

Development and Designing of Fire Fighter Robotics

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Abstract

The fire fighting occupation has a long history of dangerous situations. There has been numerous and devastating human losses due to lack in technological advancements. In daily life, fire hazards have become more common and it becomes the responsibility of fire fighters to overcome any difficulties and extinguish fires protecting the human life and other possible losses. But they are often exposed to higher risks while performing fire extinguishing operations, especially in hazardous environments such as in nuclear power plants and petroleum refineries. With the development in the field of robotics, human intrusion has become less and robots are being widely used in order to overcome difficulties faced by firemen. This is one of the reasons for which robots are used instead of humans to handle fire hazards. Therefore, this paper presents the event of a firefighting robot which will extinguish fire without the necessity for fire fighters to be exposed to unnecessary danger. In this project, we are developing a robot which can also be used on domestic levels for fire extinguishing operations. This robot is compact in size and may be wont to extinguish fires reaching the impacted areas through narrow pathways. It works on wireless technology using radio frequency transmitter and receiver to control the fire extinguishing operations.

Keywords: *Fire fighting robot, compact size, wireless robot, RF controlled transmission*

INTRODUCTION

The term robot can be defined as an electro mechanical device which is used to follow the set of instructions to be carried out as specified by its user[3]. Robot may be a mechanical design that's capable of performing human tasks or behaving during a human like manner. Building a robot requires expertise and complex programming [5]. It's about building systems and producing motors, flame sensors, wires etc. among other important components. Detecting fire and extinguishing it is a dangerous job that puts the life of a firefighter at risk. There are many fire accidents which firefighter had to lose their lives within the line of duty annually throughout the planet [6]. The research and development within the field of AI have given rise to Robotics. The aim here is to style a fireplace Fighting robot on the domestic level which may be easily controlled. A firefighter robot is the one which has small fire extinguisher attached to it. A robot capable of detecting and extinguishing fires is designed and built[9]. Once the flame is detected the robot sounds the alarm or blinks the sunshine, the robot actuates the valve as per command and releases sprinkles of water on the flame [2]. The principles utilized in this design are such it enables our robot to be a more robust

system wont to combat actual fires in residential or commercial settings.

LITERATURE SURVEY

In today's world, fire fighting is a very serious occupation. Many authors are working to develop autonomous firefighting robots to tackle this issue.

Author Kristi Kokasih et al. has developed intelligent firefighting tank robot. Tank robot is formed from acrylic, plastic, aluminum and iron. Robot components are two servo motors, two DC motors, ultrasonic sensor, compass sensors, flame detector, thermal array sensor, white detector (IR and photo transistor) , sound activation circuit and micro switch sensor. The objective is to look certain area, find and extinguish the flame for various flame positions, room configuration with disturbance. Robot is activated through DTMF transmitter and receiver.

Swati Deshmukh et al. Has developed a wireless fire fighter robot. It comprises of machine which has ability to detect fire and extinguish it. The fire fighting robot can move in both forward and reverse direction and may turned in left and right directions. Thus fire fighter can operate the robot over an extended distance and there's no need for human near the world ablaze .

Light dependent resistors are used for detection of fireside . These resistors are sensitive devices and are capable of detecting very small fire. The robot provides security reception , buildings, factory and laboratory. It is an intelligent multisensory based security system which contains fire fighting system in lifestyle.

Rohini more et al. has developed a fire fighting robot which is wireless using 8051 micro controller. They designed and built alittle Fire Fighting robot, where a robot are going to be put during a house model where a light-weight candle is out there and therefore the robot should be able to detect, and extinguish the candle in the shortest time while navigating through the house and avoiding any obstacles in the robot's path. Researches were trying within the beginning of the project to urge more information about robotics generally and to believe the planning , hardware components, and therefore the software technique which will control the robot. This robot contains Light Sensor, 2 DC motors, and Buzzer is used in the robot's body. Two DC series motors are wont to control the rear wheels and therefore the single front wheel is free.

For many years robotics became popular in some ways due to its sort of design and

technological advancement. Our motivation to style a fireplace fighter robot is to assist the community in effectively firefighting by sensing the hearth and quickly acting without heavy losses of property or life.

Author Kristi Kosasih et al. Has developed the intelligent fire fighting tank robot. Acrylic, plastic, aluminium and iron are wont to make the robot. The tank robot is consisting of components like two servo motors, thermal array sensor, two DC motors, flame detector, ultrasonic sensor, IR and photo transistors, sound activation circuit and micro switch sensor. The goal of paper is search the prescribed area find the hearth and extinguish it. The robot is activated by using DTMF transmitter and receiver.

Rolly Firefighter Robot by William Dubel, Hector Gongora, Kevin Bechtold, and Daisy Diaz. This firefighting robot is meant to look for a fireplace during a small plan of a house, extinguish the hearth then return to the front of the house. The navigation of the robot throughout the home is achieved by data provided by a line tracker and ultrasound transducers. The deployment of the extinguishing device is implemented with a custom arm controlled by servos.

Author Kristi Kosasih et al. Has developed the intelligent fire fighting tank robot. Acrylic, plastic, aluminium and iron are wont to make the robot. The tank robot is consisting of components like two servo motors, thermal array sensor, two DC motors, flame detector, ultrasonic sensor, IR and photo transistors, sound activation circuit and micro switch sensor. The goal of paper is search the prescribed area find the hearth and extinguish it. The robot is activated by using DTMF transmitter and receiver.

Fire Protection Robot by Viet Do, Ryan Norder, and Ryan Spraez. This robot designed to enter an area and hunt down a spot where there's extreme heat possibly thanks to a fireplace .Upon entering the space , the robot will once more use the colour camera to pinpoint a spot where there's an outsized concentration of sunshine . Once the robot has driven up to the sunshine source, the warmth sensor is activated to see and see if there's an outsized amount of warmth being generated. If there's an excessive amount of warmth generated, the fan is turned on and rotated quickly with a servo motor to place out the flame. If the flame isn't put out the fan will activate again and still blow on the flame. Once the flame is extinguished, the robot leaves the house .

From the various projects reviewed, certain objectives helped us to settle on a well-liked technique to fight fire efficiently by controlling it remotely by wireless technology application and using two main sensors on Temperature sensor, GAS sensor thanks to their ability to detect fire and extinguisher pump.

SYSTEM ANALYSIS AND REQUIREMENTS

A. Software Requirement

The below listed software's are used to design our project.

MPLAB IDE

Proteus VSM

Android Studio

APK SDK AVR Studio:

For Compilation with C Programming.

AVR Programmer:

For Loading The Hex File Into The Microcontroller. For Software Requirement, We have Chosen ISIS Proteus and C Software. ISIS Proteus

B. Hardware Requirement

The below listed hardware components are used to design our project.

PIC16f876A Microcontroller

4x DC motor 300RPM

Robotic Base setup

Fire Extinguisher pump
Heat sensor
Gas sensor
Motor driver circuit.
Switch circuit.
Circuit components:

C. Micro Controller

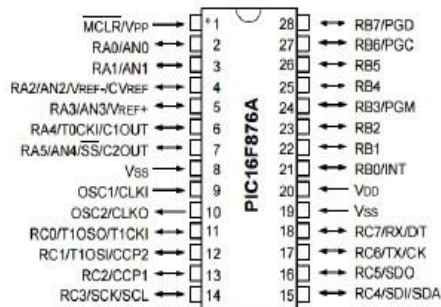


Fig 1: MC Pic16f876A

D. DC Motor

It is a brushless DC electric motor shown in the Fig 2 that divides a full rotation into a number of equal steps. The motor's position can then be commanded to move and hold at one of these steps without any feedback sensor. We have calculated the number of turns of the coil by the inductance formula i.e. (1) [5 9].

$$N = ((18 \times d + 40 \times l) \times L)^{1/2} / (\mu r)^{1/2} \times d$$

[in, μH]

Where:

L is inductance in Henries

μr is the relative permeability

N is the Number of turns

l is the length of the Coil in meters

d is the change in current



Fig 2 DC motor

E. Power Supply

It supplies electric energy to some circuit components with the appropriate power. It converts one form of electrical energy to another as shown in the Fig 3[6 13].

H. Extinguisher System:

It is an active fire protection device used to extinguish or control small fires, often in emergency situations. In our project the extinguisher uses a water pump shown in the Fig 4 to start water from water tank [2 14].



Fig.4. Extinguisher pump

G. Sensors

Gas Sensor:

The gas sensor shown in the Fig 5 will be used here to sense the gas. If the gas is sensed by the sensor it gives the signal to microcontroller and the robot movement is controlled artificially and the microcontroller activates the alarm driver circuits[8].

The diagram for the hearth fighter robot is shown in Fig 7. It consists of several units namely Power supply, Microcontroller, Sensor, Dc motors A wireless device (Bluetooth Technology) is connected to the microcontroller for remotely control and direct the robot .All motors are connected and controlled by the Microcontroller .The sensors sense the hearth and help to extinguish it .The robotic Vehicle is loaded with the cistern[5 9 7] .

A. System Testing and Results

1. Circuit Simulation

Initially the Circuit was Operating with 12 V from Dc Battery. To distribute the voltage to a transformer transistor to feed the microcontroller with 5 v to figure and therefore the driver motor circuit got 12 v directly from the battery dc source to form the four wheels to maneuver and obtain 5 v from the transformer to form the most circuit to work, also our main sensors and

therefore the Bluetooth get 5v source from the transformer to figure[5 1 9] .

About the temperature Sensor in our circuit it's programmed to require input threshold not above 50 c from outside heat source to alarm the circuit and showing the output within the mobile application that connected to the Bluetooth device connected to the most microcontroller circuit the most sensor threshold to figure from -55t-155 c. The gas sensor operating threshold from the programming to urge not above 500ppm to alarm the circuit by making the buzzer to figure and showing the output to the mobile application it mainly threshold to require from 200-10000ppm[12 14]. The driving force motor part takes command from the user to travel in four directions forward, backward, left and right. The relay part is to require alert from the temp. Sensor on reaching the edge to trigger the pump[7 10 15] . This simulation is completed by using proteus vsm.

STEPS FOR ASSEMBLY OF ROBOT

Structural Frame Operation Sheet

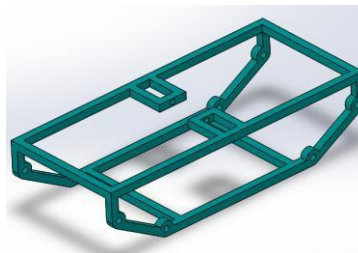


Fig. 8: Structure of Frame

Step No.	Description of Step	Fixtures or Gauges	Materials	Safety Equipment	Tools and Equipments
1	Cutting of ISA 25 x 25 x 5thk 3 feet length = qty 03 no's 4 feet length = qty 02 no's 1.5 feet length = qty 02 no's 4.5 feet length = qty 02 no's	Chapsaw machine	ISA 25 x 25 x 5thk	Safety glasses	Measuring tape, 14 inch cutting wheel
2	Plate having semicircle at top	Gas cutting and Chapsaw machine Drill Machine	Plate size 100 x 100 Thk 10 mm	Safety glasses, Hand glows	Measuring tape, 14 inch cutting wheel, Dia 20mm drill
3	Fabrication / welding of structure as per drg	Welding machine			Measuring tape Welding machine, 10 number welding rod

Manufacturing of Stub Shaft

Step No.	Description of Step	Fixtures or Gauges	Materials	Safety Equipment	Tools and Equipments
1	Facing of stub shaft	3 jaw chuck	EN8	Safety glasses	
2	Turning of shaft with dia 20 mm	3 jaw chuck	EN8	Safety glasses	

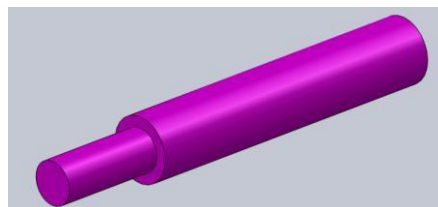


Fig9: Assembly of shaft

Assembly and Installation of Project Mechanism

Step No.	Description of Step	Fixtures or Gauges	Materials	Safety Equipment	Tools and Equipments
1	Project mechanism	Spanner 22 -24 Measuring tape		Safety glasses	Spanner 22 - 24 Measuring tape
2	Fittment of bearing and rollers	Spanner 22 -24 Measuring tape			Measuring tape,



Fig10: Project mechanism

Manufacturing of stub shaft

Step No.	Description of Step	Fixtures or Gauges	Materials	Safety Equipment	Tools and Equipments
1	Cutting of sheet metal of size 200x 150mm	Sheet metal cutting machine	Zinc coated galvanized material	Safety glasses	Measuring tape
2	Slot formation by cutting of sheet	Sheet metal cutting machine	Zinc coated galvanized material	Safety glasses	Measuring tape
3	Welding of 3 inch pipe as per required shape	Welding machine 250amp 230V	10mm welding arc rod	Welding goggles	Welding gun

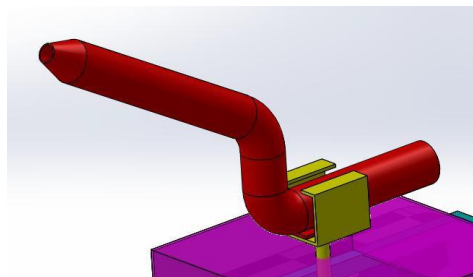


Fig11: Stub shaft

Assembly and Installation of Project

Step No.	Description of Step	Fixtures or Gauges	Materials	Safety Equipment	Tools and Equipments
1	Project mechanism	Spanner 22 -24 Measuring tape		Safety glasses	Spanner 22 -24 Measuring tape
2	Fittment of bearing and rollers	Spanner 22 -24 Measuring tape			Measuring tape,
3	Welding of structure	Welding machine 250amp 230V	10mm welding arc rod	Welding goggles	Welding gun

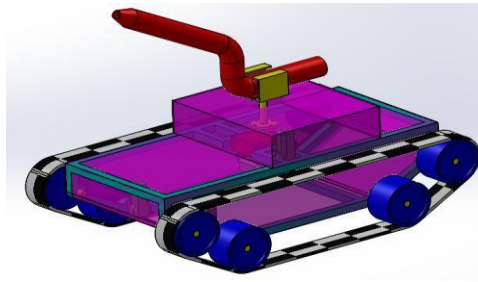


Fig12: Installation of Project

CONCLUSION

We from the engineering Department, Adarsh Institute of Technology, Vita designed and developed a fireplace fighter robotics using cyber security, with this sort of embedded systems and cyber security can save lives of Engineers in industrial sites with dangerous conditions, so we decided to travel for a robot for this particular application. This robot is often widely used for various sorts of industries like cement industries, steel industries, electrical industries, atomic power plant etc. The robot is often controlled by computer or mobile application through wireless application for safe distance.

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