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Modelling and Assembling Rocker Rover and Its Implementation in the Field of Agriculture: Designing

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Abstract: ***The Project work "ROCKER ROVER AND ITS IMPLEMENTATION IN THE FIELD OF AGRICULTURE: DESIGNING" deal with the important aspect of modification of traditional rocker rover to make it more affordable and accessible in the field of Agriculture in order to make the backbone of the Indian economy progress towards automation making it more efficient. The rocker rover has to operate on rough and harsh environments like exploring the Moon's surface and other expeditions alike for which it was designed. But the implementation of the rocker rover can be further extended in the areas of work where the land upon which the operations needs to be executed like in the field of Agricultural farming. The rover has been completely made from PVC to increase its capacity to withstand shocks, vibrations and mechanical failures caused by working on the large rough fields where it is operated on. Using SOLIDWORKS software the design of the rover has been fine-tuned and by experimenting with prototypes and models of the rover in the experimental setup of the live test, improvements and feature were included into the rocker rover.***

Keyword: ***Farming, Agriculture, Automation, PVC Pipe, Suspension less system, all-terrain, SOLIDWORKS, Design, Driverless.***

I. INTRODUCTION

A rover or sometimes planetary rover is a space exploration vehicle designed to move across the surface of a planet or other celestial body.[2] The term "rocker" describes the rocking aspect of the larger links present each side of the suspension system and balance the bogie as these rockers are connected to each other and the vehicle chassis through a modified differential.[4]

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In the system, "bogie" refers to the conjoining links that have a drive wheel attached at each end. Bogies were commonly used to bare loading as tracks of army tanks as idlers distributing the load over the terrain.
Bogies were also quite commonly used on the trailers of semitrailer trucks as that very time the trucks will have to carry much heavier load.[5] Among this mobile systems, it's the rocker-bogie suspension system that was first used for the mars rover
So journal and its currently NASA's favored for rover wheels suspension. the rocker-bogie suspension is a mechanism that enables a six-wheeled vehicle to passively keep all six wheel in a contact with the surface even driving on severely uneven terrain.
[1] There is an increasing need for mobile robots which are able to operate in unstructured environments with highly uneven terrain.[3] This rocker-bogie mechanism can be implemented in many other fields of work which could help in attaining better effectiveness and efficiency as factors such as human errors and fatigue could be eliminated.

II. LITERATURE REVIEW

The initiation of the rocker-bogie suspension system can be traced to the development of planetary rover which are mobile robots, specially designed to move on a planet surface. Early rovers were teleoperated like the Lunokhod I while recent ones are fully autonomous, such as FIDO, Discovery and recently developed Curiosity Mars exploration rover. The rovers needed to be very robust and reliable, as it has to withstand dust, strong winds, corrosion and large temperature changes under mysterious conditions. Maximum rovers remain powered by batteries which are recharged by solar panels during the day installed over there surface.[6]
NASA developed the rocker-bogie suspension system for their rovers and was implemented in the Mars Pathfinder's and Sojourner rover. The rocker-bogie suspension system passively keeps all six wheels on the robot in contact with the ground even on uneven surfaces. This creates great traction and manoeuvrability.[7]
Ashish U. Bokade. et.al, proposed a method for controlling a wireless robot for surveillance using an application built on the Android platform. The Android has a video screen for surveillance and buttons to control robot and camera. Android Smartphone and Raspberry pi board are connected to Wi-Fi. An Android Smartphone sends a wireless command which is received by Raspberry pi board and accordingly robot move.

The Raspberry pi programming is done in python language.[9]Rover named ALIVE is designed to monitor and maintain the garden. In a multispecies garden, attention to individual plant species is necessary to enhance the plant growth. Rocker-Bogie suspension system is integrated in the rover design thereby increasing its manoeuvrability. It also decreases the maintenance-related expenses involved for a suspension system.[8]

III. DESIGN OF ROCKER BOGIE

A. MODELLING AND ASSEMBLING OF ROCKER ROVER FOR IMOLEMENTATION IN THE FIELD OF AGRICULTURE.

Rocker rover's which are used in the process of space expedition are made up of alloys to withstand the cruel nature of the outer space and the habitats of other planets. One of the example of such alloys is Titanium alloy. But in the case of the rocker rover, which we intend to use for the agricultural purposes, the material used should be light weight, easily accessible and affordable as the rover does not have to face harsh atmosphere and habitats of other Planets like the space exploration rocker rover. We will be using PVC pipes for the rocker rover to make its cost to the affordable so that the rocker rover could be easily accessible to the industry.

The components which will be used for the assembling of the agricultural rocker rover are as follows:

1. **PVC PIPES:**
2. **ELBOWS:**
3. **MOTOR:**
4. **PLASTIC SHEETS:**
5. **TIRES:**
6. **BLUETOOTH MODULE:**
7. **WIRES:**

THE STEPS TO ASSEMBLE THE ROVER ARE AS FOLLOWS:

1. Take a PVC pipe of length **19cm** and attach an elbow on both the ends of the pipe. Makes two holes on one of the elbow so that a link could be attached on that end.

FIGURE 1

Remark: since the production cost and maintenance cost of The rover is required to be kept low, therefore, no suspensions are used in the rover.

2. Take an elbow and make two adjacent holes in the middle. Attach two PVC pipes of length on **14cm** both sides of the elbow.

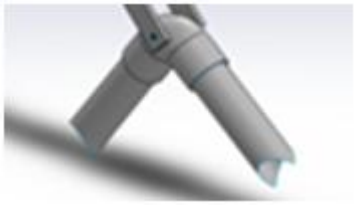


FIGURE 2

3. With the help of two plastics strips join the structure formed in figure 1 & figure 2 using, bolt and nut which will help in obtaining the structure represented as follows in fig.3:

FIGURE 3

4. Repeat the above mentioned steps to obtain the structure similar to the on displayed in fig.4 and attach the two with the help of a plastic tray like structure which has a dimension of **16cm*10cm**, which will Act As the frame of the rocker rover, displayed in fig.4.

FIGURE 4

5. Attach motors to the ending links of the rocker rover structure displayed in fig.4 with the help of T-Shaped link. Six motor of 12 volt will be required for this step which will further provide Mobility to the rocker rover.

FIGURE 5

6. Add six tires, with a diameter 3.5inch each, to the six motors shown in fig. 5. Which will Provide Locomotive ability to the rocker rover. The structure obtained is displayed as follows

In fig. 6

FIGURE 6

7. Add a hard plastic tray of dimension 14*10 represented by black on the top of the soft Plastic Sheet which is represented in white in the fig.6 in order to provide more strength to the frame of the Rocker rover. The seed distribution mechanism will be placed upon this hard plastic frame

FIGURE 7

8. Place the seed distribution mechanism on the top of the rocker rover and fix it firmly to the Hard Plastic tray so that it could stay well embedded even on the rough ploughed fields.

FIGURE 8

B. HOW THE MACHINE WORKS

STEP 1: The front rockers climbs on the obstacle.
STEP 2: The rear wheels push the front body on obstacle.
STEP 3: The half body of robot passes the obstacle.
STEP 4: The front rockers now pulls the rear part of the robot.
STEP 5: The part of the robot climbs and passes the obstacle on the other way the front part of the Robot help is to climb and pass safely.

C. ROCKER ROVER CIRCUIT DIAGRAM

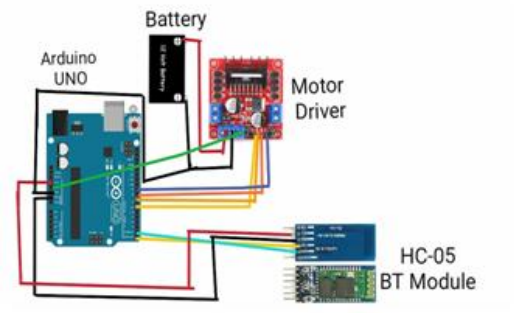


Figure 9 Circuit Diagram

D. DRAWING

Using SOLIDWORK software 3D AND 2D drawing is Prepared as per Calculated Dimension and same drawing views are shown in Fig.

1. TOP VIEW

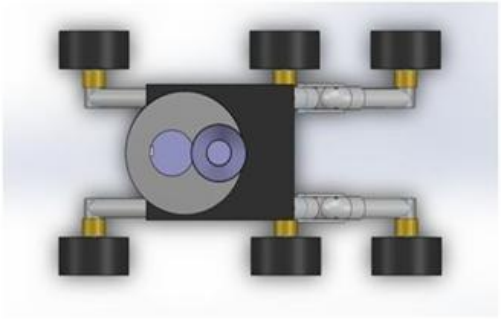


Figure 10: Solidworks Top View 3d Models Of Rocker Bogie System

2. BOTTOM VIEW

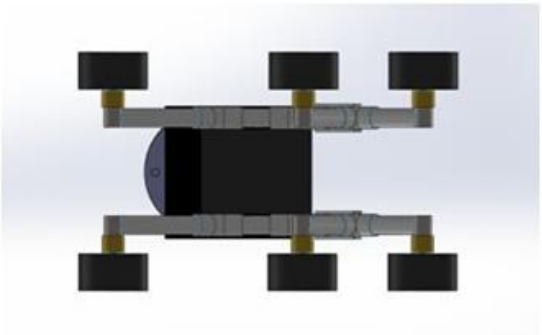


Figure 11: Solid Works Bottom View 3d Models Of Rocker Bogie System

3. FRONT VIEW

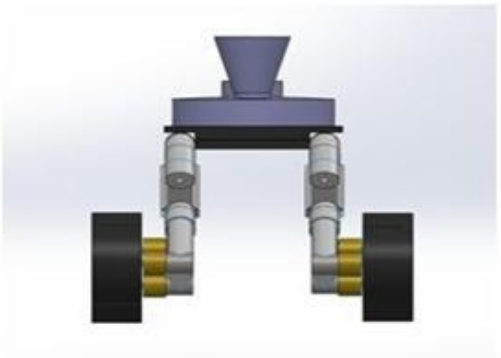


Figure 12: Solid Works Front View 3d Models Of Rocker Bogie System

4. SIDE VIEW:

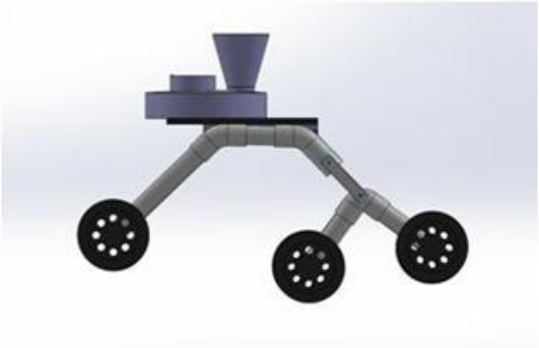


Figure 13: **Solid Works Side View 3d Models Of Rocker Bogie System**

5. BACK VIEW

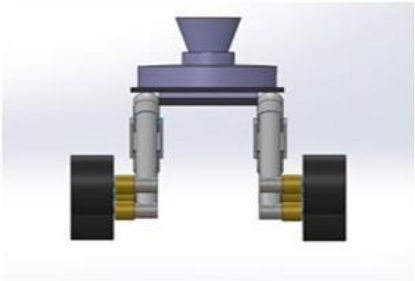
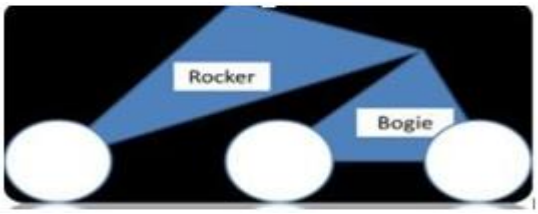


Figure 14: **Solidworks Back View 3d Models Of Rocker Bogie System**

IV. ROCKER ROVER AND AGRICULTURE

Cultivating might be one of the most distressing occupations in India. Water shortage, inconsistent power supply and lack of work have reliably prompted poor yield, reverberating an a lot bigger emergency that proceeds with quite a long time after year. The weight of credit on farmers further expands this cycle of hardship. India is ranked at #1 position in terms of global ranking in agricultural productions and most of this ranking is majorly due to the crop farming carried out in India. Still, the agriculture sector is not that much into automation. Especially in the field of farming, the farmers need to carry out most of the work with their own hands.[10] With the introduction of the Automation, the farmers, working on the fields can generate a greater amount of the yield every year. The concept of rocket-rover, a driverless all-terrain mobile technology is really one of the best engineering marvels ever created and its applications in the other fields to will work in the favour of mankind by a long shot.

With the implementation of the Rocker Rover in the field of agriculture, basic time taking processes like-seed distribution can be resolved at ease with less manpower, just to operate the rovers on the fields. The “bogie” of the Rocker Rover can carry the seeds which are required for distribution and sowing. The seeds placed on the rover will be distributed uniformly on the field which will drastically limit the wastage of the seed and also result in uniformly scattered.



(Source: S.F.Toha, Zakariya Zainol “System Modelling Of Rocker-Bogie Mechanism for disaster relief”)

The rocker-rover concept can be implemented in this field of agriculture as the cost of rocker-rover will be a lot less in comparison to that of a tractor, making it really affordable and its locomotive ability in rough terrains without the use of suspensions will result in good efficiency in crop fields.

Rocker Rover has certain **Advantages** which align very fine with the needs and demands to the cultivation sector and the farmers as well, making it suitable to the industry.

1. Reduced Jerks without the use of suspensions.
2. Less maintenance required.
3. Cost-efficient.
4. Works on alternate sources of energy.
5. Fewer movable components.
6. Rocker bogie system can bear a tilt of 50 degrees in any direction.
7. The design is simple and reliable.
8. The front and back wheel shave individual drives for climbing, enabling the Rover to traverse obstacle without slip.

V. FUTURE SCOPE OF ROCKER ROVER IN THE FIELD OF AGRICULTURE

Implementation of rocker rover in the field of agriculture has great potential in the near future. Since the cost of the equipment is in the field of agriculture is in its prime and will keep on increasing because of the current and upcoming economic structure. Therefore, the agricultural sector could appreciate a device which is in favour of cost-effectiveness as well as automation and reduction in the area of energy consumption. The rocker rover is designed as an all-terrain vehicle without the use of suspension which is great in terms of making a rover in the field of agriculture low maintenance as well as more cost-efficient device hence more affordable. The rover that will be used for the farming purpose will be a driverless vehicle will save energy and labour cost required in the process of distribution of the seeds throughout the fields.

The rocker rover is also provided with solar panels and rechargeable batteries rather than the use of convention sources like diesel which is obtained from fossil fuels which leads to large scale production of carbon footprints which can be experienced in the case of tractors and other driven machinery used in the agricultural fields.[10]

VI. CONCLUSION

The agricultural industry contributes a good percentage to India’s GDP but it still has a huge potential to grow as automation is, till this day, failing to penetrate the industry at a large enough scale since the farmers cannot afford machinery which would cost them heavily.

This research paper shows that bringing automation to the field of agriculture is not much difficult and won't be that expensive. Rocker rover, if made out of cheaper materials such as- PVC pipes, can help in carrying out monotonous tasks such as seed distribution, irrigation etc. which will enable farmers to spend their time more efficiently by only carrying out the tasks which cannot be passed on to the rover which might also eventually increase the yield.

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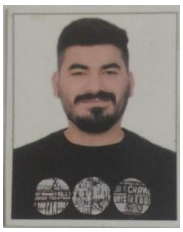
AUTHORS PROFILE

Manash Dey B.Tech (Mechanical Engineering) and M.Tech (Thermal System) is presently serving as Assistant Professor in the Department of Mechanical Engineering JEMTEC, Greater Noida, having a teaching experience of over 8 years. He has published 36 papers in International reputed journals. presented 3 papers in International reputed conference also has about 12 papers published in National reputed Journals. He has also guided about 20 undergraduate projects. He has undergone NPTEL online certification courses in various programmers such as Introduction to Industrial Engineering, Power and Plant Safety etc conducted by the IIT He presently holds the responsibilities of Training & Placement coordinator of the Mechanical Engineering Department of JEMTEC, Greater Noida.

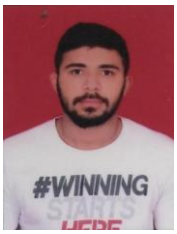
Rishab Kumar is a final year student of b. Tech (me) at JIMS engineering management technical campus greater Noida. He previously worked with a team to publish a review paper on the topic '**rocker rover and its implementation in the field of agriculture: a review**'. He like playing basketball and cricket and also great interest in automobile industry.my long term goal to place in any reputed company and give my best to your organization.

Harshit Bisht is a final year b. Tech undergraduate who never let his degree specialization in mechanical come in the way of his education. He is an aspiring entrepreneur who wants to fill the industrial and institutional voids in India with the help of his knowledge in various fields like business, management, law, consulting, marketing, negotiations, finance, coding etc. He has also previously published 3 research papers in the field of finance, marketing and agriculture; in internationally recognized journals. This generalist approach towards his career makes him capable of viewing a problem or a situation under different perspectives.

Abhinav Kumar is a final year student of bachelor of technology specialized in mechanical engineering from JEMTEC, greater Noida. He is a fast learner wants to be a passionate mechanical engineer because he has a great interest in automobile industry also wants to take the automation to the next level with his skills and knowledge. He has also previously published a paper titled 'rocker rover in field of agriculture ' in a recognized journal.



Aman Arora is a final year student of b. Tech mechanical engineering. He is an avid learner and has a keep interest in trending technology. He is academically inclined towards core subjects of mechanical engineering such as mechanics of materials, fluid mechanics, and looks forward to become a designing engineer.



Jatin is a final year student of b. Tech (me) at JEMTEC, greater Noida. he is have keen interest in armed forces aspire to become part of elite forces of India**.** he likes playing kabaddi and powerlifting. He previously worked with a team to publish a review paper on the topic 'rocker rover and its implementation in the field of agriculture: a review'