Sudan University of Science and Technology

College of Engineering

School of Electrical and Nuclear Engineering

Fire Detection & Alarm System

نظام كشف وإنذار الحريق

A Project Submitted in Partial Fulfillment for the Requirement of Degree of B.Sc. (Honor) In Electrical Engineering

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الآية

قال تعالى :

بسم الله الرحمن الرحيم

﴿اللَّهُ نُورُ السَّمَاوَاتِ وَالْأَرْضِ مَثَلُ نُورِهِ كَمِشْكَاةٍ فِيهَا مِصْبَاحٌ الْمِصْبَاحُ فِي زُجَاجَةٍ الزُّجَاجَةُ كَأَنَّهَا كَوْكَبٌ دُرِّيٌّ يُوقَدُ مِن شَجَرَةٍ مُّبَارَكَةٍ زَيْتُونِةٍ لَّا شَرْقِيَّةٍ وَلَا غَرْبِيَّةٍ يَكَادُ زَيْتُهَا يُضِيءُ وَلَوْ لَمْ تَمْسَسْهُ نَارٌ نُّورٌ عَلَى نُورٍ يَهْدِي اللَّهُ لِنُورِهِ مَن يَشَاءُ وَيَضْرِبُ اللَّهُ الْأَمْثَالَ لِلنَّاسِ وَاللَّهُ بِكُلِّ شَيْءٍ عَلِيمٌ﴾

[النور : 35]

صدق الله العظيم

Dedication

As well as everything that we do, we would be honored to dedicate this work to our parents for their emotional and financial support, our brothers, our sisters and our friends, our college, especially our friend Ahmed Yassin, whose has been a constant source of inspiration for us. They have given us the drive and discipline to tackle any task with enthusiasm and determination. Without their love and support this project would not have been made possible.

Acknowledgment

First and above all, we praise God, the almighty for providing us this opportunity, and granting us the capability to proceed successfully. Grateful for this opportunity, we would like to give our sincere thanks to our professors of the electrical department, specifically our supervisor, **Ust. Gaffar Babiker Osman** for his valuable guidance continues encouragement, suggestions, constructive ideas and advice in assisting us to complete this work.

Abstract

Fire alarm system plays an important role in maintaining and monitoring the safe of all kind environments and situation. However, the usability of many existing fire alarm system is well known but could be produce with high cost also it need regular preventive maintenance to be carried out to make sure the system operates well. Meanwhile, when the maintenance is being done to the existing system it could raise the cost of using the system the main objective of this project is to make afire control system with low cost.

This project discusses the effective method to use the microcontroller (Arduino) to control the other components to provide a cheap fire alarm, firefighting which can used for more wide vision. C language is used for programming and Proteus is used for the simulation and hardware.

From the project done, the system supposed to give quick response to current situation. system can detect heat and flame sensed by the detectors. When the sensors form each level triggered individually, the main buzzer operates and it shows in the control panel LCD display alert.

مستخلص

تلعب أنظمة الإنذار بالحريق دورا مهما في الحفاظ على سلامة المباني والممتلكات بالرغم من أن هذه الأنظمة موجودة ومعروفة لدى الجميع إلا أنها ذات تكلفة عالية وتحتاج الى صيانة دورية للتاكد من عملها بصورة سليمة هذه الصيانة تزيد من تكلفة استخدام النظام ومتابعته ، الهدف من هذه الدراسة توفيرنظام للتحكم في الحريق بتكلفة أقل بحيث يتثنى للجميع امتلاكه لا سيما ذوي الدخل المحدود.

هذه الدراسة تبين الطريقة المثلى لإستخدام المعالج الدقيق (اردوينو) والذي يتحكم في بقية المكونات لإعطاء نظام رخيص الثمن يقوم بالإنذار للحريق، ومشاهدة الوضع الحالي للمنطقة، سيتم برمجة المعالج الدقيق باستخدام لغة ال C كما سيتم عمل محاكاة للنظام باستخدام برنامج البروتوس و تصميم مجسم.

بعد الانتهاء من هذا المشروع سيكون بإمكان النظام المصمم أن يعطي إستجابة سريعة للأحداث بمعنى أن الحساسات ستقوم بإكتشاف مسببات الحريق (حرارة ولهب) بعدها سيقوم المتحكم بالإجراءات الاتية:

إرسال نبضة الى الجرس لإعطاء إنذار مسموع في المكان ومخاطبة الشاشة لتقوم بعرض حالة المنطقة.

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CHAPTER ONE
INTRODUCTION

1.1 General Concepts (Overview)

Fire is very deadly and it leads to loss of human life and property. Fire detection systems are necessary to reduce the destruction of personal belongings and caused by fire both man made and induced. The National Crime Records Bureau indicates that there have been a total of 113961 fatalities due to fire accidents during the years 2010 to 2014. Fire accidents claim roughly 65 victims every day. A total of 1.21 lakh fire accidents occurred between the years 2010 and 2014. Thankfully by the usage of more smart fire detecting systems the number of fire accidents have been reducing steadily. One of the most destructive properties of fire is that it spreads exponentially and with the right medium can spread uncontrollably. This is why timely detection of fire is necessary for avoiding a fire hazard

1.2 Problem Statement

The existing fire alarm system in market nowadays, is too complex in terms of its design and structure. Since the system is too complex and expensive, it needs regular preventive maintenance to be carried out to make sure the system operates well.

Meanwhile, when the maintenance is being 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 purposes.

1.3 Objective

The main objective is to design a fire alarm and fire control system that would fulfill the following objectives:

I-to sound the alarm if fire occurs

II-to provide the flexibility to adjust the temperature

III-to design easy use and simple firefighting system

IV-to design and implement cheap fire alarm system

1.4 Methodology

In a way to achieved above objectives, this thesis used to be implemented as below:

1) To made a simulation and hardware to achieved a project objective
2) The Arduino is used as hart of this fire alarm system to control the entire operations involved
3) The fire alarm system incorporates the heat and flame detectors that are connected in parallel to locate and identify the place that is in fire
4) The LCD display the current situation of the sensors

1.5 Research Outline

In chapter one is an introduction to fire alarm system, chapter two we discuss firefighting component and structure, chapter three firefighting control system and defriend types, in chapter four application simulation and hardware, chapter five conclusions and recommendation

CHAPTER TWO

FIRE ALARM SYSTEM COMPONENTS

2.1 Introduction:

The fire alarm system is very important for the buildings, specially, the high one, to protect human and his things from being burned, and that by giving an alarm to show that there is a fire in the building, so everyone in the building will take care to himself and get out of building immediately, and also can call the fire fighters to come and destroy the fire, and that if there is not a system of fighting (just alarm system). But if there is a fighting system, it will finish the fire in a few minutes. Fire Alarm System detects the fire to give an alarm automatically or manually. Fire alarm device is an integrated electronic device consisting of several devices sensitive to different fire outputs, control devices, auxiliary networks, and others.

The purpose of using alarm devices:

1) To detect the fire and its location.
2) To alert the occupants of the building in the event of fire, to enable them to scape.
3) To fight the fire in its early stages.
4) To inform the nearest fire station.
5) Also to operate some automatic extinguishing systems or some of the specialized services for fire protection purposes through a system board.

The alarm system is classified according to the condition of its use to:

a) System to give audible and visual alarms only.

b) System for operating fixed firefighting devices such as halon system, clean media system, water immersion system, foaming system dry chemical powder system…etc.

2.2 Fire Alarm System Components:

The Fire Alarm System is consisting of: Fire Alarm Control Panel, Detectors, Alarm unit.

The figure (2.1) shows fire alarm system components.

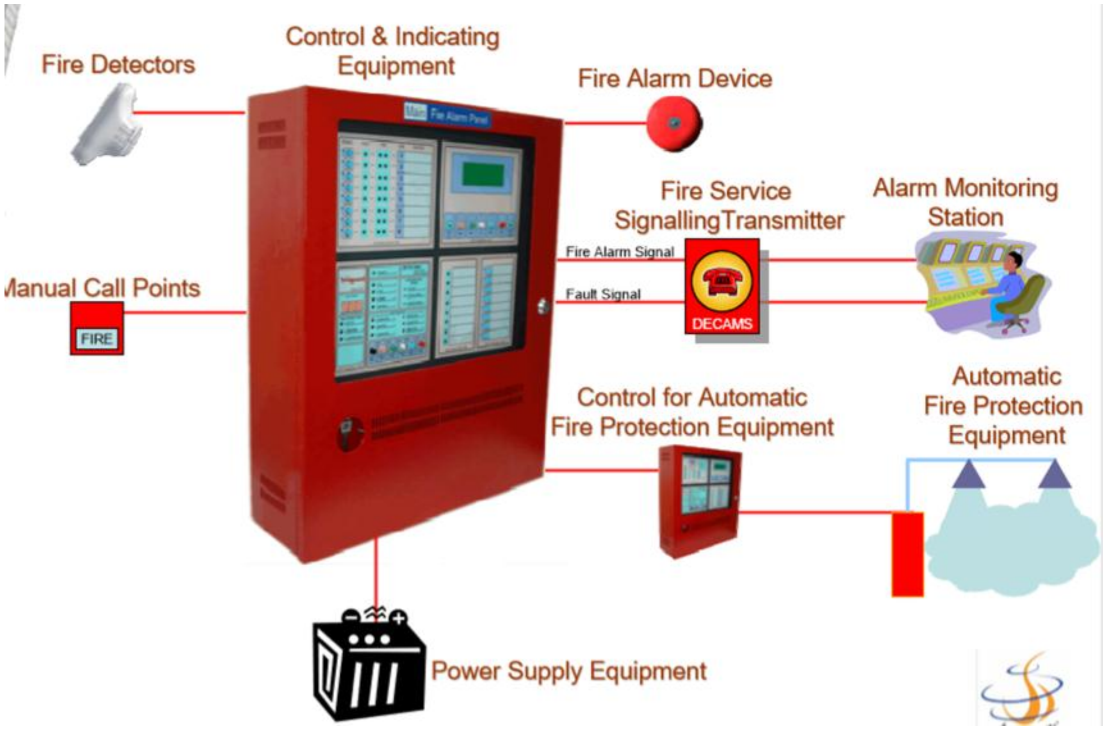


Figure (2.1) fire alarm system components

2.2.1 Fire alarm control panel (FACP):

It is the controlling component of fire alarm system. It concerned the clever mind for the fire alarm system, and it is a digital control unit receives the signals from the detectors. It converter this signal into an alarm, and sometimes an alarm and lights, by using bells or horns with or without lights. Fire Alarm Main Control Panel is an electronic device that controls all devices associated from receiving signals from all types of detectors to sounding the necessary warning sirens and carrying out the tasks assigned to it. The FACP performs three basic functions:

1) Automatic monitoring and control of the external circuits of the equipment and supply this equipment with electrical power.
2) Show the fire signals and false alarm signals and their location.
3) Manual control to facilitate the procedures for checking and stopping devices, triggering fire signals, silencing acoustic fire alarms, and restating the system after the fire signal.

The figure (2.2) shows the fire alarm control panel:

Figure (2.2): fire alarm control panel

2.2.2 Detectors:

They are detectors and sensors connected to the FACP, to detect the fire and send a signal to the FACP.

There are many types of sensors or detectors used in the fire alarm system such as:

1) Smoke detector:

It works when the smoke rises in the building and it sends a signal only when there is a smoke.

The figure (2.3) shows the smoke detector:

Figure (2.3): smoke detector

2) Heat Detector:

It is a fire alarm device designed to respond when the converted thermal energy of a fire increases the temperature of a heat sensitive element. It works when the temperature rises in the building, it detects is there any increasing in the temperature, and send a signal to the FACP.

The figure (2.4) shows the heat detector:

Figure (2.4): heat detector

3) Multi Detector:

It is a fixed of smoke and heat detector, it used in the places that can find heat and smoke together such as:

Electricity room, transformers room and control room. Figure (2.5)

Figure (2.5): multi detector

4) Gas Detector:

It is a device that detects the presence of gases in an area, often as part of a safety system. It works when there is a dropout of gases in the building, it detects is there any gases in the building, and therefore sends a signal to the FACP.

The figure (2.6) shows the Gas Detector

Figure (2.6): gas detector

5) Optical Reagents Detectors:

Also known as Flame detectors, and there are two types of them, the first one detects the light in the Ultraviolet spectrum, and the other one detect the light in the Infrared spectrum.

6) Flame Sensor:

It is a sensor senses the increasing in the flames, by wherein if the increasing is research a certain point, it sends a signal to the FACP and the system has an alarm.

The Figure (2.7) bellow shows the flame sensor:

Figure (2.7): flame detector

7) Carbon Monoxide Detector:

Or CO detector is a device that detects the presence of the carbon monoxide (CO) gas to prevent carbon monoxide poisoning. It used in the countries that have a special care about her environment. It used in the garages and the furnace, if there is any increasing in the CO in the air, it sends a signal to the FACP, and the system has an alarm.

The figure (2.8) shows the carbon Monoxide detector:

Carbon Monoxide detectors

Figure (2.8): CO detectors-

8) Beam Detectors:

They are used in the high places or the opening places such as: places without roofs and the opening places for marketing. It consists of a sender and receiver, the sender sends rays to the receiver, when there is a fire the smoke cut this rays and the sensor will work.

Figure (2.9) shows the Beam detector:

Beam detectors

Figure (2.9): beam detectors

2.2.3 Manual Call point:

If anyone in the building see the fire before hear the alarm, he can push the manual call point to make bells or horns work.

Also this point can send a signal to the FACP by pushing it manually.

The figure (2.10) shows the call point:

Figure (2.10): manual call point

2.2.4 Voice Alarm Unit:

To make a sound, there are many elements used in the alarm such as: Horns, Bells, Sirens and Led indicator.

- Horns:

They are used in the alarm system to make a noise, to make everyone in the building that there is fire in the building.

Figure (2.11): shows the Horn with strop:

Figure (2.11): horns with strop

- Bells:

Also used to make a voice to alert people.

Figure (2.12) shows the bell:

Figure (2.12): bells

- Sirens:

Used in the alarm system to alert people that there is a fire by making a loud voice.

Figure (2.13) shows the sirens:

Figure (2.13): sirens

CHAPTER THREE

Fire Fighting Control System

3.1 Introduction

History has proven that early detection of a fire and the signaling of an appropriate alarm remain significant factors in preventing large losses due to fire. Properly installed and maintained fire detection and alarm systems can help to increase the survivability of occupants and emergency responders while decreasing property losses

3.2 Fire Alarm System Components

Modern detection and signaling systems vary in complexity from those that are simple to those that incorporate advanced detection and signaling equipment each of the following sections highlights a basic component of a fire detection and alarm system. The main block diagram of system component is shown in figure (3.1).

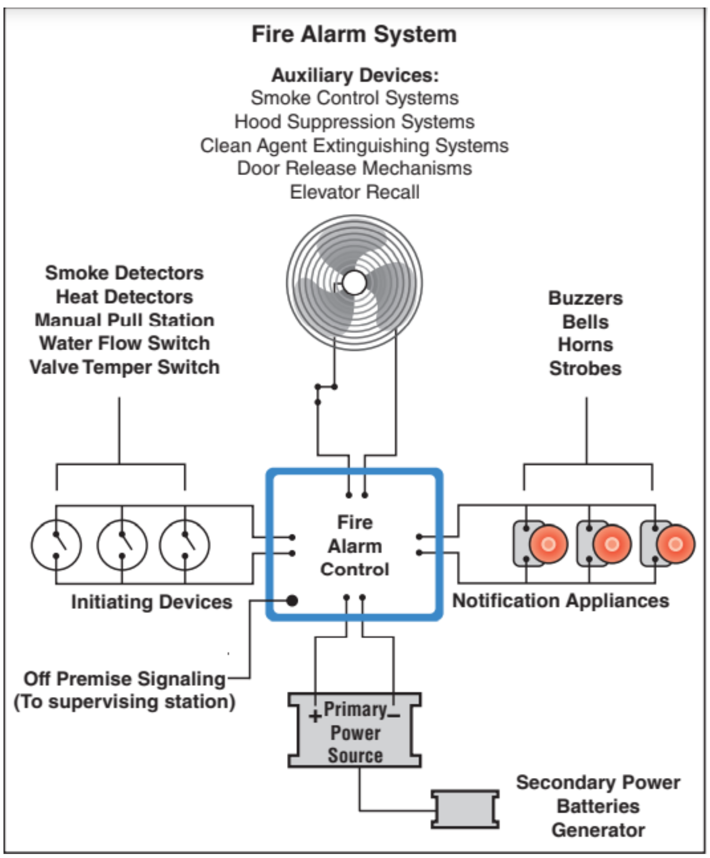


Figure 3.1 This schematic shows the different components of a re alarm control unit (FACU), the central hub of an alarm system

3.2.1 The fire alarm control unit (FACU)

Formerly called the fire alarm control panel (FACP) contains the electronics that supervise and monitor the integrity of the wiring and components of the fire alarm system. The FACU basically serves as the brain for the alarm system.

It receives signals from alarm-initiating devices, processes the signals, and produces output signals that activate audible and visual appliances. The FACU also transmits signals to an off-site monitoring station when provided. Power and fire alarm circuits are connected directly into this panel. In addition, the remote auxiliary fire control units and notification appliance panels are considered to be part of the fire alarm system and are connected and controlled. Controls for the system are located in the FACU. The FACU can also perform other functions, such as providing two-way firefighter communication, providing remote annunciator integration, Controlling elevators, HVAC, fire doors, dampers, locks, or other fire protection features

The FACU can also provide public address messages and mass notifications alerts through prerecorded evacuation messages or independent voice communications.

Some fire alarm control units are designed for both security and fire protection. In these types of systems, fire protection is engineered into the system to assume the highest priority.

3.2.2Primary Power Supply

The primary electrical power supply usually comes from the building's main power connection to the local utility provider. In rare instances where electrical service is unavailable or unreliable, an engine-driven generator can provide the primary power supply. If such a generator is used, either a trained operator must be on duty 24 hours a day or the system must contain multiple engine driven generators. One of these generators must always be set for automatic starting. The FACU must supervise the primary power supply and signal an alarm if the power supply is interrupted.

3.2.3 Secondary Power Supply

All fire alarm systems must have a secondary power supply. This requirement is designed so that the system will be operational even if the main power supply fails. The secondary power supply must be capable of providing normal, (non-alarm) standby conditions capacity and power to fully operate an alarm condition. The time period requirements for secondary power operation capabilities vary. Secondary power sources can consist of batteries with chargers, engine-driven generators with a storage battery, or multiple engine-driven generators, of which one must be set for automatic starting

3.2.4 Initiating Devices

A fire detection system consists of manual and automatic alarm-initiating devices that are activated by the presence of fire, smoke, flame, or heat (Figure 3.2). The devices then send a signal to the FACU using one of two methods: a hard-wire system or a generated signal conveyed by radio wave over a special frequency to a radio receiver in the panel. Both automatic and manual alarm initiating devices are addressed in more detail in the next sections and include but are not limited to the following devices:

- Manual pull stations.
- Smoke detectors.
- Flame detectors.
- Heat detectors.
- Combination detectors.
- Water flow devices

Figure 3.2 a ceiling-mounted
re alarm speaker and strobe light
Combination unit.

An alarm-initiating device is activated, it sends a signal to the FACU, which

Then processes the signal and initiates actions. The primary action initiated

Is usually local notification, which can take the form of?

• Bells

• Buzzers

• Horns

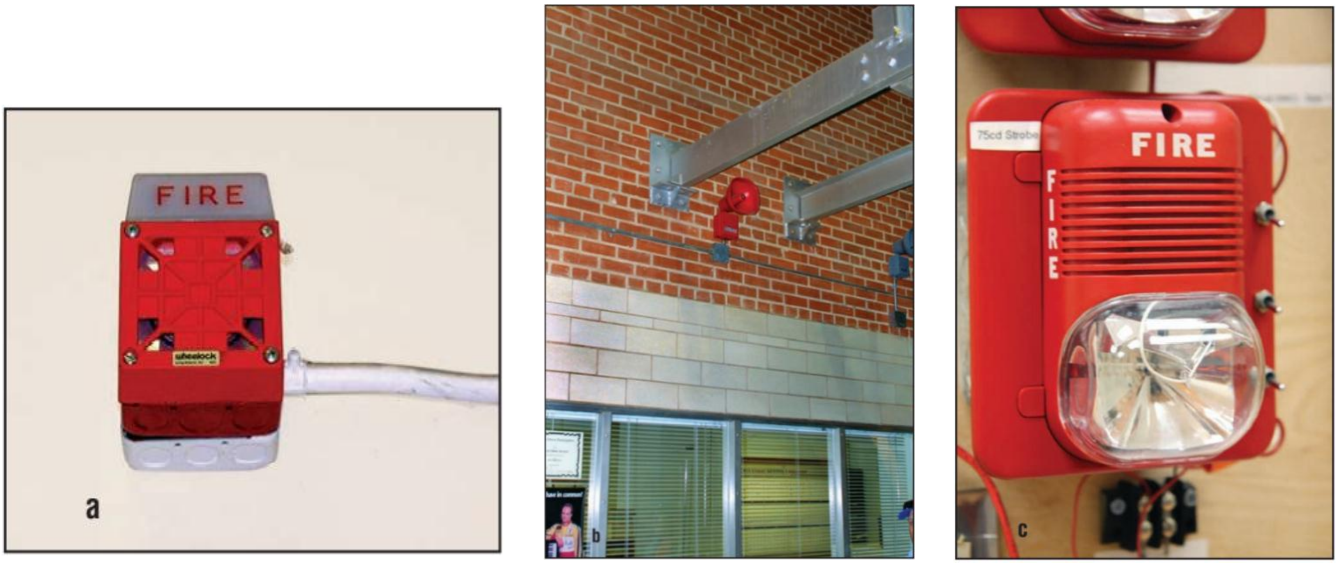
• Speakers

• Strobe lights

• Other warning appliances

Depending on the system's design, the local alarm may either activate a single notification appliance, notification appliances within a specific zone, designated floor(s), or the entire facility. Notification appliances fall under the following categories

- **Audible**: Approved sounding devices, such as horns, bells, or speakers that indicate a fire or emergency condition.
- **Visual**: Approved lighting devices, such as strobes or flashing lights that indicate a fire or emergency condition.
- **Textual**: Visual text or symbols indicating a fire or emergency condition.
- **Tactile**: Indication of a fire or emergency condition through sense of touch or vibration.



Figures 3.3 a-c Noti cation devices include bells, horns, strobe lights, and speakers.

3.2.5 Additional Alarm System

Functions Building codes have special requirements for some types of occupancies in case of fire. In these cases, the fire detection and alarm system can be designed to initiate the following actions:

- Turn off the heating, ventilating, and air-conditioning (HVAC) system.
- Close smoke dampers and/or fire doors.
- Pressurize stairwells and/or operate smoke control systems for evacuation purposes.
- Unlock doors along the path of egress.
- Provide elevator recall to the designated floor and prevent normal operations.
- Operate heat and smoke vents.
- Activate special fire suppression systems, such as reaction and deluge sprinkler systems or a variety of special-agent fire extinguishing systems

3.3 Types of firefighting control system

3.3.1 Conventional Alarm Systems

A conventional system is the simplest type of protected premises alarm system. When an alarm-initiating device, such as a smoke detector, sends a signal to the FACU, all of the alarm-signaling devices operate simultaneously (Figure3.4). The signaling devices usually operate continuously until the FACU is reset. The FACU is incapable of identifying which initiating device triggered the alarm; therefore, building and fire department personnel must walk around the entire facility and visually check to see which device was activated. These systems are only practical in small occupancies with a limited number of rooms and initiating devices. An FACU serves the premises as a local control unit. This system is found in occupancies that use the alarm signals for other purposes. In the past, schools sometimes used the same bells for class change as for fire alarms. The FACU enables the fire alarm to have a sound that is distinct from class bells, eliminating confusion as to which type of alarm is sounding. Modern codes do not allow systems such as these; however, older systems that do are still encountered.

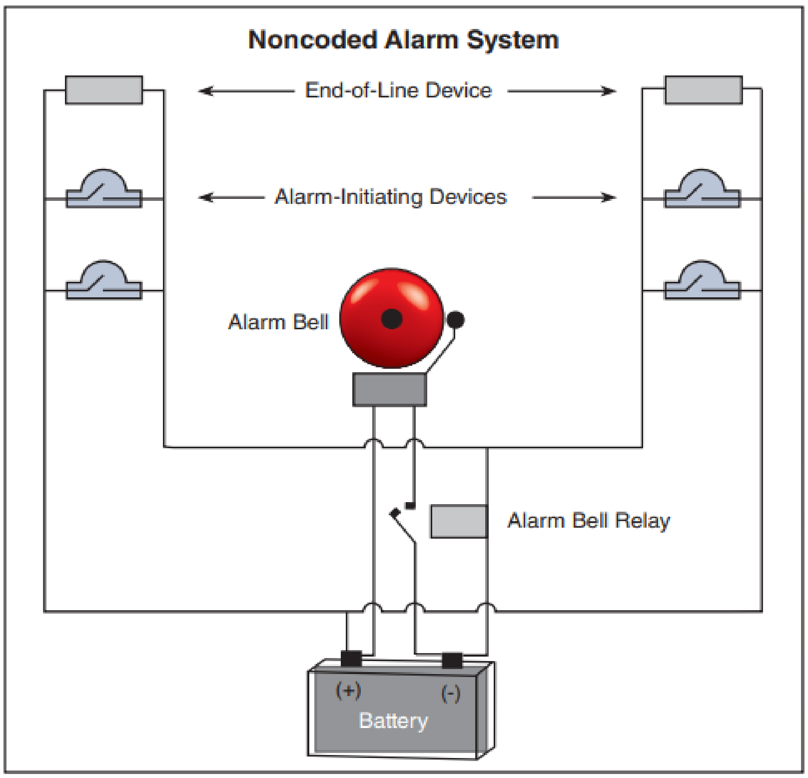


Figure (3.4) in conventional alarm systems, all the individual alarm appliances operate at the same time.

Zoned Conventional Alarm Systems Fire-alarm system annunciation enables emergency responders to identify the general location, or zone, of alarm device activation. In this type of system, an annunciator panel, FACU, or a printout visibly indicates the building, floor, fire zone, or other area that coincides with the location of an operating alarm-initiating device. Alarm-initiating devices in common areas are arranged in circuits or zones. Each zone has its own indicator light or display on the FACU. When an initiating device in a particular zone is triggered, the notification devices are activated, and the corresponding indicator is illuminated on the FACU. This signal gives responders a better idea of where the problem is located.

NOTE: A zone is a defined area within the protected premises. An annunciator panel may be located remotely from the FACU, often in a location designated by the fire department. Such an installation may be found at the driveway approach to a large residential retirement complex, for example. This type of annunciator panel usually has a map of the complex coordinated to the zone indicator lamps. Arriving firefighters use the information provided on the annunciator panel to locate the building involved. Another type of annunciator panel may be found in the lobby area of a building. It will have a graphic display of the involved area.

3.3.2 Addressable Alarm Systems

Addressable alarm systems display the location of each initiating device on the FACU and an annunciator panel if provided. This connection enables emergency responders to pinpoint the specific device that has4 been activated. Addressable systems reduce the amount of time that it takes to respond to emergency situations. These systems also allow repair personnel to quickly locate and correct malfunctions in the system.

3.4 Supervising Station Alarm Systems

Fire alarm systems are required by model fire codes to be monitored at a constantly attended location. For buildings that are not constantly attended by qualified personnel, initiating device signals are required to be transmitted to a supervising station. A supervising station is a facility that receives signals from a protected premises fire alarm system and where the signal is processed by personnel.

- Central — a central supervising station is an independent business that is also listed by a nationally recognized testing laboratory. A central station is recognized as the most reliable type of supervising station.
- Proprietary — a proprietary supervising station is a supervising station under the same ownership as the buildings protected by the fire alarm systems. At a proprietary supervising station, personnel are constantly in attendance to supervise and investigate fire alarm system signals.
- Remote — a remote supervising station is not listed and operates as a business. Personnel are in attendance at all times to supervise and investigate signals.

CHAPTER FOUR

APPLICATION

4.1 System layout

The block diagram of the hardware implementation of the entire system is as shown in figure (4.1)

The aim of the project is to illustrate the usage of the fire detection system and its applications. The equipment used is to construct the fire detection system is a microcontroller, temperature sensor, LCD, flame sensor, LEDs and buzzer.

As the system requires the use of microcontroller the design consists of two parts: hardware and software. Hardware is constructed and integrated module by module. Hardware to software for easy troubleshooting and testing.

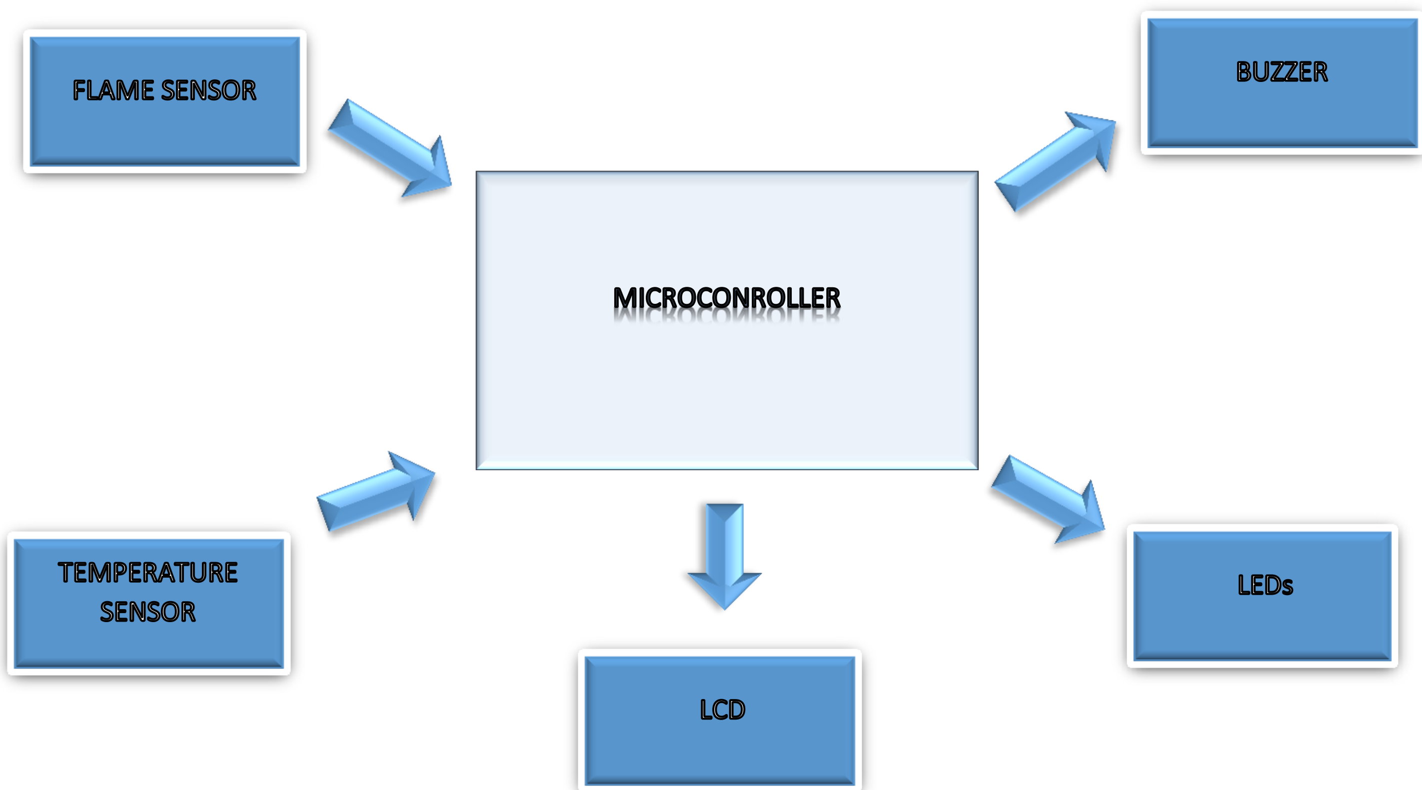


FIGURE (4.1) hardware implementation of fire detection and alarm system

4.2 Input unit

Input systems consist of two sensors. The mechanism of the input system is described as follow

4.2.1 Temperature sensor

A number of temperature sensors are available in the market. In this project the LM35 temperature sensor is used (figure 4.2).

The LM35 series are precision integrated-circuit temperature devices with an output voltage linearly-proportional to the Centigrade temperature. The LM35 device has an advantage over linear temperature sensors calibrated in Kelvin, as the user is not required to subtract a large constant voltage from the output to obtain convenient Centigrade scaling. The LM35 device does not require any external calibration or trimming to provide typical accuracies of ±¼°C at room temperature and ±¾°Cover a full −55°C to 150°C temperature range. Lower cost is assured by trimming and calibration at the wafer level. The low-output impedance, linear output and precise inherent calibration of the LM35 device makes interfacing to readout or control circuitry especially easy. The device is used with single power supplies, or with plus and minus supplies. As the LM35 device draws only 60 µA from the supply, it has very low self-heating of less than 0.1°C in still air. The LM35 device is rated to operate over a −55°C to 150°C temperature range. The LM35-series devices are available packaged in hermetic TO transistor packages

Figure (4.2) LM35 temperature sensor

4.2.2 Flame sensor

This Flame Sensor can be used to detect fire source or other light sources of the wave length in the range of 760nm - 1100 nm. It is based on the YG1006 sensor which is a high speed and high sensitive NPN silicon phototransistor. Due to its black epoxy, the sensor is sensitive to infrared radiation. Figure (4.3)

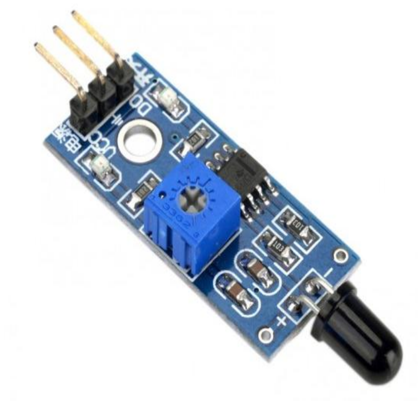


Figure (4.3) flame sensor

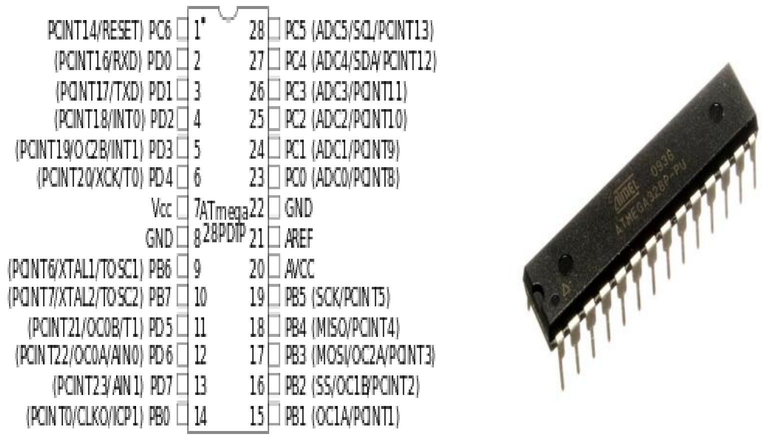
4.3 System processor

Processing system acts as the brain of robot, which generates desired output for corresponding inputs. For that purpose, microcontrollers are used .in present days; there are several companies that manufacture microcontroller. For example, ATME, Microchip, Intel, Motorola etc. ATmega 328P microcontroller is used in this project (ATMEl product)with Arduino Nano models

4.3.1 Microcontroller

Number of microcontroller from different companies are available in the market. In this project ATmega328P is used, figure (4.3.1A-B). The ATmega328 is a single-chip microcontroller created by Atmel in the megaAVR family. It has a modified

Harvard architecture 8-bit RISC processor core.



figure(4.4 A-B): ATmega328P

I. Specifications

The Atmel 8-bit AVR RISC-based microcontroller combines 32 KB ISP flash memory with read-while-write capabilities, 1 KB EEPROM, 2 KB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a byte-oriented 2-wire serial interface, SPI serial port, 6-channel 10-bit A/D converter (8-channels in TQFP and QFN/MLF packages), programmable watchdog timer with internal oscillator, and five software selectable power saving modes. The device operates between 1.8-5.5 volts. The device achieves throughput approaching 1 MIPS per MHz

II. Applications

As of 2013 the ATmega328 is commonly used in many projects and autonomous systems where a simple, low-powered, low-cost micro-controller is needed. Perhaps the most common implementation of this chip is on the popular Arduino development platform, namely the Arduino Uno and Arduino Nano models.

4.3.2 Arduino platform

Arduino is an open source electronics prototyping platform based on flexible hardware and software. The Arduino is a simple yet sophisticated device which is based on Atmel s ATmega microcontrollers. The Arduino software is supported by windows, Macin-tosh OSX and Linux operating systems despite the fact that most microcontrollers are limited to Windows operating system. The software language is based on Alf and Vegrard RISC processor (AVR) C programming language and can be expended through C++ libraries. There are various types of Arduino microcontroller board available in the market including the Arduino kits and Arduino shields.

The Arduino Nano -figure (4.5) -is a small complete and breadboard-friendly board based on the ATmega 328P it has more or less the same functionality of the Arduino duemilanove, but in a different package. It lacks only a DC power jack, and works with a mini-B USB cable instead of a standard one the Arduino Nano is programmed using the Arduino software integrated development environment (IDE) which is common to all Arduino boards and running both online and offline

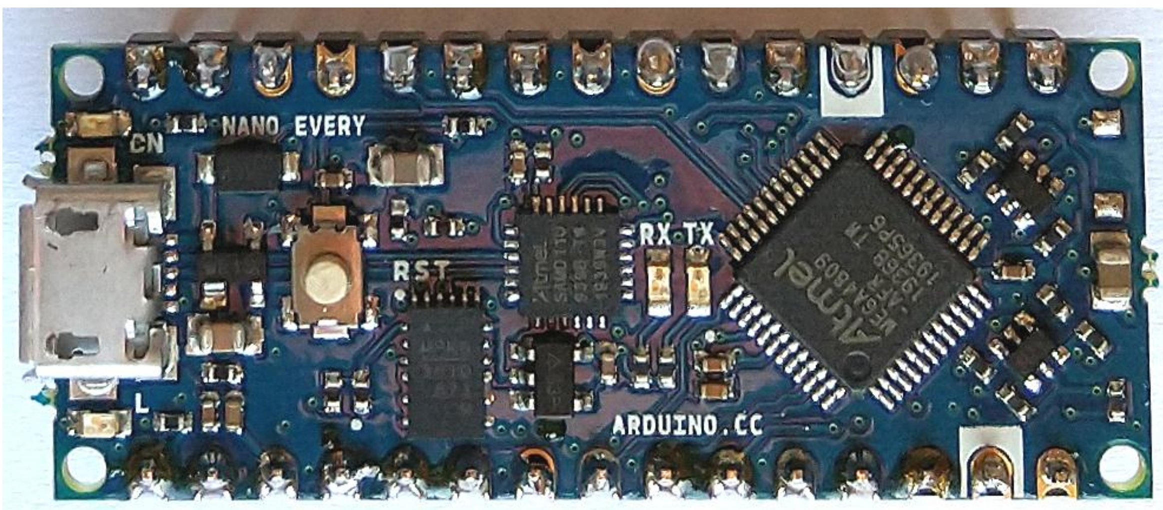


Figure (4.5): Arduino Nano

4.4 Output unit

An output device is any piece of hardware equipment used to communicate the result of data processing carried out by an information processing system (such as Arduino microcontroller). Which converts the electronically generated information into sensor

4.4.1 Light Emitting Diode (LED)

A light-emitting diode (LED) is a two-lead semiconductor light source that resembles a basic pn-junction diode, except that an LED also emits light. When an LED's anode lead has a voltage that is more positive than its cathode lead by at least the LED's forward voltage drop, current flows. Electrons are able to recombine with holes within the device, releasing energy in the form of photons. This effect is called electroluminescence, and the color of the light (corresponding to the energy of the photon) is determined by the energy band gap of the semiconductor. As shown in the figure (4.6)

Figure(4.6):red LED

4.4.2 Liquid Crystal Display (LCD)

LCD is as well another output appliance here. It is used to display character in the ASC11 code form which is mean the data for character that been send by the controller to the LCD should be 8-bit American Standard Code (ASC11) representation. The characters that will be displayed on the LCD panel should be characters that available in the LCD datasheet characters table. Most of the LCDs are using the Hitachi driver. The system is using the LCD to preview the current temperature value and alarm message with fire detection. In this project LCD Display (16*2) is used and the model number is MIS-0001 Figure () shows the LCD model MIS00010 .

Normally available LCD in the market for normal displays in the projects is 2*16 pin LCD which is easily available. Talking about its specifications it has got 8 data pin , 3 control pins , and rest 5 pins for GND and VCC connections . 2*16 LCD display and light intensity is also adjustable which makes it suitable to adjust for the day and night time use for better display.

Figure(4.7) :16*2 LCD

4.4.3 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 supply of maximum up to 12 V available on the board. Figure (4.8) shows the buzzer.

Figure(4.8) :Buzzer

4.5 Project Operation

First of all, all the hardware unit of the system were tested and it was ensured that they were in a good working condition. Then all units- Buzzer, flame sensor, temperature sensor, LCD, LEDs- were connected to each other on the board with the Arduino-Nano- (microcontroller-atmega328P-) using copper wires according to the code saved in the Arduino and according to the anode cathode and data of each unit as shown in the figure (4.9)

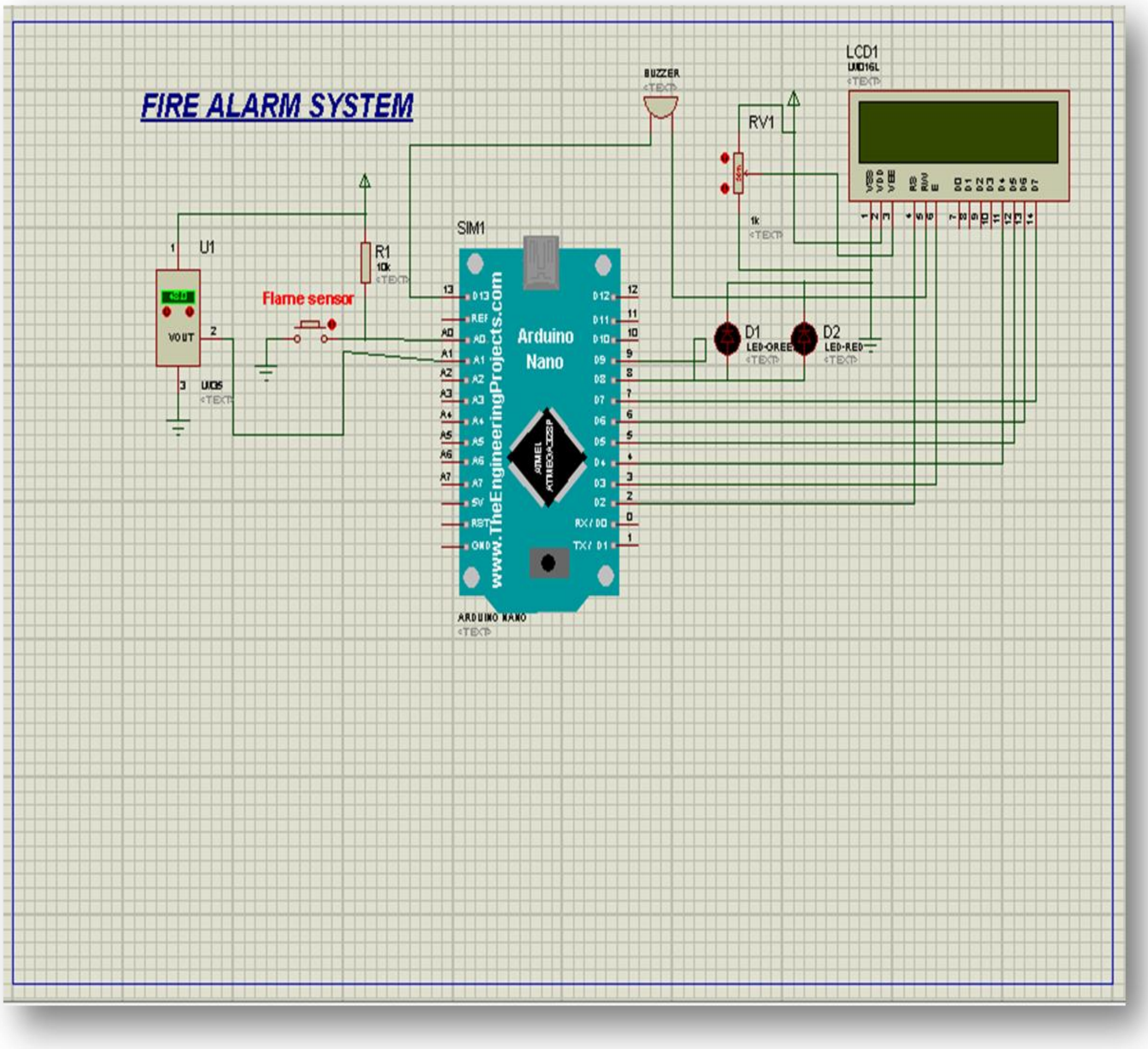


Figure (4.9): state one

After that, the circuit was fed to a voltage of 5 volts (directly or from USB socket connected to the Arduino), connected to the ground, and the Arduino was turned on.

The response was as planned as the LCD display displayed the phrase “welcome to fire detector”

Noting that on LED was lit or the buzzer sound was heard, and this lasted for 5 seconds, figure (4.10)

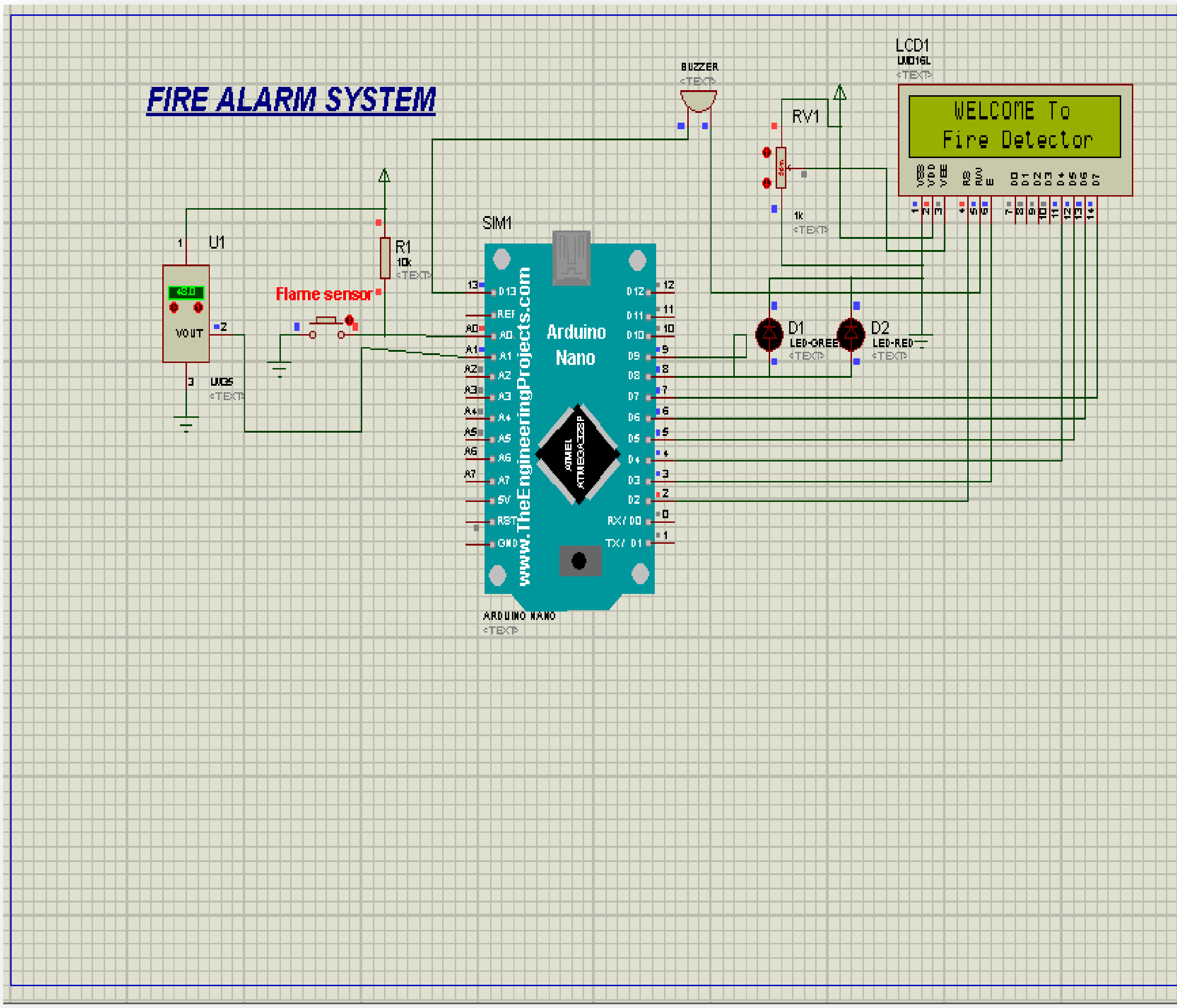


Figure (4.10) state two

After 5 seconds of the circuit's operation, the welcome message disappeared and the response become divided into two parts: normal mode – no sensitivity to fire – and when there is a signal from the flame sensor, they are detailed below

The normal situation is in the case of insensitivity to the flame, as the green LED lit up, and the LCD screen displays the phrase 'not flame _normal' and the current temperature so that the temperature could be alerted before the outbreak of the fire figure (4.11)

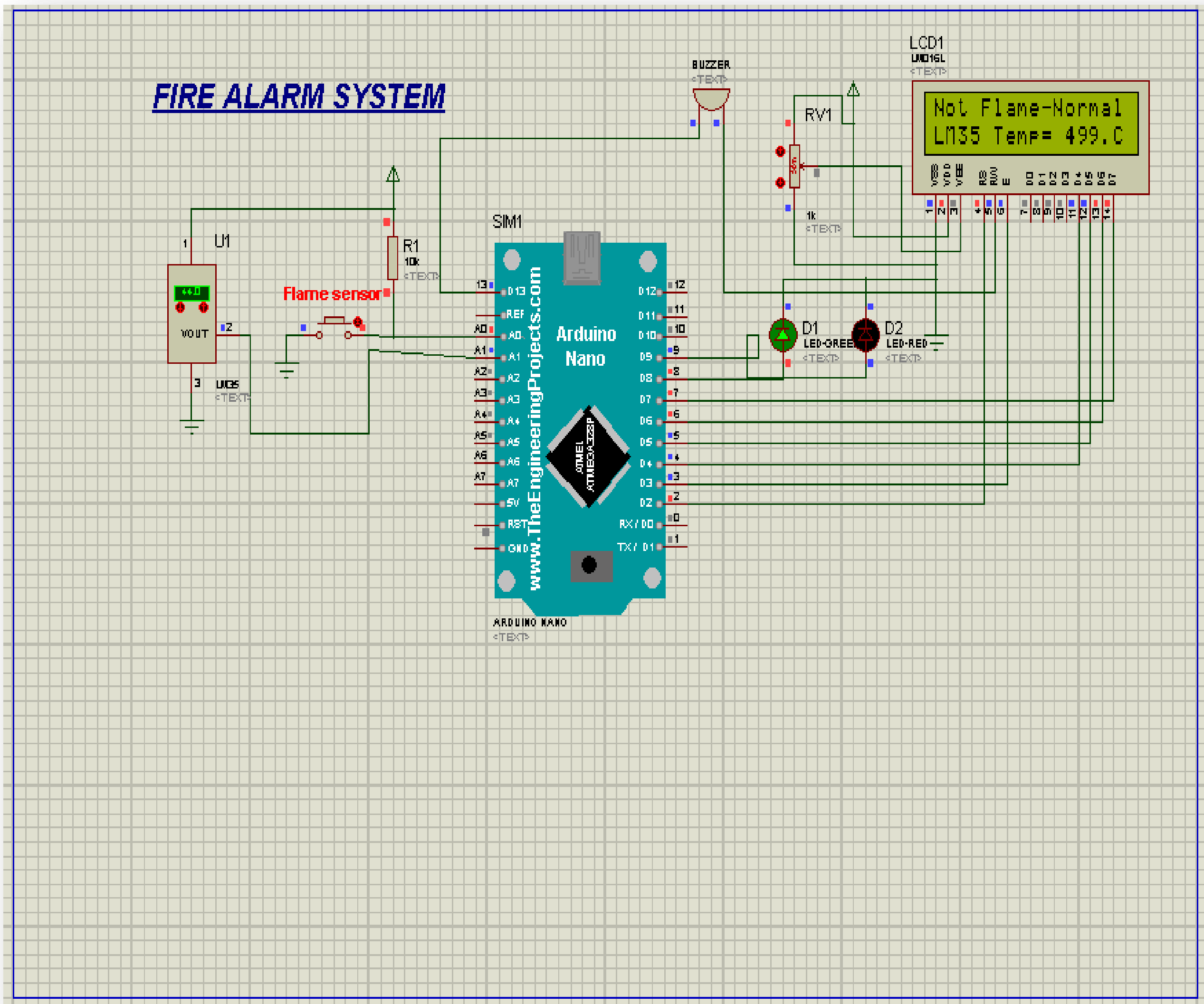


Figure (4.11) state three

The second case is when there is a signal from the flame sensor where the buzzer beeps loudly to warn the fire with the red LED lighting and the screen displayed the warning message “fire is detected Alert….!!!!”

Figure (4.12)

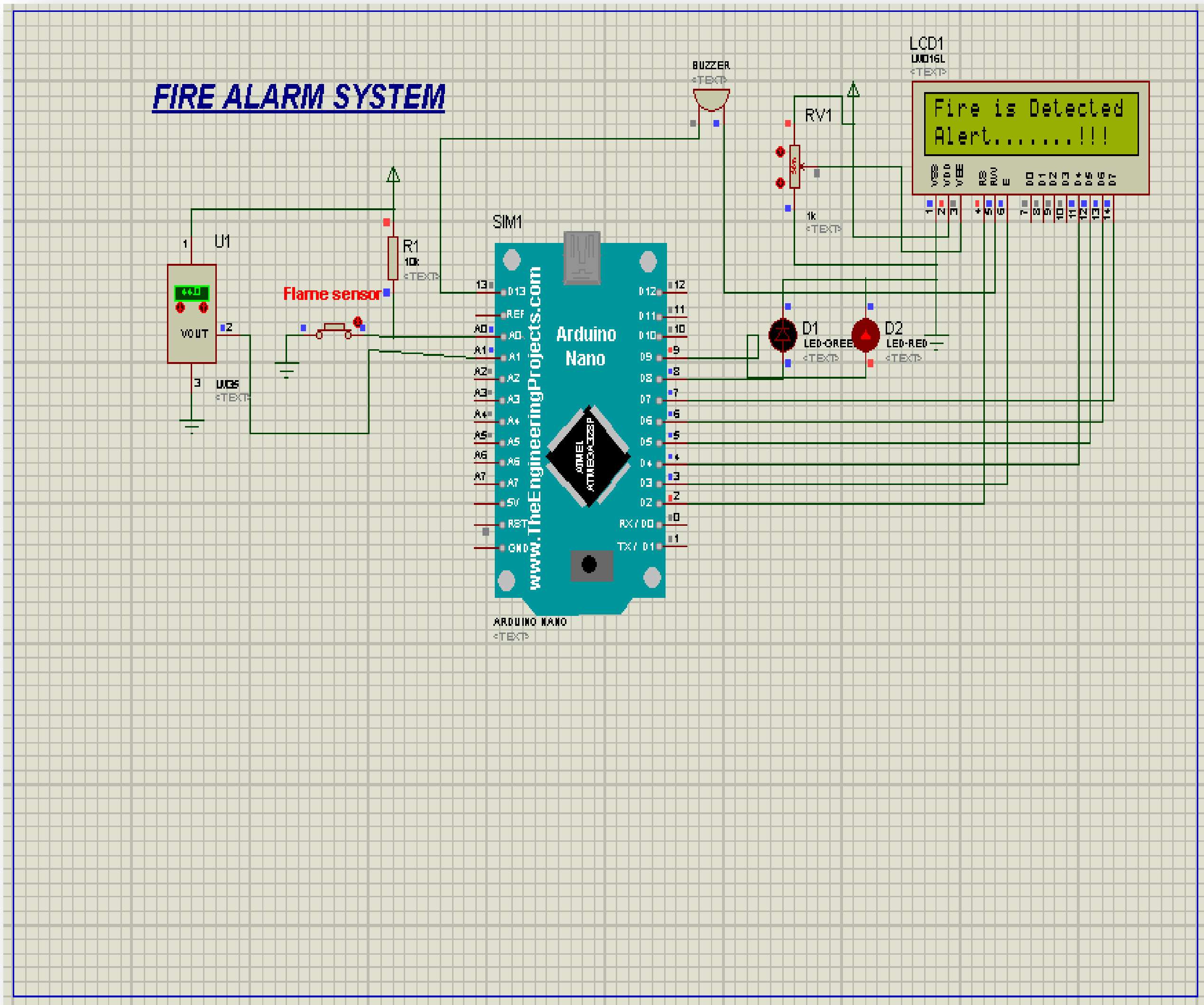


Figure (4.12) state four

4.5.1 Proteus Simulation program:

The Proteus Design Suite is a proprietary software tool suite used primarily for electronic design automation. The software is used mainly by electronic design engineers and technicians to create schematics and electronic prints for manufacturing printed circuit boards.

CHAPTER FIVE

CONCLUSIONS & RECMMENDATIONS

5.1 Conclusion

In this thesis, the aim is to design a fire alarm and control system with a Low cost with effective usage and make it more users friendly and easy to operate. so flame sensor and Arduino are used reduce the wastage of electricity, save lives reduce percentage of accident and reduce waste of electric appliance. the program embedded in the Arduino Nano works according to the need A step by step approach in designing Arduino based system for temperature measurement has been followed. According to the study and analysis of various parts of the system a design has been carried out the results obtained from the measurement has shown that the system performs well under all conditions and the attempt has been done

5.2 Recommendations

This type of system fire alarm can be represented in power stations, sub stations and industry.

We can even also combine the PIR sensor, light sensor, pressure sensor, and gas sensor with this project to make it more efficient.

Internal memory with register can be added to record the history of the application.

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APPENDIX

Arduino Code:

```
#include <LiquidCrystal.h>
LiquidCrystal lcd(2, 3, 4, 5, 6, 7);

int sensorPin = A0; // choose the input pin (for Fire sensor)
int buzzer = 13; // choose the pin for the Buzzer
int G_led = 8; // choose the pin for the Green LED
int R_led = 9; // choose the pin for the Red Led

int read_value; // variable for reading the sensorpin status
const int lm35_pin = A1;  /* LM35 O/P pin */
int temp_adc_val;
  float temp_val;
void setup(){
pinMode(sensorPin, INPUT); // declare sensor as input

pinMode(buzzer,OUTPUT); // declare Buzzer as output
pinMode(R_led,OUTPUT); // declare Red LED as output
pinMode(G_led,OUTPUT); // declare Green LED as output

lcd.begin(16, 2);
lcd.clear();
lcd.setCursor(0,0);
```

```
lcd.print("   WELCOME To   ");
lcd.setCursor(0,1);
lcd.print("  Fire Detector ");
delay(5000);
lcd.clear();
}

void loop(){
read_value = digitalRead(sensorPin); // Digital input value
temp_adc_val = analogRead(lm35_pin);  /* Read Temperature */
  temp_val = (temp_adc_val * 4.88); /* Convert adc value to equivalent voltage */
  temp_val = (temp_val/10); /* LM35 gives output of 10mv/°C */
  lcd.setCursor(0, 1);
lcd.print("LM35 Temp=");
lcd.setCursor(11, 1);
lcd.print(temp_val);
lcd.setCursor(15, 1);
lcd.print("C");
if(read_value==1){ // check if the Fire variable is High
lcd.setCursor(0, 0);
lcd.print("Not Flame-Normal");
digitalWrite(buzzer, LOW); // Turn LED off.
digitalWrite(R_led, LOW);  // Turn LED off.
digitalWrite(G_led, HIGH); // Turn LED on.


}
```

```
else{ // check if the Fire variable is Low
lcd.setCursor(0, 0);
lcd.print("Fire is Detected");
lcd.setCursor(0, 1);
lcd.print("Alert.......!!!    ");

digitalWrite(buzzer, HIGH); // Turn LED on.
digitalWrite(R_led, HIGH);  // Turn LED on.
digitalWrite(G_led, LOW);   // Turn LED off.
delay(1000);
}
delay(100);
}
```

Arduino Nano datasheet

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

Atmega328P datasheet

Parameter	Value
CPU type	8-bit AVR
Performance	20 MIPS at 20 MHz
Flash memory	32 KB
SRAM	2 KB
EEPROM	1 KB
Pin count	28 or 32 pin:
Maximum operating frequency	20 MHz
Number of touch channels	16
Hardware QTouch Acquisition	No
Maximum I/O pins	23
External interrupts	2
USB Interface	No
USB Speed	–