop a logging system, which will allow nodes to log data in to MySQL database. We are also going to develop web based application which will show all logged data on the web page and also providing control action. Controlling action is also initiated by mobile application.

3.1 Block Diagram

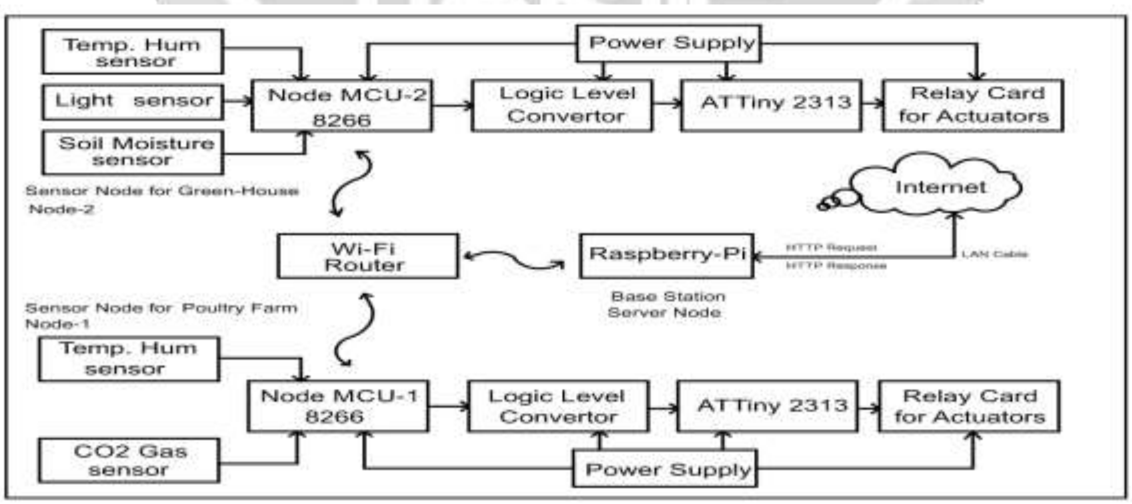

Fig- 2: schematic diagram of the system

As shown in Digital block diagram, Node MCU which is an eLua based firmware for the ESP8266 Wi-Fi SOC is a core part of entire system. Depend on the application, different types of sensors are connected with Node MCU. In the application of Green House, DHT22 sensor which provides current temperature and humidity is connected on the digital pin of Node MCU while soil moisture sensor is connected on the analog pin of the same. Light sensor is connected via I2C protocol with Node MCU.

Node MCU interprets the data from all the sensors and sends them to the Wi-Fi network by its on chip Wi-Fi feature. Further, according to present environment parameters actuator operating commands are serially send to the ATTiny2313 microcontroller which is 8 bit microcontroller from AVR family and it is introduced here to overcome the GPIO limitations of Node MCU and to provide standalone application to manage actuators connected on relays. Due to difference in operating voltage of both the chips they are interconnected by logic level translator is 74LS07. ULN2003 IC is used to drive relays for the actuators.

Digital lines from ATTiny2313 control the ULN2003 inputs and thus actuators. This entire system is provided power from the same supply. Power supply unit consists of rectifies and filter circuit as well as voltage regulators. Supply from solar panel is also taken in consideration if needed. Separate battery charging circuit with voltage regulator is also included in the circuit to charge the backup battery.

Same arrangement is done in the application of Poultry farm. The only change is selection of sensors. In this application Temperature and Humidity as well as concentration of CO2 gas is also needed so that instead of soil moisture sensor and light sensor, MQ135 sensor is connected on the analog pin of Node MCU. Rest of the arrangement is same as discussed in previous application.

Base station server node is powered by Raspberry pi. It is configured as a LAMP server. Data received from both Nodes via Wi-Fi is handled by Raspberry Pi. Raspberry Pi post sensors' data into MySQL database. A Wi-Fi router is also used which is connected to the Internet for remote login application. Using PHP script programming on Raspberry pi sensor data i.e. climate factors' values are fetched and displayed on web page of Apache server. Controlling action is initiated by raspberry pi. It checks whether the values of climatic factors are in between normal range or not. If not so it sends command to turn ON or OFF related actuators to control environment as well as turn ON an alarm as an alert to respective sensor node.

An alarm would be turned off by acknowledgement given by user on web page. Web page contains Individual graphical representation of environmental parameters and actuator's state (ON or OFF) connected to respective sensor node. It also shows dialogue box through which user can enter threshold value of various environmental parameters dynamically. Mobile application which runs on smart phone fetches these entire sensors' data and provides functionality of remote controlling and monitoring

3.2 Flow Chart

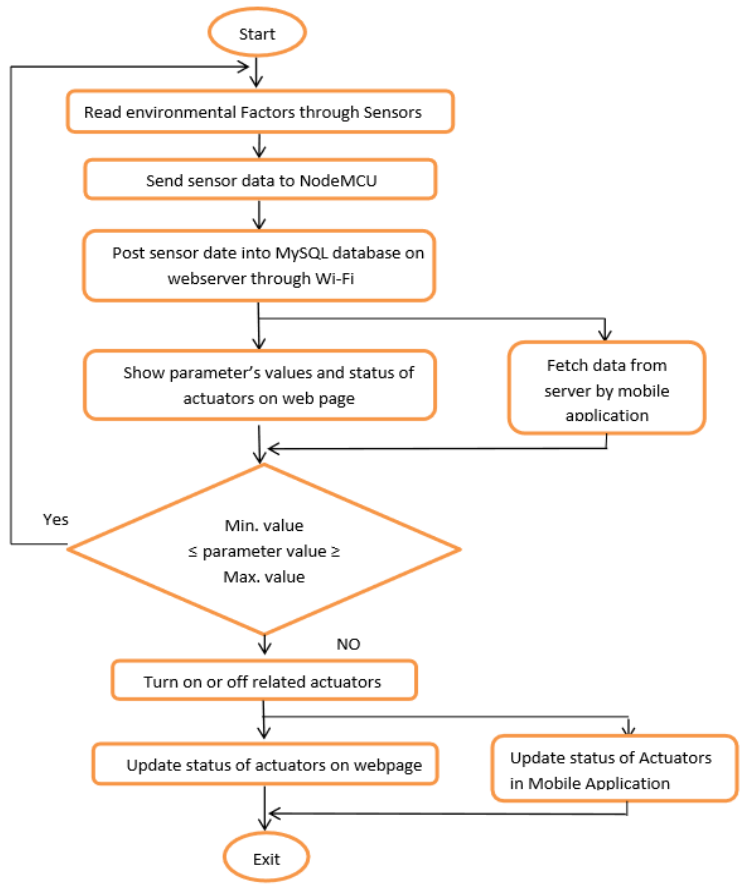

Fig-3: Flowchart for Device Operation

3.3 Hardware System Requirements

Sensor Node contain following hardware:

3.3.1 Node-MCU 8266:

The Development Kit based on ESP8266, integrates 11 GPIO, PWM, IIC and ADC all in one board which Includes firmware which runs on the ESP8266 Wi-Fi chip hardware. Uses the Lua scripting language. It is WI-FI enabled.

3.3.2 ATTINY2313 Microcontroller:

The high-performance, low-power Microchip 8-bit AVR RISC-based microcontroller combines 2KB ISP flash memory, 128B ISP EEPROM, 128B internal SRAM, universal serial interface (USI), full duplex UART, and debug WIRE for on-chip debugging. The device supports a throughput of 20 MIPS at 20 MHz and operates between 2.7-5.5 volts.

3.3.3 Relays:

These are high quality Single Pole - Double Throw (SPDT) sealed relays. Use them to switch high voltage, and/or high current devices. This relay's coil is rated up to 12V, with a minimum switching voltage of 5V. The contacts are rated up to 5A (@250VAC, 30VDC).

3.3.4 Sensors:

- DHT22- temperature and Humidity sensor
- Digital light intensity sensor
- MQ-135 Gas sensor
- Soil moisture sensor

Base Station Server Node contain following:

3.3.5 Raspberry pi:

The Raspberry Pi is a credit card-sized computer. Features of raspberry Pi B model include A 900MHz quad-core ARM Cortex-A7 CPU, 1GB RAM ,4 USB ports ,40 GPIO pins ,Full HDMI port ,Ethernet port ,Camera interface (CSI), Display interface (DSI) And Micro SD card slot

3.3.6 Router

A router connects internet and internal Wi-Fi networks.

3.3.7 Ethernet cable

Ethernet cable is used to provide internet connection to raspberry pi module.

3.3.8 Power Supply Section

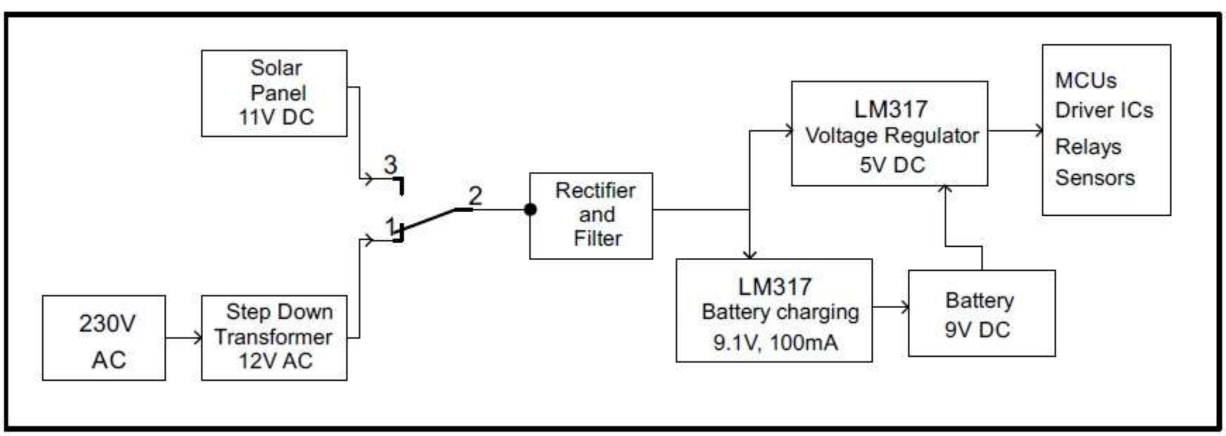

Fig- 4: schematic diagram of the power supply of the system

Power Supply Section contain Battery, Solar Plate, Transformer/Adapter As shown in diagram, Power supply unit has two different power sources.

1. 230V AC supply
2. Solar panel DC supply

User can select either of power source option. 230V AC supply is stepped down to 12V AC by using step-down transformer. It is further converted to DC power using bridge rectifier. To remove AC ripples in DC supply, capacitor filter circuit is used. DC voltage is given to both LM317 regulators such that reverse flow of current can be avoided.

3.4 Software System Requirements

3.4.1 CP2102 Driver:

CP2102 Driver is USB to serial convertor. Used for flashing NODEMCU.

3.4.2 Arduino

Arduino is an open-source electronics platform based on easy-to-use hardware and software.

3.4.3 PuTTY

PuTTY is a free and open-source terminal emulator; serial console and network file transfer application. It supports several network protocols, including SCP, SSH, Telnet, rlogin, and raw socket connection.

3.4.4 Win32 Disk Imager

This software is used to write a raw disk image file or data i.e. window image file to a removable device

3.4.5 Swish-SFTP

Swish adds support for SFTP to Windows Explorer so you can access your files on another computer securely via SSH.Swish is easy to use because it integrates seamlessly with Windows Explorer so working with remote files feels just like working with the ones on your local computer.

3.4.6 LAMP server

LAMP server which is one of the most common configurations for webservers which standard for

- **L**inux – Raspbian Operating System
- **A**pache2 – Webserver Software
- **M**ySQL5 – Database Server
- **P**HP/**P**ython– Programming Languages

4. HARDWARE IMPLEMENTATION

Sensor Node contains 7 relays for actuators, ATtiny2313 microcontroller, NODEMCU and power supply circuit as well as battery charger circuit. Sensors are also connected to sensor node as shown in diagram. Figure 5 shows Sensor Node Hardware implementation.

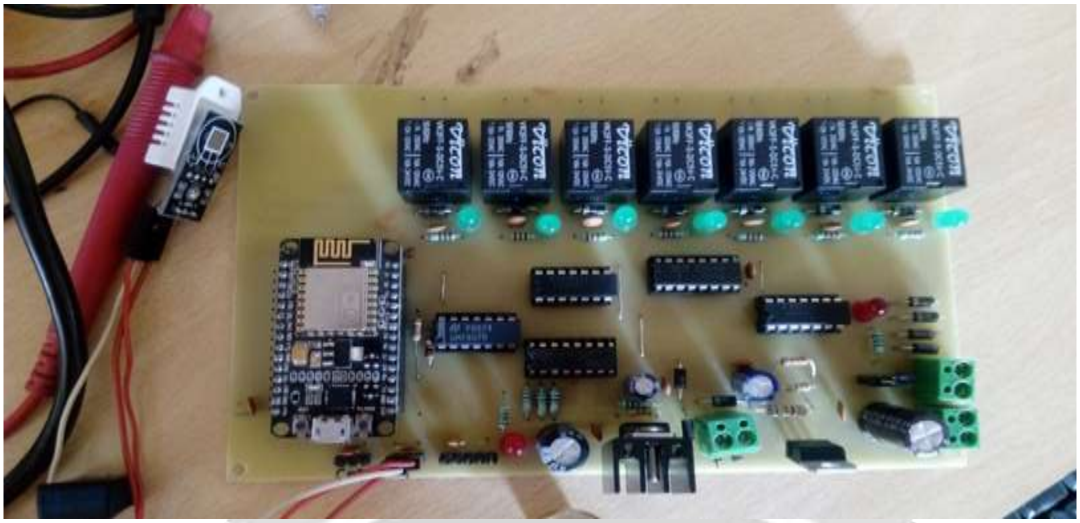

Fig- 5: schematic diagram of the power supply of the system

5. RESULTS

5.1 database

The result of MySQL data base on raspberry pi server for Node 1 and Node 2 is shown in following figure 6 and figure 7respectively.

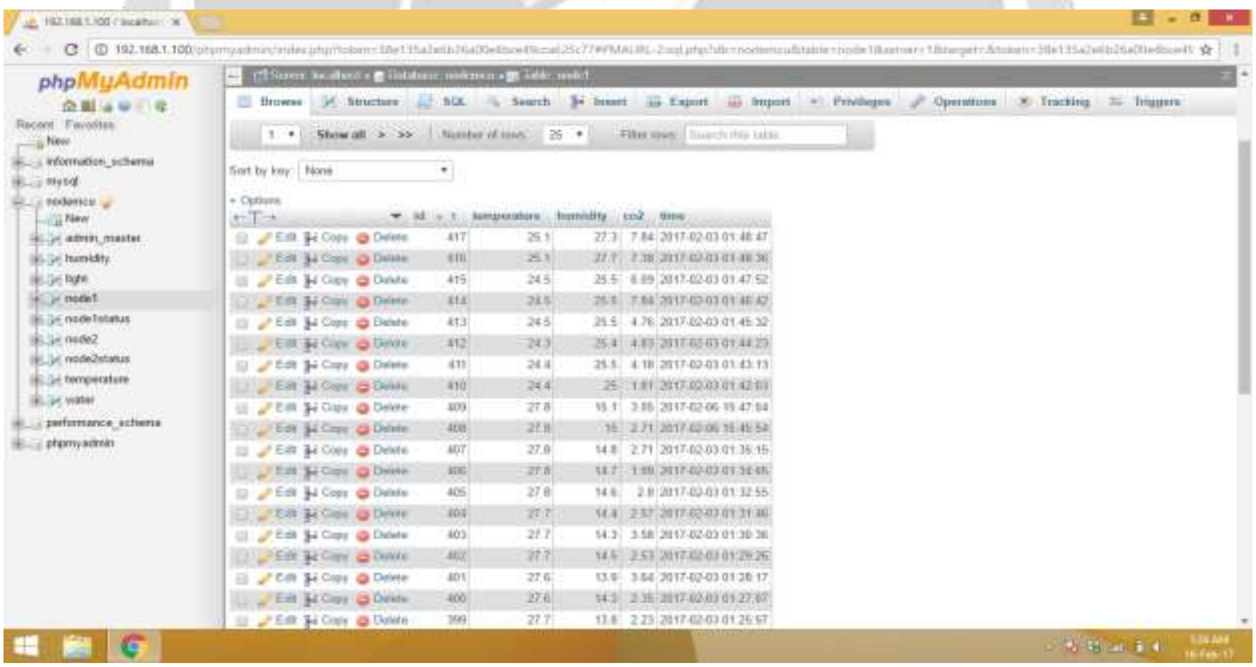

Fig- 6: Database for Sensor Node 1

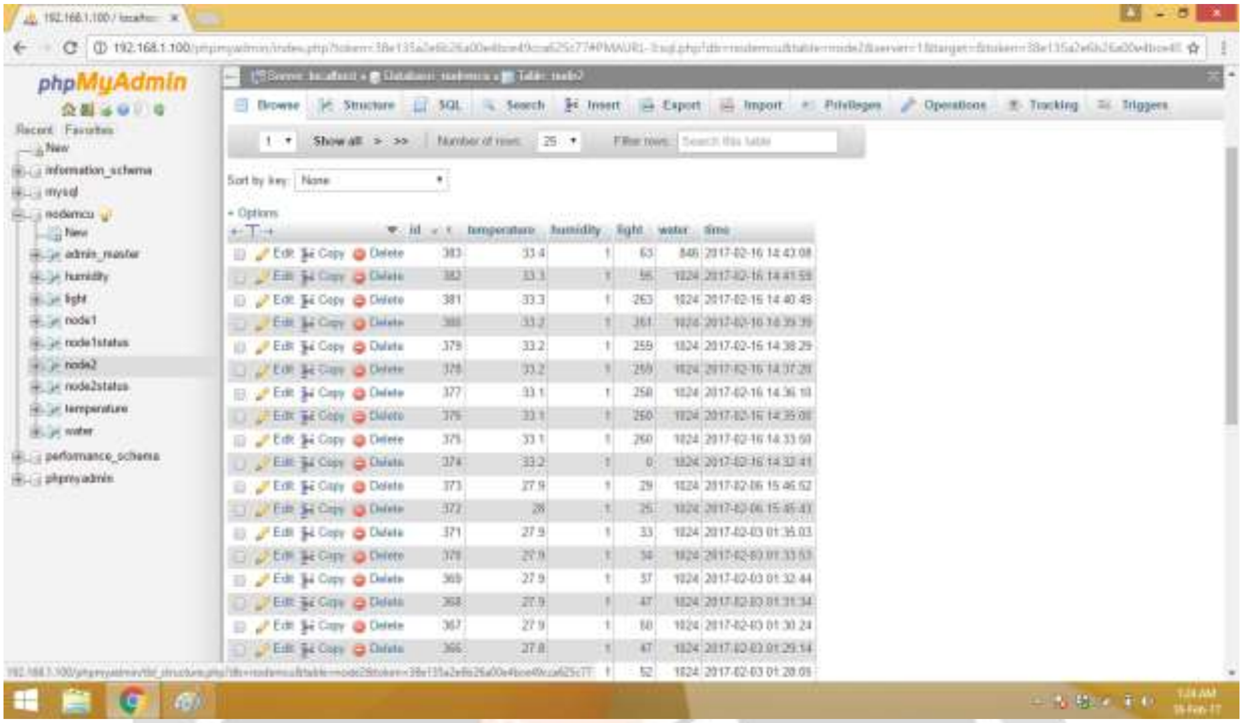

Fig- 7: Database for Sensor Node 2

5.2 Webpage

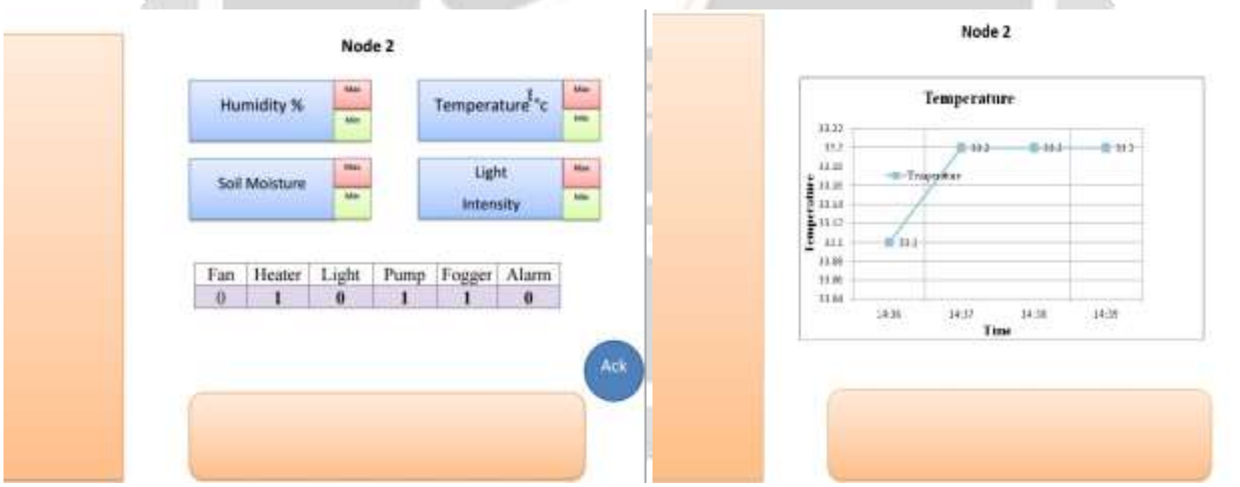

Fig- 7: webpage for Sensor Node 2

5. CONCLUSIONS

Based on the survey of all these papers different authors have presented different security systems. We have found that most of the security systems are developed using Raspberry Pi because it is cost effective and it is compatible with many programming languages. Raspberry Pi can work with various sensors like smoke sensor to detect fire and temperature sensor to detect temperature. With the help of Raspberry Pi person can implement security system with server implementation.We can conclude that every person needs cost effective security system.

There are different tools and parameters are used to provide the security. These security systems are useful for securing many places from remote location using mobile devices. In future we can implement energy efficient security systems.

6. ACKNOWLEDGEMENTS

I am very grateful to Principal of Sardar Vallabhbhai Institute of Technology for providing facilities to achieve the desire milestone. I also extend my thanks to Head of Department for his inspiration and continuous support. I wish to warmly thank my guide, Prof. K.R.Bhatt for all her diligence, guidance, encouragement, inspiration and motivation throughout. Without his treasurable advice and assistance it would not have been possible for me to attain this landmark. He has always been willingly present whenever I needed the slightest support from him. I would like to thank all of them whose name are not mentioned here but have played a significant role in any way to accomplish the work. Grace of the almighty God and blessings of my parents have formed the path to reach my desire goal.

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