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Design and Fabrication of Rocker Bogie Mechanism

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Abstract: The rocker-bogie suspension mechanism its currently NASAs one of the favourite design for wheeled mobile robots, mainly because it has multipurpose capabilities to deal with different types of surface and obstacles because it uniformly distributes the overall weight over its 6 wheels at all times. That's why it has many advantages when dealing with obstacles, there is one of the disadvantage is its low average speed of operation, the rocker bogie system generally not suitable for situations where high-speed operations for which to cover large surfaces Areas. mainly due to stability problems. Our purpose is to increase the stability of the rocker-bogie mechanism system by expanding its support design structure, making it more stable and flexible while moving at high speed, at different surfaces but keeping its original flexibility against obstacles. Most of the flexibility of this method can be achieved without any mechanical modification to existing designs only a change in control strategy. Some mechanical changes are required to Achieve the maximum Advantages and to increase the rover operations speed in future. We will develop a method of driving a rocker-bogie vehicle so that it can effectively step over most obstacles rather than impacting and climbing over them. The Rocker-Bogie Mechanism system was designed to be used at slow speeds. It is capable of overcoming obstacles that are depends upon the size of a wheel.

Keywords: Rocker bogie, Mobile robot, Multipurpose capabilities, Robustness, shortcoming.

I. INTRODUCTION

There is an increasing need for Multipurpose robots which are able to operate in Different type of environments with highly effectiveness. These robots are mainly used for the operations which are not safe and can not done by Humans . In order to achieve these operations Robot are flexible with high capabilities. Among these mobile systems, its the rocker-bogie suspension system that was first used for the Mars Rover and its currently NASAs one of the favourite designs for rover wheel suspension. The rocker-bogie Mechanism is the Suspension that Attached with a six-wheeled vehicle to comfortably keep all six wheels in contact with a surface even when driving on Different types of surfaces. There are two key advantages to this Mechanism. The first advantage is that the wheels' pressure on the ground will be equally Distributed. This is major important thing in Uneven surfaces where large Amount of ground pressure can result in the vehicle compactness into the driving surface. The second advantage is that while climbing over hard, uneven surfaces, all six wheels will constantly in contact with the surface and under load, helping to propel the vehicle over the surfaces. Flexible rovers take advantage of this configuration by integrating each wheel with a drive actuator, maximizing the vehicle's motive force capability. One of the major Disadvantage of current rocker bogie rovers is that they are slow. In order to be able to overcome significantly rough surfaces without significant risk of flipping the vehicle or damaging the suspension, these robots move slowly and climb over the obstacles by having wheels lift each piece of the suspension over the obstacle one portion at a time. While performance on rough surfaces obstacles is important, it should be also considered situations where the surface is flat or it has almost rough obstacles, where the rover should increase its speed to arrive faster from point A to point B.

II. LITERATURE REVIEW

In the Rocker bogie Mechanism, we Analyze that it is simplest design made for working operations. The term rocker comes from the rocking characteristics of the larger link on each side of the suspension system. These rockers are connected to each other and the vehicle chassis through a differential. Relative to the chassis, when one rocker goes up direction the other goes down direction. The chassis maintains the average angle of both rockers. One end of a rocker is fitted with a drive wheel and the other end is pivoted to a bogie. 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 total distributing the load over the surfaces. Bogies were also quite commonly used on the trailers of semitrailer 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. Systems using springs tend to tip more easily as the loaded side yields. Rocker Bogie Mechanism has the specialty of being able to climb over obstacles because of twice the diameter of the wheel, that too without loosing the stability of the rover as a whole. Some features of the Rover Mechanism are very usefull for working operations.

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III. WORKING OPERATIONS

The rocker-bogie Mechanism design does not consist of springs and stub axles in each wheel which allows the chassis to climb over any different typesl surfaces, such as rocks, uneven path , sand, etc. Normally all the diameter size of wheel is greater so that it can be easily moved on a rough and complex surface. Normally The front wheels are forced against the obstacles by the rear wheel. The rotation of the front wheel then lifts the front of the vehicle up and over the obstacles. The middle wheel is the pressed against the obstacles by the rear wheel and pulled against the obstacles by front, until it is lifted up and over. Finally, the rear wheel is pulled over the obstacles by the front two wheels. During each wheel travels by obstacles, forward progress of the vehicle is slow. These rover moves slowly and climb over the obstacle by having wheels lift each piece of the Rover suspension over the Different type of surfaces at same time with less Efficiency.

IV. ICAD MODEL

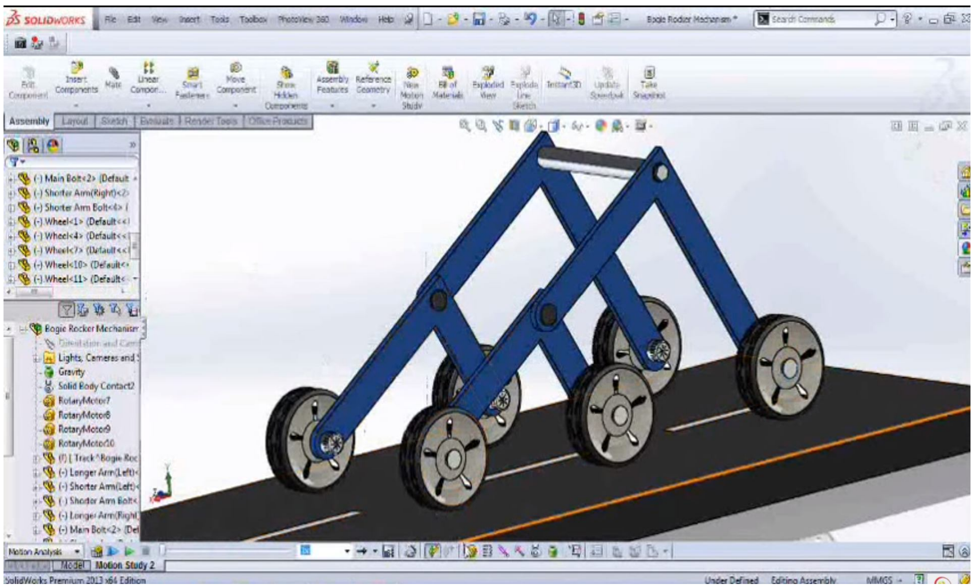

Figure 3.1: Model of RBM

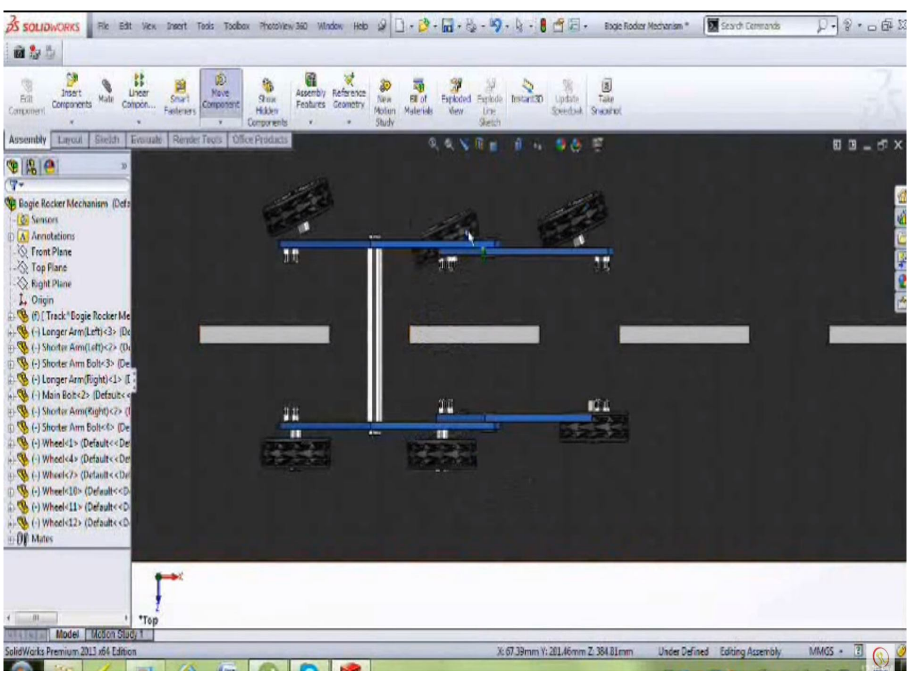

Figure 3.2: Top view of RBM

V. DESIGN CALCULATIONS

A. Design Of Wheels

$$V = \pi D N/60$$

Assumed required speed is 10 cm/s i.e., 100 mm/s

$$100 = \pi D N/60$$

$$DN = 1909.86 \text{ mm}$$

Now value of D & N is taken from table 4.1

D	N
10	190.99
20	95.49
30	63.66
40	47.75
50	38.2
60	31.83
70	27.28
80	23.87
90	21.22
100	19.1

So the selected D-N combination is

D = 70 mm, N = 27.28 rpm

Figure 4.1.2: Calculation of Wheel Base

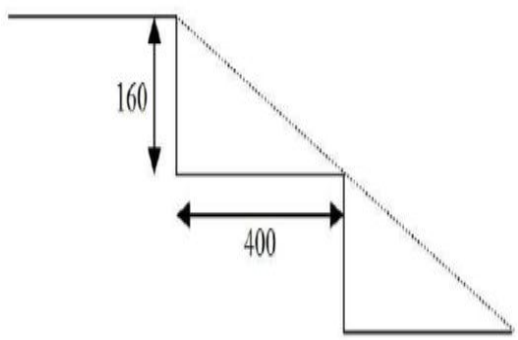

Figure- Centre Stage Stairs

$$\theta = \tan^{-1}\frac{y}{x}$$

$$\theta = \tan^{-1}\frac{160}{400}$$

Therefore, $\theta = 21.80^{\circ}$

Now, width of the stairs is 400 mm. So, the maximum length of the rover can be 400mm.

To deduce the wheel base,

Total length (radius of front wheel + radius of rear wheel)

=400-(35+35)

=330 mm

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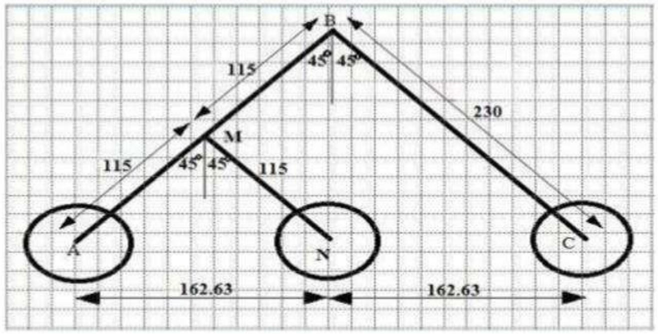
B. Length of Links



If horizontal length of stairs is 400 mm
Then wheel base = horizontal length of stairs – (Rf + Rr)
Rf = radius of front wheel
Rr = radius of rear wheel
So, wheel base = 400 (35+35)
Wheel base = 330 mm

Let θ = 450

In Triangle BNC, Angle BNC
=900Angle NBC = Angle CBN 450
Therefore, NC = NB

BC = 233.33mm
Rounding off to 230 mm

Substituting in eqn (1) we get,

2302= 2(NC2)
NC = 162.63 mm

Also,

In Triangle AMN, angle AMN =
900AM2+ MN2= AN2
2(AM2) =AN2AM =
114.99 AM =115 mm

Now due to symmetry,

BM = AB – AM
= 230-115

Height of RBM
BM =115 mm
Height2= BC2NC2
Height2= 2302162.632
Height=162.4mm

VI. CONCLUSION

This project will try reaching nearly all of our design requirements, and in many respects exceeding original design goals. Furthermore, all components, mechanical and electrical, will be thoroughly tested as a completed system in real-world field-testing conditions to validate their success. Overall, preliminary estimates for the general scope, budget, and timeline, for the project will be closely followed; with the exception if the project goes moderately over budget.

Future scopes of Rocker Bogie Mechanism are in military operations as a weapon carrier & for locating in coal mines.

VII. ACKNOWLEDGEMENT

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