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FINAL YEAR PROJECT REPORT

On

"INTELLIGENT FIRE PROTECTION SYSTEM"

Submitted By

RISHAV GHOSH
[1DS17CS742]
ANIKET NANDI
[1DS17CS742]

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Under the guidance of
Dr. RAMYA
Associate Professor
Dept. of CSE
DSCE, Bangalore

Department of Computer Science and Engineering
Dayananda Sagar College of Engineering
Bangelore-78

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELGAUM
DAYANANDA SAGAR COLLEGE OF ENGINEERING

Shavige Malleshwara Hills, Kumaraswamy Layout, Bangalore-560078
Department of Computer Science & Engineering

CERTIFICATE

This is to certify that the seminar work entitled **"INTELLIGENT FIRE PROTECTION SYSTEM"** is a bonafide work carried out by Rishav Ghosh[1DS17CS742] and Aniket Nandi[1DS17CS706] in a partial fulfilment for the 8th semester of Bachelor of Engineering in Computer Science and Engineering of the Visvesvaraya Technological University, Belgaum during the year 2020-21. The seminar report has been approved as it satisfies the academic requirements in respect of Seminar Work prescribed for Bachelor of Engineering Degree.

Dr. Ramya (Internal Guide) Asst. Professor,	**Dr. Ramesh Babu** Vice Principal & Head of Department, CSE, DSCE	**Dr. C P S Prakash** Principal, DSCE
Signature:	Signature:	Signature: ....

Signature of Examiners with date

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2.

Acknowledgement

We have taken efforts in this project on Intelligent fire protection system. However, it would not have been possible without the kind support and help of many individuals and organizations.
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Rishav Ghosh
[1DS17CS742]
Aniket Nandi
[1DS17CS706]

ABSTRACT

The transformation that is happening in the building industry with the advancing in electronics, techs information communications and sensors. Many technologies that are new have emerged. The cost of operation is being significantly lowered while performance is improved thanks to digitalization. The extensive use of materials and technologies in buildings, the risk that fire causes to property and life is increasing. Many new fire detection and sensing technologies has been developed in recent years thanks to this. The priority of making of intelligent systems and buildings worldwide has been made high. The building of intelligence is equipped with info, instrumentation and communication technology that includes lights, smoke detection, monitoring of surroundings, management of power, building health management, cooling and heating, gas and water management, ventilation, and many more.

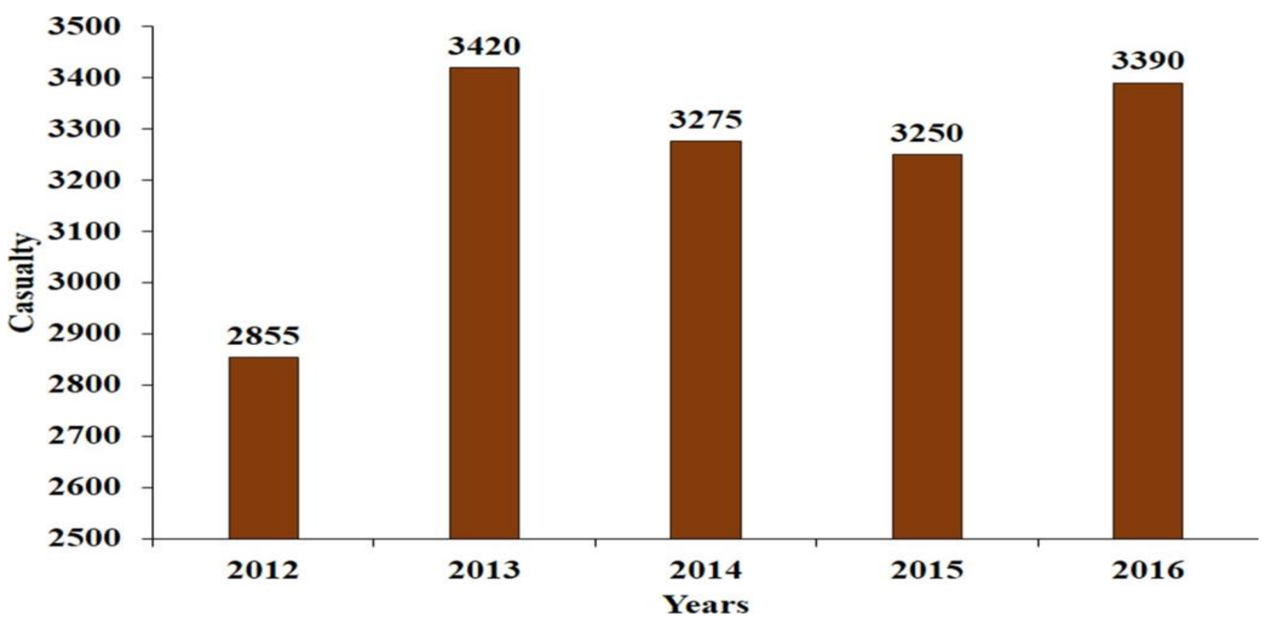
Safety of human life is the primary issue and should be prioritized over properties from man-made

disasters like fires. The international association of fire and rescue services (CTIF) reported approximately 16,190 casualties due to fire hazard in the United States, from 2012 to 2016. The ratio is very high in comparison to other reasons of casualty.

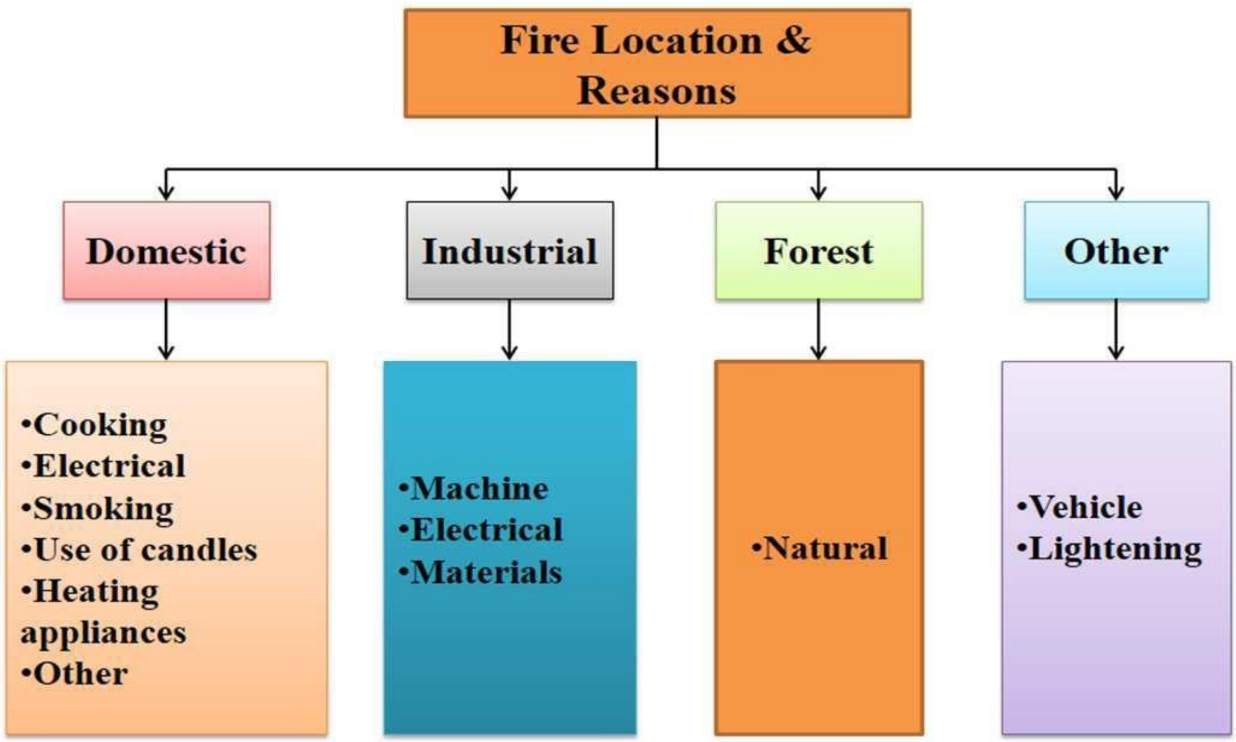
Contents

CHAPTER 1: INTRODUCTION

Fire hazards have the ability to cause loss of life along with a loss of huge amount of property, attracting the attention of many people. Thus many requirements with respect to fire safety have been pointed out by the people of our country. They issued legal documents to implement those requirements in respect to fire safety department. Due to that fact, the awareness levels displayed by people in regards to fire hazards has increased along with there knowledge. Thus many education departments have been provided to help with fire protection. Current smoke detectors still have many shortcomings and disadvantages. They have a lack of quality and efficiency and have an uneven and very small performance, limiting their usability to only alarm prompts. The short side of the stick is that these smoke detectors with their alarm prompts cannot be useful if people are not present at the moment of the fire hazard. The below figure represents the statistical data of casualty due to fire hazards for the United States, from 2012 to 2016. All these casualties are due to low awareness levels of the people in the fire safety department.

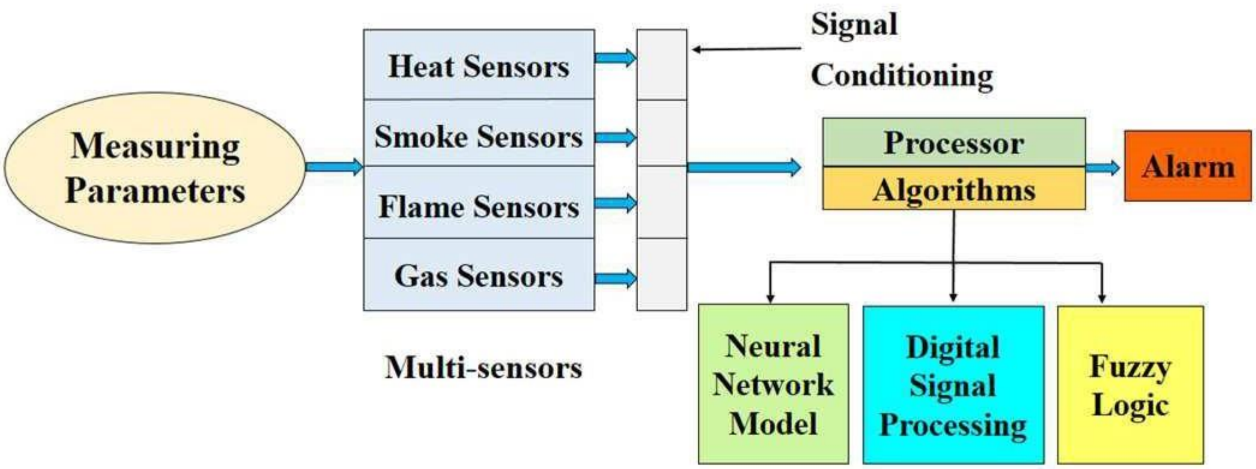


Among the sixteen different priority levels in a buildings of safety, fire safety stands out as the first priority level. Depending on the composition of oxygen, heat and fuel, fire hazard can be classified into different stages like ignition, decay, growth and fully developed. This has been defined by International Fire Service Training Association. Smoking, short circuit and cooking are some of the primary causes of fire hazards in every general building. The flow chart below represents the causes of fire hazards with respect to the environment. The major part of fire hazards worldwide has been shown to be happening due to electrical reasons with the sources being plugs, cords, panels, circuits, outlets and overloads. Short circuits can happen due to various reasons namely, improper electrical installations, arcs, and inefficient circuit breaker operations. Primary indicators for detecting fire are quality of air, heat, flame, and smoke. Recently, sensor actuator technology is very active in situations of real time fire measurement. Fire sensing and control done with sensor actuator technology is the main focus. **Reasons of fire with respect to location:**



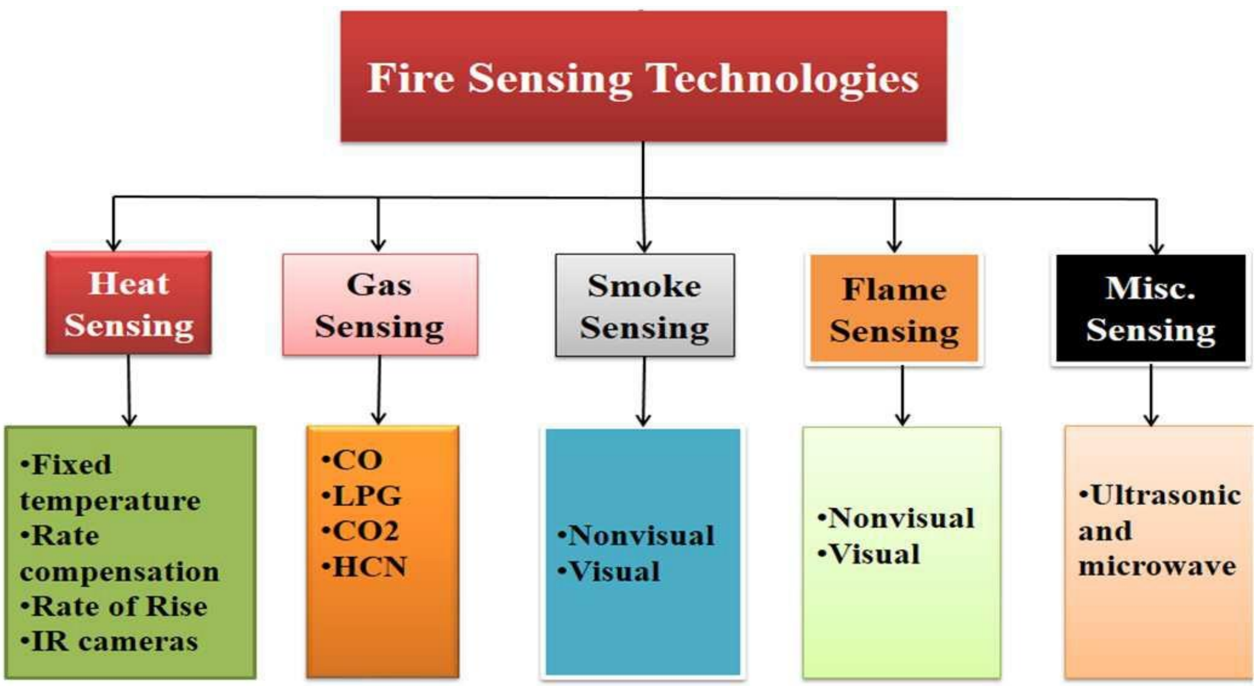
The current fire sensing technologies contains different parameters, sensor signal, an alarm, processing unit, an evacuation path display and sprinklers. The basis of control algorithms and methods are digital signal processing and neural network models. The below figure represents the current fire detection systems consisting of multi sensory method for fire detection. Proper signal conditioned output of these sensors is processed by processor. Fire is sensed and proper algorithm is applied, in case of fire hazard, the alarm will be activated.

Existing fire sensing system



FIRE SENSING TECHNOLOGIES

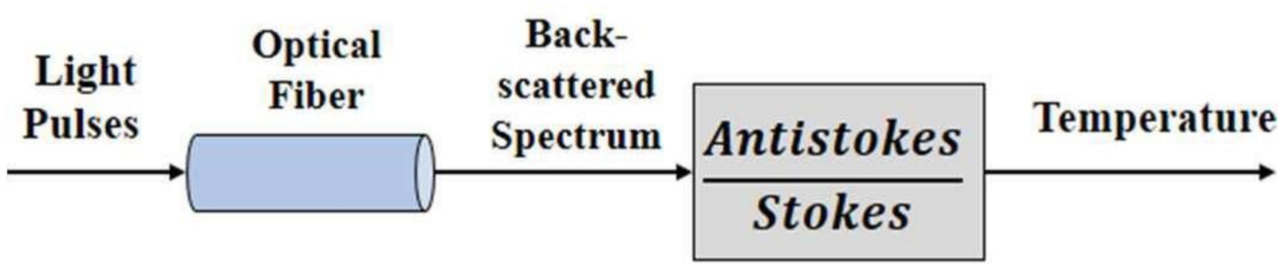
Depending upon the location and the state of the fire hazard the sensing techniques can be different. This review describes the technologies being tested along with its current use, advantages and disadvantages. Many types of fire sensing technologies have been developed over a long time. Some of them are being used currently and some are obsolete. Heat sensing, flame sensing, gas sensing, and smoke sensing along with miscellaneous fire sensing technologies are discussed. Thermistor based electronic type heat detectors are used in heat sensing in the recent fire detection systems. If heat is to be detected in a targeted area infra-red heat sensing is used. The visual methods have a low response time along with a false output rate for flame sensing as compared to non visual methods. The huge computation power of current systems opens up new research targets for convolution neural network technologies. Semiconductor metal oxide are used as gas sensors because of low cost, super sensitivity, and size although one disadvantage is their stability. Carbon nano tubes gas sensing is the current aim of research group for gas sensing. For fire sensing through walls, microwave radiometer type of sensing is used in the current market. Wireless sensor networks and Internet of Things based multi sensor fusion approach is more suitable for the fire detection. In the below flow chart is displayed the fire sensing technologies currently available.



Heat Sensing

Energy that travels from hotter area to a colder area is called heat. The amount of thermal energy converted by a heating element is detected by heat sensing. The temperature relative to various parameters like refractive index, displacement and resistance is detected by heat sensing. A heat sensor primarily consists of a signal conditioning, heating element, and amplification circuit. Heat sensors are used in buildings to measure the heat caused due to fire hazards in that building. Depending on the fixed temperature, rate of rising and rate of falling there are heat sensors available with respective classifications. When a certain static temperature threshold is crossed fixed temperature heat sensing is used. Fusible-element, bi metals and distributed are the various types. In the fire sprinklers, the heating element is melted as an indicator at a certain degree in the fusible type. The distributed type heat sensor is further divided into three different types like optical, electrical, and sheathed. The sheathed and electrical type heat sensors work based on the change of resistance and temperature respectively. The distributed heat sensor works on the principle of back scattered light pattern. It is used in tunnels and pipelines. The thermal expansion of the metals can be detected using bi metallic heat sensor. In this type of heat sensor the metal bends to the direction of increase in temperature. Bi metal is available in two different categories, namely strip and disc. Every heat sensor is designed based on the default temperature of the current environment it is used in. It is activated when temperature deviates a certain fixed amount from that default value. In electronic heat sensors more than one type of heat sensors are used at a time to determine the heat. A device was proposed which can detect the temperature inside and outside the wall surface compare them to identify a fire hazard.

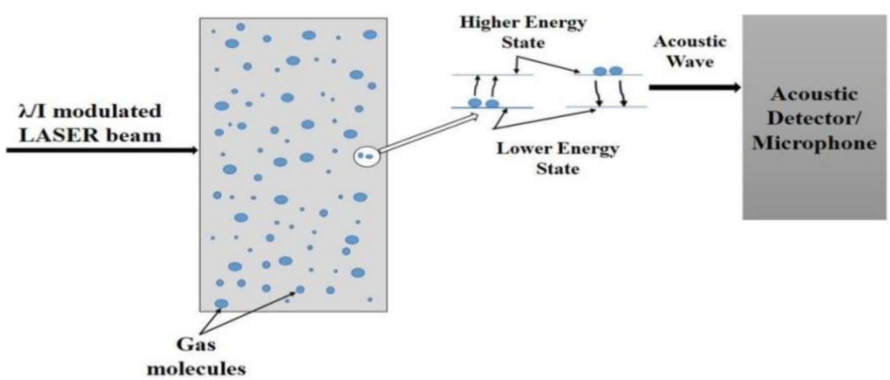
Change of certain parameters occur like capacitance, resistance and impedance with respect to temperature occurs when fire hazard is happening. The proposed model is not suitable for the measuring of various fire stages albeit suitable for its perfect placement of the fire sensor.



Gas Sensing

After comparing different gas sensing technologies a comprehensive review was provided in terms of sensitivity, response, reversibility, energy consumption, adsorptive capacity and fabrication cost. The gases in a place can be measured by the output produced by the sensors and their variations in gas sensing. It depends on the different materials used for the sensors and different ways the gas was formed. Various types of these sensors are the semiconductor gas sensors, photo ionization gas sensors, infra-red sensors, and electrochemical ones. When a fire hazard occurs, the quality of air changes thus resulting in the formation of gas and thus gas sensing technology is used. CO_2, CO and HCN are produced during fire hazards and the later two are toxic enough to cause life loss. Naturally these gases are inversely proportional to oxygen levels. Smouldering flames are caused by a small change in O_2 concentration. Liquid Fuel Flames are caused by a large change in concentration of O_2. Gas sensors can have stability problems leading to alarms triggering when they are not supposed to. An example of these type are semi conductor sensors. A hardware that provides the currant to heater of the mini sensor in which the temperature change effects of the sensor by control of feedback were compensated. Certain materials can be used to help improve which sensors to be used in which environment. Likewise certain materials can be used to help improve the performance of these sensors. A sensor array is used in multi parametric gas sensors. To improve sensitivity in gas sensing polymer is used. Semiconductor metal oxide gas sensor have lower sensitivity when compared to carbon nano tubes. Gas detection using optical methods show more sensitivity, stability, selectivity, and lower response time. The large size and cost are the main problems in harnessing these methods. A technique which results in microfilmer infiltration is suitable for the detection of CO, CO_2, and other gases. Certain gas sensing methods show a change in speed of acoustic wave because of certain parameters changing.

The below figure shows it. A LASER is passed through the testing gas. An acoustic detector detects the generated wave by the LASER. Gas concentration is determined by the magnitude of the wave.



Flame Sensing

Flames are the visible and gaseous part of the fire and it is formed due to exothermic reactions between fuel and oxidant. Temperatures of these flames depends on the burning materials. The flames have different characteristics and properties such as radiation and chromaticity. There are 2 strategies of flame detection supported invisible techniques and visual techniques. invisible techniques are characterized on the idea of flame radiation and visual techniques on the idea of chromatic properties of flame and are mentioned herein.

1) Nonvisual Flame Techniques

Flames generate radiations that are dependent on the temperature of the flame and the type of fuel being burned. UV, visible, and infrared sensors are available for flame detection, and their spectra are used to classify them. In comparison to visible and infrared sensors, the UV sensor is employed to assess brightness since the effect of infrared emissions on the UV sensor is very low. The flame is measured using infrared and visible sensors. In compared to UV sensors, IR and visible sensors are appropriate.

Using three photovoltaic cells, flame sensor was created. The IR, visible, and UV spectral bands are measured by the three photocells. Because of the deposition of aerosols on the receptor glass, the ratio of false positives in UV flame sensors has increased. UV sensors emit sparks of UV spectra which act as a disturbance signal for the sensor.

2) Visual Techniques

The difficulty with standard heat, smoke, flame, and gas sensors is that they take too long to reach their destination. It's the time it takes for particles to reach the point sensors and turn them on.

Another issue is the very small coverage area. As a result, a high number of point sensors are required to cover wide areas. Shape, size, colour, position, growth, and degree are all characteristics of the fire. Moreover, traditional sensors are incapable of capturing all of these subtleties. The majority of conventional sensors generate false alarm signals, necessitating human intervention to verify the alarm signals' veracity. All of these issues can be greatly reduced by using cameras to capture and analyze fire images for fire detection. To save money, Surveillance cameras can be used instead of specially developed fire detection cameras. IR cameras and visible cameras are the two types of cameras used to detect flames. Cameras output image signals in a variety of formats, including RAW, RGB, YUV, and JPEG. These signals are then analyzed using algorithms to determine if a fire or non-fire frame is present. There are two techniques to constructing algorithms in general. The second approach is learning-based, in which a collection of fire and non-fire test photos is used to train the system, and fire features are extracted. These are algorithms based on deep convolutional neural networks. This is an area where there is a lot of research going on. Color, shape, flickering frequency, and dynamic texture of the fire are all key aspects in the first approach. In fire detection applications, the RGB, CIE L*a*b*, YUV, or HSI colour spaces are employed.

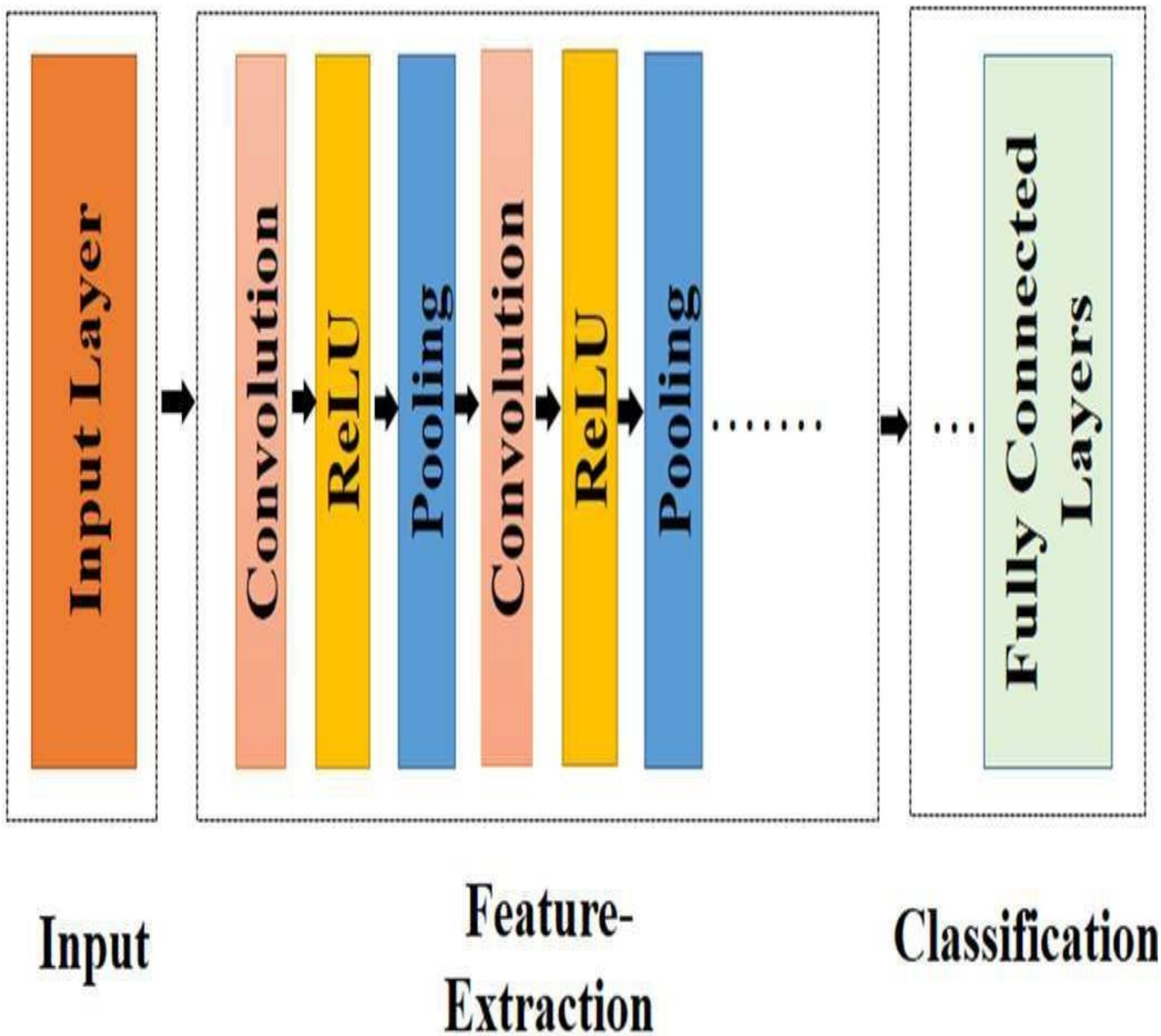
For reliable findings, colour information alone is insufficient. The mobility of fire is another feature. When contrasted to other moving things, such as humans walking, it behaves differently. The literature mentions many strategies such as the background subtraction approach, temporal differencing, and optical flow analysis. We investigated colour models and motion features for fire detection and employed Markov models to distinguish flame movement from other object movement with flame-like colours, as well as temporal wavelet analysis to detect flame boundaries. Authors additionally created an active learning capacity based on a learning management system (LMS).

However, the system's detection range is somewhat limited. We looked at fuzzy finite automata for detecting fire flames, and this method takes irregularities in flames into account. Flame detection is based on determining colour and motion probability, which is then utilized to create feature vectors. We investigated the use of feature vectors in the Wald- Wolfwitz algorithm, followed by a convolution operation to improve dependability. A probabilistic technique based on colour and motion cues was proposed by a scientist. A fire detection method based on an ensemble of experts was proposed. It is based on information about colour, shape, and flame movement. The relative variation of the red, green, and blue pixels in the histogram-based approach is another intriguing indication. If the standard deviation of the green pixel is high, it may be a sign that it needs to be confirmed further. Another characteristic is the image frame's dynamic texture analysis. This feature improves the accuracy of fire detection, but also raises the computing cost. The application of dynamic texture analysis for flame detection was investigated. In video fire detection, edge detection is a crucial step.

Changing the grey level, smoothing, using the Sobel operator, adjusting TH and TL, deleting irrelevant edges in PEI, and achieving clear edges are all phases in a proposed flame edge identification technique.

Its advantages for real-time fire detection are ease of implementation and computational lightweight. And, by sacrificing some sensitivity, temporal smoothing is employed to reduce false alarms.

In the second approach, a black box is learned using a training digital image dataset. It also recognizes the fire image frame in video data. The deep learning convolution neural networks (CNN) technique for fire detection is currently being studied in the literature. Figure 7 depicts the different levels of a deep learning CNN architecture.


Input Layer
Convolution
ReLU
Pooling
Convolution
ReLU
Pooling
Fully Connected Layers
Input
Feature-Extraction
Classification

Smoke Sensing

When fire burns for a period of time, a white gas is formed which consists of gases, liquid particles and airborne solids which is called smoke. It is basically an unwanted thing that is produces during fire. Certain materials undergo combustion or burning in order to form smoke which is basically a degradation of the air quality.

Measuring smoke comes with two techniques based on their characteristics.

1) Non visual Techniques

Measuring smoke depends on certain conditions namely smouldering, flame, pyrolysis. The fire type and its environment, the place it is occurring determines what technique of smoke measuring is used. Smouldering flames is detected using the photo electric technique and it is detected very fast using this technique. The amount of ionization in the air can determine smoke that is by using a specific type of smoke sensor called ionization smoke sensor. A chamber is taken and the potential is measured across both ends, the difference is taken and thus the current is measured. The more smoke in air the more scatter of light takes place and the less smoke the less the scatter of light. A visual arrangement is used to calculate the difference in light in photoelectric smoke sensing technique. The multi type sensing technique for smoke sensing and usage different cumulations for quantifications of smoke such as detecting of gasses predicted on photoelectric principle, and with an ion detecting method for abbreviating the mendacious positives. In room with open doors the path of smoke was analysed and additionally a field fire model for determining the fire spread was determined. A detector for smoke particulates was utilized to the to detect smoke from within the radiation as a method for smoke detection. The alpha particulates strike the gateways to generate a positive charge within. If the smoke particulates within the radius of the detector increases then the number of alpha particulates decreases as inversely proportional thus resulting is decrease of current as well. A technology that can detect smoke along with identifying the material in question that is burning is detected was invented.

2) Visual Techniques

Cams have the capability to capture smoke as well as flames due to visual imagery identification. Smoke is generally present during the period of fire just starting out and spreads very fast. Thus detecting it within the required period of time is very difficult. Visual imagery also has the capability to detect which direction the fire/smoke is spreading along with face detection to ensure whether people are within the danger radius or not. Many algorithms are compared and suitable algorithms are chosen and applied. RGB colour space with set standards is used in this project but different colour space can provide better results. The values of dominance and luminescence provide info on whether there is fire or not. A fire detection technique that uses luminance and support machines algorithm are used to remove false positive triggers of alarms. This technique has a very slow response time and requires us to have a very large sum of frame. For smoke detection in video dynamic texture analysis was used which detects smoke based on colour and motion. These dynamic features were used to detect smoke. The bigger the trainer dataset is the better this type of algorithm works.

Miscellaneous Sensing

In today's world, there are numerous fire detection techniques described, but the majority of them have their own clause. For fire and motion detection, an ultrasonic-microwave multi-sensor fusion approach was presented. The Doppler shift of an ultrasonic signal was used to quantify smoke density changes and heat. A sensor design based on a specific type of beetle with a sensory mechanism provided by nature for fire measurement and a sensor that uses a current loop circuit made up of numerous segments of nickel wire has been proposed. Each portion generates a voltage that the microprocessor can analyse. A single sensor-only technique to information fusion. Every sensor can be used to detect something. It is susceptible to a certain variable, but it is also vulnerable to other factors that operate as disturbance or noise signals. Microwave radiometers can also be used to detect fires in extreme conditions. In the presence of smoke, dust, and vapours, sensors based on these principles can function satisfactorily. These techniques can also be used to detect fires in open regions such as forests. A prototype of a band radiometer for forest fire detection has been created. The specifics of ongoing research in this area have been highlighted. The importance of the fire spot emissivity parameter, which had been overlooked in previous studies, was examined for various types of flames. SAW (Surface Acoustic Wave) sensors can also be used to detect fires in difficult situations. The sensors that are based on them are compact, robust and portable. And it can work in a wide range of frequencies and bandwidths. These are non-radioactive, wireless, and less susceptible to radiation. This is why they're useful in industries like aerospace and others. However, when it comes to resonant frequency measurements, these sensors have certain limitations. Fixed sensor-based fire detection systems have limitations. The fire sensors' mobility makes them relatively safer in adverse settings. The disadvantages of fixed fire sensing systems can be resolved by robots equipped with fire sensors and extinguishers. To detect and combat fire, robots can move on the ground or soar. As a result, firefighter fatalities and dangers can be reduced.

Researchers at the Italian Institute of Technology have built a walk-man firefighting robot with a human-like shape that can carry up to 10 kg of weight and lift a variety of objects. LUF 60 is an unmanned ground vehicle (UGV) firefighting robot designed by LUF Technology and suitable for a variety of applications.

Use in the open air. This robot's specifications include smoke removal. On it, they installed a thermal imaging camera, an acoustic detection system, and LASER range finders, as well as a remote-control facility. TAF20 (Turbine Aided Firefighting) is a robot created by the EMI Control Group as an unmanned ground vehicle (UGV). Remote operation, obstacle clearance, smoke removal, and fire extinguishing are all mentioned. Howe & Howe technologies' Thermite RS1-T3 is a UGV robot. To collect fire data, the robot used HD analogue video cameras and an infrared FLIR. The maximum water dispensing capacity indicated is 1250 GPM. Ryland Research Group built Fire mote, a UGV firefighting robot. An operation in hazardous places and the discharge of water and foam for fire suppression are mentioned as features. DRB Fatec Ltd.'s Archibot-M is a UGV water-resistant firefighting robot with a vision camera for fire detection. The robot's aptitude for interior fire fighting operations and efficient stair climbing are highlighted. A demolition operation is also essential in fire-prone areas to clear a path for evacuation. Brokk is a demolition robot created by the Brokk group, and it is built for confined areas of activities such as stair climbing. The primary goal of these firefighting robots is to put out fires. Water, CO_2, chemicals, and foam are all used in traditional fire suppression tactics. However, in a haze. However, in dangerous conditions, their use can cause issues. For small flames, a sound wave-based fire extinguishing system has been created, providing a cleaner alternative to traditional fire extinguishing. It operates on the premise of the ideal gas equation, which states that pressure is proportional to temperature.

TABLE I
EXISTING FIRE SENSING TECHNOLOGIES AND THEIR CHARACTERISTICS

Ref.	Sensor	Fire type	Range	Response Time	Limitations	Advantages
[97], [98]	NTC Thermistor		-50 to 150 degree Celsius	40 sec	Nonlinear	High sensitivity
[99],[100]	Fusible element	High-heat fire	55 to 180 degree Celsius	260 sec	Slower response	Suitable for sprinklers
[18], [101]	Distributed		Upto 120 degree Celsius	-----	Not precise	For long distances
[101], [102]	Bimetal		-75 to 540 degree Celsius	120-180 sec	Slower response	Suitable for actuators
[101], [102]	Rate of compensation		Ultra-high 260 to 302 degree Celsius	120-180 sec	Slower response	Useful for both fix and temperature rate
[101], [103]	Rate of temperature rise		7 to 8 degree Celsius per minute rate	120-180 sec	Inefficient for detecting the low rate of temperature	Useful where temperature varies
[104], [71], [72]	Photoelectric		-40 to 86 degree Celsius	18 to 3008 sec	Prone to false alarm	Useful for smoldering fire
[104], [105], [106]	Ionization		-40 to 86 degree Celsius	16 to 3691 sec	Higher cost	Useful for fast flame fire
[107]	CCTV, video camera modules	Smoldering fire	Mainly visible range	—	Time lag due to algorithms	Provide more fire features
[106]	Continuous air sampling		-40 to 86 degree Celsius	-----	Feedback of air sampling process is not respectable	Useful for fire incipient stage detection
[101], [108]	Flame detector	Fuel flames	170nm-290nm (UV), 650nm-580nm (IR)	Min 0.03 s for UV	Not useful for early fire stages	Detects an important fire feature
[109]	Spark/Ember detector	Sparks	Mainly IR range	-----	EMI/RMI noise affects the output	Detects electrical initiated fires
[110], [111]	Gas sensor	CO, O_2	10-10,000 ppm	-----	High power consumption	Detects an important fire feature
[112]	Video camera (IPXDDK-1500)	Flaming, smoldering	-----	Less than 10 sec (smoke), Less than 5 sec (flame)	High cost and time lag in algorithm processing	Provide more fire features

proposed an experimental investigation for fire suppression using sound waves, and evaluated sound waves at 30.6 Hz frequency, which are suitable for swiftly extinguishing flames, and recommended a sound wave-based fire extinguishing system for space station.

CHAPTER 2: PROBLEM STATEMENT

In order to minimize the loss of life and properties due to fire related hazards create a device which uses sensors to detect fire and extinguishes it.

Need of the Project

- Fire hazards are a common occurrence in the present world, causing a high number of casualties along with loss of property.
- The current independent smoke detectors are uneven very low quality products and have many shortcomings.
- The performance of these smoke detection products is very small.

APPLICATION

The application of the project in fire protection can allow a massive enhancement to the combating capabilities of fire fighting forces, avoiding the life loss and reducing property loss for humans.
This project can be used in Smart Homes, Smart Campus, Smart Hospital, etc.

Proposed Solution

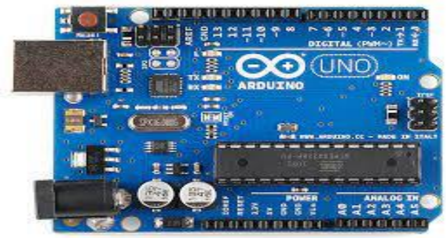
- Our idea is to design an fire protection robot.
- It can solve wiring problems and greatly decrease installation costs.
- More than 100,000 flame sensors can be connected directly as NB-IoT has a large number of connections.
- It has low power consumption.

Software Requirements

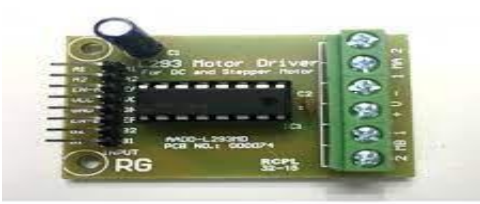
- Windows 7 and above/Mac os/ Linux
- Arduino IDE
- Servo Library

Hardware Requirements

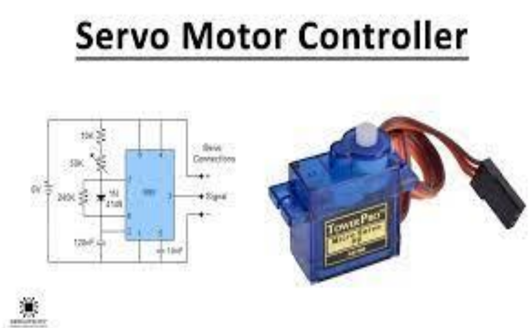
- Arduino UNO Board



- L293 Motor Driver

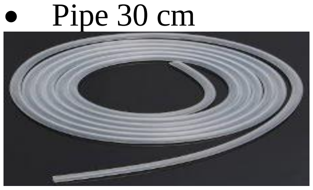


- SG90 Micro Servo Motor



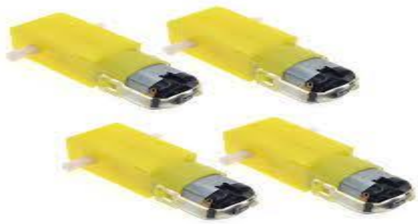
- Submersible Mini Water Pump

- Pipe 30 cm



- Mini Bread Board

- 4 Bo Motors



- 4 car Wheels

- Jumper Wires

- Soldering Kit

- Glue Gun

- Cardboard Base

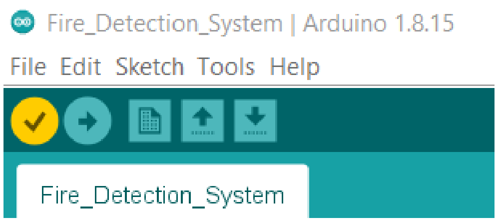
- Switch

- Arduino to pc connector

CHAPTER 3: ARCHITECTURE, DESIGN & IMPLEMENTATION

IMPEMENTATION

- Implement the code on Arduino IDE



Verify the code

- Upload the Code to Arduino UNO Board
- Connect all the Hardware according to the Circuit Diagram

Code Snippet:

```
#include <Servo.h>  //include servo.h library
Servo myservo;
int pos = 0;
boolean fire = false;
#define left 9      // left sensor
#define right 10    // right sensor
#define forward 8   //front sensor
#define lM1 2       // left motor
#define lM2 3       // left motor
#define rM1 4       // right motor
#define rM2 5       // right motor
#define pump 6

void setup()

{

  pinMode(left, INPUT);

  pinMode(right, INPUT);

  pinMode(forward, INPUT);
```

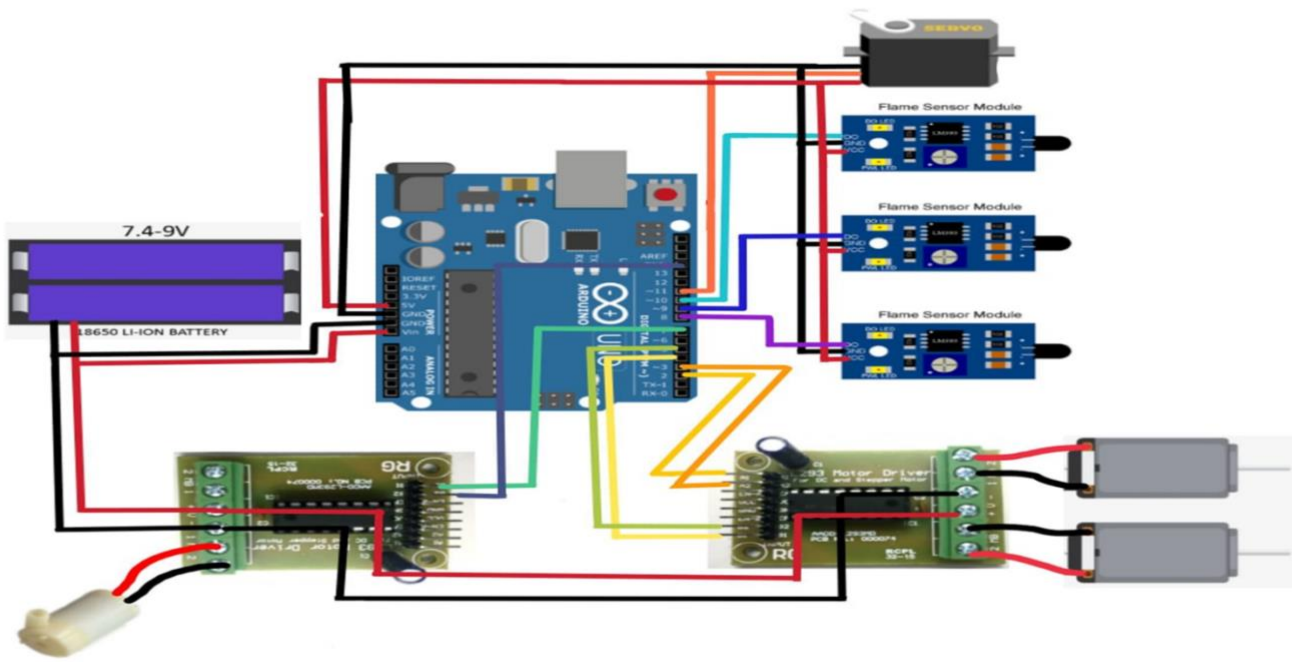
```
  pinMode(lM1, OUTPUT);

  pinMode(lM2, OUTPUT);

  pinMode(rM1, OUTPUT);

  pinMode(rM2, OUTPUT);

  pinMode(pump, OUTPUT);

  myservo.attach(11);

  myservo.write(90);

}

void put_off_fire()

{

    delay (500);


    digitalWrite(lM1, HIGH);

    digitalWrite(lM2, HIGH);

    digitalWrite(rM1, HIGH);

    digitalWrite(rM2, HIGH);


   digitalWrite(pump, HIGH);

   delay(500);


    for (pos = 50; pos <= 130; pos += 1) {

    myservo.write(pos);

    delay(10);
```

```
  }
  for (pos = 130; pos >= 50; pos -= 1) {
    myservo.write(pos);
    delay(10);
  }

  digitalWrite(pump,LOW);
  myservo.write(90);

  fire=false;
}

void loop()
{
   myservo.write(90);

    if (digitalRead(Left) ==1 && digitalRead(Right)==1 && digitalRead(Forward) ==1)
    {

    digitalWrite(lM1, HIGH);
    digitalWrite(lM2, HIGH);
    digitalWrite(rM1, HIGH);
    digitalWrite(rM2, HIGH);
    }
```

```
else if (digitalRead(Forward) ==0)
{
digitalWrite(lM1, HIGH);
digitalWrite(lM2, LOW);
digitalWrite(rM1, HIGH);
digitalWrite(rM2, LOW);
fire = true;
}

else if (digitalRead(Left) ==0)
{
digitalWrite(lM1, HIGH);
digitalWrite(lM2, LOW);
digitalWrite(rM1, HIGH);
digitalWrite(rM2, HIGH);
}

else if (digitalRead(Right) ==0)
{
digitalWrite(lM1, HIGH);
digitalWrite(lM2, HIGH);
digitalWrite(rM1, HIGH);
```

```
  digitalWrite(rM2, LOW);
  }

delay(300);//change this value to increase the distance

    while (fire == true)
    {
     put_off_fire();
    }
}
```

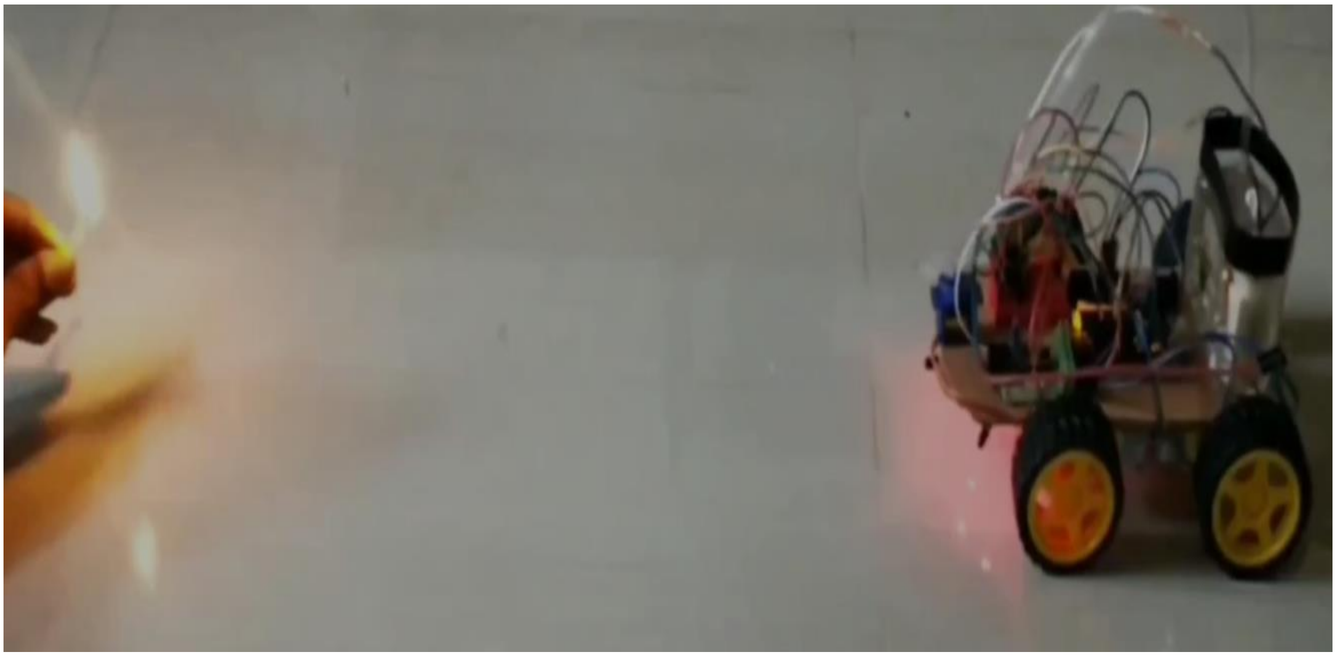
CIRCUIT DIAGRAM



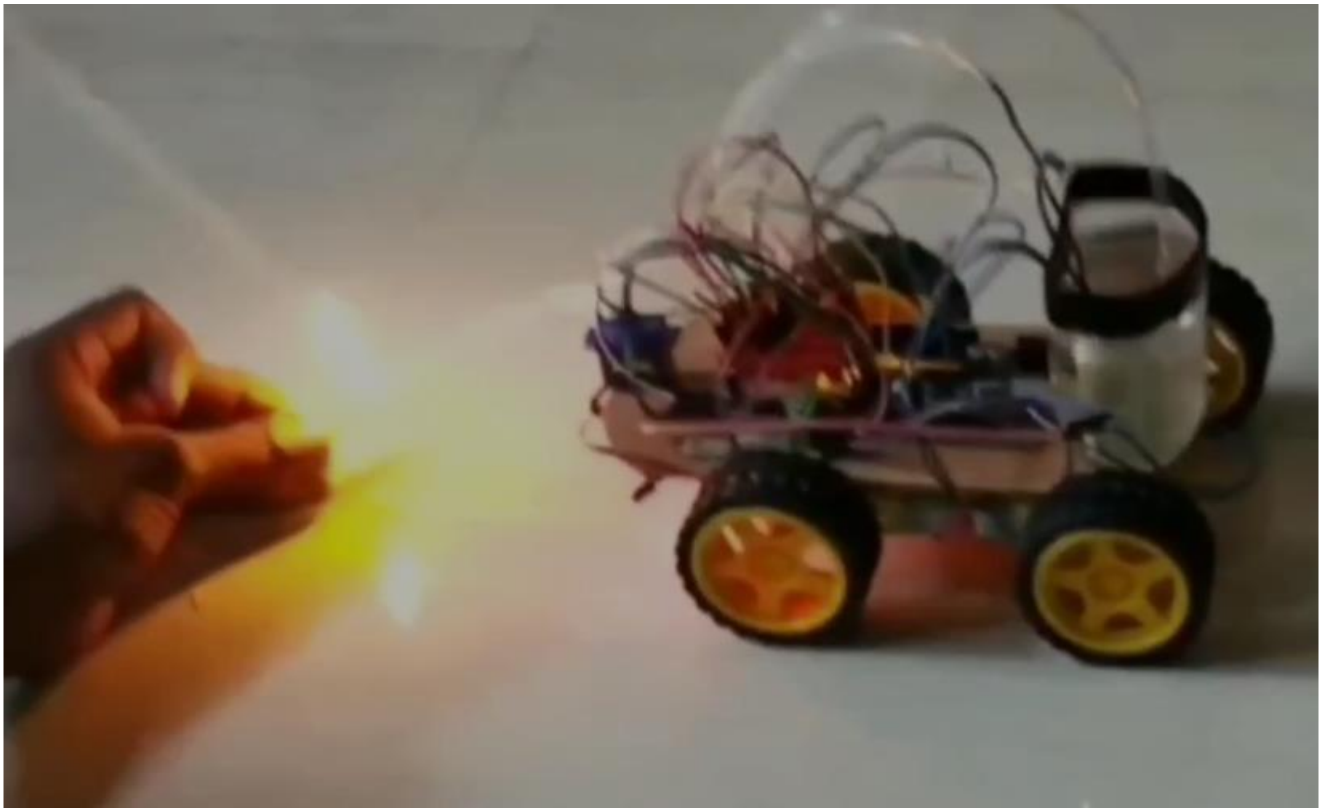
We are using Arduino UNO for our project.
It consists of 3 Flame sensor Modules, 4 Bo Motors, 4 Wheels, 1 Servo, 1 Water Pump, L293 Motor Driver, 1 Mini Bread Board, 12v Battery, 1 Container, 1 Pipe.

The above circuit diagram shows all the connections with the Arduino uno board which we have programmed with Arduino IDE.

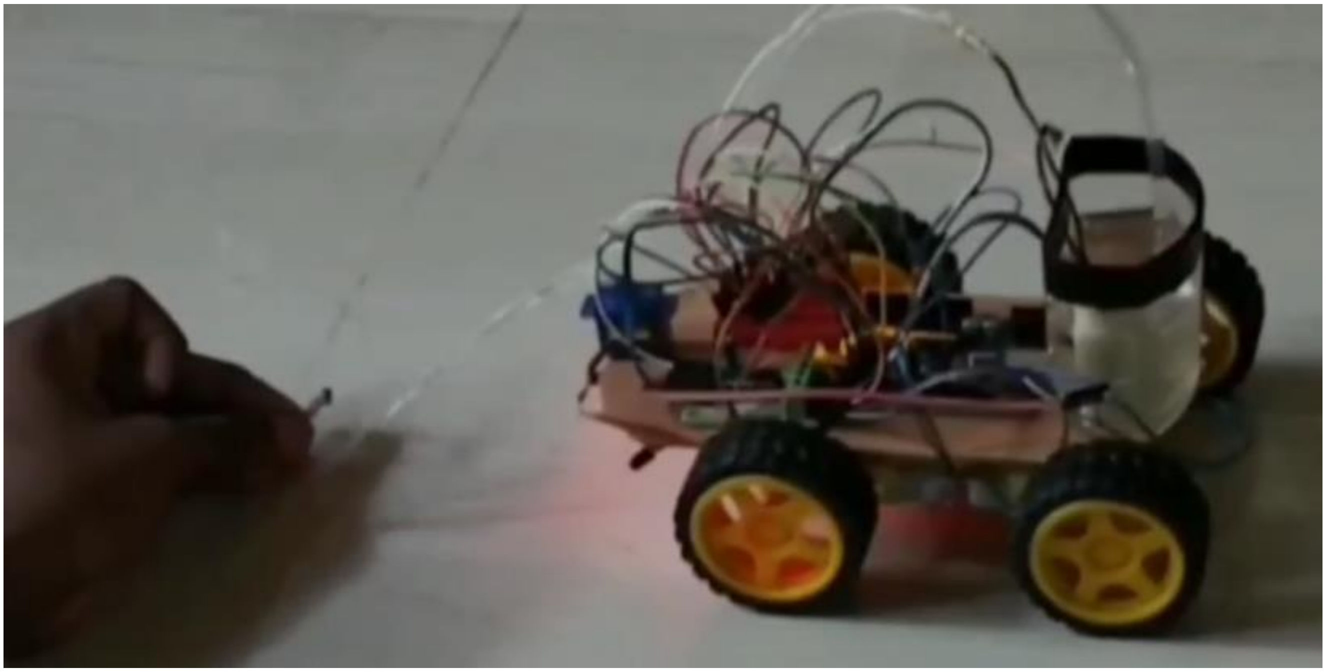
CHAPTER 4: Experimentations & Result



The above image shows that there is fire and the Intelligent Fire Protection System is Detecting it with the help of the three flame sensors fixed in front of it.
After which it sends signal to the Microprocessor Arduino UNO board which gives instructions to the wheels to move towards the fire.



This image shows that the robot has moved towards the fire as per the instruction from the microprocessor.



This Image shows the fire is being extinguished with the help of water which is present in the back container in which the pump is pumping the water out as per the instructions given from the microprocessor and the water travels through the pipe outwards to put off the fire. Here Servo is set at the end of he pipe it is used to set direction of the water towards the fire.

CHAPTER 5: CONCLUSION

In smart city construction, which has fire safety management, the Internet of Things has a very important link.

Fire protection systems should be fully reliable when in action. Although they are not at all used during times of non chaos. Usage of wired smoke sensors is because serial connection is relatively easy to cause problems, and not because all places don't have proper network, then a series of systems through serial connection cannot be used. To provide an effective means for current consumption is the reason Internet of Things is used, which will become the primary way of modern fire management system. The consequences of a city if its fire facilities are not using Internet of Things can be very desperate and severe.

The robot can prevent outbreak and chaos if used in conjunction with fire fighting forces. A robot that can move towards fire and then pump water to extinguish it was made. Results were achieved on the individual components of the robot.

Fire fighting product has their end users in areas such as defence, fire department, medicine, health monitoring etc. Obstacle and motion detectors can be used to provide better movement through terrain. Memory chip can maintain data of activation due to recent fire hazard. The range of the sensors is quite relatively small, which can cause the quality of the product to be degraded.

This project will help in generating interest in the field of robotics while working towards a practical solution to save lives and minimize the risk of property damage.

In the future, we aim to use real robot system which can afford high temperatures, and has more functionality.

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