

DESIGN AND FABRICATION OF SURVEILLANCE ROBOT USING ROCKER BOGIE MECHANISM

Tejas Bamne^{*1}, Siddhi Jadhav^{*2}, Shrutika Borkar^{*3},
Shailesh Kokare^{*4}, Mr. Pravin Alone^{*5}

^{*1,2,3,4,5}Department Of Mechanical Engineering, AICTE, Mechanical Engineering,
NHITM, Thane, Maharashtra, India.

ABSTRACT

The rocker-bogie suspension mechanism it's currently NASA's favored design for wheeled robots, mainly because it has robust capabilities to deal with obstacles. Rocker-bogie mechanism was used in the Mars rover. This mechanism helps a robot to displace from one place to another very easily even after having an uneven surface. Usually the four-wheeled robot having a normal steering mechanism cannot always move over the very uneven surface. So this mechanism helps a robot to climb any kind of surface. Our purpose is to increase the stability of the rocker-bogie system by expanding its support polygon, making it more stable and adaptable while moving at high speed, while keeping its original robustness against obstacles. When operating at low speed (greater than 10cm/seconds), dynamic shocks are minimized. For many future planetary missions rovers will have to operate at human level speed (-1m/second). Shocks result from the impact of the front wheel against a rocker-bogie vehicle so that it can effectively step over most obstacles rather than impact and climb over them. For the surveillance, a purpose camera would be fitted which will give easy and clear surveillance for any army personnel to check on.

Keywords: Rocker-Bogie, Rover, Uneven Surface, Stability, Dynamic Shocks, Obstacles Climb, Surveillance.

I. INTRODUCTION

Surveillance is that the technique for perceptive a location, a part or someone for defense and security purpose. This activity continuously happens in an exceedingly military, police, public places and even in homes these days for watching and to regulate the dirty activities. We choose a rocker-bogie mechanism for our mechanism as a result of it's 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. the bogie will resist the mechanical failures caused by the cruel atmosphere on MARS. So as to travel over the obstacle, the front wheels are forced against the obstacle by the rear wheels. The rotation of the front wheel then lifts the front of the vehicle up and over the obstacle. the center wheel is that the ironed against the obstacle by the rear wheel and force against the obstacle by the front, till the upraised up and over. Finally, the rear wheel is force over the obstacle by the front 2 wheels. throughout every wheel's traversal of the obstacle, forward progress of the vehicle is slowed or utterly halted. These rovers edge and climb over the obstacles by having wheels raise each bit of the suspension over the obstacle one portion at a time. This system uses an Spy camera as a watching camera.

Six DC motors square measure every connected to the wheels and controlled via a Bluetooth module. This watching automaton will climb stairs simply as a result of it uses a rocker bogie suspension in order that the automaton will monitor the state of the complete area. Especially, the investigation activity is employed in the main for human as a result of the individuals were doing all bootleg work against the government and at identical time to safeguard them from those activities. The arrival of technology has brought a revolutionary modification within the field of AI, particularly in the automation sector. The usage of AI is increasing day by day, that reduces the human work however the efficiency of labor will increase altogether department from military to our home and even in hotels. Today's life has modified a lot in each activity because of usage of Smartphone. The people can do all works victimization sensible phone and that they will operate any system by developing Associate in Nursing application, which may be put in the sensible and providing varied applications on different operative systems. Especially, the mechanical man OS is one of the necessary sources, that is on the market in open and helps in building the applying for several activities for people in their day these days life.

Even the individuals with minimum data will ready to create a tiny low mechanism for protective purpose. There have been varied work disbursed for investigation recently.

Here, to regulate the usage of security guard, the mechanism was designed with flipper arm mechanism, camera, Wi-Fi module and a few sensors like supersonic, thermal and sound. This mechanism is operated through Arduino UNO. Rocker over which are used in the process of space expedition are made up of alloys to withstand the cruel nature of the outer space and the habitats of other planets. One of the example of such alloys as Titanium alloy. But in the case of the rocker rover, which are intend to use for the agriculture purposes, the material used should be light weight, easily accessible and affordable as the rover does not have to face harsh atmosphere and habitats of other planets like space exploration rocker rover. So using PVC pipes for the rocker rover to make its cost to the affordable so that the rover could easily accessible to the industry.

PVC Pipe Specification:

Total Pipe Used: 8 ft

External Diameter: 33.40 mm

Internal Diameter: 25.40 mm

Selection of Acceleration for Robot:

Maximum velocity of robot is 0.2m/s. Hence the acceleration of robot will be $0.2/2$ means 0.1 m/s^2 . This means it would take 1 seconds to reach maximum speed. If robot is going up inclines (as per Equation No.1) or through rough terrain, you will need a higher acceleration due to countering gravity. We needed to climb the angle up to 45° . Hence,

$$\begin{aligned} \text{Acceleration of inclines} &= 9.81 * \sin (\text{ angle of inclination }) * \pi \\ &= 180 \quad (1) \\ &= 0.121 \text{ m/s}^2 \end{aligned}$$

$$\text{Total Acceleration} = 0.1 + 0.121 = 0.221$$

The Application that is used for controlling the robot is “Arduino Bluetooth Controlled Joystick” which is developed by Uncia Robotics and it is freely available in play-store. The Application that is used for live recording is “Look Cam” which is developed by Yves Kerbens Declerus and it is freely available in play-store. The spy camera works on Wi-Fi module which can show live feeding of camera and also recordings in day as well as night.

II. OBJECTIVES

1. Designing and manufacturing the robot for surveillance purposes.
2. Designing the multi-terrain robot.
3. Robot should be robust and economical.
4. It should record AV through a spy cam.

III. LITERATURE REVIEWS

P. Sreenivasulu al (2021) [1], researchers have successfully fabricated the Rocker Bogie Mechanism which has been tested on the rough surface for stability. Since the power is estimated based on torque, Hence the servo motor is selected for each wheel based on torque requirement. Arduino Uno is selected for the servo controller and control software for the robot. The various experiments were conducted on the robot and the results obtained were very satisfactorily. The metal detector is successfully giving information on GPS location. Pictures and image viewing are decent by the camera. The robot is tested and results are recorded.

Anmol Singh & PK Jain (2020) [2], researchers show an ideal plan of a rocker-bogie suspension framework so as to ensure high mobile stability as well as excellent flexibility of a prototype rover vehicle while traversing through uneven surfaces. It is basically a suspension arrangement employed in mechanical automated vehicles used explicitly for space investigation. The proposed suspension framework is currently the most maintained structure for each space study organization. It is basically a mechanism that contains two arms with wheels mounted to each and the two arms are linked through a versatile joint.

Sunxin Wang & Yan Li (2016) [3], work focuses on the two fields: (1) analysis of the dynamic stability margin for high-speed traversal enhancement of rocker-bogie; (2) kinematical simulation of the two operating modes

of rocker-bogie. The idea, one rocker-bogie system with two modes of operation, is useful to increase the usefulness and efficiency of the all-terrain mobile robots. This structural improvement can make the rocker-bogie more adaptable and efficient in a situation that requires high-speed traversal or dealing with surfaces that need a more robust performance over tough obstacles.

S. Muruganatham al (2019) [4], researchers show how the rocker-bogie system will work on different surfaces. It depends on the different weights acting on the link to decide the torque applied on the rocker-bogie can climb the stair with great stability the designed and fabricated model can move up the angle up to 45°.

S.F. Toha and Zakariya Zainol (2015) [5] emphasize on the improvement and design of mechanical systems on land that took into consideration the features of water vehicles. The wheel should be retracted to increase the stability of the vehicle while it in water mode. Retractable wheels are designed to reduce the loss of the bow wave wheel. It rises vehicle speed when maneuvering on the water's surface. If the wheels are organized, the water flow under the surface of the vehicle will be choked and diverted by the wheel. The wheel will interrupt the water flow path triggering a high pressure before the wheel and low pressure after it. This produces a negative pressure that will distress the speed and steadiness of the vehicle. In a post-disaster relief, the road surfaces become irregular and rough. The cleverly designed wheel suspension allows the vehicle to cross over very uneven terrain and even climb over obstacles. The rocker-bogie allows the chassis of the rover to average pitch overall wheel deflections while still maintaining load equalization on all wheels and avoiding a low fluctuation frequency.

IV. CONSTRUCTION

1. DC Gear Motor: An electric machine that converts electrical energy into mechanical energy. The working principle of a DC motor is that every time a current-carrying conductor sited in the magnetic field experiences a mechanical force DC motor the input electrical energy is the direct current which is converted into the mechanical rotation. We will be using a 60 rpm motor with a 12V DC motor the electrical motor is an electro-mechanical device that produces motion by turning electrical energy into a mechanical one.



Figure 1: DC Motor

2. Wheels: Wheels are usually in the pairs, connected by a rod of wood or metal known as an axle. Our wheel design may not be optimized in terms of strength and weight reduction. Our project wheel diameter is 70mm



Figure 2: Wheel

3. Surveillance Camera: The device works Wi-Fi module and includes Android and iOS smartphones with the free mini camera app to configure. This mini spy camera can records without Wi-Fi too, all you have to do is insert an SD card and turn it on.



Figure 3: Wi-Fi Module Camera

4. PVC Pipe Material: A thermoplastic material derived from common salt & fossil fuels the pipe material has the longest track record of all plastic materials. Our Project pipes materials are acrylic, so this is a transparent plastic material with outstanding strength, stiffness, and optical clarity. Our project pipe diameter is 25mm.



Figure 4: PVC Pipe

5. Battery: It is a 12V 2500mAh lithium-ion rechargeable battery with a minimal capacity of 2.5Ah and discharge capacity of 2A Over-voltage, over-current, over-charge, and short-circuit protection battery packs with the best wire length for the space. Safe and trustworthy, superior environment-friendly rechargeable battery with high-temperature PVC wrapper, no toxic waste.



Figure 5: 12V Battery

6. Bluetooth HC-05 Module: Designed to replace cable connections HC-05 uses serial communication to communicate with the electronics. Usually, it is used to link small devices like mobile phones using a short-range wireless connection to exchange files. It uses the 2.45GHz frequency band. The transmission rate of the data can vary up to 1Mbps and is in the range of 10 meters.



Figure 6: HC-05 Module

7. Arduino Uno R3: The Arduino Uno R3 is a microcontroller board based on a removable, dual-inline-package (DIP) ATmega328 AVR microcontroller. It has 20 digital input/output pins (of which 6 can be used as PWM outputs and 6 can be used as analog inputs). Programs can be overloaded onto it from the easy-to-use Arduino computer program. The Arduino has a widespread support community, which makes it a very relaxed way to get started working with embedded electronics. The R3 is the third, and up-to-date, revision of the Arduino Uno.



Figure 7: Arduino Uno R3

8. Motor Driver-L298D: The L298D is a dual H-Bridge motor driver which permits speed and direction control of two DC motors at the same time. The module can drive DC motors that have voltages between 5 and 35V, with a highest current up to 2A.

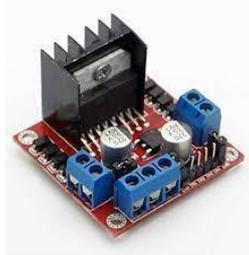


Figure 8: Motor Driver

9. Power Driver: It is a Power Source Module/USB Charger, Input voltage: DC 9V ~ 36V, Output voltage: 5.2V, Appropriate for DIY an Voltage Regulated Power Supply, Charging module, Industrial equipment Voltage convert, Power Supply Transformers, Laptop Power Supply, Batteries Buck, Car Power Supply, LED drive, Advertising screen, USB Charger, Monitoring System etc.



Figure 9: Power Driver

V. CIRCUIT DIAGRAM & CIRCUIT BLOCK DIAGRAM

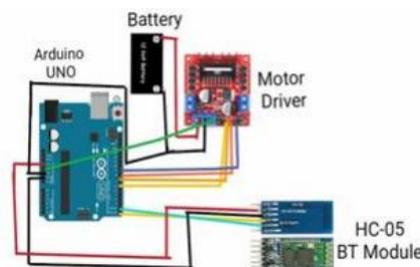


Figure 10: Circuit Diagram

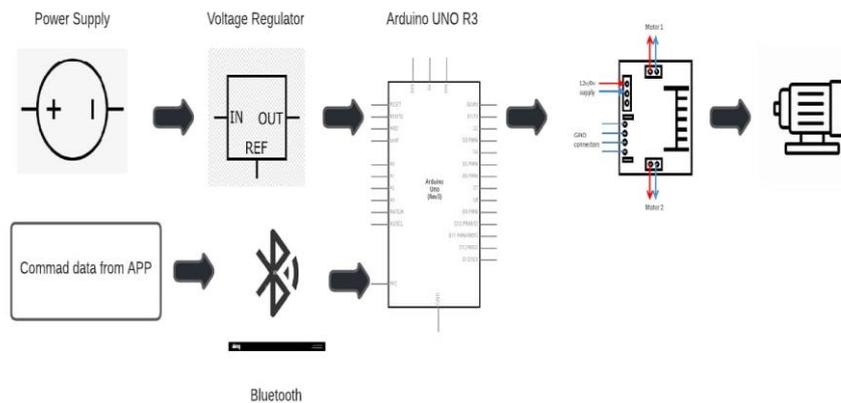


Figure 11: Circuit Block Diagram

VI. CODES OF ARDUINO UNO R3

```
#include <SoftwareSerial.h>
// defining the pin of the motor
#define IN1 8
```

```
#define IN2 9
#define IN3 10
#define IN4 11
char inputByte;
SoftwareSerial blu (4,3);
void setup() {
  Serial.begin(9600);
  blu.begin(9600);
  pinMode(IN1,OUTPUT);
  pinMode(IN2,OUTPUT);
  pinMode(IN3,OUTPUT);
  pinMode(IN4,OUTPUT);
}
void loop() {
  if(blu.available(>0) /// Receiving the data from the bluetooth
  {
    inputByte= blu.read(); /// Read the string received from bluetooth
    Serial.println(inputByte); /// serially printing the data received from bluetooth
    switch(inputByte) /// switch condition for the controlling
    {
      case 'F':
        Forward(); /// motor will move forward
        Serial.println("forward");
        break;
      case 'B':
        Backward(); /// motor will move backward
        Serial.println("backward");
        break;
      case 'L':
        Left(); /// motor will move left
        Serial.println("left");
        break;
      case 'R':
        Right(); /// motor will move right
        Serial.println("right");
        break;
      case '0':
        Stop(); /// motor will stop moving
        Serial.println("stop");
        break;
      default:
        break;
    }
  }
}
}
}
///Defining forward condition
void Forward()
{
  digitalWrite(IN1,HIGH);
  digitalWrite(IN2,LOW);
  digitalWrite(IN3,HIGH);
```

```
digitalWrite(IN4,LOW);
}
//Defining backward condition
void Backward()
{
  digitalWrite(IN1,LOW);
  digitalWrite(IN2,HIGH);
  digitalWrite(IN3,LOW);
  digitalWrite(IN4,HIGH);
}
//Defining left condition
void Left()
{
  digitalWrite(IN1,HIGH);
  digitalWrite(IN2,LOW);
  digitalWrite(IN3,LOW);
  digitalWrite(IN4,HIGH);
}
//Defining right condition
void Right()
{
  digitalWrite(IN1,LOW);
  digitalWrite(IN2,HIGH);
  digitalWrite(IN3,HIGH);
  digitalWrite(IN4,LOW);
}
//Defining stop condition
void Stop()
{
  digitalWrite(IN1,LOW);
  digitalWrite(IN2,LOW);
  digitalWrite(IN3,LOW);
  digitalWrite(IN4,LOW);
}
```

VII. PERFORMANCE AT VARIOUS CONDITIONS

As per the ground level experimentation by rocker bogie manufactured, tested found that the performance satisfactory below are the results are shown see fig. 12 to 14 on different obstacle and different surfaces.



Figure 12: Robot climbing steps



Figure 13: Robot climbing rough surface



Figure 14: Robot at plain surface

VIII. FUTURE SCOPES

- With the advance in technology the rover can be used for reconnaissance purposes with the cameras installed on the rover and reducing the size of the rover.
- With some developments like assigning arms to the rover it can be made beneficial for the Bomb Defusing Squad such that it can be able to cut the wires for diffusing the bomb.
- We could develop it into a Wheelchair too. It can be directed in valleys, jungles, or such places where humans may face some hazards.
- It can also be developed into Suspension System for automobiles through proper research.

IX. CONCLUSION

This project climbs the obstacles or ride on the abnormal surface with the help of such a rocker-bogie mechanism serves our objective because of its nature of allowing flexibility in linkages when wheel climb or goes from the abnormal road surface. Hence this mechanism does not need an extra suspension arrangement. Also, the wireless Wi-Fi mini camera which is connected to the free mini camera app configured. The AV recording of the camera can be seen in that app. The camera also has motion detection and night vision. Also, this project is budget-friendly.

X. REFERENCES

- [1] P.Sreenivasulu, Sk. Zuned, Sk.Mujamil, G.Tarun Teja, V.V. Sumanhor, "IOT Based Surveillance Robot for Military by Using Rocker Bogie Mechanism" ISSN: 2693-3713 (2021).
- [2] Anmol Singh, PK Jain, "A study on Rocker-Bogie Suspension for a Planetary Rover Prototype" Volume-8 Issue-3 (2020).
- [3] Sunxin Wang and Yan Li, "Dynamic Rocker-Bogie Kinematical Analysis in a High-Speed Traversal Stability Enhancement" Volume 2016.
- [4] S. Muruganatham, S. Karthikeyan, P. Karunakaran, S. Naveen, S. Nishanthan, " Design and analysis of Rocker Bogie field Mobile Robot" Volume-7 Issue-2 (2020).
- [5] S. F. Toha and Zakariya Zainol, "System Modelling of Rocker-Bogie Mechanism for Disaster Management" (IRIS 2015).
- [6] Abhaykant Sinha, Reshma Sinha, "Design of Stair-Climbing Rocker-Bogie Mechanism" Volume-7, Issue-7, July 2018.
- [7] B. Babu, N. Dhayanidhi, S. Dhamocharan, "Design and Fabrication of Rocker Bogie Mechanism Geosurvey Rover" Volume-3, Issue-8, August 2018 IJSDR.

- [8] D.S. Chinchkar , S.S. Gajghate , R.N. Panchal , R.M. Shetenawar , P.S. Mulik, "Design of Rocker Bogie Mechanism" Volume-4, Special Issue-1, January 2017.
- [9] M. Vigeshwaran, R. Siddhartha, G. Vijay, and S. Pravin Kumar, "Design of All- Terrain Vehicle Using Rocker Bogie Mechanism" Volume-10, Issue-03, March 2019.
- [10] Aishwarya A R, Neelaveni Ammal Murugan, Shubhendu Ojas Tewary, Ashish Sharma, Anoushka Shukla, "Agrobot: Agriculture Assitance Robot Using Rocker Bogie Mechanism and Image processing" ISSN: 2277-3878, Volume- 8, Issue-1, May 2019.