HAND GESTURE CONTROLLED ROCKER-BOGIE

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CHAPTER 1

INTRODUCTION

1.1 Introduction:

Fire can cause significant damage to buildings and seriously endanger human life. In many cases, firefighters are required to enter burning buildings to extinguish the flames and rescue individuals who may be trapped inside. However, this can be a dangerous and challenging task as firefighters must wade through smoke and debris to find and rescue victims.

To aid firefighters in their efforts, we developed a hand gesture-controlled rocker chassis equipped with a camera system that can detect the presence of people in a fire building and provide firefighters with up-to-date information. The cradle is a mobile robot that can traverse rough terrain and is controlled using hand gestures, allowing firefighters to operate it without having to be physically present in the building.

The goal of this project is to develop a system that firefighters can use to remotely detect the presence of people in a fire building and track their movements in real time, allowing them to make informed decisions about how to proceed in a rescue operation. . This system consists of two main components: a hand gesture control system for the cradle chassis and a camera system to detect people and provide live updates.

The first part of our system is a hand gesture control system for the rocker chassis. We used an Arduino nano ,RF transmitter and receiver that includes encoder and decoder blocks to receive input from the hand gesture mechanism worn by the operator on his hand. These measure the degree of bend of the palm and translate it into movement commands for the rocker chassis. The system also includes additional control inputs, such as tilting the rocker to overcome obstacles. The control algorithm was implemented in C and C++, which allowed us to easily integrate it with the camera system.

The second part of our system is a camera system to detect people and provide live updates. We used the ESP32-CAM module as the camera, which is able to stream live video to a laptop using an IP address.. The system sends live updates to firefighters in real time using a wireless communication module.

To test our system, we conducted a series of experiments in a simulated fire building environment. We evaluated the accuracy and reliability of the hand gesture control system as well as the effectiveness of the camera system in detecting people and providing live updates. Our results show that our system is able to detect people with a high degree of accuracy and can provide real-time live updates to firefighters.

In this report, we describe the design, implementation, and testing of this system. First, we provide a literature review of related works in robotics and image processing. Subsequently, we will discuss the hardware and software used in the project and provide a detailed description of the hand gesture control system and the camera system. Finally, we will present the results of our testing and evaluate the overall success of the project in achieving its goals.

CHAPTER 2

Objectives

2.1 Objectives:

- To design and develop a Rocker-bogie mechanism that can traverse rough terrain and climb over obstacles.
- To integrate the Arduino Nano, DC motors, RF transmitter and receiver modules, gyroscope accelerometer (MPU6050), and camera module into the system.
- To develop a hand gesture controller that enables remote control of the Rocker-bogie.
- To establish real-time communication between the operator and the Rocker-bogie using the RF transmitter and receiver modules.
- To implement a stability control mechanism using the gyroscope accelerometer (MPU6050) to maintain stability on uneven terrain.
- To develop a camera module that provides live feed to the firefighter for real-time monitoring of the situation.
- To test and evaluate the performance of the Rocker-bogie system in simulated rescue scenarios.
- To demonstrate the effectiveness and efficiency of the Rocker-bogie system in improving the safety and effectiveness of rescue operations during fire incidents.

CHAPTER 3

METHODOLOGY

3.1 Methodology:

The proposed rocker-bogie robot is designed step by step with NASA's Mars Curiosity Rover in mind. We start with rockers and bogie legs. The legs are bent towards each other in such a way that if you extend the imaginary line, they make a right angle at the point of intersection. The height of the rockers supporting the rockers should be equal to the height of the feet. The distance between the wheels is the same distance (approximately). The bend in the support is 135 degrees or 45 degrees from the support line. The support arm is horizontal when resting on a flat surface.

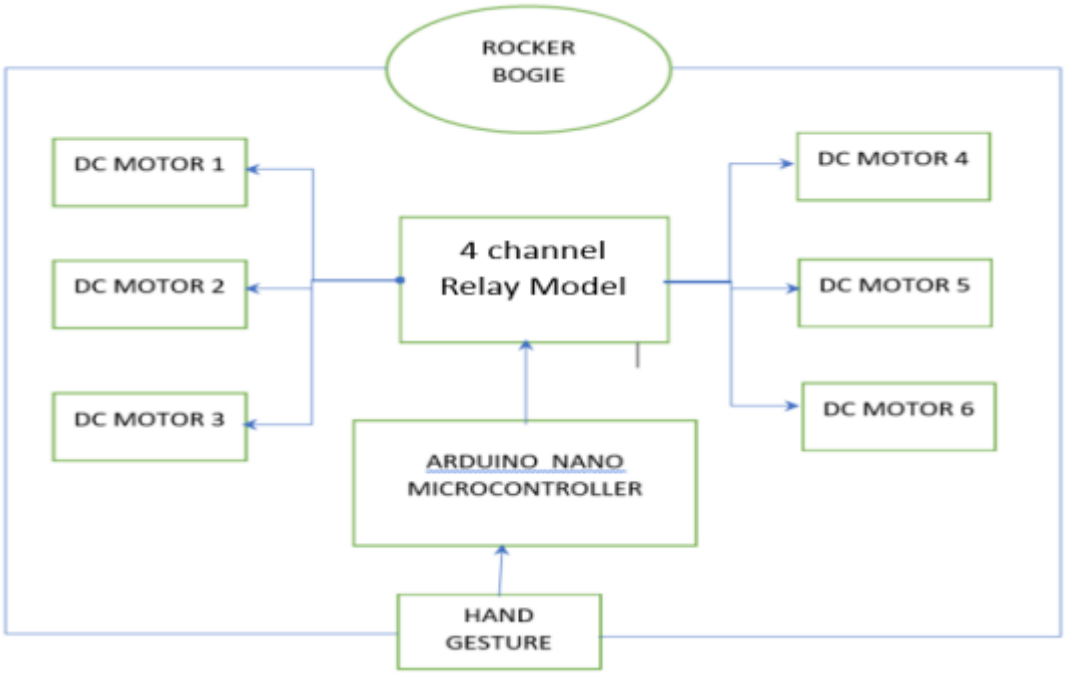

Fig 3.1: Block Diagram of Rocker-Bogie

The proposed Rocker-Bogie Fire Rescue System will consist of the following components:

1. Arduino Nano: this microcontroller board will serve as the brain of the system. It will receive inputs from various sensors and send commands to the DC motor drive to control the Rover-Bogie Rover movement.

2. 6 DC motors: Rover Rocker-Bogie will be equipped with six DC motors. Four motors will be used to control the wheels, while the remaining two motors will be used to control the suspension system.

3. DC Motor Drive: A DC motor drive will be used to control the speed and direction of the DC motor. The motor driver will connect to the Arduino Nano and receive commands from it.

4. Rocker Bogie: The Rocker-Bogie suspension system allows the car to move over uneven terrain. The suspension system will be driven by two DC motors.

5. Hand Controller: A hand controller will be used to remotely control the movement of the Rover Rocker-Bogie. The controller will be equipped with sensors that detect hand movements and send commands to the Arduino Nano.

Transmitter Block Diagram

The MPU6050 takes the hand gesture inputs and sends it to the arduino nano and then further proceeds to the RF transmitter where the RF signal is sent to the RF receiver module.

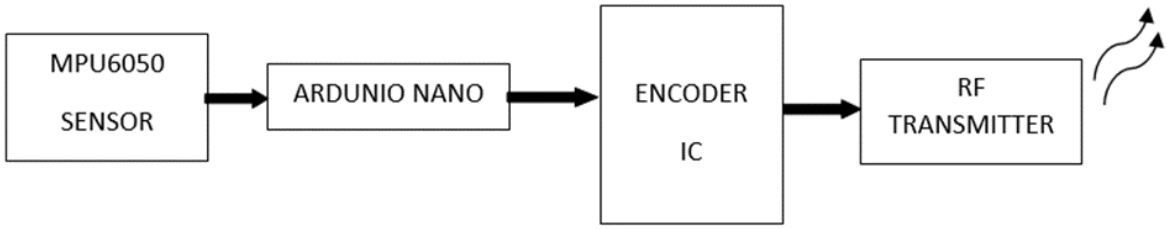

Fig 3.2: RF Transmitter

Receiver Block Diagram

The RF signals that are received are sent to the motor relay module that gives the input to the 6 DC motors that move forward or in any direction that the MPU6050 is bent in.

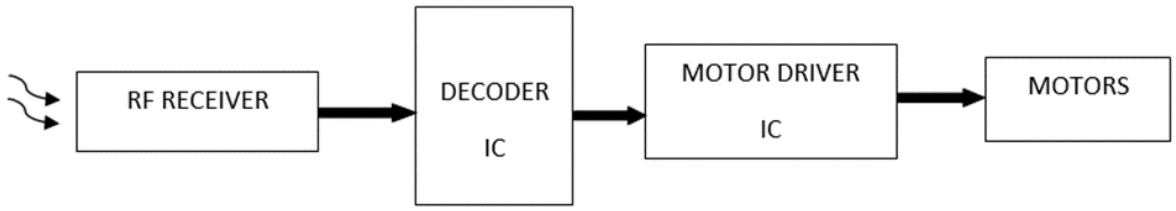

Fig 3.3: RF Receiver

The system will work in a stepwise fashion as follows:

1. The hand gesture controller will detect hand gestures and send commands to the Arduino Nano.

2. Arduino Nano will receive the command and send a signal to the DC motor drive to control the motion of the rocker-Bogie Rover.

3. The DC motor will control the speed and direction of the DC motor allowing the motor to move in the desired direction.

4. The Rocker-Bogie suspension system will adjust to the terrain as the rover moves, allowing it to move over obstacles and over uneven terrain.

5. The rover will be equipped with a camera module. If a human is detected, the firefighters start an immediate rescue operation and send in the team to save the human from further injuries.

CHAPTER 4

RESULT OF PROJECT

Our project is called "Hand Gesture-Controlled Hovering Chassis for Human Detection in Fire Buildings" and aims to develop a remote-controlled vehicle that can detect the presence of people in a fire building and provide up-to-date information to firefighters. The system consists of two primary components: a hand gesture control system for the rocker chassis and a camera system for person detection and live monitoring.

The hand gesture control system for the cradle chassis was implemented using an Arduino nano microcontroller ,RF transmitter and receiver which receives input signals from hand gesture. MPU 6050 measures the degree of flexion of the hand, which is then converted into movement commands for the rocker chassis. The system also includes additional control inputs, such as tilting the rocker to overcome obstacles. The control algorithm was implemented in C,C++ and integrated with the camera system.

A camera system for person detection and live monitoring was implemented using ESP32-CAM module .The camera can stream live video to a laptop using an IP address and is capable of detecting the presence of people even in low-light conditions or when partially obscured by smoke or debris. The system sends live updates to firefighters in real time using a wireless communication module.

To evaluate the effectiveness of our system, we conducted a series of experiments in a simulated fire building environment. We tested the accuracy and reliability of the hand gesture control system as well as the effectiveness of the camera system in detecting people and

providing live updates. Our results show that our system is able to detect people with a high degree of accuracy and can provide real-time live updates to firefighters.

Overall, our system is a promising tool to assist firefighters in their efforts to extinguish fires and rescue trapped persons. The hand gesture control system allows firefighters to operate the rocker from a distance without entering the building, reducing the risk of injury and improving efficiency. The camera system provides up-to-date information on the presence and movement of people in real time and allows firefighters to make informed decisions about the next step in a rescue operation. In future work, we plan to further optimize the system and perform further testing in more realistic fire scenarios to evaluate its potential for use in real-world situations.

In conclusion, our hand gesture controlled rocker chassis equipped with person detection and live monitoring camera system is a valuable addition to the arsenal of tools available to firefighters. By providing up-to-date information on the presence and movement of people in a fire building in real time, our system has the potential to save lives and minimize the risk of injury to firefighters and trapped persons. We believe that our project represents a significant contribution to the field of robotics and has the potential to be applied in the real world of fire safety and rescue operations.

Fig 4.1: Final Model

CHAPTER 5

CONCLUSION AND FUTURE SCOPE

The Gesture Controlled Rocker-Bogie project demonstrates the potential and feasibility of using hand gestures as a control method for locating robots in challenging environments such as firefighting buildings. The implementation of the proposed control system in a rocker-bogie type research robot provides a more intuitive and efficient control method, while improving the robot's mobility and flexibility in difficult terrain navigation.

The integration of the camera module for the detection of human presence is essential to the system, making it a valuable tool for rescue operations that require accurate and realistic monitoring of the environment. The project is in line with the growing demand for advanced robotic technology that can facilitate emergency and disaster management and is a modern revolution in research robots.

The success of this project demonstrates the importance of developing innovative management systems that can improve the safety and efficiency of rescue operations in challenging environments. Future work may focus on improving the control system and improving the search robot's capabilities for emergency response. This project makes an important contribution to the field of robotics, and its success demonstrates the potential of using advanced technology to solve critical challenges in emergency and disaster response.We can also implement image processing to detect Humans using the set parameters with ML.

CHAPTER 6

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