



## Wireless Arduino Controlled Fire Fighter Robot Designed for Residential Area

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### KEYWORDS

Fighter robot  
Arduino control  
Ultrasonic sensor  
Tracking system  
Residential area

### ABSTRACT

Fire accidents have become a common problem in human life and may lead to permanent injury or death. The fire fighter robot is developed with the aim to save lives of fire fighters who risk their lives, entering dangerous environments. This paper presents the development of the fire fighter robot, which is suitable to extinguish fire in closed areas and residential areas. The robot's movement can be manually controlled using Flysky GT2 Controller from outside of the affected area. The robot is in the form of a robust and compact vehicle which allows it to move front, back, left and right in small areas with a steady speed. The robot has a 12V water pressure pump capable of shooting water up to 3 to 5 litres per minute which allows it to control large amounts of fire. The robot also provides live streaming and GPS location tracking services during the movement of the robot. This live recording can be viewed in PC or in the user's mobile phone.

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## 1. INTRODUCTION

As technology is constantly developed, robot uses in real life situations have hiked and human interaction is made less. Additionally, the high potential for a robot to imitate human's action has led to the extent that it is able to protect a human's life from fatal accidents such as in fire. Undoubtedly, fire accidents are a common risk in a daily life and its impact may lead to permanent injury or death [1]. Hence, with the support from the available engineering technology, this proposed fire fighter robot is developed with the aim to save lives of fire fighters who risk their lives entering dangerous environments. In prior, there are numbers of published papers that proposed techniques in developing the fire fighter robot.

In the year of 2015, Unal I. and Topakci M [2] had triggered the idea to use remote controlled robot for agricultural application. The robot's motions can be manually controlled remotely in any direction and at any speed using the joystick. Software for navigation was created so the robot could steer itself. In the same year, Mukhtar M. had published his work on using the GSM and GPS module along with Google tracking and maps to be used for safety feature to a vehicle [3]. The project aims to improve vehicle safety by allowing users to

control the ignition system and door lock system of the vehicle by sending an SMS to the controller. Later on in 2017, the programmed robots became more popular when Sakhti S. et al. had produced robots that are able to detect and extinguish fire. Additionally, Sh Rejab K. et al. had produced a robotic arm control system. Both of these papers have adopted a bluetooth module and arduino to be featured in their robot [4], [5]. This had followed by Perumal K. et al. in 2019, where they have improved the fire extinguisher robot with thermal camera to detect fire and temperature, also added on a live recording feature as user can monitor the condition of the monitored area using personal computer [6].

In the same year, Jayaraman G. et al., also had produced the fire extinguisher robot, and they opted to employ IoT technology in their robot's design in order to control the mode of their robot. This has added the practical and efficient value to the robot's application. In the next year 2020, numerous authors had actively proposed their works on the programmable robot, mainly functioned to extinguish fire [7][8]. Compared to the earlier years, there were improvements that have been made to the previous fire extinguisher robot in the aforementioned

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articles, such as the robot can avoid collision, can move with various speed and can do patrolling on a predetermined route.

Nevertheless, despite the advantages from each of the proposed designed robots, they are still suffer from drawbacks such as complexity in the design, high cost, fragility especially when there is no fire resistance aspect being considered in the physical design of the robot that can harm the robot itself from the fire. Other than that, the impracticality of the robot, especially when the robot can only move at the predetermined route and just can go up to 2m in distance. Thus, other than to extinguish fire outbreaks by using a remote controlled robot and help in reducing the number of deaths, this project is also aims to propose a robust robot design with less complexity in the design, equipped with fire resistance, high practicality and cost effective, which will be imposed and benefitted to any residential area.

## 2. METHODOLOGY

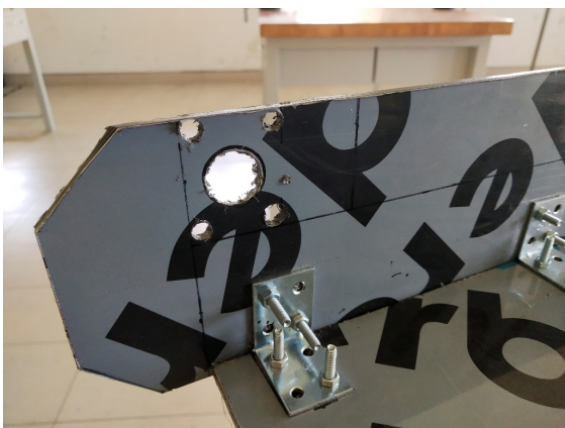
The methodology is divided into three parts. The first part will discuss about mechanical design structure of the project, followed by block diagram and flow chart of the project and final part will explained about schematic diagram.

### 2.1 Mechanical Design Structure

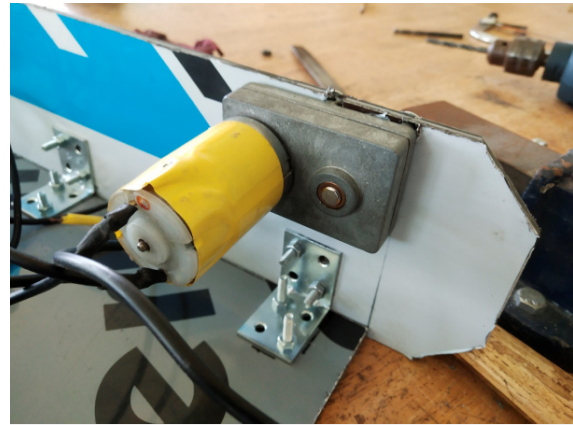
This section discusses about the development of mechanical design structure for the robot. This part includes the chassis design, aluminium coupler making for the motor and robot assembly.

#### 2.1.1 Chassis Design

Aluminium Composite Panel (ACP) boards are used for design which are waterproof, fireproof, and lighter than steel. The board is cut, and lines are drawn onto ACP board for motor, L-bar, screw, and support bar replacement before attaching the components. The ACP board is then drilled to allow bolts to pass through and is secured tightly using L-bars. The edge of the robot is cut and smoothed up using an angle grinder. The shaft measurement for motor placement and installing motors onto chassis is shown in Fig. 1 and Fig. 2.



**Fig. 1.** Shaft Measurement for Motor Placement



**Fig. 2.** Installing Motors onto Chassis

#### 2.1.2 Aluminium Coupler Making for the Robot

The project is to create tank wheels, the aluminium rod is used as a coupler. The rod is shaved into a measurement shown in Fig. 3, an aluminium rod was cut using a saw machine. The cut piece is then shaved using a lathe machine and a hole is drilled horizontally into the aluminium rod to insert the shaft into it. The outer layer of the aluminium rod is shaved for the motorcycle sprockets to slide into the coupler as shown in Fig. 4 and to be secured with nuts and chain. The sprocket model used for the robot is 428-5T. the model of the motorcycle chain used is 428. The final piece is drilled vertically, and a thread is cut using an M4 X 0.7 tap and die set.



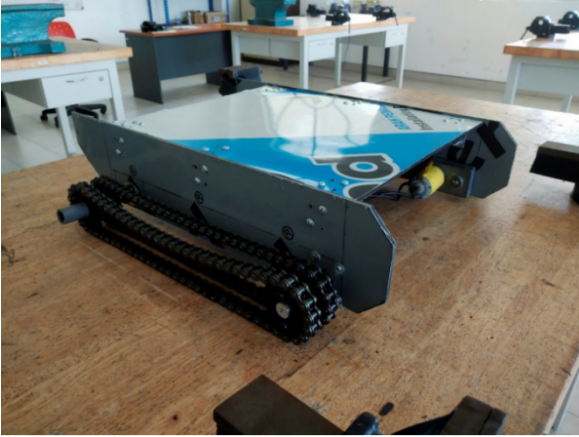
**Fig. 3.** Cutting Aluminium Rod using Saw Machine



**Fig. 4.** Shaving Aluminium Rod using Lathe Machine

### 2.1.3 Robot Assembly

The coupler set is attached with the motorcycle chains. The front area of the chassis is drilled to attach an M10 bolt. This bolt acts as the supporting shaft of the robot. This is done for the chain to rotate freely on one side of the robot and be controlled by the DC motor on the rear area of the robot. Coupler and motorcycle chain attachment onto robot chassis shown in Fig. 5.



**Fig. 5.** Coupler and Motorcycle Chain attachment onto Robot Chassis

## 3. RESULT AND DISCUSSIONS

The robot has multiple features which includes the movement control system, the water control system and also the camera features of it. This chapter discusses about each of the feature and how it is achieved successfully.

### 3.1 Robot Movement Control System and Affiliations

The movement of the robot is achieved using a Phoenix Series Motor Driver and a Fly Sky GT2 Remote control. The motor driver is known for its reliability in controlling DC powered robots such as planes, drones, boats and combat robots. The board supports 2 channels, 12V and can handle 10A of current. The board comes with a slot where a receiver can be connected. The receiver used for this project is Fly sky FS-GR3E which is capable of working under a range of 2.4Ghz. The remote control has a built-in transmitter. This transmitter is binded with the receiver of the motor driver and this allows the user to successfully control the robot's movement. Fig. 6 shows the robot being controlled from 3 meters away.



**Fig. 6.** Controlling robot movement with remote

### 3.2 Robot Water Control System

The robot's water control system is powered using a DC water pressure pump that is rated to be 12V. Fig. 7 shows the demonstration of the fire fighter robot extinguishing fire. Using the remote control, the fire ball created with paper and alcohol which is 10cm X 10cm is extinguished within 2 minutes.



**Fig. 7.** Controlling water pump with remote

### 3.3 Robot Camera Features

The robot is equipped with an ESP32 Camera which provides a clear output of the robot's whereabouts. The real-time live stream of the camera allows a user to operate the robot from far. The live stream of the camera can be viewed from the user's mobile phone. This feature allows the user to manually move the robot towards the area of fire from a distance. Fig. 8 and Fig. 9 shows the images taken during the live stream of the camera when controlling the robot.



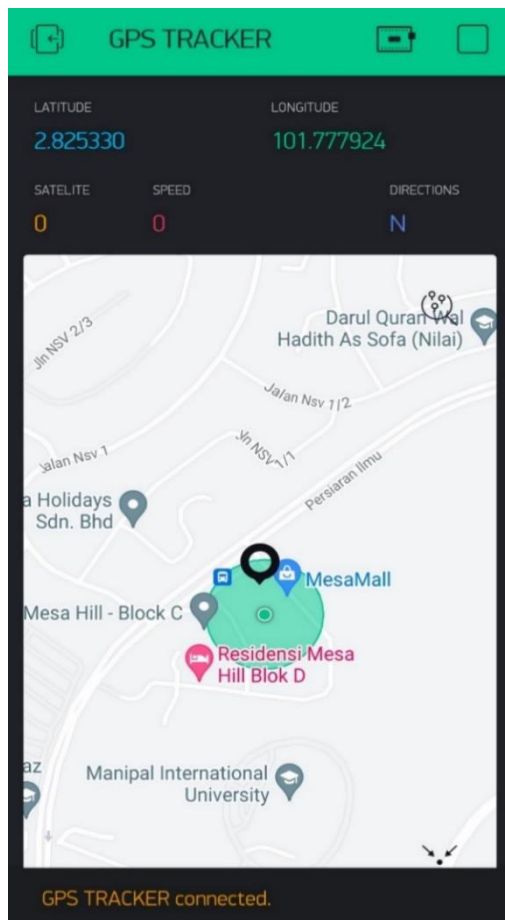
**Fig. 8.** Real time camera output 1



**Fig. 9.** Real time camera output 2

### 3.4 Robot GPS System

The robot is equipped with a GPS system. The module used for this system is GPS NEO 6M and it is controlled by ESP12E module. The real-time location of the robot is sent to the user's mobile phone through Blynk application. The Blynk application is used to create a page where google map shows the pinpoint location of the robot and the speed of the robot. Fig. 10 shows the display shown in the user's mobile during GPS tracking of robot.



**Fig. 10.** Blynk application showing real-time GPS location of robot

## 4. CONCLUSION

Fire accident is a mishap which could be either natural or man-made, which can cause great alarm and destruction or loss of life. Thus, a robust and compact fire extinguisher robot were highlighted in this project. All the objectives of the project were successfully achieved with the design of wireless controller as in to control prototypes movement, extinguish flames by using a water spray gun which is controlled by the remote and finally to be able the location of the robot to the end user. This robot would be an alternative way in extinguishing fire in closed areas, buildings, and residential areas by remotely controlling the robot outside of the affected area to control the spread of fire and property damage before further help arrives.

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