FIRE EXTINGUISHER ROBOT USING FIREBALL AS EXTINGUISHER

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Abstract - *Fire based accidents are the most dangerous and dreaded compared to others. It usually results in higher casualty and loss of property. The fire being spread isn't easily controllable in a room where a lot of properties are kept. To control this fire, we are supposed to rely on human firefighters. Human firefighters are prone to a lot of diseases in the long run and the tasks they are supposed to carry out can lead to burn injuries and even death. Even the fire extinguishing techniques being used like spraying water and foam isn't capable to control fire quickly and at times water acts an oxidizing agent. A robot being used as a firefighter instead of human will reduce the danger factor and it can access any dreaded zone with maximum ease. Instead of water and foam, fireball is being used as the extinguishing medium as it is light weight and can cover large area in a closed room as it bursts in 3 seconds getting in contact with the fire. The robot can find human presence using camera and if found, that area can be extinguished and as fireball is used to extinguish, no harm occurs to that human. Water sprayed with high pressure can cause serious injuries and this will prevent such a chance.*

Key Words: **Raspberry Pi 4, Servo Motors, High RPM Motors, Ball Shooter, Pi Camera, Fireball, PCA 9685.**

1. INTRODUCTION

Accidents related to a fire or explosion can be some of the most unexpected and devastating experiences that can occur in a person's life. The effects can be tragic and can often cause a massive loss of money and lives. These events can result in injury, property damage and even death.

1.1 CAUSES OF FIRE

The investigation into the actual cause of an explosion or fire involves complex analysis into the origins and causes. Explosions and fires may be caused by a multitude of factors, but experts have found that common causes of explosions and fires include, but are not limited to the following:

- Faulty electrical appliances
- Gas leaks
- Grain & industrial dust
- Auto accidents
- Aviation accidents

1.2 BURN INJURIES

Burn injuries are one of the most painful and traumatic injuries that a person can suffer. Second degree or third degree burn injuries can require long term hospitalization, multiple skin grafting operation and long term psychological counseling to be able to cope with the emotional and physical trauma of this terrible experience. Permanent scarring, especially on the face or hands, is especially difficult to accept. The effect on the victim's family is likewise devastating and permanent scars are a constant reminder of the traumatic accident. Burn injuries may cause wounds and scars that require plastic and reconstructive surgery.

1.3 FIRE FIGHTER

A firefighter is a rescuer extensively trained in firefighting, primarily to extinguish hazardous fires that threaten life, property and the environment as well as to rescue people and animals from dangerous situations. The complexity of modern, industrialized life has created an increase in the skills needed in fire fighting technology.

1.4 FIRE SUPPRESSION

A fire burns due to the presence of three elements: fuel, oxygen and heat. This is often referred to as the fire triangle. Sometimes it is known as the fire tetrahedron if a fourth element is added: a chemical chain reaction which can help sustain certain types of fire. The aim of firefighting is to deprive the fire of at least one of those elements. Most commonly this is done by dousing the fire with water, though some fires require other methods such as foam. Firefighters are equipped with a wide variety of equipment for this purpose that include: ladder trucks, pumper trucks, tanker trucks, fire hose, and fire extinguishers.

1.5 DIRECT RISKS

Firefighters often carry personal self-rescue ropes. The ropes are generally 30 feet long and can provide a firefighter (that has enough time to deploy the rope) a partially controlled exit out of an elevated window. Lack of a personal rescue rope is cited in the deaths of two New York fire fighters lost their life. Second risk is that it can lead to burn injury due to direct contact with fire.

1.6 LONG TERM RISKS

1.6.1 CARDIOVASCULAR DISEASE

Firefighting has long been associated with poor cardiovascular outcomes. The most common cause of on-duty fatalities for firefighters is sudden cardiac death. In addition to personal factors that may predispose an individual to coronary artery disease or other cardiovascular diseases, occupational exposures can significantly increase a firefighter's risk.

1.6.2 CANCER

Younger firefighters (under age 65) also developed bladder cancer and prostate cancer at higher rates than the general population. The risk of bladder cancer may be present in female firefighters. Firefighters are exposed to a variety of carcinogens at fires, including both carcinogenic chemicals and radiation.

2. EXISTING SYSTEM

Explosion-Proof extinguishing and scouting robot can shoot water the length of a football field (85m at 1.2Mpa) It can be remotely controlled up to 3 Kms in line of site, 500m when there is an obstruction. The robot is fitted with heat eye detection, though infrared thermal imaging to monitor and track of heat source. The strong crossing and climbing ability ensures the machine can counter different terrains.

Fig 2.1: Explosion-Proof extinguishing and scouting robot

2.1 FEATURES

• Heat resistant, flame retardant rubber, track internal adopts metal frame. Even if the external rubber melts under high temperature, the its walking stability are not affected.

• With double water hose and the anti-knot design;

• It can drag two 60m long water hoses that are filled with water.

• With the design of high-temperature resistance, which comes with automatic double water curtain cooling system

• Remote control of water cannon for rotation and pitching, large flow, high range, multiple injection modes;

• Water cannons with automatic spraying function

• With the switch between water mist and foam;

• With high-definition wireless image transmission system, which realizes the remote real-time video surveillance in line-of-sight and non-line-of-sight (line-of-sight 3km, non-lineof-sight 500m);

• Long distance communication and strong anti-interference ability;

• Strong obstacle-crossing ability, which can climb and cross obstacle trough large angle;

• Independent suspension shock mitigation system;

2.2 DESIGN ISSUES

• It can't climb to top of multistoried buildings

• The hose length is limited and can't be taken to height greater than 60m

• Water and foam won't be able to cover large area

• With height, pressure of pumping decreases and so the fire extinguishing ability decreases

•If a person is trapped inside the place and if high pressure water is sprayed over him/her, there are chances for severe injuries

•The robot needs to be water cooled if made to work for a long time

•The robot is supposed to take 2 hoses which is of the length 60 m and that creates overhead on the robot

•The robot is not capable of detecting human presence

3. PROPOSED SYSTEM

The system consists of two parts,

3.1 Robot

3.2 Fireball

3.1 Robot

The Robot is made up of aluminum and it is coated using fireproof materials to avoid damage to the robot by fire and it will resist heat. As the robot have wheels that it can move faster through the long corridor. It has legs to walk and to climb the steps. The robot has the height below 2 meter so it can move and do works easily. The robot has hands added with the metal cutter to cut the walls or any other blockage. The robot is provided with the ability to climb heights via pipeline and all and reach the room and once entered it checks the human presence using the heat detection camera and as the fire gets sensed the, fire extinguishing ball is shooted and the ball on falling into fire, bursts in 3 sec and it covers a distance upto 9.2 cubic meters. As human presence is detected the message is sent to concerned authorities for rescue. As the fire gets controlled, the authorities can easily rescue the person in danger. Head of the robot has camera to view the surroundings.

Components used to create robot are;

- Raspberry pi 4
- Servo motors
- Servo motor controller
- High RPM motor
- Pi Camera

Table 3.1: List of components required

Sl.No	Part	Component Name	Numbers
1	Overall Control	Raspberry Pi 4	1
		PCA 9685	2
2	Head	Pi Cam	1
		SG 90	1
3	Hand	MG996R	4
4	Leg	MG996R	4
		High RPM Motors	2
5	Shooter	High RPM Motors	2

3.2 Fireball

Instead of water and foam we are using fire extinguishing balls to control the fire. The ball is shooted over the place on fire and it bursts in 3 sec with a bash. It can cover about 9.2 Cubic Meters in a single burst.


Fig 3.1: Fireball

The ball is well made and of high quality material. It is lightweight. The Fire Ball is made to be safe around humans, animals and property when activated. Common handing, physical touch, hard knocks or dropping, vibration, heat or smoke will not activate the Fire Ball making it very safe overall. The agent used inside the ball is a 94% MAP (mono ammonium phosphate) active material –dry chemical powder, It is environmentally friendly and safe for humans, plants and animals.

4. WORKING

Hardware:

There are various modules depicting the functional parts of the robot along with the components being used. The modules are depicted using block diagrams, they are as follows:
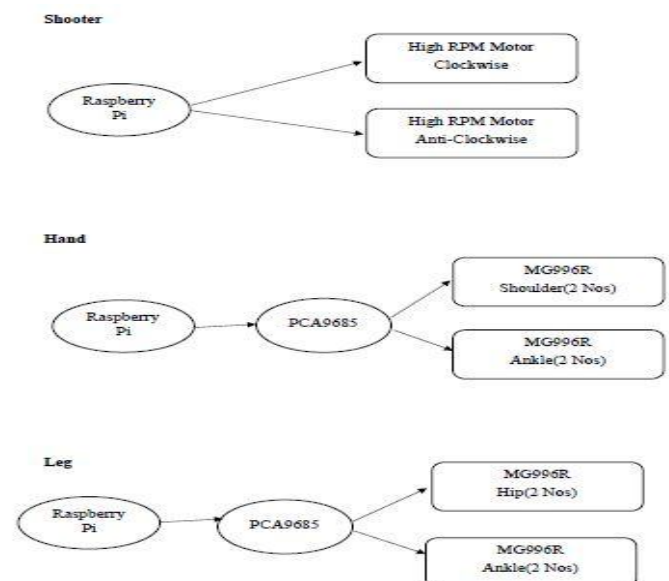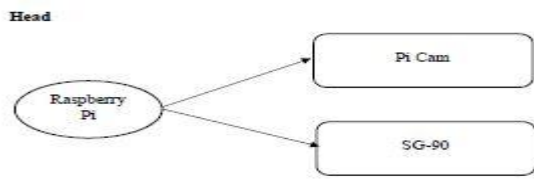
Fig 4.1: Block Diagram of functional modules

Software: Raspberry has an OS of it's own called **Raspbian** which is loaded with a number of programming languages. The robots functional parts are configured and operations to be performed coded in **Python** as it supports multiple programming paradigms, including procedural, object-oriented, and functional programming. The robot works based on the commands by the controller.

5. CONCLUSION

The presence of fire extinguishing ball over water and foam prevents the overhead on the robot. It doesn't need to be cooled using water during the task as it doesn't have overhead of carrying things like water hoses to long destination as in the existing system. The ball is light weight so the robot can easily carry it. The robot being provided with camera, can check for the presence of human in the room or building where fire occurred and assure no life is lost due to such an accident. Even if human presence is detected in the fire, the robot can extinguish the fire at that place and let the concerned authority know so that person won't lose his life There are no chances for injuries on pets and human if present. The robot prevents the overhead on firefighters and prevent chances of getting injured due to fire.

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