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Land Rover with Camera

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Abstract: *A rover is a planetary surface exploration device designed to move across solid surfaces on a planet or other planetary mass celestial bodies. Rovers have wheels and specialise in moving around. They land on the surface of a planet and drive around to different spots. Scientists use rovers to further their understanding of the composition of the planet's various regions. They are typically deployed for scientific objectives, such as gathering soil samples, looking for bacteria living on a planet's surface, discovering evidence of water, and attempting to determine whether the planet contains any signs of life. Over stationary landers, rovers offer a number of advantages: they explore more ground, can be steered to interesting sites, can position themselves in sunny areas to survive the winter, and can improve our understanding of how to handle very remote robotic vehicles.*

Key Word*: Rover; Rocker-Boogie mechanism; Arduino Uno; L293D Motor Driver; RF signals; RF receivers and transmitter module*

I. INTRODUCTION

Rovers are designed mostly for exploration purposes of various terrains and lands which are mostly inaccessible to men. They are very helpful in collecting data about soil, temperature, climate of a region. A rover can be made more efficient by integrating to it various other components like sensors and camera. A camera integrated rover can capture images and videos which is a very essential resource in any research. Our rover comes with a camera which can be rotated in all directions giving a 360° coverage. It is a simple design of a rover which works wirelessly using RF communication consisting of transmitter and receiver. When input is given to the module, the transmitter which has an encoder IC embedded in it, transforms the binary code into radio waves. Radio waves are able to travel wirelessly so it travels in air and reaches to the receiver which then converts the radio waves back into interpretable binary code. The code is written in Arduino IDE which is transferred into the Arduino board. The system also has a camera which helps in capturing images and in navigation.The Rocker-Bogie system is the suspension arrangement used in the Mars rovers (mechanical robot. It is currently NASA‘s favoured design. The larger links on either side of the suspension system rock, hence the word "rocker." The links with a drive wheel at either end are referred to as "bogies." The Rocker Bogie design, which has stub axles for each wheel and no springs, enables the rover to climb over obstacles like rocks that are up to twice as large as the wheel's diameter while maintaining contact with the ground with all six wheels. The tilt stability, like that of any suspension system, is constrained by the height of the centre of gravity. A tiny PCB sub-assembly called an RF transmitter module may send a radio wave and modulate that wave to carry data. Radio frequency modules are technological gadgets used for transmission and/or receive radio signals between two devices. In radio communications, a radio receiver, also known as a receiver, a wireless, or simply a radio, is an electronic device that receives radio waves and converts the information carried by them to a usable form. It is used with an antenna. A little electronic gadget called an RF module is used to send and receive radio signals between two devices. This wireless communication is accomplished through RF communication.Encoder IC (HT12E) linked to RF transmitter transforms binary signal into radio waves for wireless transmission. RF Receiver module is connected with a decoder IC (HT12D) which converts back radio wave signals to binary signals so it can be used for further applications. L293D Motor Driver acts as an interface between low power sensors and high power motors. The L293D is a 16-pin motor driver IC that has the ability to simultaneously operate up to two DC motors in either direction. There are numerous positive and negative pins on the module we utilised. We can put input voltage from 9 to 12 V in the motor. We have used Arduino UNO which is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins 6 analogue inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller. We just simply need to connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started. The movements of the rover can be controlled by buttons present in the RF Transmitter and we can direct the rover to any direction we want.

II. MATERIAL AND METHODS

This prospective study was carried out on robotics in the department of electronics and communications at Dayananda Sagar College Of Engineering, Kumaraswamy Layout, Bengaluru, Karnataka from March 2022 to August 2022

Study Design: Study on exploration for research purpose using robots.

Study Location: Department of electronics and communications at Dayananda Sagar College Of Engineering, Kumaraswamy Layout, Bengaluru, Karnataka

Study Duration: March 2022 to August 2022

Materials/Components: RF Receiver, RF Transmitter, L293D Motor Driver, Arduino uno, dc motors, rover chassis, camera and software (Arduino IDE)

RF Transmitter:

It is a PCB which is used to transmit and modulate radio waves to transfer data. The transmitter module operates on 433 MHz and has an encoder HT12E IC embedded in it. In order to broadcast via an RF link using a transmitter, the encoder IC HT12E turns the 4-bit parallel data from the 4 data pins into serial data.

RF Receiver:

The modulated RF signal is received by the RF receiver module, which then converts it into usable form. It receives signals through antenna. The RF Receiver consists of a decoder HT12D IC embedded in it. A decoder IC called HT12D transforms the serial data that the RF Receiver receives into 4-bit parallel data and drives the output appropriately.

L293D Motor Driver:

The microprocessor sends signals to the L293D IC, which then delivers the appropriate signal to the motors.

The 16 pins on the L293D are organised as follows:

GROUND PINS	4
INPUT PINS	4
OUTPUT PINS	4
ENABLE PINS	2
VOLTAGE PINS	2

Arduino Uno:

The Arduino Uno is an open source microcontroller based on the microchip ATmega328p microcontroller and developed by Arduino.cc. The specifications of the Arduino Uno are as follows:

Microcontroller	Microchip ATmega328p
Operating voltage	5 volts
Input voltage	7to 20 volts
Digital I/O pins	14
PWM pins	6
Analog input pins	6
DC current per I/O pin	20mA
DC current for 3.3V pins	50mA
Flash memory	32KB
SRAM	2KB
EEPROM	1KB
Clock speed	16MHz
Power sources	DC jack & USB port

Problem statement and objectives:

The main objective of our project to make science and exploration more simpler, less hazardous and very effective in order to keep the research work at a fast pace. In this modern world of science and technology there are places on the surface of the earth that are yet to be explored and exploited. These places may contain vast amount of undisturbed useful resources that could help mankind greatly. But exploring these places with only manpower is next to impossible. The place may contain harmful radiations that can affect the human body or it might just not be safe enough for humans to travel, explore and analyse that particular area. This is where robots come in handy. The robot that we have designed here is a prototype of the rover that was sent to Mars for space exploration and research purposes.

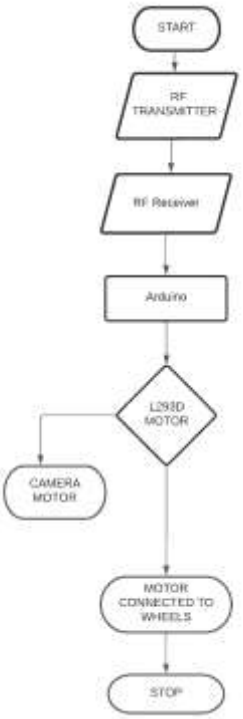
The rover that we have designed here mainly focuses on reaching the most uninhabited places on the surface in order to find new materials like minerals, resources, sand, water etc. We have mainly tackled the issue of reaching the uninhabitable places that have rocky and uneven terrain lands. Normal vehicles like JCBs , trucks , cars, vans , SUVs can travel on uneven regions only upto a certain extent. These vehicles mostly prove themselves useless while exploring unknown lands and terrain as we cannot really predict how the land region is or what the situation of the soil is.

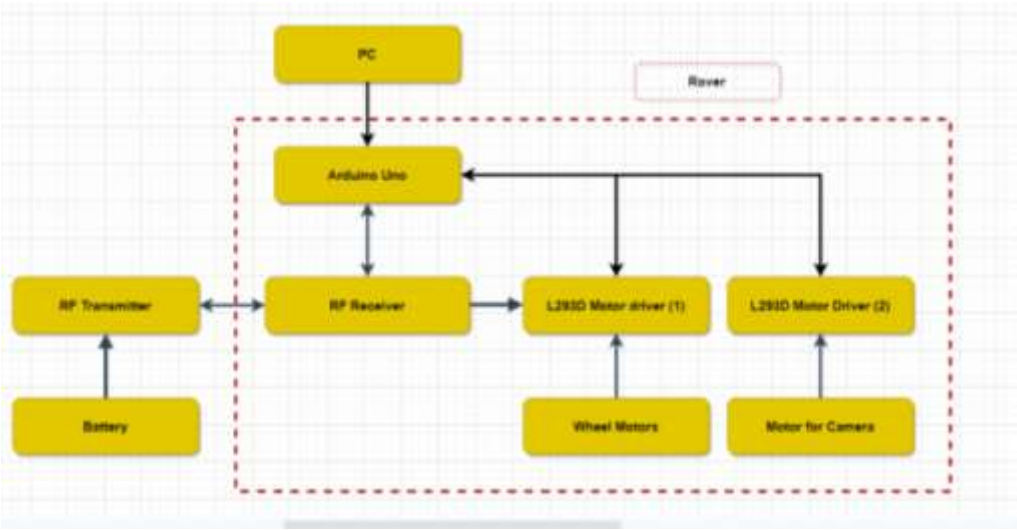
Our main objective is to overcome this above mentioned problem. By overcoming this issue we can reduce half the accessibility inconvenience. The prototype of the Mars Rover that we have designed here can move around on rocky surfaces effortlessly. It can move on any sort of region in all directions efficiently. This Mars rover prototype can move on any sort of obstacle or inconvenience that comes in its way during exploration works.

The other main objective that we have focused on improving the robot is to control it wirelessly from incomparable distances. In order to make the wheels move in the desired direction we can increase the range of the RF receiver transmitter module whilst using at a large scale. To navigate through the unexplored region we have set up a camera that can turn around in 360 degree direction to give a full fledged view of the surrounds. By adding these two main features it reduces the involvement of humans at the site of exploration. Thus places that go unexplored due to it being hazardous to humans, or just impossible to access is made easy using this robot.

Procedure methodology:

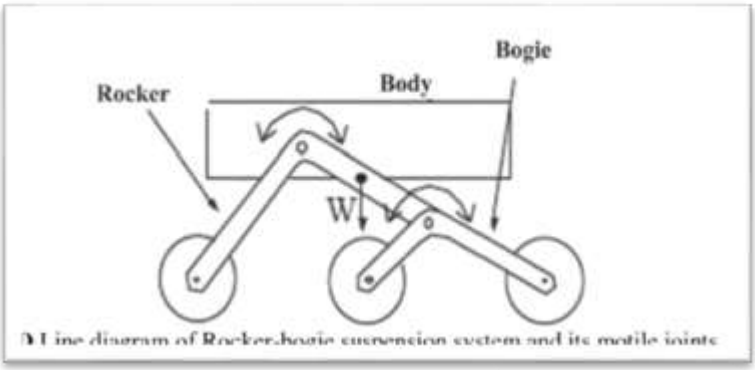
When the buttons are pressed on the transmitter the receiver receives the signal and turns on the Arduino. The code dumped into the Arduino written on IDE segregates the signal information and concludes on what to carry out as a function. The motors connected to wheels are activated through the L293D motor driver that helps move the wheels in the desired direction and desired speed. Hence by moving around the camera capturing images for processing and navigation we can control the rover wirelessly from far distance.





Rocker-bogie mechanism:

The suspension system known as the rocker-bogie system was created in 1988 for use in NASA's Mars rover Sojourner and has subsequently come to be the agency's preferred rover design. It was utilised by the Mars Exploration Rover mission robots Spirit and Opportunity in 2003, Curiosity in the Mars Science Laboratory (MSL) mission of 2012 and Perseverance in the Mars 2020 mission. The larger, body-mounted linkages on either side of the rover rock as a result of which



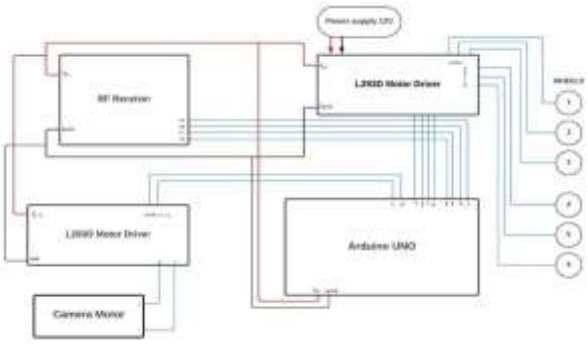
A Line diagram of Rocker-bogie suspension system and its motile joints

the suspension system has a "rocker" component. Through a differential, these rockers are linked to the chassis of the car as well as one another. To ensure roughly equal wheel contact, the rockers will rotate in opposite directions with respect to the chassis. The average pitch angle of both rockers is maintained by the chassis.

A drive wheel is attached to one end of a rocker, and the bogie is attached to the other end. The smaller linkage with a driving wheel at each end and a pivot to the rocker in the middle is referred to as the "bogie" section of the suspension. Bogies were frequently employed in trailers of semi-trailer trucks as well as as load wheels on the tracks of army tanks as idlers to distribute the load throughout the terrain. Nowadays, trailing arm suspensions are preferred by both tanks and semi-trailers. The front wheels of the Sojourner rover attach to the bogies, whereas the front wheels of the MER and MSL rovers attach to the rockers

III. RESULT AND FUTURE WORK

We have designed a fully functional Land Rover prototype that can move around on uneven terrain effortlessly. This robot can move around using six wheels. The wheels on the backend are fixed while the front four wheels are free hand wheels that act as an arm for the rover to move on irregular terrain.



We can further develop this rover by adding sensors such as temperature sensors, gas detection sensors and pressure sensors from which we can know the habitat that surrounds the rover. We can use raspberry pi instead of Arduino uno and implement image analysis using machine learning. A robotic arm can also be used in the rover to collect samples such as soil crust samples for research and exploration purposes

IV. DISCUSSION

This project is based on RF receiver and transmitter functioning which works wirelessly under long ranges and remote conditions. When the buttons are pressed on the transmitter the receiver receives the signal and turns on the Arduino. The code dumped into the Arduino written on IDE segregates the signal information and concludes on what to carry out as a function. The motors connected to wheels are activated through the L293D motor driver that helps move the wheels in the desired direction and desired speed. Hence by moving around the camera capturing images for processing and navigation we can control the rover wirelessly from far distances with the help of rocker bogie mechanism used in the rover.

V. CONCLUSION

We have designed a Land rover with camera that allows various things such as going on uneven surfaces and viewing the place where the rover is deployed through the camera. The rover we have designed uses a mechanism called Rocker-bogie mechanism. In this mechanism, we have used six tires in the rover in which the first four tires can rotate in the forward direction up to 90 degrees and the last two tires are fixed which helps in the easy movement of the rover on uneven terrain. The rover enables us to get a 360 degree view of the surrounding places. We have used 7 DC motors in which 6 DC motors help in the moving of the rover and one helps in the moving of the camera.

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