International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 09 Issue: 05 | May - 2025 SJIF Rating: 8.586 ISSN: 2582-3930

Design and Fabrication of Rocker Bogie Mechanism

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Abstract:
Rough terrain vehicles are vehicles that are used on rough terrains and risky pathways for the purpose of search, rescue operations and surveillance of border region for military. The idea is to modify the planetary rovers made by rocker bogie mechanism in such a way so that they can be used for military purposes as currently they are only used for the exploration of other planets. The modification approach will be to make the rover into a highly optimized rough terrain vehicle with high capacity and low power requirement and flying capability which will be attained by the use of Machine Learning, Computer Programming and Artificial Intelligence along with advanced designing. One of our main aim is to develop this vehicle in a very economical cost so that these vehicles can be widely used in military through which we will be able to save the valuable lives of our soldiers and protect our nation from the enemies. Hence we can say that the project will act as an initiative to the advancement in defense system of our country.

Index terms: Military purpose, Low power, Flight Capacity, Rocker Bogie Mechanism, Economical Cost.

I. INTRODUCTION

Over the past research and innovations, the rocker bogie suspension design is widely used for the different working projects and models due to its superior vehicle stability as it can move over the rough terrains easily. This type of mechanism can resist the mechanical failures which come due to harsh or uneven surfaces. The Rough terrain vehicle designed using rocker bogie mechanism is generally slow in speed as the main objective of using this mechanism is to achieve high stability. The vehicle is equipped with different types of electrical sensors, devices and microcontrollers so that the authorized person can get the real time data of border areas and can act accordingly. The major advantage of this vehicle is that we can reduce the life risk of our soldiers and increase the efficiency of army so that the defense system of our country will be strong and the military can take the fruitful advantages of science and advanced technology.

II. WORKING

There are already some spying robots which are designed for particular tasks like bomb detection, bomb recovery and fire fighting. The task we are going to perform is border surveillance and data transmission in the form of images and videos. This vehicle will be controlled by remote using Arduino Uno R3; it is an open source microcontroller which is equipped with sets of digital and analog input/output pins. Raspberry pi3 electronic board will help to transfer the current to the different sensors as per the instruction. For the task of border surveillance the camera used is raspberry pi camera which comes with 8 mega pixel (p) camera which can take 3280x2464 pixel high resolution images it also supports videos of 720p at 60 frames per second (fps) and 1080p at 30 fps. One of our innovations is that we are going to use Ultrasonic sensor, it is an instrument that measures the distance to an object using ultrasonic sound waves as the waves reflects back after the collision with the object.
Servomotor will be used in case of highly rough terrain to control the different parameters basically servomotor is a rotary actuator that allows for precise control of angular or linear position, velocity and acceleration. In short we can say it helps other device to operate. Cyclocopter will be used to recover the vehicle from the uneven situations when it will be impossible for the vehicle the overcome the hurdles or got stuck between the enemies. The last but not the least DC motor which is used to rotate the wheels as the vehicle has 6 wheels so 6 motors of 5 volts is used. These electronic sensors and devices are connected as per the circuit diagram and this circuit is mounted over the vehicle chassis which is designed using rough terrain vehicle.

III. METHODOLOGY

The system works in the way that firstly, the commands are given to the raspberry pi3 electronic board by the Arduino Uno R 3 as per the user instructing using remote. After receiving the command, the electronic board passes the current to the sensor or device as per the instruction. The command of moving ahead or backward goes to the DC motor and it rotates the wheels to move the vehicle, the command of capturing images and taking videos goes to the raspberry pi camera, this data directly goes to the authorized person's screen so that he/she can act accordingly. The ultrasonic sensor helps to detect is there any person around the vehicle or not so that the authorized person can identify whether he/she is our person or the enemy. Sometimes the situations comes when the vehicle stuck in dense rough terrain or pits where it is very difficult to overcome the hurdle at the normal speed the servomotor will help to control the linear or angular position, velocity and acceleration. Apart from this to recover the vehicle from the situations when it is impossible for the vehicle to overcome the hurdles or to come out from enemy's area Cyclocopter will play its role by making vehicle fly at some height and helping the vehicle to escape out from there, this one is one of our advance features which is used to make this vehicle.

IV. DESIGN AND CALCUTIONS

All the factors which are important for the vehicle were kept in mind while designing the different parts and calculating the different parameters. Some important factors for design are The size of the rocker and bogie joints and angles among them, Wider wheels to traverse upon the obstacles and amount of

speed required, the Static Stability Factor (SSF), Lateral stability and longitudinal stability. To have a compatible and stable design the procedure opted for the designing of vehicle is quiet organized and given in a simple manner.

A. Selection of material

The material which we are choosing for our project is "Wood" because of some important properties.

1. For being a relatively lightweight material, wood outperforms even steel when it comes to breaking length. Simply put, it can support its own weight better, which allows for larger spaces.
2. Its strength and dimensions are also not significantly affected by heat, providing stability to the finished product and even safety implications for certain fire situations.
3. Wood is a material that can be grown and re-grown through natural processes and also through replanting and forestry management programs.
4. One of the biggest challenges of many materials, including concrete, metal, and plastics, is that when they are discarded, they take an impossibly long time to decompose. When exposed to natural climate conditions, wood will break down much more quickly and actually replenish the soil in the process.

B. DESIGN OF WHEELS

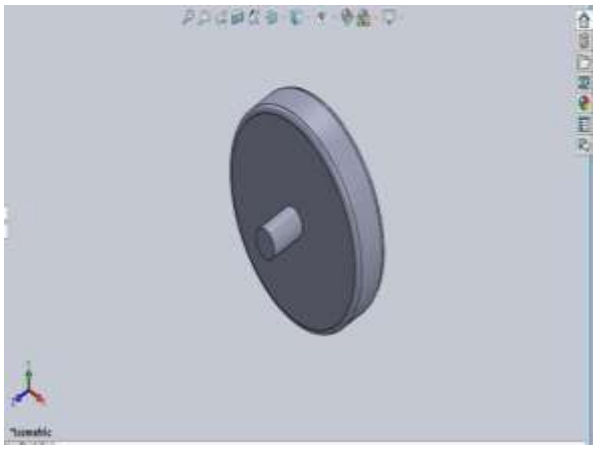

Figure.1. Design of wheel

C. CALCULATION OF WHEELS

We Know that,

$V = \pi D N/60$

Assumed that required speed is 10 cm/s i.e. 100 mm/s $100 = \pi D N/60$

$DN = 1909.86$

By the given table

We have chosen 30 rpm motor then Wheel diameter is 63.6mm so

$N = 30$ rpm

$D = 70$ mm (approx.)

Wheel width = 25 mm (approx.)

D. DESIGN OF LINKS

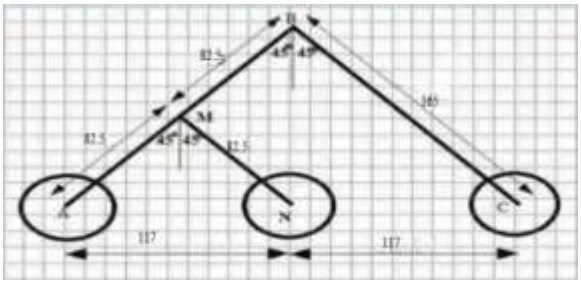

Figure.2. Link Diagram

Figure.3. Design of Link type 1

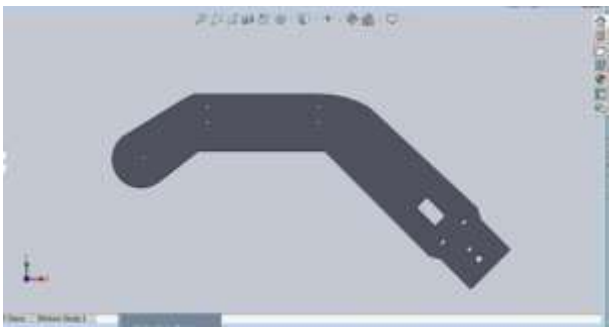

Figure.4. Design of Link type 2

E. CALCULATION OF LINKS

If horizontal length of stairs is 300 mm

Then wheel base = horizontal length of stairs – (Rf + Rr)

Rf = radius of front wheel

Rr = radius of rear wheel

So base portion of wheel = 300 – (35+35)=230 mm

Let $\theta = 45^0$

In triangle BNC, Angle BNC = 90^0 Angle

NBC = Angle NCB = 45^0

So, NC = NB

$NC^2 + NB^2 = BC^2$ (By Pythagoras theorem) -1 BC^2

$= 2(NC^2) = 2(115^2) = 164.62$ mm

Approximate to 165 mm

Substituting in equation (1) we get,

$165^2 = 2(NC^2)$

NC = 116.96 mm

Also,

NC = AN = 117 mm

In triangle AMN, angle AMN = 90^0

$AM^2 + MN^2 = AN^2$

$2(AM^2) = AN^2$

AM = 82.73

AM = 82.5 mm (approx.)

We can see the symmetry so,

AM = MN = 82.5 mm

BM = AB – AM = 165-82.5
BM = 82.5 mm
Height of RBM
$Height^2 = BC^2 – NC^2$
$Height^2 = 165^2 – 117^2$
Height = 116.3 mm
Net Height = Height + radius of wheel
= 116.3 + 35
= 151.3 mm

F. ASSEMBLY OF COMPONENTS

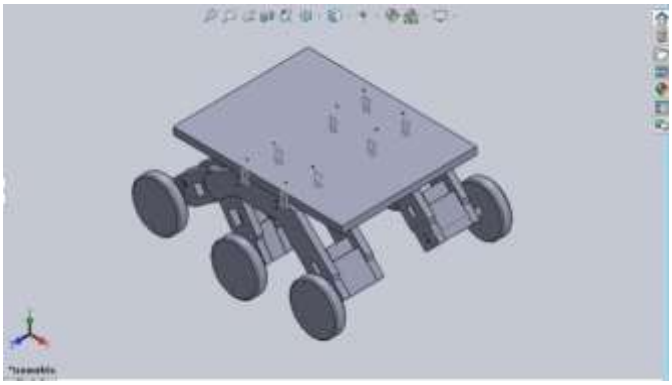

Figure.5. Assembled Design view 1

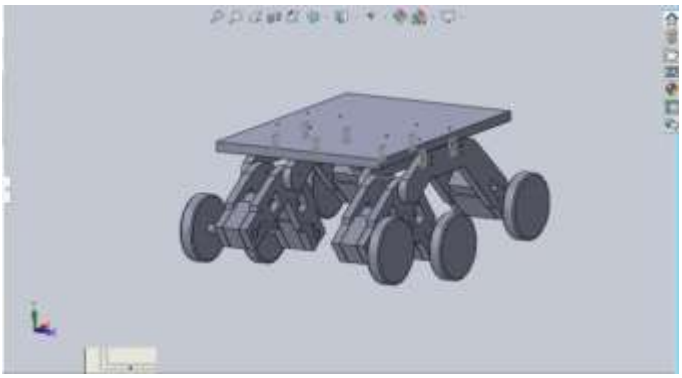

Figure.6. Assembled design view 2

V. CYCLOCOPTER

One of our innovations in this vehicle is installing flying feature and this is done by using the concept of cyclocopter. It is an aircraft configuration that uses a horizontalaxis cycloroter as a rotor wing to provide lift and sometimes also propulsion and control. In principle, the cyclocopter is capable of vertical takeoff and landing and hovering performance like a helicopter.

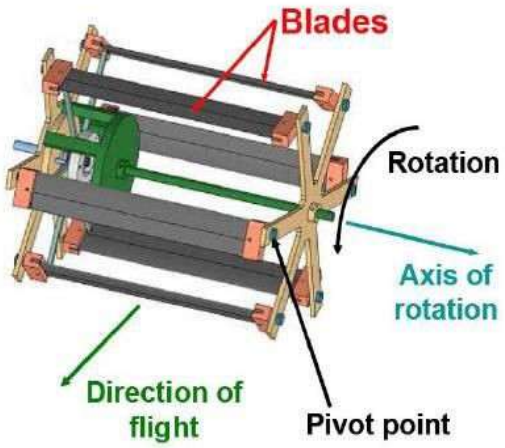

Figure.7. Cyclocopter Blade

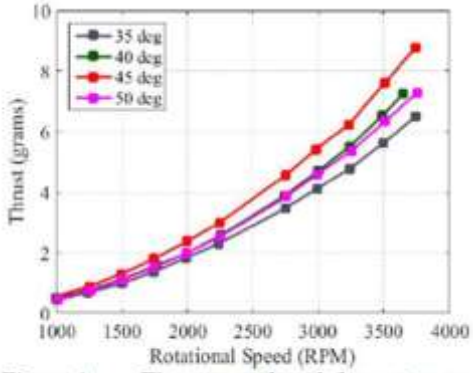

Figure 1 . Thrust produced by rotor vs. rpm at different blade pitch amplitudes.

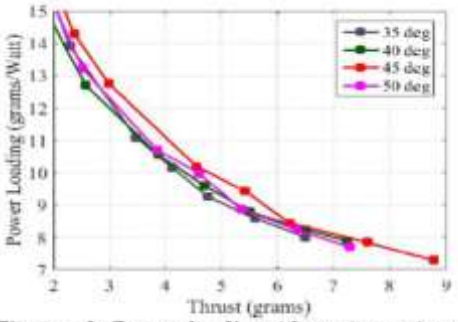

Figure 2. Power loading (thrust/power) vs. thrust for the rotor at different blade pitch amplitudes.

VI. RESULT

The main objective of our project is making a vehicle for the purpose of search, rescue operations and surveillance of border region for military so that we can try to save important lives of our soldiers and can introduce the advancement of science and technology in the defense system of our county. The essential metric for our paper would be precision and has been tried to the best of our capability. The schedule that we made to complete the work is divided into multiple sections and all the section's work is completed as per the time scheduled for it. The task of development of vehicle's chassis using rocker bogie mechanism was successful and it is working as per our requirement. The task of fabrication of different electrical sensors, devices and microcontroller is also completed. The combination of both the tasks completes the development of vehicle. Hence we can say that we have achieved the result as per our project's blue print.

VII. DIRECTION FOR FUTURE RESEARCH

This rough terrain vehicle can be modified in different ways for different purposes by consuming more operational procedures and modules like Wi-Fi module, other hi-tech sensors. Future scope of this robot is very efficient it may have the sensors which can detect harmful or hazardous gas in the surroundings. It can also be used as bomb detector and diffusers that many human lives can be saved .By using open computer vision (CV) technology we can perform the operation of face detection and recognition which will be very helpful to identify whether the person is from our team or is an enemy so that appropriate action can be taken. A laser gun may be used as a protection mechanism to guard it and soldier from the enemy. The laser gun with the help of open CV and raspberry pi digital camera will stumble on the enemy and shoot in step with mode of operation. Apart from these there are many operations that we can perform the use of different sensors and modules as per requirement.

VIII. CONCLUSION

The essential point of view of the military reconnaissance robot should make it straightforward. The administration operator robot can move without quite a bit of a track, getting pictures and transmitting them remotely, at that point the warriors give a recommendation about the dangers and conditions in the field of war. The robot moves relying upon the engines, which are reliant on the data we give about the transmitter. RF signals are utilized as control signals. By utilizing these characters, the coding is done and signal is sent by the sender. At the beneficiary end, this decoded banner is given as a commitment to the drive of the engines. The robot is utilized for brief detachment and along these lines ensures the wellbeing of the territory. This makes the powers see precisely what's going on in the encompassing locale and to set it up as it ought to. With the assistance of this proposed advancement, there is some help for our security controls in area of interloper. This mechanized structure can likewise be utilized in high height territories where it is troublesome for people, as a feature of our edges fall into high elevation areas. The proposed computerized structure can likewise be utilized in the look for the harmed individuals amidst disasters.

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