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DESIGN OF ROCKER BOGIE MECHANISM BY FABRICATION OF THE ROUGH TERRAIN VEHICLE USING THE CONCEPT OF SUSPENSION SYSTEM IN THE BOGIE MECHANISM

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ABSTRACT

The rocker bogie system is the suspension preparation used in mars rover introduced for mars radar device and also used on mars for exploring and science laboratory missions. The bogie can defend mechanical failures in harsh ambience on mars. The mechanical element of the rocker bogie design is drive train plainness, where it is expert by two supports .The rover will be completely designed with PVC pipes to increase its capability to withstand shocks, vibrations and mechanical failures caused by the insensitive environment. By using CAD software the design of the mechanism has been made, developing a highly stabled suspension system capable of operating in multi terrain surface while all the six (6) wheels is in contact with the ground. Designing the mechanism that helps the terrains where the wheels can move on individually and climb different obstacles.

I. INTRODUCTION

The Rocker Bogie is the suspension preparation used in mars rover introduced for mars radar device and also used on mars for exploring and science laboratory missions. The bogie cand defend mechanical failures in harsh ambience on mars. The mechanical element of the rocker bogie design is drive train plainness, where it is expert by two supports. Rockers are links present on both sides of the suspension. When one rocker goes up one comes down. One end is fixed in drive wheel one more is hinged in a bogie. The control and design of the systematic models of rover relates with the surroundings is necessary. Models are also needed for rover achievement setting up. For example it is important that it is able to predict if a rover can effectively understand a given ground obstacles, wheels without being trapped.

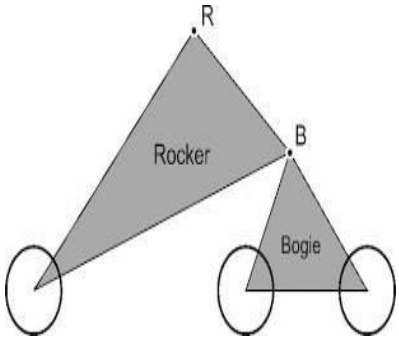


Fig.1.1 Schematic diagram of mechanism

All the six wheels have a self-governing motor. In charge to go over an upright blockage face, the front wheels are pushed to the obstacle by the middle and back wheels. Since technology is experiencing a boost

in the past few years the development of a rocker bogie mechanism is getting highly advanced.

Blynk app is a stage where it can be used in Android and IOS apps to run Arduino and Raspberry Pi etc. The control panel can construct a graphic interface for the project by dragging and dipping widgets.

The app made by Blynk facility is managed to visualize and control the hardware.

The app is very useful interface and different dissimilar widgets for dissimilar purposes. This apps works on its own called energy. New user gets 2000 quantity of Blynk energy with a free Blynk version and this energy is used to buy and set up widgets in the projects.

II. LITERATURE SURVEY

[1]Gourang Amrujkar et.al: introduced a six wheeled rover introduced on the lunar on the basis of the wheels and the lunar soil. The sinking of the wheels on the loose soil and hence further it was proved that the behind wheel is the best, the middle one is really bad and the front one is average.

[2]B.Babu et.al: has established a new way of improving the designs from previous ones. The rover which was made is used to work on difficult conditions but several problems don't allow its working capabilities. So a new way was discovered so that the rover moves slowly in a closer range and overcome mechanical shocks and vibrations.

[3]D.S.Chinchkar et.al: mentioned that nowadays the designs are very complex using multiple wheels. Multiple wheels lead to breakdown caused by the bad atmosphere. A 4 wheeled rover is introduced with good efficiency of suspension. A good series of mobility will make the rover go through rough paths, stairs, stones etc.

[4] Jotheess S et.al: recognized that the rocker bogie moves on three arms with a total of six legs. While moving over an obstacle the centre arm is pressed next to the obstacle by the back arm and it goes over the obstacle by the face arm and rear end is moved by centre and face arm.

[5]Abhay kantsinha et.al: put in the picture that there are two motors which are present which are used to increase the efficiency and reliability. The Mobility of a system is maintained so that the rover can move in a slow and safe manner without the harm of nature.

[6]Dongkyu Choi et.al: documented about the size and lengths of rocker bogie and how they help in climbing up stairs. Now suppose there are two prototypes one with small links and one with large link set to climb up two stairs the rover with small link will only climb up one stair and not the other but in case of large link it is set to climb both stairs.

III. METHODOLOGY

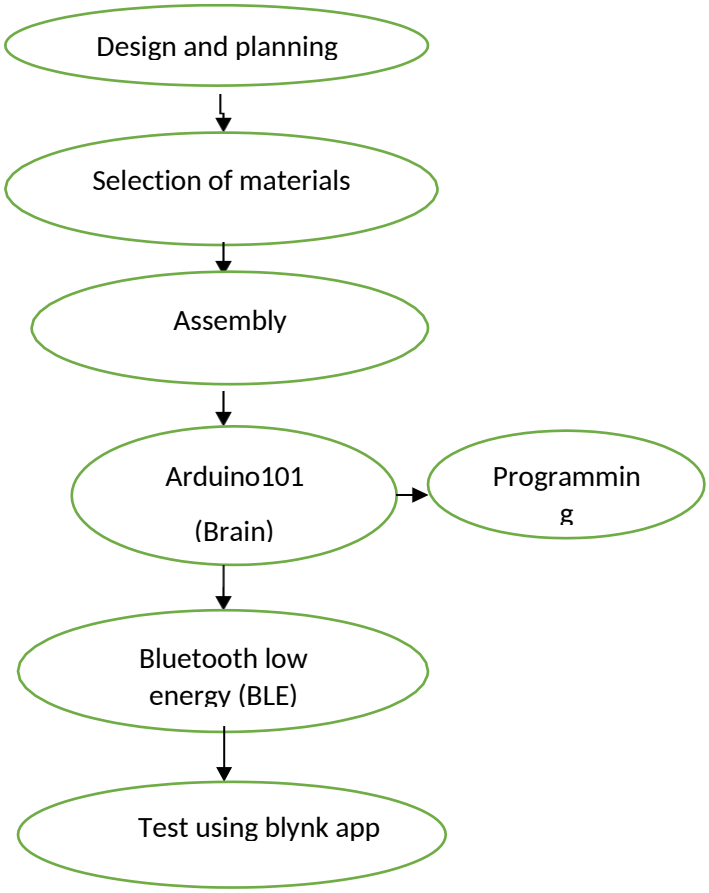


Table- 3.1 Primitive flow table

The rocker bogie system moderates the action by short, when compared to other suspensions. The wheels have its own mechanism for movement and in which the rear and front wheels have separate mechanism which allow the rover to turn in position as turning relation. Each wheel has thick cleats which provide grasp for uphill in mud and scramble over rock with easiness.

To overwhelm perpendicular obstacle faces, the face wheels are put on next to the problem by the middle and back wheels which create extreme necessary torque. The wheels stay on the central, is then pushed beside the obstacle by the back wheels and dragged

touching the obstacle by the visible till the moment it is lifts over and up. The back wheel is pulled above the obstacle by anterior 2 wheels due to apply of power. The methodology is being more or less proved by apply it on 8 wheel steer all-terrain vehicle to increase excessive benefit by bogie system.
This methodology is explained in four parts. Design and planning using required dimension. Materials which have to be selected accordingly, Assembly where the parts have to be fixed according to the calculation. Arduino will be programmed and will be controlled using the Bluetooth connecting the phone.

IV. PROBLEM STATEMENT

- The problem in the suspension when installed in intense rovers is that it moves slowly which upset the pace to absorb the shock generated by wheels.
- Initially in order to make the rover go above obstacles the rover must be geared losing to allow sufficient torque to lift the rover. So this reduces the speed of heavy vehicle.
- The vehicle is travelling in quick and finds obstacle opposite to it then a shock is transmitted to the chassis which would damage the suspension and the whole vehicle will fall down. That is why heavy load vehicles move at 10m/s velocity through an uneven path.
- Rocker bogie faces a lot of contamination problems by leftover oil from the industrialized of systems drill bits and the software will still have two problems.
- First problem is the vehicle action and routing the controls the way the vehicle recovers from short-term failures and fault.
- Legs of a rocker bogie are mechanically complex with slow mobility and poor load weight to mechanism weight ratio.
- The wheels have comparatively small slope climbing capacity due to wheel slippages.

V. OBJECTIVES

- The rocker bogie can be used for military purposes for locating the enemies by setting up cameras on top of the rover and making the rover small.
- The main objective is the suspension system should be light weight and makes all the wheels in contact with surface.
- To optimize the pace such that the vehicle does not fall and make it to travel fast.
- The rover must maintain good wheel grip in challenging rough terrains.
- With developing the arms of the rover it can be made to diffuse bombs by cutting the wires so it will be useful for bomb squad.
- If the rover can be made big then it would be able to transport humans over rough paths and obstacles and even stairs.
- It can be sent into valleys, forests and dangerous places where human cannot go.
- Can be used for wheelchair purpose also.

VI. DESIGN OF MECHANISM

Design of Mechanism

The factor in developed of rover mechanism is to control the dimension then calculations. The lengths and dimension can be transformed as per necessity. The mechanism can overcome the obstacle around 150mm of height. To achieve the target we have designed the mechanism in such way that it can climb the stair. Using Pythagoras theorem we got the proper dimensions angels between the linkages is 90 degree.

6.1 Design calculation

6.1.1 Design for First Triangle

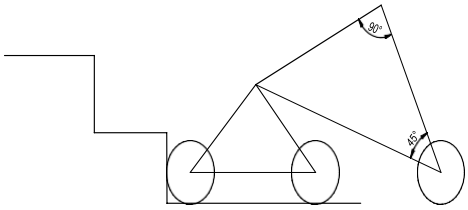


Fig.6.1.1 CAD DRAWING (1ST ANGLE)

1ST and 2nd wheel have obtained a space among them. This drawing is done CAD having dimension of 270millimeter

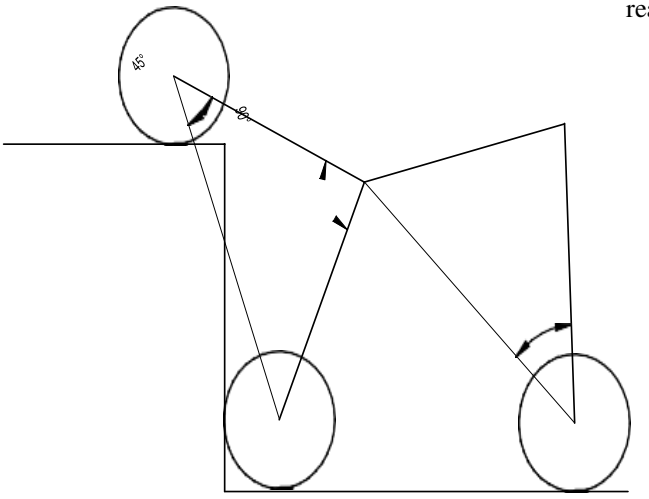
In view of the 90 degree Δ ABC,

By means of Pythagoras in triangle ABC, let BC and AB be length x

$AB^2 + BC^2 = AC^2$
$x^2 + x^2 = 270^2$
$2x^2 = 270^2$
135mm + 65 mm= x
Therefore AB = BC =200 mm

6.1.2 Design for Second Triangle

Fig.6.1.2 CAD DRAWING (2ND ANGLE)



6.1.3 Design for both Triangles

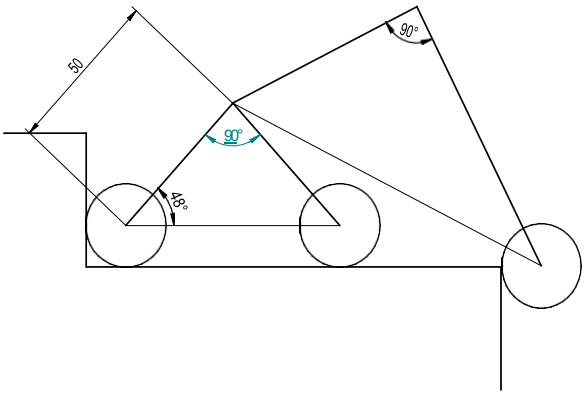


Fig.6.1.3 CAD Drawing for both Triangle

6.2 Design & choice of Wheel:

Proposal of wheel is necessary at speed till 0.5 m/s. Pace can be 60 - 100 rpm motor. Using speed relative rate is designed for expected speed. Calculate the rate value essential to discovery out thickness of wheel is 95.35 mm. The selected circle is 100 mm diameter. Choosing the wheel types it less weight, provide outstanding grip, resistance. The fake wheels proposal a less price answer that is hard-wearing sufficient for a battle rover has less adequate to be realistic.

Likewise, to treasure size for rocker linkage 1st two wheel pairs must be located at straight place. 3rd wheel couple must nearly cover its cumulative previous to initial of increasing of primary couple of wheel. By insertion wheel in such manner we got dimension of connection BE of dimension 420mm. Here and now take triangle BDE

$BD^2 + DE^2=420^2$

$2y^2=420^2$

210mm + 30 mm = y

Hence, DE = 240=BD

Wheels of rover, Diameter: 100 mm

Width: 40 mm Shaft Diameter: 6mm

6.3 Choice of Robot Acceleration:

For a classic rover on level land, it's wanted to get acceleration around half of maximum speed. Maximum speed of rover is 0.5 m/s. The acceleration of rover will be around 0.25 m/s². It might get around 2 second to attain highest speed. Due to countering gravity the rover needs higher acceleration on rough terrain. It is required to scale the angle by 45˚.

Ac□□□□□□□□□□ □□□□□□□□:

= gravitational pull *sin angle tendency * π/ 180

=

0.121 m/s2

Acceleration

= 0.37 m/s²

6.4 CHOICE OF MATERIAL

Choice of material is a vital action in design of a factor the main return of material variety are

- It surges the dependability of product
- It decreases the rate of result.
- It can enhance the mass of invention.

6.4.1 DESIGN OF COMPONENTS

DESIGN IN WHEELS

VELOCITY = π* DIAMETER* SPEED/60

Expected required pace is 100 mm/s

100 = π * DIAMETER* SPEED /60

DN = 1909.86

D	N
100	19.098
90	21.220
80	23.873
70	27.283
60	31.830

Table No 6.4.1 Table of wheel diameter and speed

Calculation of Diameter and RPM

From the table we get the value of D and N So the designated D-N is

D = 100 mm N = 19.10 rpm

The wheel diameter taken for the rover is 100mm.

VII. RESULT

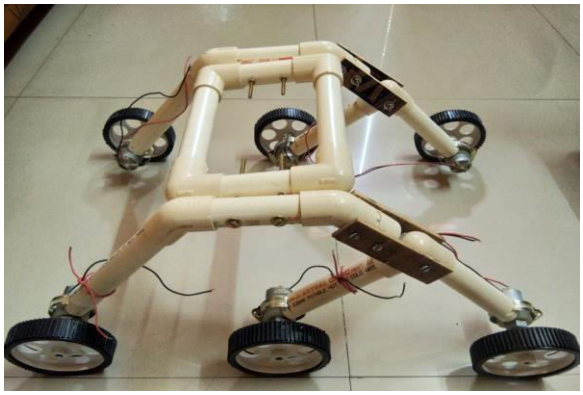


Fig 7.1 Prototype

The design follows of raising the rover mobility in predictable intense load rover behaviour when rapidly traversal is necessary. The arrangement installed in

intense rovers and unadventurous off road cars, this will drop off the difficulty as control supplies to keep bumping off. The resources used in the developed of the vehicle are PVC Pipes & wood pieces. This device was productively installed and operates using motorized mechanism in the active rover bogie mechanism. Design of mechanism can go over terrain where the right and left rover independently go up altered obstacles

- The rover bogie would be able to move on top of stairs and on harsh conditions.
- Bigger the vehicle it would be able to carry heavy loads.
- It would be able to enter places where no man has ever entered.
- It can be used as one of the main sources for mission mars.
- Each arm supports one and other and will be able to move with the help of other arms.
- It can be used to take photos and videos with a help of a camera.
- Wheelchair is one of the best application of this mechanism

The knee after rover and centre wheel strut are solidified to provide lodgings increases stress

VIII. CONCLUSIONS

This rover mechanism is mainly worn in the NASA project of MARS ROVER to conquer the uneven terrains constancy. They consist of 2 arms with wheel mount on all the sides. Mutual arms are linked from side to side a changeable united. They enable to contain a delay on machine that gives the rover load as consistently as likely still on bumps and uneven plane. This invent consists of a mechanism deferment based gap constrain arrangement that allows the rover get above rock and stones. Vibrations escort to quicker show off and rip in sensors and track panel. The rover device was calculated custody this in intelligence by provided that highest constancy in terrain. Thus we study the design of rocker bogie mechanism by fabrication of rough terrain vehicle using concepts suspension system in the bogie mechanism.
The Rover mechanism have negative spring, stub axles for all the wheel, allow the vehicle to mount more than obstacles, like stones, which are double the wheel's size. With any deferral system, the tip constancy is partial by the altitude of the middle of gravity. System with spring tends to tilt extra simply as the weighted down side yield. The structure is planned to be worn at time-consuming speeds of approximately 10 cm/s, so to reduce vibrant shocks and significant break to the rover where surmounting is sizable obstacle.

This idea, one rover structure with two modes of operation, is useful to boost the effectiveness and efficiency of the all-terrain mobile robot. This structural improvement can create the rover more flexible & efficient situations that involve speedy traversal and dealing with exterior that require an extra robust performance over tough obstacles.

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