AUTOMATED ACOUSTIC FIREFIGHTER

A PROJECT REPORT

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BONAFIDE CERTIFICATE

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ABSTRACT

Fire is a particularly feared hazard. Therefore, a fire extinguisher is a very important piece of equipment. Unfortunately, existing fire extinguisher has some drawbacks such as using a chemical compound that is dangerous and it leaves a residue. Current extinguishers contain different kinds of chemicals depending upon their application. Generally, they are pressurized with Nitrogen or Carbon-dioxide (CO_2) and when this pressure is released on the fire, it extinguishes the fire. There are many asphyxiating and extinguishing agents like water, potassium bicarbonate, foam, etc

The waste materials generated by these methods can be toxic and harmful. Innovative methods are necessary to minimize the generation of this waste. The need for innovation and modernization in fire extinguishing techniques is extremely necessary. The existing techniques have been created considering only their efficiency in extinguishing fires and not considering the harm they can cause to the environment.

Study shows that sound waves could be one of the potential alternatives for extinguishing fires. Acoustic pressure and air velocity produced from a woofer is the fundamental concept used to explain how sound waves put off flames. In this project, we proposed a new method using sound waves to extinguish the fire. Our method was using a woofer and a converging tube to focus the sound wave to overcome the fire energy and thus put the fire down. The aim is to develop a closed-loop fire extinguisher with fire detection using digital image processing.

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INTRODUCTION

1.1 REVIEW OF THE PROJECT

The fire extinguishing ways used currently are having colorful down sides. The need for new fire extinguishing ways is veritably important as fire accidents cause damage. This design demonstrates an idea of a developing device that can extinguish the fire using sound. Traditional fire extinguishers, similar to chemical froth or water, are used successfully but pose the trouble of oppressively damaging inner outfits, whereas an acoustic fire extinguisher would cover them from further damage caused by the fire. The low-frequency acoustic produced from a subwoofer tends to extinguish the fire.

Fire extinguishing using sound waves wasn't a new technology. The sound waves were first reported by John Leconte in 1858, who noted flames are sensitive to sound. A German physicist, Heinrich Rubens in the1900s, showed the technique using a section of pipe with holes perforated along the top. One end was sealed off with a sound woofer connected; the other was sealed off and attached with a gas supply. Subsequently, by igniting the gas leaking from one of the openings and varying the sound frequency being emitted, the height of the flames could be manipulated, this effect is called the Rubens tube.

The development of a closed-loop fire extinguisher is initiated with the introductory design approach. The generated sound swells are made to travel to the vertex tube. The subwoofer along with the vertex tube is designed to concentrate the sound waves in a single direction.

1.2 PREFACE TO FIRE

Fire is a self-sustaining, chemical chain response with varying degrees of light and heat. Flame is the observable portion of the fire. Fires start when an ignitable and/ or a combustive material, in combination with an acceptable volume of an oxidizer for the case, oxygen gas is exposed to a source of heat or ambient temperature above the flash stage for the energy/ oxidizer blend and is suitable to repel a rate of rapid-fire oxidation that produces a chain response. Fire is made up of three compounds. Energy, Oxygen, and Heat. This is typically called the fire triangle. Fire cannot live if deprived of any one of these components. Fire extinguishers are divided into five orders, grounded on different types of fires similar to Class A, Class B, Class C, Class D, and Class K. they are,

Class A fires are ordinary combustibles similar to wood, paper, cloth, rubber, and plastics.

Class B fires are fires in flammable liquids such as gasoline, petroleum greases, tars, oils, oil-based paints, solvents, and alcohol. Class B fires also include flammable gases such as propane and butane. Class B fires do not include fires involving cooking oils and grease.

Class C fires are fires involving energized electrical equipment such as computers, servers, motors, transformers, and appliances. Remove the power and the Class C fire becomes one of the other classes of fire.

Class D fires are fires in combustible metals such as magnesium, titanium, zirconium, sodium, lithium, and potassium.

Class K fires are fires in cooking oils and greases.

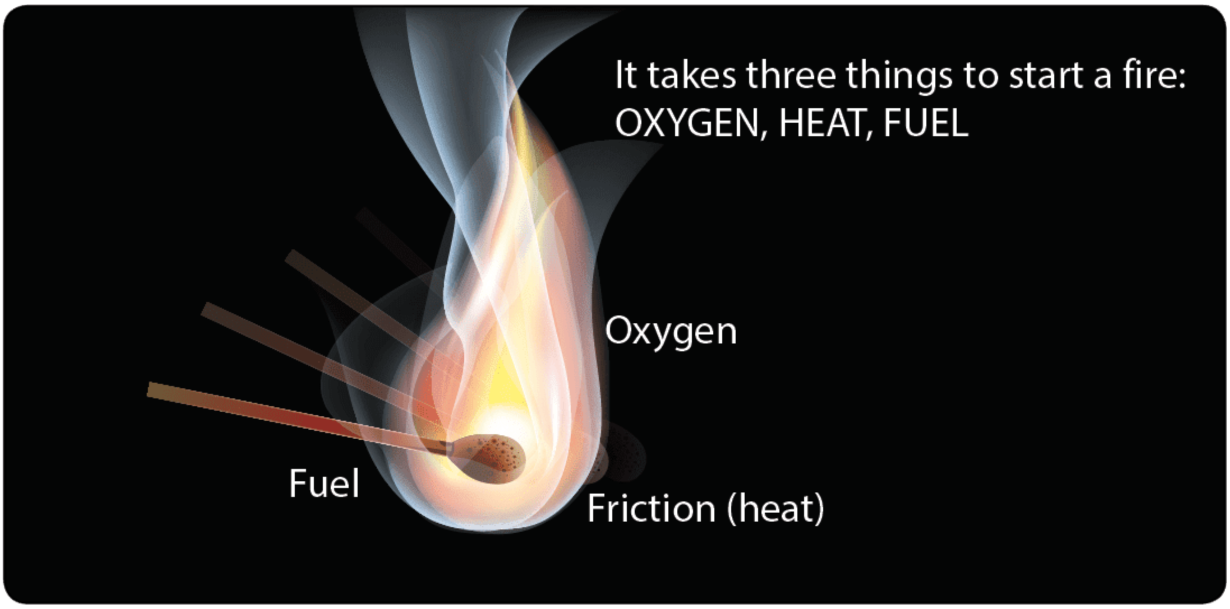

Fig 1.1: Fire triangle

1.2.1 LOSSES OF FIRE

Everyone knows that fires can cause devastating destruction. If you have been personally affected by a residential or commercial fire, you understand this better than most. The most recent Total Cost of Fire report from the National Fire Protection Association covers estimated losses from 2011. By breaking down the total cost of fire, you'll recognize the importance of installing adequate fire protection equipment in your building to preserve life and protecting property.

1.2.2 TYPES OF LOSSES

These losses can be divided into two categories:

Direct property damage: When a home or business is damaged or destroyed in a fire, the losses resulting directly from the flames are known as direct property damage. ...

Indirect loss: When flames cause damage, it takes time and money to recover.

1.2.3 PROVISION TO PREVENT AND MIGRATE FIRE

Not all fire losses occur after the fact. In an attempt to limit the occurrence of fires, people invest in prevention and mitigation efforts. The goal in the fire protection industry is to achieve adequate fire safety at a lower cost since, surprisingly, prevention and mitigation methods account for well over half of the country's total fire costs per year.

Fire departments: One of the highest fire costs is the expenditure of local career fire departments, which totaled $42.3 billion in 2011. An even greater cost is the monetary value of donated time from volunteer firefighters, which totaled $139.8 billion. This amount is estimated by determining what it would cost local communities if the services provided by volunteer firefighters were covered by paid career firefighters.

Building construction and installation of fire protection equipment: Constructing new buildings with proper fire protection measures is a large part of preventing fires and mitigating damage. The total cost for such construction in 2011 came to $31 billion. This amount is comprised of passive protection, such as fire doors and fireproof concrete, as well as active protection, including fire alarms, sprinkler systems, and automatic fire suppression.

Insurance: The net cost of fire insurance coverage in 2011 was $20.2 billion. This figure is estimated by subtracting customers' claims from the monthly premiums they pay for fire insurance.

1.3 PREFACE TO SOUND WAVES

Sound is a form of energy, just like electricity, heat, or light. When you strike a bell, it makes a loud ringing noise. Now instead of just listening to the bell, put your finger on the bell after you have struck it. Can you feel it shaking? This movement or shaking, i.e., the to and fro motion of the body is termed

Vibration. The sound moves through a medium by alternately contracting and expanding parts of the medium it is traveling through. This compression and expansion create a minute pressure difference that we perceive as sound. Sound is a vibration that propagates as a perceptible mechanical wave of pressure and displacement, through a medium such as air or water.

Sound propagates through compressible media such as air, water, and solids as longitudinal waves and also as transverse waves (in solids). The sound waves are generated by a sound source, such as the vibrating diaphragm of a speaker. The sound source creates vibrations in the surrounding medium. As the source continues to vibrate the medium, the vibrations propagate away from the source at the speed of sound, thus forming the sound wave. At a fixed distance from the source, the pressure, velocity, and displacement of the medium vary in time. At an instant in time, the pressure, velocity, and displacement vary in space.

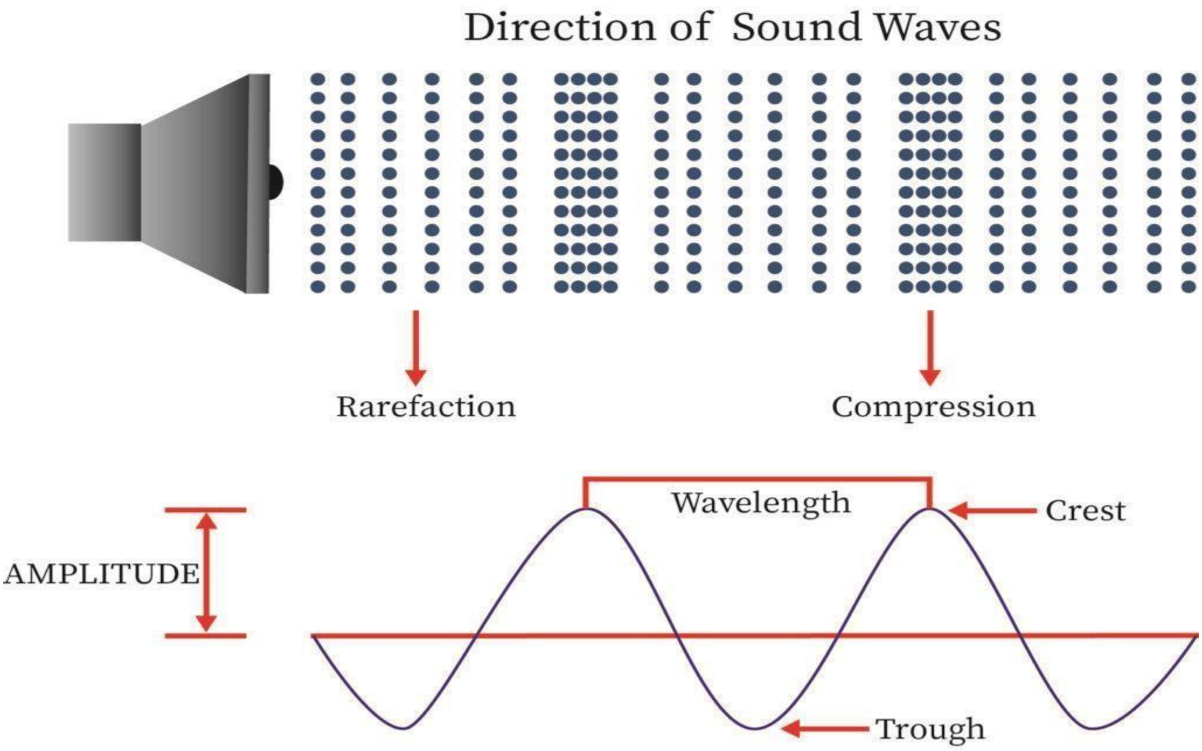

Fig 1.2: Sound in particle and waveform.

CHAPTER 2

LITERATURE SURVEY

2.1 CONVENTIONAL FIRE EXTINGUISHING TECHNIQUES

There are four common techniques used in extinguishing fires. Cooling down the burning material is the most common practice used to extinguish the fire. Water is usually available and the best cooling agent to use particularly in fires involving solid materials. By vaporizing in contact with fire, water also mantles the fire, cutting off the oxygen supply. However, water should never be applied to fires involving hot cooking oil or fat because it can cause the fire to spread. Secondly, is by excluding oxygen from the fire. Asphyxiating agents are substances used to extinguish a fire by cutting off the oxygen supply. Foam, which is the content of some fire extinguishers, can help to cool down and isolate the fuel surface from the air, reducing combustion and being able to resist wind and draught disruption. Nevertheless, the foams should never be used on energized electrical equipment, because it is an electrical conductors. Other smothering agents include carbon dioxide, which is found in some fire extinguishers and is ideally used in electric equipment, and sand, which is effective only in small burning areas.

Another method of extinguishing a fire is to remove the fuel supply by switching off the electrical power, isolating the flow of flammable liquids, or removing the solid fuel, such as wood or textiles. In woodland fires, a firebreak cut around the fire helps to isolate further fuel. In the case of a gas fire, closing the main valve and cutting off the gas supply is the best way of extinguishing the fire. Flame inhibitors are substances that chemically react with the burning material, thus extinguishing the flames.

Dry-chemical fire extinguishers work in this way and can contain mono ammonium phosphate, sodium and potassium bicarbonate, and potassium chloride. Vaporizing liquids also have a flame-inhibiting action. Conversely, most of these substances have been phased out due to high levels of toxicity.

2.2 TYPES OF SOUND WAVES

Sound is a vibration that propagates as a typically audible mechanical wave of Pressure and Displacement, through a medium such as gases, liquids, and solids. Sound is a pressure wave and Displacement caused in the medium through which particles will move in a random direction, transferring the pressure from one particle to another, hence this is how sound travels in any medium. Sound can be travel in two forms they are:

2.2.1 LONGITUDINAL WAVE:

Longitudinal waves, also known as”l waves”, are waves in which the displacement of the medium is in the same direction as, or the opposite direction to, the direction of travel of the wave. Mechanical longitudinal waves are also called compression waves because they produce compression and rarefaction when traveling through a medium.

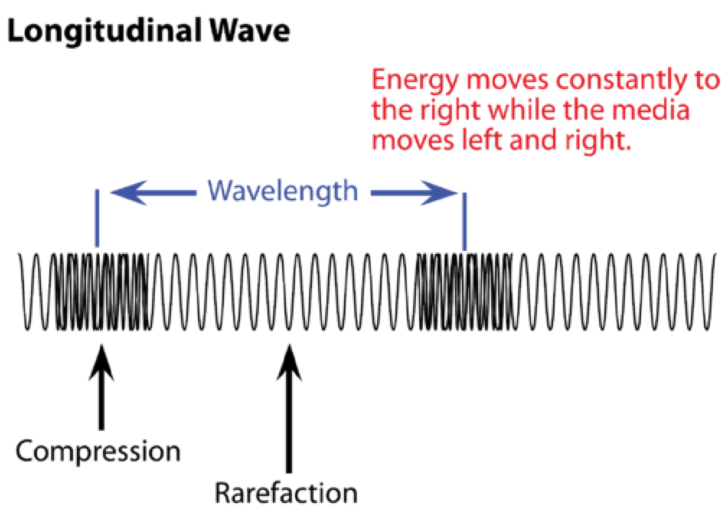

Fig 2.1: Longitudinal wave

2.2.2 TRANSVERSE WAVE:

A transverse wave is a moving wave that consists of oscillations that occur perpendicular (or right-angled) to the direction of energy transfer. If a transverse wave is moving in the positive x-direction, its oscillations are in up and down directions that lie in the y–z plane. Light is an example of a transverse wave. For transverse waves in matter, the displacement of the medium is perpendicular to the direction of propagation of the wave. A ripple in a pond and a wave on a string are easily visualized as transverse waves.

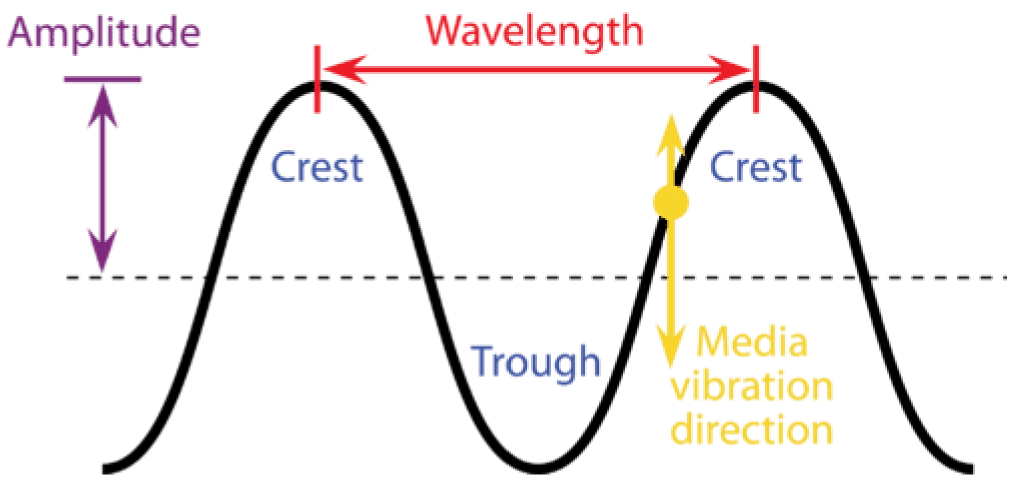

Fig 2.2: Transverse wave

2.3 OBSERVATION

Longitudinal waves are the most pressure waves and we can use these waves in our system. From the Observations made above, we can say that the particles of sound vibrate from one to next one and it can able to move the heating element from fire by creating a pressure in the area, but here there is a key point to remember that the sound wave of any frequency may not vibrate the particles such that they can cause fire to put off. There are particular ranges of frequencies that can only extinguish.

2.4 HYPOTHESES OF SOUND AS FIRE EXTINGUISHERS

Sound waves are produced by variation in the pressure of a medium the energy from the vibration producer moves to air particles in a pattern of high and low-pressure zones

Acoustics increases the air velocity fire is thinned and higher fuel vaporization widens the flame. Flames are extinguished because the sound waves change the air pressure A decrease in pressure can lead to a decrease in temperature If the maximum and minimum pressures caused by a sound wave are different enough, the flame will go out.

2.5 PROBLEM STATEMENT

The current method of firefighting using has significant drawbacks such as being toxic to humans and leaving residue (for dry chemical base fire extinguishers) while water-based fire extinguishing techniques freeze in cold climates and conduct electricity. Using sound waves with a certain frequency as a fire extinguisher will have significant advantages such as leaving no residues and being non-toxic. The immediate sensing of fire is done by using digital image processing.

- How to extinguish the fire using sound waves?
- How to identify the flame using the camera?
- What is the range of frequency that can extinguish the fire?
- Which method is used for firefighting?
- What is the distance between the prototype and the flame?

2.6 SCOPE OF PROPOSED SYSTEM

The existing system can extinguish only alcohol-fueled fires. Our proposed solution aims to extinguish different types of fires such as solid, liquid, and gas. Our proposed system has an advantage over the existing system in aspects such as size, cost, electricity, and wide scope for advancement because we are making use of acoustic waves instead of water and chemical foam. The step towards sound waves is the wide scope as it provides safety to humans.

It is a portable device that conducts no electricity as well as it saves water and leaves no residue & it's non-toxic. It helps make our work simple and also, we can attach to it other peripherals as per our wish to modify like we are providing the facility of attaching it to a drone and extinguishing the fire in that area where humans can't reach.

2.7 OBJECTIVES

- Our objective is to develop an environmentally friendly and safe method to extinguish the fire.
- It is done by using closed-loop acoustics set up by digital image processing.
- To overcome the harmful effects of chemical and water fire extinguishers.
- To avoid the toxic effects.
- To avoid pollution and provide reliable operation at a low cost.

CHAPTER 3
EXISTING SYSTEM

Fire Systems are used to extinguish, control, or in some cases, entirely prevent fires from spreading or occurring. Fire Suppression Systems have an incredibly large variety of applications, and as such, there are many different types of suppression systems for different applications being used today. Of these, some are still in use but are no longer legal to manufacture and produced.

3.1 TYPES OF EXISTING SYSTEM

- Fire sprinkler system
- Dry pipe system
- Special hazards of fire protection systems
- Dry chemical fire suppression systems
- Gaseous fire suppression systems
- Form fire suppression systems

3.1.1 FIRE SPRINKLER SYSTEM

A fire sprinkler system is an active fire protection method, consisting of a water supply system, providing adequate pressure and flow rate to a water distribution piping system, onto which fire sprinklers are connected. Although historically only used in factories and large commercial buildings, systems for homes and small buildings are now available at a cost-effective price. Fire sprinkler systems are extensively used worldwide, with over 40 million sprinkler heads fitted each year. In buildings completely protected by fire sprinkler systems, over 96% of fires were controlled by fire sprinklers alone.

Sprinklers have been in use in the United States since 1874, and were used in factory applications where fires at the turn of the century were often catastrophic in terms of both human and property losses. In the US, sprinklers are today required in all new high rise and underground buildings generally 75 feet (23 m) above or below fire department access, where the ability of firefighters to provide adequate hose streams to fires is limited.

Sprinklers may be required to be installed by building codes, or may be recommended by insurance companies to reduce potential property losses or business interruption. Building codes in the United States for places of assembly, generally over 100 persons, and places with overnight sleeping accommodation such as hotels, nursing homes, dormitories, and hospitals usually require sprinklers either under local building codes, as a condition of receiving State and Federal funding or as a requirement to obtain certification (essential for institutions who wish to train medical staff)

Fig 3.1: Fire sprinkler system.

3.1.2 DRY PIPE SYSTEM

The dry-pipe system employs automatic sprinklers attached to a piping system containing air or nitrogen under pressure. When released, the water flows into the piping system and discharges only from those sprinklers which have been operated by the fire. Dry-pipe systems are installed instead of wet-pipe systems where piping is subject to freezing.

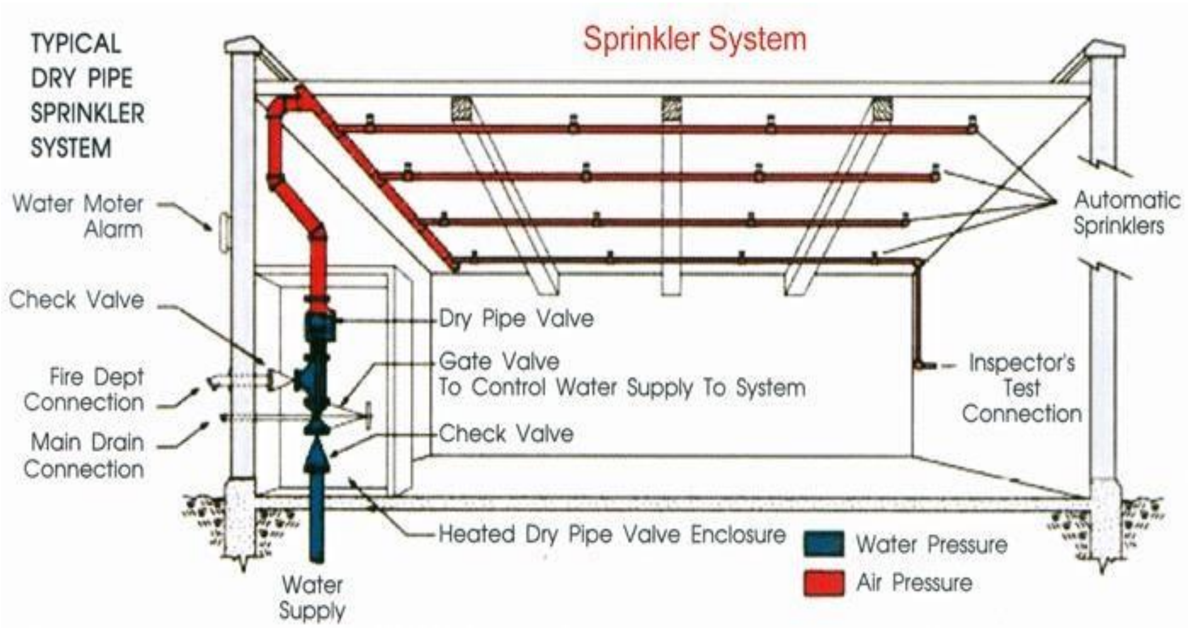

Fig 3.2: Dry pipe system

A dry pipe sprinkler system is one in which pipes are filled with pressurized air or nitrogen, rather than water. This air holds a remote valve, known as a dry pipe valve, in a closed position. Located in a heated space, the dry-pipe valve prevents water from entering the pipe until a fire causes one or more sprinklers to operate. Once this happens, the air escapes and the dry pipe valve releases. Water then enters the pipe, flowing through open sprinklers onto the fire.

Dry pipe sprinkler systems provide automatic protection in spaces where freezing is possible. Typical dry pipe installations include unheated warehouses and attics, outside exposed loading docks and within commercial freezers.

Many people view dry pipe sprinklers as advantageous for protection of collections and other water sensitive areas. This perceived benefit is due to a fear that a physically damaged wet pipe system will leak while dry pipe systems will not. In these situations, however, dry pipe systems will generally not offer any advantage over wet pipe systems. Should impact damage happen, there will only be a mild discharge delay, i.e. 1 minute, while air in the piping is released before water flow.

3.1.3 SPECIAL HAZARDS OF FIRE PROTECTION SYSTEMS

Special systems are designed to detect and extinguish fires in locations where standard suppression systems are not appropriate or adequate.

Fig 3.3: Special hazards of fire protection systems

A special hazards fire suppression system is used to put out fires in areas where water damage from fire sprinklers can cause costly or irreparable damage to the assets being protected. Special hazards systems use agents to extinguish a fire quickly without damaging property.

Special fire hazards are linked to some specific process or activity in particular occupancies. Chemicals, spray painting, welding, combustible dusts, and flammable liquids are examples of special fire hazards.

Special hazards fire protection systems are designed to protect high risk areas from a fire. Special hazards can be costly equipment, irreplaceable assets, or hazardous materials. If any of these hazards are present in your building, traditional fire sprinklers may not be the right form of fire protection for you. Special hazards suppression systems are designed to protect the specific hazards within your property.

3.1.4 DRY CHEMICAL FIRE SUPPRESSION SYSTEMS

Dry chemical fire suppression systems have several key advantages over water-based solutions for a wide range of applications. This article entails everything you need to know about dry chemical systems.

A dry chemical fire suppression system is designed to immediately extinguish fires and reduce the chances of reignition. A great advantage dry chemical has over water-based systems is that it extinguishes fire without the disastrous consequences of water.

Dry chemical fire suppression systems use chemical compounds like sodium bicarbonate and mono-ammonium phosphate which are quick-acting extinguishants. While the former chemical effectively knocks down Class B and C fires, the latter is used for Class A, B, and C hazards.

Pressured dry chemicals, used in conjunction with the proper detection system, can extinguish a fire before it becomes detectable to the eye, thus protecting resources from damage and businesses from any major interruptions.

Fig 3.4: Dry chemical fire suppression systems

3.1.5 GASEOUS FIRE SUPPRESSION SYSTEMS

Carbon dioxide is a clean and non-flammable gas that is commonly used as a fire-extinguishing agent for areas that are not typically occupied by people. CO2 efficiently and effectively extinguishes fires without leaving any toxic or liquid residue that might damage property or equipment.

Broadly speaking, there are two methods for applying an extinguishing agent: total flooding and local application:

Systems working on a total flooding principle apply an extinguishing agent to a three dimensional enclosed space in order to achieve a concentration of the agent (volume percent of the agent in air) adequate to extinguish the fire.

These types of systems may be operated automatically by detection and related controls or manually by the operation of a system actuator.

Systems working on a local application principle apply an extinguishing agent directly onto a fire (usually a two dimensional area), or into the three dimensional region immediately surrounding the substance or object on fire. The main difference in local application from total flooding design is the absence of physical barriers enclosing the fire space.

In the context of automatic extinguishing systems, local application generally refers to the use of systems that have been emplaced some time prior to their usage rather than the use of manually operated wheeled or portable fire extinguishers, although the nature of the agent delivery is similar and many automatic systems may also be activated manually. The lines are blurred somewhat with portable automatic extinguishing systems, although these are not common.

Fig 3.5: Gaseous fire suppression system

3.1.6 FOAM FIRE SUPPRESSION SYSTEMS

Foam extinguishing systems are effective for rapidly controlling and extinguishing flammable liquid fires.

The “foam” in foam fire suppression systems is an extinguishing agent that can extinguish flammable or combustible liquid by cooling and separating the ignition source from the surface. The foam suppresses and smothers fire and vapor alike. It can also prevent reignition. It is also known as “firefighting foam.”

There are three types of foaming agent that have varying characteristics like expansion rate. These types include low, medium, and high expansion systems.

Expansion rate is the volume of finished foam divided by the volume of foam solution used to create the finished foam. For example, a ratio of 5 to 1 would mean that one gallon of foam solution after aeration would fill a 5-gallon container with the expanded foam agent.

Low expansion foams have the lowest viscosity, or thickness/consistency, and expand at a ratio of between 2 to 1 and 20 to 1. Medium expansion foams expand at a ratio of 20 to 1 and 200 to 1. High expansion foams have an expansion ratio above 200 to 1.

All foams can quickly cover large areas, but at varying rates and density. As a result, low expansion foams are typically Each offers its own level of protection that is based on the needs of the facility in which the system is set to protect.

Fig 3.6: Foam fire suppression system

This foaming agent is made up of small air-filled bubbles that have a lower density than water. Foam is made up of water, foam concentrate, and air. Different manufacturers have their own foam solutions and concentrate. The proportion of foam to water depends on the application.

3.2 CONCLUSION

The existing system uses either water or chemical components to extinguish fire but, neither of this is effective because water can't be used for electric use since it conducts electricity and use of chemical compounds leaves huge amount of reside and damages the product so we think the proposed system which uses sound to extinguish would be a better alternative.

CHAPTER 4

PROPOSED SYSTEM

4.1 INTRODUCTION

A server room is a room used to store, power, and operate computer servers and their associated components. This room is part of a data center, which typically houses several physical servers lined up together in different form factors, such as rack-mounted, tower, or blade enclosures. A data center might consist of several server rooms, each of which is used for separate applications and services.

If a fire occurs in the server room the existing fire extinguish technique uses a wet mixture of alkaline chemicals such as potassium carbonate, potassium acetate, or potassium citrate that turns into a foam, or water is used to extinguish the fire which damages the electronic and electrical components which can be prevented by our system. As our system uses acoustic waves to extinguish the fire.

4.2 DIGITAL IMAGE PROCESSING

The proposed work employs image processing where images are fed into the system by recognizing the fire in the targeted image space.

The RGB values of the input image are processed into the system that allows the image interpretation with the desired input. Here in our project, we use sound waves to extinguish the fire as a target. This target fire can be identified using the camera that feeds the input into the system that can be used to desired frequency sound waves to be given as output.

The main problem identified in this project is that the server room contains electrical components where liquid can’t be used as an extinguisher. If water or any kind of liquid substances are used to extinguish the fire, relative damage can be expected to the servers and other allied components. Some alternatives are present such as using foam as an extinguisher but they relatively provide some after-effects of leaving behind some residue to make it an obstacle to recover the data from the servers.

Thus, our idea is to use sound waves of a specific frequency tuned just to extinguish the fires in the target place. Using these sound waves is harmless to the data and other components in the target space. Image processing and sound amplification principles are used in this system and thus these concepts are very well interpreted and executed in our system. The sound waves are recorded in specific storage so that they can be generated when the input triggers the system to process the output.

Some specific trigger processes are manipulated in this proposed system where the extinguishment of fire is been calculated based on the input provided and the amount of output can be tuned to make it a perfect match to accomplish the proposed output.

Some general input devices used here are the image feed from the camera, the input feed from the processed image such as RGB values, and the control of sound frequency is the major work to be done on an input basis.

Sounds with specific frequency are required to be set before the output needs to be executed, to reach the perfect levels, the input-based system needs to be monitored using a specific memory storage device and the spatial work is been accomplished through the original image as input. Measuring some contrast and other parameters in the image is the major showstopper to the proposed system as the image needs to be further processed and refined so that unwanted fire triggers can be avoided. There can also be a separate image parameter monitoring part so that the trigger can be properly executed.

4.3 FREQUENCY OR PITCH OF THE SOUND WAVES

Frequency in a sound wave consults to the rate of the wavers of sound that travel through the air. This detail decides whether a sound is recognized as high-pitched or low-pitched. In sound, frequency is also known as Pitch. The frequency of the source of sound is calculated in cycles per second. Frequencies SI Unit is Hz and its definition is 1/T where T is the time period of the wave. The time required for the wave to complete one cycle is called the Period. The wavelength and frequency of sound waves are written mathematically as given below:

The velocity of Sound = Frequency * Wavelength

4.4 FIRE EXTINGUISHING METHODS

If the three parts of the fire triangle are kept in mind, extinguishing a small blaze should be a matter of common sense. The principles of fire extinction state that a fire will be put out if one of the three elements is removed, and this can be done using three different approaches. They are Cooling (Cooling the Burning Material), Starving (Removing Fuel from the Fire), and Smothering (Excluding Oxygen from the Fire).

Table 4.1: List of class, method, and suitable extinguishers for fire. The current method of fire fighting has many drawbacks such as being toxic to humans and leaving a residue (for dry chemical base fire extinguishers) while water-based fire extinguishing techniques freeze in cold climates and conduct electricity. Using sound waves with a certain frequency as a fire extinguisher will have advantages as they are not leaving any residues and toxic material behind.

Table 4.1: List of class, method, and suitable extinguishers for fire.

Class	Source	Method	Suitable Extinguishers
A	Paper Wood	Cooling blanketing	Water type (CO2cartridge type) Water (stored pressure type) Water bucket Sand bucket
B	Petrol	starvation	BCF CO2 Dry chemical power Sand bucket
C	LPG CNG	Smothering starvation	BCF CO2
D	Sodium phosphorus	smothering	Special Type DCF
E	Motors Transformer	Smothering Starvation	CO2 DCP
F/K	Oil	Blanketing	AFFF fire extinguisher

4.5 METHODOLOGY

This experiment will be focusing on the observation in the frequency range of 35–200 Hz (human hearing frequency) to confirm the results from previous research. The types of flames that are going to be tested are Solid combustibles including paper, cloth, plastic, metals, or electrical equipment to determine if it is needed to change the frequency to extinguish the flame. A collimator will be used to modify the intensity and direction of the sound wave in the experiments. The collimator will increase the intensity of the sound wave to a single point which will provide better results in suppressing the flame. An acoustic simulation will be executed before the experimental setup to study the propagation of the sound wave (acoustic waves), specifically to study the acoustic pressure and acoustic velocity profiles in the collimator.

4.6 DESIGN LAYOUT

The development of a fire extinguisher is initiated with the basic design approach. The key components include a frequency generator here a file of 54 Hz mp3 file is used, a power amplifier, a woofer, a power supply, and vortex cannon.

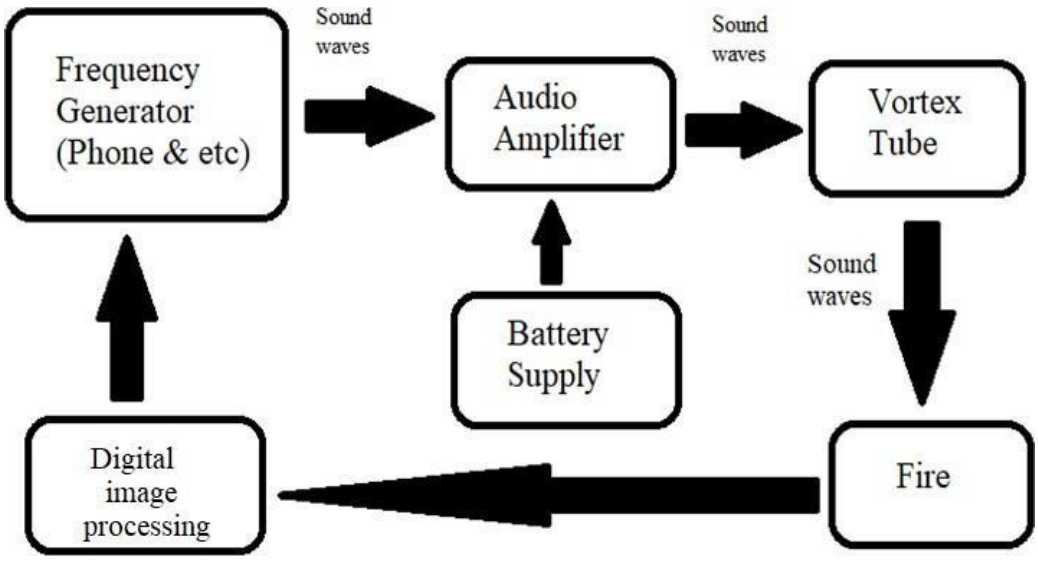

Fig 4.1 Block diagram.

4.7 WORKING PRINCIPLE

This concept utilized the scientific principle of physics and the engineering aspects of electronics to successfully suppress a flame. Based on the physical aspects of acoustic waves, it is important to understand that acoustic wave patterns are referred to as longitudinal pressure waves –meaning that the waves move in a back-and-forth vibrating motion in which they can agitate air molecules away from the fuel of the flame. Therefore, when the frequency waves are being directed at the source of a flame, it will decrease the pressure at the source, which in turn will decrease the temperature of the flame.

We have taken the above-said idea as a base for our model as the working principle of our model is to extinguish the fire using acoustic waves which are generated at 54 Hz, this frequency is particularly selected because it has given the best results among the efficiency range of 40 Hz to 60 Hz, which then gets its intensity multiplied which can be made possible by using an amplifier then the amplified acoustic sound waves are sent to the woofer, here the woofer is connected to a vortex cannon, the vortex cannon is used because the basic design of a woofer diverges the sound to maximum distance as it is most commonly used in home theatres and sound systems and not to extinguish the fire so for it to work for our purpose we have to use a vortex cannon which helps to converge the distorted waves and concentrate it at the core of the fire and displace the oxygen (O_2) which is a necessary component for the fire to continue burning or to ignite further and spread around to sum up when sound travels at a particular frequency that is between 40 Hz to 60 Hz and most efficiently at 54 Hz it displaces the oxygen (O_2) from the fire triangle and extinguishes the fire.

The above part explains how our system works and for the sensing part, we are using digital image processing which detects fire through a video that is being continuously captured by a camera that is connected to a system where the detection part is taken care of using some programming language and software like the OpenCV, etc. In our model, we have used a webcam and Python programming language with OpenCV which is then executed with the help of command prompt.

The program runs continuously until it detects fire when the fire is detected by our program through the webcam that is connected to the system that runs the code. Once the fire is detected it acts as a switch to the circuit that is connected to the system that runs the program where the program sends the file that contains the desired frequency (54 Hz) that is preloaded in the program, then the circuit becomes a closed-loop and then the process of amplification is done by the amplifier and sends to the woofer and thus extinguishes the fire with the help of the vortex cannon.

Here the sensing part acts as a switch that opens and closes the circuit depending on the detection of fire and the program acts as an initiator of the extinguishing process. This loop is open once the fire is detected and closed once the fire is extinguished.

The idea being implemented in a server room makes sense as the server room is a particular place where conventional either fails or damages components in detail methods like the usage of water on these will fail as server room which contains data and conducts electricity and the other to use chemical components to suppress fire which leaves a huge amount of residue which damages the data stored in the servers and leads to huge loss in the data. So, using the method of extinguishing the fire using acoustic waves can be a game-changer in the case of a fire outburst in a server room.

Fig.4.2 Damage caused by chemical fire extinguisher.

A server room already contains CCTV cameras for monitoring purposes and systems to monitor those cameras, as the cameras are kept for security reasons it mostly does not leave any blind spot behind it would be an amazing alternative for additional cameras as it can be used for digital image processing and the systems which are connected to them will be suitable for initiating our process which minor changes made.

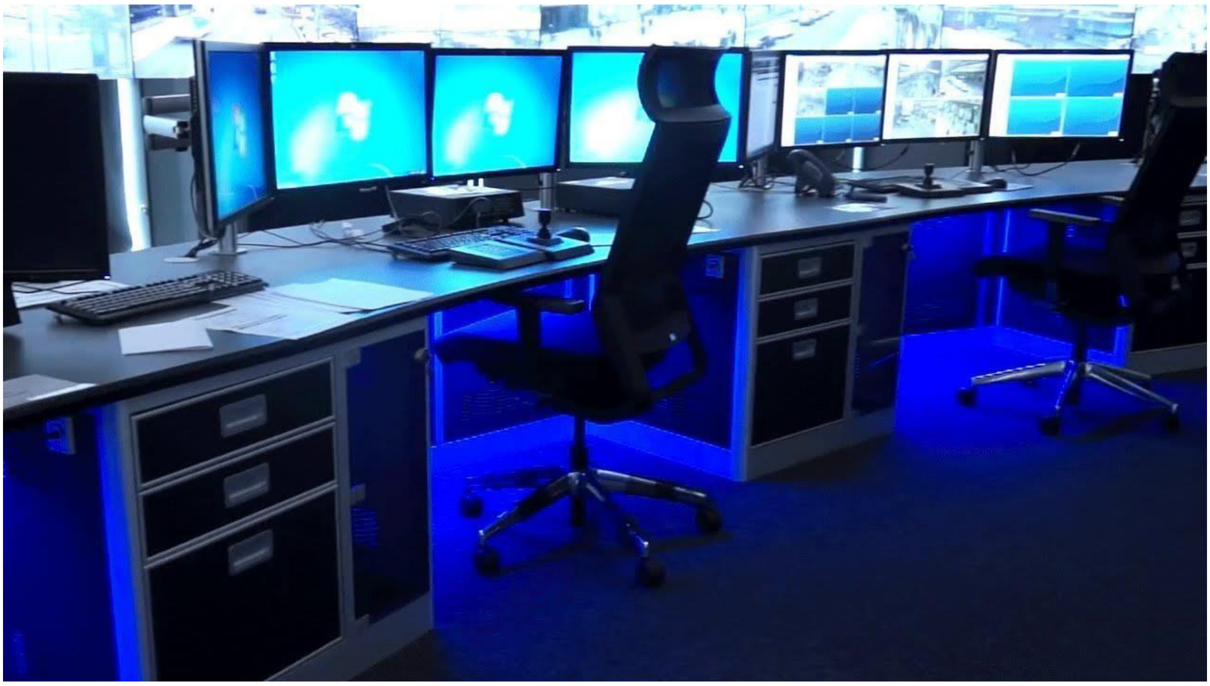

Fig 4.3 Surveillance room

Once the cameras and systems are set then we can connect multiple woofers to a single amplifier as we can set our woofers in a sprinkler system method with approximately 1 meter to 1.5 meters each to extinguish the fire by activating the nearby woofers.

Fig 4.4 Server room

When a fire occurs in a server room the CCTV camera act as a sensing element and triggers the power amplifier of the particular zone in which the fire occurs the gunning vortex cannon rotate the direction towards the fire to extinguish it. The effective distance of each vortex cannon is 1.5 meters so to cover the overall area distribution of each vortex cannon should be placed at a distance of 3 meters distance to cover the whole area.

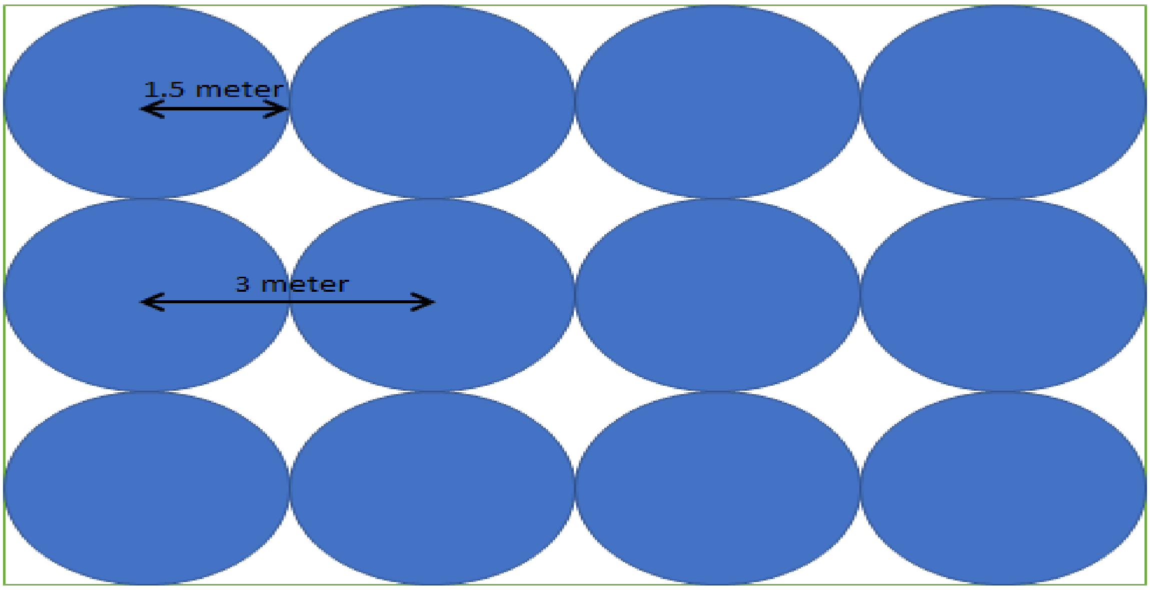

Fig.4.5 Vortex measurements

4.8 PROGRAM ALGORITHM

Step 1 : First we need import the CV2 which is the name for module import name for OpenCV- Python

Step 2: Then we need to save the Pre load data in the xml(extensible markup language) format to detect the fire with file name as 'fire_detection.xml'

Step 3 : After detection of fire we need generate acoustic waves by playing audio to stop the fire .For this process we need to save the audio in mp3 formag

Step 4 : In order to run the program we need to classify fire_detection.xml as variable called fire-case-case

Step 5: cap is variable which will take operation of capturing environment

Step 6 : Inside while loop we ought to create two variables gray and fire to classify color and detect the muti scale respectively

Step 7 : for loop will be used to detect the fire inside the rectangle frame

Step 8 : if fire is detected inside the rectangle then it results in playing audio.mp3

4.9 IMAGE IN WEBCAM:

4.9.1 Without lights:

Fig 4.6 Without light

Detection of fire without light using digital image processing.

4.9.2 With lights:

Fig.4.7 With light

Detection of fire with light using digital image processing

OUTPUT:

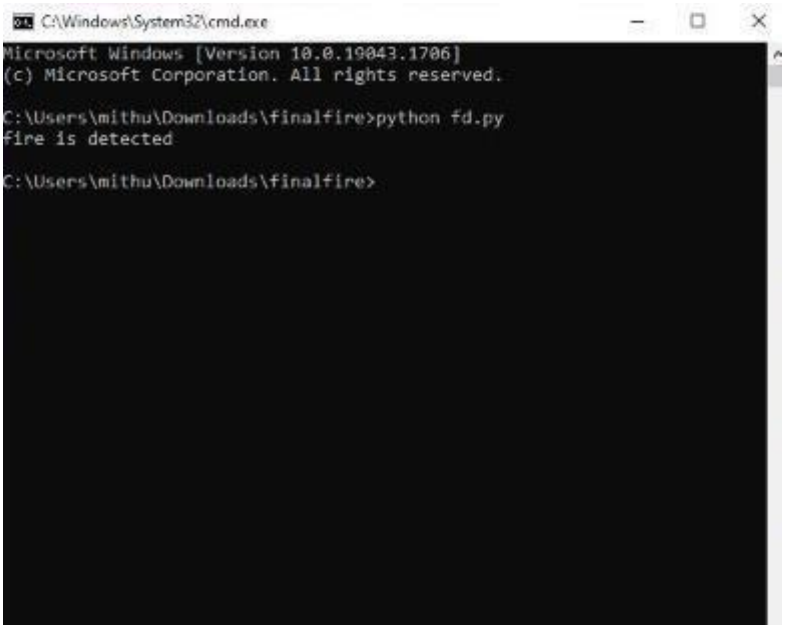

Fig 4.8 Output

SAMPLE OULINE OF OUR PROJECT

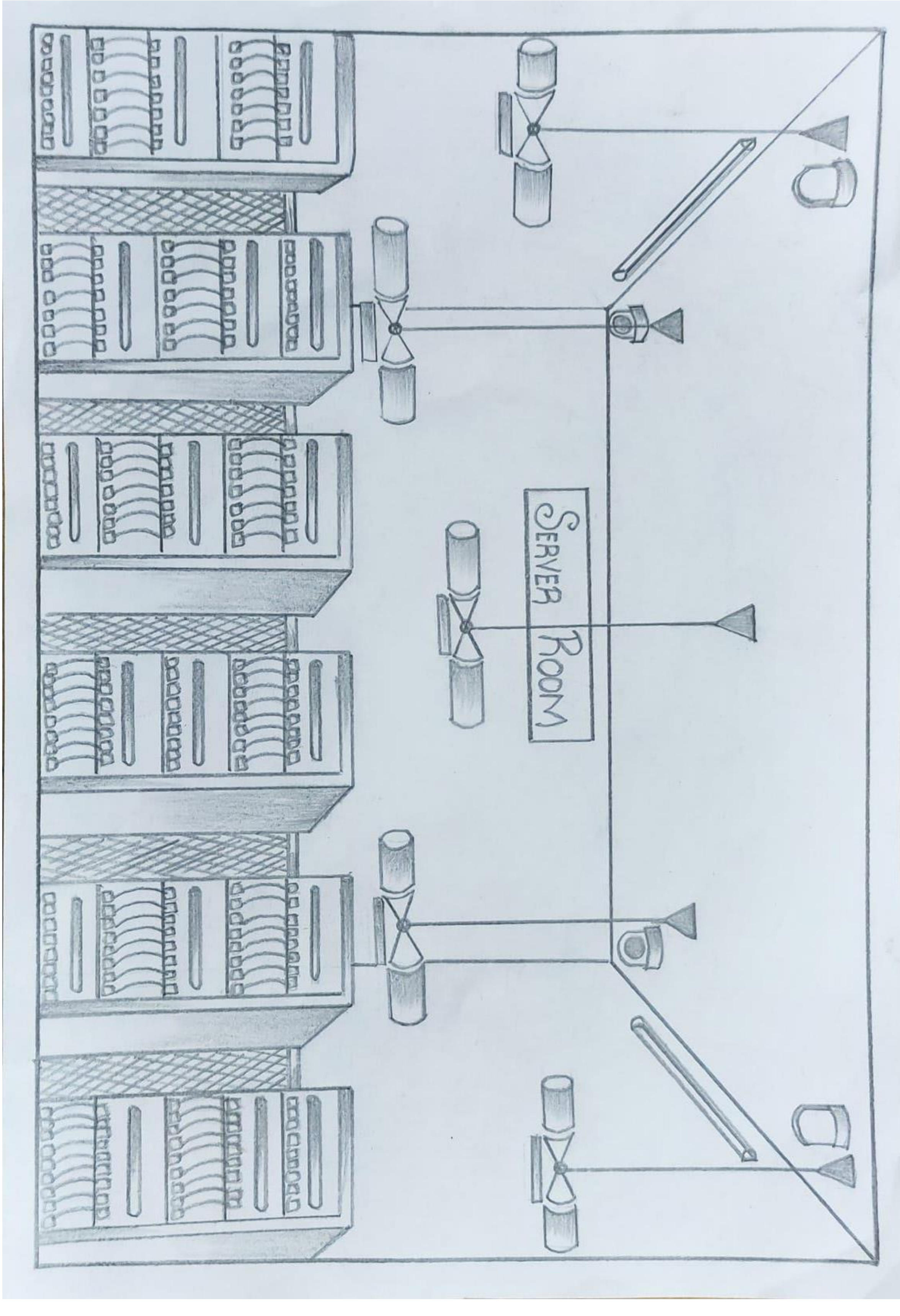

Fig 4.9 Project diagram

CHAPTER 5

HARDWARE & SOFTWARE IMPLEMENTATION

5.1 HARDWARE

The following compounds have been used for our hardware implementation.

- Transformer
- Power amplifier board
- Woofer
- Vortex tube
- Frequency generator
- Camera

5.1.1 TRANSFORMER

A transformer is a passive component that transfers electrical energy from one electrical circuit to another circuit or multiple circuits. A varying current in any coil of the transformer produces a varying magnetic flux in the transformer's core, which induces a varying electromagnetic force across any other coils wound around the same core. Electrical energy can be transferred between separate coils without a metallic (conductive) connection between the two circuits. Faraday's Law of induction, discovered in 1831, describes the induced voltage effect in any coil due to a changing magnetic flux encircled by the coil.

Transformers are used to change AC voltage levels, such transformers being termed step-up or step-down type to increase or decrease voltage level, respectively. Transformers can also be used to provide galvanic isolation between circuits as well as to couple stages of signal-processing circuits. Since the invention of the first constant-potential transformer in 1885, transformers have become essential for the transmission, distribution, and utilization of alternating current electric power. A wide range of transformer designs is encountered in electronic and electric power applications. Transformers range in size from RF transformers less than a cubic centimeter in volume, to units weighing hundreds of tons used to interconnect the power grid.

Various specific electrical application designs require a variety of transformer types. Although they all share the basic characteristic transformer principles, they are customized in construction or electrical properties for certain installation requirements or circuit conditions.

In electric power transmission, transformers allow transmission of electric power at high voltages, which reduces the loss due to heating of the wires. This allows generating plants to be located economically at a distance from electrical consumers. All but a tiny fraction of the world's electrical power has passed through a series of transformers by the time it reaches the consumer.

In many electronic devices, a transformer is used to convert voltage from the distribution wiring to convenient values for the circuit requirements, either directly at the power line frequency or through a switch mode power supply.

Signal and audio transformers are used to couple stages of amplifiers and to match devices such as microphones and record players to the input of amplifiers. Audio transformers allowed telephone circuits to carry on a two-way conversation over a single pair of wires. A balun transformer converts a signal that is referenced to ground to a signal that has balanced voltages to ground, such as between external cables and internal circuits. Isolation transformers prevent leakage of current into the secondary circuit and are used in medical equipment and at construction sites. Resonant transformers are used for coupling between stages of radio receivers, or in high-voltage Tesla coils.

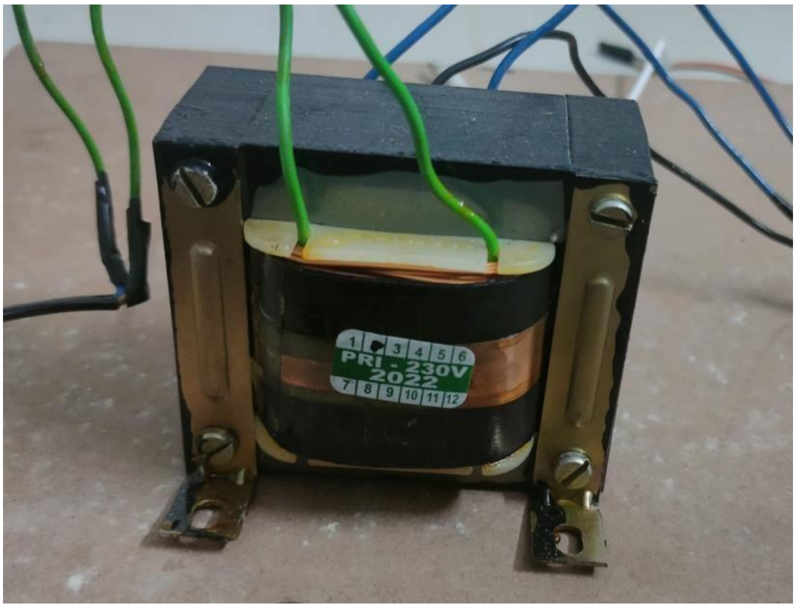

Fig 5.1 Transformer

SPECIFICATION FOR TRANSFORMER

Output Voltage	: 18 V
Input Voltage	: 230 V AC
Winding Material	: Copper
Output Current	: 5 A
Mounting	: Vertical Mount Type
Body Materials	: Brass

5.1.2 AMPLIFIER

An amplifier, electronic amplifier, or (informally) amp is an electronic device that can increase the power of a signal (a time-varying voltage or current).It is a two-port electronic circuit that uses electric power from a power supply to increase the amplitude of a signal applied to its input terminals, producing a proportionally greater amplitude signal at its output. The amount of amplification provided by an amplifier is measured by its gain: the ratio of output voltage, current, or power to input. An amplifier is a circuit that has a power gain greater than one.

An amplifier can either be a separate piece of equipment or an electrical circuit contained within another device. Amplification is fundamental to modern electronics, and amplifiers are widely used in almost all electronic equipment. Amplifiers can be categorized in different ways. One is by the frequency of the electronic signal being amplified.

For example, audio amplifiers amplify signals in the audio (sound) range of less than 20 kHz, RF amplifiers amplify frequencies in the radio frequency range between 20 kHz and 300 GHz, and servo amplifiers and instrumentation amplifiers may work with very low frequencies down to the direct current. Amplifiers can also be categorized by their physical placement in the signal chain; a preamplifier may precede other signal processing stages, for example. The first practical electrical device which could amplify was the triode vacuum tube, invented in 1906 by Lee De Forest, which led to the first amplifiers around 1912. Today most amplifiers use transistors.

Depending on the frequency range and other properties amplifiers are designed according to different principles.

Frequency ranges down to DC are only used when this property is needed. Amplifiers for direct current signals are vulnerable to minor variations in the properties of components with time. Special methods, such as chopper stabilized amplifiers are used to prevent objectionable drift in the amplifier's properties for DC. "DC-blocking" capacitors can be added to remove DC and sub-sonic frequencies from audio amplifiers.

Depending on the frequency range specified different design principles must be used. Up to the MHz range only "discrete" properties need be considered; e.g., a terminal has an input impedance.

As soon as any connection within the circuit gets longer than perhaps 1% of the wavelength of the highest specified frequency (e.g., at 100 MHz the wavelength is 3 m, so the critical connection length is approx. 3 cm) design properties radically change. For example, a specified length and width of a PCB trace can be used as a selective or impedance-matching entity. Above a few hundred MHz, it gets difficult to use discrete elements, especially inductors. In most cases, PCB traces of very closely defined shapes are used instead (strip line techniques).

The frequency range handled by an amplifier might be specified in terms of bandwidth (normally implying a response that is 3 dB down when the frequency reaches the specified bandwidth), or by specifying a frequency response that is within a certain number of decibels between a lower and an upper frequency (e.g. "20 Hz to 20 kHz plus or minus 1 dB").

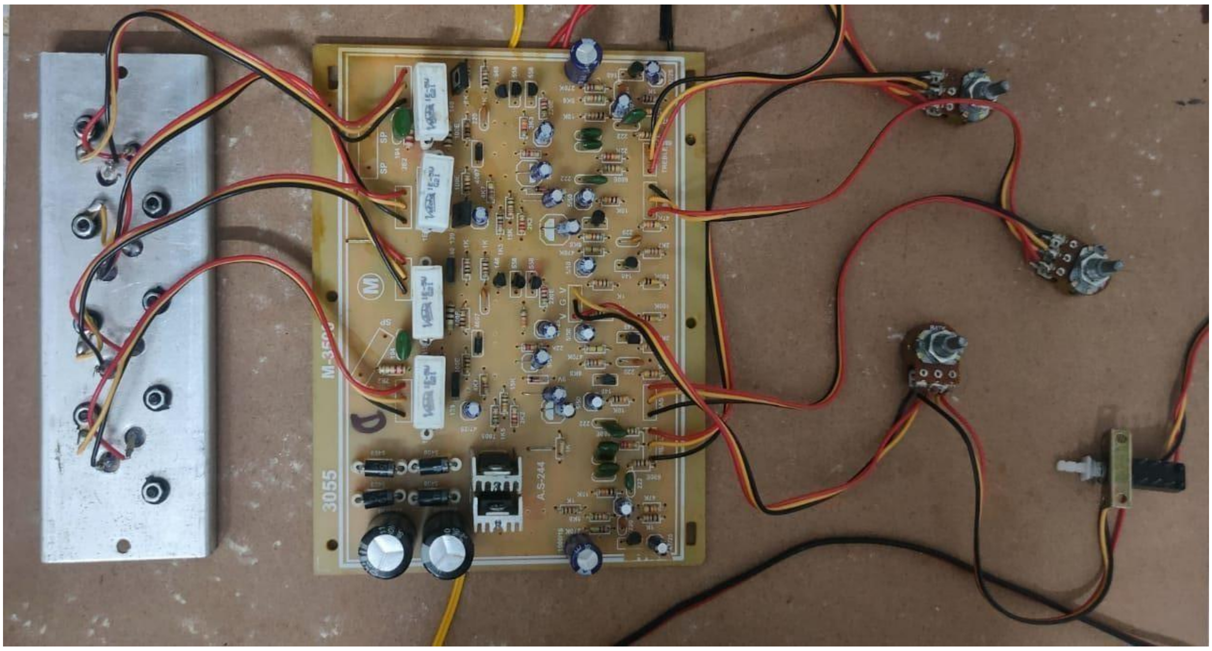

Fig 5.2 Amplifier.

SPECIFICATIONS FOR AMPLIFIER

Power	: 320 w
Model Name/Number	: 3055
Design	: Customized
Automation Grade	: Automatic
Voltage	: 36 V

5.1.3 WOOFER

A woofer or bass speaker is a technical term for a loudspeaker driver designed to produce low-frequency sounds. The voice coil is attached by adhesives to the back of the loudspeaker cone. The voice coil and the magnet form a linear electric motor. When current flows through the voice coil, the coil moves about the frame according to Fleming's left-hand rule for motors, causing the coil to push or pull on the driver cone in a piston-like way. The resulting motion of the cone creates sound waves, as it moves in and out.

At ordinary sound pressure levels (SPL), most humans can hear down to about 20 Hz. Woofers are generally used to cover the lowest octaves of a loudspeaker's frequency range. In two-way loudspeaker systems, the drivers handling the lower frequencies are also obliged to cover a substantial part of the midrange, often as high as 2000 to 5000 Hz; such drivers are commonly termed *mid woofers*. Since the 1990s, a type of woofer (termed subwoofer), which is designed for very low frequencies only, has come to be commonly used in home theatre systems and PA systems to augment the bass response; they usually handle the very lowest two or three octaves (i.e., from as low as 20 to 80 or 120 Hz).

At ordinary sound pressure levels, most humans can hear down to about 20 Hz. To accurately reproduce the lowest tones, a woofer, or group of woofers, must move an appropriately large volume of air — a task that becomes more difficult at lower frequencies. The larger the room, the more air the woofer's movement will have to displace in order to produce the required sound power at low frequencies.

Fig 5.3 Woofer

5.1.4 VORTEX TUBE

The vortex tube, also known as the Ranque-Hilsch vortex tube, is a mechanical device that separates a compressed gas into hot and cold streams. Pressurized gas is injected tangentially into a swirl chamber and accelerated to a high rate of rotation. Due to the conical nozzle at the end of the tube, only the outer shell of the compressed gas is allowed to escape at that end. The remainder of the gas is forced to return in an inner vortex of reduced diameter within the outer vortex.

This activity is designed to get students thinking about what happens when air moves. Sometimes it is difficult to think about air and what it does because it is invisible. The air cannon is a way to 'see' air as it moves objects within its 'blast zone. The air that shoots out of the cannon is a vortex of air similar to rings of smoke sometimes blown by smokers. A vortex is a spinning flow of fluid or gas. Water going down the drain and the air in a tornado form vortices in the shape of funnels.

The air cannon vortex is a donut shape or, mathematically, a torus. The air in the donut rolls from the center to the edge. The air forms this shape because the air leaving the cup at the center of the hole is traveling faster than the air leaving around the edge of the hole. The air keeps its shape since the surrounding air is relatively slow-moving (and under higher pressure).

Vortex tubes have lower efficiency than traditional air conditioning equipment. They are commonly used for inexpensive spot cooling, when compressed air is available.

An air vortex cannon works primarily by applying force quickly and efficiently to air molecules contained in a semi-enclosed space. When the stretchy balloon surface at the back of the cannon snaps forward, it collides directly with air molecules, accelerating them towards the opening of the cannon and setting off a chain reaction of high-speed collisions with other air molecules and the sides of the cannon’s barrel. The only way for all of these colliding high-speed air molecules to escape is out through the opening at the end of the barrel. The rapid escape of the air molecules forms a stream, or jet, of air that flows straight out of the cannon.

Vortex tubes are used for cooling of cutting tools (lathes and mills, both manually-operated and CNC machines) during machining. The vortex tube is well-matched to this application: machine shops generally already use compressed air, and a fast jet of cold air provides both cooling and removal of the chips produced by the tool. This completely eliminates or drastically reduces the need for liquid coolant, which is messy, expensive, and environmentally hazardous.

Fig 5.4 Vortex tube

5.1.6 FREQUENCY GENERATOR

A frequency generator is one of a class of electronic devices that generates electronic signals with set properties of amplitude, frequency, and wave shape. These generated signals are used as a stimulus for electronic measurements, typically used in designing, testing, troubleshooting, and repairing electronic or electroacoustic devices, though it often has artistic uses as well.

A function generator is usually a piece of electronic test equipment or software used to generate different types of electrical waveforms over a wide range of frequencies. Some of the most common waveforms produced by the function generator are the sine wave, square wave, triangular wave and sawtooth shapes. These waveforms can be either repetitive or single-shot (which requires an internal or external trigger source). Integrated circuits used to generate waveforms may also be described as function generator ICs.

In addition to producing sine waves, function generators may typically produce other repetitive waveforms including sawtooth and triangular waveforms, square waves, and pulses. Another feature included on many function generators is the ability to add a DC offset.

Although function generators cover both audio and RF frequencies, they are usually not suitable for applications that need low distortion or stable frequency signals. When those traits are required, other signal generators would be more appropriate.

Some function generators can be phase-locked to an external signal source (which may be a frequency reference) or another function generator.

Function generators are used in the development, test and repair of electronic equipment. For example, they may be used as a signal source to test amplifiers or to introduce an error signal into a control loop. Function generators are primarily used for working with analogy circuits, related pulse generators are primarily used for working with digital circuits.

There are many different types of generators with different purposes and applications and at varying levels of expense. These types include function generators, RF and microwave signal generators, pitch generators, arbitrary waveform generators, digital pattern generators, and frequency generators. In general, no device is suitable for all possible applications.

In our project we use audio file which contain sound which generate frequency of 54 HZ. To extinguish the fire.

An electronic circuit element that provides an output proportional to some mathematical function (such as the square root) of its input; such devices are used in feedback control systems and in analog computers

5.1.6 CAMERA

A webcam is a video camera that feeds or streams an image or video in real-time to or through a computer network, such as the Internet. Webcams are typically small cameras that sit on a desk, attach to a user's monitor, or are built into the hardware.

The term "webcam" (a clipped compound) may also be used in its original sense as a video camera connected to the Web continuously for an indefinite time, rather than for a particular session, generally supplying a view for anyone who visits its web page over the Internet. For example, those used as online traffic cameras, are expensive, rugged professional video cameras.

The term "webcam" (a clipped compound) may also be used in its original sense of a video camera connected to the Web continuously for an indefinite time, rather than for a particular session, generally supplying a view for anyone who visits its web page over the Internet. Some of them, for example, those used as online traffic cameras, are expensive, rugged professional video cameras.

Webcams typically include a lens, an image sensor, support electronics, and may also include one or even two microphones for sound.

Digital imaging solutions are becoming increasingly important due to the development and proliferation of imaging-enabled consumer electronic devices, such as digital cameras, mobile phones, and personal digital assistants. Because its performance, flexibility, and reasonable expenses digital imaging devices are used extensively in applications ranging from computer vision, multimedia, sensor networks, surveillance, automotive apparatus, to astronomy.

Information about the visual scene is acquired by the camera by first focusing and transmitting the light through the optical system, and then sampling the visual information using an image sensor and an analog-to-digital (A/D) converter. Typically, zoom and focus motors control the focal position of the lens. Optical aliasing filter and an infrared...

The webcam captures the thermal image and analysis whether the fire is detected.

Fig 5.5 Web Cam

5.2 SOFTWARE

5.2.1 OPEN CV WITH PYTHON

OpenCV (Open Source Computer Vision Library) is a library of programming functions mainly aimed at real-time computer vision. Originally developed by Intel, it was later supported by Willow Garage then It sees (which was later acquired by Intel). The library is cross-platform and free for use under the open-source Apache 2 License. Starting in 2011, OpenCV features GPU acceleration for real-time operations

OpenCV is written in C++ and its primary interface is in C++, but it still retains a less comprehensive though extensive older C interface. All of the new developments and algorithms appear in the C++ interface. There are bindings in Python, Java, and MATLAB/OCTAVE. The API for these interfaces can be found in the online documentation. Wrappers in several programming languages have been developed to encourage adoption by a wider audience. In version

3.4, JavaScript bindings for a selected subset of OpenCV functions were released as OpenCV.js, to be used for web platforms.

cv2 is the module import name for OpenCV-python, "Unofficial pre-built CPU-only OpenCV packages for Python". The traditional OpenCV has many complicated steps involving building the module from scratch, which is unnecessary. I would recommend remaining with the OpenCV-python library.

cv2 (old interface in old OpenCV versions was named as cv) is the name that OpenCV developers chose when they created the binding generators. This is kept as the import name to be consistent with different kind of tutorials around the internet.

OpenCV is an essential part of the computer vision community and using it we can build thousands of amazing applications. You might have thought that some of these applications are used by us in day-to-day life.

And we use “Python” to run our project.

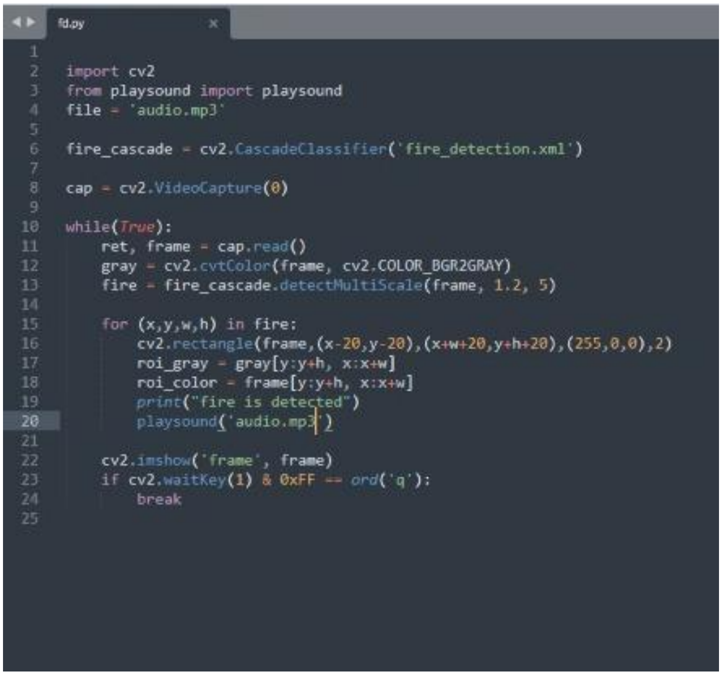

Fig 5.6 OpenCV with Python

CHAPTER 6

RESULTS AND DISCUSSION

6.1 OPTIMIZATION OF FREQUENCY

It was stated that the optimum sound frequency for fire extinction is 60 Hz. According to a sound lens for a sound fire extinguisher, the sound fire extinguisher needs to produce a low-frequency sound of less than 100 Hz. This experiment will be focusing on the observation in the frequency range of 30–100 Hz. So, the first stage of the experiment is conducted to confirm the frequency found in previous research. A candle flame was first tested to initiate the experiment. The sound wave was able to extinguish the candle between 48 Hz and 60Hz. An optimum distance, 30cm, is assumed by trial and error method and the candle flame is extinguished by using all the above frequencies and the time needed to extinguish the fire. A graph is plotted by using this data.

Table 6.1: Frequency-time table for three experiments.

Frequency (Hz)	Expt.1	Expt.2	Expt.3	Avg. (Time taken in sec.)
48	1.873973	1.968774	1.734569	1.859105
49	1.634783	1.220414	1.567894	1.474363
50	1.100341	1.125721	1.394567	1.206876
51	0.956895	0.938701	1.189546	1.028380
52	0.803614	0.892493	0.938597	0.878234
53	0.692591	0.738588	0.893752	0.774977
54	0.756975	0.823924	0.997587	0.859495
55	0.861255	0.864036	1.012395	0.912562
56	0.963842	0.938701	1.093701	0.998575
57	1.195678	1.192396	1.182321	1.190131
58	1.253793	1.210357	1.204059	1.222736
59	1.298798	1.287314	1.289125	1.291745
60	1.303614	1.293829	1.310456	1.302633

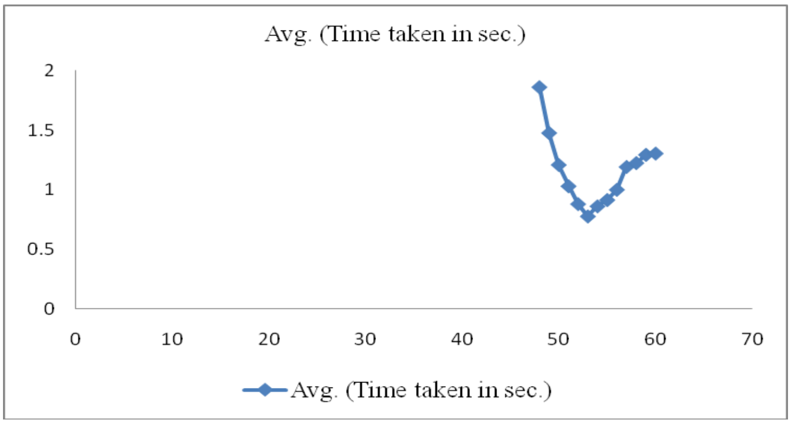

Fig 6.1: Variation of time with frequency

The sound wave was able to extinguish the candle at 53 Hz within 0.774977sec. Figure 6.1 shows the sequence of high-speed images of candle flame leading to flame extinction. It can be seen that the flame boundary resonates (back and forth) with the sound wave. After a certain period, the flame boundary slowly thins due to varying high and low pressure, which induces air velocity and causes flame extinction.

6.2 EFFECT OF TIME TAKEN ON DISTANCE

Now, 53-54Hz is used to test the change of time taken to extinguish the firewith the distance between the vortex tube and flame. Its graph is shown

Table 6.2 Effect of time taken on distance.

Distance (cm)	Time Taken(sec.)
10	0.424912
20	0.556813
30	0.723569
40	0.783265
50	0.893569
60	0.938645
70	1.038241
80	1.278459
90	1.438714
100	1.578108

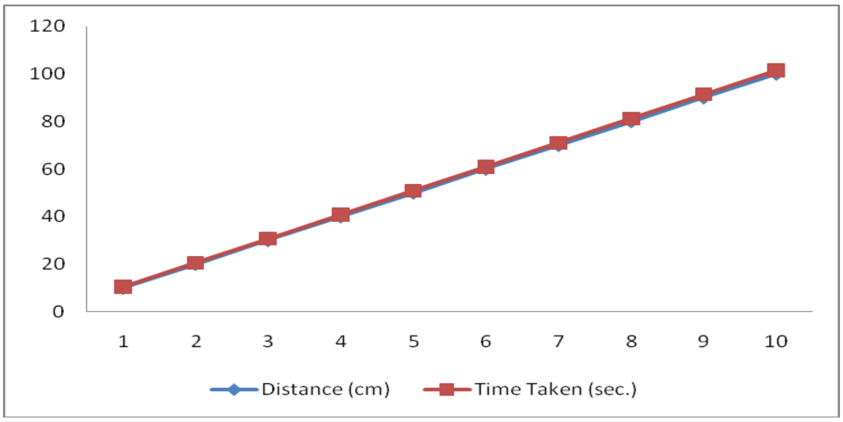

Fig.6.2: Effect of time taken on the distance between the vortex tube and flame

The graph shows that the shape of the curve is linear. So the distance between the vortex tube and flame increases the time taken to extinguish fire also increases.

6.3 CONCLUSION

Here the experiment is conducted at 53-54 Hz for different distances between the flame and the tip of the vortex tube and time taken for flame to extinguish is recorded from this data we can infer that with increases in distance, the time taken for extinguish the fire increases linearly which shown in fig 6.2.

CHAPTER 7

CONCLUSION AND FUTURE SCOPE

7.1 CONCLUSION

The idea of extinguishing the fire with sound can be an innovative one, however, it is efficient and effective, and can be used in today's world. The frequency range at which the flame can be suppressed effectively is 40-60 Hz. However, in these experiments, the flame boundary created was relativity small as compared size or sound intensity of the speaker and does represent a real fire related accident. This is mainly due to the concern of safety issues as a larger flame could lead to uncontrollable accidents.

Nevertheless, this sound wave-based fire extinguishing could be used to extinguish initial stage fires. With many possible applications, fighting fire with sound is a promising venue. In order to extinguish large area flames acoustically using the current setup, either a larger or more powerful speaker would need to be used. Directly increasing the output power of a speaker will cause signal distortion of the output signal. One can multiplex speakers to achieve extinction of larger flames, however, the practically of such a system comes into question. Hence there is a need for further research investigation to attempt for large fire extinguishers.

In the experimental part, different parameters could be used to further explore is study such as using different intensity of sound (by using different speaker power rating), positioning of sound towards the fire source and size of flame (or flame intensity) & varying design of vortex tube. The idea of extinguishing fire with sound is a novel one. A small fire which is left untreated leads to a bigger one. The proposed system will indeed be useful in fighting fire in multilevel information conveyance capabilities so that a bigger disaster can be avoided.

7.2 FUTURE SCOPE

The device can be automated by using any android application in order to control the waves. Mobile phones can also be used as a computing tool for the generation of the waves. These devices will have a receptor medium that is capable of sending and receiving signals. These devices are configured to operate in full-duplex, whereby they are capable of sending and receiving signals at the same time. Another main scope is this device can be mounted to a moving robot prototype system and the robot is controlled through User Voice Command. The voice input allows a user to interact with the robots which controls the movements of the robot.

This Robot can be used in rescue operations during fire accidents where the possibility for servicemen to enter the fire prone areas is very less. The Controller can be interfaced to the Bluetooth module through UART protocol. Based on commands received from Android the motion of robot can be controlled.

A booster can be attached to the vehicle to make it a powerful extinguisher. For security purposes, authentication for accessing the robot can also be done. A piston spray can be used which uses the concept of formation of mist as a heat absorbing ability to reduce heat. The vehicle can be mounted with a thermal camera so that auto detecting of heat areas is made possible and live images of the incident can be seen through a wireless camera. GPS enabling can be done so that the vehicle can be controlled from a remote place. This device specifically uses new ways of tackling fires in enclosed spaces, such as aircraft cockpits and ship hold, kitchen, hospitals and shopping malls, Industry, and railways where fires are obviously devastating and incredibly difficult to control. Generally, when fire is caused in an electrical panel circuit, using water is not possible as water conducts electricity, thus using sound waves to extinguish fire is one of its main applications

APPENDIX

```
## import cv2
## from playsound import playsound
## file = 'audio.mp3'
## fire_cascade = cv2.CascadeClassifier('fire_detection.xml')
## cap = cv2.VideoCapture(0)
## while(True):
### ret, frame = cap.read()
### gray = cv2.cvtColor(frame,cv2.COLOR_BGR2GRAY)
## fire =fire_cascade.detectMultiScale(frame, 1.2, 5)
## for (x,y,w,h) in fire:
### cv2.rectangle(frame,(x-20,y-20),(x+w+20,y+h+20),(255,0,0),2)
### roi_gray = gray[y:y+h, x:x+w]
### roi_color = frame[y:y+h, x:x+w]
### print("fire is detected")
### playsound('audio.mp3')
## cv2.imshow('frame', frame)
### if cv2.waitKey(1) & 0xFF == ord('q'):
### break
```

This is the program that we use to sense the image and run the frequency generator to off the fire by using sound waves.

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