Design And Manufacture of Rocker Bogie Mechanism For Geosurvey

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Abstract- *As the rovers are essential medium for space exploration. Many rovers' designs have developed to comprehendthe geography of planetary surface of solar system. Standard rocker bogie suspension mechanism has excellent weight distribution for different surfaces on rough territory. The rover is used for geological survey on earth in places where it's difficult for us to reach. The project aims to overwhelmthe obstacles such as Rough terrain, Climbing Stairs etc. The rover is made from PVC and Nylon Material to increase its potential to sustain shocks, vibrations and mechanical failures initiated by the harsh environment where it is maneuvered on. Using AutoCAD software the design of the rover has been modified and by using CREO Parametric the 3D model was executed and analyzed. The rover is propelled using DC motors which are controlled via Bluetooth using the Microcontroller Arduino UNO. The Rover is installed with Ultrasonic Sensor and camera for survey. The result of the project was the execution of the design according to our knowledge and skills in every aspect such as Designing, Machining, Handling, Control and Communication.*

Keywords- Rocker, Bogie, PVC, Arduino, Ultrasonic Sensor, Camera, Bluetooth, Android Application.

I. INTRODUCTION

The rocker-bogie mechanismis known for its excellentvehicle steadiness and obstacle climbing capacity. Several technology and research rover performances, the system were successfully fluttered as part of Mars Pathfinder's Sojourner rover. When the Mars Exploration Rover (MER) Project was first planned, the use of a rocker bogie suspension was the apparent choice due to its extensive heritage. The challenge imitated by MER was to develop a light-weight rocker-bogie mechanism that might allow the mobility to stow within the limited space available and deploy into an arrangement that the rover could then safely explore the Martian surface. While building a robot you'd like it to be as simple as possible. The "rocker" part of the term comes from the rocking characteristic of the larger, forward leg on each side of the suspension system. These rockers are connected to each other and the vehicle chassis via a differential. Relative to the chassis, both the rockers are inversely proportional to each other i.e. when one rocker goes up, the other goes down. The "bogie" part of the term indicates to the smaller, to the rear leg that pivots to the rocker in the middle and which has a drive wheel at each end. Bogies were commonly used as load wheels in the pathways of army tanks as idlers allocating the load over the terrain.

II. LITERATURE REVIEW

The concept of the project work is to make a rocker bogie drive system supported that of NASA. NASA established the rocker-bogie suspension system for their rovers and was executed in the Mars Pathfinder's and Sojourner rover. The rocker-bogie suspension system inertly keeps all six wheels on the robot in contact with the ground even on irregular surfaces. This generates great traction and maneuverability. The rocker-bogie suspension mechanism which was currently NASA's permitted design for wheeled mobile robots, mainly because it had study or robust competencies to affect obstacles and since it uniformly distributes the payload over its 6 wheels in the least times. It is also used for other functions to operate in rough terrains and to climb the steps. As per the research it's find that the rocker bogie system reduces the motion by half contrasted to other suspension systems since each of the bogie's six wheels has an independent mechanism for motion and during which the 2 front and two rear wheels have separate steering systems which permit the vehicle to show in situ as 0 degree turning ratio. In order to beat vertical obstacle faces, the front wheels are forced against the obstacle by the Centre and rear wheel which produces maximum required torque. The rotation of the front wheel then elevates the front of the vehicle up and over the obstacle and obstacle overtaken. Those wheels which remain within 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 elevated up and over. At last, the rear wheel is drawn over the obstacle by the front two wheels due to applying pull force. After this research, Design and Dimensions were finalized as per requirement. In AutoCAD we drafted 2D drawing of every part which are to be manufactured and the 2D assembly drawing for exact

dimensions. After 2D Design and Drafting we modeled the parts using those dimensions into CREO 4.0 and then assembled it

III. DESIGN OF ROCKER BOGIE

The important factor in manufacturing of rocker bogie mechanism is to determine the dimensions of rocker and bogie linkages and angles between them. The lengths and angles of this mechanism can be changed as per requirement. In the work aim is to manufacture the rocker bogie mechanism which overcomes the obstacles of 300 mm height (like stones, wooden blocks) and climbs over stairs of height 300 mm. Also another target is to climb any surface at an angle of 45˚. To achieve the above targets we had design the rocker-bogie model by assuming stair height 300 mm and length 500 mm.

1. Design Calculation

The key design decisions were made to meet the requirements and goals presented in the previous sections. Each one of these is related to meeting fundamental requirements. The objective of the research work is for stair climbing. The dimensions of linkages should be correct to attain proper stair climbing. Assume the stair height and length to be 300 mm and 500 mm respectively. To climb stairs with higher constancy, it is required that only one pair of the wheel should be in a rising position at a time. Therefore, to find the dimension of bogie linkages, the first pair of wheels should be placed at horizontal position, i.e. at the end of the rising and second pair should be placed just before the start of rising. There should be some distance between the vertical edge of stair and second pair of the wheel to prevent striking of wheels of the rocker bogie.

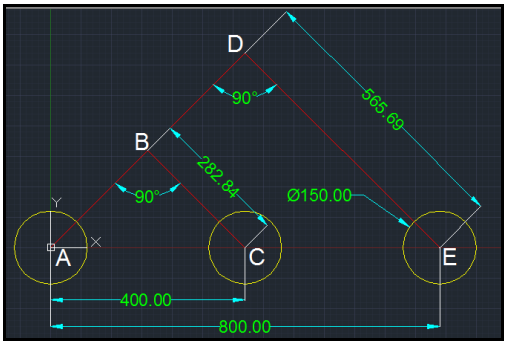

Fig.1. Design and Calculations.

A. Calculation of Bogie

Using Pythagoras Theorem
Consider Δ ABC

$$AB^2 + BC^2 = AC^2$$
$$AB^2 + BC^2 = 400^2$$
$$x^2 + x^2 = 400^2$$
$$2x^2 = 400^2$$
$$Hence\ x = AB = BC = 282\ mm$$

B. Calculation of Rocker

Using Pythagoras Theorem
Consider Δ ADE

$$AD^2 + DE^2 = AE^2$$
$$AD^2 + DE^2 = 800^2$$
$$y^2 + y^2 = 800^2$$
$$2y^2 = 800^2$$
$$Hence\ y = AD = DE = 565\ mm$$

By considering all these lengths &angles we have designed whole mechanism.

C. Design & Selection of Wheel

Design of wheel is required at velocity up to 80 mm/s. Assume speed is 10-20 rpm motor. Using velocity relation, velocity is calculated for assumed speed.

$$V = \frac{\pi . D . N}{60}$$

$$80 = \frac{\pi . D \times 10}{60}$$
$$Hence\ D = 152.3\ mm$$

Using velocity relation the Dia. of wheel is 152.3 mm. Hence we select the wheel of 150 mm diameter (standard wheel). Selection of Nylon wheel makes it more durable and strong.

2. Design And Drafting

A. AutoCAD:

After Calculations we drafted the 2D sketch of our design with required measurementsas shown in Figure 2&3

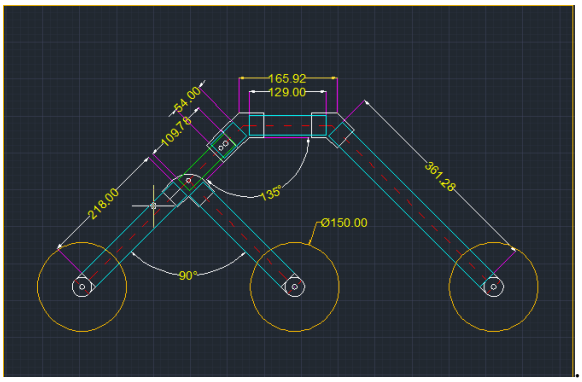

Fig.2. Front View of Rover

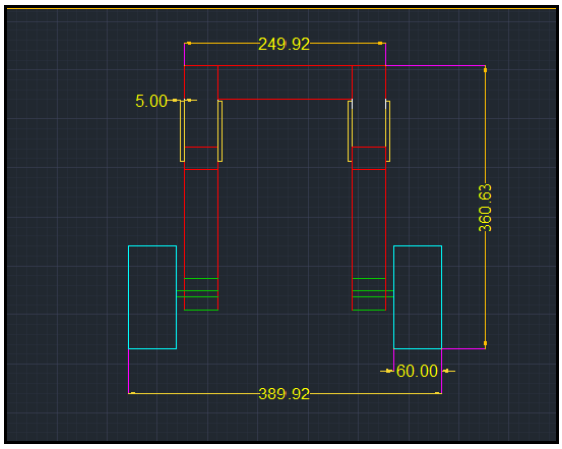

Fig.3. Side View of Rover

B. CREO 4.0:

After drafting in AutoCAD the 2D sketch was converted into 3D Parts and then assembled it as shown in Figure 4 and 5.

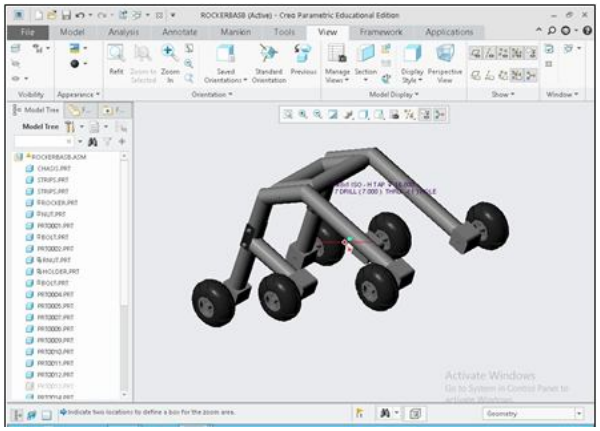

Fig.4. 3D Model of Rover.

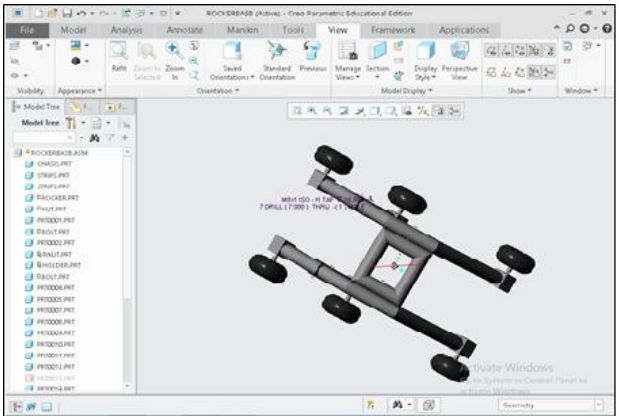

Fig.5. Solid Model of Rover.

IV. SET-UP AND CONSTRUCTION

Construction Details:

1. Mechanical Components:-

i. PVC Pipes and Joints
ii. MS Strips
iii. Nuts And Bolts
iv. MS Plate
v. Nylon Bars And Blocks
vi. Nylon Wheels
vii. Split Pins

2. Electrical Components:-

i. 10 RPM Geared Motors
ii. 12V Battery
iii. Arduino Uno
iv. Motor controller
v. Bluetooth Relay
vi. Wi-Fi Module
vii. Ultrasonic Sensor
viii. Wireless Camera
ix. Wires and Cables

3. Codes For Arduino

i. 10 RPM Geared Motors
ii. 12V Battery
iii. Arduino Uno
iv. Motor controller
v. Bluetooth Relay
vi. Wi-Fi Module
vii. Ultrasonic Sensor
viii. Wireless Camera
ix. Wires and Cables

Block Diagrams Of Electrical Connections:

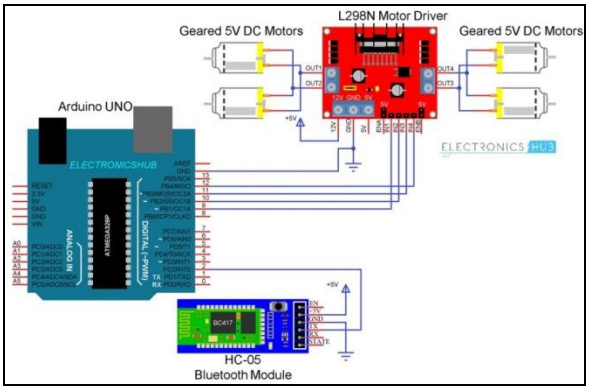

Fig.6. Arduino Uno and Motor Connections

V. WORKING

After Manufacturing and machining the rover, we assembled every part and then connected the Electrical Components with 12V Battery. We controlled the rover using Arduino Uno via Bluetooth with the help of an Android Application. We tested its performance at different conditions, which was found satisfactory. Below in Figure (7, 8, and 9) is the result of performance at different conditions.

Fig.7. Rover at rough terrain.

Fig.8. Rover climbing the Steps.

Fig.9. Rover climbing an inclination.

VI. CONCLUSION

The rocker bogie mechanismclimbs the stair with great steadiness. The design and manufactured model climbs up to45˚inclination.

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