Smart Rescue Robot for Human Detection

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Abstract— project presents the design and development of a Smart Rescue Robot for Human Detection using IR Remote Control. The robot is built using an Arduino Nano as the central controller, which coordinates all input and output operations.

The movement of the robot is controlled wirelessly using a TV IR remote through a TSOP1738 IR receiver, allowing the user to operate it in four directions: forward, backward, left, and right.

Intended use: Surveillance, rescue, restricted-area monitoring.

The project demonstrates a reliable and intelligent robotic solution for assisting in human detection and rescue operations with simple control and alert mechanisms.

I. INTRODUCTION

In recent years, technological advancements in the field of robotics have revolutionized the way we approach disaster management and rescue operations. Robotics systems have proven to be invaluable tools for executing tasks that are dangerous or impossible for humans to perform directly. Disasters such as earthquakes, landslides, explosions, or structural collapses often trap people in areas that are unsafe for human rescuers. The Smart Rescue Robot for Human Detection project addresses this challenge by developing a remotely controlled The Smart Rescue Robot for Human Detection using IR Remote Control is designed to assist in search-and-rescue operations, especially in hazardous environments where human access is difficult or dangerous. The system uses an Arduino Nano as the central controller to manage all functionalities of the robot..

II. LITERATURE REVIEW

1.Several research studies have been conducted in the field of rescue robotics and human detection systems to improve disaster management and surveillance operations. Earlier rescue robots mainly used wired communication systems, which restricted the movement range and operational flexibility of the robot. To overcome these limitations, wireless technologies such as IR, RF, Bluetooth, and Wi-Fi were later introduced for remote navigation and control.

2. PIR (Passive Infrared) sensors are commonly used in human detection systems because they can detect infrared radiation emitted from the human body. Studies show that PIR sensors are simple, reliable, power-efficient, and suitable for indoor and semi-controlled environments. Due to these advantages, PIR sensors are widely adopted in security systems, surveillance robots, and automated rescue devices.

3.Recent developments in robotics also focus on integrating wireless communication and real-time alert systems to assist rescue teams during emergencies. Motor driver modules such as L298 and L293D are frequently used to control DC motors for robot movement and navigation. Researchers have also explored RF communication modules for transmitting alerts and monitoring robot activity remotely. This study presents a Wi-Fi controlled robotic system using the L293D motor driver and DC motors.

4.In earlier systems, robots were controlled manually using wired communication, which limited their range and flexibility. With advancements in embedded systems, wireless technologies such as IR, RF, and Wi-Fi have been widely adopted for robot control. The use of microcontrollers like the Arduino Nano has simplified the design and implementation of such systems due to its low cost and ease of programming.

III. PROBLEM STATEMENT

In disaster situations such as earthquakes, landslides, and fire accidents, it becomes extremely difficult and risky for rescue teams to locate trapped victims. Manual search operations are time consuming and may endanger rescuers' lives.

Existing advanced rescue systems are often expensive and complex, making them unsuitable for small-scale or low-budget applications. Therefore, there is a need for a low-cost, easy-to-operate robotic system that can detect human presence and assist in rescue operations without risking human life.

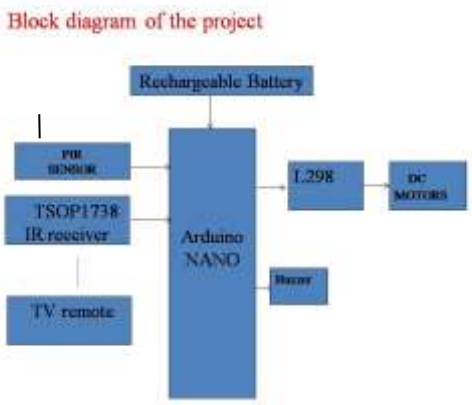
IV. OBJECTIVES

1. To design and develop a compact rescue robot using an Arduino Nano as the main control unit.

2. To provide an alert system using a buzzer when human presence is detected.
3. To ensure portability and continuous operation using a rechargeable battery
4. To implement human detection using a PIR Sensor based on body heat sensing..
5. To improve safety and reduce human effort in searching for victims in hazardous environments.
6. To develop a low-cost and user-friendly rescue system for disaster management and surveillance applications.
7. To create a low-cost solution
8. To enable wireless control of the robot using an IR remote through the TSOP1738 IR Receiver for movement in forward, backward, left, and right directions.
9. To provide an alert system using a buzzer when human presence is detected.

V. PROPOSED SYSTEM

A. Block Diagram



System Overview

The Smart Rescue Robot for Human Detection using IR Remote Control is an intelligent robotic system designed to assist rescue teams during emergency and disaster situations. The system is mainly developed to detect human presence in hazardous areas where direct human access may be difficult or dangerous. It combines wireless navigation, human detection, and alert mechanisms into a compact and cost-effective robotic platform.

The robot is built around the Arduino Nano microcontroller, which acts as the central processing unit of the system. All input and output components are connected to the Arduino, allowing it to control the complete operation of the robot. The movement of the robot is controlled wirelessly using an IR remote control and a TSOP1738 IR receiver module. This enables the user to move the robot in forward, backward, left, and right directions remotely.

For human detection, the system uses a PIR (Passive Infrared) sensor. The PIR sensor detects infrared radiation emitted from the human body and identifies the presence of a person within its sensing range. Whenever a human is detected, the Arduino activates a buzzer to provide an immediate alert to the operator. This feature helps rescue teams quickly identify trapped victims in disaster-affected areas.

The movement of the robot is achieved using DC motors connected through an L298 motor driver module. The motor driver controls the speed and direction of the motors according to commands received from the Arduino. The entire system is powered using a rechargeable battery, making the robot portable and suitable for continuous operation.

The project provides a simple, reliable, and affordable solution for rescue operations, surveillance, and security applications. The combination of wireless control, automatic human detection, and real-time alerting makes the system highly useful for search-and-rescue missions in dangerous environments.

VI. SOFTWARE ARCHITECTRURE

There are several different types of software architecture in common use.

• Simple Control Loop:

In this design robot continuously monitors human detection and movement commands using the loop() function in Arduino programming

• Interrupt Controlled System:

An Interrupt Controlled System responds immediately when a specific event occurs without continuously checking the input manually. Interrupts improve response speed and efficiency

Although the current project mainly uses polling inside the loop, the PIR sensor or IR receiver can be upgraded using interrupts for faster human detection and remote command processing.

• Cooperative Multitasking:

Cooperative Multitasking allows multiple tasks to run one after another where each task voluntarily gives control back to the main system after completion. The robot performs sensing, movement, and alert operations in sequence without using a real operating system. This behavior is similar to cooperative multitasking.

• Primitive Multitasking:

In this type of system, a basic multitasking method where multiple operations appear to run simultaneously by rapidly switching between tasks. The Smart Rescue Robot performs movement control and human detection together using fast repetitive execution inside the Arduino loop, which resembles primitive multitasking behavior.

VII. TESTING

The Smart Rescue Robot for Human Detection was tested under different operating conditions to verify its performance, reliability, and response accuracy.

The testing process included checking the movement control, human detection capability, alert system, and overall system operation.

VIII. RESULT

The Smart Rescue Robot for Human Detection using IR Remote Control was successfully designed, developed, and tested under controlled conditions. The project demonstrated efficient wireless navigation, reliable human detection, stable motor operation, and effective alert generation. The integration of Arduino Nano, PIR sensor, IR receiver, L298 motor driver, DC motors, and buzzer provided smooth coordination between sensing and movement operations.

The robot was capable of moving in multiple directions using an IR remote control while simultaneously monitoring the surroundings for human presence. The PIR sensor effectively detected infrared radiation emitted from the human body and generated immediate alerts through the buzzer system. Experimental observations confirmed that the robot performed all intended functions accurately and efficiently.

IX. CONCLUSION

The robot uses an Arduino Nano microcontroller to control all operations, while the PIR sensor effectively detects human presence using infrared radiation. The IR remote control provides smooth wireless navigation, and the L298 motor driver ensures proper control of DC motors for robot movement. Whenever a human is detected, the buzzer alert system immediately informs the operator. The system provides good response time, reliable detection, easy operation, and low power consumption.

Overall, the project successfully achieves its objective of developing an efficient rescue robot capable of human detection and remote operation.

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