A Data Fusion Based Fire Alarm System

Submitted in partial fulfillment of the requirements
of the degree of

Bachelor of Engineering

in

Electronics and Telecommunication

by

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2018-19

CERTIFICATE

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This is to certify that the project entitled **"A Data Fusion Based Fire Alarm System"** is a bonafide work of **Zaid Siddique (16DET131), Zeeshan Siddiqui (15DET132), Zaid Pawaskar (15DET71), Chetan Sawant (14ET36)** submitted to the University of Mumbai in partial fulfillment of the requirement for the award of the degree of Bachelor of Engineering in Department of Electronics and Telecommunication Engineering.

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Supervisor	Examiner
____________________	____________________
Head of Department	Director

Project Report Approval for Bachelor of Engineering

This project entitled **"A Data Fusion Based Fire Alarm System"** by **Zaid Siddique, Zeeshan Siddiqui, Zaid Pawaskar, Chetan Sawant** is approved for the degree of **Bachelor Engineering in Electronics and Telecommunication** .

Examiner

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Supervisor

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Declaration

I declare that this written submission represents my ideas in my own words and where others ideas or words have been included, I have adequately cited and referenced the original sources. I also declare that I have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in my submission. I understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

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Abstract

In this project automatic fire detection through multiple types of sensors are Flame sensor, Gas sensor, Temperature sensor is implemented. The main purpose of these project is to build a system which not only detect fire but also identify false fire. To execute it a important techniques is used here Data Fusion. Multi-sensors differentiate changes in environment and gives this in- formation to data fusion which finds whether the detected fire is genuine or fake and if the risk is genuine then there will be an immediate action by water pump which will reduce the risk of spreading of fire. In fatal and dangerous situation like fire a quick and early warning plays an important role ,unlike conventional system this system will respond on time and will send an early message to firefighters and building occupants about the occurrence of fire with the help of GSM.

Keyword: Flame Sensor, Gas Sensor, Temperature Sensor, GSM, Arduino.

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Chapter 1

Introduction

1.1 Introduction

The biggest challenge today is to provide better detection of fire and better differentiation during the change of environment and also to find whether the fire detected is not false. Fires are the accidents which occur most frequently, every now and then we get to hear about fatal incident and the damage cause by it. Unfortunately your home is the place where accidents are most likely to occur. Everyone should be aware of the dangers in the home so that accidents can be avoided. Fires can start suddenly and spread quickly, damaging your home and furniture and putting lives in danger. Prevention of such incident is always better by taking simple precautions but sometimes some uncertain situation can cause fire in unpredictable way. Fire can be because of many reason it might be because of leakage in domestic gas or short circuit in electrical connection or any electrical equipment, fireworks. This project mainly deals with the fire in small scale places like household or small shops and all other places where there is no installment of fire prevention system. We see high cost fire prevention and extinguishing system in many big industries and commercial places and high estates but we forget to install it in our homes, so building fire prevention system which is cost effective and moreover gives acute result is important that means avoiding any false alarm. The data available with the National Crime Records Bureau (NCRB) indicates that fire accidents of all types caused more than 1.13 lakh deaths from 2010 to 2014, at a staggering average of 62 deaths per day. Most number of deaths took place in Maharashtra (24293) accounting for 21.3 percentage of all the deaths.

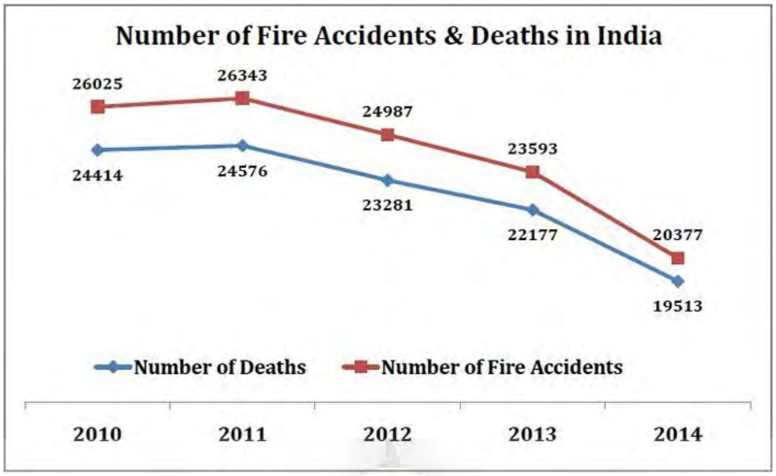


Figure 1.1: Number of Fire Incidents and Deaths

1.2 Project architecture:

Fire accidents can cause destruction of property and loss of lives therefore prevention and detection of fire plays an vital role. There are number of ways and techniques to detect fire but in this project we are specifically using sensors as it is gives effective result and is economically viable. Early fire detection system were not automated and were time consuming so in today's fast life and world where time plays an important role we are building the project which is automated and quick to distinguish the change in environment. The rise of false alarm have been increasing in today's time and it is very important to tackle this issue as this is having serious pernicious impact on fire operators and also there is loss of resource due to this. Fire accident creates hustle and bustle in the place of its occurrence as its residents do not know the exact location of fire. This might create confusion and panic which may ensue stampede of people therefore knowing the exact location of fire is very important. And this project deals with all the thing mentioned above.

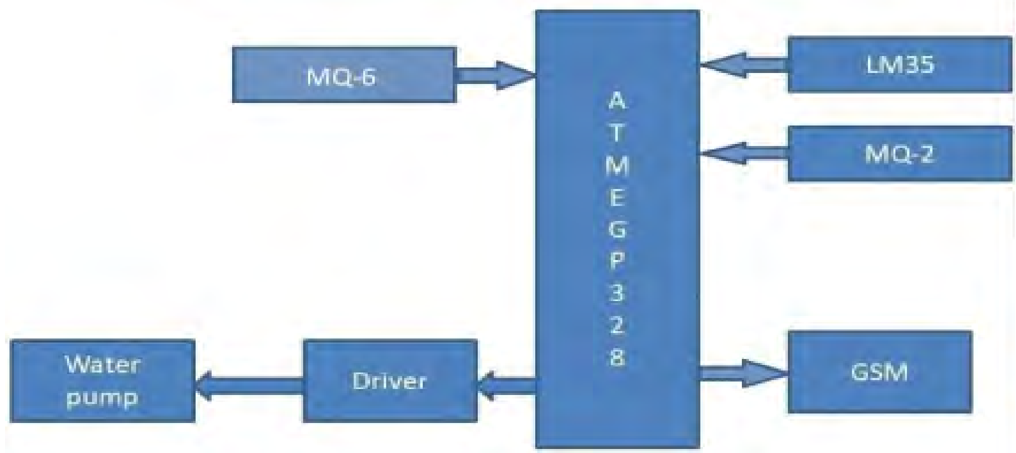


Figure 1.2: block diagram

1.3 Motivation:

There have been continuous increase in fire accident and loss in property and lives which brings us to build the fire detection system which is more reliable and quicker in informing the occupants about the occurrence of fire. It is also found that there has been increase in false alarm, as the early system is not able to differentiate real and fake fire which results in problem for the fire operators and create unwanted panic in the place.

1.4 Objective Scope:

The objective of this project is to replace manual conventional system with automatted and early warning system. This will provide benefit to the fire service provider which gives them real time information about the occurrence of fire and also to the occupants as they can be deposited to the safe place as early as possible.

1.5 Report organization:

Chapter 1 consist of introduction about the project and architecture of the project.

Chapter 2 consist of the literature survey of the project.

Chapter 3 consist of the basic concept of the project which is data fusion, GSM module, arduino and all the sensors used that are smoke ,heat and flame sensor.

Chapter 4 consist of proposed methodology that is flow chart and its algorithm.

Chapter 5 consist of result of the outcome of the project.

Chapter 6 consist of conclusion and future scope of the project.

Chapter 7 consist of the bibliography.

Chapter 2

Literature Survey

2.1 Fire Detection Mechanism using Fuzzy Logic:

The Study of **Vikshant Khanna from Department of CSE IT Lovely Professional University, India** and **Rupinder Kaur Cheema from Department of CSE IT Lovely Professional University, India** shows that research in wireless sensor networks (WSNs) has experienced a significant growth in recent years. One topic of special interest is the use of WSNs in the detection of forest fire as it is a common disastrous phenomenon that constitutes a serious threat. Numerous detection mechanisms are available for forest fire in the literature using wireless sensor networks and other methods. The work presented in this paper expresses the idea of implementing Fuzzy Logic on the information collected by sensors. This collected information will be passed on to the cluster head using Event Detection mechanism. Thus multiple sensors are used for detecting probability of fire as well as direction of fire. Each sensor node consists of multiple sensors that will sense temperature, humidity, light and CO density for calculating probability of fire and azimuth angle for calculating the direction of fire. It will improve accuracy of the detection system, as well as reduce the false alarm rate.

2.2 Multi-Sensor Fuzzy Data Fusion Using Sensors with Different Characteristics.

This paper by **Amin Ahmad Akhoundi , Ehsan Valavi** proposes a new approach to multi sensor data fusion, suggesting by considering information about the sensors different characteristics, aggregation of data acquired by individual sensors can be done more efficient. Same as the most effective sensors characteristics, especially in control systems,the focus is on sensors accuracy and frequency response. A rule based fuzzy system is presented for fusion of raw data obtained from the sensors having complement characteristics in accuracy and bandwidth. Furthermore, a fuzzy predictor system is also suggested aiming to extremely high accuracy for highly sensitive applications. The great advantages of the proposed sensor fusion system are revealed on simulation results of a control system utilizing the fusion system for output estimation.

2.3 Automatic Fire Detection: A Survey from Wireless Sensor Network Perspective:

This article by **M. Bahrepour, Nirvana Meratnia, Paul J.M. Havinga** shows

automatic fire detection is important for early detection and promptly extinguishing fire. There are ample studies investigating the best sensor combinations and appropriate techniques for early fire detection. In the previous studies fire detection has either been considered as an application of a certain field (e.g., event detection for wireless sensor networks) or the main concern for which techniques have been specifically designed (e.g., fire detection using remote sensing techniques). These different approaches stem from different backgrounds of researchers dealing with fire, such as computer science, geography and earth observation, and fire safety. In this report we survey previous studies from three perspectives:fire detection techniques for residential areas, fire detection techniques for forests, and (3) contributions of sensor networks to early fire detection.

2.4 An Intelligent Fire Detection and Mitigation System Safe from Fire (SFF)

Safe From Fire (SFF) paper by **Md Iftekharul Mobin , Md Abid-Ar-Rafi , Md Neamul Islam , and Md Rifat Hasan** is an intelligent self controlled smart fire ex- tinguisher system assembled with multiple sensors, actuators and operated by micro-controller unit (MCU). It takes input signals from various sensors placed in different position of the monitored area, and combines integrated fuzzy logic to identify fire breakout locations and severity. Data fusion algorithm facilitates the system to discard deceptive fire situations such as: cigarette smoke, weld- ing etc. During the fire hazard SFF notifies the fire service and oth- ers by text messages and telephone calls. Along with ringing fire alarm it announces the fire affected locations and severity.

2.5 Real-Time Identification of Smoldering and Flaming Combustion Phases in Forest Using a Wireless Sensor Network-Based Multi-Sensor System and Artificial Neural Network.

This study by **Xiaofei Yan 1, Hong Cheng 2, Yandong Zhao 1,*, Wenhua Yu 1, Huan Huang 1 and Xiaoliang Zheng** attempts to real-time identify different combustion phases using a developed wireless sensor network (WSN)-based multi-sensor system and artificial neural network (ANN). Sensors (CO, CO2, smoke, air temperature and relative humidity) were integrated into one node of WSN. An experiment was conducted using burning materials from residual of forest to test responses of each node under no, smoldering-dominated and flaming-dominated combustion conditions. The results showed that the five sensors have reasonable responses to artificial forest fire. To reduce cost of the nodes, smoke, CO2 and temperature sensors were chiefly selected through correlation analysis. For achieving higher identification rate, an ANN model was built and trained with inputs of four sensor groups: smoke; smoke and CO2; smoke and temperature; smoke, CO2 and temperature.

Chapter 3

Basic concept

3.1 Data fusion:

Data fusion is getting the information from different sources and combining it to get the more accurate result which cannot be obtained from single source. In this project we use multiple sensors to obtain the result, the reading of this multiple sensors like flame, gas and temperature are combine in multi-sensor data fusion technique which can overcome the high occurrence.

If one of these sensor gets high this technique will check the other sensors whether they are high or not. If all the sensors are high then it will understand that there is occurrence of fire and it will inform the stranded people about the occurrence of fire and it will sprinkle water automatically. Data fusion is a method of integrating data. What sets it apart from other approaches is that it is a respondent-level matching of data sets: respondents from one survey are paired with respondents from another survey. The matching uses the common characteristics of the two surveys; these are usually demographic (household and persons characteristics), geographical, media and any other relevant information.

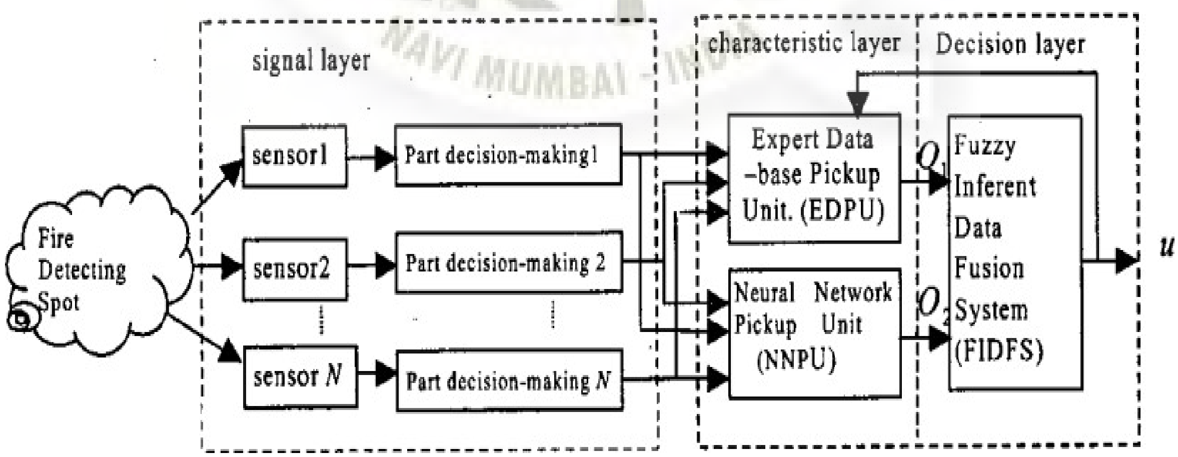
Data fusion is the process of getting data from multiple sources in order to build more sophisticated models and understand more about a project. It often means getting combined data on a single subject and combining it for central analysis.

Safe From Fire (SFF) is an intelligent self controlled smart fire extinguisher system assembled with multiple sensors, actuators and operated by micro-controller unit (MCU). It takes input signals from various sensors placed in different position of the monitored area, and combines integrated fuzzy logic to identify fire breakout locations and severity. Data fusion algorithm facilitates the system to discard deceptive fire situations such as: cigarette smoke, welding etc.

During the fire hazard SFF notifies the fire service and others by text messages and telephone calls. Along with ringing fire alarm it announces the fire affected locations and severity. To prevent fire from spreading it breaks electric circuits of the affected area, releases the extinguishing gas pointing to the exact fire locations. This paper presents how this system is built, components, and connection diagram and implementation logic. Overall performance is evaluated through experimental tests by creating real time fire hazard prototype scenarios to investigate reliability. It is observed that SFF system demonstrated its efficiency most of the cases perfectly

Data fusion technology is a new method in fire detecting to improve detecting precision, eliminate infection of disturbance, overcome time-varying and aging etc. Structure model of data fusion is usually classified as parallel, serially, detract and tree-like type . In this system the parallel and distributed structure shown in is used.

The fire detecting system has three data fusion layers: the signal layer, the characteristic layer and the decision layer. The signal layer collects and processes the data primarily at a fore spot. The characteristic layer picks up the fire characteristic of the data from the first layer. The decision layer fuses the various fire characteristics from the second layer and makes a decision of fire probability.



To obtain a set of entire and effective detecting signals, diverse type of fire sensors is needed. At a fire spot, determining the kind and number of fire sensors is an important factor. A lot of experiments shows that, in general condition, CO density in air is very low. When a fire breaks out, a vast amount of CO can be produced only and the CO density in air is increased urgently. So the change of CO density will reflect a burn phenomenon and course of fire in a great extent. In addition fire phenomenon also goes with the increasing of temperature and smoke density. So CO density, smoke density and temperature are usually used as fire detecting parameters.

Part decision-making unit in first layer completes the analyses of detecting data from single sensor. Based on the fact that the around temperature rise very fast and CO and smoke density strengthen greatly when a fire breaks out, we use the rate-surveying algorithm to find a valid fire signal. That is, whether the change rate of the three parameters exceeds a given value helps us judge whether there is any effective fire signal. The detailed algorithm is described:

Define a sum function a(k) as:

$\alpha i(k)=\{\alpha i(k-1)+1,0,ifXi(k)-Xi(k-1)\geq GiifXi(k)-Xi(k-1)<Gi$…………..(1)

where $Xi(k)$ is the k-th sample and $Xi(k-1)$ is the (k-l)-th sample of the i-th type of sensors; Gi is a given signal varying threshold. And $\alpha i(0)=0$.

The output of the part decision-making Yi(k) is

$Yi(k)=U[ai(k)-\theta ilim]$…………………………………………………………….(2)

where U(□) is a unit step function and θtlim is a given over-limit number.

If any output of the part decision-making Yi(k)(k=1,2,3) is one, it indicates that one of the fire detecting signals appears in non-stable state. In this case, it can be considered as an effective fire signals.

The characteristic layer in this system extracts the fire characteristics of the data sent from the signal layer by means of the expert-database pickup unit (EDPU) and the neural network pickup unit (NNPU). A lot of fire experts' experience data are stored in the EDPU. We may lookup the expert database based on the three fire signals from the signal layer to obtain the corresponding fire experience characteristic. For the fire data existed in the expert database, the EDPU is able to give a high precise probability. But for the data without any information in the expert database, their fire experience probability may have a greater error. Considering the non-structure behavior of the fire data and the non-linear mapping between detecting parameters and the fire process, to match the fire characteristic by neural network technology will show a grate advantage. So for those data, the data-fitting characteristic will be extracted by the NNPU.

The decision layer in the fire data fusion system is implemented by using fuzzy inference technology. It sends the fire data characteristic obtained by the NNPU and the experience characteristic output from the EDPU to a fuzzy inference fusion system, where they are fused. The fuzzy system is capable of processing unsure information and implements the fusion inference in terms of the two characteristics to obtain the final system output. A fuzzy system makes as similar an inference as a human being does, thus greatly reducing the rate of wrong alarms.

3.2 G.S.M technology:

GSM is used for communication between computer and GSM system. 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 same as mobile phones for their identification. Here we are using GSM SIM300,it is called GSM SIM300 because it works on 300MHz.We are interfacing this GSM module with Arduino Uno R3 and whenever the fire is detected it will send text message to fire service provider and the occupants of the building or management about the fire. We can send message and call as well because we get so many messages everyday so one can ignore the message so we are here providing call facility to the stranded people.

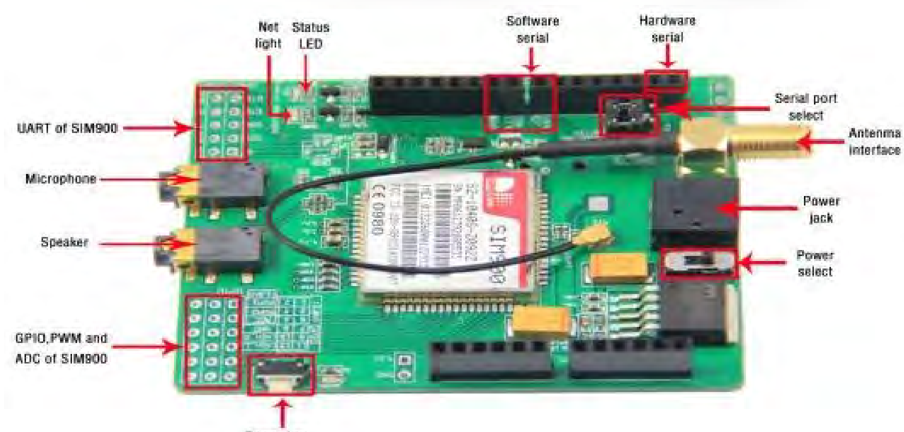


Figure 3.2: GSM SIM300 Module

3.3 Arduino Uno R3:

The Arduino Uno R3 is a microcontroller board based on a removable, dual-inline package (DIP) ATmega328 AVR microcontroller. It has 20 digital input/output pins (of which 6 can be used as PWM outputs and 6 can be used as analog inputs). Programs can be loaded on to it from the easy-to-use Arduino computer program. The Arduino has an extensive support community, which makes it a very easy way to get started working with embedded electronics. The R3 is the third, and latest, revision of the Arduino Uno.

Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online. You can tell your board what to do by sending a set of instructions to the microcontroller on the board. Over the years Arduino has been the brain of thousands of projects, from everyday objects to complex scientific instruments.

A worldwide community of makers - students, hobbyists, artists, programmers, and professionals has gathered around this open-source platform, their contributions have added up to an incredible amount of accessible knowledge that can be of great help to novices and experts alike. Arduino was born at the Ivrea Interaction Design Institute as an easy tool for fast programming. As soon as it reached a wider community, the Arduino board started changing to adapt to new needs and challenges, differentiating its offer from simple 8-bit boards to products for lot applications, wearable, 3D printing, and embedded environments.

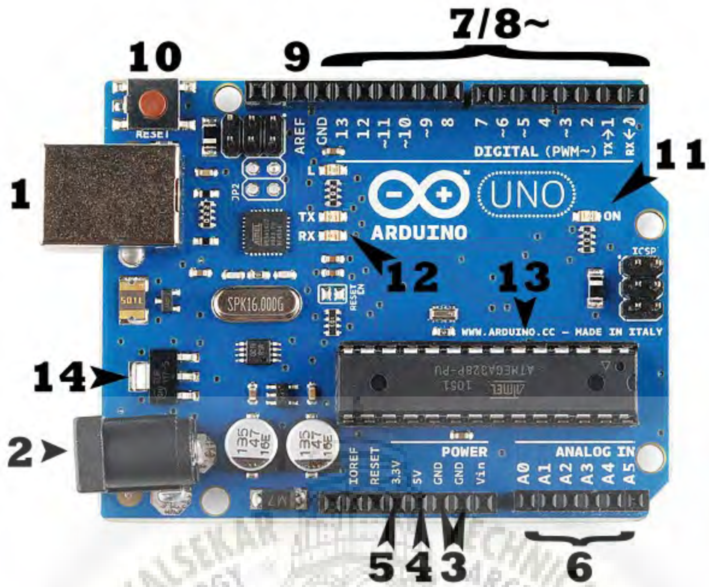


Figure 3.3: Arduino uno R3

GND (3): Short for Ground. There are several GND pins on the Arduino, any of which can be used to ground your circuit.

5V (4) 3.3V (5): As you might guess, the 5V pin supplies 5 volts of power, and the

3.3V pin supplies 3.3 volts of power. Most of the simple components used with the Arduino run happily off of 5 or 3.3 volts.

Analog (6): The area of pins under the Analog In label (A0 through A5 on the UNO) are Analog In pins. These pins can read the signal from an analog sensor (like a temperature sensor) and convert it into a digital value that we can read.

Digital (7): Across from the analog pins are the digital pins (0 through 13 on the UNO). These pins can be used for both digital input (like telling if a button is pushed) and digital output (like powering an LED).

(PWM).We have a tutorial on PWM, but for now, think of these pins as being able to simulate analog output (like fading an LED in and out).

AREF (9): Stands for Analog Reference. Most of the time you can leave this pin alone. It is sometimes used to set an external reference voltage (between 0 and 5 Volts) as the upper limit for the analog input pins.

Reset Button

Just like the original Nintendo, the Arduino has a reset button (10). Pushing it will temporarily connect the reset pin to ground and restart any code that is loaded on the Arduino. This can be very useful if your code doesn’t repeat, but you want to test it multiple times. Unlike the original Nintendo however, blowing on the Arduino doesn’t usually fix any problems. Power LED Indicator

Just beneath and to the right of the word UNO on your circuit board, there’s a tiny

LED next to the word ON (11). This LED should light up whenever you plug your Arduino into a power source. If this light doesn’t turn on, there’s a good chance something is wrong. Time to re-check your circuit! TX RX LED’s
TX is short for transmit, RX is short for receive. These markings appear quite a bit in electronics to indicate the pins responsible for serial communication. In our case, there are two places on the Arduino UNO where TX and RX appear once by digital pins 0 and 1, and a second time next to the TX and RX indicator LED’s (12). These LED’s will give us some nice visual indications whenever our Arduino is receiving or transmitting data (like when were loading a new program onto the board). The black thing with all the metal legs is an IC, or Integrated Circuit (13). Think of it as the brains of our Arduino. The main IC on the Arduino is slightly different from board type to board type, but is usually from the AT mega line of IC’ from the ATMEL company. This can be important, as you may need to know the IC type (along with your board type) before loading up a new program from the Arduino software. This information can usually be found in writing on the top side of the IC. If you want to know more about the difference

between various ICs, reading the datasheets is often a good idea. Voltage Regulator

The voltage regulator (14) is not actually something you can (or should) interact with on the Arduino. But it is potentially useful to know that it is there and what its for. The voltage regulator does exactly what it says it controls the amount of voltage that is let into the Arduino board.

3.4 Gas sensor:

The Grove - Gas Sensor(MQ2) module is useful for gas leakage detection (home and industry). It is suitable for detecting H2, LPG, CH4, CO, Alcohol, Smoke or Propane. Due to its high sensitivity and fast response time, measurement can be taken as soon as possible. The sensitivity of the sensor can be adjusted by potentiometer. There are 4 kinds of gas sensors, every can detect different type of gas, here we use a table to illustrate.

Sensor	Gas Type
MQ2	Combustile Gas
MQ3	Alcohol Vapour
MQ5	LPG, Natural Gas
MQ9	Carbon Monoxide

Types of Gas sensors

Figure 3.4: Gas Sensor MQ2

3.5 Flame Sensor MQ6:

This semiconductor gas sensor detects the presence of LPG, isobutane, and propane at concentrations from 300 to 10,000 ppm. The sensors simple analog voltage interface requires only one analog input pin from your microcontroller or arduino. This propane gas sensor detects the concentrations of LPG, isobutane, and propane in the air and ouputs its reading as an analog voltage. The sensor can measure concentrations of 300 to 10,000 ppm. The sensor can operate at temperatures from -10 to 50C and consumes less than 150 mA at 5 V. During the ignition sequence, your gas furnace undergoes a process where either a spark or a hot surface igniter will actually ignite the gas. As the gas is ignited, the flame sensor creates a current of electricity. The electricity is quantified in micro amps. If the furnaces control board doesn’t read the proper level of micro amps, the furnace will quit giving the system fuel to stop an explosion.

Figure 3.5: Flame Sensor MQ6

3.6 Temperature Sensor:

The LM35 is an integrated circuit sensor that can be used to measure temperature with an electrical output proportional to the temperature (in C).It can measure temperature more accurately than a using a thermistor. The sensor circuitry is sealed and not subject to oxidation. The LM35 generates a higher output voltage than thermo couples and may not require that the output voltage be amplified. The LM35 has an output voltage that is proportional to the Celsius temperature. The scale factor is .01V/C. The LM35 does not require any external calibration or trimming and maintains an accuracy of +/-0.4C at room temperature and +/-0.8C over a range of 0C to +100C.Another important characteristic of the LM35 is that it draws only 60 micro amps from its supply and possesses a low self-heating capability. The LM35 comes in many different packages such as TO-92 plastic transistor-like package,T0-46 metal can transistor-like package,8-lead surface mount SO-8 small outline package.

Figure 3.6: Temperature Sensor LM35

3.7 Servo Motor:

A servomotor is a rotary actuator or linear actuator that allows for precise control of angular or linear position, velocity and acceleration. It consists of a suitable motor coupled to a sensor for position feedback. It also requires a relatively sophisticated controller, often a dedicated module designed specifically for use with servomotors. Servomotors are not a specific class of motor although the term servomotor is often used to refer to a motor suitable for use in a closed-loop control system. Servomotors are used in applications such as robotics, CNC machinery or automated manufacturing. The servo motor is a closed-loop servomechanism that uses position feedback in order to control its rotational speed and position. The control signal is the input, either analog or digital, which represents the final position command for the shaft. A type of encoder serves as a sensor, providing speed and position feedback. In most cases, only the position is reported. The final position is reported to the controller and this is compared to the initial position input, and then if there is a discrepancy, the motor is moved in order to get to the correct position.

Figure 3.7: Servo Motor

3.8 Buzzer:

A buzzer or beeper is an audio signalling device, which may be mechanical, electro mechanical, or piezoelectric (piezo for short). Typical uses of buzzers and beepers include alarm devices, timers, and confirmation of user input such as a mouse click or keystroke.

Figure 3.8: Buzzer

3.9 Sprinkler: A fire sprinkler or sprinkler head is the component of a fire sprinkler system that discharges water when the effects of a fire have been detected, such as when a predetermined temperature has been exceeded. Fire sprinklers are extensively used worldwide, with over 40 million sprinkler heads fitted each year. In buildings protected by properly designed and maintained fire sprinklers, over 99 percentage of fires were controlled by fire sprinklers alone.and PCs. It has power regulation, SIM holder and external antennas.

Features of GSM:

Uses SIM300 GSM module transmission.

Operating Voltage: 7 15V AC or DC (board has onboard rectifier.

Comes with an onboard wire antenna for better reception.

Can be used for Data/Fax, GSM based Voice communications, TCP/IP stack.

SIM300 allows an adjustable serial baud rate from 1200 to 115200 bps(9600).

Provides RS232 interface for connection to computers and other devices.

3.11 Software

Diptrace

DipTrace is an EDA/CAD software for creating schematic diagrams and printed circuit boards. The developers provide a multi-lingual interface and tutorials (currently available in English and 21 other languages). DipTrace has 4 modules: schematic capture editor, PCB layout editor with built-in shape-based autorouter and 3Dpreview export, component editor, and pattern editor.

Version history

Version 3.0

Differential pairs: define differential pair and its rules; automatic or manual defining of paired pads; paired routing and editing of differential pair; single-track differential pair routing and editing; phase tune tool (place custom / regular size meanders); real-time control of phase and length tolerance; differential pair manager; support of differential pairs for external autorouters, recognition of paired traces. Custom user-defined keyboard shortcuts for tools and dialogs. ODB++ (version 7.0) manufacturing output. Gerber X2 manufacturing output. DRC rule details (easy editing of routing constraints). Tree view of 3D models in All Models list, sorted by categories (folders). Overall speed and memory optimization for large designs.

Optimized UI fonts. 8143 new components. 5694 new STEP models for 3D.

Version 3.2

Length matching rules. Real-time length comparison table. Layer stackup table. Using layer stackup and pad signal delay for trace length and differential pair phase calculation. Meander tool for any trace, easy resizing and moving of meanders. DRC same net clearance check (Trace to Trace, SMD to Pad, SMD to Via, SMD to SMD). Altium ASCII import (Schematic, PCB, libraries). Eagle XML import (Schematic, PCB, libraries).

Basic features Simple user interface

Multi-sheet and hierarchical schematics

High-speed and Differential signal routing

Smart manual routing modes

Wide import / export capabilities

High-speed shape-based autorouter

Advanced verifications with real-time DRC

Real-time 3D PCB preview

Export of PCB to STEP 3D file format

ODB++ and gerber (including Gerber X2) manufacturing outputs

PCB Layout in DipTrace

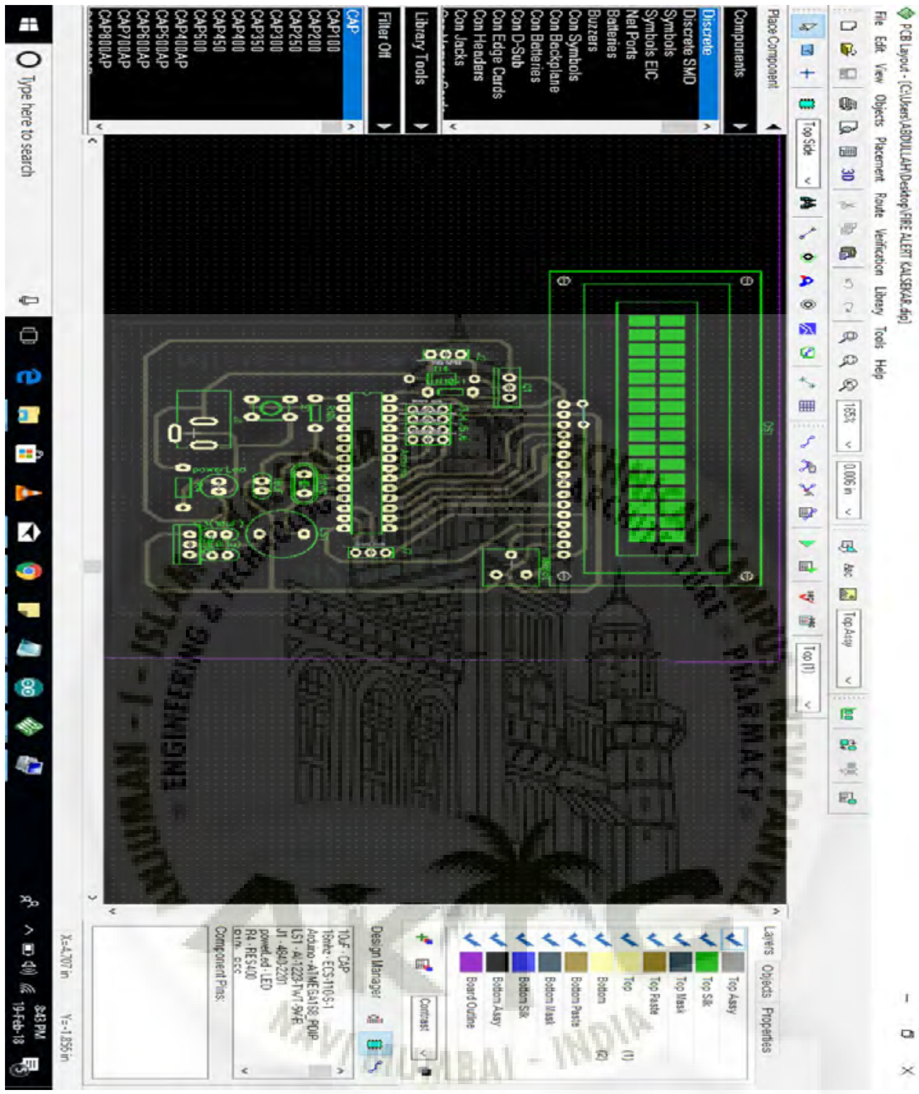


Figure 3.11.a: PCB Layout 1

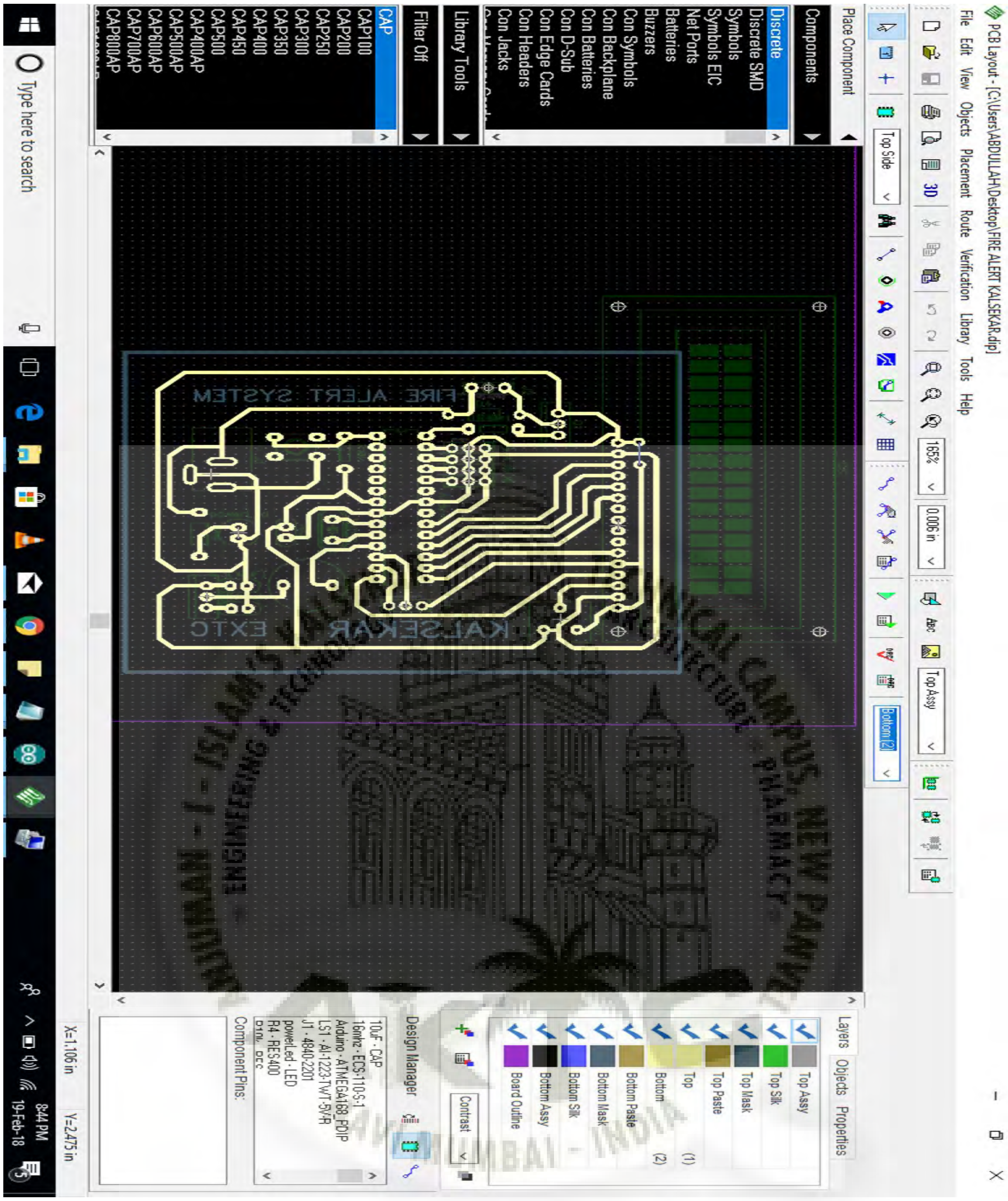


Figure 3.11.b: PCB Layout 2

Arduino IDE (Integrated Development Environment)

The Arduino Integrated Development Environment - or Arduino Software (IDE) contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino and Genuino hardware to upload programs and communicate with them.

Figure 3.11.c : Arduino IDE

Programs written using Arduino Software (IDE) are called sketches. These sketches are written in the text editor and are saved with the file extension .ino. The editor has features for cutting/pasting and for searching/replacing text. The message area gives feedback while saving and exporting and also displays errors.

Tools

Auto Format

This formats your code nicely: i.e. indents it so that opening and closing curly braces line up, and that the statements inside curly braces are indented more.

Archive Sketch

Archives a copy of the current sketch in .zip format. The archive is placed in the same directory as the sketch.

Fix Encoding Reload Fixes possible discrepancies between the editor char map encoding and other operating systems char maps.

Serial Monitor

Opens the serial monitor window and initiates the exchange of data with any connected board on the currently selected Port. This usually resets the board, if the board supports Reset over serial port opening.

Board

Select the board that you're using. See below for descriptions of the various boards.

Port

This menu contains all the serial devices (real or virtual) on your machine. It should automatically refresh every time you open the top-level tools menu.

Programmer

For selecting a hardware programmer when programming a board or chip and not using the on board USB-serial connection.
Normally you won't need this, but if you're burning a boot loader to a new microcontroller, you will use this.

3.12 PCB Designing and Interfacing:

Printed circuit boards(PCB) are physical components of electrical devices. They are made up of board, which is typically resin or plastic, and solder, the conductive metal part that channel energy , usually made of copper. The solder makes the electrical connections between PCB and part of the device possible. there's also a screen layer on top of the board that indicates what goes where, like a road map. PCB don't just supply power; they also support mechanism of a device. That's because they not only route power, they route signals to different components. This is why a PCB acts like the brain of a device and a device cant function without it. There are numerous techniques and standard to design a PCB that is easy to manufacture and yet small and inexpensive. We went through following steps to design PCB circuit:
First we have designed the schematic of the diagram. A schematic is a crucial step before designing the board itself. A Schematic is like a road map for a circuit,containing series of symbols that represent aspects of the circuit:switches. resistors, diodes, nodes .this can helpful later for troubleshooting any issue with your PC.

After the circuit design is captured in a schematic, its translated into electronic design automation(EDA) software package like designer ,eagle Allegro. Here in this specific project we use Dip Trace design software .The design has to be exported into an industry standard format. The resulting file acts a set of instruction for the production phase of PCB.

Taking a printout of the PCB layout using a laser printer and A4 photo paper/glossy paper. while taking printout it should be mirror printout. Copper board which we are using here should be according to the size of layout, firstly

here we have to rub the copper side of PCB using steel wool or abrasive sponge scrubs. This removes the top oxide layer of the copper and also photoresist layer

,now there will be transferring of printed image from paper to board ,the transferring of the image is done by hot electric iron as we iron the printed image upside down to the copper side. The end result which we get here is: this process transfers the ink printed on the glossy paper to the copper plate .Now to separate the paper and copper board we use lukewarm water as it helps to loosen the paper and as the paper get soft we can peel it off from the copper board.

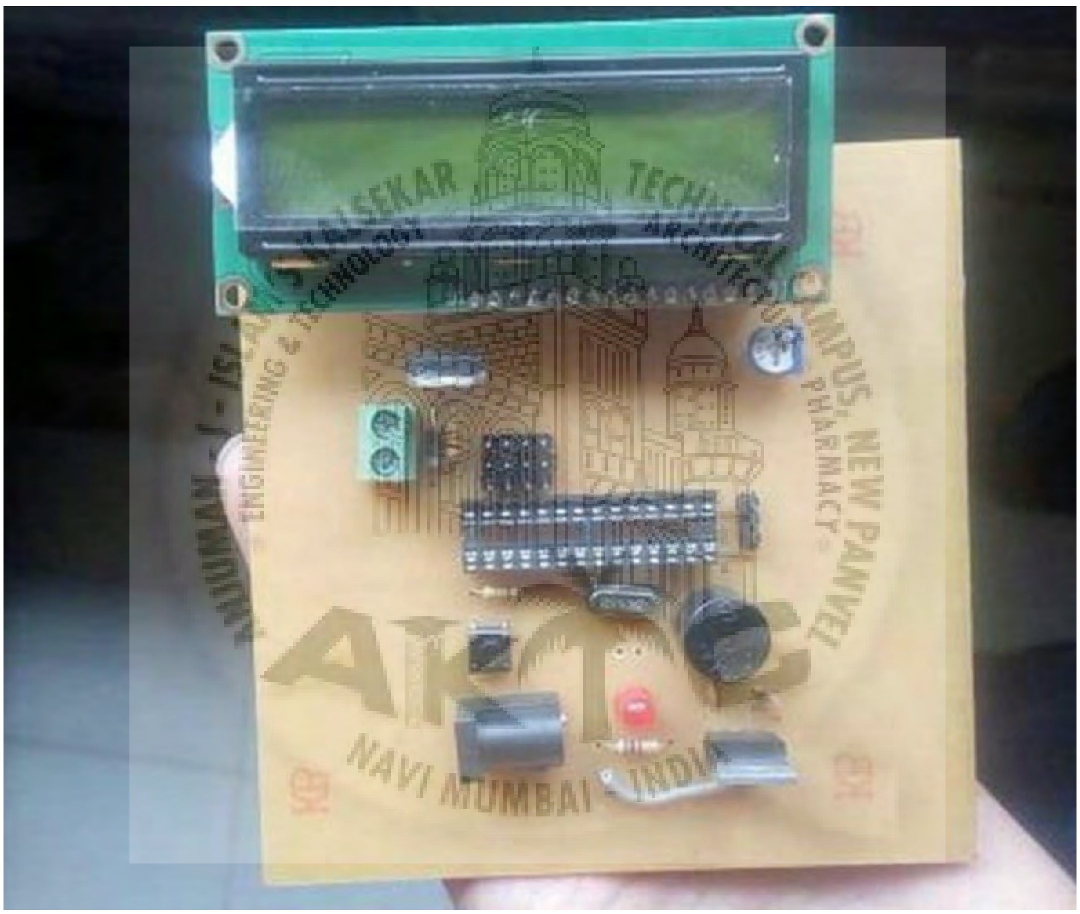


Figure 3.12 a: PCB(a)

4.now the next step is called Etching as we remove the unmasked/unwanted copper from the PCB. The solution which is used here is ferric chloride solution.

The future final steps to complete the PCB designing are drilling, components placement and soldering.

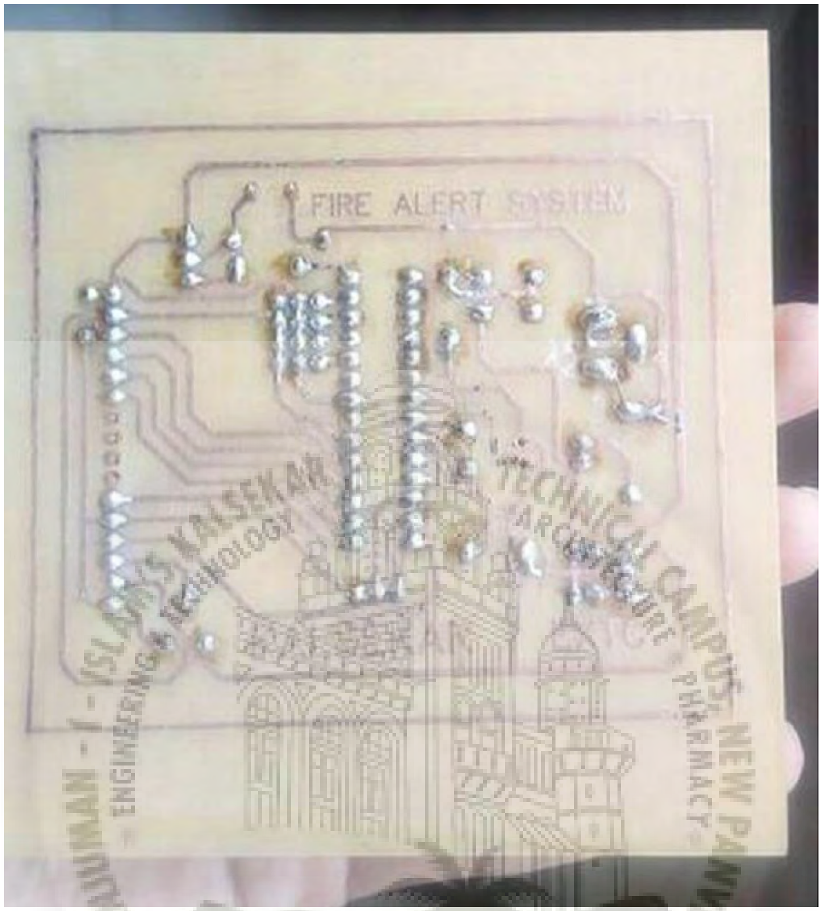


Figure 3.12 b: PCB(b)

Interfacing of PCB :

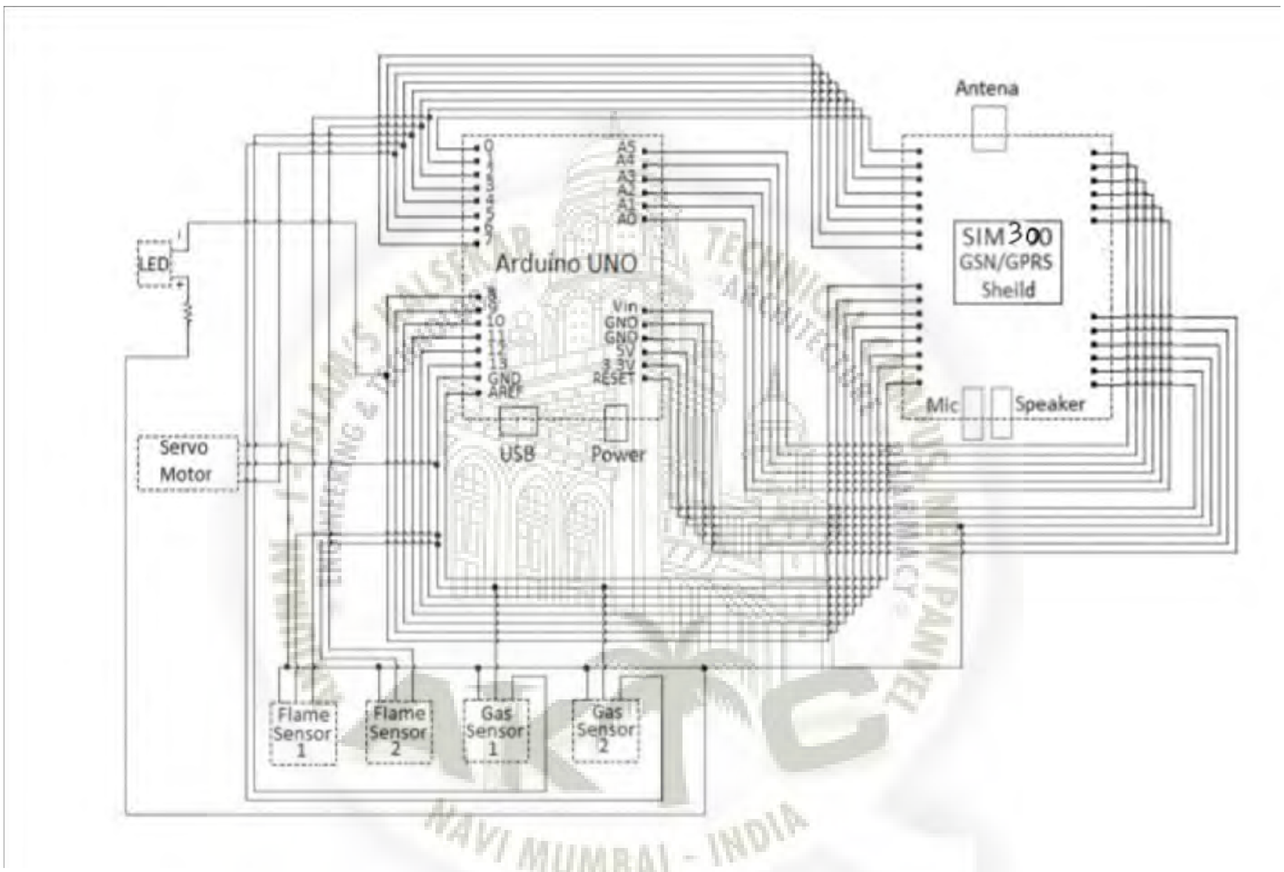


Figure 3.12.c: CIRCUIT DIAGRAM

Chapter 4

Proposed algorithm

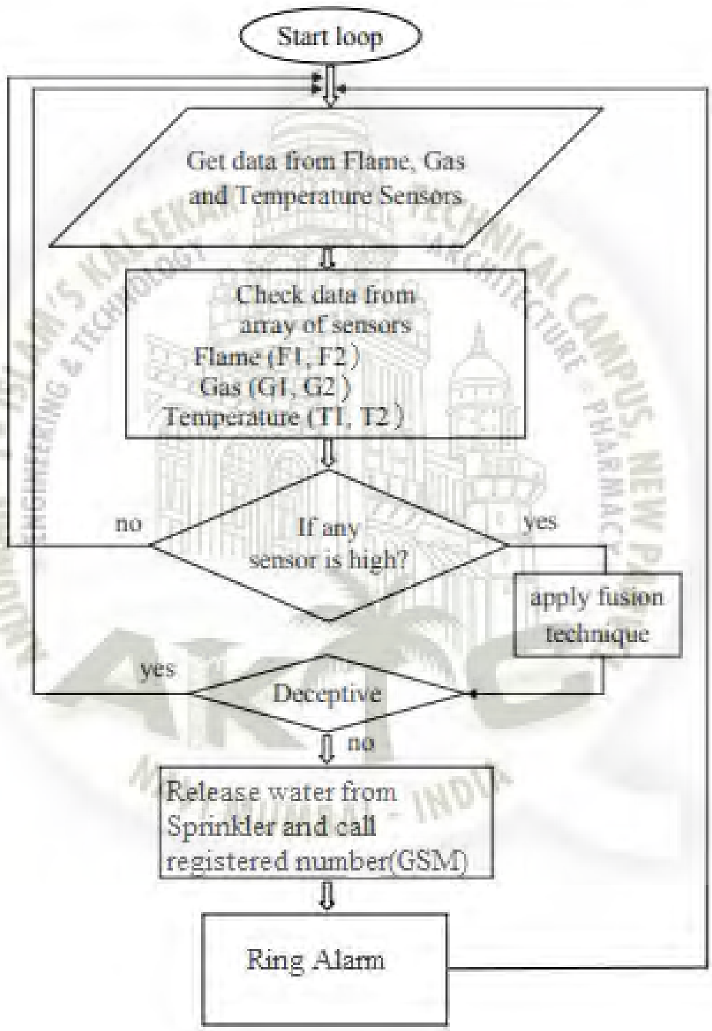


Figure 4.1: Flow Chart (figure 1)

Algorithm 1: Algorithm for the SFF system

```
Initialization: Assign sensors, servo pin and position
/*prepare array of sensor data*/
Flame[Flame SenNum] ⇐ {F1, F2,..., Fn}
Gas[Gas SenNum] ⇐ {G1, G2,..., Gn}
Temp[Temp SenNum] ⇐ {T1, T2,..., Tn}

Calibration: Initialize sensors and servo motor direction angle
while sensor value = high do
    LogData(Flame, Gas, Temp)    /*Save data*/
    D ⇐ DataFusion (Flame, Gas, Temp)
    if D == True then
        /*Save deceptive data*/
        SaveData(Flame, Gas, Temp)
        /*Send SMS from GSM module as warning*/
        SendTextMessage()
        break;
    end
    else
        RelayPinVolt ⇐ high    /*break circuit/*
        GasReleaseValvePinVolt ⇐ high    /*release fire
        extinguisher gas*/
        SendTextMessage()
        /*Call fire services and play predefined audio e.g. Fire,
        Fire .....*/
        DialVoiceCall()

        while !D = True && ( Flame[] = high || Gas[] = high ||
        Temp[] = high) do
            Alarm::ring()
            /*Cumulative result of all the sensors*/
            AnnounceFireSeverity() /*Announce location of all
            the sensors*/
            AnnounceFirelocation()
        end
    end
end
```

Since it is shown in the previous section several research papers have been published about fire detection and prevention system before. Compared to these system SFF is a complete package specified all the necessary jobs needs to be done during fire. Also it can detect deceptive fire. Similar to for the fire detection a group of sensors data are combined. These sensor have one smoke sensors, one flame sensors and one temperature sensors. Adaptive fusion method is used in each group for fire detection, and deceptive event isolation. A flow chart is shown in figure for the SFF system implementation. According to the flowchart an algorithm is written to explain how this system logic works. In this flowchart it is clearly revealed that three different types of sensors are used in SFF system implementation. One group of sensors is used for the flame detection purposes, F1, F2, ..., F n. Similarly for the gas detecting purpose gas sensors have been used, which are G1, G2, ..., Gn and so on for the temperature sensors T1, T2, ..., T n. At the beginning there is an infinite loop which checks whether there is any high value for any sensor in any place. After that it checks are there any sensor values high? If it does then it look for a set of values combined with flame, gas and temperature sensors. Adaptive fusion method is used here to determine the deceptive fire identification. An algorithm for the SFF system is shown below in algorithm 1. From that algorithm it is revealed that there is data logging functionality which provides the advantage to save data for future analysis of fire accident. This algorithm shows more clear and vivid outline of SFF system software program implementation logic. In this algorithm various Arduino library has been used. one of the example was using alarm library. Whenever fire is detected this library instance is called that generate a fire alarm sound using Alarm ring method see line number 24 in algorithm 1. Send Text Message and Dial Voice Call methods are included from GSM module. One of the significant constraints of SFF system is, this system needs to know exactly where the sensors are mounted or attached to detect the exact location of the fire spot. The location needs to predefined specified in angle between the fire extinguisher and adjacent sensors. From the adjacent angle between the sensors fuzzy logic determines the exact location of fire.

Then whenever the fire detected it sends SMS to fire services and building maintenance committee, releases fire extinguisher gas, ring alarms and announce severity. Severity is nothing but a cumulative counter of the numbers of sensors reading. If there are more sensors provide reading of fire then fire is spreading and growing intensively. From the mounted position in the building, SFF knows the sensor index and corresponding location of fire. The circuit diagram for the SFF system is shown in.This figure shows a abstract schematic diagram of SFF system implementation. The actual SFF circuit diagram contains more modules and components. To keep the schematic diagram drawing simple an abstract schematic view is shown here. It shows how the GPS SIM900 model shield is attached with main Arduino circuit diagram board, how the flame sensors, gas sensors and fire extinguisher motors are attached. Here, fire extinguisher relay temperature sensors, and gas extinguisher gas valve attachment are not shown which are included in SFF circuit prototype.

Chapter 5

Result & discussion

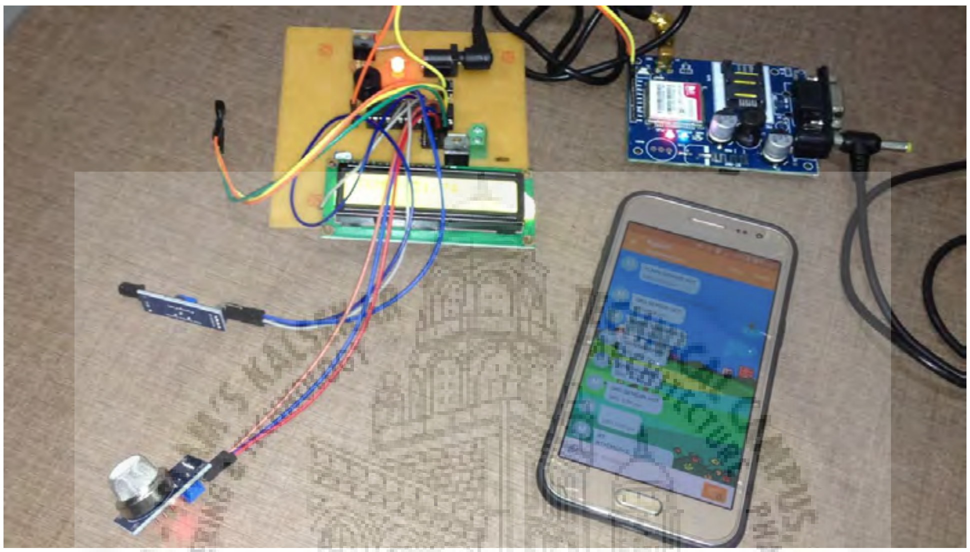


Figure 5.1: Project Result

After connecting all the components when we starts the project the display shows names of all the sensors connected that is smoke sensor, heat sensor , light sensor . We can also adjust the brightness of the display by rotating the notch at the side . Now we start testing each and every sensor . The temperature sensor triggers when the temperature goes beyond 50 degree . The smoke sensor triggers when there is 20% smoke in the surrounding of the sensor The sensor can operate at temperatures from -10 to 50C and consumes less than 150 mA at 5 V. The flame sensor triggers when the rays from the flame falls on the sensor . Now when we give input to one of the sensor there will be no action taken . When the input is given to two or more sensors the alarm will start ringing which is a buzzer in this project . A SMS will be send to the mobile phone of the responsible person and the fire station by the GSM module and the sprinkler will get started . There will be no action taken is only one sensor detects the change this could be a false alarm if there is actual fire all the three sensors will detect it or at least two will detect the change . The whole process is done by data fusion technique .

To do the experiments cigarette lighter has been used as a fire source. Whenever cigarette lighters are lighted it send signal and trigger fire incident.The fire detection module can transmit the decision results to mobile phone through the GSM module. The experimental results are shown in fig Since, it takes multiple reading sometimes actual fire can be determined as deceptive fire. However, since there is an warning alarm sending scheduler that sends deceptive occurrence hence ambiguous fire hazard scenarios also can be detected. By which fire monitoring or security committee can be aware and take precautions.

The fire detection a group of sensors data are combined. These sensor have one smoke sensors, one flame sensors and one temperature sensors. Adaptive fusion method is used in each group for fire detection, and deceptive event isolation.One group of sensors is used for the flame detection purposes, Similarly for the gas detecting purpose gas sensors have been used, which are and so on for the temperature sensors. At the beginning there is an infinite loop which checks whether there is any high value for any sensor in any place. After that it checks are there any sensor values high? If it does then it look for a set of values combined with flame, gas and temperature sensors.

Adaptive fusion method is used here to determine the deceptive fire identification. Arduino library has been used. one of the example was using alarm library. Whenever fire is detected this library instance is called that generate a fire alarm sound using Alarm ring method see line number 24 in algorithm. Send Text Message and methods are included from GSM module.

Chapter 6

Conclusion and Future Scope

6.1 Conclusion:

Fire is hazardous but it can be prevented as well as excellently managed by using proper system and technique.In India death's occurred due to fire are approx 62 deaths per day.This project is all-round package which gives you quick cost effective early warning system which not only detect fire but also distinguish between fake and genuine fire.And this system can be installed anywhere in buildings, colleges, school, offices,shops,malls and any public place where the chances of fire accident is high and ensure safety to innocent lives as well as property.Accuracy and speed of a measurement system highly affects the performance of control systems. If the feedback provided for a control system is not accurate and rapid enough, the system will fail to regulate the output properly. Choosing inappropriate sensors also may lead to the systems oscillation and even its instability. Because of the significant role of measurement systems in control applications, our focus for assessing the fusion method is on evaluation of response of the control system which uses it. As a benchmark we have chosen an inverted pendulum control system for evaluation of the proposed measurement system.

6.2 Future Scope:

The designed fire alarm system is simple but it has wide area of application in household and industrial safety, especially in developing countries. Using this system, quick and reliable alert response is possible to initiate preventive measures to avert danger of fire hazards and minimize losses of life and property.This is a cost-effective fire alarm system which performs reliably to ensure safety from fire, and can be installed in houses,industries, offices, ware-houses etc. very easily.One of the biggest issues in fire protection at the moment is false alarms. Not only is this clearly a waste of resources which diverts help from potential incidents of real need, but it also influences the fire policies of different fire brigades throughout the country.

Chapter 7

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