Vol.(6),No.(1),(2018),29-44
MUTHANNA JOURNAL OF ENGINEERING AND TECHNOLOGY (MJET)
مجلة المثنى للهندسة والتكنولوجيا
Journal homepage:www.muthjet.com
Print ISSN:2572-0317, Online ISSN:2572-0325

Wemos-D1 and Raspberry Pi3 Based Smart Communication and Control of Home Appliances System

Bilal Naji Alhasnawi [a*], Basil Hani[b]
[a,b] Electrical Engineering Dept., College of Engineering ,University of Basrah

ARTICLE INFO

Received: 01/08/2017

Accepted: 17/08/2017

Keywords
MQTT; Raspberry Pi3 board; Home devices; Sensors; Wemose-D1 board.

ABSTRACT
Expansion in smart home technology assists people around the world to improve the quality of life individuals. Various smart home technologies considered in our work include Email based smart home systems, Bluetooth based smart home systems, Global System for Mobile communication or mobile based smart home systems, Short Messaging Service based smart home systems and Internet-based smart home systems. We need a low power device that transmits messages through a less verbose protocol. Owing to the ubiquitous availability of WiFi, all the appliances within a home can be connected through a common gateway (Raspberry pi3). This paper presents an overview of a lightweight Message Queuing Telemetry Transport (MQTT) protocol. Sensors and actuators are connected to Wemos-D1 board. In the prototype home, we implemented MQTT on Raspberry pi3 and Wemose-D1 board.

التحكم بالاجهزة المنزلية بالاعتماد على الأتصالات الذكية بين جهاز الويموس و الراسبري باي

الخلاصة
التطور في تكنولوجيا المنزل الذكي يساعد الناس في جميع أنحاء العالم لتحسين نوعية الحياة. في نظامنا المقترح تم تصميم و تنفيذ مجموعة طرق للمنزل الذكي تعتمد على تقنيات ذكية مختلفة. هذه الطرق تتضمن التحكم في الأجهزة المنزلية بواسطة البريد الالكتروني، التحكم في الأجهزة المنزلية بواسطة تقنية بلوتوث، التحكم في الأجهزة المنزلية بواسطة خدمة الرسائل القصيرة، التحكم في الأجهزة المنزلية بواسطة صفحة الويب عن طريق الإنترنت. نظرا لتوافر شبكة الواي فاي في اغلب المنازل، تم استخدام شبكة الواي فاي لتوصيل جميع الأجهزة داخل المنزل من خلال بوابة مشتركة (الراسبري باي). أيضا قدم هذه الورقة نظرة على بروتوكول الاتصال لنقل الرسائل عن بعد (MQTT) في الرسائل النصية. تم ربط أجهزة الاستشعار و الاجهزة المنزلية ب لوحة ويموس و يتم التحكم بهذه الاجهزة من خلال الراسبري باي. في المنزل الذي تمت التجربة عليه، تم تنفيذ بروتوكول MQTT على الراسبري باي ويموس.

الكلمات المفتاحية
جهاز ويموس, جهاز راسبيري باي, مجموعة متحسسات,اجهزة منزلية

*Correspoding author:.
E-mail addresses: bilalnaji11@yahoo.com

DOI:10.52113/3/eng/mjet/2018-06-01/29-44

Introduction

Wireless sensor networks (WSNs) consists of sensor nodes to obtain the monitoring information of the objects in their coverage areas. The nodes sense and transmit information indirectly or directly to the sink or Base Station (BS) in a wireless way [1]. WSNs improve the fault tolerance and precision by distributed processing and have broad application prospects in industry, military, daily life and agriculture [2]. In 2003[3], Liew, implemented a complete control system to control heating, ventilating, and air conditioning simulated with LabView, the whole system uses the home power line network for connectivity based on the X-10 standard. In 2004 [4], Karataş and Aksoy, used the X-10 standard as the basis of their microcontroller based home automation system and the PIC microcontrollers as a Master – Slave approach. Microcontrollers were used in control units for data processing and TDA5051A integrated modem for data transmission on the line. Noise is reduced by choosing the X10 protocol that sends control message twice; modem uses coupler circuit on sides connected to line .In 2004[5], BESTEPE used the Public Switch Telephone Network (PSTN) to read a digital electricity meter remotely through microcontroller connected with the serial port of the PC. The software used for remote reading was designed with Delphi 7.0 by using APRO (Asynchronous Professional) libraries. In 2005 [6], Wilson worked on the detection of the undesired interactions between home devices and services while allowing positive interactions between services and devices. He provided an online manager, which is responsible for avoiding interactions among services. He also produced one of the plug and play home network approaches. This was to minimize user interventions as possible an attempt, through introducing the approach of environmental variable. In 2008[7], LeMay designed a heterogeneous robust sub networks that manage to survive from a disaster. He provided a methodology to enhance the network by an Emergency-Response Network (ERN) using techniques from mobile ad-hoc networks. This ERN was to provide ability for home network to contact rescuers and /or relatives (specific contacts) in case of disasters. In 2008[8], Szabo designed a home automation system based on connecting the i^{2}home system with the PLC (programmable Logic Controller), which enables usage of wanted devices (PIR, magnetic, sensors, relays, switches). The system was designed to fulfill the requirements of persons with mild cognitive disabilities and older persons. In 2008[9], Hasaj designed an interesting smart home system. In his work, the system brain contains a neural network that able to learn automatically the inhabitants' behavior and help them in their everyday routine. The software part designed using JAVA, developed on Linux OS. The system was designed to support multiple interfaces. In 2016 [10] smart home was designed using, MQTT Publish/Subscribe Protocol and Django Web Framework to give users the capability to integrate many open source devices with open-source tools and mobile site optimization.

System overview

This research has focused on the use of modern technology to help manage smart home, which means home management automation in various ways. The proposed smart home system is a flexible system that can control and create a link between nearly all the loading devices in a home. All the devices can be controlled from any place in outdoors and indoors. The main advantages of this system are:

1- The user can control device through internet web page from anywhere.

2- Control can be by GSM (SMS), where the appliance is capable of recognizing the customer.

3- Control can be by Email, where the appliance is capable of recognizing the customer.

4- Control can be through an Android application for mobile phone by Bluetooth.

The first, second and the third mechanism is suitable to control home appliances from anywhere in the world during the fourth mechanism only applicable inside the house. In the internet web page, GSM, Email, and Bluetooth the field can be designed in zones. Each zone must contain at least one node (including the sensing required parameters and the controlling appliances). These nodes must communicate with the BSU by wireless Wi-Fi technology. Our design use MQTT Publish/Subscribe Protocol, node-red and Python to give the client the capability for integrating many open source tools with open-source devices and mobile site optimization. The MQTT publish/subscribe protocol between machines that have the capability of connecting to a network (between Raspberry pi3 and ESP8266 for Wemos-D1 and between raspberry pi3 and node red dashboard). Raspberry pi3 Service Interface Programming messages can be exchanged using MQTT. The central benefit is that clients can join their requirements to numerous nodes: as a replacement for opening a socket for each microcontroller, the client can simply publish and subscribe messages to a broker. Similarly, the MQTT bridges forward serial messages from the board to publish actions for appropriate topics and to route subscribed messages to the serial channel [11]. To provide greater detail, it was assumed that each microcontroller was identified via a single name.

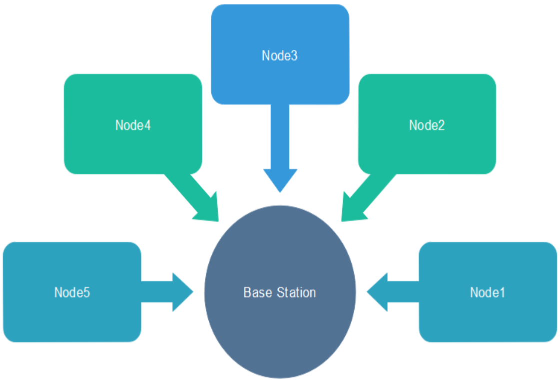


Figure1: Proposed system diagram

Methodology

The system have input processing and output that are shown in below:

A. Internet web page Module (For Dashboard-Based smart home)

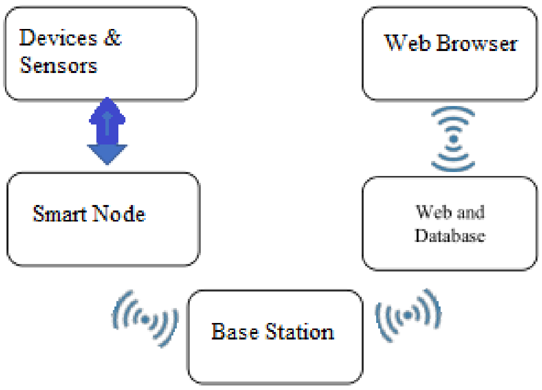


Figure 2:Block diagram of internet web page connection

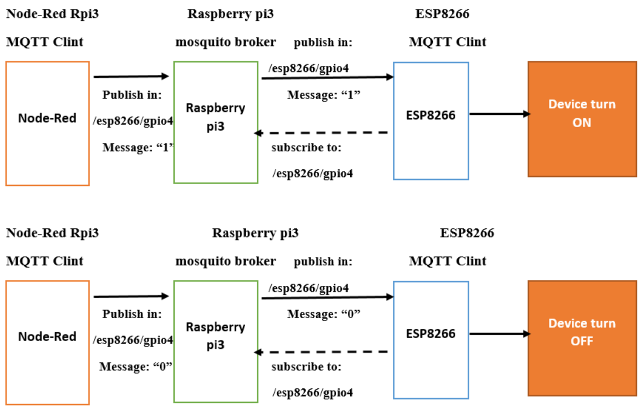


Figure 3: Show overview of the internet system

By using internet web page, we can control our load connections from any place and anywhere that we want. It's a new system that we are proposed for the smart home system. Just guess we are out of our country and need to know the status of our home. For this system, we have to make an account on the ngrok website.

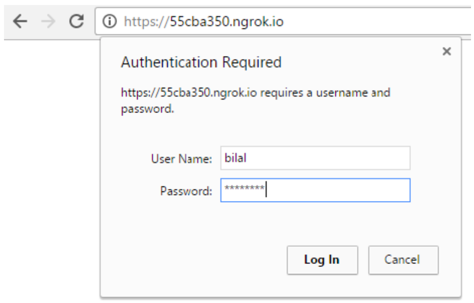
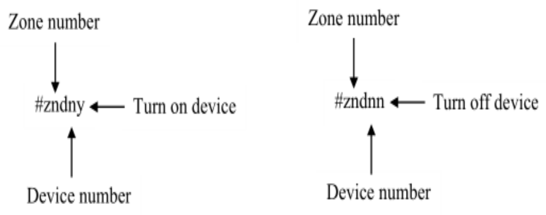


Figure 4: Show Access the home page to control your smart home

B. GSM-SMS

The system allows home devices control using message phone through GSM (global system for mobile communication) technology. Message communications is a dynamic solution for such remote controlling activities. SMS (short message service) can be used to control home device from a long distance. Remotely control system allows the home owner to control the home devices from mobile phone set by commands (z1d1y, z1d1n, z2d1y and z2d1n) in the form of SMS messages and receiving the appliances that are actually the GSM number for knowing the status. Devices control (switch on and off) is performed by sending a code as SMS from a mobile code 's formula is shown below:-



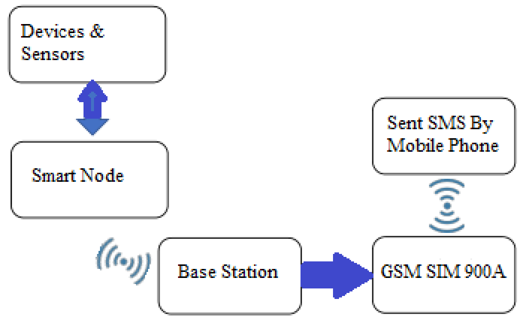


Figure 5: Block diagram of GSM connection

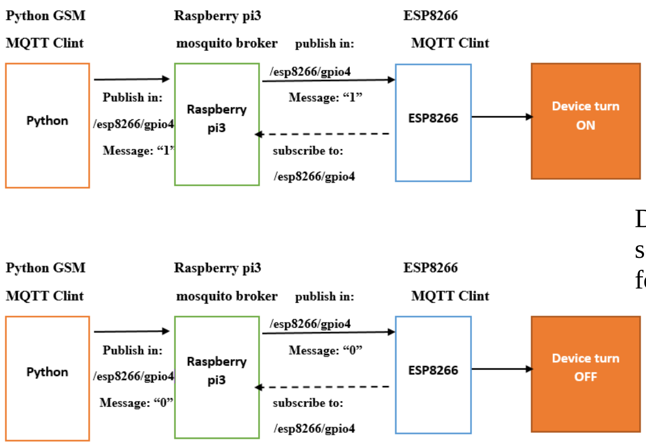


Figure 6: Show overview of the GSM system

C. Bluetooth

Our third method use Bluetooth HC-05. To create the Bluetooth connection, we need five Bluetooth HC-05 devices, five wemose-d1, channel relay shield, one Android application to control the system and six light and other devices to be able to demonstrate how the system works.

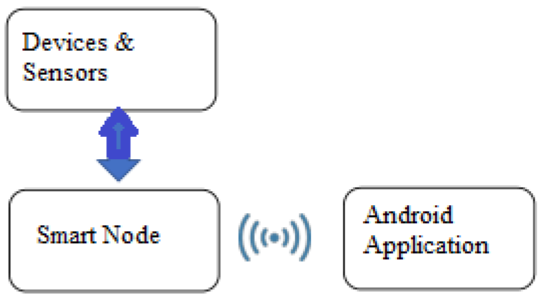


Figure 7: A pictorial view of Bluetooth setup.

D- Devices control and receive notification through email

Fig. 8 describes the configuration of the proposed system. Wemose-d1 and Raspberry Pi3 has been chosen as the processing unit for the system because of its user friendly features and economic benefits. More, Node-RED coded algorithm has been fed into the raspberry Pi3 it is connected to the internet through Wireless network (Wi-Fi) interface to access and send Email to the consumer. Results were given by a series of E-mails sent to the G-mail account of raspberry pi3 and the corresponding inbox and sent mails of raspberry pi G-mail account is shown in Fig. 36.

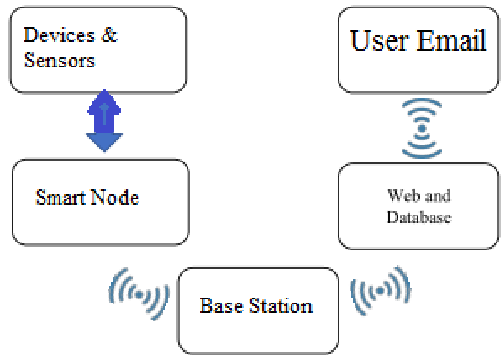
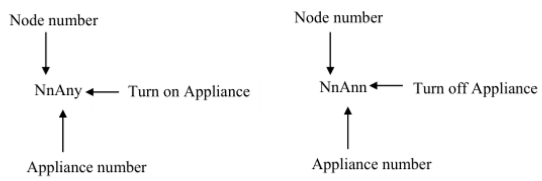


Figure 8: Show email processing

Devices control (switch on and off) is performed by sending a code as an email from an email code 's formula is shown below:-



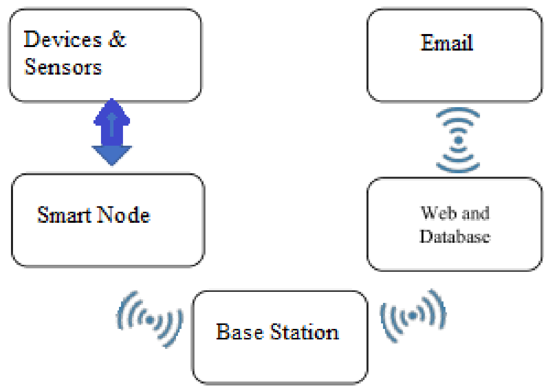


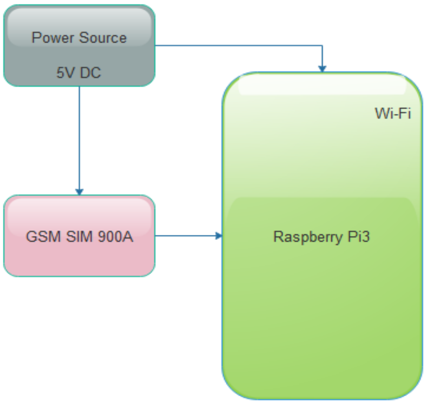
Figure 9: Block diagram of Email connection

Hardware Description

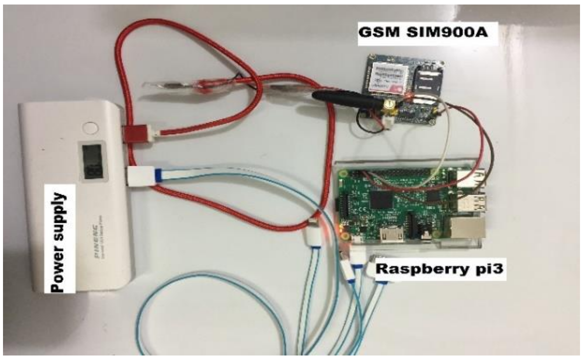
The system hardware consists of a single BSU and numerous SUs. The details are as follows:

A. The Base Station Unit (BSU)

The base station plays a key role in the designed system. The hardware of base station consists of a Raspberry pi3 board, GSM SIM 900A, which is used for monitoring the required parameters and Wi-Fi model used to communicate wirelessly between the SUs and BSU. Fig. 10(a), shows the BSU schematic diagram and Fig. 10(b), shows the internal construction of a prototype BSU that used for implementing the system.



(a)



(b)

Figure 10: Base station unit. (a) Schematic diagram. (b) Internal construction.

1. The Raspberry pi3 Board

The Raspberry Pi 3 board model B has a processor of 1.2 GHz 64-bit quad-core ARMv8 CPU and 1 GB RAM which almost acts like a mini computer. Raspberry pi 3 board has 802.11n wireless LAN and Bluetooth 4.1. We installed Raspbian Jessey in the memory card used for the board. Raspberry Pi 3 has a LINUX based operating system call Raspbian. There are also 40 GPIO pins can be used as both digital input, digital output to control and interface with various other devices in the real world, 4 USB ports, 1 HDMI port, 1 Ethernet port, 1 3.5mm Audio jack, micro USB power supply. This board also has serial connections for connecting a camera (CSI) and a display (DSI) [17] [18]. Fig. 11 shows the raspberry pi3 model B board.

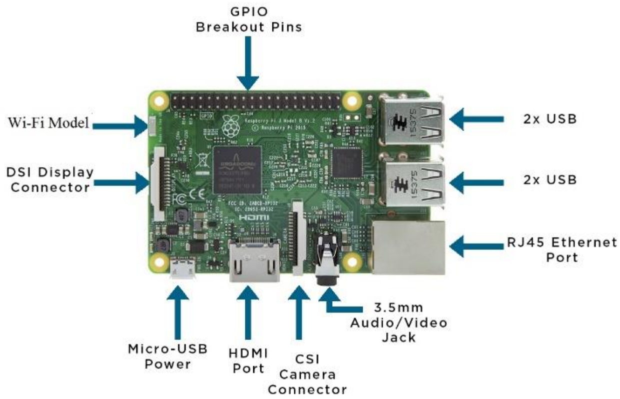


Figure 11: Raspberry Pi3 Board.

2. GSM SIM 900A

GSM (Global System for Mobile communication) is a digital mobile system used in Iraq and other parts of the world. GSM uses one wireless telephone technologies such as TDMA. It can only understands AT commands, and can respond accordingly to it. The SIM900A is a complete Quad-band GSM/GPRS solution in an SMT module which can be embedded in the user applications. Featuring an industry-standard interface, the SIM900A provide GSM 850/900/1800/1900MHz performance for voice, SMS, Data, in a small form factor and with low power consumption. With a tiny configuration of 24mm x 24mm x 3 mm, SIM900A is used for slim and compact demand of design especially in M2Mapplication.SIM900 is designed with a very powerful single-chip processor. The TX pin of GSM is connected to digital pin RX of raspberry pi3 and the RX pin is connected to digital pin TX of raspberry pi3.

3. The Wi-Fi Module

In this work, the Wi-Fi modules are used for Wi-Fi wireless communication in the system.

B. The Sensor Units (SUs)

The SUs are responsible for the measurements of water level, humidity, temperature, flam, light intensity, and gas depending on the sensors content in the nodes. Each node has Wemose-D1 microcontroller. Sensor Units supported with an ESP8266 board for processing the signals from the sensors and a Wi-Fi to communicate wirelessly with BSU.

A . Microcontroller Wi-Fi wemose-d1

Wemose-d1 is a low cost development board that consolidates GPIOs, I2C, UART, ADC, PWM and WiFi for rapid prototyping. Powered by 5V supply, ESP8266 together with voltage regulator and USB to serial is packaged as Wemose-d1 module. Applications can be developed on this board through Arduino IDE or Lua based ESPlorer.. You can create an MQTT communication, control outputs, read inputs and interrupts. The wemose-d1 comes with more GPIOs for your projects [19].

Figure 12: Wemose-D1 Board.

1. The First Sensor Unit for the Bedroom

The first sensor unit is system microcontroller that responsible for the measurements of temperature and control (turn on/off) of light, Air condition, and control (open/close) door and window. LM35 sensor is used for sensing the temperature. Fig. 13, shows the schematic diagram of the first sensor unit.

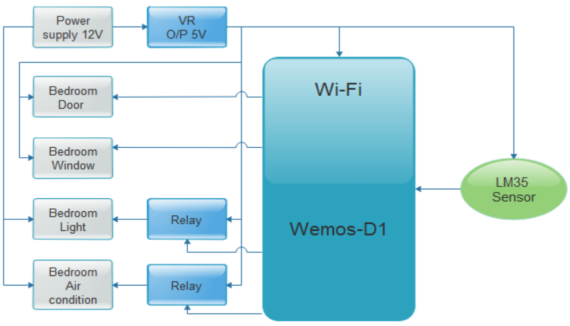


Figure 13: The system first node schematic diagram.

2. The Second Sensor Unit for the hall, garden and water tank.

The second sensor unit is system microcontroller that responsible for the measurements of the Water level of the tank, the intensity of the garden light, Control (turn on/off) of garden light, water pump, hall light, Control (open/close) hall door. The ultrasonic sensor is used for sensing the Water level of the tank. The LDR sensor is used for sensing the intensity of the garden light. Fig. 14, shows the schematic diagram of the second sensor unit.

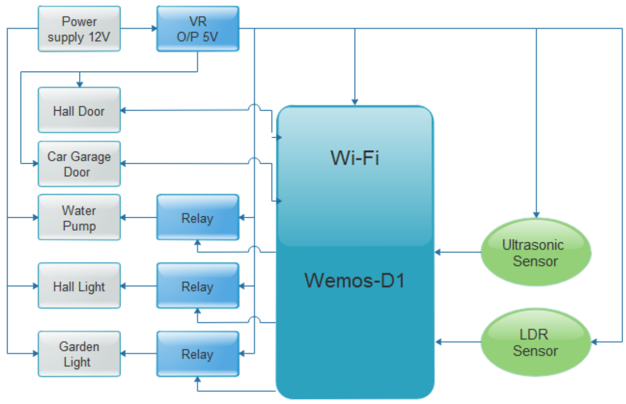


Figure 14. The system second node schematic diagram.

3. The Third Sensor Unit for the living room.

The third sensor unit is the system microcontroller that responsible for the measurements of temperature and control (turn on/off) of light, TV, and control (open/close) door and window. DHT11 sensor for sensing the temperature and humidity. Fig. 15, shows the schematic diagram of the third sensor unit.

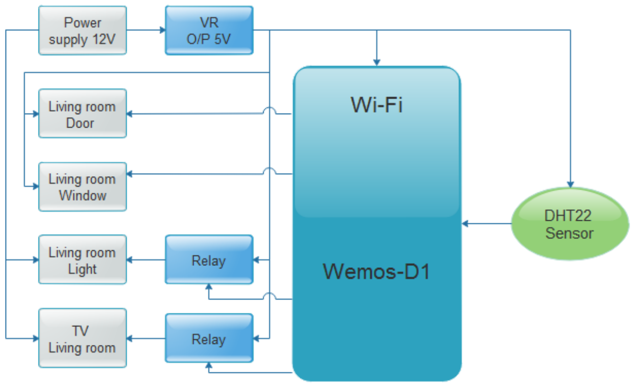


Figure 15: The system third node schematic diagram.

4. The forth Sensor Unit for the kitchen.

The forth sensor unit is the system microcontroller that responsible for the measurements of gas and flam. Control (turn on/off) of light, refrigerator. Control (open/close) kitchen doors and windows. Fig. 16, shows the schematic diagram of the fourth sensor unit.

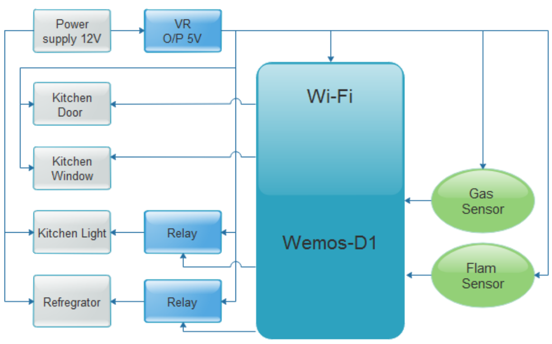


Figure 16: The system forth node schematic diagram.

5. The fifth Sensor Unit for office.

The fifth sensor unit is the system microcontroller that responsible for the measurements of office motion. Control (turn on/off) of light, computer and Control (open/close) office doors. Fig. 17, shows the schematic diagram of the fifth sensor unit.

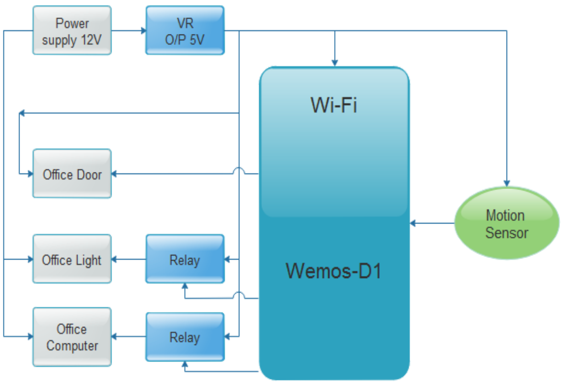


Figure 17: The system fifth node schematic diagram.

Software Description

The software part contains the programming of Wi-Fi network, the system protocol using the wemose-d1 Integrated Development Environment (IDE) and raspberry pi3 with Python and node-red.

A-Node red dashboard internet web page.

Node-RED is open source and developed by IBM (International Business Machines). The open source language is used in this project to the selection of node-red, a high–level Framework Web.

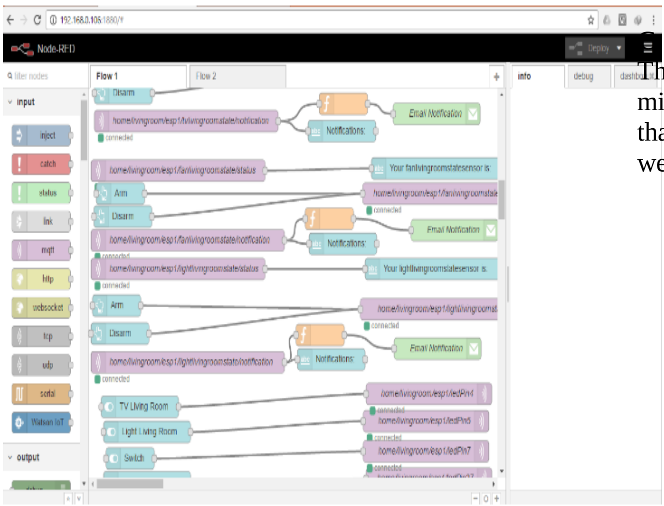


Figure 18: Show node-red code

Node-red is a powerful open source tool for building IoT applications with the aim of simplifying the programming component. It uses a visual programming that allows you to connect code blocks, known as nodes, together to perform a task.

B. Wi-Fi Network

In this work, a simple point-to-multipoint topology is used. This can be achieved by using python and IDE software that used for Wemose-d1 and raspberry pi3 module configuration for building the wireless Wi-Fi network. In this simple network, all nodes are managed by a central node which is called a coordinator or master or base station. Fig. 19 shows the base station configuration by using Python software and Fig. 20 shows the node configuration by using IDE software.

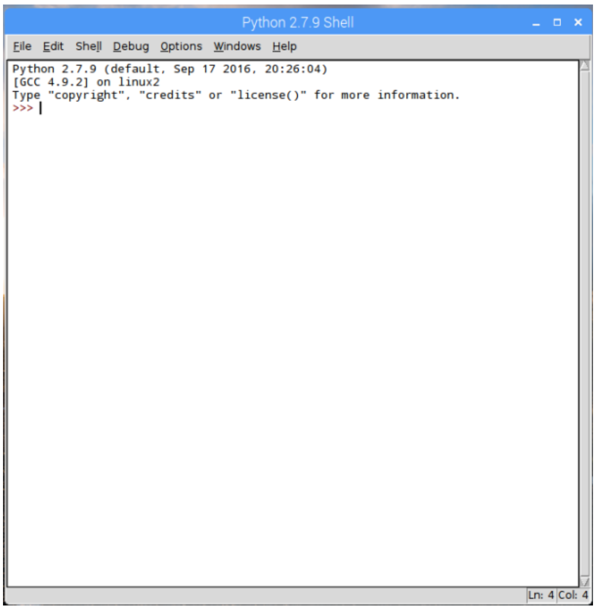


Figure 19: The base station configuration by using Python software

wemose-d1 IDE

The wemose-d1 board which contains an ESP8266 microcontroller is programmed using IDE software that utilizes C language. The screenshot of the wemose-d1 software can be seen in Fig. 20.

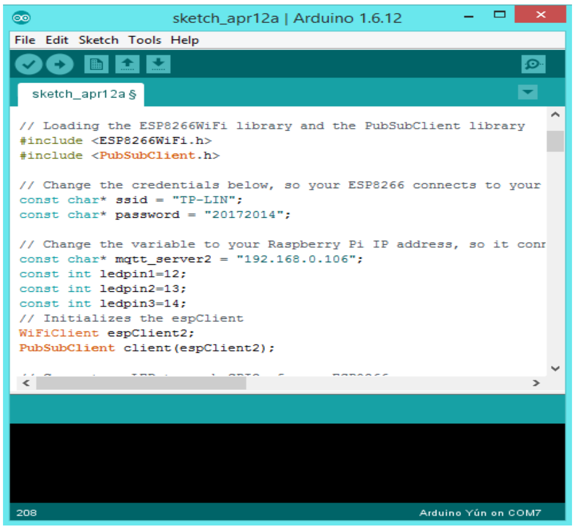


Figure 20: The node configuration by using IDE software

D. Android Application

Fig.33. shows a smart phone application to communicate with the wemose-d1 board. The smart phone application is developed using MIT AppInventor. The advantage of using this AppInventor open-source platform instead of Java that it is easy to program and extremely user friendly. Since this project is a prototype for a real smart home, the software needs to be easy to understand and modify. The Bluetooth module needs to be paired manually before using the application. A person can choose the address of the Bluetooth module in order to connect with it and then communicate with the wemose-d1 board. Note that only one phone can be connected to the bluetooth module at once.

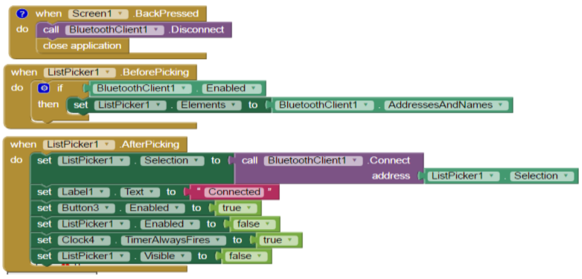


Figure 21: Show MIT app inverter code

B. The System Protocol

We can describe the system protocol as following, after power up, the base station Unit (BSU) sends addresses data to all SUs for getting the data. The SU responds according to its address from the BSU, if the SU address matches the BSU, it can evaluate the measurement of the sensor, then sends these data with address to the BSU. The BSU checks the data according to the determined threshold values and sends the control signals to the required node in order to turn on or turn off the devices. The data and the node state will be displayed on the raspberry pi screen in the BSU.

Fig. 22 shows a flowchart of the BSU while Fig. 23, Fig. 24, Fig. 25, Fig. 26, Fig. 27 shows a flow charts of the SUs.

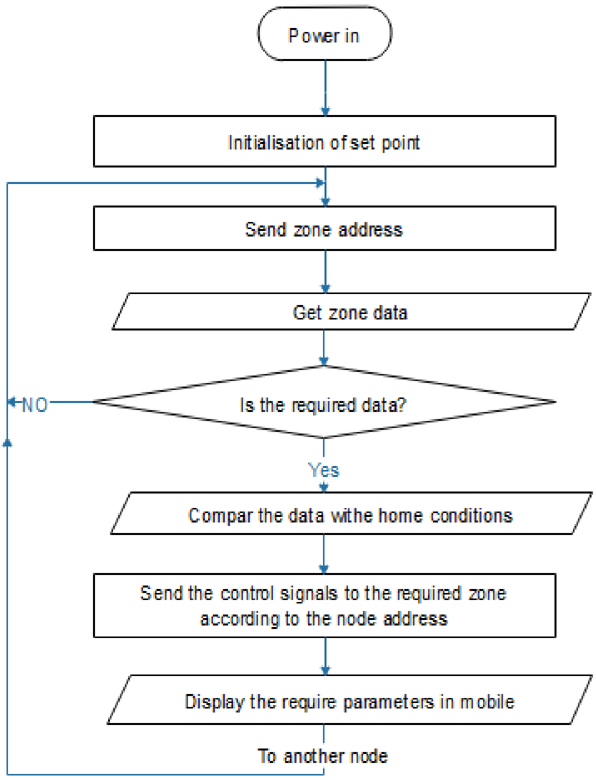


Figure 22: BSU flowchart

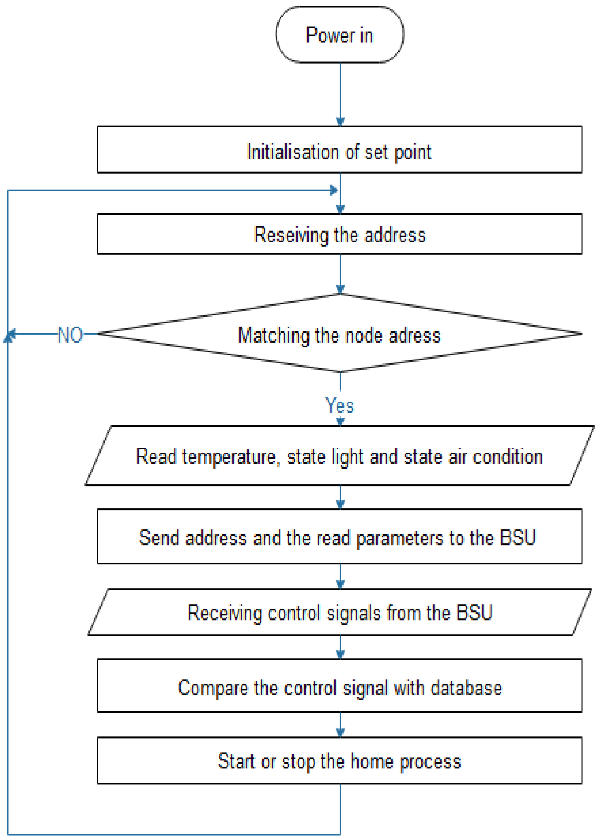


Figure 23: first SU flowchart

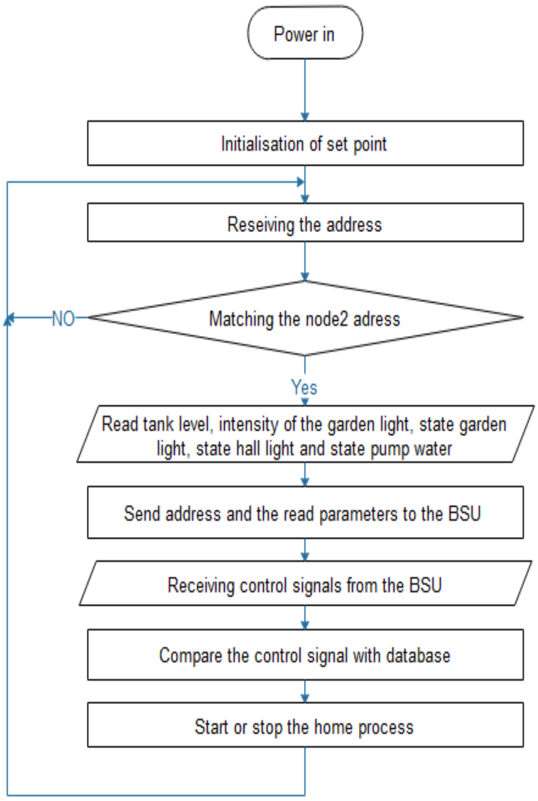


Figure 24: second SU flowchart.

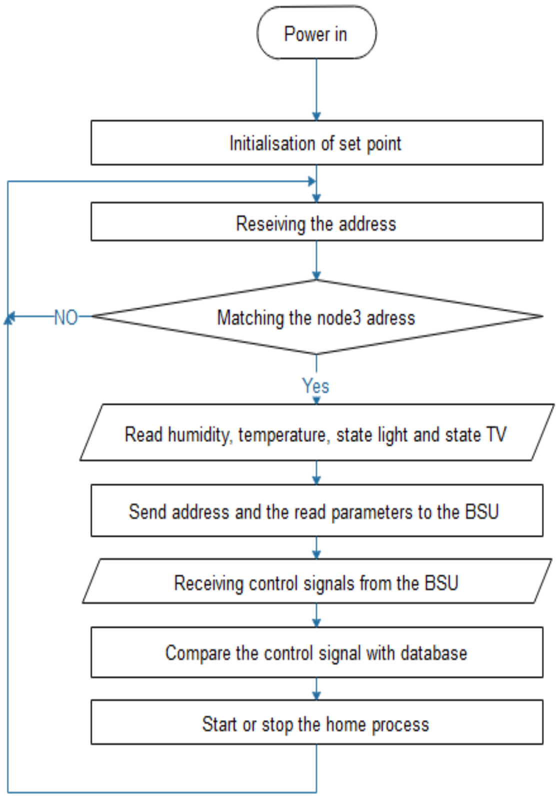


Figure 25: third SU flowchart.

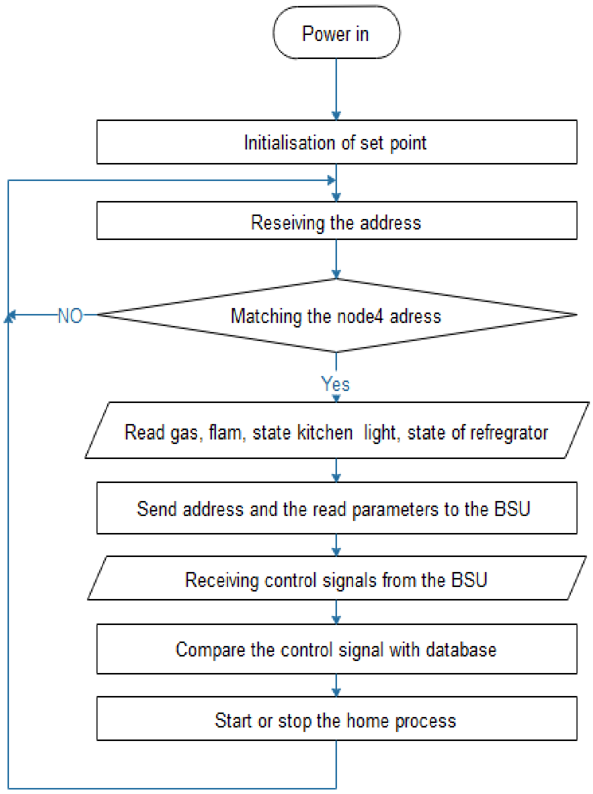


Figure 26: forth SU flowchart.

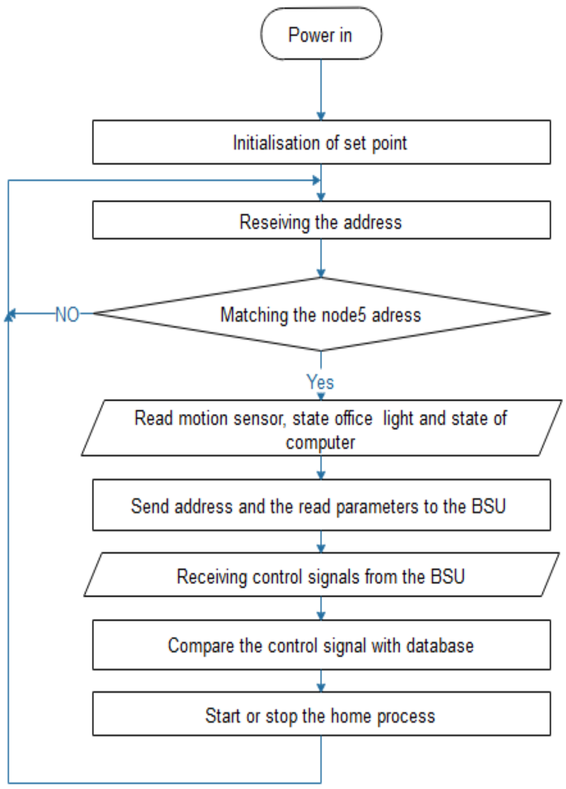
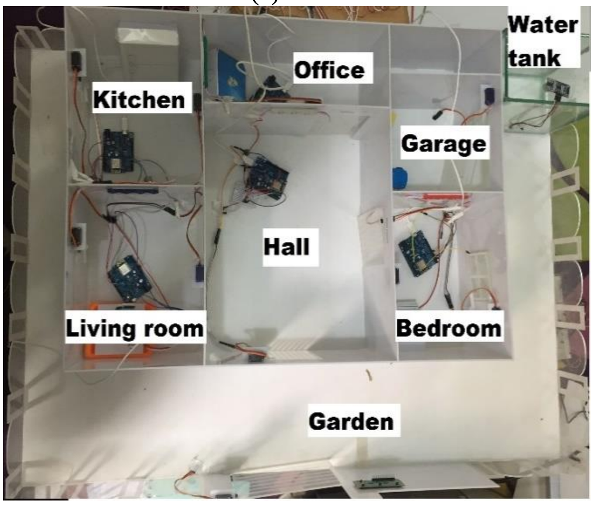


Figure 27 :fifth SU flowchart.

Results and Discussion

The proposed system has been applied to typical house in the actual field for measuring required data from weather field using LM35 sensor, temperature and humidity sensor, motion sensor, water level sensor, intensity light sensor, flam sensor and a gas sensor. Finally the system is able to control lights, doors, windows and other devices.

(a)



(b)

Figure 28: typical home. (a) and (b)

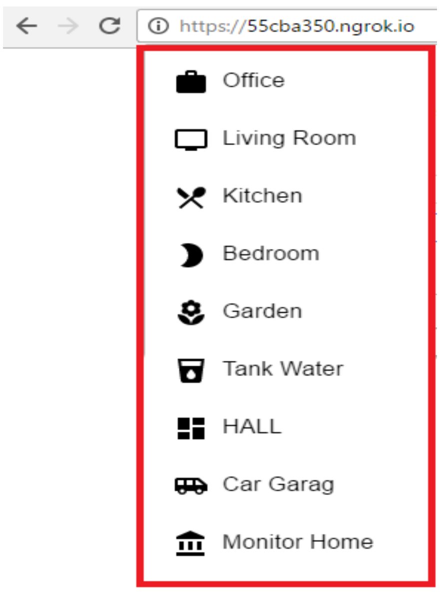


Figure 29: List of contents of the internet web page

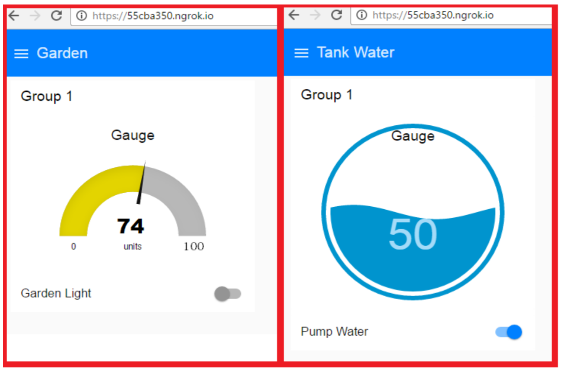


Figure 30:Contents of the garden and water tank

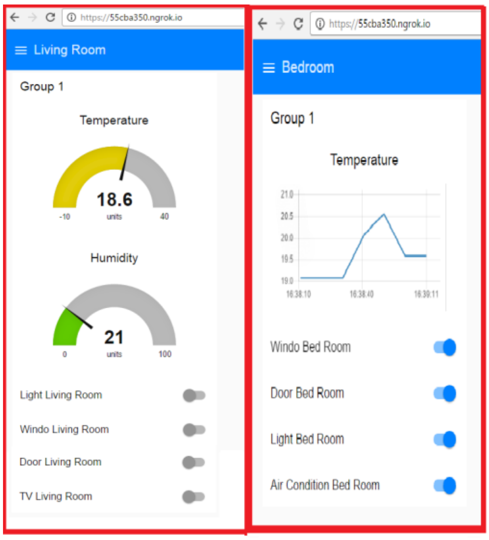


Figure 31: Contents of the living room and bedroom

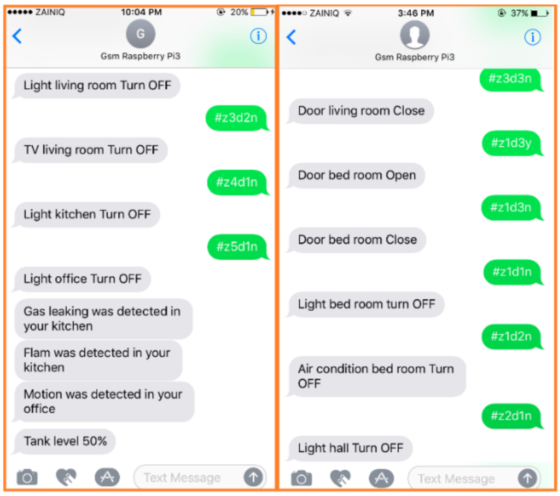


Figure 32:control and monitor appliances home by SMS to GSM

Figure 3: Show Bluetooth application in android phone

Figure 34:show office and kitchen of Bluetooth application

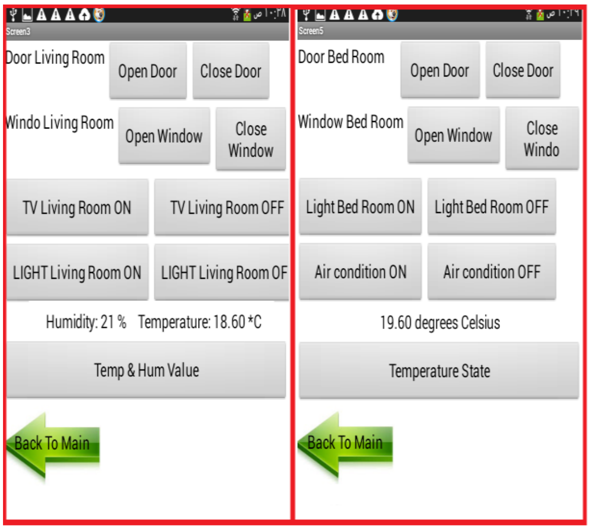


Figure 35:show living room and bedroom of Bluetooth application

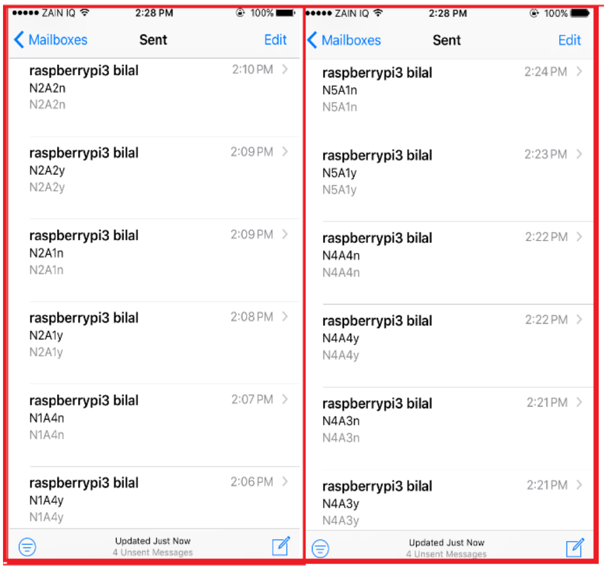


Figure 36 :Control of home appliances by the email

Table 1 shows the different cases of zone1 working

Comman ds from internet page	Sent SMS from Mobile	Sent from Emai l	Commands from android application by Bluetooth	Actions carried out	message to internet page	SMS to mobile	message to Android application	message to the email
Bedroom light ON	#z1d1y	N1A1 y	Bedroom light ON	Bedroom light turn ON	Light ofbedroom turn ON	Lightof bedroom turn ON	Light of bedroom turn ON	Light of bedroom turn ON
Bedroomli ght OFF	#z1d1n	N1A1 n	Bedroomlight OFF	Bedroomlig ht turn OFF	Light ofbedroom OFF	Lightof bedroom OFF	Light of bedroom OFF	Light of bedroom OFF
Bedroom air condition ON	#z1d2y	N1A2 y	Bedroom air condition ON	Bedroom air condition turn ON	Air condition of Bedroom turn ON	Air condition of Bedroom turn ON	Air condition of Bedroom turn ON	Air condition of Bedroom turn ON
Bedroom air condition OFF	#z1d2n	N1A2 n	Bedroom air condition OFF	Bedroom air condition turn OFF	Air condition of Bedroom turn OFF	Air condition of Bedroom turn OFF	Air condition of Bedroom turn OFF	Air condition of Bedroom turn OFF
Open bedroom door	#z1d3y	N1A3 y	Open bedroom door	Open the bedroom door	Door of bedroom open	Door of bedroom open	Door of bedroom open	Door of bedroom open
Close bedroom door	#z1d3n	N1A3 n	Close bedroom door	Close the bedroom door	Doorof bedroom close	Door ofbedroom close	Door ofbedroom close	Doorof bedroom close
Openbedr oom window	#z1d4y	N1A4 y	Open bedroom window	Open the bedroom window	window ofbedroom open	window ofbedroom open	windowof bedroom open	windowof bedroom open
Close bedroom window	#z1d4n	N1A4 n	Closebedroom window	Close thebedroom window	the window of bedroom close	the window of bedroom close	the window of bedroom close	the window of bedroom close

Table 2: The work of the first zone sensor

Sensor sensitivity	message to user internet web page	message to user mobile phone by SMS	message to user Android application	message to the email user
LM35	Value of temperature	Valueof temperature	Value oftemperature	Valueof temperature

Table 3 shows the different cases of zone2 working

Commands from internet page	Commands from mobile	Commands from email	Commands from android application by Bluetooth	Actions carried out	message to user internet page	message to user mobile	message to Android application	message to email user
Hall light ON	#z2d1y	N2A1y	Hall light ON	Hall light turn ON	Light of hall turn ON	Light of hall turn ON	Light of hall turn ON	Light of hall turn ON
Hall light OFF	#z2d1n	N2A1n	Hall light OFF	Hall light turn OFF	Light of hall turn OFF	Light of hall turn OFF	Light of hall turn OFF	Light of hall turn OFF
Garden	#z2d2y	N2A2y	Garden	Garden	Light of	Light of	Light of	Light of

light ON			light ON	light turn ON	garden turn ON	garden turn ON	garden turn ON	garden turn ON
Garden light OFF	#z2d2n	N2A2n	Garden light OFF	Garden light turn OFF	Light of garden turn OFF	Light of garden turn OFF	Light of garden turn OFF	Light of garden turn OFF
Open hall door	#z2d3y	N2A3y	Open hall door	Open the hall door	Door of hall open	Door of hall open	Door of hall open	Door of hall open
Close hall door	#z2d3n	N2A3n	Close hall door	Close the hall door	Door of hall close	Door of hall close	Door of hall close	Door of hall close
Open car garage door	#z2d4y	N2A4y	Open car garage door	Open the car garage door	Door of car garage open	Door of car garage open	Door of car garage open	Door of car garage open
Close car garage door	#z2d4n	N2A4n	Close car garage door	Close the car garage door	Door of car garage close	Door of car garage close	Door of car garage close	Door of car garage close

Table 4: The work of the second zone sensors

Sensor sensitivity LDR	message to user dashboard web page Value of lightintensity	message to user mobile phone by SMS Valueof light intensity	message to user Android application Valueof light intensity	message to the email user Value of lightintensity
ULTRASONIC	Value of water level	Value of waterlevel	Valueof water level	Value of water level

Table 5 shows the different cases of zone3 working

Commands from internet page	Commands from mobile	Commands from email	Commands from android application by Bluetooth	Actions carried out	message to user internet page	message to mobile	message to Android application	message to email
Living room light ON	#z3d1y	N3A1y	Livingroom light ON	Living room light turn ON	Light of living room turn ON	Light of living room turn ON	Light of living room turn ON	Light of living room turn ON
Living room light OFF	#z3d1n	N3A1n	Livingroom light OFF	Livingroom light turn OFF	Light of living room turn OFF	Light of livingroom turn OFF	Lightof living room turn OFF	Lightof living room turn OFF
Livingroom TV ON	#z3d2y	N3A2y	Livingroom TV ON	Livingroom TV turn ON	TV of livingroom turn ON	TV of livingroom turn ON	TV of livingroom turn ON	TV of livingroom turn ON
Livingroom TV OFF	#z3d2n	N3A2n	Living room TV OFF	Living room TV OFF	TV of livingroom turn OFF	TV of livingroom turn OFF	TV of living room turn OFF	TV of livingroom turn OFF
Open Living room door	#z3d3y	N3A3y	Open Living room door	Open the Living room door	Door of living room open	Door of livingroom open	Door of livingroom open	Door of livingroom open
Close Living room door	#z3d3n	N3A3n	Close Living room door	Close the Living room door	Door of living room close	Door of living room close	Door of living room close	Door of living room close

Open Living room window	#z3d4y	N3A4y	Open Living room window	Open the Living room window	the window of the livingroom open	the window of the livingroom open	the window ofthe living room open	the window ofthe living room open
Close Living room window	#z3d4n	N3A4n	Close Living room window	Close the Living room window	the window of living roomclose	the window of living roomclose	the window of livingroom close	the window of living roomclose

Table 6 : The work of the third zone sensor

Sensor sensitivity	message to user internet page	message to user mobile	message to Android application	message to email
DHT11	Valueof temperatureand humidity	Valueof temperature and humidity	Value of temperature and humidity	Value of temperature and humidity

Table 7 shows the different cases of zone4 working

Commands from internet page	Commands from mobile	Commands from email	Commands from android application by Bluetooth to	Actions carried out	message to internet page	message to mobile	message to Android application	message to email
Kitchen lightturn ON	#z4d1y	N4A1y	Kitchen light turn ON	Kitchen lightturn ON	light of kitchen turn ON	light of kitchen turnON	light of kitchen turnON	light of kitchen turn ON
Kitchen lightturn OFF	#z4d1n	N4A1n	Kitchenlight turn OFF	Kitchenlight turn OFF	light of kitchen turn OFF	lightof kitchen turn OFF	light of kitchen turnOFF	light of kitchen turn OFF
Kitchen refrigerator turn ON	#z4d2y	N4A2y	Kitchen refrigerator turn ON	Kitchen refrigerator turn ON	Refrigerator of kitchen turn ON	Refrigerator of kitchen turn ON	Refrigerator of kitchen turn ON	Refrigerator of kitchen turn ON
Kitchen refrigerator turn OFF	#z4d2n	N4A2n	Kitchen refrigerator turn OFF	Kitchen refrigerator turn OFF	Refrigerator of kitchen turn OFF	Refrigerator of kitchen turn OFF	Refrigerator of kitchen turn OFF	Refrigerator of kitchen turn OFF
Open the kitchen door	#z4d3y	N4A3y	Open the kitchen door	Open the kitchen door	Door of kitchen open	Door of kitchen open	Door of kitchen open	Door of kitchen open
Close the kitchen door	#z4d3n	N4A3n	Close the kitchen door	Close the kitchen door	Door of kitchen close	Door of kitchen close	Door of kitchen close	Door of kitchen close
Open the kitchen door	#z4d4y	N4A4y	Open the kitchen door	Open the kitchen door	the window of kitchen open	the window of kitchen open	the window of kitchen open	the window of kitchen open
Close the kitchen door	#z4d4n	N4A4n	Close the kitchen door	Close the kitchen door	the window of kitchen close	the window of kitchen close	the window of kitchen close	the window of kitchen close

Table 8: The work of the fourth zone sensors

Sensor sensitivity	message to internet page	message to mobile	message to Android application	message to email
GAS great threshold	Gas leaking was detected in your kitchen	Gas leaking was detected in your kitchen	Gas leaking was detected in your kitchen	Gas leaking was detected in your kitchen
FLAM great	Flam was detected in	Flam was detected in	Flam was detected in	Flam was detected in your

threshold	your kitchen	your kitchen	your kitchen	kitchen
Gas less from threshold	No gas	No gas	No gas	No gas
Flam less from threshold	No flam	No flam	No flam	No flam

Table 9 shows the different cases of zone5 working

Commands from internet page	Commands from mobile	Commands from Email	Commands from android application by Bluetooth	Actions carried out	message to internet page	message to mobile	message to Android application	message to email
Office light ON	#z5d1y	N5A1y	Office light ON	Office light turn ON	light of office turn ON	light of office turn ON	light of office turn ON	light of office turn ON
Office light OFF	#z5d1n	N5A1n	Office light turn OFF	Office light turn OFF	light of office turn OFF	light of office turn OFF	light of office turn OFF	light of office turn OFF
Office computer ON	#z5d2y	N5A2y	Office computer ON	Office computer turn ON	Computer of office turn ON	Computer of office turn ON	Computer of office turn ON	Computer of office turn ON
Office computer OFF	#z5d2n	N5A2n	Office computer OFF	Office computer turn OFF	Computer of office turn OFF	Computer of office turn OFF	Computer of office turn OFF	Computer of office turn OFF
Open office door	#z5d3y	N5A3y	Open office door	Open the office door	Door of office open	Door of office open	Door of office open	Door of office open
Close office door	#z5d3n	N5A3n	Close office door	Close the office door	Door of office close	Door of office close	Door of office close	Door of office close

Table 10: The work of the fifth zone sensor

Sensor sensitivity	message to user internet page	message to mobile	message to Android application	message to email
Body in front of motion sensor	Motion was detected in your office	Motion was detected in your office	Motion was detected in your office	Motion was detected in your office
No Body in front of motion sensor	No motion	No motion	No motion	No motion

Conclusions

A smart home is a statement used to define a home that has highly feature smart systems for security, temperature, humidity, lighting control, windows and door automation and many other functions. A wireless sensor network with Raspberry Pi3, wemose-d1 which contain ESP8266 has been utilized, a number of open source software packages has a number of attractive features including scalable, low cost, compact, easy to maintain, easy to deploy and easy to customize. This paper presents the design and implementation of a low cost and security home system for overall customers. The safety level is increased due to the usage of Raspberry pi3.

References

1.R. Kulkarni, A. Forster and G. Venayagamoorthy,2011"Computational Intelligence in Wireless Sensor Networks: A Survey, Communications Surveys & Tutorials, IEEE, Vol. 4, No. 13, pp. 68–9.

2. J. Yick, B. Mukherjee and D. Ghosal, 2008"Wireless sensor network survey, Computer Networks, Elsevier Vol. 52, No. 12, pp. 2292–2330.

3. H. Chua In October 2001"Home Security System with Bluetooth Technology", Submitted for the degree of Bachelor of Engineering (HONOURS) In the Division of Electrical Engineering in Queensland University.

4. Y. Liew December 2003"Remote Control of Heating, Ventailating, and Airconditioning System with Labview", M.Sc. Thesis, Electrical Engineering, Mississippi State University.

5. P. Karataş and M. Aksoy, 2004"Microcontroller Based Home Automation", Proceedings of International Conference on Intelligent Knowledge Systems (IKS-2004), pp. 1-8. August 16-20.

6. F. Beştepe, December 2004 "Microcontroller-Based Multiport Communication System for digital electricity meters" , M.Sc. Thesis in Electrical and Electronic Engineering in the Middle East Technical University.

7. M. Wilson, September 2005"An Online Environmental Approach to Service Interaction Management in Home Automation", PhD Thesis in Computer Science, University of Stirling.

8. Z. Lin and L. Fu, 2007" Multi-user Preference Model and Service Provision in a Smart Home Environment", Automation Science and Engineering, IEEE International Conference on Volume, Issue 22-25, pp. 759 – 764.

9. M. LeMay, 2008"Dependable Emergency-Response Networking Based on Retaskable Network Infrastructures", M.Sc. Thesis in Computer Science in the Graduate College of the University of Illinois at Urbana-Champaign.

10. A. Szabó, 2008"Smart House", Diploma Thesis in Computer Science and Engineering, Czech Technical University in Prague Faculty of Electrical Engineering.

11. M. Hasaj, 2008"Smart Home – Opportunity to Make Life Easier", Msc. Thesis in Computer Science, University of Catalonia.

12. M. SIKANDAR, H. KHIYAL, A. KHAN, E. SHEHZADI, 2009 "SMS BASED WIRELESS HOME APPLIANCE CONTROL SYSTEM (HACS) FOR AUTOMATINGAPPLIANCESAND SECURITY," IEEE TECHNOLOGY, VOL. 6.

13. D. Han and Jae-Hyun Lim. 2010"Smart home energy management system using IEEE 802.15. 4 and zigbee." IEEE Transactions on Consumer Electronics, vol 56, no. 3, pp, 1403-1410,.

14. Byun, Jinsung, et al. 2012 "An intelligent self-adjusting sensor for smart home services based on ZigBee communications." IEEE Transactions on Consumer Electronics, vol. 58, no. 3 pp. 794-802.

15. A. Ahmim, Tam Le, E. Ososanya and S. Haghani. 2016 "Design and Implementation of a Home Automation System for Smart Grid Applications" IEEE.

16. Gianluca Barbon, Michael Margolis, Filippo Palumbo, Franco Raimondi and Nick Weldin 2016 "Taking Arduino to the Internet of Things: The ASIP programming Model" elsever.

17. Raspberry pi datasheet.

18.wemos-a1 datasheet

19. J. Wiley, and S. Inc, "Raspberry Pi For Dummies" 2013 simultaneously in Canada.