KSCST 46th Series SPP

Project Reference Number : 46S_BE_3867

Project Title: Multi-Terrain Robot – Rocker Bogie Design

Name of the College: Dayananda Sagar College of Engineering.

Branch: Electrical and Electronics Engineering

Name(s) of project guide(s):

1. Name: Prof. Sreevidya T R
Email id: sreevidya-eee@dayanandasagar.edu
Contact No.: +91 99163 61891

Name of Team Members:

1)Name: NISHANT PATHAK
USN No.: 1DS19EE055
Email id: pathaknishant1019@gmail.com
Mobile No: +91 62322 99226

2) Name: SAMPURNA NAND SHUKLA
USN No.: 1DS19EE078
Email id: sampurnanandshukla3@gmail.com
Mobile No.: +91 63872 07123

3) Name: SAURAV GIRI

USN No.: 1DS19EE080
Email id: giri.saurav008@gmail.com
Mobile No.: +91 90016 57010

4)Name: YASHOVARDHAN
USN No.: 1DS19EE104
Email id: 1ds19ee104.yashovardhan@gmail.com
Mobile No.: +91 76520 37251

Keywords

Rocker Bogie Mechanism, Multi Terrain Robot, Remote Controlled Rover, Rough Terrain Vehicle, Stair Climbing Robot.

Introduction

The Rocker Bogie system is the suspension preparation used in mars rover introduced for mars radar device and also used on mars for exploring and science laboratory missions. The bogie can defend against mechanical failures in harsh ambience on mars. The mechanical element of the rocker bogie design is drive train plainness, where it is expert by two supports. Rockers are links present on both sides of the suspension. When one rocker goes up the other one comes down. One end is fixed in the drive wheel, one more is hinged to a bogie. The control and design of the systematic models of rover relates with the surroundings is necessary. Models are also needed for rover achievement setting up. For example, it is important that it is able to predict if a rover can effectively understand a given ground obstacles, wheels without being trapped.

We intended to create a robot with stair climbing ability which can provide fast locomotion in planar areas as well as a stable structure in very rough terrain. We chose a rocker-bogie mechanism for our mechanism as a result of its extremely stable suspension that is capable of operative in multi tract surfaces whereas keeping all wheels to bear with ground. This mechanism is that the suspension arrangement employed in Mars rovers introduced for Mars expert and conjointly used on Mars Exploration Rover (MER) and Mars laboratory (MSL) missions.

In this project we intend to develop such robot which will be able to traverse through multi terrain such as rocky or uneven surfaces and also climb stairs, using this Rocker Bogie Mechanism. We also intend to propose an algorithm for the locomotion of robot based on the feedback from the Ultrasonic sensors. The design is such that it can be used for the applications that include surveillance and security and to obtain information about an unexplored terrain that may be potentially hazardous for humans. For the surveillance, a purpose camera would be fitted which will give easy and clear surveillance for any army personnel to check on.

Objectives

The objectives kept in mind to create the robot is as shown:

 The rocker bogie can be used for military purposes for locating the enemies by setting up cameras on top of the rover and making the rover small.

 The suspension system should be light weight and should ensure at all times that all the wheels stay in contact with surface.

 To optimize the pace such that the vehicle does not fall in rough conditions and maintains its stability whereas also allow it to be able to travel fast.
 The rover must maintain good wheel grip in challenging rough terrains and should have detachable wheels in case it is being used in a certain terrain for long periods of time.
 The long-term goal of our project is to develop a robust outdoor platform which is suitable to be included in disaster mitigation as well as in security and surveillance missions.

Methodology

To implement the above proposed structure, first we need to understand the principle or working of Rocker- Bogie Suspension and then design the suspension as per our needs. As per the research it is found that the rocker bogie system reduces the motion by half compared to other suspension systems because each of the bogie's six wheels has an independent mechanism for motion and in which the two front and two rear wheels have individual steering systems which allow the vehicle to turn in place as ZERO degree turning ratio.
Every wheel also has thick cleats which provides grip for climbing in soft sand and scrambling over rocks with ease. In order to overcome vertical obstacle faces, the front wheels are forced against the obstacle by the centre and rear wheels which generate maximum required torque. The rotation of the front wheel then lifts the front of the vehicle up and over the obstacle and obstacle overtaken.

Those wheels which remain in the middle, is then pressed against the obstacle by the rear wheels and pulled against the obstacle by the front till the time it is lifted up and over. At last, the rear wheel is pulled over the obstacle by the front two wheels due to applying pull force. During each wheel's traversal of the obstacle, forward progress of the vehicle is slowed or completely halted which finally maintain vehicles center of gravity.
The rocker bogie mechanism mainly comes in two different kinds of suspension designs – the linear type and the trapezoidal type suspension. Combining the two different types of suspensions into one a specific design is created, which inculcates certain qualities of both the suspensions. It has aerodynamic properties like the lateral suspension and also has great stability and torque for climbing protrusions and stair like structures.

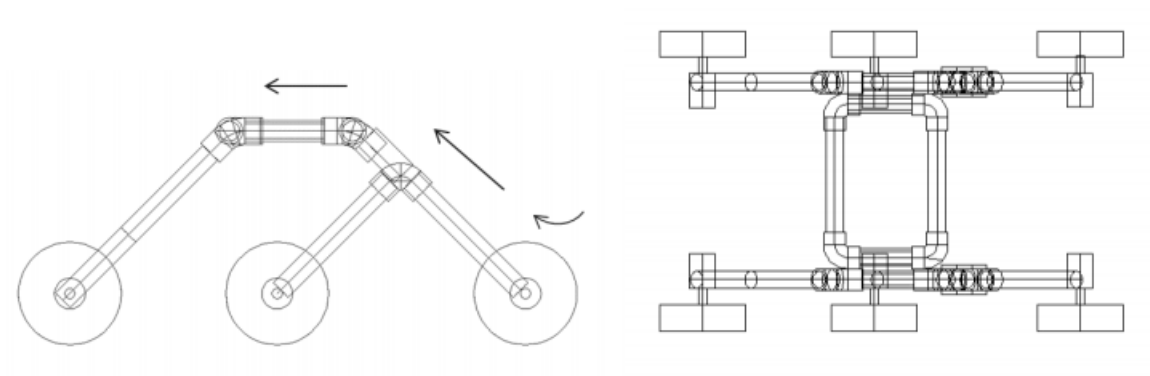

Figure (1). shows the side and top view of the specifically designed Rocker -Bogie Suspension.

The final design is created by referring the various research papers available and calculation are done to evaluate the height of the structure, the diameter of the wheels, the torque required for the motor etc., for a certain type of obstacle with the maximum height, pre-defined.

The robot thus contains two major components – the first one being the receiver which will be mounted on the robot consisting of a Microcontroller Unit. This controller will also be connected with sensors like, Ultrasonic Sensor for Obstacle Detection, Temperature and Humidity sensor, Camera – for live video feed transmission, motor drivers to control the motion of vehicle etc. The second significant component would be a transmitter circuit which will be embedded in controller from where the user can operate the robot.

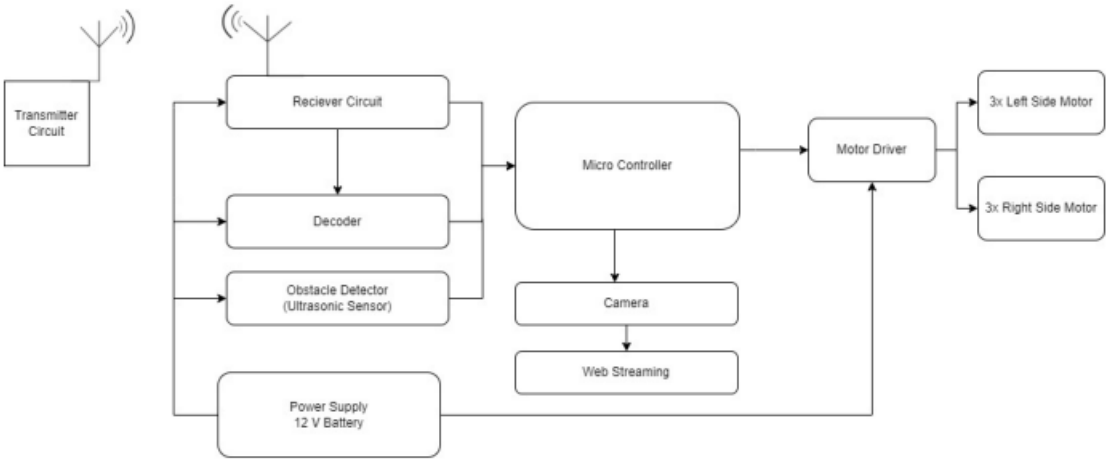

Figure (2). shows the general block diagram of the proposed system.

Results and Conclusions

Through this project, we attempt to make a multipurpose robot, which has the ability to travel on almost all kinds of terrain without losing much of its balance. The Robot is remotely controlled with the radio frequency which enables it to have a large range and consist of sensors like ultrasonic, camera, temperature and humidity sensor so the user can have an access to view and analyze the scene where the human intervention is not possible like Mining Sites, Small Caves, Debris etc. Techniques traditionally used in robotics, such as mechanical modeling and sensor fusion, can be used to remotely measure the vital signs of wildlife. It will provide ecologists and veterinarians with an early warning system to help them detect if an animal is ill.

In the workplace, robots perform various repetitive and demanding tasks quickly and reliably. Robots can take care of repetitive tasks like carriage of file etc. for which wastage of human time can be avoided. Robots also increase safety in the workplace by performing tasks that would be dangerous to humans.

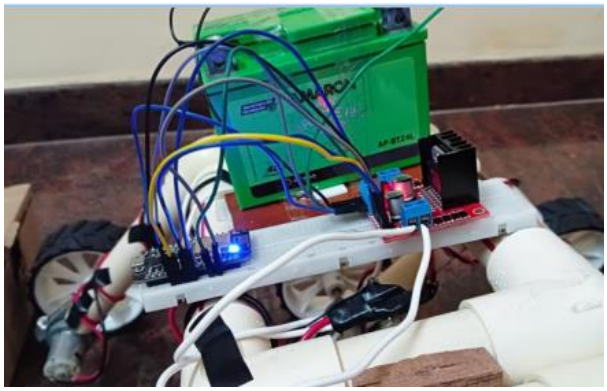

Figure 3 and 4 shows the connections of the microcontroller unit and the motor driver along with battery, the motor and wheel joint, and designed prototype respectively.

Scope of Future work

Multi-terrain robots often face harsh environmental conditions, including extreme temperatures, vibrations, and dust or water exposure. Future work could involve design with increased ruggedness and reliability to withstand such conditions, instead of PVC pipes used here, Metal pipes can be made into use. This may involve improved circuit protection, sealed enclosures, and enhanced fault tolerance mechanisms. Also, a better interaction system, In future we can implement touchscreens, voice recognition systems, or gesture-based controls using the microcontroller. This would enhance the usability and accessibility of the robot,

making it easier for operators or users to interact with it. Further, developing power-efficient algorithms, implementing low-power modes, and optimizing the microcontroller's energy consumption would extend the robot's operational time, reduce battery weight, and enhance overall efficiency.

Multi-terrain robots often require sophisticated algorithms for autonomous navigation. Future work could focus on developing advanced control systems that utilize the microcontroller's capabilities to execute complex navigation tasks. This may involve implementing algorithms for terrain mapping, localization, simultaneous localization and mapping (SLAM), and autonomous path planning.