Sudan University of Science and Technology

College of Engineering

Electronics Engineering Department

Home Automation System

A Research Submitted in Partial fulfillment for the Requirements of

The Degree of B.Sc. (Honors) in Electronics Engineering

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الآيـة..

قَالَ تَعَالَى:

﴿فَمَنْ يَمْشِي مُكِبًّا عَلَى وَجْهِهِ أَهْدَى أَمَّنْ يَمْشِي سَوِيًّا عَلَى صِرَاطٍ مُسْتَقِيمٍ)

صدق الله العظيم

الإهداء

إلى نبراس العلم الخالد ،،، إلى من نحت تحت الصخر فى الهجير

إلى من وضع إلىّ أسس الحياه ،،، إلى من سهل لى الطريق

إلى من غرس فىّ الصدق و الأمانة ،،، إلى من صبّ عرقه و جاهد من أجلى

أبى الغالي ،،،

إلى من ضحت و كانت مشعل التضحية

إلى ينبوع الحنان و عنوان المحبة و نهر العطاء

إلى بلسم الحياة النابض ،،، أمي الحبيبة

إلى شموس وطني ،،، أساتذتي

إلى زهرات أسرتي ،،، إلى من أحبوني و شجعوني ،،، إلى من شاركوني العيش

إخوتي

أهدى ثمرة جهدي هذا

و إلى كل طالب علم يسعى جاهداً لخدمة و تنمية قدراته و مهاراته

و كل من يسعى للارتقاء بالعمل الهندسي في هذا البلد الطيب

و الله ولى التوفيق

الشكر والعرفان..

لابد لنا ونحن نخطو خطواتنا الأخيرة في الحياة الجامعية من وقفة نعود إلى أعوام قضيناها في رحاب الجامعة مع أساتذتنا الكرام الذين قدموا لنا الكثير باذلين بذلك جهودا كبيرة في بناء جيل الغد لتبعث الأمة من جديد ...
وقبل أن نمضي تقدم أسمى آيات الشكر والامتنان والتقدير والمحبة إلى الذين حملوا أقدس رسالة في الحياة ...
إلى الذين مهدوا لنا طريق العلم والمعرفة :

إلى جميع أساتذتنا الأفاضل...

"كن عالما .. فإن لم تستطع فكن متعلما ، فإن لم تستطع فأحب العلماء ،فإن لم تستطع فلا تبغضهم"

وأخص بالتقدير والشكر:

الدكتور / ياسر عبيد محمد

Abstract

Home automation trade has drawn goodish attention of researchers for quite a decade. The main plan is to mechanically management and monitor electrical and electronic home appliances. This project makes use to control the home appliance Such As lighting, heating, ventilation..etc automatically and manually using Arduino and Android. Initially simulation is done using Proteus software, the circuit is built designed the interface of Android a installed on Smartphone, then system has been tests and found to be operating properly and enabling full automation of home.

المستخلص

لقد وجدت أتمتة المنازل اهتمام من الباحثين لفترة من الزمن. الهدف الأساسي هوإدارة ومراقبة الأجهزة المنزلية الكهربائية والإلكترونية . في هذا المشروع يتم التحكم في الأجهزة المنزلية مثل الإضاءة والحرارة والتهوية وغيرها أتوماتيكيا ويدويا باستخدام الأردوينو و الأندرويد . بداية تم عمل محاكاة بواسطة برنامج البروتوس و تم بناء الدائرة ثم تصميم واجهة الأندرويد وتثبيتها في هاتف ذكي. تم إختبار النظام ووجد أنه يعمل بكفاءه ويتمكن من التحكم الكامل في المنازل .

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LIST OF ABBRIVIATION

ADC	Analog to Digital Converter
AVR	Advanced virtual RISC
CMOS	Common Metal Oxide Semi-conductor
DC	Direct Current
GSM	Global System Mobile
GUI	Graphical User Interface
HAS	Home Automation System
ID	Information Domain
IDE	Integrated Development Environment
IOT	Internet of Things
LCD	Liquid Crystal Display
LDR	Light Dependent Resistor
LM	Lunar Module
MIT	Massachusetts Institute of Technology
MQ	Message Queuing
OS	Operating System
PDA	Personal Digital Assistant

PIC	Programmable Interrupt Controller
PWM	Pulse Width Modulation
SPI	Serial Peripheral Interface
TTL	Transistor Transistor Logic
ULA	Upper Layer Architecture
USB	Universal Serial Bus
WIFI	Wireless Fidelity
3G	Third Generation
4G	Fourth Generation

CHAPTER ONE

INTRODUCTION

1.1Preface

Home automation is becoming popular due to its numerous benefits. Home automation refers to the control of home appliances and domestic featuresby local networkingor by remote control. Artificial Intelligence providesthe framework to enable real-time decision and automation for Internet of Things (IoT).This work details differentintelligenthome automation systems and technologies from a various featuresstandpoints. The work focuses on concept of home automation where the monitoring and control operations are facilitate through smart devices installed in residential buildings. Heterogeneous home-automation systems and technologies are considered in review with central controller based on (Arduino or Raspberry Pi), web based, email based, Bluetooth-GSM based, mobile based, android based, Dual Tone Multi Frequency-based, cloud-based and the Internet.To make tasks more convenient save money on utilities, have a safe home to feel more comfortable as engineers we must apply the technologyto our lifefor all these reasons mentioned here.[1]

1.2 Problem Statement

Problem address here can be stated in two points; Lack of homesafety system and energy consumption.

1.3 Proposed Solutions

To design an automation system that controls home lighting and ventilation in order to conserve energy and maintain security and provides safety in case of fire.

1.4 Approach

Gain detailed information about previous researches by extensive study and analysis of similar projects to master basic ideas about our work. Then we have to enrich our knowledge about devices and components to be used in our system. Next design and test of the circuit using simulation program is to be completed before the development of the systemincluding hardware and software prior to its assembly.

1.5 Thesis Outlines

CHAPTER ONE: Provides over view and states the research problem and proposed solution besides describing work approach and outlines.

CHAPTER TWO: Background and past experiences related to our project review.

CHAPTER THREE: IllustratesThe System Components

CHAPTER FOUR:Simulation and Results.

CHAPTER FIVE: System Implementation.

CHAPTERSIX: Conclusion and Recommendation.

CHAPTER TOW

LITERATURE REVIEW

2.1 Introduction

This chapter previews home automation and details almost everything related to Arduino and briefly elaborate on Android operation and capabilities This chapter also contain some examples of home automation projects.

2.2 Background

The “Home Automation” concept has existed for many years. The terms “Smart Home”, “Intelligent Home” followed and has been used to introduce the concept ofnetworking appliances and devices in the house. Home automation systems (HASs) represent a great research opportunity in creating new fields in engineering, andcomputing. HASs includecentralized control of lighting, appliances, security locks of gates and doors and other systems, to provide improved comfort, energy efficiencyand security system. HASs become popular nowadays and enter quickly in theemerging market. However, end users, especially the disabled and elderly due to theircomplexity and cost, do not always accept these systems. Figure 2-1 and Figure 2-2 are two examples of home automation systems.

Figure 2-1: Home Automation System example 1

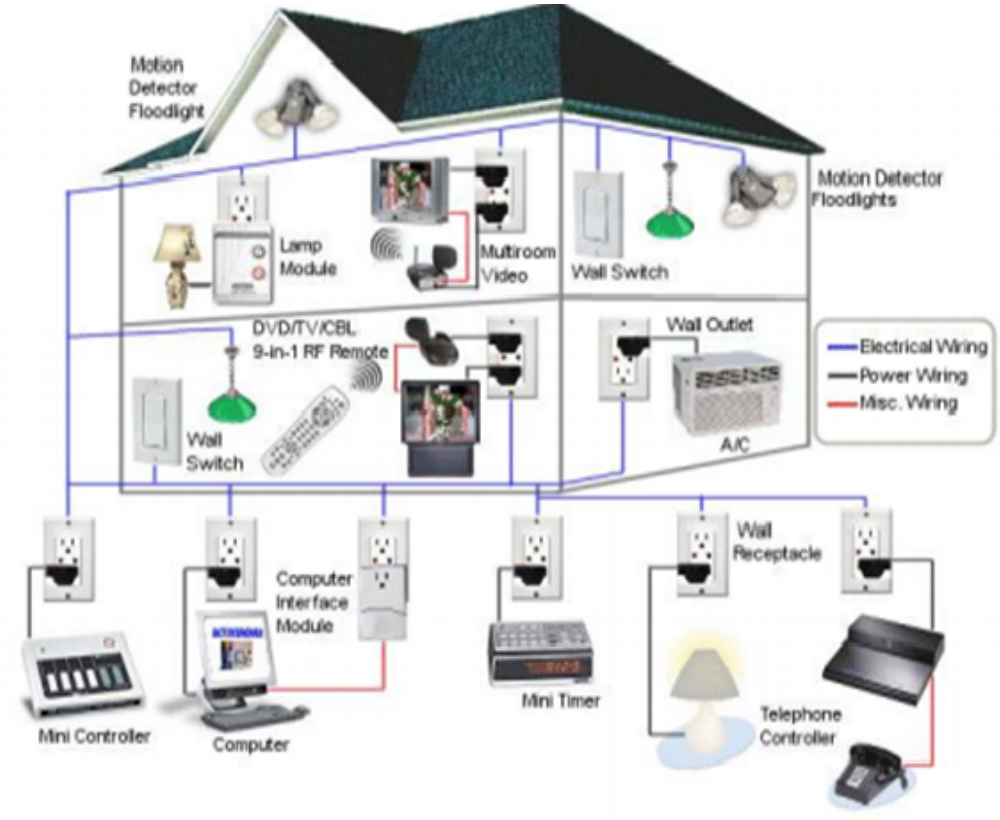

Figure 2.2: Home Automation System example 2

Due to the advancement of wireless technology, several different ways ofconnections are introduced such as GSM, WIFI, x10 protocol,and Bluetooth. Each of theseconnection methods has its own unique specifications and applications. Among the fourpopular wireless connections that often implemented in HAS projects, WIFI is beingchosen due to its suitable capability. The capabilities of WIFI are more than enough tobe implemented in the design. Also, most of the current laptop/notebook orSmartphones come with built-in WIFI adapter. This indirectly reduces the cost of the control system.

Nowadays, everyone cannot be separated from his smartphone. A number of five Thousands individuals from USA, UK, South Korea, India, China, South Africa, Indonesia andBrazil took a survey regarding this issue and was done by Time magazine. The result proved most of them is inseparable from their smartphones; eighty four percent allegedly claimed that they cannot survivewithout their smartphones.

Another study shows that seventy five percent of the market share is Android and a totalof one hundred and six million android smartphone were shipped in the second half of 2012.

Android smartphone became the top operating system in the market in the present timeworldwide and it became the most popular operating system known tohuman.

2.3Arduino

Arduino is an open source physical processing element which is based on a microcontroller board andan incorporates development environment for the board to be programmed. Arduinocontains a fewinputs,

for example, switches or sensors and control a few multiple outputs, for example, lights,engine and others. Arduino program can run on Windows, Macintosh and Linux operatingsystems (OS) opposite to most microcontrollers' frameworks which run only on Windows.Arduino programming is easy to learn and apply to beginners and amateurs.Arduino is simply an instrument used to build a better version of a computer which can control, interact and sense more than a normal desktop computer.

Arduino can be utilized to create interactive items, taking inputs from a diverse collection of switches or sensors, and controlling an assortment of lights, engines, and other physicaloutputs. Arduino activities can be remaining solitary, or they can be associated with programsrunning on your machine (e.g. Flash, Processing and Maxmsp.) The board can be amassed by hand or bought preassembled; the open-source IDE can be downloaded free of charge.

Focused around the Processing media programming environment, the Arduinoprogramming language is an execution of Wiring, a comparative physical computing platform.[2]

2.3.1Reasons for choosing Arduino

There are numerous different microcontrollers and microcontroller platforms accessiblefor physical computing. Parallax Basic Stamp, Net media's BX-24, Phi gets, MIT's Handy board,and numerous others offer comparative usefulness. These apparatuses take the chaotic subtleelements of microcontroller programming and wrap it up in a simple to-utilize bundle. Arduinoadditionally rearranges the methodology of working with

microcontrollers; moreover it offers some advantages for instructors, students, and intrigued individuals such as:

• Inexpensive - Arduino boards are moderately cheap compared with other microcontrollerboards. The cheapest version of the Arduino module can be amassed by hand, and even thePreassembledArduino modules cost short of what $50.

• Cross-platform - The Arduino programming runs multiple operating systems Windows,Macintosh OSX, and Linux working frameworks.

• Straightforward, clear programming method - The Arduino programming environment is easyto use for novices, yet sufficiently versatile for cutting edge customers to adventure as well. Foreducators, its favorably engaged around the Processing programming environment, sounderstudies finding ways to understand how to program in that environment will be familiarwith the nature of Arduino.

• Open source and extensible programming. The Arduino program language is available as opensource, available for development by experienced engineers. The lingo can be reached outthrough C++ libraries, and people expecting to understand the specific purposes of differentinterests can make the leap from Arduino to the AVR C programming language on which it isbased. Basically, you can incorporate AVR-C code clearly into your Arduino programs if youhave to.

• Open source and extensible hardware - The Arduino is concentrated around Atmel's Atmega8and Atmega168 microcontrollers. The plans for the modules are circulated under a CreativeCommons license, so experienced circuit designers can make their own particular interpretationof the module,

extending it and improving it. Slightly inexperienced customers can build thebreadboard variation of the module remembering the finished objective to perceive how it capacities and save money. [2]

2.4 Android

A Smart phone is a mobile phone based on a mobile operating system, with more advanced computing capability and connectivity than a feature phone. Android is a software stack for mobile devices that includes an operating system, middle-ware and key applications. Android, by simple definition, is an operating system for many mobile phones. Android is a customizable platform that can look and feel very different on every different handsets. Android gives users tools for creating applications that look great and take more advantage of the hardware capabilities available on each device.

Android is mainly based on Linux operating system which uses java-like languages for running applications. The main purpose of using android is to send the control signals from smart phone through X10 protocol.

Google Play is Android essential application store. There were roughly 700,000applications accessible for Android in October 2012 and created by a vast group of Androidapplication designer.

2.5 Related work

Following models describe the work being performed by others:

- N. Sriskanthan [3] explained the model for home automation using Bluetooth via PC.Butunfortunately the system lacks to support mobile technology.
- Muhammad IzharRamli [4] designed a prototype electrical device control system using Web. Theyalso set the server with auto restart if the server condition iscurrently down.
- Hasan [5] has developed a telephone and PIC remote controlled device forcontrollingthe devices based on Pin check algorithm where it has been introduced and implemented ona cable networkbut not a wireless communication one.
- AmulJadhav [6] developed an application in a universal XML format which can beeasily ported to any other mobile devices rather than targeting a single platform.
- Al-Ali and Al-Rousan [7] presented a design and implementation of a Java-based automation system through World Wide Web. It had a standalone embedded system board integrated into a PC-basedserver at home.
- R.Piyare [8] have introduced design and implementation of a low cost, flexible and wireless solution to the home automation.
- Jitendra R. [9] showed that with the ZigBeenetwork how to remove the problem of wiring in case of wired automation. There is also considerable amount of power saving possible,operating range is more than Bluetooth.

Each of these system has their own unique features and on comparison to one another lacks some advancement.

2.7 Summary

The increasing ubiquity ofheterogeneous computing devices such as laptop computers,palms, mobiles etc. shows that users prefer a ubiquitous access of a system rather than to beuncomfortably forced to go physically to the nearest control point. Remote control saves timeand everybody is aware of this, it also provides increased security and flexibility.

Forexample, if the user receives an SMS saying that there is an intrusion, he/she can connect tothe internet and watch the video cameras inside the house to see what happens. Anotherexample could be the possibility to turn on the heaters from the distance using a mobile,laptop or PDA so as soon as the user reaches the house it would be warm already, this could bereally useful especially in cold countries.

As a matter of fact security will always be a mainpriority in all families, and prevention is better than cure. By receiving alerts in a portabledevice user is informed of all possible issues occurring in the house and it gives the possibilityto deal with it using different ways of control like instant messaging, since many users arealready familiar with the concepts and user interfaces of instant messaging. Many computersand mobile devices also already have instant messaging clients installed (Aurell, 2005).

Good scalability properties, independence of location or geographical distance, and highflexibility due to the different existing protocols make remote-controlling HASs suitable formost user needs.

CHAPTER THREE

SYSTEM COMPONENT

3.1 Introduction

This chapter describes components used to develop our system proposed for home automation in order to achieve this research work objectives and goals.

3.2 Parts and components needed for the project circuit

The following list contains all necessary parts to build our system.

- Arduino Nano.
- A board.
- Android phone.
- Android application.
- Resistors.
- Jumping Wires.
- Light Bulbs.
- Portable Fan.
- Uln2003.
- Motors.
- RFID.
- Sensors.
- Capacitive.
- Relay.

- Camera.

3.3 System Design

Figure 3.1 shows the system breakdown of this project. In this project two types of communication is used, first one is wireless (Via Wifi) and the second one is wired (appliances connected to the controller).

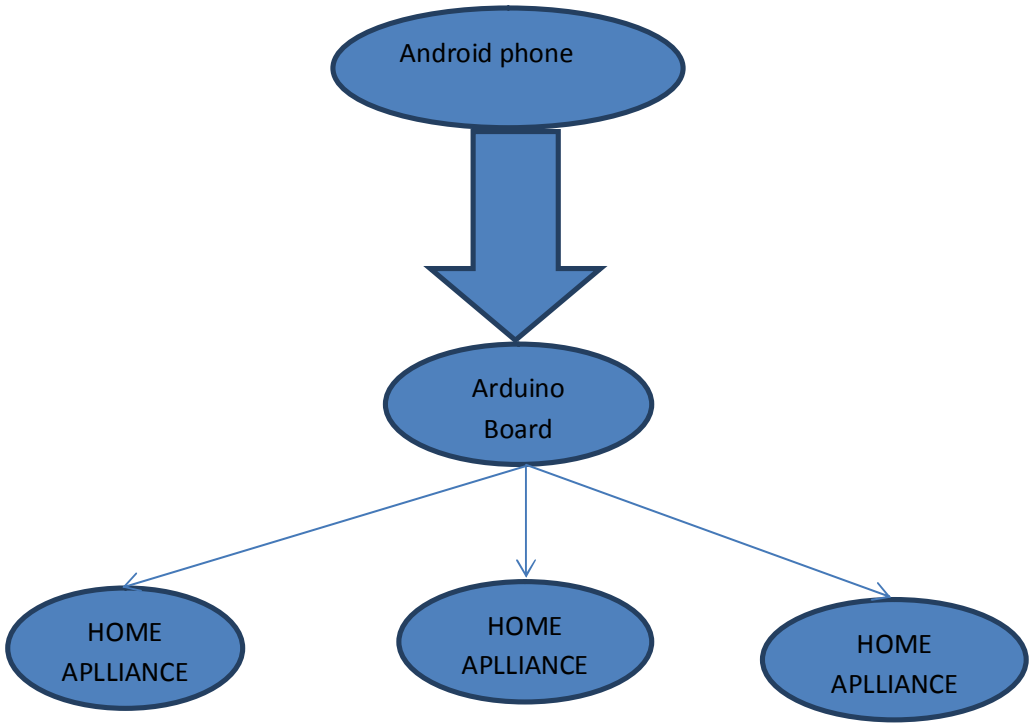

Figure3.1: SystemDesign

3.2.1 Arduino Nano

The Arduino Nano is a small , complete, and breadboard friendly board based on the ATmega328 (Arduino Nano 3.0) or ATmega 168 (Arduino Nano 2.x). It has more or less the same functionality of the arduinoDuemilanove , but in a different package . It lacks only a DC power jack, and works with mini-B USB cable instead of a standard one. Nano was design and it begin product by Gravitech, As shown in figure3-2.

Advantages of using Arduino Nano

- Ready to use.
- Examples of codes.
- Effortless functions.
- Large community.

Disadvantages of using Arduino Nano

- Structure.
- Cost.
- Easy to use.

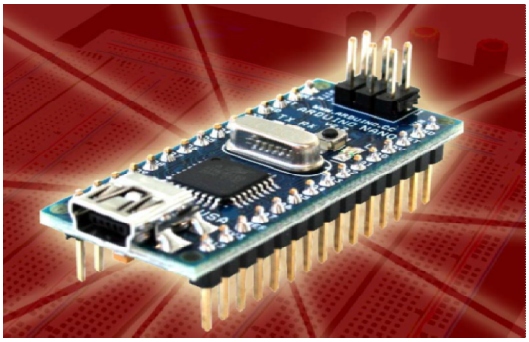

Figure 3.2:Arduino Nano

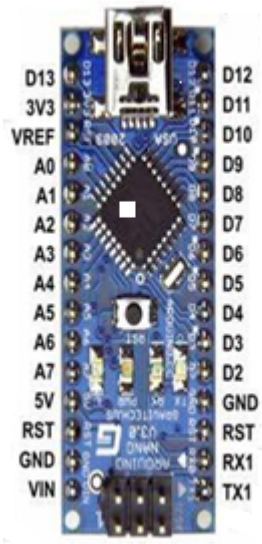

Figure 3.3:Arduino Nano Pins

Table 3-1: Arduino Nano Pins

Pin No.	Name	Type	Description
1-2, 5-16	D0-D13	I/O	Digital input/output port 0 to 13
3, 28	RESET	Input	Reset (active low)
4, 29	GND	PWR	Supply ground
17	3V3	Output	+3.3V output (from FTDI)
18	AREF	Input	ADC reference
19-26	A7-A0	Input	Analog input channel 0 to 7

27	+5V	Output orInput	+5V output (from on-board regulator) or +5V (input from external power supply)
30	VIN	PWR	Supply voltage

3.2.2 LM35

As shown in figure 3-4 The LM35 series are precision integrated-circuit temperaturesensors, whose output voltage is linearly proportional to theCelsius (Centigrade) temperature. The LM35 thus has anadvantage over linear temperature sensors calibrated inKelvin, as the user is not required to subtract a large

constant voltage from its output to obtain convenient Centigradescaling.

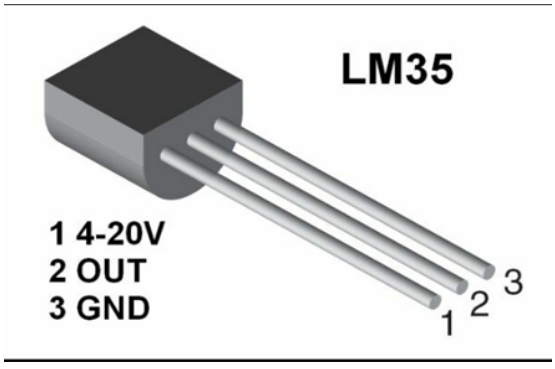

Figure 3.4: Lm35 Sensor

- **Features of LM35**
  - n Calibrated directly in ° Celsius (Centigrade)
  - n Linear + 10.0 mV/°C scale factor
  - n 0.5°C accuracy guarantee able (at +25°C)
  - n Rated for full −55° to +150°C range
  - n Suitable for remote applications
  - n Low cost due to wafer-level trimming
  - n Operates from 4 to 30 volts
  - n Less than 60 μA current drain
  - n Low self-heating, 0.08°C in still air
  - n Nonlinearity only ±1⁄4°C typical
  - n Low impedance output, 0.1 □ □for 1 mA load

3.2.3 Light Dependent Resistor (LDR)

AS shown in figure3-5 a light dependent resistor also knows as a LDR, photoresist or, photoconductor or photocell, is a resistor whose resistance increases or decreases dependingon the amount of light intensity. LDRs (Light Dependent Resistors) are a veryuseful tool in a light/dark circuits. LDRs can have a variety of resistance andfunctions. For example it can be used to turn on a light when the LDR is indarkness or to turn o_ a light when the LDR is in light. It can also work theother way around so when the LDR is in light it turns on the circuit and whenit's in darkness the resistance increase and disrupts the circuit.

The way an LDR works is that they are made of many semi-conductive materials with high resistance. The reason they have a high resistance is that are very few electrons that are free and able to move

because they are held in a crystal lattice and are unable to move. When light falls on the semi conductive material it absorbs the light photons and the energy is transferred to the electrons, which allow them to break free from the crystal lattice and conduct electricity andlower the resistance of the LDR.

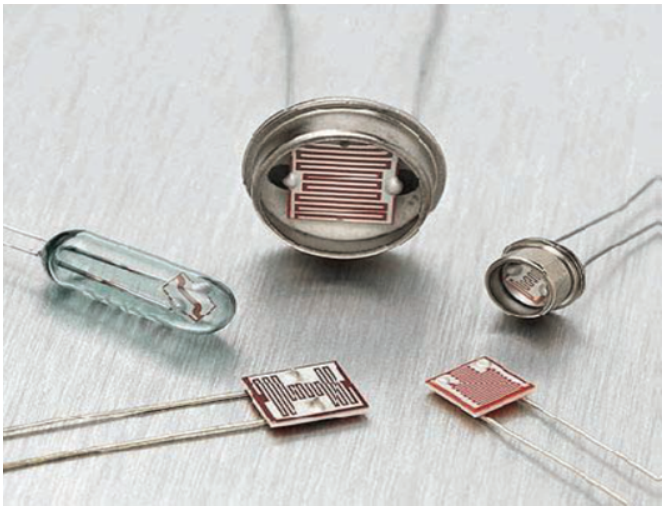

Figure 3-5: Light Resistor

3.2.4 MQ5

As shown in figure 3-6 The Grove - Gas Sensor (MQ5) module is useful for gas leakage detecting (in home and industry).

It can detect H2, LPG, CH4, CO, Alcohol. Based on its fast response time. Measurements can betaken as soon as possible. Also the sensitivity can be adjusted by the potentiometer.

Figure 3-6: MQ5 Sensor

- **Features of MQ5 Sensor**
  - Wide detecting scope
  - Stable and long life
  - Fast response and High sensitivity
- **Application Ideas**
  - Gas leakage detecting
  - Toys

3.2.5 ALPHANUMERIC LCD DISPLAY (16 X 2)

As shown in figure 3-7 Alphanumeric displays are used in a wide range of applications, including palmtopcomputers, word processors, photocopiers, point of sale terminals, medicalinstruments, cellular phones, etc. The 16 x 2 intelligent alphanumeric dot matrixdisplay is capable of displaying 224 different characters and symbols. A full list ofthe characters and symbols is printed on pages 7/8 (note these symbols can varybetween brand of LCD used). This booklet provides all the technical specificationsfor connecting the unit, which requires a single power supply (+5V).

Available as an optional extra is the Serial LCD Firmware, which allows serialcontrol of the display. This option provides much easier connection and use of theLCD module. The firmware enables microcontrollers (and microcontroller basedsystems such as the PICAXE) to visually output user instructions or readings ontoan LCD module. All LCD commands are transmitted seriallyvia a singlemicrocontroller pin. The firmware can also be connected to the serial port of a computer

Figure 3-7:LCD

3.4.6 ULN2003

As shown in figure 3-8 ,ULN2003 driver is a high voltage and high current Darlington arrayIC. It contains seven open collector Darlington pairs with common emitters. A Darlington pair is an arrangement of two bipolar transistors. ULN2003 belongs to the family of ULN200X series ofICs. Different versions of this family interface to different logic families. ULN2003 is for 5V TTL, CMOS logic devices. These ICare used when driving a wide range of loads and are used as relaydrivers, display drivers, line drivers etc. ULN2003 is also commonly used while driving stepper motors.

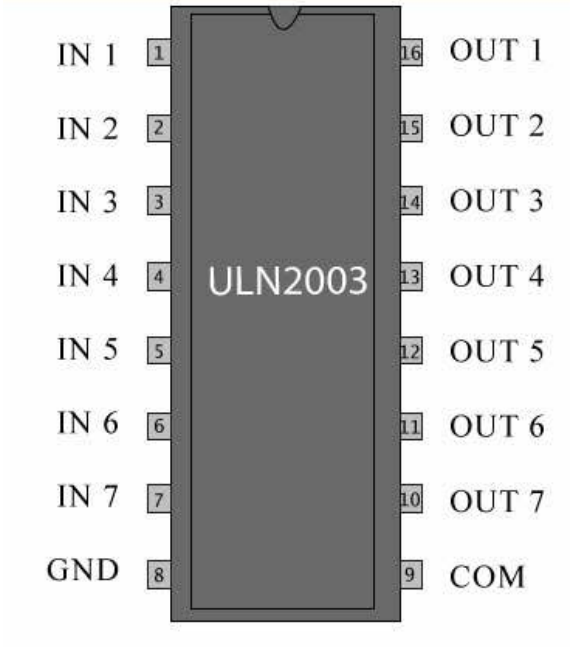

Figure 3-8: ULN2003 Pins

3.2.7Servo motor

As shown in figure 3-9 ,Servo control is achieved by sending a servo a PWM (pulse-width modulation) signal, a series of repeating pulses of variable width where either the width of the pulse (most common modern hobby servos) or the duty cycle of a pulse train (less common today) determines the position to be achieved by the servo. The PWM signal might come from a radio control receiver to the servo or from common microcontrollers such as theArduino.

Small hobby servos (often called radio control, or RC servos) are connected through a standard three-wire connection: two wires for a DC power supply and one for control, carrying the control pulses.

The parameters for the pulses are the minimal pulse width, the maximal pulse width, and the repetition rate. Given the rotation constraints of the servo, neutral is defined to be the center of rotation. Different servos will have different constraints on their rotation, but the neutral position is always around 1.5 milliseconds (ms) pulse width.

Figure 3-9: Servo motor

3.2.8 Relay

As shown in figure 3-10, a relay is usually an electromechanical device that is actuated by an electrical current. The current flowing inone circuit causes the opening or closing of another circuit. Relays are like remote control switches and are used inmany applications because of their relative simplicity, long life, and proven high reliability. Relays are used in a widevariety of applications throughout industry, such as in telephone exchanges, digital computers and automation systems.

Highly sophisticated relays are utilized to protect electric power systems against trouble and power blackouts as well asto regulate and control the generation and distribution of power. In the home, relays are used in refrigerators, washing machines and dishwashers, and heating and air-conditioning controls.

Although relays are generally associated with electrical circuitry, there are many other types, such as
Pneumatic and hydraulic. Input may be electrical and output directly mechanical ,or vice versa.

Figure 3-10: Relay Module

3.2.9 USB Cameras

As shown in figure 3-11, USB Cameras are imaging cameras that use USB 2.0 or USB 3.0 technology to transfer image data .USB Cameras are designed to easily interface with dedicated computer systems by using the same USB technology that us found on most computers.The accessibility of USB technology in computer systems as well as the 480 Mb/s transfer rate of USB 2.0 makes USB Cameras ideal for many imaging application. An increasing selection of USB 3.0 Cameras is also available with data transfer rates of up to 5 Gb/s.USB Cameras using low power USB ports, such as on a laptop, may require a separate power supply for operation.

Figure 3-11: USB Cameras

3.2.10 RFID

As shown in figure 3-12, Radio Frequency Identification (RFID) is the wireless use of electromagnetic fields to transfer data, for the purposes of automaticallyidentifying and tracking tags attached to objects.

- **RFID – Access Control Application**
    - Create an Application for reading RFID Tags using a RFID Card Reader

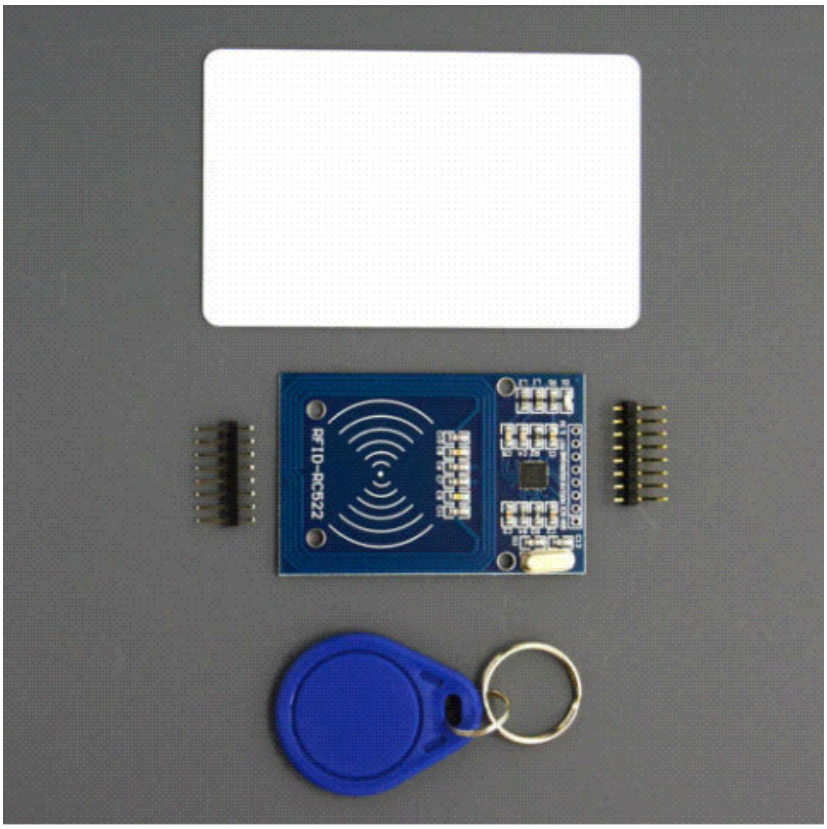

Figure 3-12: RFID Module

3.2.11 DC Motor

DC Motor converts electric energy into mechanical energy.

A DC Motor use direct current in other words, the direction of currentflows in one direction. As shown in figure 3-13.

Figure 3-13: DC Motor

CHAPTER FOUR

SIMULATION AND RESULTS

4.1 System Design Simulation

In this chapter the system simulation is presented and detailed.

4.1.1 Scenario (1)

At first a simple simulation is created to simulate the hardware of the system using Proteus program because it is more flexible than other simulation programs and also due to the availability of components required in our design in this program. The resultant circuit is shown in Figure 4.1.

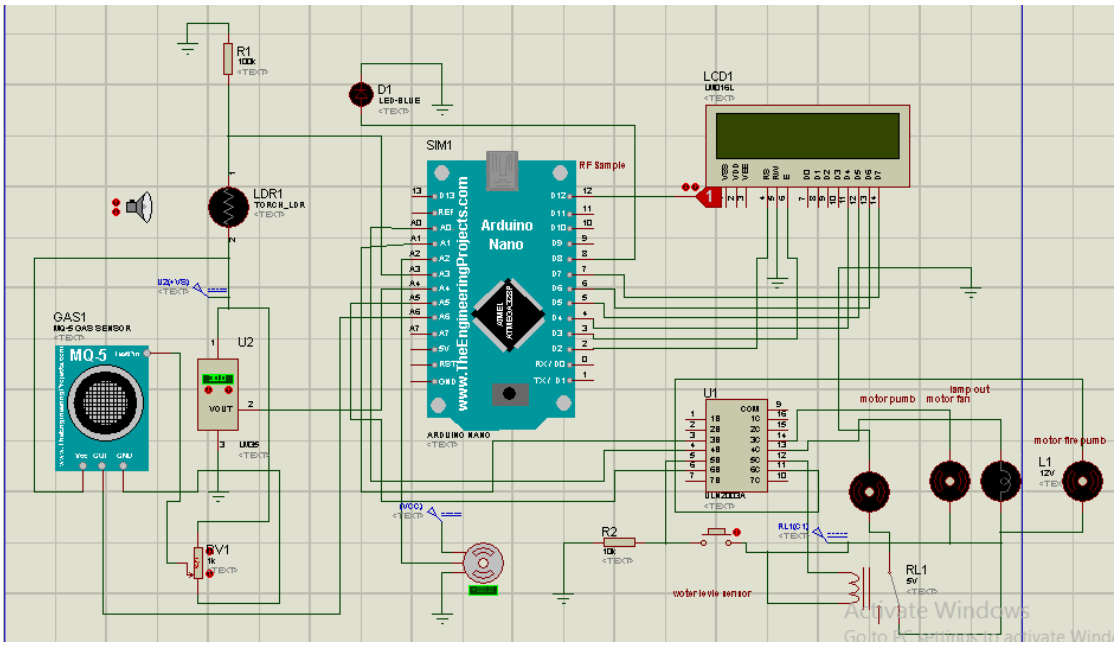

Figure 4-1 : scenario 1

4.1.2 Scenario (2)

As shown in Figure 4.2 when controller is powered from power supply the LCD screen displays the sensors reading.

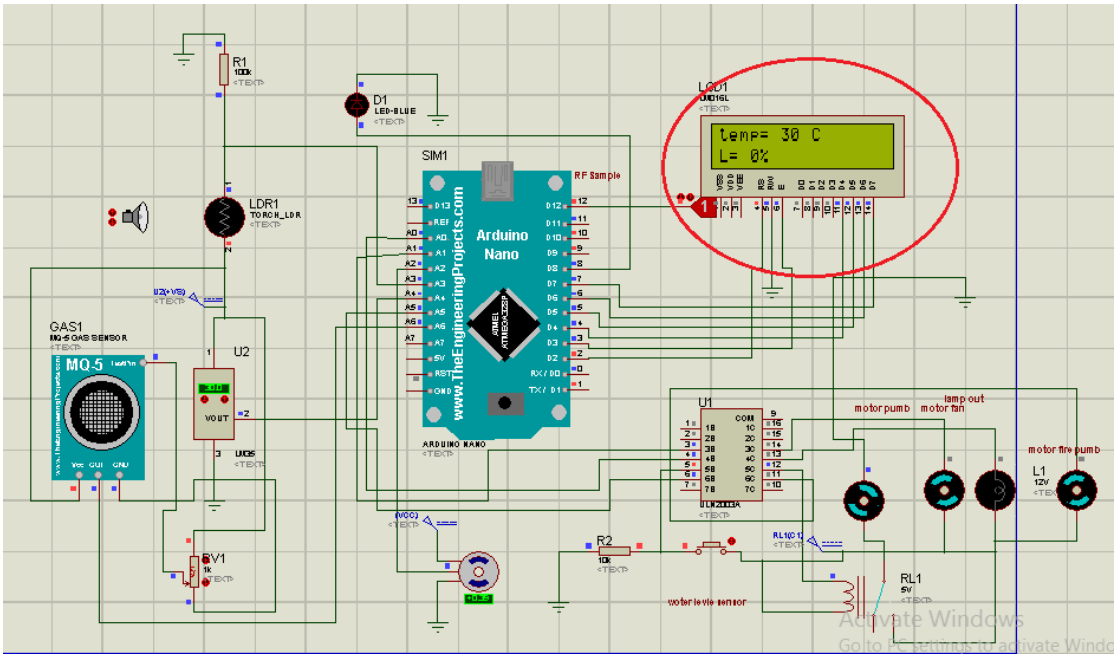

Figure 4-2: scenario 2

4.1.3 Scenario(3)

As shown in Figure 4-3 theLCD screen illustrates the fire sensor reading when the smoke reached the level of (40) the sensor responds by sending pulse to operate the motor of the fire extinguisher.

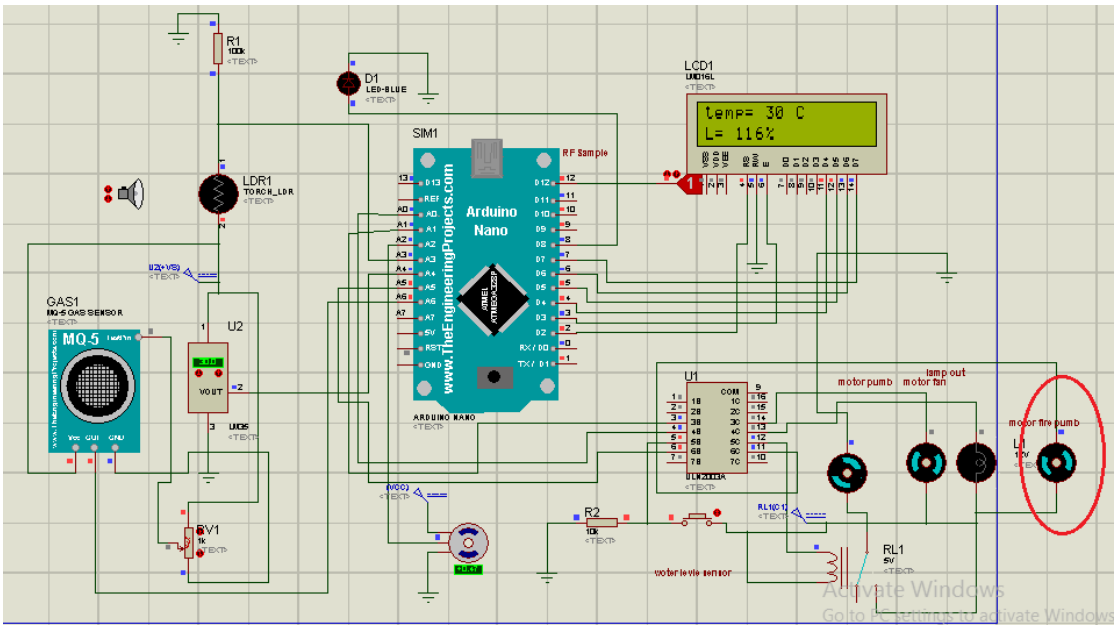

Figure 4-3 : scenario 3

4.1.4 Scenario(4)

As shown in Figure 4-4 the LCD screen illustrates the temperature sensor,when the temperature sensor readings reaches (35c) the sensor responds by sending pulses to operate the motor of ventilation fan

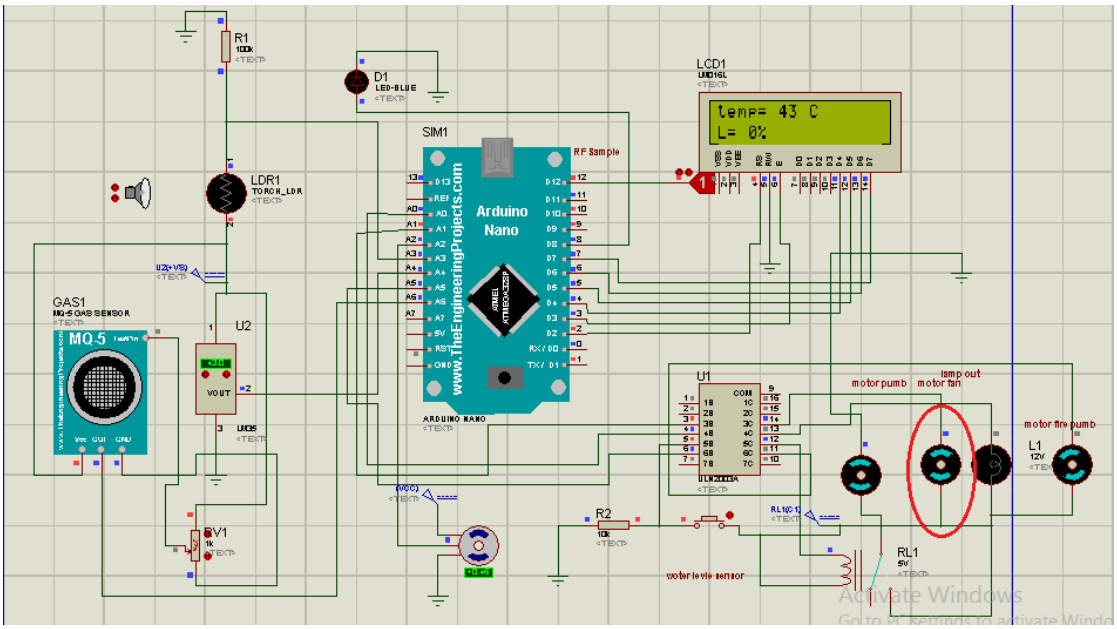

Figure 4-4 : scenario 4

4.1.5 Scenario (5)

As shown in Figure 4-5, which illustrates the way of operation of the light sensorwhich responds by switching on the LED lamp.

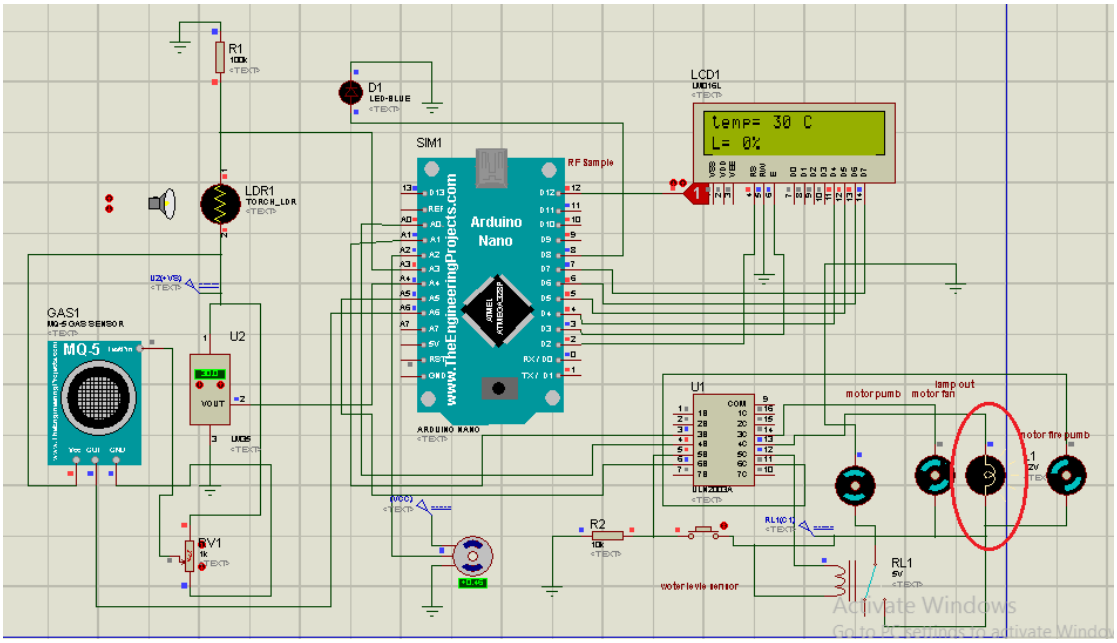

Figure 4-5 : scenario 5

4.1.6 Scenario(6)

As shown in Figure 4-6 which illustrates the water tank operation by connecting bush button with motor ,When button is closed it indicates that the tank is full and therefore the pump does not work , if the buttonis open it indicates that the tank is empty and the pump starts working.

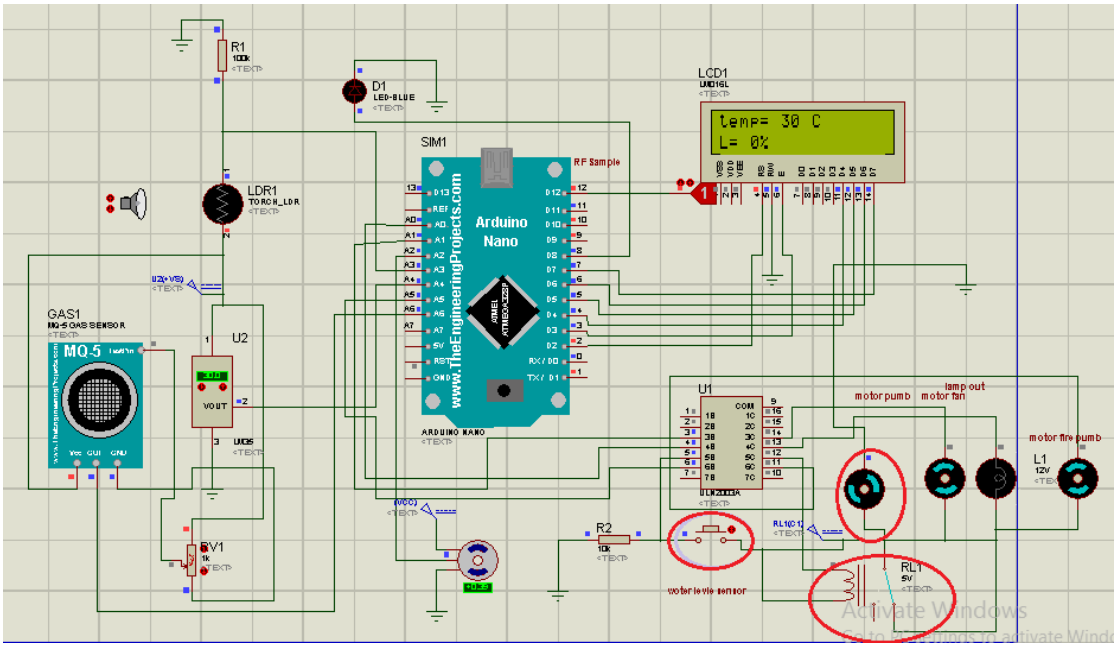

Figure 4-6 : scenario 6

CHAPTERFIVE

HARDWARE IMPLEMENTATION

5.1 Introduction

The Smart home system we work to develop is supposed to control a fan at home switches it on when home temperaturereaches a certain value taken here to be 35 degrees. The second job to be smartly control is the water level in home water tank where the system should switch a pump off whenever the water in the tank reaches a certain level sensed by a sensor. An essential required function o be performed by the system is to switch on a motor whenever smoke is detected by the smoke sensor MQ5in home premises indicating that the motor switches on a water valve to hold the fire source. Another function performed by the system is to open home door whenever an RFID tag is detected. Finally the system automatically switches on outdoor lights when it gets dark over there and switches it off during day light.

System is developed on Android to display all data on smart phone. It is also connected via net so that the user can see home and other information from all over the world.

5.2 Circuit Block diagram

Circuit developed in our work block diagram is shown in Figure 5-1 while following sections details the operation of each component used besides their interconnection and whole system operation.

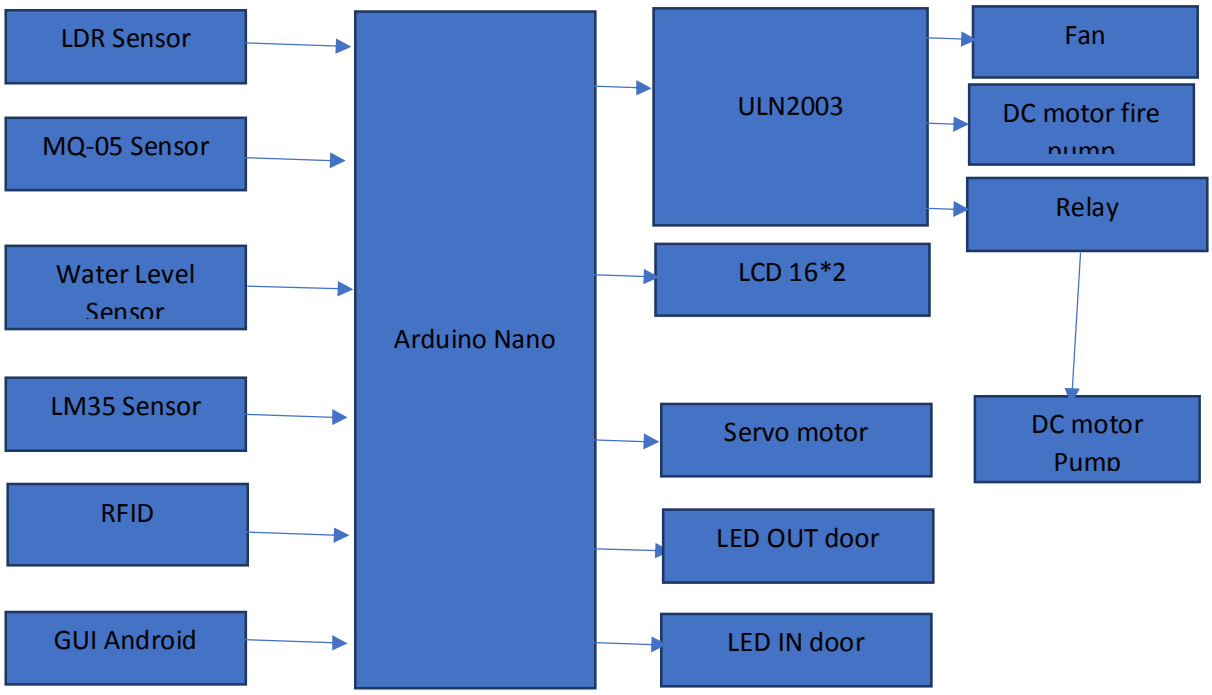

Figure5-1 CircuitBlock Diagram

5.2.1 Arduinoconnection with RFID

Module RFID RC522 is executed on the chip MFRC522from NXP Company. This chip provides two-way wireless (up to 6 cm) communication at 13.56 MHzRFID is an abbreviation for "Radio Frequency Identification". Chip MFRC522 supports the following interfaces:

- SPI (Serial Peripheral Interface, a serial interface for connection of peripheral devices), provides data transfer speeds up to 10 Mbps;
- two-wire I2C interface, speed up to 3400 Kbit / s in High-speed mode, up to 400 Kbit / s in Fast mode;

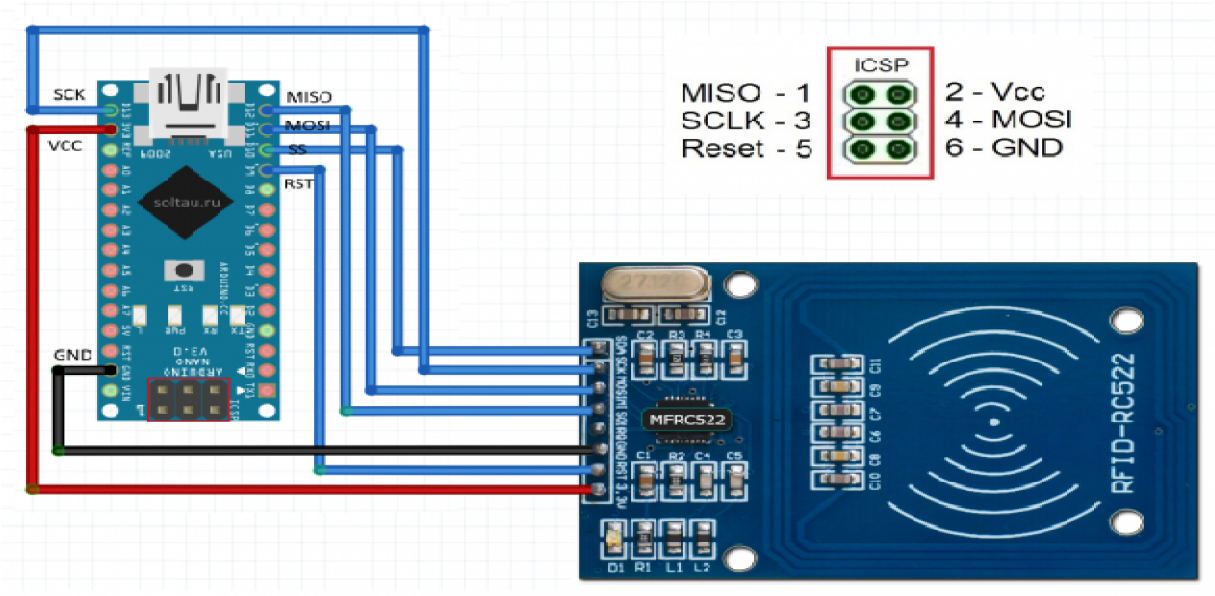

Figure 5-2:Arduino with anRFID

Figure 5-2 presents an Arduino board along with an RFID chip connected to it. While Figure 5-3 shows the Arduino connection to LCD chip.

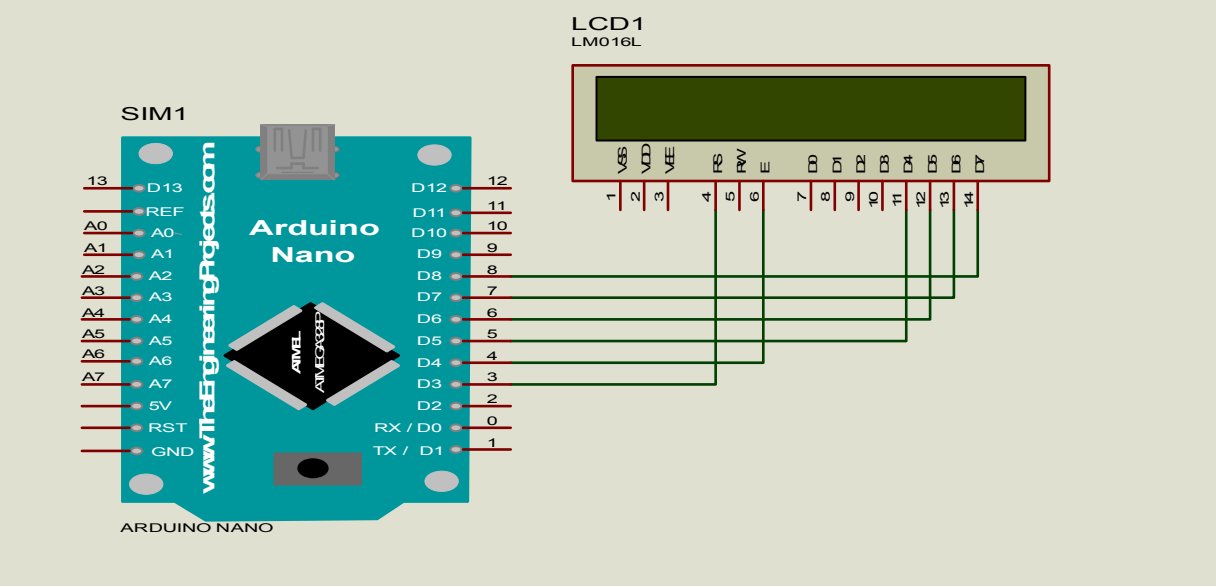

Figure 5-3Exact connection of Arduino to the LCD

LCD module is professional industry which is used todisplays in machine/man interfaces like printers. This LCD is cheap, easy to use and it comes in a few number of size configurations: 8×1 (one row of eight characters), 16×2.

For this project we have used a simple library called LiquidCrystal, this library is included in the standard package of Arduino 1.0.10.

For this project an Arduino Nano 3.0 is needed beside a Hitachi HD44780 LCD module and a 10kOhm trimmer to preserve the LCD state contrast.

5.2.2 Arduinoconnection with LM 35

Figure 5-4 shows connection of Arduino to the LM 35 circuit.

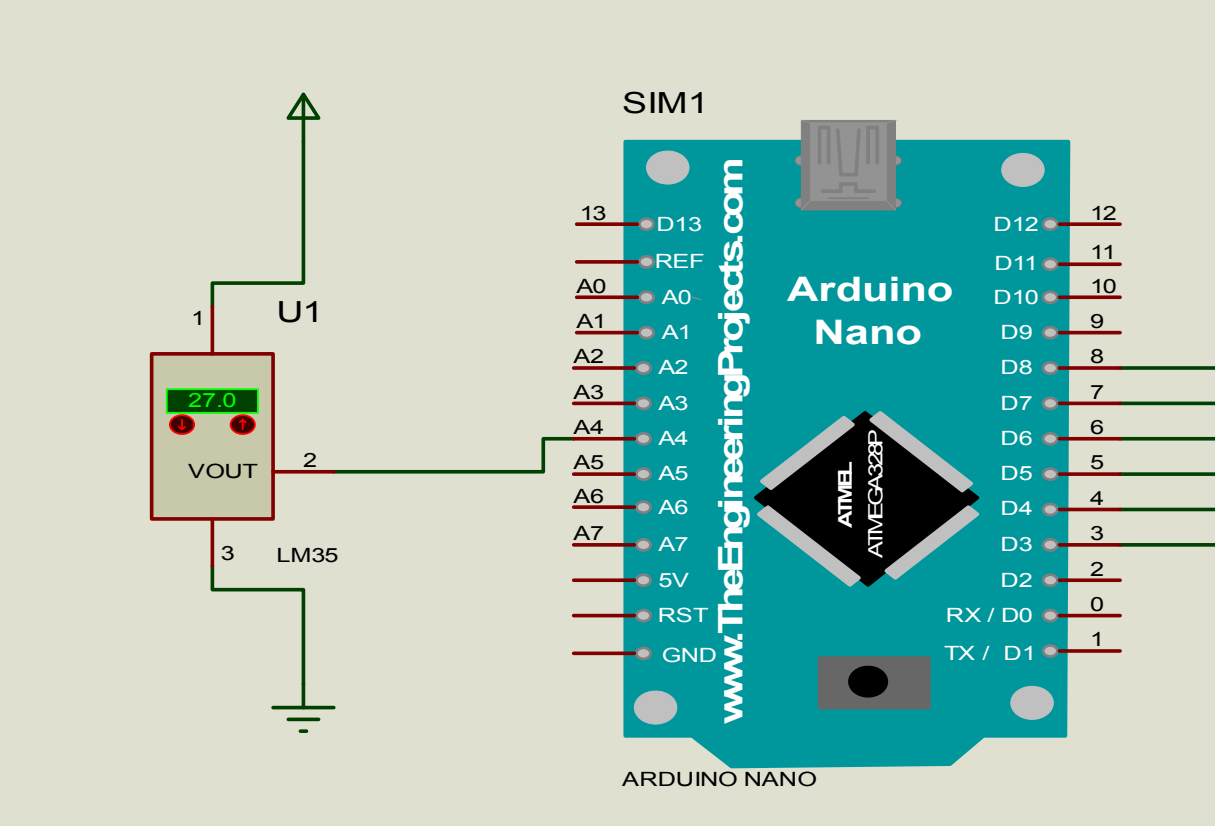

Figure 5-4Arduino connected to the LM 35

Arduino can sense the surroundings by receiving input signal from a variety of sensors and can affect its environment via actuators.

An analog temperature sensor is a chip that tells you what the ambient temperature is. The LM 35 is a basic, ultra low-cost digital temperature sensor It uses a capacitive thermistor to measure the surrounding air, and spits out a digital signal on the data pin (no analog input pins needed). It is fairly simple to use, but requires careful timing to grab data. The only real downside of this sensor is you can only get new data from it once every 2 seconds, so when using our library, sensor readings can be up to 2 seconds old.

5.2.3Connection of Arduino with LDR

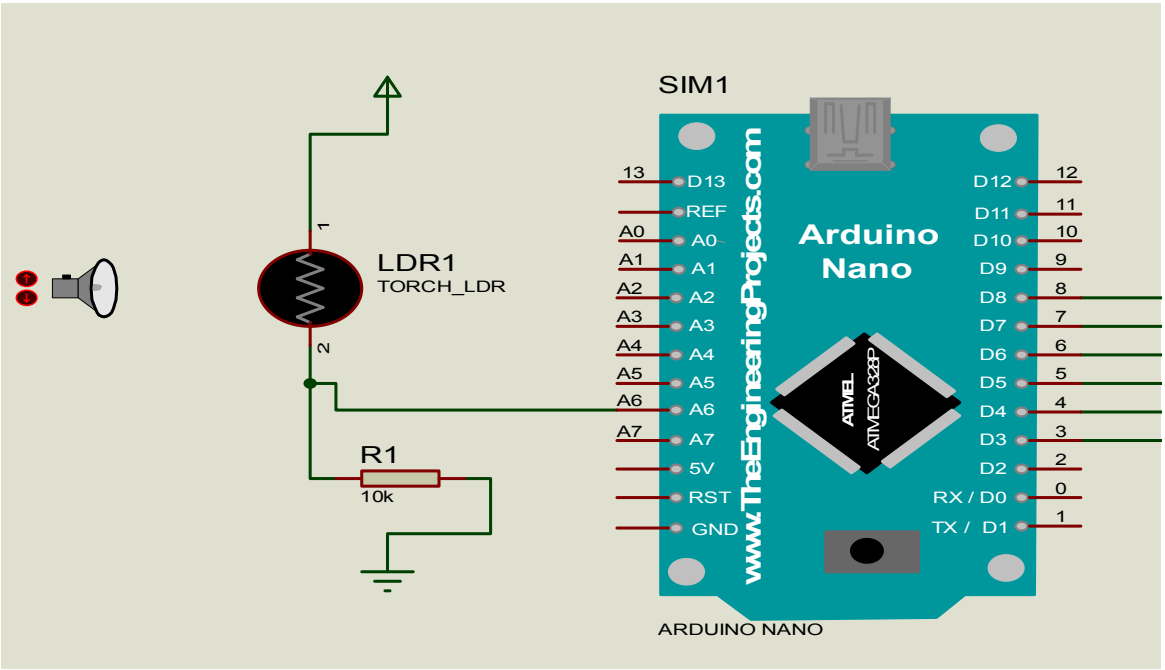

Figure 5-5Arduinoconnected with LDR

5.2.4Arduino with servo motor

Servos are controlled by sending an electrical pulse of variable width, or pulse width modulation (PWM), through the control wire. There is a minimum pulse, a maximum pulse, and a repetition rate. A servo motor can usually only turn 90° in either direction for a total of 180° movement. The motor's neutral position is defined as the position where the servo has the same amount of potential rotation in the both the clockwise or counter-clockwise direction. As shown in figure 5-6

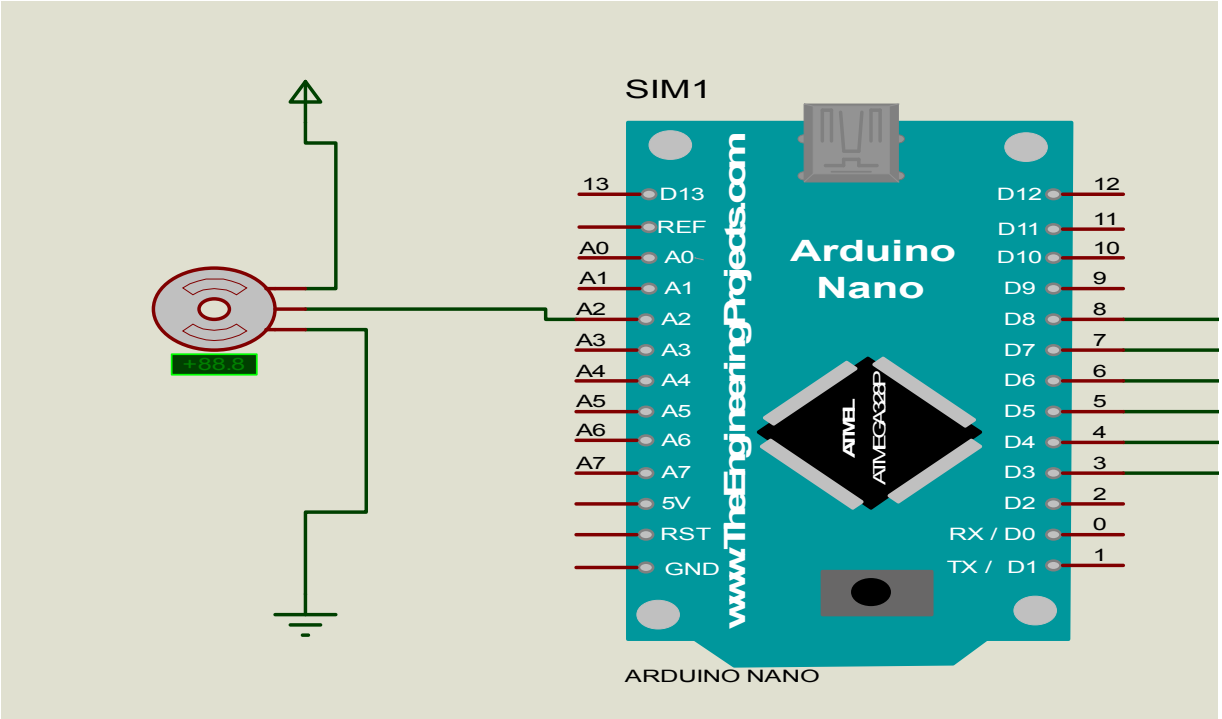

Figure 5-6Arduino connected with the motor

5.3 Installing TeamViewer toandroid:

TeamViewer has been long trusted by IT and other technical experts around the world. Most families have a quick phone call and launching TeamViewer on both ends and that genius is able to solve any user problems, even if they are located thousands of miles away.

It is essential to go with the Basic installation shown in the screen of Figure 5-7 and make sure you select “Personal/Non-commercial use” since you’re using the free version of the software.

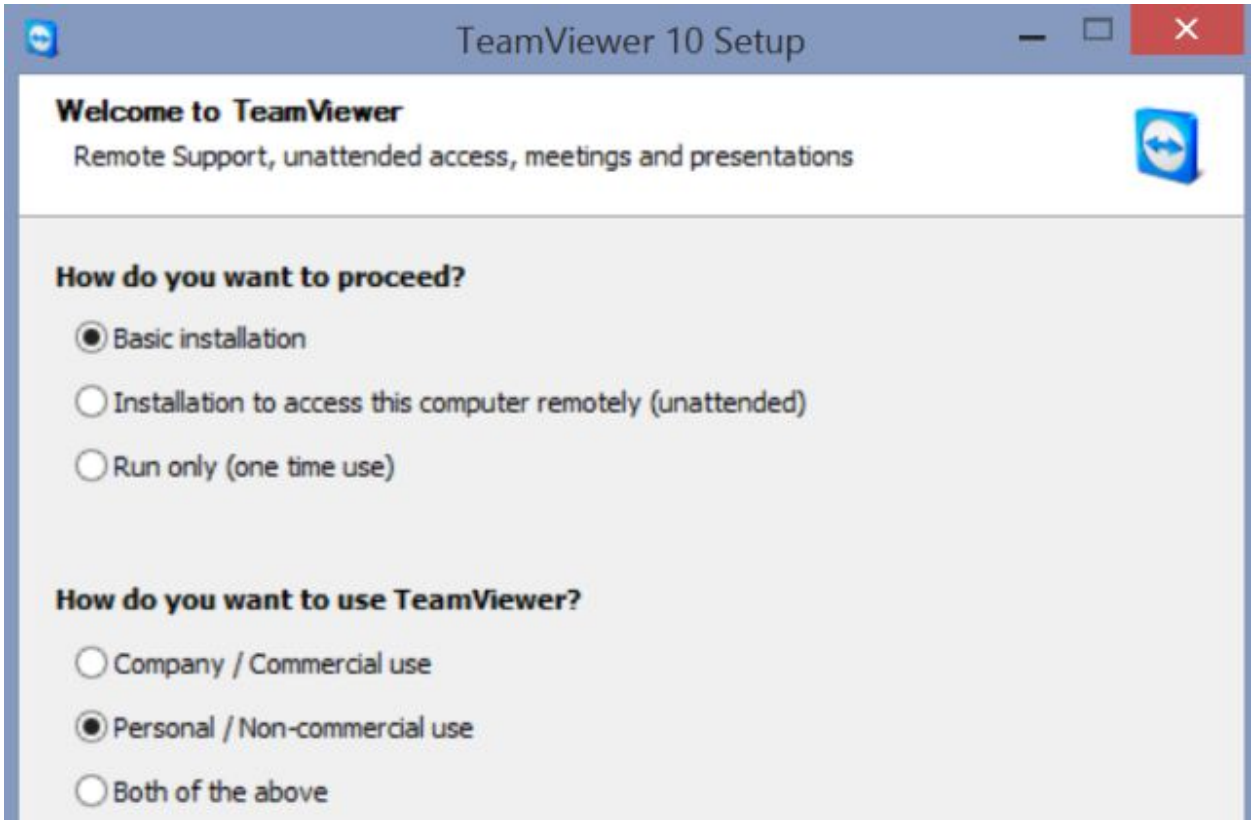

Figure 5-7: Basicinstallation of TeamViewer Screen

Next a user has to choose the destination and any add-on features you’d like by selecting appropriately from the screen displayed in Figure 5-8. You really don’t need any of the add-ons for the purposes of what we’re doing here.

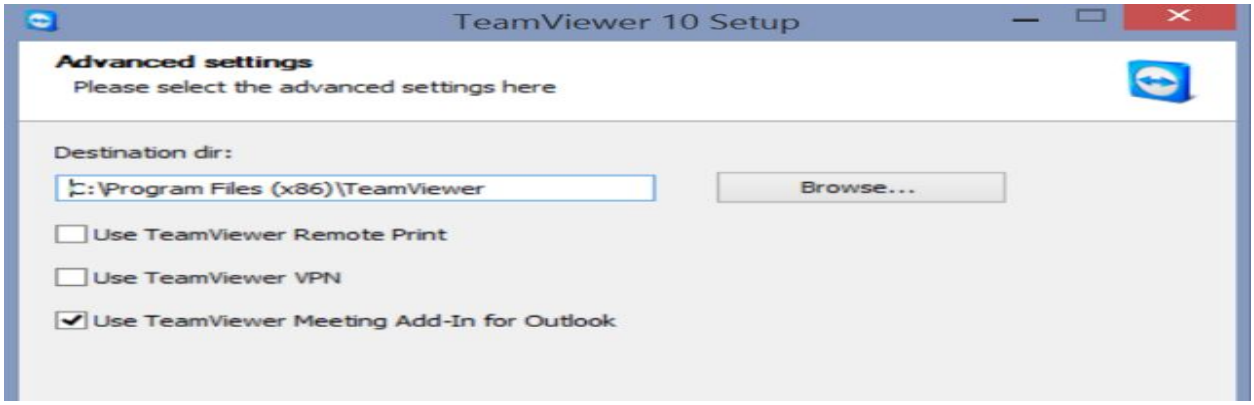

Figure 5-8 selecting proper add-ins

The download and install is pretty fast, under 5 minutes, and when the user is done, he will see a screen that lets him allow remote control access to his own system using the panel on the left, using the given ID and password, or remotely access another computer using the panel on the right of the screen displayed in Figure 5-9.

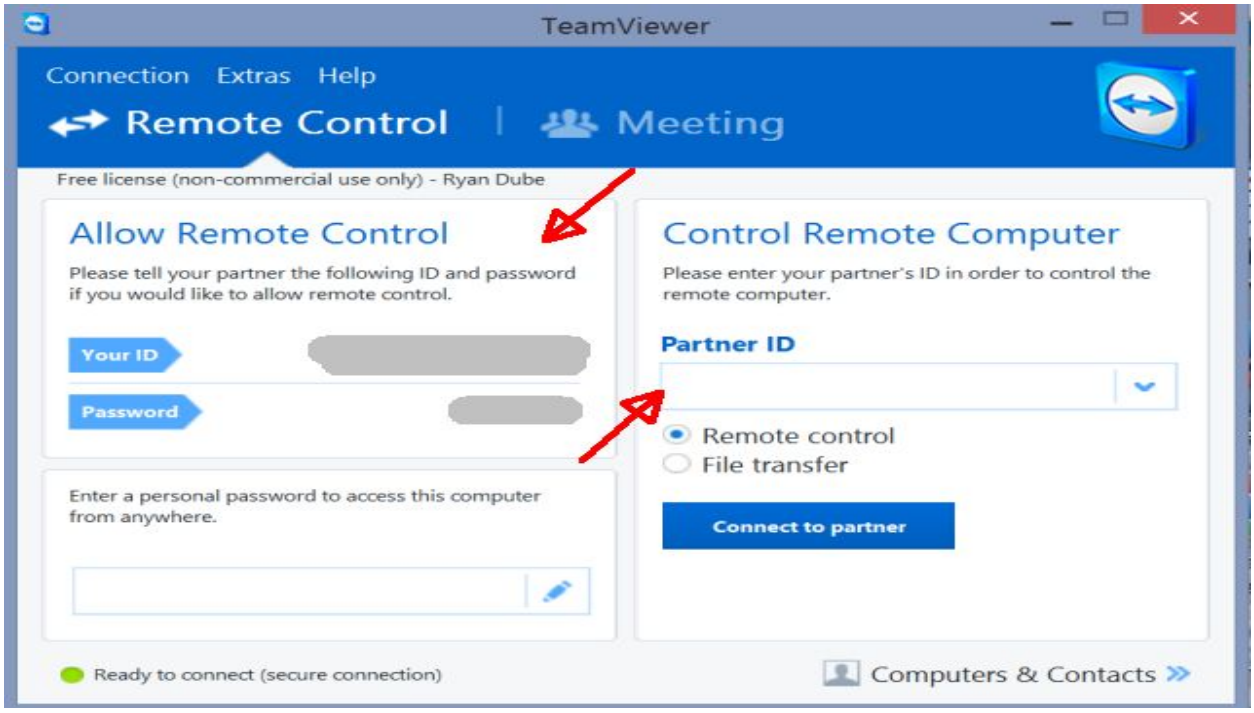

Figure 5-9 initiating ID and password in TeamViewer

Ifyou’re installing on something other than Windows – no worries, there’s Linux, Mac and mobile versions available as well. In my case users actually have TeamViewer installed on a remote Linux station in another building.

Once you launch the app, type in the ID and password of the system you want to connect to. Finally you end up with your copy of TeamViewer ready to use starting from the screen shown in Figure 5-10.

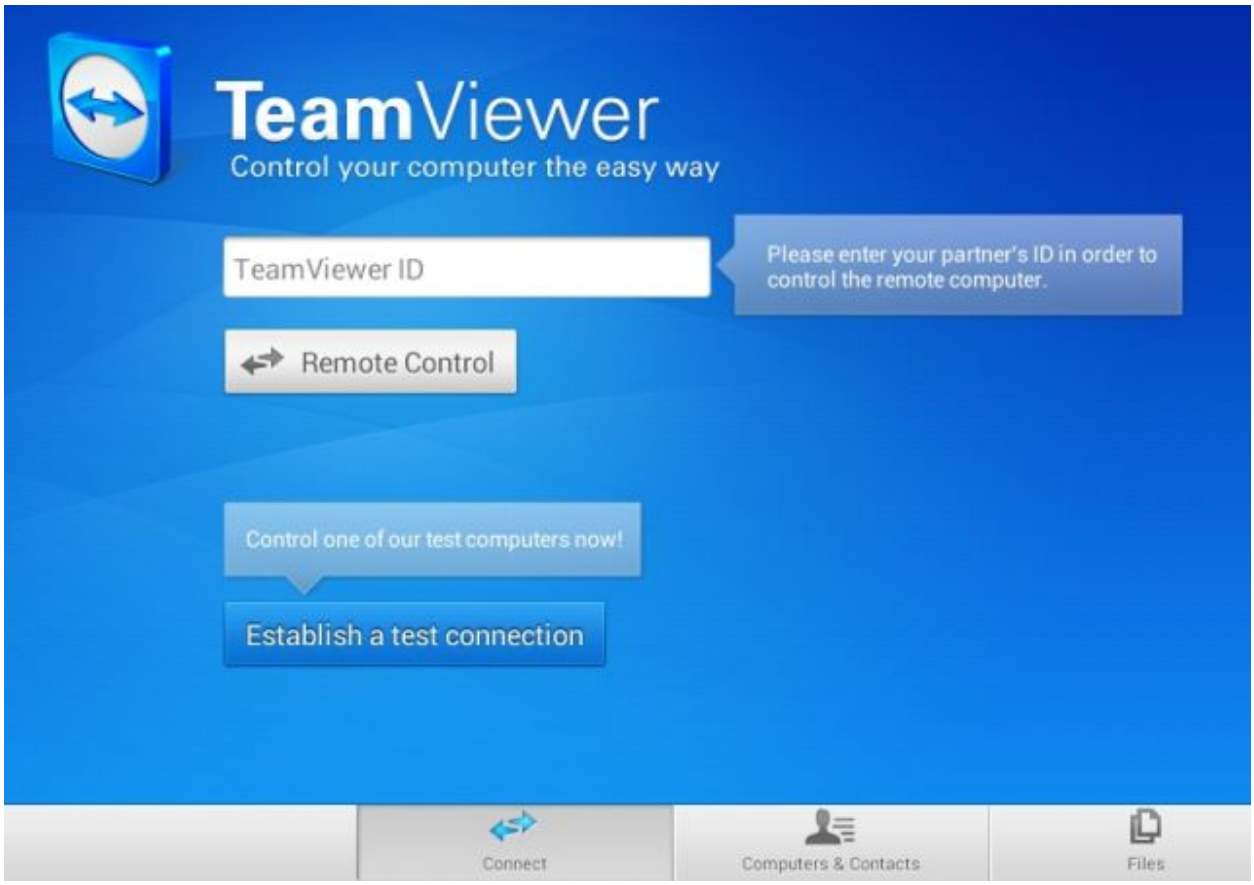

Figure 5-10 starting using TeamViewer

5.4 GUI byMATLAB

Our project the graphical user interface which provides the main screen to the system user is developed using MATLAB. The main screen looks as shown in Figure 5-11.

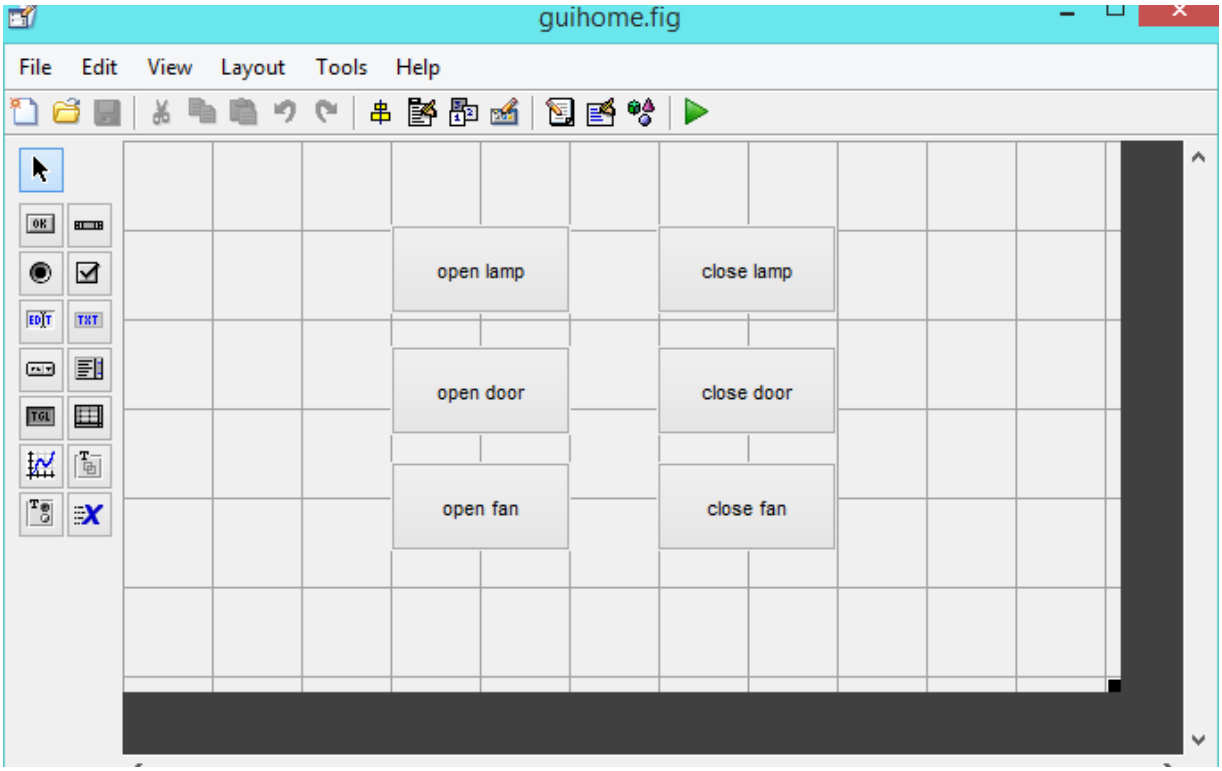

Figure 5-11 system user main screen

5.5 Results

The temp sensor produces a voltage output which is proportional to the absolute temperature of the die in the device. The relationship between these voltages and the temperature in degrees C is shown in graphical form in Figure 5-12.

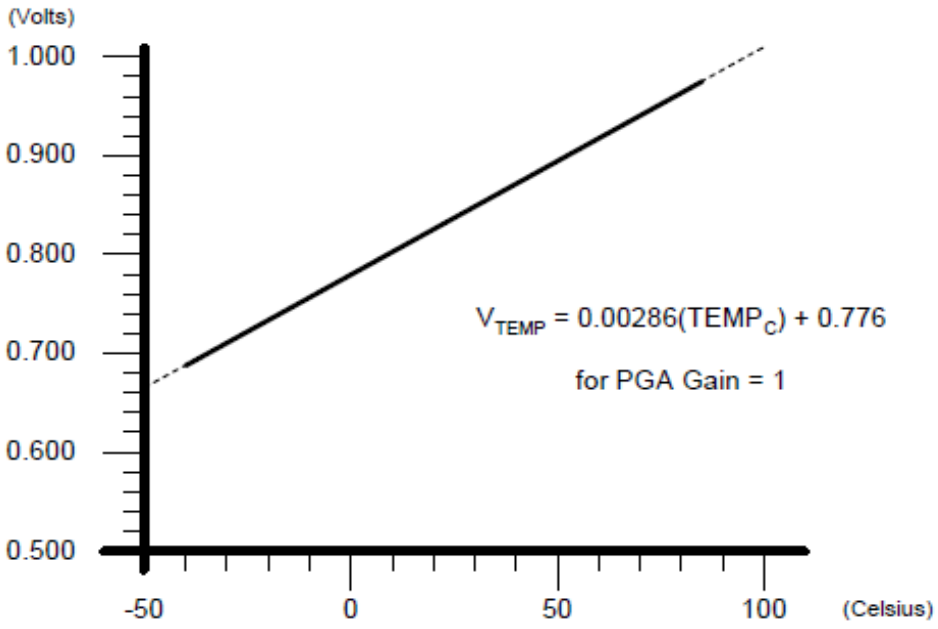

Figure 5-12 home temperature versus voltage

The transfer characteristic of the temp sensor is shown graphically. The voltage is not directly measurable outside the device. Instead, it is presented as one of the inputs of the ADC mux, allowing the ADC to measure the voltage and produce an output code which is proportional to it.

The code produced by the ADC in left-justified single-ended mode is proportional to the input voltage.

CHAPTER SIX

CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

In this projecta novel architecture for low cost and flexible home control and monitoring system using Android based Smart phone is proposed and implemented. The proposed architecture utilizes a micro web server as an interoperable application layer for communicating between the remote user and the home devices. Any Android based Smart phone with built in support for network can be used to access and control the devices at home. When a network connection is not available, mobile cellular networks such as 3G or 4G can be used to access the system.

6.2Recommendation

Prospective future works include incorporating SMS and call alerts, and reducing the wiring changes for installing the proposed system in pre-existing houses by creating a wireless network within the home environment for controlling and monitoring the smart home environment , and also can be uses the Google speech recognition engine thus eliminating the need for an external voice recognition module.

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Appendix A

Arduino code:

```
#include <LiquidCrystal.h>

#include <SPI.h>

#include <RFID.h>

#include <Servo.h>

LiquidCrystallcd(2, 3, 4, 5, 6, 7);

Servo myservo;

#define SS_PIN 10

#define RST_PIN 9

int state;

RFID rfid(SS_PIN,RST_PIN);

intsensorPin = A6;

int sensor1Pin = A4;

constintbuttonPin = A3;

intbuttonState = 0;
```

```
constint button1Pin = 12;

int button1State = 0;

intsensorValue = 0;

int sensor1Value = 0;

int sensor2Value = 0;

int temp;

int l;

int s;

intpos=0;


intserNum[5];

int cards[][5] = {


  {64,62,27,124,25}


};
```

```
bool access = false;


void setup(){


Serial.begin(9600); // open serial connection to print out distance values

SPI.begin();

rfid.init();

myservo.attach(A2);

analogReference(INTERNAL);

pinMode(buttonPin, INPUT);

pinMode(button1Pin, INPUT);

pinMode(0, OUTPUT);

pinMode(11, OUTPUT);
```

```
pinMode(10, OUTPUT);

pinMode(9, OUTPUT);

pinMode(8, OUTPUT);

pinMode(1, OUTPUT);

pinMode(13, OUTPUT);

pinMode(A5, OUTPUT);

pinMode(A1, OUTPUT);

pinMode(A7, OUTPUT);

pinMode(A0, OUTPUT);

lcd.begin(16, 2);









}


void loop(){
```

```
if(Serial.available() > 0){

state = Serial.read();



if (state == 'a'){

digitalWrite(8, HIGH);

Serial.print("Distance[cm]: ");

    }



else if (state == 'b'){



digitalWrite(8, LOW);

    }



if (state == 'c'){

for (pos = 180; pos>= 0; pos -= 1) { // goes from 180 degrees to 0 degrees

myservo.write(pos);              // tell servo to go to position in variable 'pos'
```

```
delay(15);                    // waits 15ms for the servo to reach the position
  }
return ;              // waits 15ms for the servo to reach the position
  }



else if (state == 'd'){



for (pos = 0; pos<= 180; pos += 1) { // goes from 0 degrees to 180 degrees
   // in steps of 1 degree
myservo.write(pos);              // tell servo to go to position in variable 'pos'
delay(15);
   }
return ;
   }
```

```
else if (state == 'e'){
digitalWrite(A1, HIGH);
Serial.print("Distance[cm]: ");
    }

else if (state == 'f'){

digitalWrite(A1, LOW);
    }



  }
sensorValue = analogRead(sensorPin);
  sensor1Value = analogRead(sensor1Pin);
buttonState = digitalRead(buttonPin);
```

```
  button1State = digitalRead(button1Pin);
temp= sensor1Value / 9.31;
    l= sensorValue / 4;



lcd.setCursor(0, 0);
lcd.print("temp= ");
lcd.print(temp);
lcd.print(" C");
lcd.setCursor(0, 1);
lcd.print("L= ");
lcd.print(l);
lcd.print("%");
lcd.print(" ");
if (buttonState == HIGH) {
   // turn LED on:
```

```
digitalWrite(A0, HIGH);


  }
if (buttonState == LOW) {
    // turn LED off:
digitalWrite(A0, LOW);


  }


if (temp > 35) {
    // turn LED on:
digitalWrite(A1, HIGH);


  }
if (temp < 35) {
    // turn LED on:
```

```
digitalWrite(A1, LOW);


  }
if (l > 40) {
    // turn LED on:
digitalWrite(A5, HIGH);


  }
if (l < 40) {
    // turn LED on:
digitalWrite(A5, LOW);


  }
```

```
if(rfid.isCard()){


if(rfid.readCardSerial()){


Serial.print(rfid.serNum[0]);

Serial.print(" ");

Serial.print(rfid.serNum[1]);

Serial.print(" ");

Serial.print(rfid.serNum[2]);

Serial.print(" ");

Serial.print(rfid.serNum[3]);

Serial.print(" ");

Serial.print(rfid.serNum[4]);

Serial.println("");
```

```
for(int x = 0; x <sizeof(cards); x++){

for(int i = 0; i <sizeof(rfid.serNum); i++ ){

if(rfid.serNum[i] != cards[x][i]) {

access = false;

break;

                } else {

access = true;

                }

            }

if(access) break;

          }



      }
```

```
if(access){
for (pos = 180; pos>= 0; pos -= 1) { // goes from 180 degrees to 0 degrees
myservo.write(pos);              // tell servo to go to position in variable 'pos'
delay(15);                       // waits 15ms for the servo to reach the position
  }
delay(1500);
for (pos = 0; pos<= 180; pos += 1) { // goes from 0 degrees to 180 degrees
    // in steps of 1 degree
myservo.write(pos);              // tell servo to go to position in variable 'pos'
delay(15);                       // waits 15ms for the servo to reach the position
  }
```

```
     } else {
```

```
      }
delay(50);
   }
rfid.halt();
}
```