MINISTRY OF HIGHER EDUCATION
AND SCIENTIFIC RESEARCH
DIYALA UNIVERSITY
COLLEGE OF ENGINEERING
COMPUTER AND SOFTWAR
ENGINEERING DEPARTMENT

"SMART HOME SYSTEM"

A Project Submitted To The Department Of Computer And Software Engineering\College Of Engineering In Partial Fulfilment Of The Requirement For The Degree Of B.SC. In The Computer and Software Engineering.

BY:

Haneen Z.Zamel

Aseel N. Jameel

Abdallah Th.Toa'ma

SUP:

Khuder N. Abed

Royida A. Ibrahem

May 2016Rijab 1437

بسم الله الرحمن الرحيم

﴿يُؤْتِي الْحِكْمَةَ مَن يَشَاءُ وَمَن يُؤْتَ الْحِكْمَةَ فَقَدْ أُوتِيَ خَيْرًا كَثِيرًا وَمَا

يَذَّكَّرُ إِلَّا أُولُوا الْأَلْبَابِ﴾

(البقرة \269)

الاهداء

الى الممرة الأصيلة التي طالما سبقت دنياها وزمانها وأعطتنا الكثير

ديالي..

إلى اليد الطاهرة التي أزالت من أمامنا أشواك الطريق

ورسمت المستقبل بخطوط من الأمل والثقة

إلى الذي لا تفيه الكلمات والشكر والعرفان بالجميل

أبي الحبيب..

إلى من ركع العطاء أمام قدميها ,الغالية التي لا نرى الأمل إلا من عينيها

وأعطتنا من دمها وروحها وعمرها حبا وتضحيا ودفعا لغدٍ أجمل

أمي الحبيبة..

إلى أزهار النرجس التي تفيض حباً وطفولةً ونقاءً وعطراً

أخواتي الغاليين..

الى الذين تسكن صورهم وأصواتهم أجمل اللحظات والأيام التي عشتها

أصدقائي الاعزاء..

إلى من أخذ بيدي ... ورسم الأمل في كل خطوة مشيتها

أستاذي الفاضلين (خضر نجم , رويدة الحيالي)

نهديكم هذا الجهد المتواضع

حنين , أسيل , عبدالله

شكر وتقدير

الحمد لله رب العالمين والصلاة والسلام على سيد المرسلين محمد صلى الله عليه وسلم

الشكر والتنزيه لله العلي القدير الذي منّ علينا بنعمة الايمان والعلم ويشرفنا التقدم بالشكر والامتنان الجزيل الى الاساتذةالأفاضل "خضر نجم عبد"والاستاذة "رويدة عبدالله ابراهيم" لتفضلهما بالاشراف على هذا البحث وتوجيهاتهما القيمة في كل خطوة نخطوها وكل درب نسلكه.

ونتقدم بالشكر الى رئيس قسم هندسة الحاسوب والبرامجيات د. علي جاسم عبود وجميع أساتذتنا الافاضل على كل شي. ونتقدم بشكر خاص الى الذي كان عونا لنا في بحثنا هذا ونورا يضيء الظلمة التي كانت تقف أحيانا في طريقنا, الى من زرع التفاؤل في دربنا وقدم لنا المساعدات والتسهيلات والأفكار والمعلومات، ربما دون يشعر بدوره بذلك فله منا كل الشكرالزميل (أيمن جليل ابراهيم) .وشكر الى كل من شد ازرنا وساندنا وساعدنا .

الباحثين

حنين , أسيل , عبدالله

SUPERVISORS CERTIFICATION

We certify that this project entitled "**Smart Home System**",was prepared under our supervision at computer and software engineering department/ college of engineering by (**Haneen Z. Zamel**and**Aseel N. Jameel**and**Abdallah Th. Toa'ma**)as a partial fulfilment of requirements for the degree of B.Sc. in computer and software engineering**.**

Signature: **signature:**

Name: Khuder N. Abed **Name:Royida A. Ibrahem**

Title: Assistant Lecturer **Title: Assistant Lecturer**

Date: / / 2016 **Date: / / 2016**

In view of the available recommendations, I forward this project for debate by the examining committee.

Signature:

Name :Dr. Ali J. Abboud

(Head of the department)

Title : Lecturer

Date : / / 2016

CERTIFICATION OF THE EXAMINATION COMMITTEE

We certify that we have read this project entitled "**Smart Home System**"and as examining committee examined the studentsby(**Haneen Z. Zamel and Aseel N. Jameel and Abdallah Th. Toa'ma**)in its contents and that in our option it meets the standard of project for the degree of B.Sc. in Computer and Software Engineering.

Signature :

Name :

Title :

(Member)

Date :

signature :

Name :

Title :

(Member)

Date :

Signature :

Name :

Title :

(Chairman)

Date :

Approved for Computer and Software Engineering Department

Signature:

Name :Dr. Ali J. Abboud

(Head of the department)

Title : Lecturer

Date : / / 2016

Declaration

We hereby declare that the project entitled **"Smart Home System "** is the result of our own work and includes nothing which is the outcome of work done in collaboration except as declared in the preface and specified in the text, and is not submitted a degree or diploma or other qualification at the DiyalaUniversity **or** other University or similar institution except as declared in the preface and specified in the next. We further state that no substantial part of the thesis has already been submitted, or is concurrently submitted for any such degree, diploma, or other qualification at the DiyalaUniversity **or** other any other University or similar institutionexcept as declared in the preface and specified in the next.

HANEEN Z. ZAMEL

ASEEL N. JAMEEL

ABDALLAH TH. TOA'MA

Abstract

Smart Home (SH) technology, comprising smart devices in the home context, there are numerous possibilities to change the pattern of our lives in the future because of these smart devices, Smart home technology has demonstrated new and good contributions to increased safety and reliability, At the same time, it might have its own influence to change our living habit. Today mobile phones are not only used to make calls. Use of mobile phones is changing with the development of technology; it can be used for different purposes. It's Available in the market with various applications and hardware that can be implemented without any further development or enhancement of smartphones today. With the help of a network. Mobile phone can be used to implement the smart home by controlling the devices getting alerts on robbery and burglary. The Objectives of the project was to implement a smart home by controlling electronic devices at home remotely and to get an alert on intrusion or movement around the restricted premises. The devices were controlled by a mobile phone using the SMS service available and the alerts were also received as an SMS mentioning the activity occurring around the premises.

TABLE OF CONTENTS

CHAPTER ONE

INTRODUCTION

1.1. Introduction

Lifestyle in the modern society along with human behaviour and thinking is changing dramatically with the advancement of technology, and the concept of a simple home is changing into a smart home. 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. Mobile phones today are not just used to make calls. The use of mobile phones is changing with the development of technology and they can be used for different purposes. They can be used as clocks, calendars or controllers instead of being used just as phones. Today smart phones are available in the market with different applications and hardware which can be implemented without any further development or enhancement. With the help of the GSM network, a mobile can be used to implement a smart home by controlling devices and getting alerts on robbery and burglary. There are different types of built smart home systems in the market, and they do not have flexibility over choosing the types and number of sensors used and the cost of the system. These systems are prebuilt devices with a limited number of sensors, with a limited area of coverage and with a limited capacity to control the electronic devices. Therefore the idea of a smart home system was proposed, to overcome the limitations of the systems already available in the market. The user can choose the number of sensors, types of sensors, the area of coverage of the systems along with the number and types of electronic devices to be controlled. The cost of the system can be determined by the user as the cost depends on the hardware used in the system chosen by the developer. The goal of the project is to implement a smart home system by controlling the electronic devices at home remotely with the help of a mobile device and getting alerts on intrusion or movement around the restricted premises. The SIM900-GPRS module and the Adriano Uno Board are used to communicate between the mobile phone and the devices and sensors installed at home. The mobile phone can be used as a controller from anywhere in the world if the GSM network is available. The project consists of a led light which is controlled by the mobile phone to show the demo of controlling mechanism of the household devices such as light, fan or television. In addition, three

sensors are used as a heat detector, motion detector and intrusion detector which trigger the alarm upon reaching the critical limit. The system is limited to the area with the GSM network available and the whole system does not work without the network. [1]

1.2 Smart Home Systems

Smart Home is the term commonly used to define a residence that uses a Home Controller to integrate the residence's various home automation systems. The most popular Home Controllers are those that are connected to a Windows based PC during programming only, and are then left to perform the home control duties on a standalone basis. Integrating the home systems allows them to communicate with one another through the home controller, thereby enabling single button and voice control of the various home systems simultaneously, in pre-programmed scenarios or operating modes. The Home Automation field is expanding rapidly as electronic technologies converge. The home network encompasses communications, entertainment, security, convenience, and information systems. Power line Carrier Systems (PCS) is a technology which is used to send coded signals along a home's existing electric wiring to programmable switches, or outlets. These signals convey commands that correspond to "addresses" or locations of specific devices, and that control how and when those devices operate. A PCS transmitter, for instance, can send a signal along a home's wiring, and a receiver plugged into any electric outlet in the home could receive that signal and operate the appliance to which it is attached.X10 is a common protocol for PCS, it is a signalling technique for remotely controlling any device plugged into an electrical power line. X10 signals, which involve short radio frequency (RF) bursts that represent digital information, enable communication between transmitters and receivers. In Europe, technology to equip homes with smart devices centres. [2]

On development of the European Installation Bus, or Instabus. This embedded control protocol for digital communication between smart devices consists of a two-wire bus line that is installed along with normal electrical wiring. The Instabus line links all appliances to a decentralized communication system and functions like a

telephone line over which appliances can be controlled. The European Installation Bus Association is part of Konnex, an association that aims to standardize home and building networks in Europe. [1]

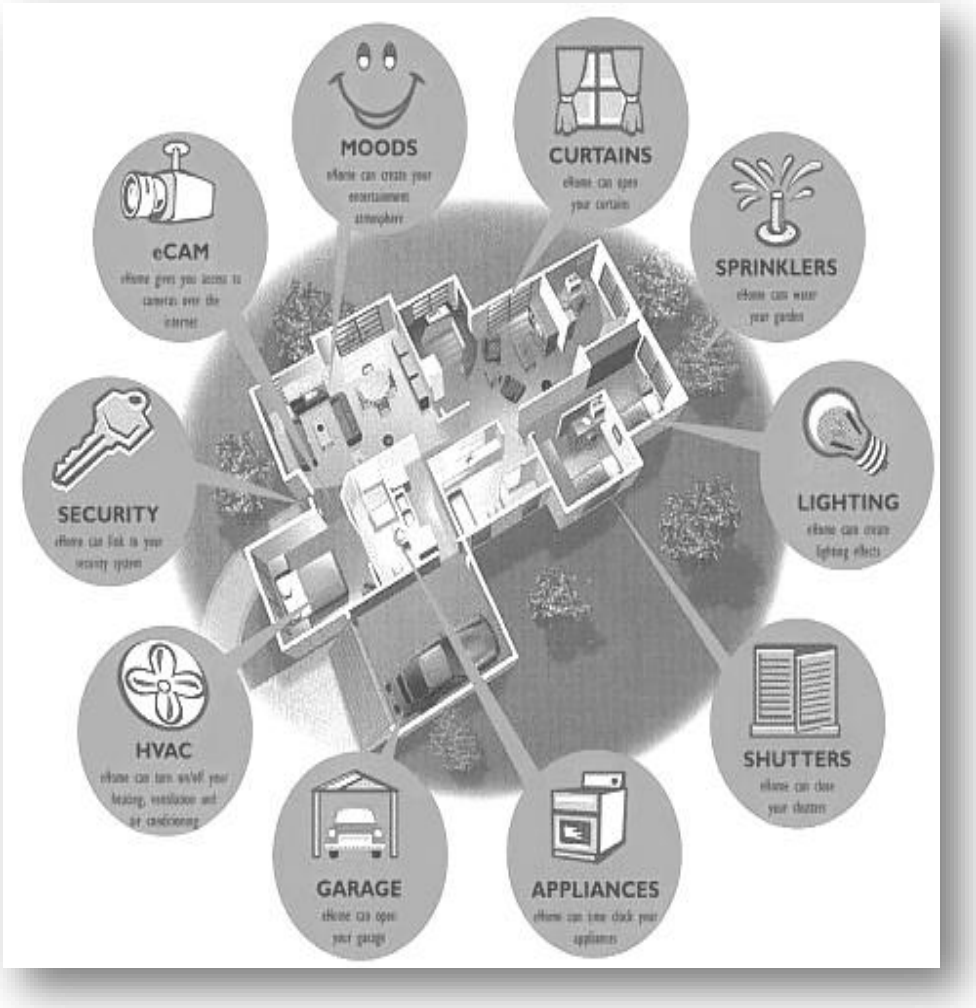

Figure 1.1 Smart Home Technology Automation

The creator of the Lon Works system, Echelon Corp., is helping drive adoption of an open interoperability standard among vendors in the control networks industry. Lon Works is an open standard for network automation and control for the building, transportation, industrial and home markets. The American National Standards Institute (ANSI) has adopted the protocol underlying Lon Works control networks as an industry standard. The Lon Mark Interoperability Association is made up of more than 200 controls companies' mission working on standard to integrate multi-vendor systems based on Lon Works networks. [2]

1.2.1 Smart Home Technology

All the appliances and devices are receivers, and the means of controlling the system, such as remote controls or keypads, are transmitters. If you want to turn off a lamp in another room, the transmitter will issue a message in numerical code that includes the following:

a) An alert to the system that it's issuing a command.

b) An identifying unit number for the device that should receive the command.

c) A code that contains the actual command, such as "turn off."

All of this is designed to happen in less than a second, but X10 does have some limitations. Communicating over electrical lines is not always reliable because the lines get "noisy" from powering other devices. An X10 device could interpret electronic interference as a command and react, or it might not receive the command at all. While X10 devices are still around, other technologies have emerged to compete for your home networking dollar. Instead of going through the power lines, some systems use radio waves to communicate, which is also how Wi-Fi and cell phone signals operate. However, home automation networks don't need all the juice of a Wi-Fi network because automation commands are short messages. The two most prominent radio networks in home automation are ZigBee and Z-Wave. Both of these technologies are mesh networks, meaning there's more than one way for the message to get to its destination.

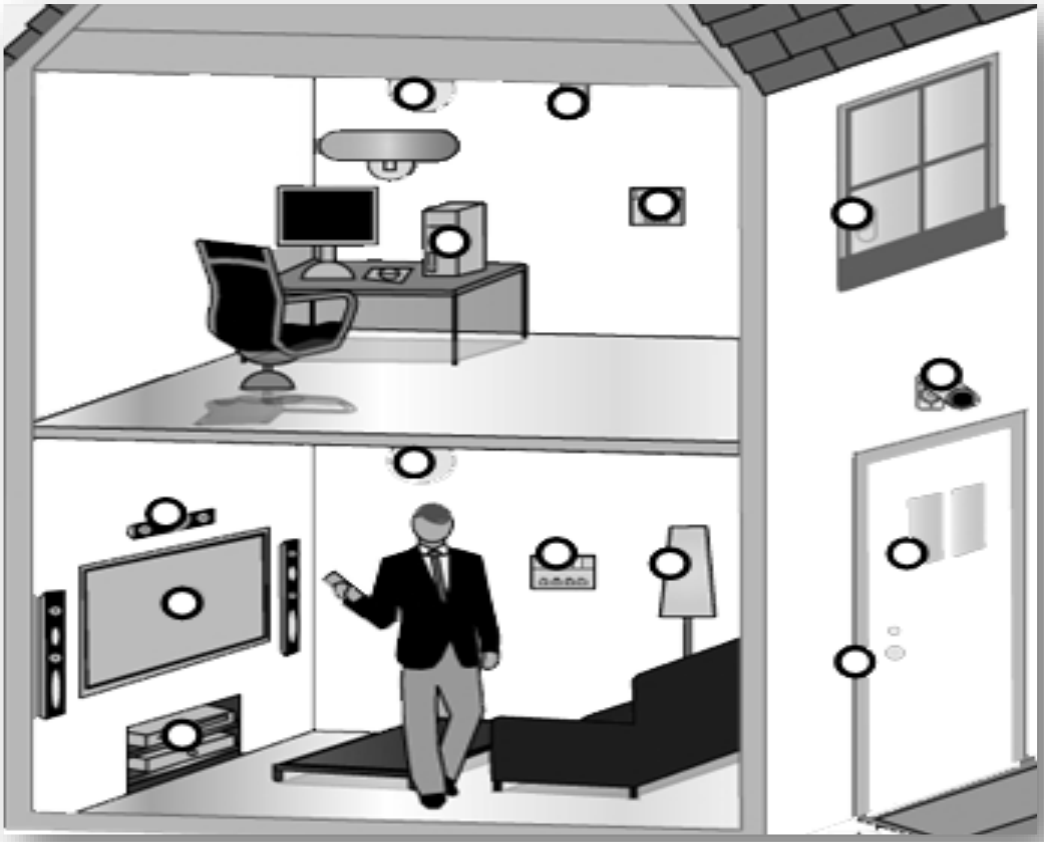

Figure 1.2 the dots represent devices that could be connected to your smart home network.

1.2.2 Z-Wave

Z-Wave uses a Source Routing Algorithm to determine the fastest route for messages. Each Z-Wave device is embedded with a code, and when the device is plugged into the system, the network controller recognizes the code, determines its location and adds it to the network. When a command comes through, the controller uses the algorithm to determine how the message should be sent. Because this routing can take up a lot of memory on a network, Z-Wave has developed a hierarchy between devices: Some controllers initiate messages, and some are "slaves," which means they can only carry and respond to messages. [2]

1.2.3 ZigBee

ZigBee name illustrates the mesh networking concept because messages from the transmitter zigzag like bees, looking for the best path to the receiver. While Z-Wave uses a proprietary technology for operating its system, ZigBee platform is based on the standard set by the Institute for Electrical and Electronics Engineers (IEEE) for wireless personal networks. This means any company can build a ZigBee-compatible product without paying licensing fees for the technology behind it, which may eventually give ZigBee an advantage in the marketplace. Like Z-Wave, ZigBee has fully functional devices (or those that route the message) and reduced function devices (or those that don't). [2]

1.2.4 Insteon

Using a wireless network provides more flexibility for placing devices, but like electrical lines, they might have interference. Insteon offers a way for your home network to communicate over both electrical wires and radio waves, making it a dual mesh network. If the message isn't getting through on one platform, it will try the other. Instead of routing the message, an Insteon device will broadcast the message, and all devices pick up the message and broadcast it until the command is performed. The devices act like peers, as opposed to one serving as an instigator and another as a receptor. This means that the more Insteon devices that are installed on a network, the stronger the message will be. [1]

1.3 Installing a Smart Home

Z-Wave, X10, Insteon and ZigBee just provide the technology for smart home communication. Manufacturers have made alliances with these systems to create the products that use the technology. Here are some examples of smart home products and their functions. [4]

Cameras will track your home's exterior even if it's pitch-black outside. Plug your table top lamp into a dimmer instead of the wall socket, and you can brighten and dim at the push of a button. [4]

A video door phone provides more than a doorbell -- you get a picture of who's at the door. [4]

Motion sensors will send an alert when there's motion around your house, and they can even tell the difference between pets and burglars. Door handles can open with scanned fingerprints or a four-digit code, eliminating the need to fumble for house keys.

Audio systems distribute the music from your stereo to any room with connected speakers. [4]

Channel modulators take any video signal -- from a security camera to your favourite television station -- and make it viewable on every television in the house.

Remote controls, keypads and table top controllers are the means of activating the smart home applications. Devices also come with built-in web servers that allow you to access their information online. [4]

The Remote keypad will send a message to your lamp. These products are available at home improvement stores, electronics stores, from technicians or online. Before buying, check to see what technology is associated with the product. Products using the same technology should work together despite different manufacturers, but joining up an X10 and a Z-Wave product requires a bridging device. When designing a smart home, you can do as much or as little home automation as you want. You could begin with a lighting starter kit and add on security devices later. If you want to start with a bigger system, it's a good idea to design carefully how the home will work, particularly if rewiring or renovation will be required. In addition, you'll want to place strategically the nodes of the wireless networks so that they have a good routing range. The cost of a smart home varies depending on how smart the home is. One builder estimates that his clients spend between $10,000 and $250,000 for sophisticated systems. If you build the smart home gradually, starting with a basic lighting system, it might only be a few hundred dollars. A more sophisticated system will be tens of thousands of dollars, and elements of home theatre systems raise the cost of a system about 50 percent. [4]

1.4 Smart Home Advantages

Smart homes obviously have the ability to make life easier and more convenient. Home networking can also provide peace of mind. Whether you're at work or on vacation, the smart home will alert you to what's going on, and security systems can be built to provide an immense amount of help in an emergency. For example, not only would a resident be woken with notification of a fire alarm, the smart home would also unlock doors, dial the fire department and light the path to safety. Smart homes also provide some energy efficiency savings. Because systems like Z-Wave and ZigBee put some devices at a reduced level of functionality, they can go to "sleep" and wake up when commands are given. Electric bills go down when lights are automatically turned off when a person leaves the room, and rooms can be heated or cooled based on who's there at any given moment. One smart homeowner boasted her heating bill was about one third less than a same-sized normal home. Some devices can track how much energy each appliance is using and command it to use less. Smart home technology promises tremendous benefits for an elderly person living alone. Smart homes could notify the resident when it was time to take medicine, alert the hospital if the resident fell and track how much the resident was eating. If the elderly person was a little forgetful, the smart home would perform tasks such as shutting off the water before a tub overflowed or turning off the oven if the cook had wandered away. It also allows adult children who might live elsewhere to participate in the care of their aging parent. Easy-to control automated systems would provide similar benefits to those with disabilities or a limited range of movement. [12]

1.5 Smart Home Devices

The prevalence of smart home appliances, which can be programmed to do nearly anything, is such that consumers purchase and use them without a second thought. Currently, there are virtually no appliances in the home that are not available with some degree of automation. The combination of automation and programmability with artificial intelligence is the next step in the evolution of the home automation system. [3]

1.5.1 Home Automation Systems

Instead of being forced to move into a nursing home when unable to achieve full self-care, elderly individuals can rely on their smart home appliances. An intelligent interface that monitors the residents' movements, and learns to recognize their habits, can notify loved ones if the habits are interrupted. In addition, a smart home has the capability of monitoring the vital signs of residents. If an elderly person has a medical condition that could be of concern, the vital signs can be routinely sent to the appropriate medical facility. The smart home equipped with artificial intelligence will learn to distinguish dangerous readings, and alert medical personnel immediately. [3]

1.5.2 Smart Home Appliances for Physically Challenged Individuals

If an individual has difficulty moving around effectively, they are often forced to depend on others for care. With the implementation of smart home appliances, such as an effective security system, those with physical challenges are often able to live on their own. A smart home security system allows the homeowner to remotely view visitors on a camera, and speak to them via microphone and speakers. If the visitor is welcome, the security system unlocks and opens the door to allow the visitor access to the home. Smart home security systems can also learn which visitors are always allowed, and what areas they may have access to. [3]

1.6 Smart Home Technology Trends

Many smart home devices provide home automation technology, nowadays many tools that are used in computer systems can also be integrated in Smart Home Systems. In this section, we review the tools and technology trends related to Smart Home. [7]

1.6.1 Automatic Vehicle Parking System

The Parking System works like the following scenario, the vehicle has to be driven to the gate of the parking garage. The driver draws a parking ticket, and then drives the vehicle to search an available parking space for parking. The automatic vehicle parking system has to be designed to be smart and easily managed. Vehicles can search parking space and park themselves in correct spaces automatically. [5]

The major work of the parking management subsystem is to supply user interface, and to display system status and information. The control and positioning subsystem is embedded on the vehicle, and is able to control the behaviour of the mobile vehicle and compute its current position according to the received signals. The WSN network and management subsystem is deployed in the parking garage. It is responsible for monitoring the status of the vehicle, and transmitting commands and data between the parking management subsystem and the control and positioning subsystem. [5]

Sensor nodes are equipped with the parking spaces for the purposes of positioning and communications. A guide line is painted on the road surface. The infrared detector embedded on the vehicle can detect the guide line and report to the control and positioning subsystem. The vehicle thus can avoid deviation from the guide line, due to the accuracy of the position estimated. In the automatic vehicle parking system, the driver just takes a parking ticket and leaves the vehicle on the gate. The parking management system will communicate with the control and positioning subsystem on vehicle, and command the vehicle to move to and park on an assigned available parking space. The WSN management system will keep monitoring the parking space for the reason of security. As long as the driver wants to take back the vehicle, he just pays the parking fees and the vehicle will automatically move to the exit gate. [5]

1.6.2 The Ubiquitous Home

At the Ubiquitous Home, experimenters can collect real-life data as if living in their own house, not in a laboratory.

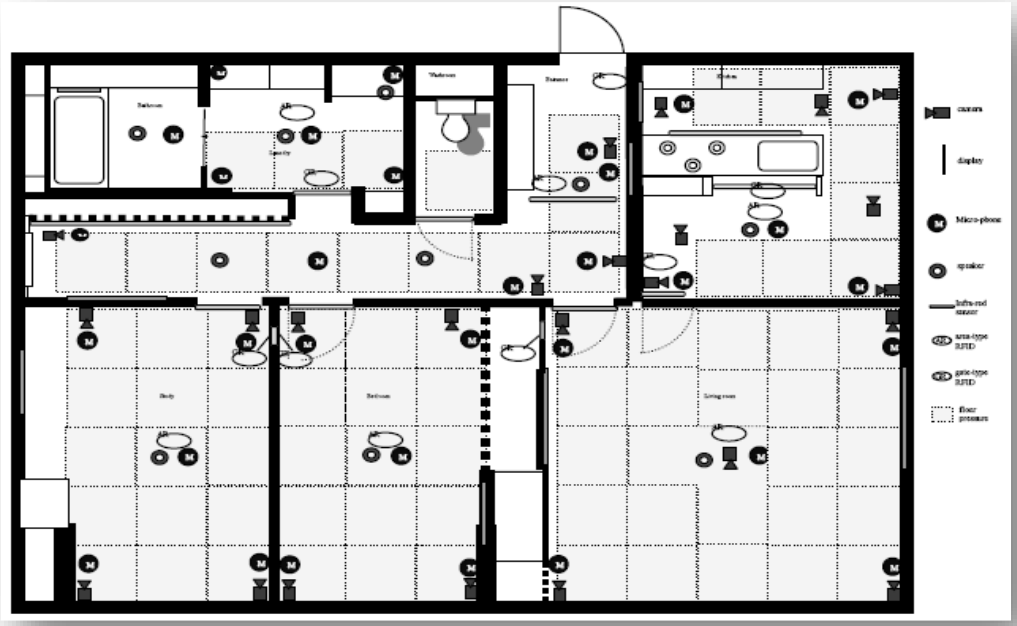

Figure 1.3. The Layout of the Ubiquitous Home

The Ubiquitous Home differs from other test beds in three aspects: first, it's enhanced ubiquity of sensors in the Ubiquitous Home; it have many cameras and microphones in each room and various types of sensors to monitor locations in every space of the home. Second, it has remote Japanese-style room, with which we can test remote family connectivity and create a test bed for specific Japanese services. Third, the robots in home service . The robot is called Phyno and has a camera, a microphone and a speaker. Its neck has three degrees of freedom (DOF), its arm does one DOF and its waist does one DOF. Using the camera, Phyno can recognize registered user faces. A decomposed Eigenface method is used for the face recognition. The method realizes robust recognition under various lighting conditions. [5]

The Ubiquitous Home has a living room, dining-kitchen, study, bedroom, washroom and bathroom, these rooms comprising an apartment. In addition to the apartment, a Japanese style room is provided as a living space for remotely living family members, such as a grandmother and/or a grandfather. Between the apartment and the Japanese-style room is a computer room called the Network Operating Center (NOC). [5]

1.7 The goal of the peoject

The goal of the project was to implement a smart home system by controlling the electronic devices at home remotely with a mobile phone and to receive alerts on intrusion and movement around restricted premises. The goal was achieved successfully. The devices were controlled by sending instructions as an SMS and the alerts were received as an SMS as well. A Hall Effect proximity sensor and a passive infrared sensor were used as detectors to detect the intrusion and movement around the restricted premises respectively. A temperature sensor was used as a heat detector and a led light was used to show the demonstration of an electronic device management. Arduino Uno Board was used as a microcontroller while the SIM900 GPRS/GSM model was used for communication between the microcontroller unit and the mobile station. The mobile phone did not need to have any special application or hardware to be used as a mobile station. Any mobile phone supporting the SMS could be used as a mobile station.

1.8 Outline of the peoject

The project is basically divided into four chapters.

Chapter 1 this chapter provides general background to field of the search , followed by explanation of the problem stamtement and the proposed objective that deals with the search problem .

Finally , the scope of the work is also discussed.

Chapter 2 describes the field of the software of the project ; it includes system design and introduction of Heat sensor.

Chapter 3 includes of Testing the system and the result.

Chapter 4 presents a conclusion of the entire design and result as well as the recommendation for future work.

CHAPTER TWO

DESIGN & DEVELOPMENT

SMART HOME SYSTEM

2.1 System Design

The system mainly comprises two parts: the mobile station and the microcontroller unit. The mobile station is responsible for giving the command and the control instruction to the devices and sensors and to get the response from them. It is just a user interface and does not control the devices. The second unit, the microcontroller unit, is responsible for controlling the devices, processing information gathered from the devices as well as from the mobile station. The microcontroller unit is the brain of the system and controls and processes information to and from all other units of the system. [11]

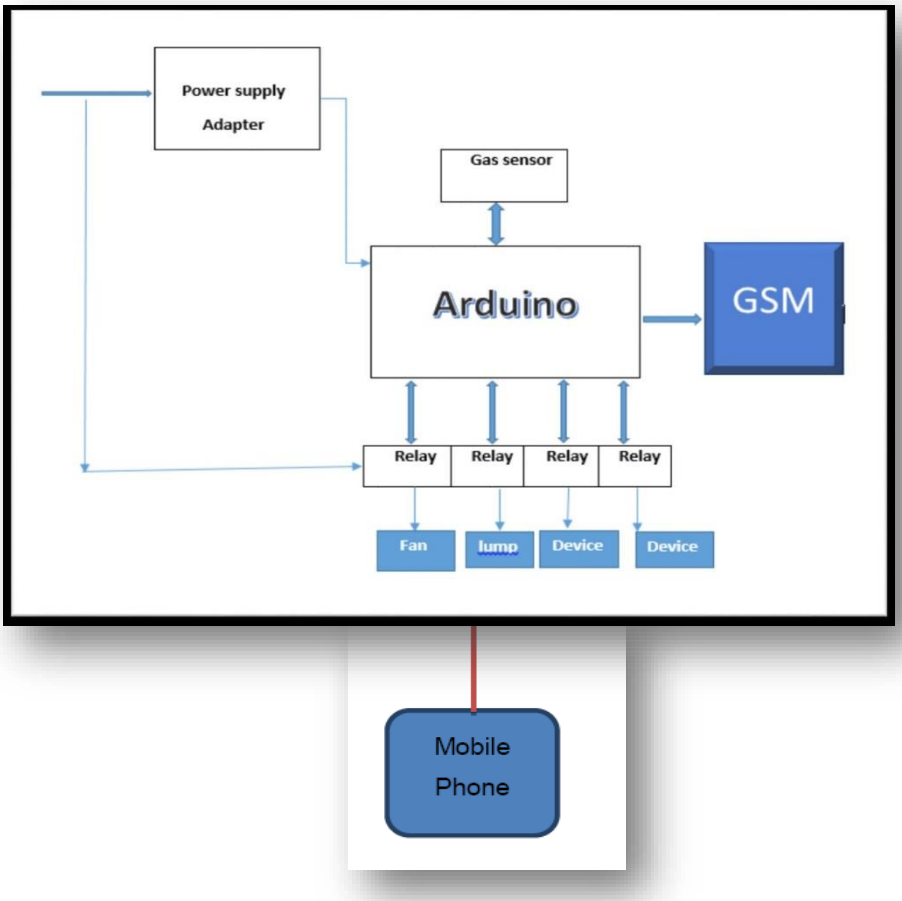

figure 2.1 Block Diagram for system

The block diagram of the system is shown in figure 2.1 as it is mentioned above, the system comprises two units. The microcontroller unit consists of four sensors and a

light along with the sim900 module. Lm35 is the temperature detector, the digital output proximity sensor is the intrusion detector and the Panasonic passive infrared sensor is the motion detector of the system. The data from the sensors is continually processed by the microcontroller and an alert is sent to the mobile station if something is sensed or something reaches beyond the limit in case of a temperature sensor. Besides getting the alert after reaching the limit, it is possible to know the temperature at home at any time by sending an instruction to the microcontroller. These three units of the system are responsible for the security of a home. The other part of the microcontroller unit is the light system which can be operated remotely using the mobile stations. In this project, a simple led light is used to show the demo of the remote light management sys-tem. The user could get information about the state of light, whether it is ON or OFF, in the mobile station and control the state of light remotely from the mobile station. And also there's heat sensor which is responsible if a fire happened he send to us SMS. [11]

The Sim900 GPRS/GSM module acts as the mediator between the microcontroller unit and the mobile station and is responsible for the communication between them. This unit is responsible for sending information from the microcontroller to the mobile station and for sending the instruction from the mobile station to the microcontroller. The instruction sent by the user from the mobile station is executed by the microcontroller. In addition to the microcontroller unit, the second unit of the system is the mobile station which is just a mobile phone. It does not require any special feature or any special application for the mobile phone to be a part of the system. Any mobile phone supporting the messaging application is suitable for the system. The instruction to the microcontroller is sent by using text messages and the alert from the microcontroller is received as a text as well. The system acts as a smart home system providing security to the home as well as providing a remote management system for the devices inside the home. [11]

2.2 Interfacing Sim900 GPRS/GSM Module

The Sim900 module is an important part of the system responsible for communication between the microcontroller and the mobile phone. AT commands are used to interface the module as well as to configure it. AT commands are inserted in C-language as a string of characters which are sent to the module using the terminal program. [9]

```
mySerial.println("AT+CPIN=4510"); //the pin code for the sim
delay(5000); mySerial.println("AT+CMGF=1"); //sets the text mode
```

Listing 1: AT command syntax to set the text mode

The pin code of SIM is required to activate the SIM card. The instructions are defined within a program as a C-language code which could be actuated at a specific moment. The code would then be simply compiled and uploaded into the Arduino/GPRS shield unit. [9]

```
pos = msg.indexOf(",");
 String index = msg.substring(pos+1);     //the index of SMS
myS When exposed to the fire of an ignited lighter:
erial.print("AT+CMGR = ");
 mySerial.println(index);                 //read the incoming SMS
```

Listing 2: AT commands to read the SMS message defined within a program

Listing 2 shows AT commands to find the index of the SMS and to read the contents of the SMS message. It is necessary to read the index of the SMS every time with an in-coming SMS message as the index keeps on increasing. Otherwise the program keeps on reading the same SMS again and again even if there are new SMSs. Since the storing capacity of the SIM card is limited, the SMS is deleted after it is read and the instruction is executed. The microcontroller performs the action based on the instruction sent by the mobile phone as an SMS message. [9]

2.3 Interfacing and Implementing Sensor

There are different areas which have to be monitored frequently and devices which have to be checked in and around the house. The doors and windows need to be monitored from burglars if they try to open them as well as the movement of strangers around the house premises should be monitored. Similarly, a member of the home might want to know the state of electronic devices after leaving home and might need to turn

the devices off if they are left on. In addition, the temperature of the home has to be monitored as well to trigger the alarm upon reaching the critical point. The monitoring of temperature, a stranger's movement and the opening and closing of doors and windows are done by the designated sensors. The sensors could be implemented as different types of detectors according to the necessity of the application and the human desire. The operation of sensors is managed by software. Since there are different types of sensors, they are interfaced according to the output and properties of the sensor. The external circuit for interfacing the sensor for the application depends on the type of the sensor and it is not a must as some of the sensors do not need it and the output can be driven directly and used on the application. [6]

2.3.1 Heat Sensor

Heat (Flame) sensor is the most sensitive to ordinary light that is why its reaction is generally used as flame alarm purposes. This module can detect flame or wavelength in 760 nm to 1100 nm range of light source. Small plate output interface can and single-chip can be directly connected to the microcomputer IO port. The sensor and flame should keep a certain distance to avoid high temperature damage to the sensor. The shortest test distance is 80 cm, if the flame is bigger, test it with farther distance. The detection angle is 60 degrees so the flame spectrum is especially sensitive. The detection angle is 60 degrees so the flame spectrum is especially sensitive. [13]

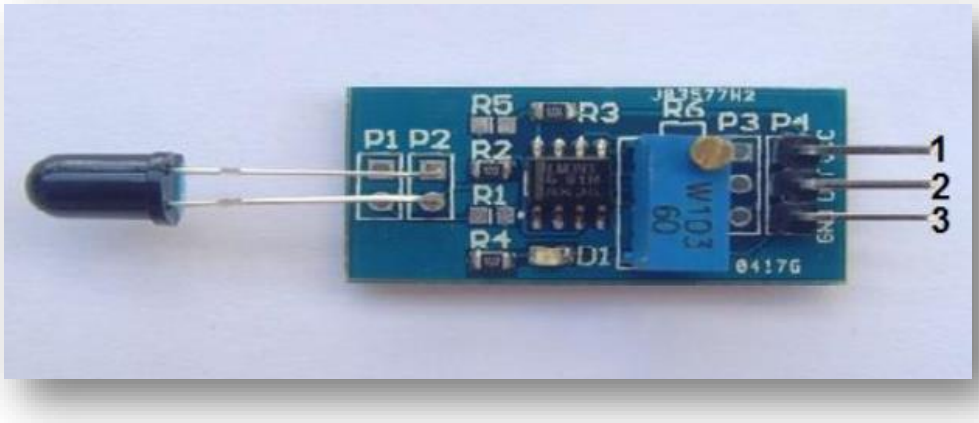

Figure 2.2 Heat Sensor

```
void setup() { Serial.begin(9600);
} void loop()
{ if (analogRead(A0) < 250) Serial.println("No Fire");
else Serial.println("There's a Fire!");
 delay(100); }
```

Listing 3: C code used to read the temperature

The microcontroller reads the output voltage of the sensor every second by using the function analogRead. Temperature is the function of output voltage, and thus tempera-ture can be calculated by using mathematics. The temperature is calculated from the output voltage by using the formula shown in listing 3 and if it exceeds the limit defined in the software, it will automatically send an SMS to the mobile phone specified in the software. The limit of the temperature to send the SMS can be changed depending on the environment of the place where the sensor is placed and on the application. For example, if the sensor is placed in a cold room to maintain the temperature of the room, the limit should be very low, and if the sensor is placed in a room to detect a fire, the limit should be high. In addition, it is possible to get the temperature of the place where the sensor is located by simply sending an SMS to the GPRS module. [13]

Implementation of remotely managed light system There are many electronic devices in the home whose status is unknown (on or off) and which could be left on unknowingly or accidently. The status of the device has to be known by the owner, and if the device is on, it has to be turned off. It is not always possible to go back home and turn the devices off. There arises a need to manage the electronic devices remotely to prevent the risk of some accidents as well as to de-crease the use of electricity. There are different ways to implement remotely managed electronic devices, for example management using the Ethernet, management using wireless devices or management using the GPRS/GSM module. The electronic device (the light system) is managed

remotely using the GPRS/GSM module (especially using the SMS) in this project. In this application, light is managed remotely, and the light represents the electronic devices as a whole. Since the light uses a 220V AC current and the Arduino can provide only a 5V DC current, a relay is used in between the Arduino and the light. The relay can be controlled by the I/O pins of the Arduino which finally controls the light. The circuit diagram to control the electronic devices using the I/O pins of the Arduino Board via the relay shield is shown in figure 2.2

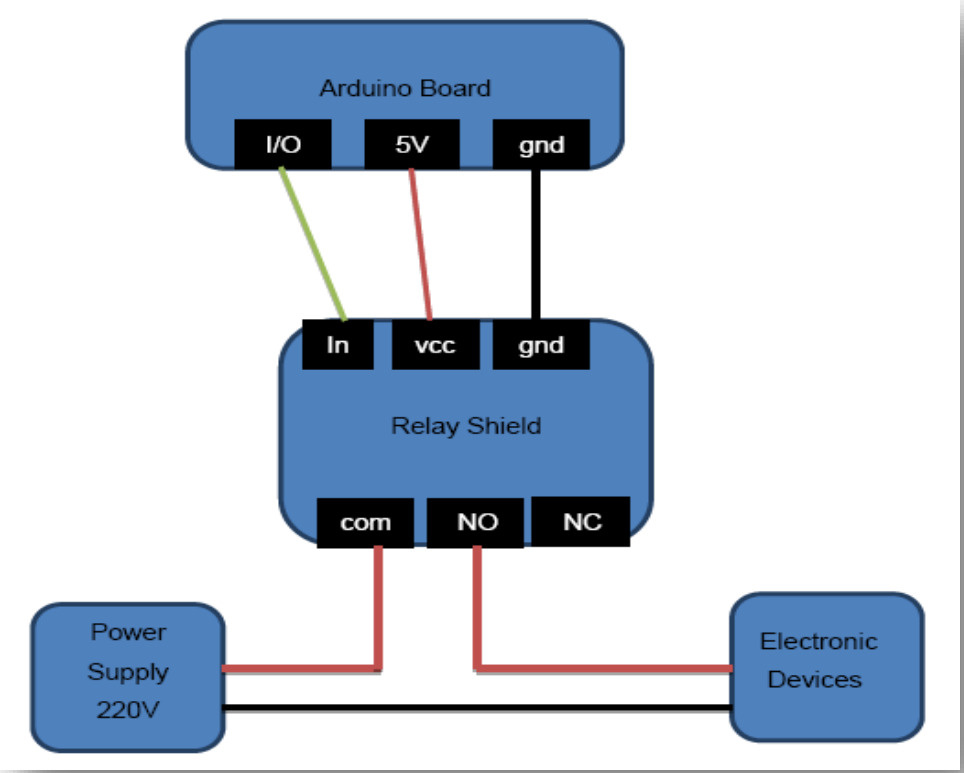

Figure 2.3 Circuit diagram for the control of electronic devices

The electronic device is controlled by the I/O pin of Arduino connected to the relay. The com (common) is connected to NC (normally closed) when the I/O pin is low and the com is connected to the NO (normally open) when the I/O pin is high. It means that the electronic device is on when the I/O pin is high and the device is off when the I/O is low. Basically, the electronic device can be managed remotely just by managing the I/O

pin of the Arduino board. To show the demo of the remotely managed light, a led is used, and it is controlled remotely in this application instead of the light bulb. The principle of management of light is the same as the principle of management of led; the light is controlled by the I/O pins of the Arduino via relays and the led is controlled by the I/O pins itself.

```
int led = 13;
pinMode(led,OUTPUT);
 if(msg.indexOf("Turn light on") >= 0){ digitalWrite(led,HIGH);
} if (msg.indexOf("Turn light OFF") >= 0){
digitalWrite(led,LOW);
} if(msg.indexOf("State of light") >= 0){ val =
bitRead(PORTB,5);
 switch(val){ case 0: send_SMS();
break;
 case 1: send_SMS();
 break; } }
```

Listing 4: C-code compilation for management of light remotely

Listing 4 shows the C-code compilation for the management of light remotely using a mobile phone. The code first checks the SMS messages and does the operation according to the content of the messages. The light will turn on or off according to the instruction sent by the mobile phone by the function shown in listing 6. The fifth bit of the B port holds the status of the light (i.e. the status of the I/O pin 13) and it is read by the function bitRead. Upon the query of the status of light, an SMS is sent back to the mobile phone containing the status of light. In this way, the status of light can be known remotely and the light can be turned on or off with the help of a mobile phone remotely. [12]

The smart home system was developed by implementing the sensors and the remotely managed light system in this project. In this project, only one light system was used to show the demo of remotely managed electronic devices along with three detectors: an LM35 temperature sensor as the heat detector, a Panasonic passive infrared sensor as the motion detector and a Hall Effect proximity sensor as the intrusion detector. The number of sensors used and the electronic devices managed remotely can be in-creased or decreased according to the necessity of the application.

This project was the demonstration project of the smart home system using three sensors and a light system. The smart home system triggered alarms to intrusion into the house through doors and windows as well as to the movement of a human being around the premises and around the restricted areas. The system also kept surveillance over the temperature and triggered alarm upon reaching the critical point and above it. The whole system was the integration of implementation of the sensors and the light system is implemented on Arduino platform using the Arduino Uno Board. Figure 2.4: The final system

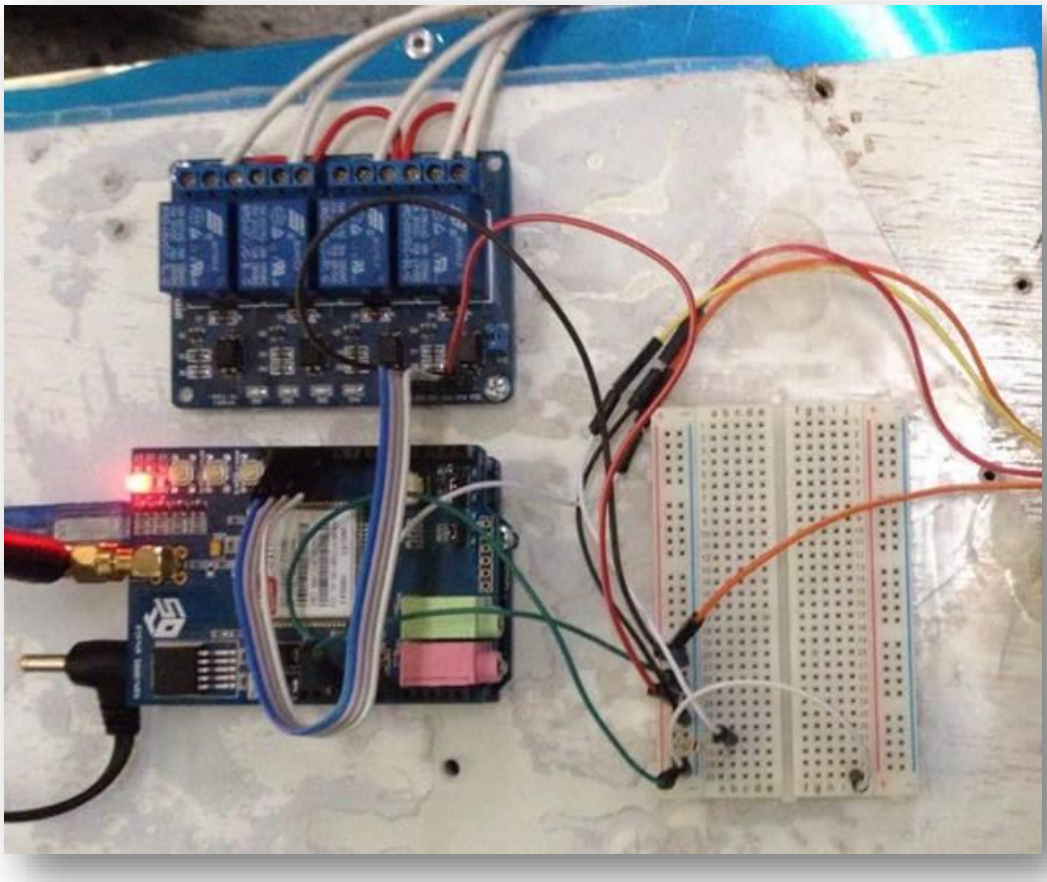

Figure 2.4 the final system

Figure 2.4 shows the microcontroller unit with the Arduino board, GPRS shield, light and sensors. Power supply to the unit can be provided externally or from the USB port of the computer. The power supply is supplied from the USB port in this project and the sensors and the GPRS shield drives the power from the unit. The whole system

is implemented using the C-code language written on the Arduino platform. The software written on the platform can be uploaded to the microcontroller (i.e. the Arduino board) using Arduino IDE software. [5]

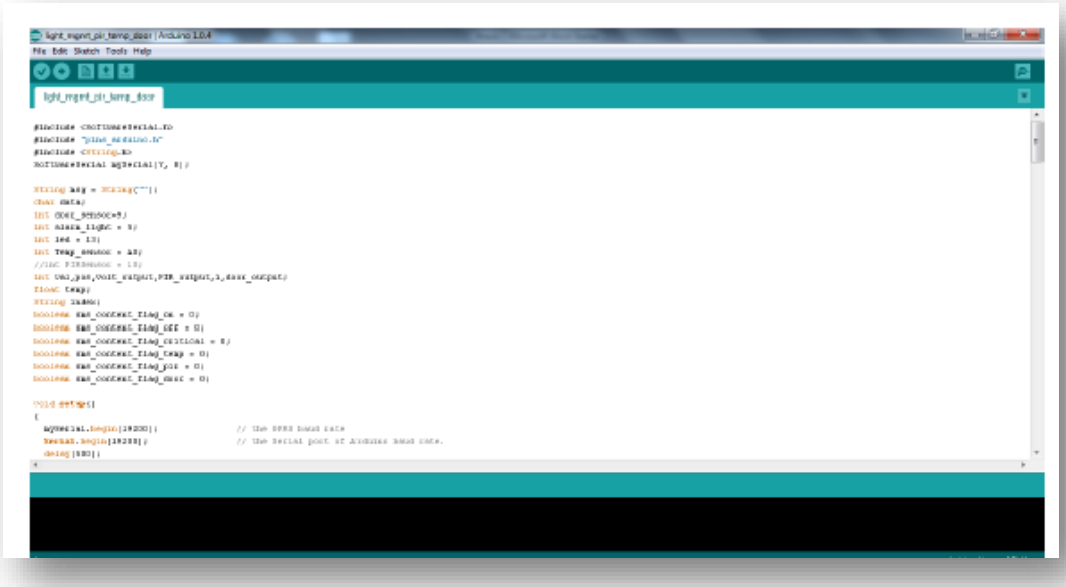

Figure 2.5 Screenshot of the Arduino Software IDE

The Arduino integrated development environment (IDE) is a cross-platform written in Java, whereas the programs are written in C or C++, which is shown in figure 2.5. The platform comes with a software library along with the code editor with features such as syntax highlighting, brace matching and automatic indentation. The whole program is written in the platform in the C language code which can be uploaded to the board by a simple upload button. Basically, the project is the integration of the software (C language code) used to interface and implement the sensors, the GPRS module and the remote management of light. In addition, the program contains some more code to co-ordinate among those parts along with some extra C code rather than the individual codes described above. [5]

CHAPTER THREE

TESTING THE SYSTEM

AND

THE RESULTS

3.1 Testing the system

First of all, all the hardware units of the system were tested and it was ensured that they were in a good working condition. Then, each and every unit were interfaced and implemented individually with the microcontroller board and drove with the software according to the necessity of the application. The testing of the application was not done at once after it was completed. Rather each unit of the application was tested individually. The second unit was not tested until the first unit gave the expected result and until it was not working according to the necessity of the application. After all of the units were working correctly, the units were kept together and then the whole system was developed and tested. It was easy to figure out the bugs and the problem of the system as the behaviour of each unit was known while testing it. It would be impossible to figure out the problems and the bugs in the system if the system was developed and tested after it was completed. After the hardware units were tested, the communication of the mobile station with the GPRS module was tested. [10]

We check that the SIM is active and it is connected to Sonar's GSM network. Similarly, the module is able to call a specific number as well as the module can be operated in text mode and a message can be sent to a specific number. The mobile phones used to test communication along with the whole system are Samsung Galaxy s4 and HTC desire. After it was made sure that the communication of the mobile station with the GPRS module was working according to our wish, the sensors were interfaced with the micro-controller and the result were captured and analysed with the help of a terminal pro-gram. Finally all the hardware and software were integrated and the whole system was developed after the sensors were working correctly. [10]

The system keeps on reading the temperature continuously and the output of the proximity sensor and the infrared sensor at an interval of one second. The system will read the incoming message immediately after it is received and an SMS will be sent if any alarm is triggered in between reading the outputs. Then the system again starts to read the outputs at an interval of one second. As can be seen from figure 16, the system reads an incoming message state of light and sends back the response. The response sent can be seen as +CMGS 137 and OK in the terminal program. [10]

3.2 The Result

The aim of the project was to implement a smart home system and the goal was met. The microcontroller unit responds to the instructions sent by the mobile phone according to the necessity of the application as well as triggers the alarm upon a critical situation. The aim of the application to manage the electronic devices remotely was also achieved. [11]

Table 1: Result of the instructions and the response to and from the mobile station

Unit	Instruction sent by mobile	Response to the mobile	Output/Alarm triggering condition		
Light	State of light	The light is ON/OFF			
	Turn light on		Light is turned ON		
	Turn light OFF		Light is turned OFF		
Heat sensor	What is the flam sensor?	The flam is x ºC			
		The flam is too high	If the flam is > y ºC		
Switches	Turn Devise on	The Devise is ON/OFF			
	Turn Devise OFF				

Table 1 shows the instructions sent to the microcontroller from the mobile station and output of the instructions as well as the response sent to the mobile station from the microcontroller respectively. As can be seen from table 2, the instructions are sent only to the light system and the temperature sensor and they behave according to the instruction sent by the mobile phone. [14]

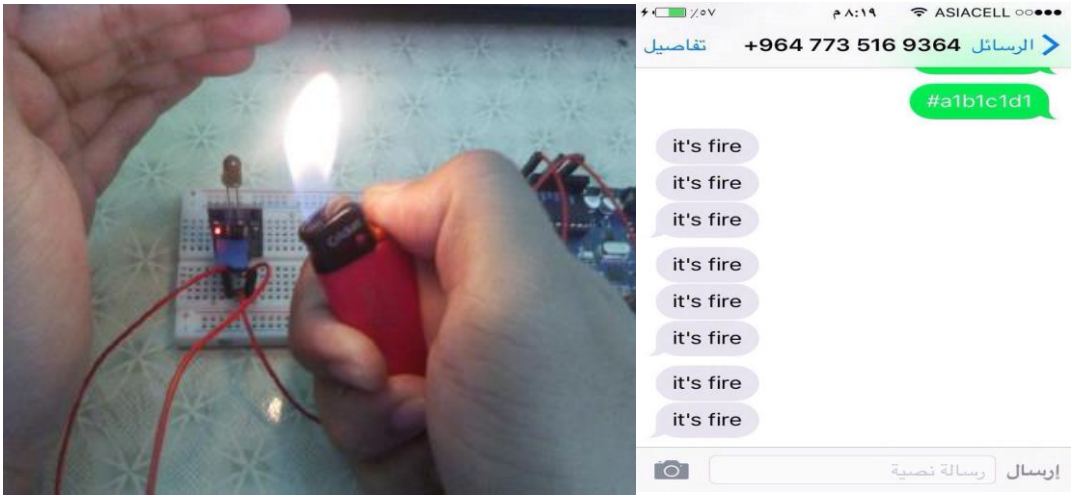

Figure 3.1 Screenshot of the mobile station managing the light remotel1

Figure 3.1 shows a screenshot of management of electronic devices (light system) by the mobile station (i.e. the mobile phone). As can be seen from figure 3.1, the microcontroller will send a response to the mobile phone as an SMS mentioning whether the light is on or off upon the instruction (state of light) sent by the mobile phone. The light can be turned on and off by the SMS which can be visualized, and the response to the instruction will also be different when the light is on or off which can be seen in figure 3.1. [11].

CHAPTER FOUR

CONCLUSIONS

&

FUTURE WORKS

4.1 Conclusions

The goal of the project was to implement a smart home system by controlling the electronic devices at home remotely with a mobile phone and to receive alerts on intrusion and movement around restricted premises. The goal was achieved successfully. The devices were controlled by sending instructions as an SMS and the alerts were received as an SMS as well. A Hall Effect proximity sensor and a passive infrared sensor were used as detectors to detect the intrusion and movement around the restricted premises respectively. A temperature sensor was used as a heat detector and a led light was used to show the demonstration of an electronic device management. Arduino Uno Board was used as a microcontroller while the SIM900 GPRS/GSM model was used for communication between the microcontroller unit and the mobile station. The mobile phone did not need to have any special application or hardware to be used as a mobile station. Any mobile phone supporting the SMS could be used as a mobile station. [13]

There are many smart home systems available in the market costing hundreds of dollars. Designing one's own home security system will save hundreds of euros as it is cheaper and the cost could be decided by the designer who is the ultimate user of the system. Not only the economic side but also the technical side is more flexible with this concept. With this concept, the designer could be able to decide the type and number of sensors to be used and the area to be covered. The systems available in the market are limited to number, type and area of coverage as well as to the number of electronic devices that could be controlled. Flexibility to the number of electronic devices con-trolled was also available in the application. [13]

Flexibility with the technical customization and economy are the main advantages of the design. However the system is limited to the GSM network available and will not work if the GSM network is not available. The IR sensor could be triggered with the movement of some animals such as a rat around the premises or by light striking the sensor directly, which could trigger a false alarm. The project could be further extended by using other technologies for communication, for example wireless communication using radio frequency, the Bluetooth technology or the Internet. The

ideas and information used in the design could be used for development of smart a home system. [13]

4.2 Future work

As a suggestion for future work, the following point can be considered:

Increasing the number of sensors used along with an increase in the number of installation places.

REFERENCES

[1] Best Home Automation System - Consumer Reports". www.consumerreports.org. Retrieved 2016-02-14.

[2] Chadwick, Susan (December 1985). "The His and Her Gift". Texas Monthly. p. 147. Retrieved August 16, 2013.

[3] Spicer, Dag (August 12, 2000). "If You Can't Stand the Coding, Stay Out of the Kitchen: Three Chapters in the History of Home Automation". Dr. Dobb's Journal. Retrieved August 16, 2013.

[4] Preville, Cherie (26 Aug 2013). "Control Your Castle: The Latest in HVAC Home Automation". ACHRNews (ACHRNews). Retrieved 15 Jun 2015.

[5] Griffiths, Melanie (March 2008). "Smart Home Security". Homebuilding & Renovating. Retrieved 27 February 2012.

[6] Kit Walsh (2016-04-05). "Nest Reminds Customers That Ownership Isn't What It Used to Be". Retrieved 2016-04-07.

[7] William George (2003). Antique Electric Waffle Irons 1900-1960: A History of the Appliance Industry in 20th Century America. Trafford Publishing. p. 1. ISBN 978-1-55395-632-7.

[8] Chadwick, Susan (December 1985). "The His and Her Gift". Texas Monthly. p. 147. Retrieved August 16, 2013.

[9] Berger, Lars T.; Schwager, Andreas; Pagani, Pascal; Schneider, Daniel M. (February 2014). Smart Grid Applications, Communications, and Security. Devices, Circuits, and Systems. CRC Press. ISBN 9781466557529.

[10] The Internet of Things (IoT) and Security Risks". www.symantec.com. Retrieved 2016-04-20.

[11] Arduino. Introduction to Arduino [Online]. Italy: Arduino URL: http://arduino.cc/en/Guide/Introduction Accessed July 15 2013.

[12] Anttalainen T. Telecommunications Network Engineering. 2nd ed. London: Artech House Inc; 2003.

[13] ActiveXperts Software B.V. GPRS Introduction [Online]. The Netherlands: Ac-tiveXperts Software B.V. URL : http://www.activexperts.com/mmserver/cellular/gprsintro/ Accessed 18 July 2013

[14] SIMCom Wireless Solutions Co. Ltd. SIM900 Specifications [Online]. China: SIMCom Wireless Solutions Co Ltd. URL: http://wm.sim.com/producten.aspx?id=1019 Accessed 18 July 2013

الخلاصة

المنزل الذكي والتكنولوجيا، التي تضم الأجهزة الذكية في سياق المنزل، وهناك العديد من الاحتمالات لتغيير نمط حياتنا في المستقبل بسبب هذه الأجهزة الذكية، وقد أثبتت تكنولوجيا المنزل الذكي مساهمات جديدة وجيدة لزيادة السلامة والموثوقية، وفي الوقت نفسه، فإنه قد يكون من نفوذه لتغيير هذه العادة التي نعيش فيها .لا يتم استخدام الهواتف النقالة اليوم فقط لإجراء المكالمات .استخدام الهواتف النقالة يتغير مع تطور التكنولوجيا؛ أنها يمكن أن تستخدم لأغراض مختلفة .انها متوفرة في السوق مع مختلف التطبيقات والأجهزة التي يمكن تنفيذها دون أي مزيد من التطوير أو التحسين من الهواتف الذكية اليوم .مع مساعدة من الشبكة .الهاتف المحمول يمكن استخدامها لتنفيذ المنزل الذكي عن طريق التحكم في الأجهزة الحصول على تنبيهات على السرقة والسطو .وكانت أهداف المشروع لتنفيذ المنزل الذكي عن طريق التحكم في الأجهزة الإلكترونية في المنزل عن بعد والحصول على تنبيه على اقتحام أو الحركة حول الأماكن المحظورة .كانت تسيطر عليها الأجهزة عن طريق الهاتف المحمول باستخدام خدمة الرسائل القصيرة المتاحة وردت أيضا التنبيهات باعتبارها SMS بالذكر أن النشاط التي تحدث في جميع أنحاء المبنى.

وزارة التعليم العالي والبحث العلمي

جامعة ديالى

كلية الهندسة

قسم الحاسوب والبرامجيات

" نظام المنزل الذكي"

مشروع مقدم إلى كلية الهندسة / جامعة ديالى – كجزء من متطلبات
نيل درجة البكالوريوس في هندسة الحاسوب والبرامجيات

أعداد الطلاب:

حنين زاهد زامل

اسيل نزار جميل

عبدالله ثائر طعمة

بأشراف:

م.م. خضر نجم عبد

م.م. رويدة عبدالله إبراهيم

هـ/ رجب 1437 م/أيار 2016