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FABRICATION OF ROUGH TERRAIN ROBOTIC VEHICLE USING ROCKER BOGIEMECHANISM

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ABSTRACT

Rocker bogie mechanism is a mechanism primarily used in the mars rovers to overcome the rough terrains while maintaining stability. It is NASA's favorite mechanism for space vehicles & rovers. It consists of two arms with wheel mounted to each. Both arms are connected through a movable joint. This enables to have a suspension based mechanism that distributes the vehicle load as evenly as possible even on bumps and irregular surfaces. The design consists of a spring free suspension based differential drive system that allows the bogie to move over rocks, pebbles with ease. The sensors and cameras mounted on a rover must be stable to work properly and also to increase their life spam. More vibrations and jerks lead to faster wear and tear in sensors, circuit boards and cameras. The rocker bogie mechanism was designed keeping this in mind by providing maximum stability in all terrains. Thus we study the design and fabrication of the rocker bogie mechanism by fabrication of this rough terrain vehicle using concepts of the bogie mechanism. The Rocker Bogie Mechanism and its traction control through a microprocessor. The model above depicts the simplest yet most effective Rocker Bogie traction system that may be employed in. The model below demonstrates the most basic yet successful implementation of the Rocker Bogie traction system, which may be employed in any application involving uneven terrain conditions.

Keywords: -: Cost-effective, Defense, Long-lasting battery, Maximum stability, Rocker Bogie Mechanism, RoughTerrain, Stair Climbing.

INTRODUCTION

NASA has recently started an ambitious exploration program on Mars. Path finder is the first over Explorer in this program. Future rovers will need to travel several kilometres over the period of months and manipulates the rock and soil samples. The term "rocker" describes the rocking aspects of the larger link's present each side of the suspension system and balance of the bogie as these rockers are connected to each other and the vehicle is chassis through a modified differential. In the system, "bogie" refers to the conjoining link's that are have a driving wheel attached at each end. Bogies were commonly used to bare the loadson tracks of army tankers as idlers distributing the load over the terrains. Bogies were also quite commonly used on the trailers of semitrailer truckers as that very time the truckers will have to carry much heavier loads.

This mechanism has 6 legs with 6 wheels and have no springs and stub axles, it doesn't have any kind of steering mechanism. This robotic vehicle climbs over obstacles such as rocks that are twice the size of the wheels. This terrain robot is designed for low speed and high torque. This vehicle is prepared by using CPVC pipes, 6 gear motors and wheels, Arduino UNO, Motor driver module, Bluetooth module. This robotic vehicle is applicable for multi-purpose use such as mobile control robotic vehicle, Fire detection robot, Army application, House hold applications, etc. There is a rise in requirement for rough terrain vehicles that can handle formless environments with uneven terrains. These mobile robots are used for objectives that are not achievable by a human and are hazardous to human life. The rocker-bogie mechanism has demonstrated vehicle mobility to be effective because of its superior stability and its ability to overcome hurdles and obstacles. One major drawback of the rocker-bogie vehicle is that it moves at slow speeds. This is done to maximize stability while moving over uneven terrain and to avoid the likelihood of the rover rollover due to rugged surfaces which would in the long run harm the rocker-bogie design. Complications such as navigation, mobility, and vision can marginally be affected in between missions depending on the specific scenario. Our main objective is to fabricate a simple design and develop a platform suitable for subjecting to harsh military environments. The vehicle will focus on essential features that can carry out most of the military operations and hence giving us the motivation to develop a vehicle to strengthen our military defence. The majority of the benefits of this strategy may be realized with simply a change in control structure and no mechanical changes to the same designs. To maximize profit and considerably enhance the effective speed of future rovers, certain machine adjustments are recommended. One of the most common suspension methods is the rocker bogie. Which was initially designed for In the creation of space travel vehicles, there is a long history. It is a wheel robot by design, with six powered wheels.

LITERATURE REVIEW

The rocker-bogie system is the suspension arrangement used in the Mars rovers introduced for the Mars Path finder and also used on the Mars Exploration Rover (MER) and Mars Science Laboratory (MSL)missions. It is currently NASA's favored design.The term “rocker” comes from the rocking aspect of the larger link on each side of the suspension system. These rockers are connected to each other and the vehicle chassis through 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. 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 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.

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Based on the center of mass, the Curiosity rover of the Mars Science Laboratory mission can withstand a tilt of at least 45 degrees in any direction without overturning, but automatic sensors limit the rover from exceeding 30- degree tilts. The system is designed to be used at slow speed of around 10 centimeters per second (3.9 in/s) so as to minimize dynamic shocks and consequential damage to the vehicle when surmounting sizable obstacles. MER vehicle body by half compared to other suspension systems. Each of the rover's six wheels has an independent motor. The two front and two rear wheels have individual steering motors which allow the vehicle to turn in place. Each wheel also has cleats, providing grip for climbing in soft sand and scrambling over rocks. The maximum speed of the robots operated in this wayis limited to eliminate as many dynamic effects as possible so that the motors can be geared down, thus enabling each wheel to individually lift a large portion of the entire vehicle's mass.

In order to go over a vertical obstacle face, the front wheels are forced against the obstacle by the center and rear wheels. The rotation of the front wheel then lifts the front of the vehicle up and over the obstacle. The middle wheel is then pressed against the obstacle by the rear wheels 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. This is not an issue for the operational speeds at which these vehicles have been operated to date.

Rocker Bogie Suspension has the specialty of being able to climb over obstacles twice the diameter of the wheel, that too without compromising the stability of the rover as a whole. Some features make it a real design. The basic idea of our research work is to fabricate a rocker-bogie mobility vehicle that is based on that of NASA. The rocker-bogie system keeps the 6 wheels of the vehicle planted at all times even on rocky terrains. This helps the wheels to generate traction and help in pushing and moving the vehicle in various directions. The rocker-bogie is at present NASA’s preferred mechanism for rough terrain mobility robots, primarily because its distribution of workload over the 6 wheels helps it overcome obstacles and keeps the vehicle steady. It can also be used for various purposes along with operating on rough tracks and climbing hurdles. It has numerous advantages, but one drawback is the rotation of the mechanism when and where it is required. This is made possible by attaching individual motors but also causes a rise in cost and complexity in design. A rough terrain amphibious vehicle was made to provide aid on the east coast of Malaysia which faced a disastrous flood leading to huge losses to lives of people and property. The flood tracks consisted of soil, water, debris, damaged property, etc. which left the roads rocky and uneven. This put the task force in a tough spot as it wasn’t practical for them to assist the damages and provide aid where necessary. The research showcased a rough terrain amphibious vehicle that could move over all terrains using the rocker-bogie suspension.

METHODOLOGY

The type of locomotion used by a mobile robot is crucial for the robot to perform its task and reach its goal in a given environment. This work focuses on the optimization of the design of a planetary rover’s wheel suspension system subject to optimizing well defined mobility metrics. As robots evolve from industrial fixed base robots to autonomous mobile platforms, the concept of locomotion in robotics becomes much more important. Similar to nature, also robot locomotion must be adapted to the given terrain or task.

The optimal type of locomotion must be applied in a challenging environment. The scope of this work is to design an efficient Mars Rover suspension system and to develop and implement a Genetic Algorithm methodology which optimizes the design of the locomotion system and can be applied to diverse mechanisms or other problems. As the Mars Rover is a mobile robot, the wheel suspension system of the rover is most crucial. It allows for movement, mobility and stability of the robot while it is travelling through a Mars environment. The rover must be able to traverse over obstacles of at least half its wheel diameter and keep its stability on slopes or other rough or hazardous terrain.

Since the ordinary robots use more wiring or complicated circuit it causes to short circuit because of it there are to much chances of damage the robot for avoiding this problem we use wireless circuit. Basically robots requires more power for working so, the power consumption become rapidly that’s why, we use high capacity with long life battery this robot is operated by only one person so there a no required much people for operate, it that’s why it causes to reduce man power .With the help of six wheels it can be easily climb any thrust and steps. This chapter will begin by reviewing some past space exploration rovers as well as rovers currently in development. It will go through individual missions, as well as the design elements and capabilities that made these rovers effective in achieving their goals on the Martian or lunar surface, particularly in terms of mobility navigation and following that, numerous aspects of these rovers are discussed in order to have a better grasp of the technology used in exploration rovers. Both hardware and software design options are analyzed in relation to ground compliance and hazard avoidance mobility considerations. Finally, analogue testing research demonstrates what NASA and others are doing presently to assess planetary rovers on Earth. A number of hostile Earth settings are tested in analogue testing to see whether they may accurately reflect characteristics of the Martian and Lunar environments. A few NASA-sponsored competitions are also examined since they can frequently give unique chances for analogue testing at NASA facilities.

DESIGN OF ROCKER BOGIE

Different materials were used for different purposes. The materials for the project were purchased at a local market. Machining and mechanical devices were used to fabricate various parts such as PVC pipe frames and so on. Different components of the Rocker Bogie were built using hot glue, nut and bolts from manufactured components (Arduino, motor driver, Bluetooth chip, pipe frame, etc.). The project was tested by moving it on animbalanced surface and noting its performance.

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

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angles of this mechanism can be changed as per requirement. The aim of this work is to manufacture the rocker bogie mechanism which can overcome the obstacles of 150 mm height (like stones, wooden blocks) and can climb over stairs of height 150 mm. Also another target is to climb any surface at an angle of 45˚. To achieve the above targets we had designed the rocker-bogie model by assuming stair height 150 mm and length 370 mm. Using Pythagoras theorem, we found the dimensions of the model. It have both angles of linkages are 90^0 and 45^0. A Design calculation The objective of the research work is stair climbing. To achieve proper stair climbing the dimensions of linkages should be proper. Assume the stair height and length 150 mm and 370 mm respectively. To climb stairs with higher stability, it is required that only one pair of wheel should be in rising position at a time. Hence to find dimension of bogie linkages, first pair of wheels should be placed at horizontal position means at the end of the rising as shown in Fig.1. And second pair should be placed just before the start of rising. There should be some distance between vertical edge of stair and second pair of wheel to striking of wheels.

PERFORMANCE AT DIFFERENTCONDITIONS

As per the ground level experimentation by rocker bogie manufactured; tested found that the performance satisfactory below are the result are shown see fig1-4 on different obstacle and different surfaces.

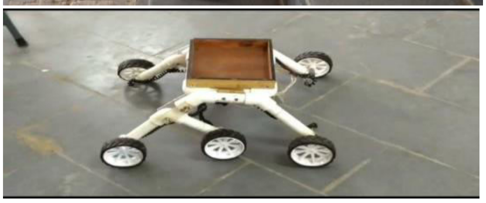

Fig: 1-Vehicle climbing steps. Fig: 2-Vehicle at stable surface.

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Fig: 3- Vehicle climbing unequal surfaces.

Fig:4- Vehicle climbing rocks.

RESULT

The main objective of this research is to use the vehicle in the military, defence, and Martian planes. We aim to adjust the dimensions of the vehicle to be able to face more harsh environmental conditions than before and the rocker-bogie mechanism was designed keeping this in mind by providing maximum stability in all terrains. The camera mounted on the rover is stable to work properly and also with an increased life span. More vibrations and jerks lead to faster wear and tear in circuit boards and cameras so we have considered this and also the battery is placed inside the links to make the placement of it at a safe location in the rover.

FUTURE SCOPE

As modular research platform the rover developed by this project is designed specifically to facilitate future work. With the development in technology the rover can be used for reconnaissance purposes with the cameras installed on the rover and minimizing the size of the rover. With some developments like attaching arms to the rover. It can be made useful for the bomb diffusing squad such that it can be able to cut the wires for diffusing the bomb. By thedevelopment of a bigger model it can be used for

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transporting man and material through a rough terrain or obstacle containing regions like stairs. We could develop it into a wheel chair too. It can be send in valleys, jungles or such places where humans may face some danger. It can also be developed into low cost exploration rover that could be send for collecting information about the environment of some celestial bodies.

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 goals moderately over budget.

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