FIRE FIGHTING ROBOT

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Abstract- Nowadays, fire accidents are very common and sometimes it becomes very difficult for a firefighter to save a person's life. It is impossible to appoint a person to keep an eye on a fire hazard where robots can do that. So in such cases a fire-fighting robot comes into play. A robot can detect a fire in the distance. These robots are very useful in industries where the risk of fire hazard is higher. The proposed vehicle can detect the presence of a fire and extinguish it automatically using a gas sensor and a temperature sensor. It consists of gear engines and a car driver to control the movement of the robot. The transmission circuit is used to control the pump and when it detects a fire it will communicate with a microcontroller (Arduino UNO R3) via a Bluetooth module. The proposed robot has a water jet spray that can spray water. The sprinkler can go where it needs to .When going to the fire source it may encounter certain obstacles, and then have the ability to avoid the obstacle. It will provide arduino performance GUI using android. It detects obstacles using ultrasonic sensors up to 80 m high. The connection between the phone and the robot will be possible via Bluetooth which will have a GUI to control the movement of the robot. When the phone is first connected to Bluetooth it will set the module name, baud rate. It is possible to use Bluetooth connectivity between smartphones and microcontrollers. An Android-controlled robot can be easily used in everyday life such as homes, markets, companies etc. Building Android apps on Android SDK is easy and free.

Index Terms- fire fighting Robot, microcontroller,Arduino IDE, Tracking System

I. INTRODUCTION

The robot is a human-like machine and performs many complex tasks. There are many types of robots such as fixed base robot, mobile robot, underwater robot, personal robot, space robot and medicine robot etc. In this paper it is proposed that the VIOLENCY Robot. The robot is fitted with a multi-flame sensor that is used to detect local fire and provides signals on a small controller to activate a water spray pump to extinguish a fire. This robot can be controlled using a cell phone / remote control via Bluetooth / rf / wifi. It can also work with autonomous mode. This robot uses the concept of natural fire sensor, vehicle control equally. The relay driver is used for dual control of motor-mounted motors. All movement control instructions are given to the robot with the help of a cell phone. Thus, the robot processes information from its various important hardware components such as the fire sensor with the Arduino Uno (microcontroller) board. Robot editing is done using arduino C based on languages C and C ++.

Fire extinguishing systems are robots designed with specific functions in mind. These include fire detection and recovery, search and rescue, emergency dynamic monitoring and the main function of fire control and firefighting. Fixed fire extinguishing systems, such as automatic fire sprinklers and alarms, are used in crowded and dangerous areas to quickly extinguish any threat. These are usually simple systems that rely heavily on UV or IR sensors and, as the name suggests, are fixed. Robotic fire extinguishing systems are another type, especially in the case of remote vehicles attached to fire extinguishers such as water or foam pipes. These are able to navigate in unsafe environments by means of multiple sensors, a built-in camera, IR and additional technology that transmits navigation information to a remote operator. Safety experts and engineers even experiment with airborne robots to gain more insight into the environment, as well as in-house robots that can extinguish fires in the immediate vicinity. The following are some real-life advancements in firefighting robots that can reduce the number of injuries and fatalities caused by fire.

1. Thor/Saffir
2. Thermite Robot
3. Turbine Aided Firefighting Machine (TAF 20)
4. Fire Ox

II. REQUIREMENT ANALYSIS

The basic premise of this paper is to detect a natural fire and extinguish it with the help of a water pump. Board of Arduino UNO Microcontroller based on ATmega328P. The ATmega328P is a great platform for robots. So real-time firefighting can be done. Arduino software works on various platforms like mac, windows and Linux. A simple and clear program is possible with Arduino software. Arduino libraries play a major role in making the system easier by providing comprehensive libraries. There are many built-in libraries available in Arduino software and it allows you to add additional libraries available from open source for download. Adding new boards to Arduino software is possible. As such, Arduino C is based on the C and C ++ system and is much simpler compared to other control systems.

The main objective of this project is to develop a RF portable / controlled fire extinguisher that detects the area of the fire and extinguishes the fire by using sprayers to trigger the pump. The direction of the robot's movement is defined by the relay driver board. It is used to provide high voltage and high power is given

as a result of using motors used in a robotic motion project. In this project a simple DC motor is used for wheel rotation which is responsible for the movement of the robot. Fire extinguisher pumps are used to pump water into flames. A simple engine is used to pump water. The pump engine in the extinguishing system controls the flow of water from the pump

Hardware Requirements

1) Ultrasonic Sensor
2) Gas Sensor.
3) Temperature Sensor
4) Bluetooth module
5) Relay Driver
6) DC motor
7) Arduino
8) Embedded C
9) Smart Phone
10) Power supply
11) Operation of Proposed System Tracking Fuzzy Logic Controller (TFLC) and Obstacles Avoiding Fuzzy Logic Controller (OAFLC)

III. HARDWARE & SOFTWARE SPECIFICATION

1. ATmega328P microcontroller (Arduino UNO):

Fig 3.1: Arduino Uno microcontroller based development board

Fig 3.1 shows the arduino Uno board. Arduino/Genuino Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller.

Technical specifications

- Operating Voltage: 5 Volts
- Input Voltage: 7 to 20 Volts Digital I/O Pins: 14 (of which 6 can provide PWM output)
- Analog Input Pins: 6
- DC Current per I/O Pin: 20 mA
- DC Current for 3.3V Pin: 50 mA
- Flash Memory: 32 KB of which 0.5 KB used by bootloader
- SRAM: 2 KB EEPROM: 1 KB
- Clock Speed: 16 MHz

2. Flame Sensors:

Fig 3.2: Flame Sensor

This sensor is able to detect a flame by sensing light wavelength between 760 –1100 nanometers. The test distance depends on the flame size and sensitivity settings. The detection angle is 60 degrees, so the flame does not have to be right in front of the sensor.

3.Bluetooth module:

Fig 3.3:HC-05 Bluetooth module

The HC-05 is a very cool module which can add two-way (full-duplex) wireless functionality to your projects. You can use this module to communicate between two microcontrollers like Arduino or communicate with any device with Bluetooth functionality like a Phone or Laptop. There are many android applications that are already available which makes this process a lot easier. The module communicates with the help of USART at 9600 baud rate hence it is easy to interface with any microcontroller that supports USART. We can also configure the default values of the module by using the command mode. So if you are looking for a Wireless module that could transfer data from your computer or mobile phone to a microcontroller or vice versa then this module might be the right choice for you. However do not expect this module to

transfer multimedia like photos or songs; you might have to look into the CSR8645 module for that.

4.Relay module 4CH

Fig 3.4:4CH Relay module

This is a 4-Channel Relay interface board that allows you to control various appliances, and other equipment with large current. It can be controlled directly by Micro-controller (Arduino, Raspberry Pi, 8051, AVR, PIC, DSP, ARM, ARM, MSP430, TTL logic).
Specifications:

- 4-Channel Relay interface board, and each one needs 15-20mA Driver Current
- Both controlled by 12V and 5V input Voltage
- Equipped with high-current relay, AC250V 10A ; DC30V 10A
- Standard interface that can be controlled directly by microcontroller (Arduino , 8051, AVR, PIC, DSP, ARM, ARM, MSP430, TTL logic active low)
- Opto-isolated inputs

5.775 DC motor

Fig 3.5 : 775 DC motor

In this project we use a simple DC motor for the rotation of the wheel which are responsible for the movement of the robot. Usually DC motors convert electrical energy into mechanical energy.

6.Water pump

Fig 3.6: water pump

Pump is a mechanical device which is used to pump water onto the fire to extinguish it. It uses a simple motor to pump water

7.Relay 1CH

Fig 3.7: Relay module

This is a 1-Channel Relay interface board that allows you to control various appliances, and other equipment with large current. It can be controlled directly by Micro-controller (Arduino, Raspberry Pi, 8051, AVR, PIC, DSP, ARM, MSP430, TTL logic).

8)9v,20v,5v Battery

Fig 3.8:Battery module

Software Interface

1. Arduino IDE 1.8.8

For programming the microcontrollers, the Arduino project provides an integrated development environment (IDE) based on a programming language named Processing, which also supports the languages C and C++.The open source Arduino IDE makes it easy to write code and upload it to the board.

2.Dabble

Dabble App transforms your Smartphone into a virtual I/O device and lets you control hardware using Bluetooth, communicate with it, access sensors like accelerometer, GPS, proximity and other features of your Smartphone. You can use Dabble as a Bluetooth Controller App for Arduino Uno-Mega-Nano, ESP32, and evive for making various DIY projects or IoT applications. You can write the program in Arduino IDE or PictoBlox (graphical programming based on Scratch 3.0). Example codes are also provided in the Arduino library of Dabble.

IV. DESIGN OF ROBOT

The main purpose of the robot is to reach the fireplace, to spray the extinguisher foam after the driver's command and to extinguish it while you have information about the behavior of the fire with the help of a camera, microphone. There are fire-fighting robots built for the same reason but they are not robots that move in the right sense; they have a cable or pipe connection from the fireplace to the outside. And they were blown by the fireman near the fire and not in the middle of the fire. There are some difficulties you must face while extinguishing a fire. These factors must be taken into account when designing a fire engine. When designing a robot for the first time its limits should be considered after the robot has begun designing and producing. These limits can be in different parameters such as weight, length and ease of production. From the bottom of the page are a brief description of the design features of a fire engine.

1. The speed of the robot should be low enough to extinguish a fire. Speed of travel (3 km / h) is sufficient.
2. The weight of the robot should be as simple as possible so as not to damage the debris.
3. The size of the robot should also be as small as possible to fit into small holes.
4. The height of the robot from the ground desired height so that there were no tail obstacles.
5. The power requirement will be determined by the weight and size of the robot and the power and the engines. 35
6. Also batteries are used during machinery for at least 15 minutes.
7. The design of the machine should allow electronic components to be disposed of easily without interference.
8. The small part simplifies the robot and makes repairs easier when necessary.
9. The development of the robot should be easy because it selects the minimum operating time and the cheapest method of production.
10. The ability to direct a robot makes the robot very useful in its work.
11. The design of the robot should be as basic as possible to make it easier to understand and adjust.
12. The robot must be resistant to fire and heat.

The design should be able to move on the ground and get into the fire. And the design should be able to send and receive camera views and radio waves from the scene to the operator's location.

4.1. Sketch

The issues that were considered and decided on a pre-construction fire extinguisher are described below:

• The design should be able to fit inside the fire as its function

• A walkway system will be used

• The system must be strong enough to penetrate the fire, spray the fire extinguisher and operate the camera and operate for at least 15 minutes with full batteries.

In this step we must create more than one drawing. Then the advantages and disadvantages of all the designed methods will be evaluated soon. After that one of them is selected to be produced as a prototype of a fire-fighting robot.

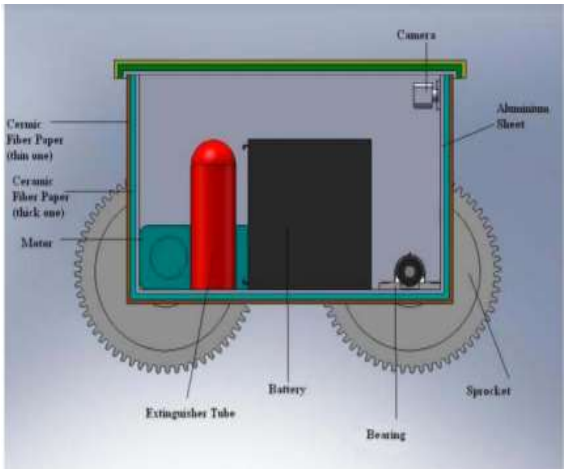


Figure 4.1. Cross section view

The above design is a basic but very cheap and very simple design. There is no cooling system in it or no breakable structure in it. This model is illustrated in Figure 4.4. Heat protection is ensured by a sufficient thickness of the ceramic fiber paper cover. Its magnitude is theoretically determined using heat transfer measurements with only minor variations. Thermal and flame-resistant ceramic paper is readily available from suppliers. It is simple, requires less space and is less expensive compared to other methods of assembling designs. In addition this is easy to mount the main body.

4.2. Track System

The most common tracking system is a dual tracking system used in a fire truck. It is simple, easy to understand, and easy to build. Two tracks are attached to both sides of the main robot chassis, and each is powered by its own engine. In this design, the engine is mounted deep inside the robot and is directly connected to the drive sprocket.

Another two-way tracking system is to place two tracks inside the robot. In this system stability can be a problem; it requires accurate statistics to specify exactly where the tracks are going. It is very complex and difficult to set. And the system also has a big problem with the fire extinguisher robot, because the electronic components near the heat can easily pass compared to a double-track system.

If the robot is large the track system can turn into a complex system i.e. two tracks driven differently, and the robot is guided by a normal set of wheels placed in front of the tracks. This project is about the time when big cars did not have enough power on unpaved roads and replaced the rear wheels with tracks that solved that problem. These songs were called half-tracks. For a mobile robot, this is a less efficient travel system as it can no longer turn into a space as it does the design of two basic tracks.

4.3. Power Requirements for the Robot

The robotic locomotion system, which includes engines, gears, wheels or tracks, and other devices directly related to the robot's motion, allows the robot to navigate.

It is known that a large part of the drivetrain is the engine. Although there are many different types of electric motors modified for use in locomotion, DC motors and stepper motors are better suited for motion control systems.

The DC motor uses magnets and telephone windows to generate rotation using electromagnetic induction and constantly uses available power to power the engine. The current is supplied with batteries or AC wall current with the help of a converter. DC motors vary in size and weight depending on the robot specification.

DC motors run much faster than what the wheels require so that high rotation speed makes the use of DC motors difficult. In addition, additional mechanical systems (such as gears, belts, sprockets, and chains) are used to slow down the DC car and increase its torque. It is called a servo motor with a DC motor, a gearbox (gear set) and a motor controller that allows precise control of the car's axis movement, inside the house which protects the entire assembly.

More important than moving power, gears are used to convert high-speed, low-torque output from DC motors to slow motion and power that you need to move your arms, legs, and other body parts to robots. Gears are a highly integrated way to increase the torque / low revolutions per minute (RPM) of an engine.

The stepper motor operates with the same basic principles of a DC motor, different from the DC one-stepper motor which has a magnetic shaft and its wire windows inside the engine wall. Due to this difference the rotating shaft can move from one coil to another, called a stator, to another. Moving from one stator to another gives the engine its "step" name.

The speed of controlled stepper motors can be done more accurately than DC motors. And these types of motors do not need gears to slow down. But stepper motors are as big as needing more power to operate, different electronic circuits and their efficiency are lower than other types of cars.

Except that the DC and stepper motor linear motor is calculated by another mode of driving. It is to move the load faster without any additional means. And these motors run smoothly because they have no moving parts connected to them. Linear motors are more expensive sensors for feedback action than other types of motors. In addition linear motors cannot emit heat as easily as other models.

Stepper motors are cheap and reliable options for many robotic systems that do not require speed and precise setting. Increased position accuracy can be achieved by installing the motor in the control loops. But DC motors are often preferred for applications that require a more precise position.

In order to select a powerful engine the calculation of a simple torque has been done according to the weight

of the robot. At first the weight of the robot was thought to be 35kg. It should not be forgotten that this value was the theoretical value and not the real one and even 1 kg of weight gain made power consumption significantly increased. To carry the load on the ground, the engines have to use more power than the opposing power. Most dry matter composites have a coefficient of difference between 0.3 and 0.6. When you find the force of a collision it is assumed that the coefficient of friction is approximately 0.45 and the entire robot load is affected by this collision. The formula used to determine a car rating is:

Pm = Fapp. ν

As a result, in the catalogs should be selected an engine with a torque of 10 Nm. The fire engine consists of two old DC servo motors (Figure 4.5), which provide sufficient torque and speed to overcome obstacles. They were made in West Germany so there was no information about those engines. By controlling the two engines separately the robot can go in any direction. In addition it can turn on itself 42. Side tracks provide high mobility while passing obstacles. The engines used in the fire rescue robot are supplied with 12 V DC.

4.4. Battery

Many robots are usually powered by batteries that process chemicals, either wet or dry. Batteries are an integral part of the design of robots, as important as the frame, engine, and electronic circuit. They form an electric current; is transmitted wirelessly to actuators, sensors, and controls.

From the natural chemistry of batteries there are a variety of complex structures that determine battery performance are:

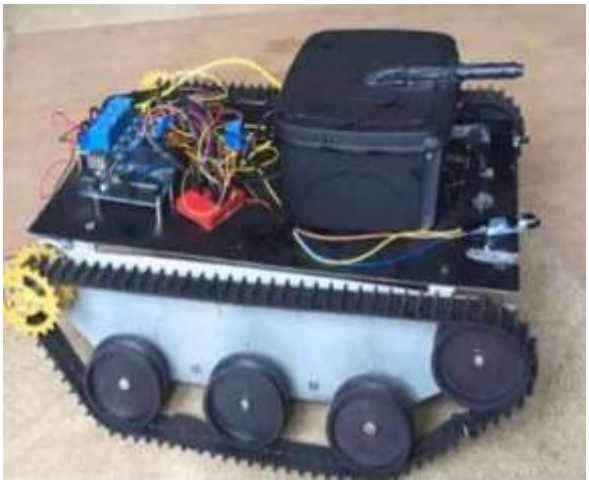
• Rechargeability: A rechargeable battery is called a primary cell. The rechargeable is called a second cell or storage battery.

• Power density: The most important parameter of battery technology is density. Power density is the maximum amount of energy a unit of battery weight can hold. Energy density is measured in units of Watt Hours / kilogram (Wh / kg).

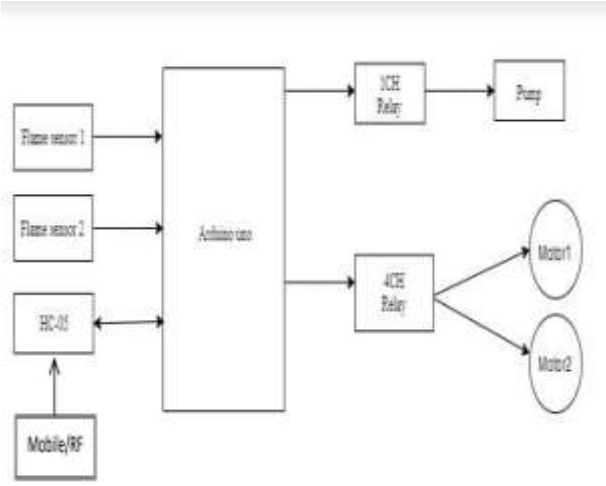
• Capacity: Battery capacity is the amount of energy stored in a cell. Power is usually reported in amp-hours units.

• Electrical energy: The voltage produced by a cell is a factor in the chemical reaction of something that occurs in a battery. Although it is desirable that the battery retain a constant voltage under load that voltage also changes with the charging mode.

• Internal Resistance: The current supply of the battery is limited to its internal resistance. Battery resistance increases as the battery drains. It was required that a good battery with a high power output, maintain a constant voltage during discharge, have low internal resistance, and therefore be able to discharge quickly. It should also be charged, and cheap. Unfortunately, there is no single battery that offers all of these features. Therefore, in practice, it is necessary to decide on the appropriate factors according to the needs of the job.



V. DATA FLOW DIAGRAM



VI. CONCLUSION & FUTURE SCOPE

This thesis is about designing and producing mobile fire extinguishing robots to extinguish a fire before it spreads in a short period of time and to get information about fire behavior. Also to help and protect firefighters for other purposes. Throughout this research, the ideas and designs of a fire extinguisher are discussed. The robot has been designed and tested according to its architecture. The robot, built, is a basic representation of what was planned. The budget was limited and advanced production equipment could not be used, so the robot had to be manufactured using the cheapest parts available in the market. Despite the inconveniences, the fire engine did well in testing. At C 0 C, that is the temperature of the ground where the fire was burned because the IR thermometer could not measure suspicion, the fire engine

extinguished the fire in the concrete area without any damage. The batteries were fully charged before the test, and they lasted until the operation was completed. With continuous development and development, the robot will be more reliable in achieving its goal.

To improve the fire engine, some changes need to be made. For example to attach different types of sensors - such as temperature, gas and sound detection - to understand the behavior of fire easily and connectors, accelerometers to control the movement of the robot properly. Advanced sensors are usually expensive devices and must be supported by complex electrical circuits. In addition, they need an authorized person to install them. The main body of the robot can be made of different materials instead of aluminum. New materials must have a melting point higher than aluminum. For example metal alloys with vanadium (19100 C), wolfram (tungsten) (34100 C) and molybdenum (46390 C) in its structure are suitable for the purpose of a fire extinguisher robot. But they are more expensive, harder and more difficult to process than aluminum. With the exception of 68 these composite materials such as special ceramic tiles can be used to prevent parts of the robot from the negative heat effect. But ceramic tiles are as bad as the production and the difficulty of climbing.

For optimal performance, the remote control range can be expanded. And the robot can be transformed into a semi-autonomous robot with the help of sensors, advanced software configurations and motor motors. These changes require a lot of budget and the person authorized to install them because power circuits can be complex and may interfere with each other. Other improvements can be made to the travel system. For example, a chain and sprockets can be converted into a double or more chain. And the link between the chain and the ground can be expanded using dense chains. Selecting sprockets with a wider range increases the barrier beyond capacity and does not injure itself due to the lower and lower base. Minor variations such as battery This thesis is about the design and production of a mobile fire extinguisher robot to extinguish a fire before it spreads in a short period of time and to obtain information about fire behavior. Also to help and protect firefighters for other purposes. Throughout this research, ideas and the design of a fire extinguisher are discussed. The robot has been designed and tested according to its architecture. The robot, built, is a basic representation of what was planned. The budget was limited and advanced production equipment could be used, so the robot had to be manufactured using the cheapest parts available in the market. Despite the inconveniences, the fire engine did well in testing. At C 0 C, that is the temperature of the ground where the fire was burned because the IR thermometer could not measure suspicion, the fire engine extinguished the fire in the concrete area without any damage. The batteries were fully charged before the test, and they lasted until the operation was completed. With continuous development and development, the robot will be more reliable in achieving its goal.

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