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PST002 - THE FIREFIGHTER ROBOT WITH CAMERA-BASED DETECTION AND GPS NAVIGATION

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ABSTRACT

Firefighting is a high-risk job where firefighters are often exposed to dangerous conditions such as fire, smoke, toxic gases and unstable structures. This project introduces a Firefighter Robot equipped with a night vision camera, designed to reduce or eliminate the need for human presence in hazardous situations. The robot can be remotely controlled or operate autonomously to navigate through rough terrain, detect fire in low visibility environments and extinguish flames using a built in fire suppression system. It also includes GPS tracking for real-time location monitoring and live video streaming to support decision making from a safe distance. The integration of these technologies into one system allows the robot to perform critical firefighting tasks efficiently and safely. This innovation not only protects human lives but also enhances the speed and effectiveness of emergency responses in dangerous or hard to reach areas.

Keywords – firefighter, robot, camera, gps tracking, arduino

INTRODUCTION

Firefighting is inherently a high risk profession, where firefighters are frequently exposed to life threatening situations while rescuing individuals in danger. As a result, they often operate in unpredictable and rapidly changing environments. The job is physically demanding and firefighters routinely encounter numerous hazards as part of their everyday duties (Heydari et al., 2022). According to (Cuenca-Lozano & Ramírez-García, 2023), firefighters are exposed to harmful substances in the environment, such as carbon monoxide, hydrogen cyanide, aerosols and tiny particles in the air. These can negatively affect their health. Thus, this project presents a Firefighter Robot that can be controlled from a distance to put out fires and handle dangerous situations. It helps reduce injuries and damage while providing a quick and effective response even in dark or difficult to reach places.

OBJECTIVE

There are three (3) primary objectives of the Firefighter Robot project: First, to develop a remotely controlled robot capable of navigating and performing firefighting tasks in hazardous environments without human intervention by integrating a night vision camera system that allows accurate detection and response to fire outbreaks in dark or smoke filled areas. Second, to equipped the robot with a fire suppression system such as a water or chemical spray mechanism to effectively extinguish various types of fires. Lastly, to integrate GPS technology in allowing for real-time location tracking.

DESCRIPTION OF THE PROJECT

The Firefighter Robot is designed with two main components: a transmitter and a receiver. The transmitter uses joystick modules to control the robot's movement, while push buttons are used to activate the DC water pump and request GPS location data. These inputs are sent wirelessly to the receiver using the nRF24L01 module, which then carries out the corresponding actions; water spraying as in Figure 1 and location sharing as in Figure 2. To support remote operation in dark or smoke filled environments, the robot is equipped with a night vision camera that streams live video directly to a mobile device as in Figure 3. This robot is constructed with durable materials such as aluminum composite panels and custom couplers to withstand extreme conditions. Its tank-style wheels further enhance mobility, enabling the robot to navigate across rough and uneven terrain with stability and ease.

Figure 1: The Firefighter Robot with a Fire Suppression System

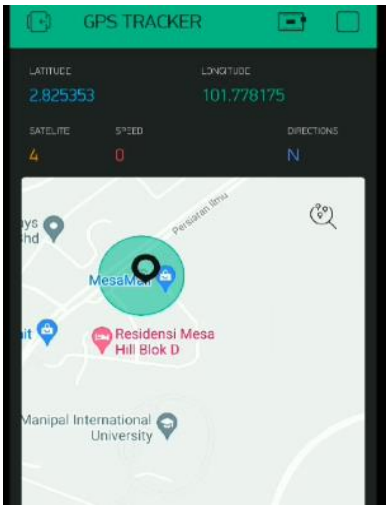

Figure 2: The Firefighter Robot GPS Location

Figure 3: The Prototype of Firefighter Robot and Camera View from Smartphone

NOVELTY

The novelty of this project is in creating a robot that can take over dangerous firefighting tasks without needing a person to be there. It combines night vision, remote or automatic control, live video and a fire suppression system in one machine. Unlike other robots that only help firefighters, this one is built to work on its own in dark, smoky or risky places. It can move through rough areas to find fires and send its location which make it a new and safer way to fight fires without putting people in danger.

CONCLUSION

In conclusion, the Firefighter Robot with camera detection and GPS navigation offers a safer and smarter way to handle fire emergencies without risking human lives. With its ability to navigate dangerous environments, it can detect fires in low visibility and operate

firefighting tools remotely. It serves as a strong alternative to human firefighters in high risk situations. This project shows how technology can improve safety, reduce injuries and response more effective toward emergency.

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