DESIGN AND FABRICATION OF ROCKER BOGIE ROVER

[1]Jakeer Hussain Shaik, [2]Rohit Eswar T, [3]Tameez Khan, [4]Mallikharjuna S, [5]Mohan Sai Krishna T
[1]Assoc. Professor,[2,3,4&5] Scholar,
[1-5]Department of Mechanical Engineering,
[1-5]KKR & KSR Institute of Technology and Sciences, Guntur, India.

Abstract: The rocker-bogie system is the suspension arrangement used in the Mars rovers (mechanical robot) introduced for the Mars Pathfinder. It is currently NASA's favored design. The term "rocker" comes from the rocking aspect of the larger links on each side of the suspension system. These rockers are connected to each other and the vehicle chassis through a differential. The term "bogie" refers to the links that have a drive wheel at each end. Bogies were commonly used as load wheels in the tracks of army tanks as idlers distributing the load over the terrain Human being is full of desires and adventures, once we had to think of visiting another planet ex. Mars, to see whether mankind can live there or not. We can't experiment our self for that. Here, we need a robot, the robot which used to find path. The robot, which can travel in any kind of path. The robot which is used detects gasses of that atmosphere. The robot, which can record live-footage. The solution with which we came up for this problem is Rocker-bogie rover. It is a six-wheeled vehicle with six wheel motor drive and with a flexible design to prevent damage from all uneven surfaces. Here, rockers are connected to each other and the vehicle chassis through a differential. Relative to the chassis, when one rocker goes up, the other goes down. The chassis maintains the average pitch angle of both rockers. One end of a rocker is fitted with a drive wheel and the other end is pivoted to a bogie.

INTRODUCTION

Over the past decade, the rocker-bogie suspension design has become approve mobility application known for its superior vehicle stability and obstacle-climbing capability. Following several technology and research rover implementations, the system was successfully flown as part of Mars Pathfinder's Sojourner rover. When the Mars Exploration Rover (MER) Project was first proposed, the use of a rocker-bogie suspension was the obvious choice due to its extensive heritage. The challenge posed by MER was to design a lightweight rocker-bogie suspension that would permit the mobility to stow within the limited space available and deploy into a configuration that the rover could then safely use to egress from the Lander and explore the Martian surface.

When building a robot, you'd like it to be as simple as possible. In most cases you'd never need a suspension system, but there were several instances when a suspension system cannot be avoided. The term "bogie" refers to the links that have a drive wheel at each end. Bogies were commonly used as load wheels in the tracks of army tanks as idlers distributing the load over the terrain. Bogies were also quite commonly used on the trailers of semi-trailer trucks. Both applications now prefer trailing arm suspensions. The rocker-bogie design has no springs or stub axles for each wheel, allowing the rover to climb over obstacles, such as rocks, that are up to twice the wheel's diameter in size while keeping all six wheels on the ground. As with any suspension system, the tilt stability is limited by the height of the center of gravity.

The Rocker bogie system is the suspension arrangement used in Mars rovers introduced for Mars Pathfinder and also used on Mars Exploration Rover (MER) and Mars Science Laboratory (MSL) missions. This bogie can resist mechanical failures caused by the harsh environment on MARS. The primary mechanical feature of the Rocker Bogie design is its drive train simplicity, which is accomplished by two rocker arms. In order to go over an 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 middle wheel is pressed against the obstacle by the rear wheel and pulled against the obstacle by the front, until it is lifted up and over. Finally, the rear wheel is pulled over the obstacle by the front two wheels. During each wheel's traversal of the obstacle, forward progress of the vehicle is slowed or completely halted. These rovers move slowly and climb over the obstacles by having wheels lift each piece of the suspension over the obstacle one portion at a time.

LITERATURE SURVEY

Chinchkar et al**. [1]** briefs that the project aim is to design a complex application-oriented vehicle to travel on the inconvenient conditions on mass. So, they designed different 6 or 8 wheeled vehicles to make impossible things possible and can make this vehicle travel in the impossible places. This work shows how rocker bogie system works on different surfaces. Abhaykant Sinha et al**. [2]** explains in planetary exploration, Rocker-Bogie Mechanism will continue to play a significant role. Present mobility designs are complicated, using number of wheels or legs. They are not built up to mechanical failure initiated by the tough environment on Mars. Murali Mohan et al**. [3]** describes that Rocker bogie is important for conducting in-situ scientific analysis of objectives that are separated by many meters to tens of kilometers. Current mobility designs are complex, using many wheels or legs. Gautam Buragohain et al**. [4]** briefs that a rover is a vehicle for driving over rough terrain, especially one driven by remote control over extraterrestrial terrain. It uses a suspension system that has 6 wheels with provide great stability. Wesley B et al**. [5]** explored the resulting design was fabricated and tested to ensure both range of motion and stiffness during static loading. After modifications to increase the stiffness in key areas, the design was tested under dynamic conditions to mimic the arena obstacles and found to meet or exceed the desired performance. Chris Voorhees et al**. [6]** explains that over the past decade, the rocker-bogie suspension design has become a proven mobility application known for its superior vehicle stability and obstacle-climbing capability. Zakariya Zainol et al**. [7]** briefs the east coast of Malaysia faced a massive flood from heavy downpour, leading to huge flood damage and caused irreparable loss to life and property.

MATERIALS AND METHODS:

Instead of using wireless camera we are using smart phone for live streaming of surroundings for spying this can be done with help of BLUETOOTH application which is installed in mobile phone and due to internet services we can easily spy at any time. For wireless communication with Robot unit we are using Bluetooth module and easily control our robot with the help of android Application using USART Technology. Hence Android application is used as a remote control for robot which control movements of motors due to which wheel and is controlled laser shooter.

Hardware components:

1. Chassis

A chassis is the basic framework of your vehicle. Sometimes the chassis is only the frame, while other times it includes the wheels, transmission, and sometimes even the front seats.

A chassis is one of the most important components of a vehicle, without which the car would have no structure. It is the canvas in which the final construction of the vehicle is placed upon. Chassis are usually made of carbon steel. More recently, as a way to create more inexpensive vehicles, some chassis have been made with aluminium.

There are two different types of chassis used on vehicles today. The original type, which is still used on heavier vehicles like trucks and off-road vehicles, is the body-on-frame chassis. It's called this because the body of the vehicle literally sits on top of the frame. They are not attached as one unit, but instead, work separately from one another.

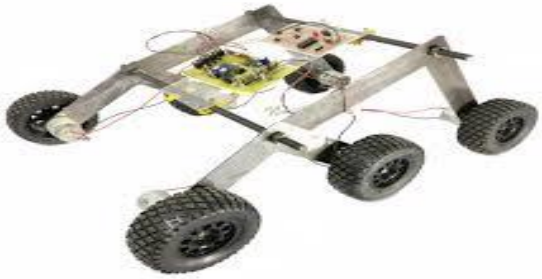

Fig 1. Chassis

A body-on-frame chassis is easier to modify or repair in case of an accident. This type of chassis makes the vehicle slightly harder to handle and steer.

Unibody chassis are exactly as they sound. The chassis and body of the vehicle are actually one piece and function together as the base of the car. Unibodies are used for lighter vehicles. This type of chassis makes cars easier to handle and drive. They are lighter than body-on-frame chassis, which makes them better on fuel, too.

In particular applications, such as school buses, a government agency like National Highway Traffic Safety Administration (NHTSA) in the U.S. defines the design standards of chassis and body conversions.

2. BO Wheels (Battery-Operated Wheels)

Dragging a load using a wheeled cart is far easier than dragging it on the ground—for two reasons: Wheels reduce friction. Instead of simply sliding over the ground, the wheels dig in and rotate, turning around sturdy rods called axles.

Fig 2. BO Wheels

Wheels made life easier because transportation was now very easy. They didn't have to have so many men on the big objects, Life got more simpler and less hard work. People did not have to strain carrying a heavy object. Construction was made a lot easier and transporting goods from cities to were easier also. Power Wheels vehicles have been the subject of Safety Recalls.

The first recall in 1991 involved the 18 Volt Porsche 911, in which the contacts in the foot pedal switch could weld together in use. If this were to happen, the motor would remain running and the vehicle would continue moving forward, unable to stop. A new accelerator pedal was fitted that eliminated the possibility of welded contacts.

3. Fasteners

These are very important because each component or machinery or vehicle needs these to hold it together. Fasteners are main components used in many sectors such as automation, manufacturing, infrastructure and others in which different types of items are produced that require assembling of machinery or vehicle parts.

A fastener (US English) or fastening (UK English) is a hardware device that mechanically joins or affixes two or more objects together. In general, fasteners are used to create non-permanent joints; that is, joints that can be removed or dismantled without damaging the joining components. Welding is an example of creating permanent joints. Steel fasteners are usually made of stainless steel, carbon steel, or alloy steel.

Fig 3. Various Fasteners

SOFTWARE REQUIREMENT:

1. Arduino UNO

The Arduino Uno R3 is a microcontroller board based on a removable, dual-inline-package (DIP) ATmega328 AVR microcontroller.

Fig 4. Arduino UNO

2. Motors

An electric motor is an electrical machine that converts electrical energy into mechanical energy. Most electric motors operate through the interaction between the motor's magnetic field and winding currents to generate force in the form of rotation. ... Small motors may be found in electric watches.

3. Bluetooth Module

The HC-06 is a class 2 slave Bluetooth module designed for transparent wireless serial communication. Once it is paired to a master Bluetooth device such as PC, smart phones and tablet, its operation becomes transparent to the user. All data received through the serial input is immediately transmitted over the air.

Fig 5. Bluetooth Module

4. Micro-Processor

A microprocessor is a computer processor that incorporates the functions of a central processing unit on a single integrated circuit (IC), or at most a few integrated circuits.

DESIGN AND FABRICATION MEHODS

CATIA DESIGN:

CATIA is a computer aided three-dimensional interactive application, pronounced is a multi-platform software suite for computer-aided design (CAD), computer-aided manufacturing (CAM), computer-aided engineering (CAE), PLM and 3D, developed by the French company Dassault Systems. CATIA started as an in-house development in 1977 by French aircraft manufacturer Anions, at that time customer of the CAD/CAM CAD software to develop Dassault's Mirage fighter jet, then was adopted in the aerospace, automotive, shipbuilding, and other industries.

Commonly referred to as a 3D Product Lifecycle Management software suite, CATIA supports multiple stages of product development (CAX), from conceptualization, design (CAD), manufacturing (CAM), and engineering (CAE). CATIA facilitates collaborative engineering across d1isciplines, including surfacing & shape design, mechanical engineering, equipment and systems engineering.

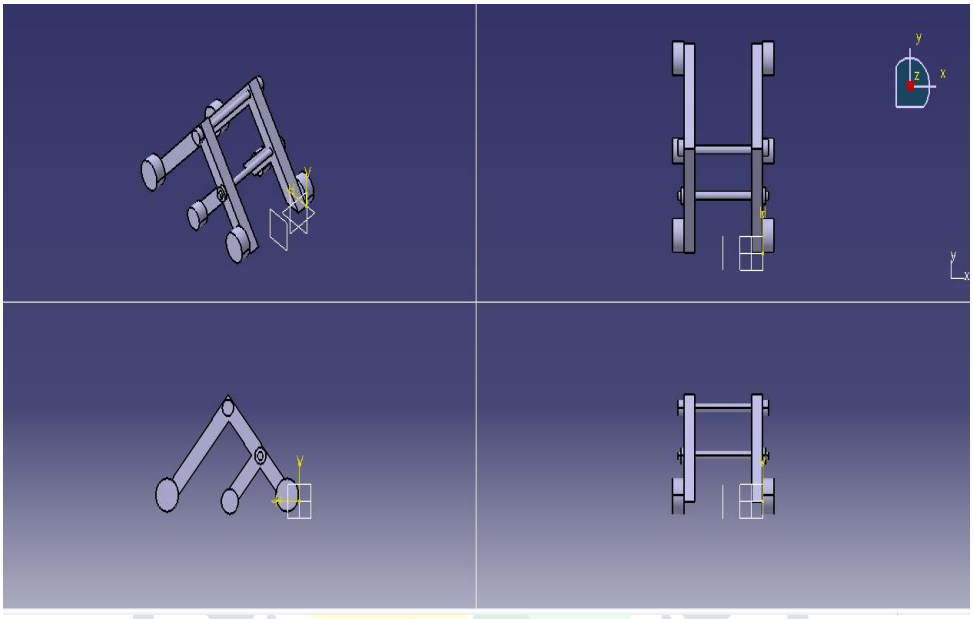

Fig .CATIA Model

FABRICATION MODEL OF PROJECT:

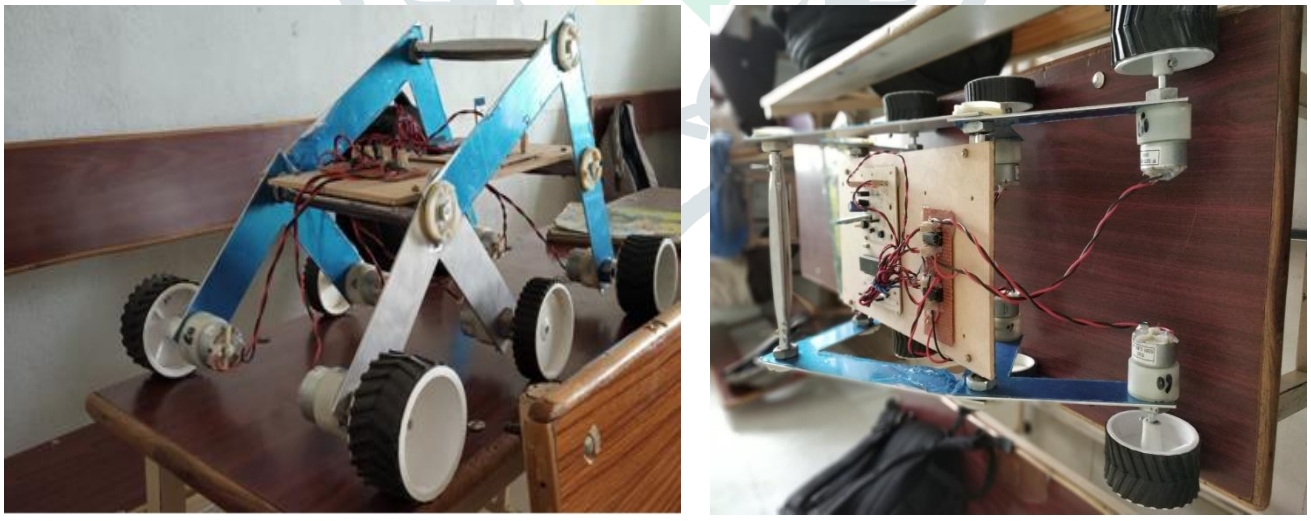

Fig 6. Fabrication Model

ALGORITHM AND FLOW CHARTS:

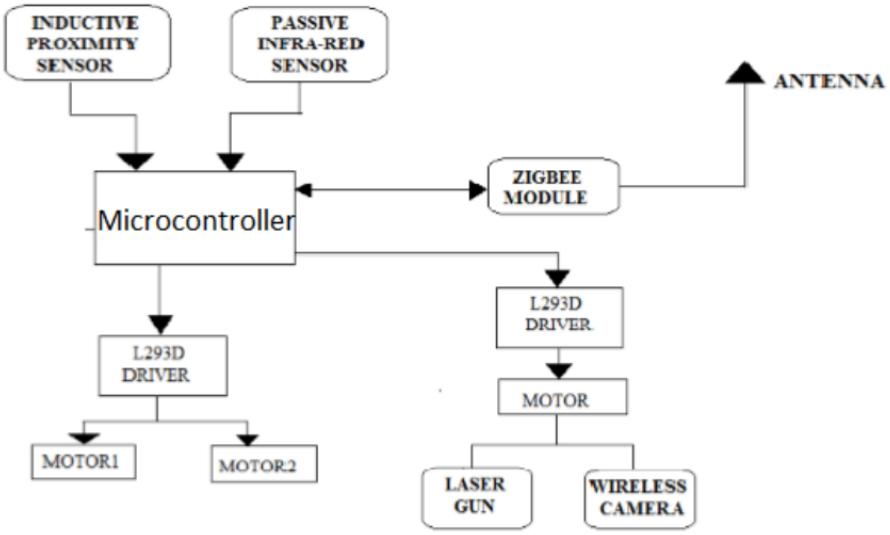

Fig. 7. Fabrication Algorithm

- STEP 1: Automation and Manual Mode
- STEP2: Area Sensing
- STEP3: Live video transmission
- STEP4: Image capturing
- STEP5: Database Management
- STEP6: Commanding Information
- STEP7: Attacking or Leaving

RESULTS AND DISCUSSIONS:

Android Application:

Below is the screenshot of Android application which is used in this project to control the Robot. This application has 9 keys / commands. We have used 7 commands. Command 7 and 9 are not used and are reserved for future scope. User can even rename these key text as Forward / Reverse using the Set Keys option. User needs to turn on the Bluetooth on his/her mobile and press scan button as shown below. Then connect to the Bluetooth receiver on robot. Once the connection is established then the application will show connected status.

METHOD OF IMPLEMENTATION:

1. The HC-05 Bluetooth modules should be paired with the mobile and the default password to establish the connection would be 1234 or 0000
2. Then you need to click on "Select Device" option to select the paired Bluetooth module
3. When you press the "Up arrow" it sends the data "A" to the Bluetooth module connected with the bot and the microcontroller is programmed in such a way that whenever it receives the command "A" it moves forward
4. Similarly, when you press the "Down arrow" it sends the data "B" to the Bluetooth module connected with the bot and the microcontroller is programmed in such a way that whenever it receives the command "B" it moves reverse
5.And, when you press the "Left or Right arrow" it sends the data "C or D" respectively to the Bluetooth module connected with the bot and the microcontroller is programmed in such a way that whenever it receives the command "C or D" it moves left or right accordingly
6. When the "Stop" button is pressed, it sends the data "E" to the Bluetooth module connected with the bot and the microcontroller is programmed in such a way that whenever it receives the command "E" the robot's movement gets stopped
7. You can then click on the "Disconnect" option to remove the paired Bluetooth module.

CONCLUSIONS:

- This work shows how rocker bogie system works on different surfaces. As per the different weight acting on link determines torque applied on it. By assuming accurate stair dimensions, accurately dimensioned rocker bogie can climb the stair with great stability.
- The design and manufactured model can climb the angle up to 45˚. Also, we tested for the Web cam with AV recording mounted on rocker bogie system and found satisfactorily performance obtains during this test camera has rotated around 360˚.
- During stair climbing test for length less than 375 mm (15 inch) system cannot climb the stair. It can be possible to develop new models of rocker-bogie which can climb the stairs having low lengths.
- The proposed paper produces a novel design in pursue of increasing the rocker-bogie mobility system in conventional heavy loading vehicle behaviour when high-speed traversal is required.
- Presented situation was faced presenting two modes of operation within same working principle which is a rocker-bogie system with a robust obstacles traverse features and another is an expanded support hexagon achieved by rotating the bogies of each side of the vehicle.
- The proposed modification increases in the stability margin and proved with valuable and profitable contrasting the SSF metric with the 3D model simulations done in SOLIDWORKS.

REFERENCES:

[1]. Chinchkar D. S, Gajghate S. S, Panchal R. N, Shetenawar R. M and Mulik P. S., " Design of Rocker Bogie Mechanism", Vol-4(1), pp.46-50, 2017.
[2]. Abhay Kant Sinha, Reshma Sinha "Design of Stair-Climbing Rocker-Bogie Mechanism", Vol-7(7), pp. 8316-8323, 2018.
[3]. Harish Chandu. K, Hari Narayana. P, Charan Teja K. C, Sai B and Murali Mohan. Y, "Design and Fabrication of Rocker Bogie Mechanism", Vol-7(4), pp. 0781-0784, 2018.
[4]. Gautam Buragohain, Karan Borah and Rakesh Nath, "Design of a Rocker Bogie with Spherical Wheel insertion.", Vol. 2(10), pp.01-02, 2017
[5]. Wesley B. Williams and Eric J. Schaus, "Design and Implementation of a Rocker-Bogie Suspension for a Mining Robot." 2015.
[6]. Brian D. Harrington and Chris Voorhees, "The Challenges of Designing the Rocker-Bogie Suspension for the Mars Exploration Rover." 2004.
[7]. Toha. S. F and Zakariya Zainol, "System Modelling of Rocker-Bogie Mechanism for Disaster Relief",pp.243-249, 2015.