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Title: GSM Based Fire and Smoke Detection and Prevention System

By:

1. Agazi weldesyase……………..RET 0081/05
2. Bahta G/meskel……………….RET 0181/05
3. Mekonen Abreha……………..RET 0788/05
4. Solomon Baynes ……………..RET 1365/06

Advisor:

Mulubrehan A.

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DECLARATION

This is to certify that project report entitled “GSM BASED FIRE AND SMOKE DETECTION AND PREVENTION SYSTEM” is submitted in partial fulfillment of the requirements for the award of bachelor of technology in Electrical and computer engineering specialization in Computer Engineering. We declare that the work contained in this thesis is our own, except where explicitly stated otherwise. In addition, this work has not been submitted to obtain another degree or professional qualification.

ACKNOWLEDGEMENT

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ABSTRACT

Fire alarm system plays an important role in maintaining and monitoring the safe of all kind environments and situations. However the usability of many existing fire Alarm system is well known but could be produce with high cost. Subsequently, it is not affordable for the low income users. The main objective of this project is to make a fire control system with low cost. The project has three main systems the detection system the monitoring system and the appliance system.

The detection system operates as the fire detector and smoke detector. This paper discusses the design and implementation of a fire alarm system using the ARDUINO UNO R3 which operates the entire system. The detectors are placed in parallel in different levels. Any signal from each detector at any level is monitored using monitoring system.

The appliance system has components like GSM for sending SMS services, buzzer for alarming, servos for automatic lockdown of doors in emergency exits and motor pump fire extinguishing foam to stop the fire and GPS module to indicate the location where the fire is occurred for the fire extinguishing car. The entire system is controlled by microcontroller. The microcontroller is programmed in such way by using C-Programming with ARDUINO IDE. From the project done, the System can detects smoke, flame, heat etc. sensed by the detector, followed by the monitoring system which indicates smoke, light, flame, heat etc. at that particular level.

Finally when the sensors form each level triggered individually, the main Buzzer operates, send SMS. Then it shows in the control panel LCD display which area is affected and which is safe. Then it runs the emergency exit servo motor to escape and the water pump motor to the affected zone to stop the fire.

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List of Acronyms

- GSM – Global System for Mobile
- SMS – Short Message Service
- SIM – Subscriber Identity Module
- LCD – Liquid Crystal Display
- AVR – Advanced Virtual RISC
- PFP – Passive Fire Protection
- LED – Light Emitting Unit
- UV – Ultraviolet
- IR – Infrared
- NFPA – National Fire Protection Association
- CPU – Central Processing Unit
- ALU – Arithmetic Logic Unit
- ROM – Read-Only Memory
- PIC – Programmable Intelligent Computer
- RISC – Reduced Instruction Set Computer
- EEPROM – Electrically Erasable Programmable Read-Only Memory
- RAM – Random-Access Memory
- MIPS – Millions of Instructions per Second
- CMOS – Complementary Metal Oxide Semiconductor
- IC – Integrated Circuit
- GND – Ground
- DC – Direct Current
- AC – Alternative Current
- NO – Normal Open
- NC – Normal Closed
- RS – Register Select
- R/W – Read/Write
- IMEI – International Mobile Equipment Identity
- GPS – Global Positioning System

- USB - Universal Serial Bus
- IDE – Integrated Development Environment
- PWM – Pulse-Width Modulation

CHAPTER ONE
INTRODUCTION

1.1. Background

Nowadays, securing one's property and business against fire is becoming more and more important. Monitoring commercial and residential areas all-round is an effective method to reduce personal and property losses due to fire disaster.

Home fire detection is a matter of great concern, and thus many efforts are devoted in most developed countries to the design of automatic detection systems. A fire alarm system should reliably and in a timely way notify building occupants about the presence of fire indicators, such as smoke or high temperatures. A fire detector is usually implemented as a smoke sensor due to its early fire detection capability, fast response time and relatively low cost. Other options for the fire detection are based on gas sensors or temperature sensors fire detectors that use a single sensor, generally a smoke sensor, and present high false-alarm rates due to temperature changes.

In order to prevent fires from occurring or minimize their impact, accurate and early detection is essential and automatic fire detection is becoming very essential to reduce the fire in the building and industry. Automatic fire alarm system provides real-time surveillance and monitoring. A key aspect of fire protection is to identify a developing fire emergency in a timely manner, and to alert the building's occupants and fire emergency organizations. This is the role of fire detection and alarm systems.

Generally, fire detectors are designed to respond at an early stage to one more of the four major characteristics of combustion, heat, smoke, flame or gas. No single type of detector is suitable for all types of premises or fires. Heat detectors respond to the temperature rise associated with a fire and smoke detector respond to the smoke or gas generated due to fire.

1.2. Description of the project

This system is a kind of stand-alone embedded system. It is a self-contained device. It takes either digital or Analog inputs from its input ports, calibrates, converts, and processes the data, and outputs the resulting data to its attached output device, which either displays data, or controls and drives the attached devices.

These devices could be for example, Global System for Mobile Communication (GSM) and short message service (SMS) to carry out data from the building with sensors directly alert the owners to their mobile phone. Therefore, this makes controlling damages caused by fire easier by directly sending alert notification messages to owners or fire department using GSM technology. So, we designed a smart fire alarm model. Parameters like, temperature and smoke level will be controlled by microcontroller. Each of these parameters is measured by a sensor that is set at a specific range, if this sensor signals any change in that range, the system will take the appropriate action required, and the system sends a daily report to the user by SMS.

1.3. Statement of the Problem

The most prevalent threat faced by all institutions is FIRE. No institution is immune from fire. Until the owners/trustees of these institutions develop plans for dealing with the fire threat, they place the building and its occupants and collections at risk.

The complexity of these plans may vary from a simple evacuation plan, to a fire prevention program, to a more complex plan that includes passive and automatic fire protection systems almost 90% of fire damages occur due to lack of early fire detection. A fire attack is usually silent and people will know about fire only when it has spread across a large area. SMS based Fire Alert system gives warning immediately to one or more mobile numbers and hence remedy actions can be taken quickly. This helps to prevent major damages and losses created by a fire accident.

In Ethiopia the hazard of fire and related problem is occur frequently in the urban area of the country. There for existing fire alarm system in market nowadays, is too complex in term of its design and structure. Since the system is too complex, it needs regular preventive maintenance to be carried out to make sure the system operates well. Meanwhile, when the maintenance is been done to the existing system, it could raise the cost of using the system. Therefore, the project is designed with a low cost and all level users can have one for a safety purpose.

Property damaged by floods can often be dried out and restored. Structural damage from an earthquake might be repaired. Stolen property always has a chance of being recovered. Damage from fire, however, is usually permanent and irreparable. Historical buildings or contents, once reduced to ash, can never be restored. Fire is more cunning and less discriminating than a thief. It can travel (spread) through very small openings and concealed spaces to reach other parts of a building, deprive occupants of a life supporting environment, and cause partial to total destruction of property.

1.4 Objective of the project

1.4.1 General objective

The main purpose of this project is to design and implement an automatic fire and smoke detection and prevention system that can be produced at a low cost with effective and competitive usage. This System is designed to be more users friendly and easy to operate at any level.

1.4.2 Specific objective

The project is also been designed to be further working vision using minimum hardware at the lower level of processing. These systems are directed at specific applications.

Our objective is to design a fire and smoke detection and prevention system that would fulfill the following:

- To indicate the room in which fire erupted.
- To indicate the location where the fire is occurred.
- To prevent fire and smoke.
- To sound the alarm if fire occurs.
- To run the emergency EXIT servo motor and control the fire by supplying water to the remote area by motor pump.
- To indicate the state of the room as ‘Safe’ in order to avoid any confusion under normal condition. So the system should never be in any ambiguous state.

1.5 Project Scope

In a way to achieved above objectives, this project need to be implemented as below:

- This fire alarm system can also incorporate the heat and flame detector that are connected in parallel.
- The microcontroller is used as the heart of this fire alarm system that controls the entire operations involved.
- The fire alarm system is capable to locate and identified the place that is in fire where by it is monitored using the monitoring system.
- Capable to display the output from each sensor in the monitoring system.

CHAPTER TWO

LITERATURE REVIEW

From the beginning of recorded history people have learned that early response to fires had positive results in controlling those fires. When someone discovered a fire the fire brigades and fire departments were alerted by roving watchmen using hand bell-ringers or church sextons ringing church bells or factory steam whistles. Unfortunately, these systems did not provide very much detail and often directed the fire department to the wrong location. But with the advent of the telegraph, invented in the early 1840ís by Samuel F. B. Morse, firefighters were given a faster and more accurate fire reporting system.

In 1847, New York became the first American city to begin construction of a municipal fire alarm system required by ordinance to construct a line of telegraph, by setting posts in the ground, for communicating alarms of fire from the City Hall to different fire stations, and to instruct the different bell-ringers in the use of said invention.

The Automatic Fire Alarm Telegraph is operated by any dangerous Heat, and detects the presence of fire at its commencement. The apparatus, usually set at 125 Fahrenheit, is placed on the ceiling at regular intervals in every room, office, closet, and elevator in the Building the alarm is given directly to the Insurance patrol and fire department. It tells the *exact location of the fire* to the companies *before they leave their station,* giving the particular building and floor. Each instrument performs the service of a constant, vigilant watchman, ready to act in time of danger in every part of the building.

Fire and smoke spread within the building can be affected by various factors such as the geometry, dimension, layout and usage of the building. In order to provide fire protection in the building, it is very important to detect fire at its early stage. The most common fire and smoke detection methods include the use of point type detectors (i.e. ionization smoke detectors, photoelectric detectors, heat detectors), line type detectors etc. These detection methods based on the use of fire signatures such smoke and heat.

Fire is a chemical reaction known as combustion. It is defined by the rapid oxidation of a combustible material accompanied by release of energy in the form of heat. In order for ignition to occur, the presence of both a fuel and a heat energy source is required. When the two come together, with the appropriate proportions, either by a lack of separation or by some type of active interaction, a fire occurs.

The creation of the faster evacuation technologies and safer living conditions at affordable cost for everyone. This paper discusses the automatic fire detection system, the composition and working principle. The principle of the proposed circuit is derived from the physical principles of ionization. Fire detectors using two-wire method to reduce the wall alignment, improve reliability, and ease of construction and installation. This describes the overall structure of the fire detection system and control software in the design.

Low cost fire detection and control system based on smoke and heat detection is proposed. It is comprised of a combination of electrical/electronic devices/equipment’s working together to detect the presence of fire and alert people through audio or visual medium after detection. These alarms may be activated from smoke detectors or heat detectors which, when detects fire. Then, it automatically operates a relay which can be used to send Short Message Service (SMS) to the registered mobile numbers and switch on a water sprayer or a Solenoid Pump to spray water or fire ceasing foam.

A Short Message Service (SMS) was used as a method of wireless connection in the designed system. The adopted (T-BoxN12R device) which was programed in Java to Micro Edition language (J2ME) will keep scanning the received gas smoke data signal from the Gas Smoke Sensor output to pre monitor the ability of occurrence of a fire, once it detects that the collected data (Gas Level) exceed a predefined threshold it will enable the communication with GSM network and send the ALARM SMS message to the predefined phone number. Also it will Turn Alarm Buzzer “ON”, and Turn Water Pumping Motor “ON”**.**

2.1 Review of the components and theories

2.1.1 The Need for a Fire Detection System

Over the years death rates by fire has increased tremendously. Fire consumes homes and commercial premises quickly, indiscriminately taking lives and ruining property. No one should have to be become a victim of fire, but the reality is that people do become victims every day.

The problem with having just detection is that although you know you have a fire (the fire alarm sounders) there is no way to safely suppress the fire yourself and that’s if you are there. The Fire service will put it out when called but the smoke damage occurring before they arrive and the water damage after can be quite significant. Fire suppression systems are used to reduce the level of damage and down time by automatically suppressing the fire. Smoke alarms and sprinkler systems combined can reduce fire-related deaths by 82 percent and injuries by 46 percent.

2.1.2 Fire Triangle

The fire triangle or combustion triangle is a simple model for understanding the ingredients necessary for most fires. The triangle illustrates a fire requires three elements: heat, fuel, and an oxidizing agent (usually oxygen).

The fire is prevented or extinguished by removing any one of them. A fire naturally occurs when the elements are combined in the right mixture without sufficient heat, a fire cannot begin, and it cannot continue. Heat can be removed by the application of a substance which reduces the amount of heat available to the fire reaction. This is often water, which requires heat for phase change from water to steam. Introducing sufficient quantities and types of powder or gas in the flame reduces the amount of heat available for the fire reaction in the same manner. Turning off the electricity in an electrical fire removes the ignition source without fuel, a fire will stop. Fuel can be removed naturally, as where the fire has consumed all the burnable fuel, or manually, by mechanically or chemically removing the fuel from the fire. The fire stops because a lower concentration of fuel vapor in the flame leads to a decrease in energy release and a lower temperature. Removing the fuel thereby decreases the heat without sufficient oxygen, a fire cannot begin, and it cannot continue. With a decreased oxygen concentration, the combustion process slows. In most cases, there is plenty of air left when the fire goes out so this is commonly not a major factor.

2.1.3 Types of Fire Protection

2.1.3.1 Active Fire Protection

Active fire protection systems need to respond effectively and appropriately to a fire. They require activation through a combination of detectors or mechanical means and may consist of fire alarms and notification systems, sprinklers, standpipes, water supplies, and smoke detectors.

- Detection systems such as alarms to enable immediate evacuation and notify fire services.
- Suppression systems such as sprinklers and extinguishers reduce damage to buildings and contents. These systems help reduce the growth of a fire, thereby increasing life safety and limiting structural damage.

Categories of Active Fire Protection

- **Fire suppression**

- Fire can be controlled or extinguished, either manually (firefighting) or automatically. Manually fighting a fire includes the use of a fire extinguisher or a standpipe system. Automatic fire fighting means that it includes a fire sprinkler system, a gaseous clean agent, or a fire fighting foam system. Automatic suppression systems would usually be found in large commercial kitchens or other high-risk areas.

- **Sprinkler systems**
  - Fire sprinkler systems are installed in all types of buildings, commercial and residential. They are usually located at a ceiling level and are connected to a reliable water source, most commonly city water. A typical sprinkler system operates when heat at the site of a fire causes a glass component in the sprinkler head to break, thereby releasing the water from the sprinkler head. Sprinkler systems help to reduce the growth of a fire, thereby increasing life safety and limiting structural damage.
- **Fire detection**
  - The fire is detected either by locating the smoke, flame or heat, and an alarm is sounded to enable an emergency evacuation as well as to dispatch the local fire department. When a fire detection system is activated, it can be programmed to carry out other actions. These include de-energizing magnetic hold open devices on fire doors and opening servo-actuated vents in stairways.

2.1.3.2 Passive Fire Detection

- Passive Fire Protection attempts to contain fires or slow their spread, to the standard expected by building codes. A PFP system is an integral part of the building layout and construction materials, covering these key areas:
- Fire-resistance rated walls.
- Firewalls not only have a rating, they are also designed to sub-divide buildings such that if collapse occurs on one side, this will not affect the other side.
- Fire-resistant glass using multi-layer intumescing technology or wire mesh embedded within the glass may be used in the fabrication of fire-resistance rated windows in walls or fire doors.
- Fire-resistance rated floors.
- Occupancy separations. These barriers designated as occupancy separations are intended to segregate parts of buildings.
- Closures (fire dampers). Sometimes fire stops are treated in building codes identical to closures.

- Grease ducts. (These refer to ducts that lead from commercial cooking equipment such as ranges, deep fryers and double-decker and conveyor-equipped pizza ovens to grease duct fans).

2.2.4 Fire Detectors Review

Fire detectors can be of different types with various specific features depending upon different scenarios and demands. More or less these detectors can be categorized as heat or thermal detectors, smoke or gas detectors, semiconductor gas detectors, and flame detectors.

2.2.4.1 Heat or Thermal Type Detectors

Heat or thermal type detectors are the most primitive types of autonomous fire detectors, dating back to mid-1800. Most of these detectors are fixed temperature ones, which activates upon reaching a predefined temperature. Others include types, which activate whenever there is an abnormal rise in temperature in the premises.

Thermal detectors are reliable, inexpensive, easy to maintain, and have lower false alarm rate. But these detectors are slow, and by the time they reach predefined detection point, damage could already been underway. Therefore these detectors are of limited use.

2.2.4.2 Smoke or Gas Detectors

Smoke or gas detectors, a relatively newer invention, became widespread during 1970's and 1980's.These detectors usually detect fire in early flaming or smoldering stages. These detectors can be of different types having different operation principles, namely optical or photoelectric detectors, ionization detectors, air sampling detectors etc. Each of these types has specific applications in specific circumstances.

Photoelectric or optical smoke detectors include various components, mainly, a light source (usually an infrared LED), and a lens to converge light rays into a beam, and a photodiode. In normal condition, the light beam passes straight. But whenever smoke interrupts the path of light, scatters fraction of light into the photo diode, the smoke detector is activated. This method of detection can detect fires that begin with long duration of smoldering aptly. Ionization smoke detectors are based on ionization from radioactive elements like americium-241. This radioactive isotope emits alpha particles into an ionization chamber, which comprises of electrodes. The alpha particles ionize the air inside the chamber, resulting current flow between the electrodes. Now, whenever smoke particles from a nearby fire passes through the chamber, the ions get attached to smoke particles, and thereby interrupts the current flow between the electrodes, and activates the detector. This type of detectors is more suited to rapid flaming fire outbursts, unlike the photoelectric detectors, which responds better to smoldering stages. Ionization detectors might perform better where there is risk of fast flaming fire, whereas photoelectric detectors react better to cases of slow smoldering, like electrical or furnishing fire. Ionization devices are weaker in scenarios where air-flow is high. Although ionization type detectors are cheaper than photoelectric ones, they have more chance of false alarm than the photoelectric detectors. However, ionization based detectors have safety issues and possess threats to environment, because of americium-241. Therefore, on the basis of performance and safety concern some countries have banned ionization based alarms, and different fire authorities and associations have reports not recommending use of these detectors. Air sampling detectors have applications in very sensitive areas, as they can detect very fine smoke particles. These detectors are mostly air aspirating type systems. Generally they comprise a control unit, and a network of sampling tubes or pipes. The control unit consists of detection chamber, an aspiration fan, and necessary operation circuitry.

Since this type of detectors are very sensitive and fast responding, they have applications in high-value and critical areas, such as, aesthetic galleries, archives, vaults, server rooms, high-tech organizations etc. However, these detection systems are complex and expensive.

Moreover, some combination smoke alarms include both ionization and photoelectric technologies in a single device. Some smoke alarms use a carbon dioxide sensor or carbon monoxide sensor for detection as well.

2.2.4.3 Flame Type Detectors

Flame type detectors are sophisticated equipment to detect the flame phenomena of a fire. These detectors have various types depending on the light wavelength they use. Such as, ultraviolet, near infrared, infrared, and combination of UV/IR type detectors. UV detectors generally work with wavelengths shorter than 300 nm. This type of detectors can detect fires and explosions situations within 3 - 4 milliseconds from the UV radiation emitted from the incident. However, to reduce false alarm triggered by UV sources such as lightning, arc welding etc. a time delay is often included in the UV flame detector. The near Infrared sensor or visual flame detectors work with wavelengths between 0.7 to 1.1 µm. One of the most reliable technologies available for fire detection, namely multiple channel or pixel array sensors, monitors flames in the near IR band. The Infrared (IR) flame detectors work within the infrared spectral band (700 nm - 1 mm). Usual response time of these detectors is 3 - 5 seconds. Also, there is UV and IR combined flame detectors, which compare the threshold signal in two ranges to detect fire and minimize false alarms.

2.2.4.4 Semiconductor Gas or Smoke Detectors

These work by the principle of chemical reaction taking place between gas from fire incident and semiconductor material present inside the sensor. The semiconductor material used in these sensors is metal oxides, generally Tin dioxide, Tungsten oxide, etc. Under normal circumstances, the surface potential acts as a potential barrier to restrict electron flow within the sensor circuitry. However, the deoxidizing gases from fire incidents diminish the oxygen surface density, and thereby reduce barrier potential to permit electron flow. The associated electrical circuitry detects the rise in conductivity due to electron flow, and activates alarm to undertake necessary measures.

2.2.5 Fire Protection Systems

To detect fires or overheat conditions, detectors are placed in the various zones to be monitored. Fires are detected in reciprocating engine and small turboprop aircraft using one or more of the following:

- Overheat detectors: A fire detection system should signal the presence of a fire. Units of the system are installed in locations where there are greater possibilities of a fire. Three detector system types in common use are the thermal switch, thermocouple, and the continuous loop.
- Rate-of-temperature-rise detectors
- Flame detectors and Observation by crewmembers

In addition to these methods, other types of detectors are used in aircraft fire protection systems but are seldom used to detect engine fires. For example, smoke detectors are better suited to monitor areas where materials burn slowly or smolder, such as cargo and baggage compartments.

Other types of detectors in this category include carbon monoxide detectors and chemical sampling equipment capable of detecting combustible mixtures that can lead to accumulations of explosive gases. The types of detectors most commonly used for fast detection of fires are the rate-of-rise, optical sensor, pneumatic loop, and electric resistance systems.

2.2.5.1 Classes of Fires

The following classes of fires that are likely to occur onboard aircraft, as defined in the U.S. National Fire Protection Association (NFPA) Standard 10, Standard for Portable Fire Extinguishers, 2007 Edition, are:

- **Class A:** fires involving ordinary combustible materials, such as wood, cloth, paper, rubber, and plastics.

- **Class B:** fires involving flammable liquids, petroleum oils, greases, tars, oil-based paints, lacquers, solvents, alcohols, and flammable gases.
- **Class C:** fires involving energized electrical equipment in which the use of an extinguishing media that is electrically nonconductive is important.
- **Class D:** fires involving combustible metals, such as magnesium, titanium, zirconium, sodium, lithium, and potassium.

2.2.5.2 Extinguisher Types

The following is a list of extinguishing agents and the type (class) fires for which each is appropriate.

- ✓ Water - class A. Water cools the material below its ignition temperature and soaks it to prevent re-ignition.
- ✓ Carbon dioxide - class B or C. CO 2 acts as a blanketing agent. NOTE: CO 2 is not recommended for hand-held extinguishers for internal aircraft use.
- ✓ Dry chemicals - class A, B, or C. Dry chemicals are the best control agents for these types of fires.
- ✓ Halons - only class A, B, or C.
- ✓ Halocarbon clean agents - only class A, B, or C.
- ✓ Specialized dry powder - class D. (Follow there commendations of the extinguisher's manufacturer because of the possible chemical reaction between the burning metal and the extinguishing agent).

CHAPTER THREE
METHIDOLOGY

3.1 Basic Overview

In the basic overview of our project we use sensors (MQ-2 smoke sensor and LM35 temperature sensor) for input, and GSM module, GPS module, motors (servo and DC motor), buzzer and LCD display for output. And also ARDUINO UNO microcontroller in side it uses for the overall decision maker of the entire system. We use ARDUINO code typically C programing language to interface the hardware and the software.

3.2 Hardware Requirement

3.2.1 Microcontroller

An embedded microcontroller is a microcomputer that contains most of its peripherals and required memory inside a single integrated circuit along with the CPU. It is in actuality "a microcomputer on a chip."

A microcontroller can be considered to be a self-contained system comprising a processor, memory modules and peripherals. Hence, a microcontroller can be used as an embedded system. The majority of microcontrollers in use today are embedded in other machinery such as automobiles, telephones, appliances and peripherals for computer systems.

The Intel 8051series was one of the first microcontrollers to integrate the memory, I /O, arithmetic logic unit (ALU), program ROM, as well as some other peripherals, all into one very neat little package. These processors are still being designed into new products. There are five major 8-bit microcontrollers. They are: Free scale semiconductor’s 68hc08/68hc11, Intel’s 8051, Atmel’s AVR, Zilog’s Z8 and PIC from microchip technology. Each of the above microcontrollers has a unique instruction set and register set; therefore, they are not compatible with each other.

Three criteria in choosing microcontrollers are as follows:

- Meeting the computing needs of the task at hand efficiently and cost effectively;
- Availability of software and hardware development tools such as compilers assemblers, debuggers, and emulators;
- Wide availability and reliable source of the microcontroller.
- Based on the above criteria we choose the Atmega 328p Microcontroller.

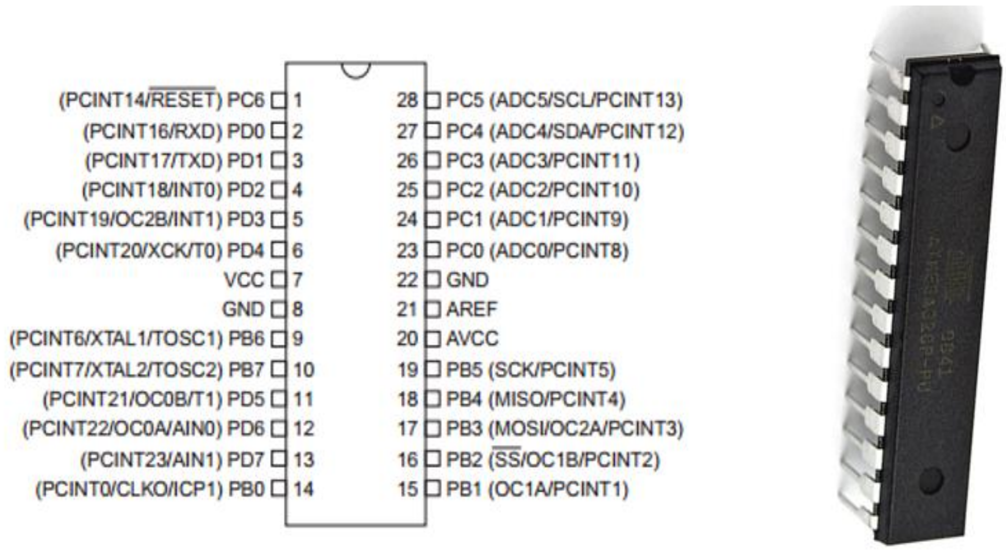

Figure 3.1 Microcontroller

AVR family microcontrollers

AVR stands for advanced virtual RISC. AVR is an 8-bit RISC single chip microcontroller with Harvard Architecture that comes with some standard features such as ROM data RAM data EEPROM, timers and I/O ports. Atmel’s AVR is addressing the 8-bit and 16-bit market.

The motivation that has led us for choosing AVR is the growing popularity of the AVR and other RISC microcontrollers, the ever increasing level of integration (more on a chip and fewer chips on a circuit board), and the need for "tuned thinking" when it comes to developing products utilizing this type of technology. You may have experience writing C for a PC, or assembler for a microcontroller. But when it comes to writing C for an embedded microcontroller, the approach must be modified to get the desired final result: small, efficient, reliable, reusable code.

The microcontrollers being considered are the Atmel AVR RISC microcontrollers. This one sentence says volumes about the architecture of the devices. First, they are RISC devices. RISC stands for reduced instruction set computing" and Means that the devices, are designed to run very fast through the use of a reduced number of machine-level instructions. This reduced number of instructions contributes to the speed due to the fact that, with a limited number of machine instructions, most can run in a single cycle of the processor clock in terms of MIPS (millions of instructions per second), this means that an AVR processor using an 8 MHz clock can execute nearly 8 million instructions per second, a speed of nearly 8 MIPS.

AVR Key Benefits:

- High performance

- Pico Power technology
- High code density
- High integration and scalability

The watchdog timer is a safety device. It is designed to cause a processor reset in the case where the processor is lost or confined or doing anything other than running the program it is supposed to be running.

ATmega328P Microcontroller

This microcontroller is a low-power CMOS (Complementary Metal Oxide Semiconductor) 8-bit microcontroller based on the AVR enhanced RISC (Reduced Instruction Set Computer) architecture. The powerful execution of instructions in a single clock cycle leads to the achievement of 1 MIPS per MHz throughputs allowing the designer to optimize power consumption versus processing speed.

3.2.2 Temperature Sensor (LM35 Precision Centigrade Temperature Sensor)

The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 thus has an advantage over linear temperature sensors calibrated in° Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling.

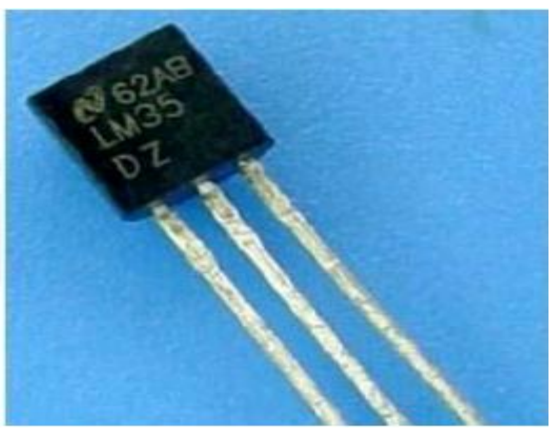

Figure 3. 2 LM 35 Temperature sensor

The LM35 does not require any external calibration or trimming to provide typical accuracies of ± 1⁄4°C at room temperature and ± 3⁄4° cover a full −55 to +150°C temperature range. Low cost is assured by trimming and calibration at the water level. The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy.

It can be used with single power supplies, or with plus and minus supplies. As it draws only 60 μA from its supply, it has very low self-heating, less than 0.1°C in still air. The LM35 is rated to operate over a −55° to +150°C temperature range, while theLM35C is rated for a −40°to+110°C range (−10°with improved accuracy).

Another cool feature of the precision centigrade temperature sensor is that you can operate it using a single DC power supply or bipolar (positive/negative) voltage source, so it's convenient for the hobbyist! To use a temperature IC, you just have to add three wires to the device and provide a DC power supply.

Features:

- Calibrated Directly in Celsius (Centigrade)
- Linear + 10-mV/°C Scale Factor
- 0.5°C Ensured Accuracy (at 25°C)
- Rated for Full −55°C to 150°C Range
- Suitable for Remote Applications

3.2.3 MQ-2 Smoke Sensor

The MQ-2 smoke sensor reports smoke by the voltage level that it outputs. The more smoke there is, the greater the voltage that it outputs. Conversely, the less smoke that it is exposed to, the less voltage it outputs. The MQ-2 also has a built-in potentiometer to adjust the sensitivity to smoke. By adjusting the potentiometer, you can change how sensitive it is to smoke, so it's a form of calibrating it to adjust how much voltage it will put out in relation to the smoke it is exposed to.

We will wire the MQ-2 to an Arduino so that the Arduino can read the amount of voltage output by the sensor and sound a buzzer if the sensor outputs a voltage above a certain threshold. This way, we will know that the sensor is detecting smoke and we will sound a buzzer alerting a person such as a homeowner to this fact.

Figure 3. 3 Structure and configuration of Gas sensor MQ-2

The 3 leads are Output, Vcc, and GND. The gas sensor needs about 5 volts of power in order to operate. This is done by connecting 5 volts to Vcc and GND. The Output pin gives out the voltage reading, which is proportional to the amount of smoke that the sensor is exposed to. Again, a high voltage output means the sensor is exposed to a lot of smoke. A low or 0 voltage output means the sensor is exposed to either little or no smoke.

Features:

- Wide detecting scope
- Stable and long lifetime
- Fast response and High sensitivity

3.2.4 BC548 NPN transistor

BC548 is general purpose silicon, NPN, bipolar junction transistor. It is used for amplification and switching purposes. The current gain may vary between 110 and 800. The maximum DC current gain is 800.

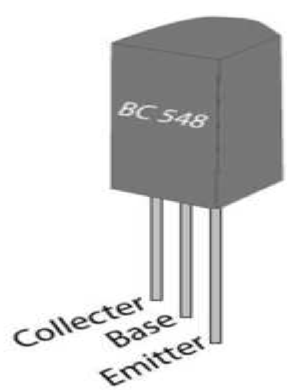

Figure 3. 4 BC548 Pin Diagram

The transistor terminals require a fixed DC voltage to operate in the desired region of its characteristic curves. This is known as the biasing. For amplification applications, the transistor is biased such that it is partly on for all input conditions. The input signal at base is amplified and taken at the emitter. BC548 is used in common emitter configuration for amplifiers. The voltage divider is the commonly used biasing mode. For switching applications, transistor is biased so that it remains fully on if there is a signal at its base. In the absence of base signal, it gets completely off.

3.2.5 Relay

Relay is one of the most important electromechanical devices highly used in industrial applications specifically in automation. A relay is used for electronic to electrical interfacing i.e. it is used to switch on or off electrical circuits operating at high AC voltage using a low DC control voltage. A relay generally has two parts, a coil which operates at the rated DC voltage and a mechanically movable switch. The electronic and electrical circuits are electrically isolated but magnetically connected to each other, hence any fault on either side does not affects the other side.

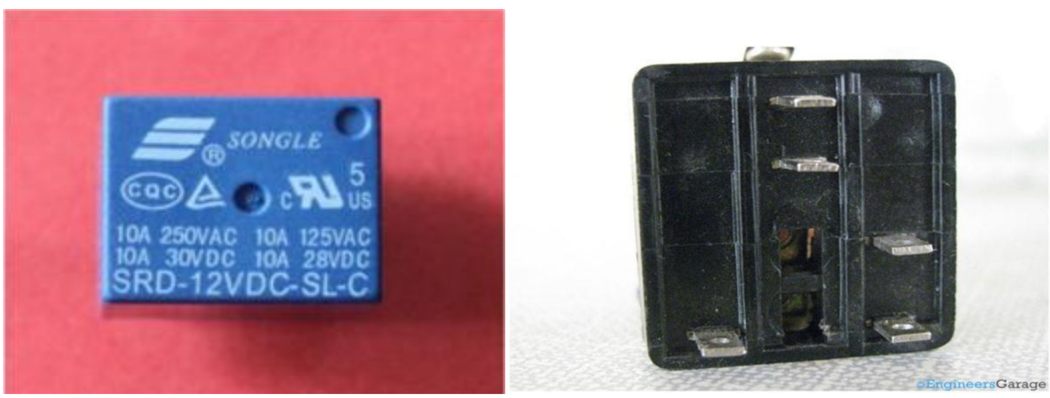

Figure 3. 5 DC Relay

Relay switch shown in the image above consists of five terminals. Two terminals are used to give the input DC voltage also known as the operating voltage of the relay. Relays are available in different operating voltages like 6V, 12V, 24V etc. The rest of the three terminals are used to connect the high voltage AC circuit. The terminals are called Common, Normally Open (NO) and Normally Closed (NC). Relays are available in various types & categories and in order to identify the correct configuration of the output terminals, it is best to see the data sheet or manual. You can also identify the terminals using a multi-meter and at times it is printed on the relay itself.

3.2.6 LCD Display (16X2 LCD)

A **Liquid Crystal Display** commonly abbreviated as **LCD** is basically a display unit built using *Liquid Crystal technology*. When we build real life/real world electronics based projects, we need a medium/device to display output values and messages. – **Liquid Crystal Displays** comes in different size specifications. Out of all available LCD modules in market, the most commonly used one is**16×2 LCD Module** which can display 32 ASCII characters in 2 lines (16 characters in 1 line).

Some of the 1602 LCD functional characteristics are as follows:

- Display capacity: 16x2 characters;
- Chip operating voltage: 4.5V~5.5V;
- Operating current: 2.0mA(5.0V);
- Best operating voltage: 5.0V;

Figure 3. 6 16X2 LCD display

3.2.7 GSM Modem

The acronym GSM is presently understood to mean Global System for Mobile Communications. We chose the SIM 900A because that our county Ethiopia support the SIM 900 2G network. It requires a **SIM (Subscriber Identity Module)** card just like mobile phones to activate communication with the network. Also they have **IMEI** (International Mobile Equipment Identity) number similar to mobile phones for their identification.

The MODEM needs AT commands, for interacting with processor or controller, which are communicated through serial communication. These commands are sent by the controller/processor. The modem sends back a result after it receives a command. Different AT commands supported by the modem can be sent by the processor/controller/computer to interact with the GSM and GPRS cellular network.

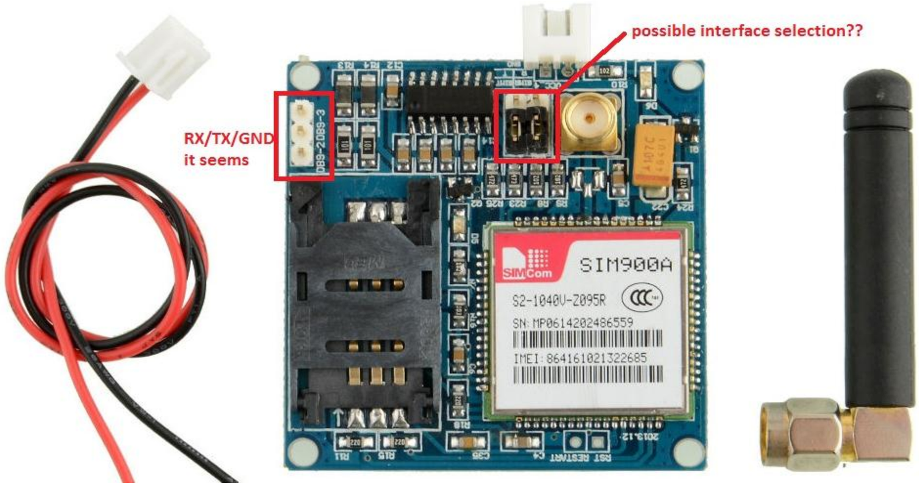

Figure 3. 7 SIM900A GSM module

3.2.8 Power Supply

The input to the circuit is applied from the regulated power supply. The A.C. input i.e, 220V from the mains supply is step down by the transformer to 12V and is fed to a rectifier. The output obtained from the rectifier is a pulsating D.C voltage. So in order to get a pure D.C voltage, the output voltage from the rectifier is fed to a filter to remove any A.C components present even after rectification. Now, this voltage is given to a voltage regulator to obtain a pure constant dc voltage.

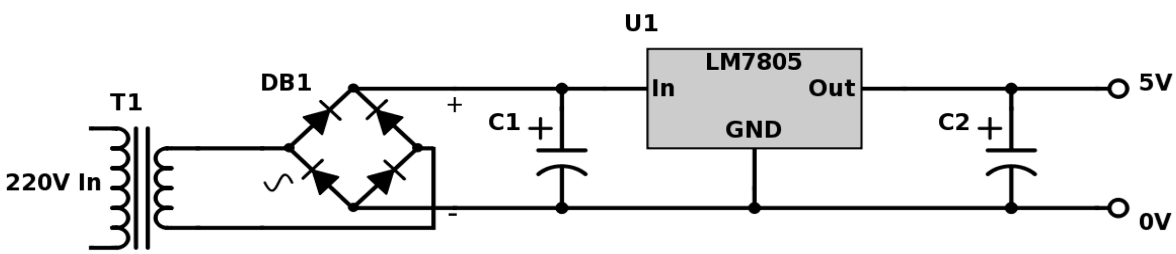

Figure 3. 8 System power supply circuit diagram

Parts List:

Part	Value	Description
T1	220V(110V) to 12V	Transformer
DB1		Diode Bridge rectifier
C1	470μF (20V & upwards)	Capacitor
C2	1 μF (10V and upwards)	Capacitor
U1	7805	Voltage Regulator

Table 3. 1 part list for system power supply circuit diagram

3.2.9 Buzzer

For alarm purposes a lot of electric bells, alarms and buzzers are available in the market that has got different prices and uses. The buzzer being used in this project is a 5-12 V buzzer and has got enough alarm sound to be used in a fire alarm system. Louder buzzer would have been even better but then their operating voltages are high as we had a supply of maximum up to 12V available with us on the board.

Figure 3. 9 Buzzer

3.2.10 DC motor

A DC motor is a mechanically commutated electric motor powered from direct current (DC). The stator is stationary in space by definition and therefore the current in the rotor is switched by the commentator to also be stationary in space. This is how the relative angle between the stator and rotor magnetic flux is maintained near 90 degrees, which generates the maximum torque.

DC motors have a rotating armature winding (winding in which a voltage is induced) but non rotating armature magnetic field and a static field winding (winding that produce the main magnetic flux) or permanent magnet. Different connections of the field and armature winding provide different inherent speed/torque regulation characteristics. The speed of a DC motor can be controlled by changing the voltage applied to the armature or by changing the field current. The introduction of variable resistance in the armature circuit or field circuit allowed speed control. Modern DC motors are often controlled by power electronics systems called DC drives.

The introduction of DC motors to run machinery eliminated the need for local steam or internal combustion engines, and line shaft drive systems. DC motors can operate directly from rechargeable batteries, providing the motive power for the first electric vehicles. Today DC motors are still found in applications as small as toys and disk drives, or in large sizes to operate steel rolling mills and paper machines.

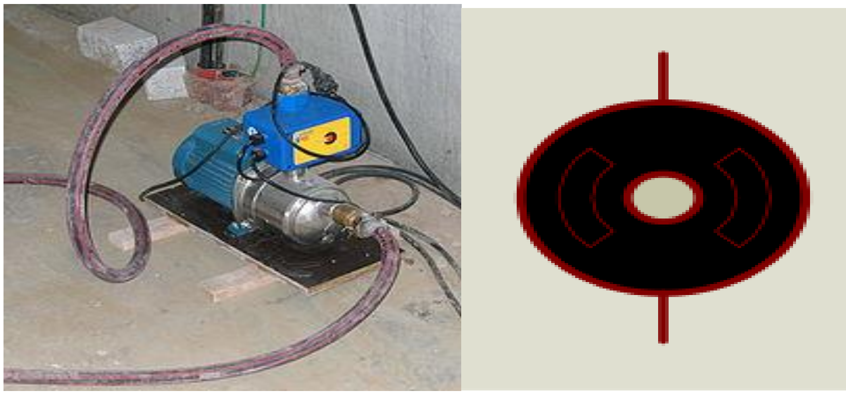

Figure 3. 10 DC motor

3.2.11 Servo motor

Inside a servo motor, there are a small DC motor, potentiometer, and a control circuit. The motor is attached by gears to the control wheel. The motor rotates, the potentiometer's resistance changes, so the control circuit can precisely regulate how much movement there is and in which direction. The servo motor in this project operates on 6V. Servo motors are mainly used for armature movement. The servo serves as a means of moving the supporting structure vertically with precision. The speed of servo motor can be varied. The speed of the motor can be controlled by providing consecutive pauses. A pause of hundred milliseconds was chosen after each degree movement of the motor.

Figure 3. 11 Servo motor

3.2.12 GPS Module

GPS or Global Positioning System is a satellite navigation system that furnishes location and time information in all climate conditions to the user. GPS is used for navigation in planes, ships, cars and trucks also. The system gives critical abilities to military and civilian users around the globe.

The Global Positioning System (**GPS**) is made up of satellites, ground stations, and receivers. **GPS** is a system. It's made up of three parts: satellites, ground stations, and receivers. ... Once the **receiver** calculates its distance from four or more satellites, it knows exactly where you are.

It is a global navigation satellite system that provides relocation and time information to a **GPS** receiver anywhere on or near the Earth where there is an unobstructed line of sight to four or more **GPS** satellites.

The GPS system consists of three segments:

The space segment is the number of GPS satellites used to route/navigation signals and to store and retransmit the route/navigation message sent by the control segment.

The control system comprises of a master control station.

The user segment comprises of the GPS receiver, which receives the signals from the GPS satellites and determine how far away it is from each satellite.

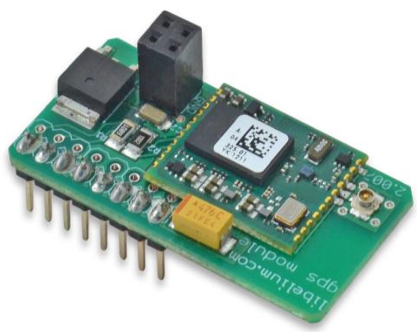

Figure 3. 12 GPS Module

3.3 Software Requirements

In our project we used two software for simulation and writing the code.

- ❖ Arduino IDE – to write the code
- ❖ Proteus 8 professional – to design the system

CHAPTER FOUR
SYSTEM DESIGN AND ANALAYSIS

4.1 System Requirements

In this Chapter we are going to explain about the system design construction through hardware and development of software. In addition, the chapter elaborates the hardware and the software stage by stage. All the operations of hardware and software are also included in this chapter.

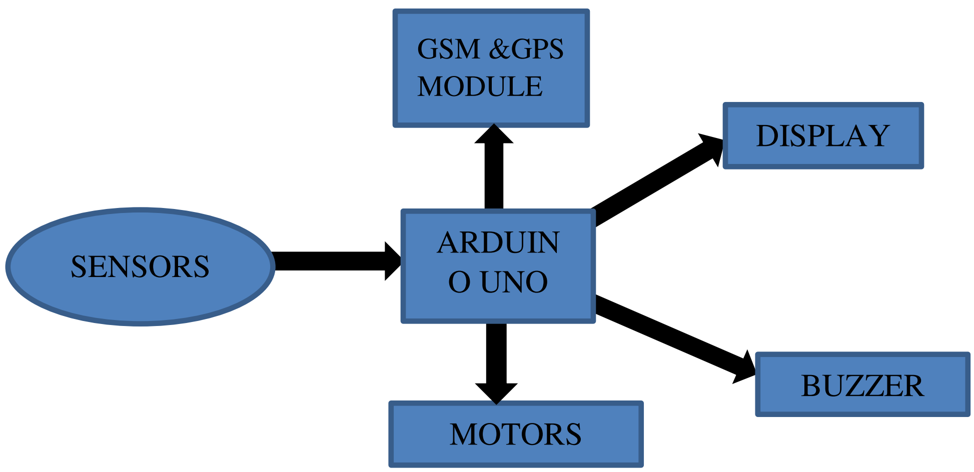

Figure 4. 1 System block diagram

The sensor basically the input that will be triggered to the controller to control the motor by certain condition or programming. The controller is set to decide how the output will be produced from the motor and will be displayed at the display part. As the system requires the use of microcontroller, the design consists of two parts, hardware and software. Hardware is constructed an integrated module by module, hardware to software for easy troubleshooting and testing.

4.2 System Architecture

The system architecture of the automatic output appliance can be divided into four main Modules.

They are:

- Microcontroller Module

- Sensory Module
- GSM Module
- Liquid Crystal Display (LCD) Module

The integration of the modules are producing the system which is more or less can be divided into two phase where the first phase is the output smart Appliance system and the second phase the monitoring system. The microcontroller, sensory and Appliance modules are in the first phase of the system and LCD module is in the second phase monitoring system.

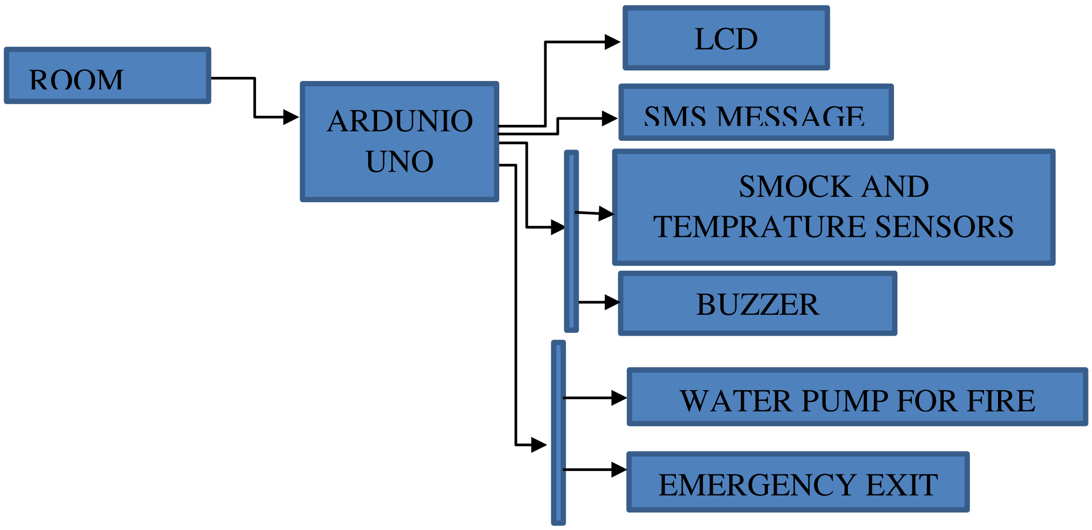

Figure 4. 2 Block diagram of smart appliance system

This appliance system will produce the output in three different areas that are the same level with input is senses. Each level is sensed by the input which will trigger the same level of output and the status of the output and temperature view on the LCD panel. Microcontroller module controller is the main part of the system where all the process flow will be controlled by this hardware accordingly to the embedded programming in it. Micro controller is chosen for the system as the controller. In other word it is the heart of this device system.

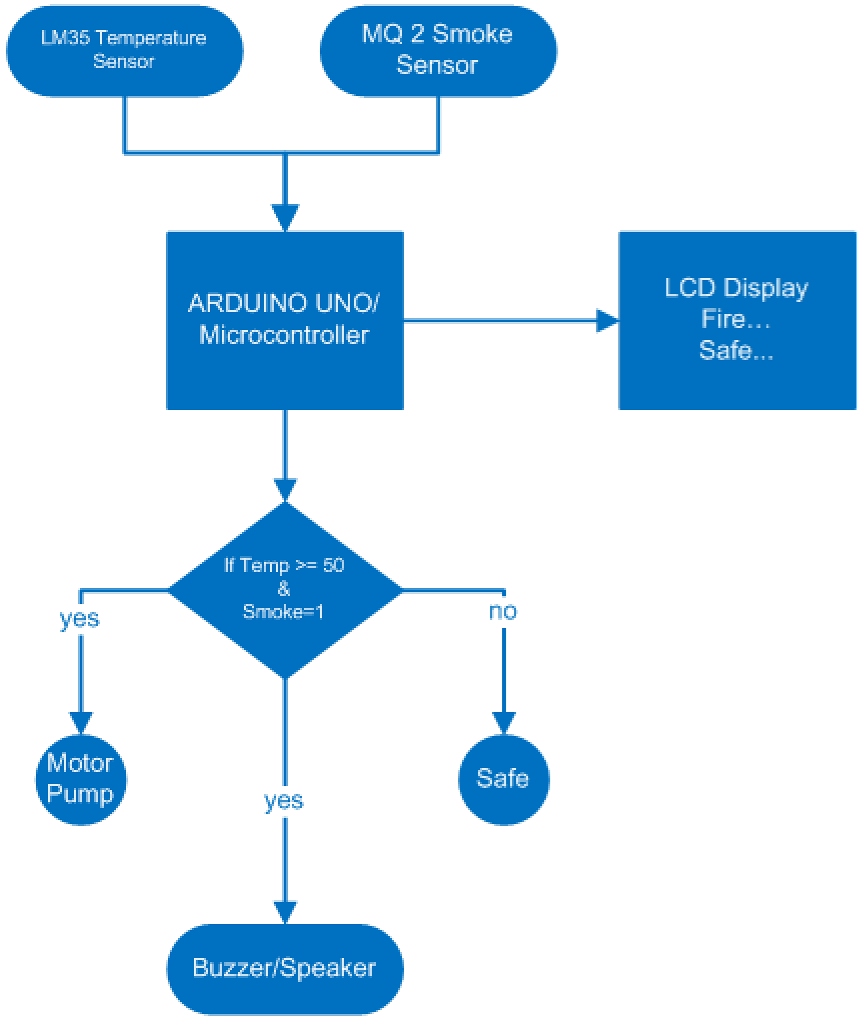

Figure 4. 3 Architect of the project without GSM Flowchart

4.3 Software design

The program creation (development) cycle

To create a C program:

- Do the requisite mental work. This is the most important part.
- Create the C source code. This can be done using a text editor, but is normally done within the IDE (Integrated Development Environment). C source files are plain text and saved with a ".c" extension.
- Compile the source code. This creates an assembly output file. Normally, compiling automatically fires up the assembler, which turns the assembly file into a machine language output file.

- Link the output file with any required libraries using the linker. This creates an executable file. For desktop development, this is ready to test.
- For embedded development, download the resulting executable to the target hardware (in our case, the Arduino development board). For the Arduino, steps 3, 4, and 5 can be combined by selecting “Build” from the IDE menu.
- Test the executable. If it doesn’t behave properly, go back to step one.

A **program** is text that you write using a programming language that contains behaviors that you needs a processor to acquire. It basically creates a way of handling inputs and producing outputs according to these behaviors.

Designing a program is the fact you have to think about first, before you begin coding it. It generally involves writing, drawing, and making schematics of all the actions you want your processor to make for you. Sometimes, it also implies to write what we call **pseudo code**. I hope you remember that this is what we created in the previous chapter when we wanted to define precisely all the steps of our desired LED behavior.

Writing a program is typically what converts the pseudo code into real and well-formed code. It involves having knowledge of programming languages because it is the step when you really write the program. This is what we'll learn in a moment. *Testing* is the obvious step when you run the program after you made some modifications to the code. It is an exciting moment when you also are a bit afraid of bugs, those annoying things that make running your program absolutely different from what you expected at first.

Debugging is a very important step when you are trying to find out why that program doesn't work well as expected. You are tracking typo errors, logic discrepancies, and global program architecture problems. You'll need to monitor things and often modify your program a bit in order to precisely trace how it works. *Maintaining the source code* is the part of the program's life that helps to avoid obsolescence. The program is working and you improve it progressively; you make it up-to-date considering hardware evolutions, and sometimes, you debug it because the user has this still undiscovered bug. This step increases the life duration of your program.

Programming is the process of designing, writing, testing, debugging and maintaining the source code of computer programs.

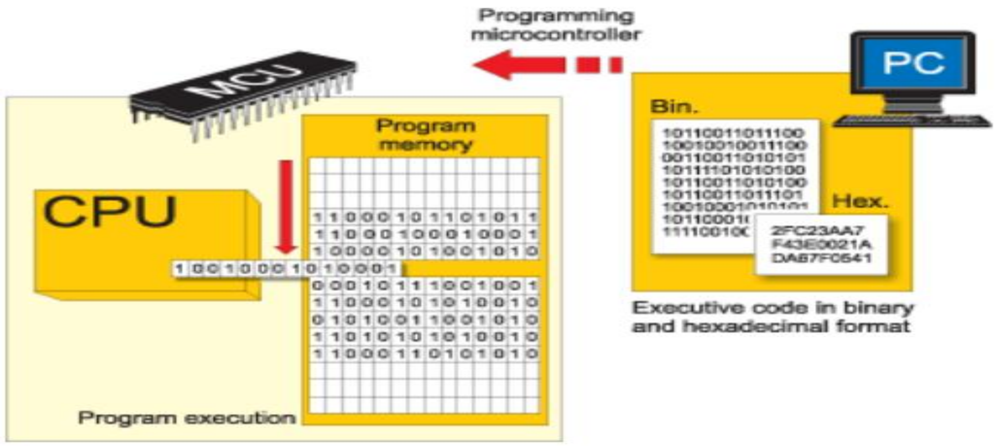

Figure 4. 4 program creation steps

The microcontroller executes the program loaded in its Flash memory. This is the so called executable code comprised of seemingly meaningless sequence of zeros and ones. It is organized in 12-, 14- or 16-bit wide words, depending on the microcontroller's architecture. Every word is considered by the CPU as a command being executed during the operation of the microcontroller. For practical reasons, as it is much easier for us to deal with hexadecimal number system, the executable code is often represented as a sequence of hexadecimal numbers called a Hex code. It used to be written by the programmer. All instructions that the microcontroller can recognize are together called the Instruction set.

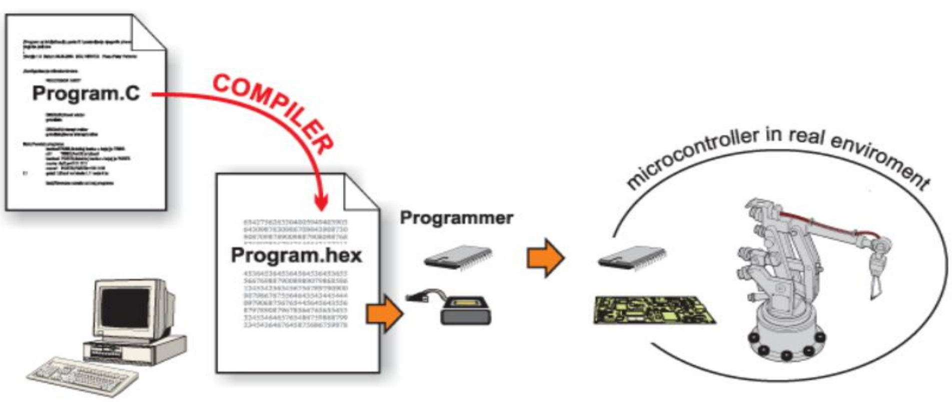

Figure 4. 5 generating hex file

Every sketch needs two void type functions that do not return any value, **setup ()** and **loop ()**. The **setup ()** method is run once, just after the Arduino board is powered up and the loop () method is run continuously afterwards. The setup () is where you want to do any initialization steps, and loop () is for codes you want to run over and over again to program ATMEGA328P at first we have to burn boot loader of new ATMEGA328P using ARDUINO-UNO R3 Programmer. For burn boot loader connect new ATMEGA328P with programmer. Connection is shown below.

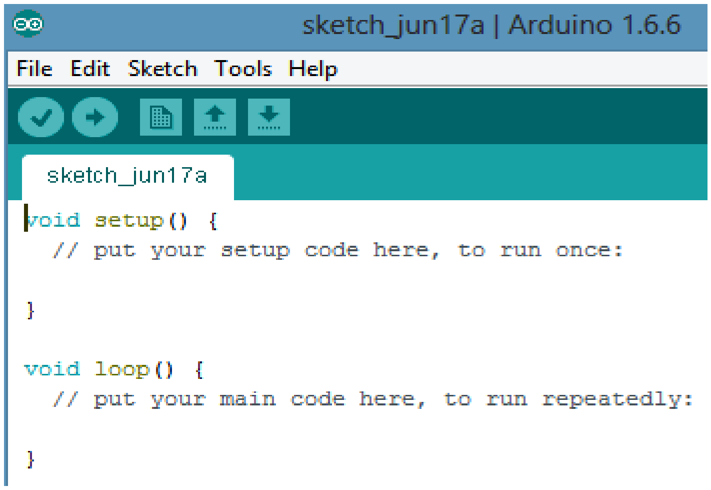

Figure 4. 6 Arduino sketch simple function

Caution: make sure Programmer is not connected to external power source because it get required power from USB cable connected to computer and circuit with ATMEGA328P have regulated +5v supply.

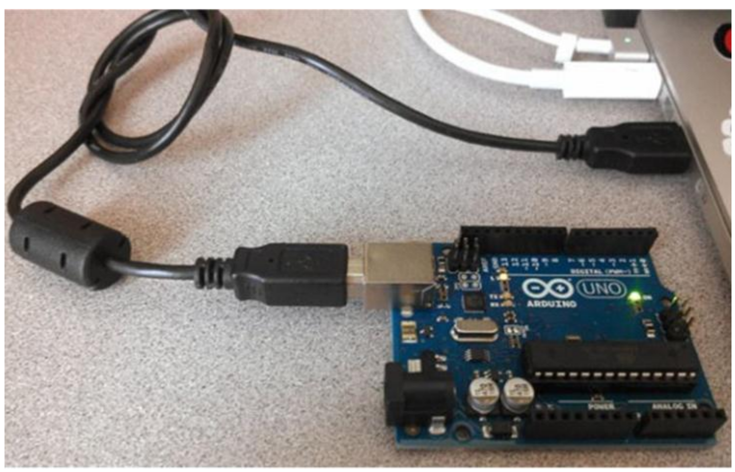

Figure 4. 7 Interfacing ARDUINO Programmer with PC

Then this System is ready for burn boot loader, to do this action simply open IDE on computer then upload configuration code which is consists of two different code named “optiLoader.h” and “optiLoader.pde”.

Then upload both code to microcontroller, process is shown bellow

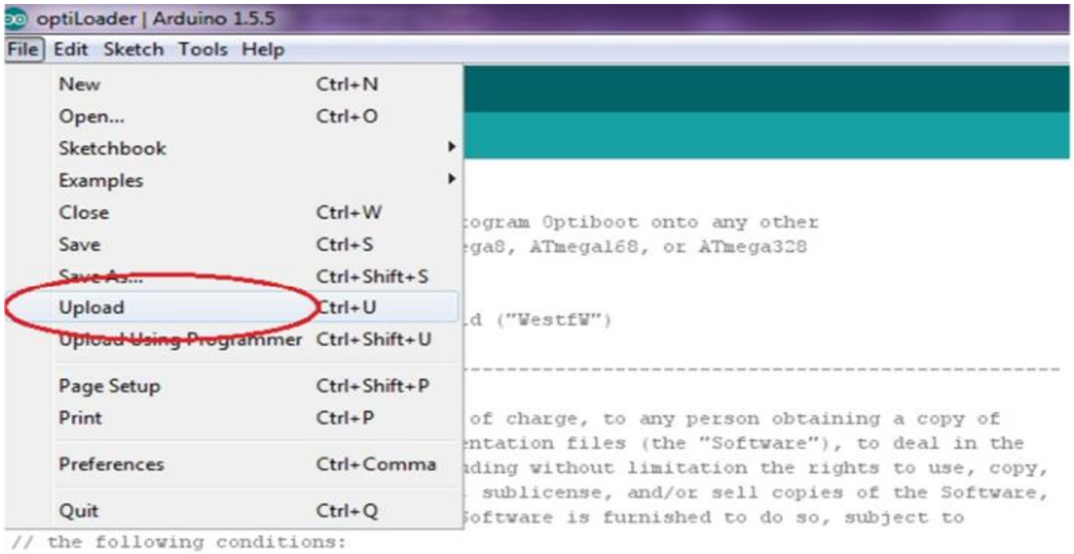

Figure 4. 8 Upload Boot loader to ARDUINO Programmer

4.4 System Testing

First of all, all the hardware units of the system were tested and it was ensured that in a good working condition or not. 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 behavior of each unit was known while testing it. It would be impossible to figure out the system development when a sensor gets activation in ROOM, defined program and the response at the output pin D4 to D7connected LCD display will show “On Fire” consequently GSM module will most definitely will activate a message response saying “FIRE OCCURRED “output pin B.1 & B.2 will get high pulse which is given to a bipolar switching transistor’s base, this pulse create base emitter forward bias which is responsible for transistor activation. Then this transistor activate a relay to power on a water pump for specific fire location, main power disconnect by magnetic contactor and a motor will get ON for open an emergency exit. Here we used a transistor because it can carry up to 500mA current but this much of current cannot tolerate a microcontroller.

Where microcontroller ratings are as follows Power Consumption at 12 MHz, 5V, 50°C, Active: 3.6 mA, Idle Mode: To protect transistor and microcontroller from burn out, we used a 1kΩ resistor in between base of the transistor and microcontroller's output pin. We also used in this circuit to light ON an indication LED with connected a 2.2kΩ resistor output pin to common GND. Output pin D.6 is common for the system as we defined program to activate a buzzer alarm and a main water pump ON. For instant smoke sense, we can use a high sensitivity smoke sensing detector to give high pulse to input pin of microcontroller from which it will get fictional activity as per program installed in the microcontroller.

For magnetic contactor activate we connected a relay NC (Normally close) point and when relay will get activation by the transistor the NC point of relay will open hence main power will disconnect in the specific fire area.

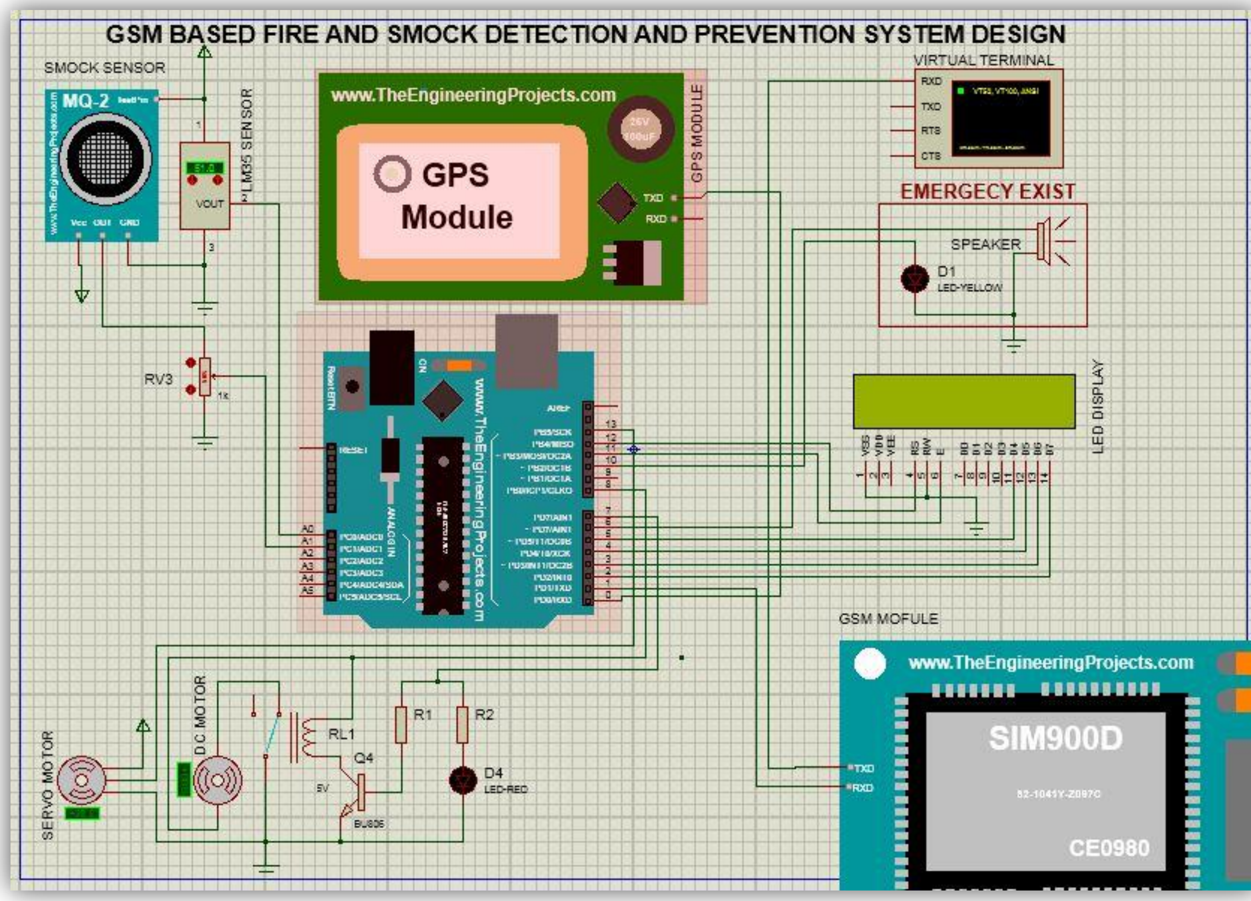

Figure 4. 9 Overall system design

CHAPTER FIVE
RESULT AND DISCUSION

5.1 Result

The aim of the project was to implement and design automatic fire alarming and monitoring for factories, a smart home system aviation industries 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.

In our first approach we were faced with individual testing each of the components in order they are working accordingly.so we started with the detection then headed to sms exchange and the configuring the motors and finally combing all the components in to one set operational tools.

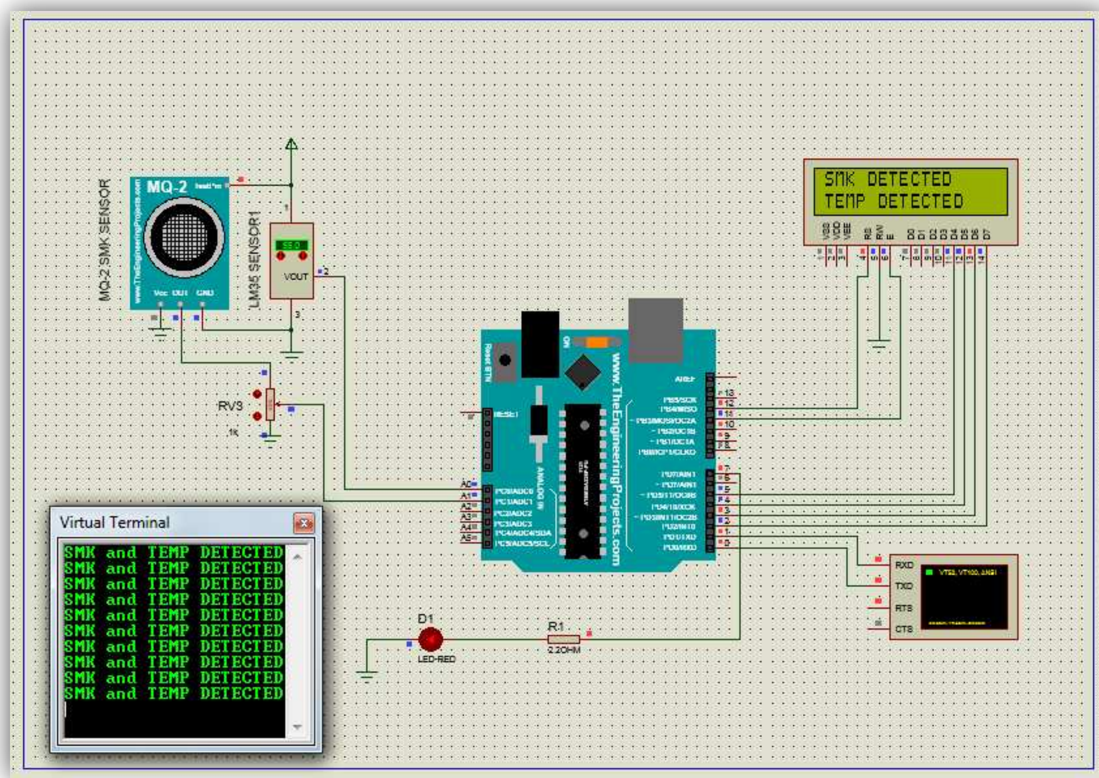

Figure 5. 1 Fire and smoke detection

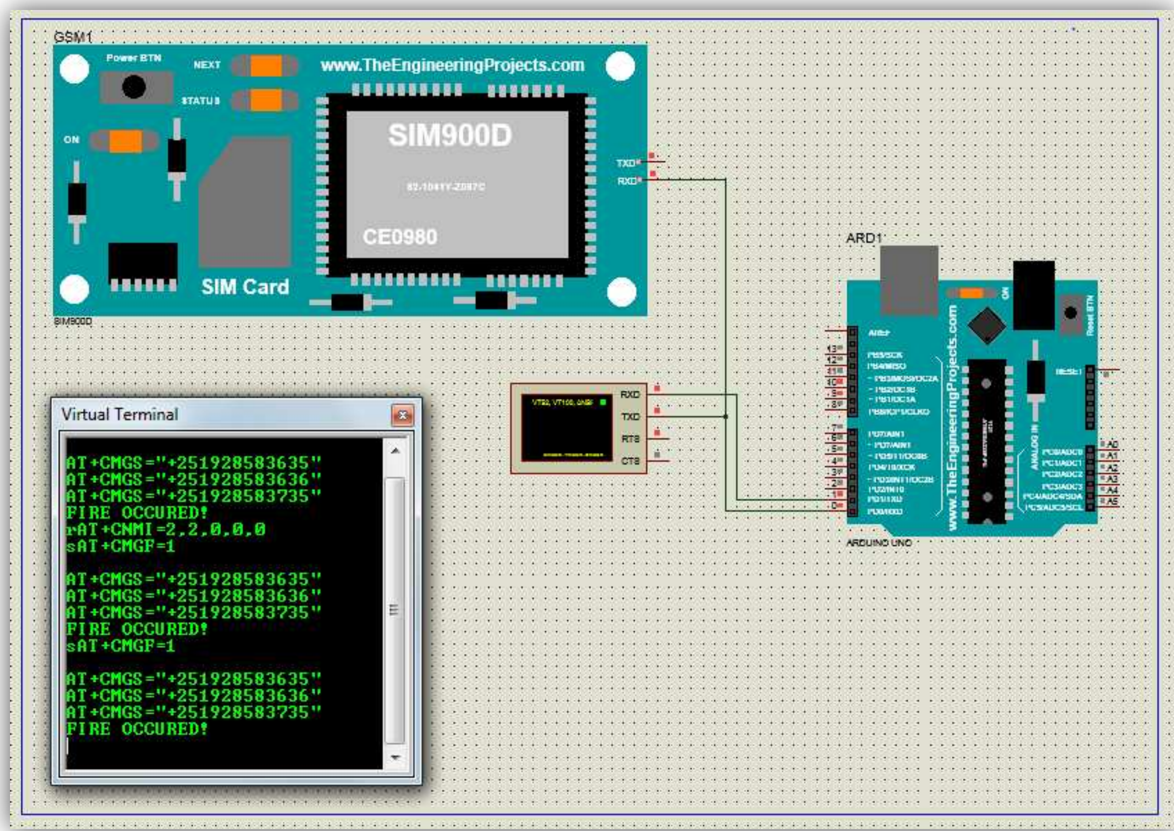

Figure 5. 2 SMS message form SIM900 GSM module

And finally the complete set will give as values depending on the result we get from the simulation response to and from the microcontroller can be indicated below.

- **For water pump:** in order for fire to occur the temperature value should be greater than or equal too fifty or smoke value should be high for sensors. And the GSM module will send "FIRE OCCURED" and in the LCD display "NO SAFE".

ROOM	LCD display	SMS	pump
ROOM	No Safe	Fire Occurred	Pump on

Table 5. 1 Overall output of the system

- Finally, the emergency exit is manly dependent on the servo motor in order to operate in a manner that can close and open the digital door lock and automatically positioned the motor pump in case of fire incidents only.

5.2 Discussion

The development of technology has been affecting the life style of people. They are dependent on technology even to carry out daily activities and technology has made the lifestyle more sophisticated and relaxing. It seems as if it was impossible to live without technology in this century. Advanced technology has replaced the traditional lifestyle of people. For example, a coffee machine has replaced the traditional way of coffee making, finger-print and voice controlled electronic lock have replaced traditional locks, electronic news and media have replaced the traditional paper news and media, bank cards and online shopping have replaced the traditional cash and shopping. The examples mentioned above are a few least advanced technologies replacing the traditional lifestyle.

Besides these, there are many advanced technologies used by people for different purposes, they are playing significant roles in changing the lifestyle of people. With the development of technology, the concept of simple home has also been changing into smart home and the concept of home has changed drastically during the last decade. The advancement of technology has not only played a significant role in the development of positive aspects but has also played an important role in the development of negative aspects. It has increased the risk of burglary and intrusion using the latest modern technologies available. The busy lifestyle of human beings along with the increasing risk has led to the necessity of remote surveillance of homes.

There are different ways to have the surveillance but the easiest and most advanced technology accessible to everybody is mobile phone surveillance. The mobile phone can be used for different purposes with the help of the applications developed for the phones.

This project was a simple application project demonstrating a fire alarm & control system. The movements and the temperature are detected by installing sensors at different places. The temperature of the premises where the sensors are installed can be known at any time before reaching the critical limit set by the user. As this project was a fire alarm & control system demonstration project, a few sensors and a LED light were used.

The project can be extended by increasing the number of sensors used along with an increase in the number of installation places. The remote management of electronic devices can also be extended with the use of different real electronic devices. The system is implemented on Arduino platform using the Arduino Uno Board. 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.

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 14. 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.

5.3 Drawbacks / Limitation of the thesis

- Detects the fire from one location at a time, if there is fire in this location, the System will be able to detect and hence locate only in this location.
- Prevention of smoke is not contained in this project because we can't get any nothing for this purpose.
- No record keeping is being done in the system which deprives us from any type of analysis which can be beneficial for the betterment of the existing system.
- The project has been limited to a desired area of condition which is estimated by small area coverage
- This is to make the system more sensitive and obtain a quick feedback from the desired area of condition.
- Because of the absence of hardware requirements we can't reach into the practical part, so our system is done in simulation only.

CHAPTER SIX
CONCLUSION AND RECOMMENDATION

6.1 Conclusion

The design and construction of a GSM – based Fire and Smoke detection and prevention system was successfully carried out and tested effectively. The system did not pose extra-ordinary constraint and the components and materials used conform to engineering standard. A close look at the circuit diagram of the smoke detector reveals that all the components used were all locally sourced and available. Also, consideration has been made in the area of cost and size (packaging) compared to other similar designs. In situations where components could not be obtained exactly, standard values closest to be calculated should be chosen so as to obtain optimum degree of accuracy and resolution in the design of the units of this device. Finally, project design was challenging because it gave an exposure into the practical application of theoretical knowledge in solving problems associated with design and construction most especially in developing countries. Likewise, it gave more exposure to fire issues.

6.2 Recommendations

Accomplishing tasks needs time and resource which gives smart and persuasive output. But the time for the project and sources of information is scarce due to lack of access. Even if our electronics LAB has not anything to support in material to do our project and the free time use of our computer LAB also is not opened in a time. Therefore such obstacles should be proved for the coming final project. And the department should supply students particularly for students who are doing there BSC. With relevant information regarding there project.

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Appendix A

C-language code of the system:

```
#include<Servo.h>
Servo myservo;
int pos = 0;
int val;
int motor = 8;

#include <LiquidCrystal.h>
LiquidCrystal lcd(12, 11, 5, 4, 3, 2);

#include <TinyGPS.h>
#include <SoftwareSerial.h>
SoftwareSerial mySerial(9, 10);
byte tx=1;


TinyGPS gps;  //Creates a new instance of the TinyGPS object

const int SPEAKER = 6;
const int LED_RED = 7;
const int LED_YELLOW = 10;
int Relay=7;
int tempC_1 = 0; //set initial tempC 0° for all LM35
int smkC_1 = 0; //set initial tempC 0º for all MQ 2
const int SensorPin1 = A0; //input sensor pin
const int SensorPin2 = A1;
String textForSMS;

void setup()
{
  pinMode(motor, OUTPUT);
  pinMode(tx, OUTPUT);
  pinMode(Relay, OUTPUT);
  myservo.attach(13);
  pinMode(SPEAKER, OUTPUT);
  lcd.begin(14, 2);
  delay(100);
  pinMode(SensorPin1, INPUT);
  pinMode(SensorPin2, INPUT);
  pinMode(SPEAKER, OUTPUT);
```

```
  pinMode(LED_RED, OUTPUT);
  pinMode(LED_YELLOW, OUTPUT); //Set control pins to be outputs
  digitalWrite(LED_RED, LOW);
  digitalWrite(LED_YELLOW, LOW);//set both motors off for start-up
  mySerial.begin(9600);
  Serial.begin(9600); //Start the serial connection with the computer
}

void loop()
{


  int tempC_1 = analogRead(SensorPin1);
  int SmkC_1 = analogRead(SensorPin2);
  tempC_1 = analogRead(SensorPin1); //read the value from the LM35 sensor
  tempC_1 = (5.0 * tempC_1 * 100.0) / 1024.0; //convert the analog data to temperature
  smkC_1 = analogRead(SensorPin2); //read the value from the MQ 2 sensor
  smkC_1 = (5.0 * smkC_1 * 100.0) / 1024.0; //convert the analog data to temperature
  delay(50);


  bool newData = false;
  unsigned long chars;
  unsigned short sentences, failed;
  for (unsigned long start = millis(); millis() - start < 1000;)
  {
    while (Serial.available())
    {
      char c = Serial.read();
      if (gps.encode(c))
      newData = true;
    }
  }

if (tempC_1 >= 50)
{

    digitalWrite(Relay,HIGH);
    val = analogRead(pos);
    val = map(val, 0, 1023, 0, 180);
    myservo.write(val);
    delay(50);
    digitalWrite(motor, HIGH);
```

```
    digitalWrite(LED_RED, HIGH);
    digitalWrite(LED_YELLOW, HIGH);
    lcd.clear();
    lcd.setCursor(0, 0);
    lcd.print("On FIRE");
    lcd.setCursor(0, 1);
    lcd.print(" NO SAFE");
    delay(100);
    lcd.clear();
    lcd.print("Sending SMS...");
    delay(100);

    tone(SPEAKER, 1047, 500);
    delay(200);
    tone(SPEAKER, 1109, 300);
    delay(200);
    tone(SPEAKER, 1175, 100);
    delay(5);

    float flat, flon;
    unsigned long age;
    gps.f_get_position(&flat, &flon, &age);
    Serial.print("AT+CMGF=1\r");
    delay(100);
    Serial.print("AT+CMGS=\"+251928583635\"\r");
    Serial.print("FIRE OCCURED!\r");
    delay(100);
    Serial.print("AT+CMGS=\"+251928583636\"\r");
    Serial.print("FIRE OCCURED!\r");
    delay(100);
    Serial.print("AT+CMGS=\"+251928583735\"\r");
    Serial.print("FIRE OCCURED! in\r");
    delay(200);
    Serial.print("Latitude = ");
    Serial.print(flat == TinyGPS::GPS_INVALID_F_ANGLE ? 0.0 : flat, 6);
    Serial.print(" Longitude = ");
    Serial.print(flon == TinyGPS::GPS_INVALID_F_ANGLE ? 0.0 : flon, 6);
    delay(200);
    Serial.println((char)26); // End AT command with a ^Z, ASCII code 26
    delay(200);
    Serial.println();
  }
else
```

```
{
  digitalWrite(Relay,LOW);
  delay(50);
  digitalWrite(LED_RED, LOW);
  digitalWrite(LED_YELLOW, LOW);
  digitalWrite(motor, LOW);
  lcd.clear();
  lcd.setCursor(0, 0);
  lcd.print("NO FIRE");
  lcd.setCursor(0, 1);
  lcd.print("ALL SAFE");
 }
}
```