Smart Security System For Home Appliances Control Based On Internet Of Things

Su Zin Zin Win, Zaw Min Min Htun, Hla Myo Tun

Abstract: Technology is always evolves. Home security is essential for occupants' convenience and protection. Security systems are being preferred over manual system. With the rapid increase in the number of users of internet over the past decade has made Internet a part and parcel of life, and IoTs is the latest and emerging internet technology. Home Appliances Control of Smart Security System using IoTs uses computers or mobile devices to control basic home functions and features through internet from anywhere around the world. This security system differs from other system by allowing the user to operate the system from anywhere around the world through internet connection. With the implementation of Arduino Mega microcontroller as an Embedded device, security system design was constructed with many sensors and web server database. The Arduino Ethernet shield is used to eliminate the use of a personal computer (PC). The motion sensing circuit, temperature and humidity sensing circuit, smoke or gas sensing circuit, door lock sensing circuit, light on/off circuit were designed to be connected with Arduino Mega microcontroller and Ethernet shield. This system can monitor the temperature and humidity values and the state of some sensors for intruder detection. It can also control the electric appliances like lights and door at home. Real time result was displayed on web server page via the internet.

Keywords: Internet of Things (IoT), Arduino Mega, Ethernet.

I. INTRODUCTION

Safety and security of any living or working place is one of the most primary concerns. The advancement of technology has increased the safety and security of people along with their belongings. One of the reasons for the rise of the smart home is the increasing risk of burglary and robbery and the busy lifestyle. The busy lifestyle of people is leading to the necessity of controlling the devices at home remotely and increasing the necessity of keeping surveillance over their homes. With advancement of internet technology lifestyle of every person is changing constantly. Internet of Things can be described as connecting everyday objects like smart phones, internet televisions, sensors and actuators to the internet where the devices are intelligently linked together to enable new forms of communication amongst people and themselves. The significant advancement of IoTs over the last couple of years has created a new dimension to the world of information and communication technologies. The IoTs technology is useful one for creating new concepts and wide development space for smart home security in order to provide intelligence, comfort and improved quality of life[2]. Therefore, home security is the most significant one for every homeowner either in an individual house or an apartment. To get the absolute peace of mind whether you are at first time home or out of home you must ensure that your home is installed with the perfect home security monitoring system. This home security system can be used to provide security system for residential, industrial, and for all domestic and commercial purposes using IoTs technique. Security systems are certain electronic devices which are used to detect intrusions in home or industry. The basic components of a home automation security system are motion detectors, temperature and humidity detectors, door lock detector and smoke detector[6].

II. SYSTEM CONTROL DESIGN

The system control design is divided into two portions for smart security system. The first portion is MCU (microcontroller unit) and the second is web control design.

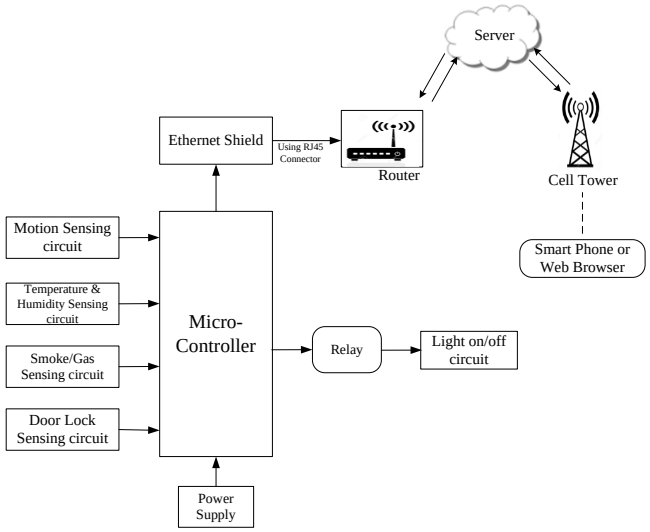

Fig.1.*Overall Block Diagram of the Smart Security System for Home Appliances*

The block diagram of the smart security system shown in Fig.1 is for overall design of security system for home. In this block diagram, motion sensing circuit, temperature and humidity sensing circuit, smoke or gas sensing circuit, door lock sensing circuit, microcontroller, light on/off circuit, Ethernet shield, router, server, cell tower and smart phone are shown. Motion Sensing Circuit gives the detection from the unwanted movement of people around the restricted premises. Temperature and Humidity Sensing Circuit is used to measure the ambient temperature. Smoke or gas sensing circuit is used for fire detection. Door Lock Sensing circuit is placed at the doors and windows to detect the intrusion of a burglar in the home. The relay controls the light on/off circuit.

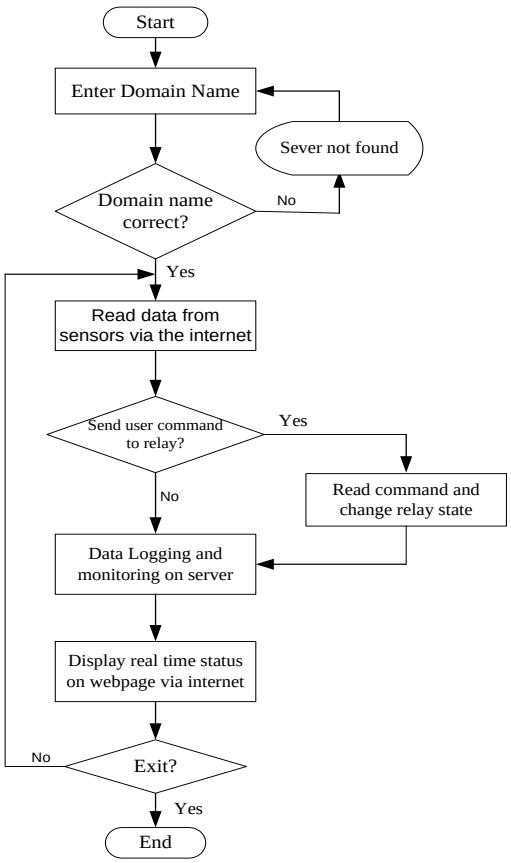

Fig.2. *Flowchart of general processing for proposed home security system*

When the corrected domain name enters, the Arduino Mega microcontroller reads smoke signal, magnetic signal, room temperature and moisture, and motion detector. It will send these data to the web server page via the internet. The relay state will be changed when the command and data is received. The microcontroller will read command and change relay state. And then, the data will be recorded and displayed on web server database. The real time status will display on web server page through the internet.

2.1. MCU (Microcontroller Unit)

The Microcontroller unit is separated into two sections. First section is sensor section and the second one is driver section.

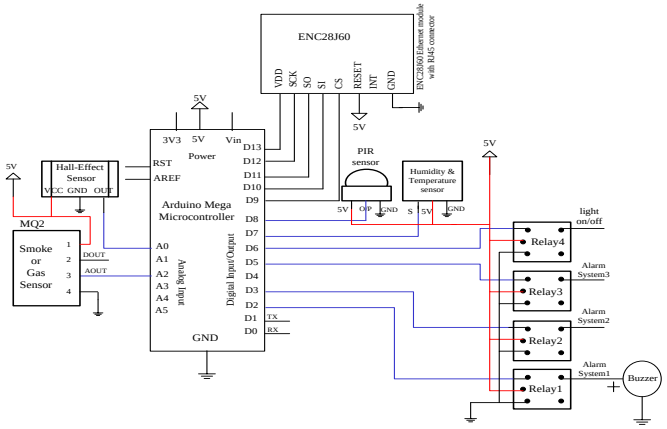

Fig.3. *Overall Circuit Diagram of the Smart Security System*

The smart security system for home appliances based on IOTs has the capabilities to control the light ON/Off and monitor the sensors shown in Fig.3. In the Fig.3, the alarm system1 is used for smoke or gas sensor and the alarm system2 for PIR sensor. And then, the alarm system3 is used for hall-effect sensor. ENC28J60 Ethernet module with RJ45connector was used to connect each other Arduino Mega microcontroller and web server data. The Ethernet is interfaced to the Arduino Mega via the Arduino SIP pins. Arduino Mega microcontroller implemented with C language, using IDE comes with the microcontroller itself. Arduino software is responsible for collecting event from connected sensors, then apply action to actuators and pre-programed in the server. Another work is to report and record the history in the server database.

2.1.1. Sensor Section

The sensor section is considered with the following detection of:

- Smoke or gas detection
- Motion detection
- Door lock detection
- Temperature and humidity detection

A. Smoke or Gas detection

The smoke or gas sensor is used to detect the gas leakage and smoke occurring in home. This is used to detect gases like LPG/I butane/ propane/ methane/ alcohol/ hydrogen/ smoke. There are different types of gas sensor which detects different gases according to different concentration parameter. Here we are using MQ-2 gas and smoke sensor. MQ2 is a semiconductor type sensor, which can appropriately sense the presence of smoke, LPG, methane, butane, propane and other hydrocarbon combustible gases. Whenever the gas/smoke leakage is detected by the sensor, the circuit starts working with 5 volts supply.

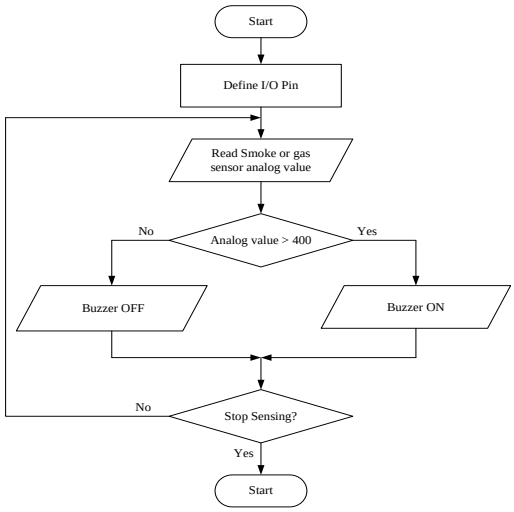

Fig.4. *Overall Flowchart of Smoke or Gas sensor sensing*

The flowchart represents loop function of smoke or gas sensing shown in Fig.4. Firstly the microcontroller will define input/output pins. Until the program is restarted, the signal will be generated repeatedly. When sensed smoke or gas analog value is greater than 400, Arduino pin for buzzer will be high. When sensed smoke or gas analog value is less than 400, Arduino pin for buzzer will be stopped.

B. Motion detection

Motion detectors are used to detect the unwanted movement of people around the restricted premises. Hence, the passive Infrared (PIR) sensors could be used as a motion detector if there is some movement around the restricted premises. The passive Infrared sensor is used as a motion detector in the system. The PIR (Passive Infra-Red) sensor is a pyroelectric device that detects motion by measuring changes in the infrared level emitted by surrounding objects. This motion can be detected by checking for a high signal on a signal I/O pin. PIR sensor is electronic devices which is used in some security systems to detect an infrared emitting source. All living beings whose temperature is anything above absolute zero (-273.15®C or -459.67®F), emits infrared radiation. This radiation (energy) is invisible to the human eye but can be detected by electronic device designed for such a purpose.

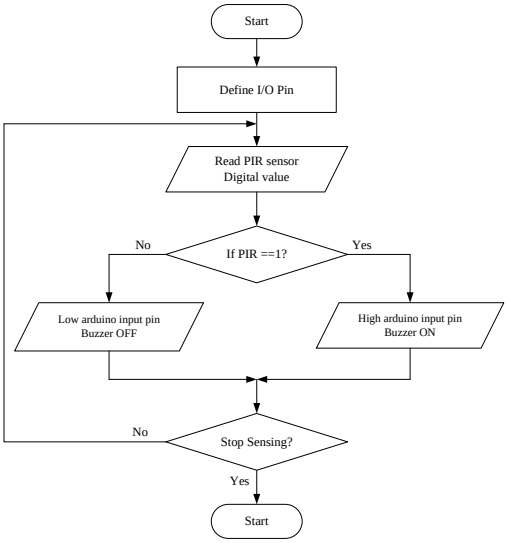

Fig.5. *Overall Flowchart of PIR sensor sensing*

The flowchart shown in Fig.5 is the operation of the PIR sensor sensing. Whenever the PIR sensor digital value is high, arduino input pin will be high and buzzer will be energizing as beat of alarm signal.

C. Door Lock detection

The intrusion sensors are placed at the doors and windows to detect the intrusion of a burglar in the home. The intrusion detector is used to give extra security along with other detectors. The hall-effect proximity sensor is used for intrusion detector. A hall-effect proximity sensor is a magnetic sensor based on the hall effect of the magnet. Voltage perpendicular to both the current and the field is generated when a current carrying conductor is placed into a magnetic field and this principle is known as the Hall Effect. For the installation of the proximity sensor, a magnet is attached to the frame of the door or window, whereas the sensor is attached to the door or window itself. The magnet and the sensor should be installed such that they are close to each other whenever the door or window is closed.

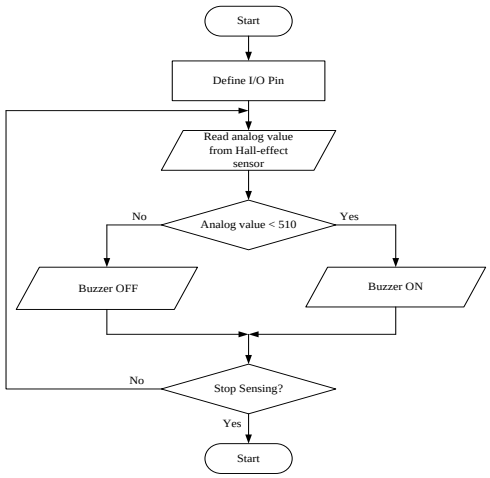

Fig.6. *Flowchart of Door lock sensing*

Above flowchart shows how hall-effect sensor sensing work. When sensed magnetic analog value is greater than 510, Arduino pin for buzzer will be high. When sensed magnetic analog value is less than 510, Arduino pin for buzzer will be stopped. Until program stop, the routine will be repeated infinitely.

D. Temperature and humidity detection

For temperature and humidity detection, DHT11 is used. The DHT11 is a basic, ultra low-cost digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air, and spits out a digital signal on the data pin (no analog input pins needed). It is fairly simple to use, but requires careful timing to grab data. The overall circuit diagram of humidity and temperature detection circuit is shown in Fig.3. This is to design the monitoring system for smart security system. The humidity and temperature values will be display on user interface.

2.1.2. Driver Section

The driver section includes the relay and buzzer for smart security system. The buzzer is used for alarm system and relay is used for light ON/OFF.

2.2. Web Control Design

The web control design is composed of two portions. The first portion is the database logging system and the second one is the user interface.

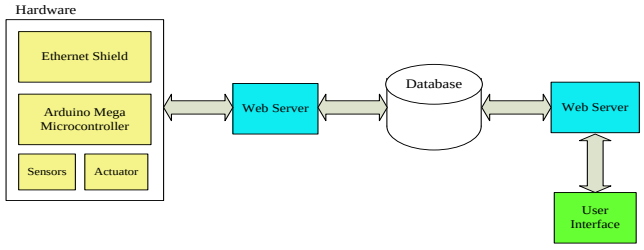

Fig.7. *Block Diagram of the Data Flow For Home Security System*

The block diagram of the data flow for home security system is shown in Fig.7. The hardware including Ethernet shield, Arduino Mega microcontroller, sensors and actuator, web

server, database and user interface are represented in this block diagram. In the hardware portion, when the Arduino Mega microcontroller achieves 5V supply, it will collect data from sensors. And then, the Arduino will send data to web server with POST method. The post.php web server page reads the data from the Arduino and will change the data to the relative variables. This page will send the relative variables to the database. The data logging in the database will also send to the index web server page and then this web server will monitor to the user interfaced.

2.2.1. Database logging system

The smart security system for home appliances control deals with information that has to be logged in database and monitored through web page on browser.

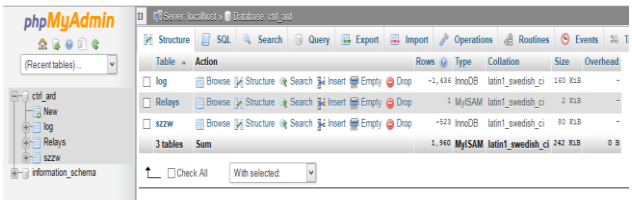

Fig.8. *PhpMyAdmin in browser to administer database*

The Figure.8 shows the PhpMyAdmin page in browser. Now the database has to be created in MySQL Server. The method is by browsing link to localhost/PhpMyAdmin/ and creating database with the list of option available. Then, MySQL Database Server in browser to manage database can be administrated. This feature enabled to create database simply by logging on PhpMyAdmin web page on browser and then click on create panel to create new database. Further, tables and columns can be created, edited or as well delete and other properties related to implement of database was available.

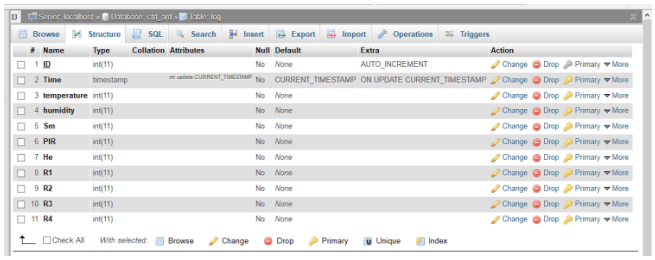

Fig.9. *Screenshot of log Table & Column in Php My Admin*

2.2.2. User Interface

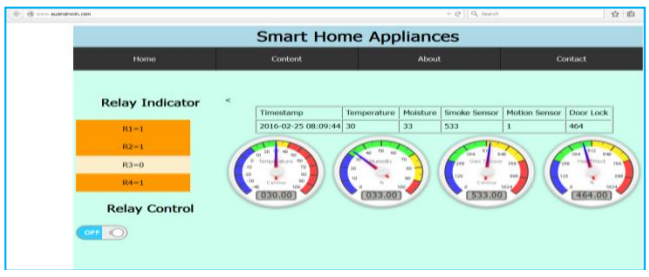

Fig.10. *Overall Real Time Monitor and Control User Interface*

The user interface was implemented not only for monitoring system but also for control the light ON/OFF. The user can also easily watch the real time status and control light ON/OFF from relay control on the webpage thought the web server via the internet.

III. IMPLEMENTATION

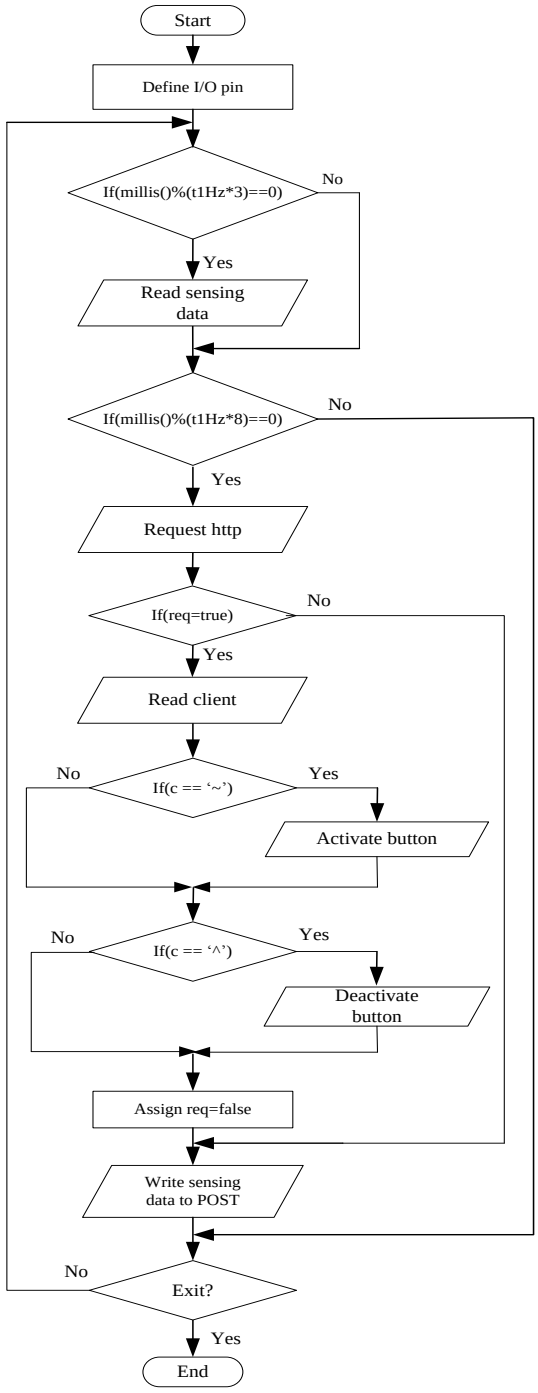

FIG.11. *FLOWCHART FOR MICROCONTROLLER IN SMART SECURITY SYSTEM*

The millis() is the appeared time when the Arduino Mega microcontroller is supplied power. Assume t1Hz is 500ms. If the remainder, millis() is divided into t1Hz multiply into three,

is equal to zero, the sensing data is read. If millis()%(t1Hz*8) is equal to zero, httpRequestRcmd function is started. And then, if req is true, the char c is read from post.php web page. If char c is equal to the sign '~', button is high. If the char 'c' is equal to the sign '^', the button is low. If req is false, the microcontroller writes sensing data to POST.

```
client.println("POST /post.php HTTP/1.1");
client.println("Host:  www.suzinzinwin.com");
client.println("User-Agent: Arduino/1.7.8");
client.println("Connection: close");
        client.println("Content-Type: application/x-www-form-urlencoded;");
        client.print("Content-Length: ");
        client.println(data.length());
        client.println();
        client.println(data);
        Serial.println(data);
```

Fig.12. *A part of Arduino code for Send Sensing Data*

The Arduino sends the sensing data to the post.php web server page with post method. The host is www.suzinzinwin.com and the user-agent is Arduino/1.7.8. And then, this web server also sends the sensing data to the database.

IV. Test And Result

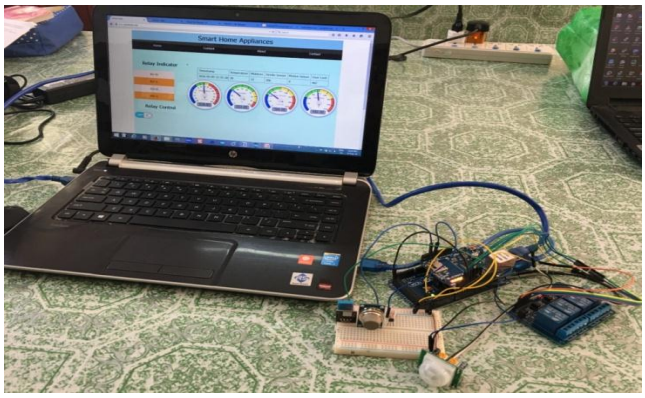

Fig.13. *Real Time Control of Prototype Mode*

In the Fig., the Arduino Mega microcontroller and Arduino Ethernet shield are mounted. The mounted shield is connected to the sensors and relays. The sensors are the smoke sensor MQ2, PIR sensor, hall-effect sensor and temperature & humidity sensor DHT11. The Arduino Ethernet shield is connected to computer with RJ45 connector.

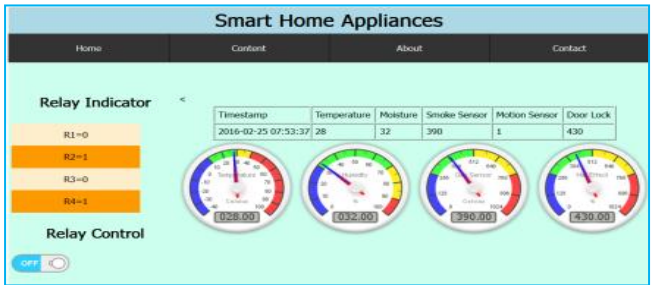

Fig.14. *Real Time Monitor and Control User Interface On html*

In the Fig.15, the smoke level is exceeded desired smoke level, smoke level alarm R1 will be ON. If not, smoke level alarm R1 will be OFF. Therefore, if there is something smoke or gas on the room, the smoke or gas is detected, the alarm will be ON. If not, the alarm will be OFF. And then, the R2 is motion sensing and the R3 is the door lock sensing respectively. The R4 is relay control for light ON/OFF. Finally, the temperature and moisture level are also monitored on web server page for home appliances control of smart security system.

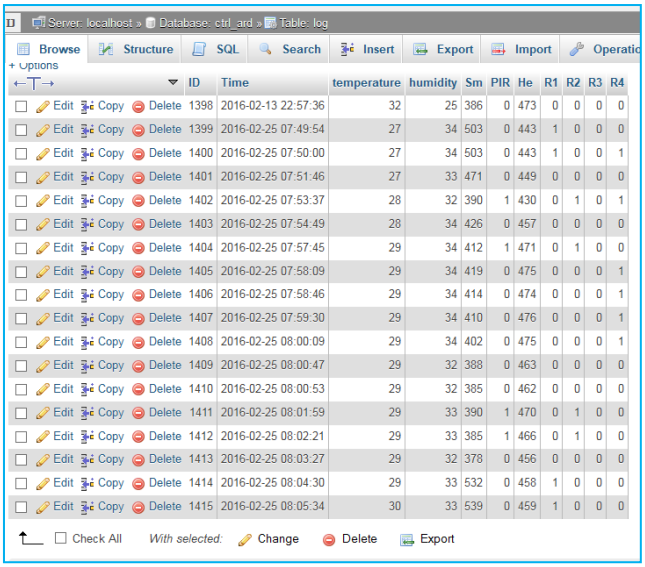

Fig.15. *Database of the sensing data in Table: Log PhpMyAdmin*

All the required data is stored in the database of web server. The stored data can be analysed at anytime and anywhere. The Fig.16 shows the information of temperature, humidity, smoke(Sm), motion(PIR) and hall-effect(He) levels respectively. And also it provides the state of the relays along with the time. All this information is stored in the database which can be checked by the user anytime when away from the home.

V. Discussion

In smart security system, the sensors were used for information and then control device accordingly. Information was logged on in database of Table: Log PhpMyAdmin. It was new completely on different matters like database, webpage design and so on. Therefore, the desire time was much more than expected. Moreover, this system can also occur delay in real time due to internet connection. More devices can be monitored controlled such as Fan speed, Door motor control etc. These features can be added on next level.

VI. Conclusions

This home appliances control of smart security system using Internet of Things is effectively achieved by using web server, PHP script language. The proposed system is a distributed smart security system, consists of server and sensor. In this system, sever controls and monitors the various sensors, and can be easily configured to handle more hardware interface module (sensors). This system not only monitors the sensor data, like temperature, gas, motion sensors, but also actuates

a process according to the requirement, for example switching on the light when it gets dark.

Acknowledgment

The author wishes to acknowledge especially to Dr. Myint Thein, Rector of Mandalay Technological University, for his guidance, help and sharing fruitful ideas. The author is deeply grateful to Dr.Hla Myo Htun, Associate Professor and Head, Department of Electronic Engineering, Mandalay Technological University for supplying all necessary things. The author also wishes to U Zaw Min Min Htun, Lecturer, Department of Electronic Engineering, Mandalay Technological University, accomplished guidance, his willingness to share his idea and, helpful suggestions and for his patience, continuous supervision and encouragement during a long period of this paper.

REFERENCES

[1] Vinay sagar K N, Kusuma S M, “Home Automation Using Internet of Things”, International Research Journal of Engineering and Technology (IRJET) ISSN: 2395 -0056, Volume: 02 Issue: 03 | June-2015.

[2] Shiu Kumar, “UBIQUITOUS SMART HOME SYSTEM USING ANDROID APPLICATION”, International Journal of Computer Networks & Communications (IJCNC) Vol.6, No.1, January 2014.

[3] Mrs. Latha A.P.,Pratik Agarwal (8th Sem),Rishabh Rajgarhia (8th Sem), Shashank Sinha (8th Sem), Nafiya Monis (8th Sem),“Home Automation using Android Application and Predictive Behaviour Implementation”, International Journal of Engineering and Techniques - Volume 1 Issue 3, May - June 2015.

[4] Shruthi Raghavan and Girma S. Tewolde, “Cloud based low-cost Home Monitoring and Automation System”, Proceedings of the 2015 ASEE North Central Section Conference, Copyright © 2015, American Society for Engineering Education.

[5] Subhajit Dey, Tamaghna Kundu, Sourav Mukherjee and Mili Sarkar,“ Web Based Real-Time Home Automation And Security System”, ISSN 2319 – 2518 www.ijeetc.com Vol. 4, No. 3, July 2015

[6] R.Anandan1, Mr.B.Karthik, Dr.T.V.U.Kiran Kumar,“ Wireless Home And Industrial Automation Security System Using GSM”, Journal of Global Research in Computer Science, ISSN-2229-371X, Volume 4, No. 4, April 2013