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Implementation of Rocker Bogie Mechanism in Agriculture

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Abstract: ***The rocker bogie mechanism is a mechanical design which allows for improved mobility and stability on rough terrains. The mechanism was initially used by NASA in space exploration vehicles and has been adapted for use in agricultural equipment. In agriculture, the mechanism is used to maintain the stability of vehicle on uneven terrain thereby reducing the risk of overturning. By increasing the efficiency and safety of the equipment, the rocker bogie mechanism can provide significant benefits in agriculture.***

Keywords: Agriculture, Rocker Bogie, Stability, Efficiency, Overturning

I. INTRODUCTION

The agricultural industry is constantly working on new ways to improve productivity, safety, and efficiency of the vehicle in the field. One key area to focus on is to develop a vehicle which can move through rough terrain while maintaining stability. The rocker bogie mechanism which was primarily used by NASA in space exploration can also be used for agricultural operations like seed sowing, pesticide spraying, land levelling etc. The traditional vehicles cannot be stable while performing agricultural operations. Hence the use of rocker bogie mechanism in vehicle makes it stable while performing agricultural operations on uneven land. This mechanism allows the wheels to independently adjust their position and angle of contact with the ground providing improved stability and traction on uneven land. The stability is maintained as the load acting on the rocker bogie vehicle is evenly distributed on to the wheels. The robust design enables the vehicle to move through obstacles like rocks, tree stumps or other debris in the field. The vehicle can sustain a tilt of 40 degrees without tipping over the sideways. The mechanism can also be used in mining, search and rescue missions, military operations etc. In this project the rocker bogie vehicle is remotely controlled using a microcontroller, Bluetooth module and other electronic components. The agricultural operations like seed sowing and pesticide spraying are controlled using relay switches.

A. Working Principle

The rocker bogie vehicle consists of 6 wheels. The front set of wheels is mounted on a rocker arm while the rear set of wheels is mounted on bogie arm. When the vehicle encounters an obstacle, the rocker bogie mechanism allows each wheel to independently adjust its position and angle of contact with the ground. This allows the wheels to maintain stability on uneven land thereby reducing the risk of overturning. As the vehicle moves through uneven surfaces, the rocker arm and bogie arm move up and down independently allowing the wheels to make contact with the ground and adjust to changes in terrain.

B. Materials used

TABLE I Materials used in project

Sno	Title	Specification
1	Rocker	Mild steel
2	Bogie	Mild steel
3	Wheels	10 cm Diameter
4	Pesticide sprayer	-
5	Seed sowing equipment	-
6	Microcontroller	C embedded
7	Relay switches	-
8	Battery	10 AH
9	Communication	Bluetooth module

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C. Applications

1) Can be used for seed sowing.
2) Pesticide spraying
3) Land levelling and other agricultural operations.

II. LITERATURE REVIEW

Manash Dey, et al [1] says bringing automation to the field of agriculture is not much difficult and won't be that expensive. Rocker rover, if made 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.

P Rajendran, et al [2] analysed the application of rocker bogie mechanism and came to a point that it is most effective in exploration purposes where it is difficult for normal vehicle and humans to go. The paper also discusses about some projects which were initiated during space exploration which had applications of rocker bogie mechanism.

Franziska Ullrich, et al [3] describes the modelling of a quasi-static rocker-bogie suspension system for a Mars Rover, followed by the identification of several performance metrics which are to be optimized if the rover is to execute its tasks and reach its goals in the best possible way.

Abhishek Verma, et al [4] presented two modes of operation within same working principle which is a rocker-bogie system with a robust obstacles traverse feature, and another an expanded support hexagon achieved by rotating the bogies of each side of the vehicle.

The paper proposed a novel design in pursue of increasing the rocker-bogie mobility system in conventional heavy loading vehicle behaviour when high-speed traversal is required.

Shubhangi.S.Shetake, et al [5] shows how rocker bogie system works on different surfaces. As per the different weight acting on link determines torque applied on it. By assuming accurate stair dimensions, accurately dimensioned rocker bogie can climb the stair with great stability. The design and manufactured model can climb the angle up to 45˚.

III. PROBLEM DEFINITION

The existing agricultural machinery and equipment often struggle to traverse challenging terrains like uneven land, steep slopes or muddy surfaces.

The rocker bogie mechanism inspired by the suspension system used in NASA's Mars rovers has the potential to address these challenges in agriculture.

IV. WORKING PROCEDURE

The working procedure of rocker bogie mechanism is as follows:

1) *Design and Build the Rocker Bogie Mechanism:* The mechanism consists of two rocker arms which are connected to the chassis through two pivots, and each pivot connects to two bogies, which have two wheels each. The mechanism is designed to always maintain three wheels on the ground, which provides stability and prevents the rocker from tipping over.
2) *Install the Microcontroller and Bluetooth Module:* The microcontroller is the brain of the rover, which controls the motors that drives the wheels. In Operation, the battery powers the Microcontroller The Bluetooth Module allows the rover to be controlled remotely from a smartphone.
3) *Program the Microcontroller:* The microcontroller is programmed using Embedded C Language to receive commands from the Bluetooth module and translate them into movements of the rotor. The program should include commands for moving forward, backward, turning left or right, and stopping the rover.
4) *Testing the Rover:* Once the programming is complete, the rover should be tested in a controlled environment to make sure that it responds correctly to commands that can traverse different types of terrain. The Bluetooth module should be tested to ensure that it establishes a reliable connection with the control device.
5) *Deploy the Rover:* Once the rover is fully tested, it can be deployed to explore different environments. The Bluetooth module allows the rover to access areas that are difficult or dangerous for humans to reach.

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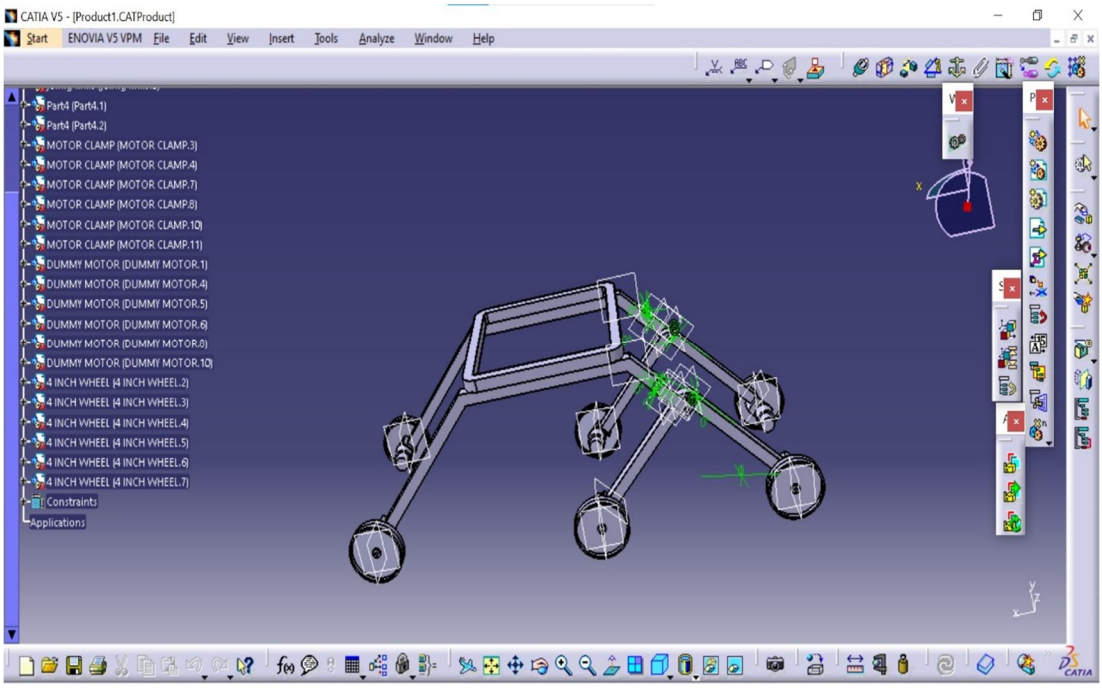


Fig. 4.1 Design of rocker bogie vehicle

V. CONCLUSION

In conclusion, the rocker bogie mechanism is a unique design that provides benefits for agricultural operations. The mechanism's ability to move through rough and uneven land and reduce soil compaction can improve crop yields. Additionally, the mechanism can be used in mining, search and rescue missions and military operations.

The mechanism also has disadvantages such as it's design, limited speed, manoeuvrability, and higher initial cost.

Overall, this mechanism can be a useful tool for farmers to improve the efficiency and effectiveness of agricultural operations. However, it is important to carefully evaluate the advantages and disadvantages of the mechanism when considering its suitability for specific applications.

VI. FUTURE SCOPE

1) The rocker bogie mechanism can be integrated with autonomous technology for improved efficiency and reduced labour costs.

2) The use of new materials and manufacturing techniques can help reduce the weight and increase the durability of the rocker bogie mechanism, improving its efficiency.

3) The mechanism can be integrated with farming technologies such as GPS and sensors to allow for more precise placement of seeds, fertilizers, and other inputs, reducing waste and increasing yields.

4) The rocker bogie mechanism can potentially be adapted to integrate with renewable energy sources such as solar or wind power, reducing the carbon footprint and operating costs of agricultural operations.

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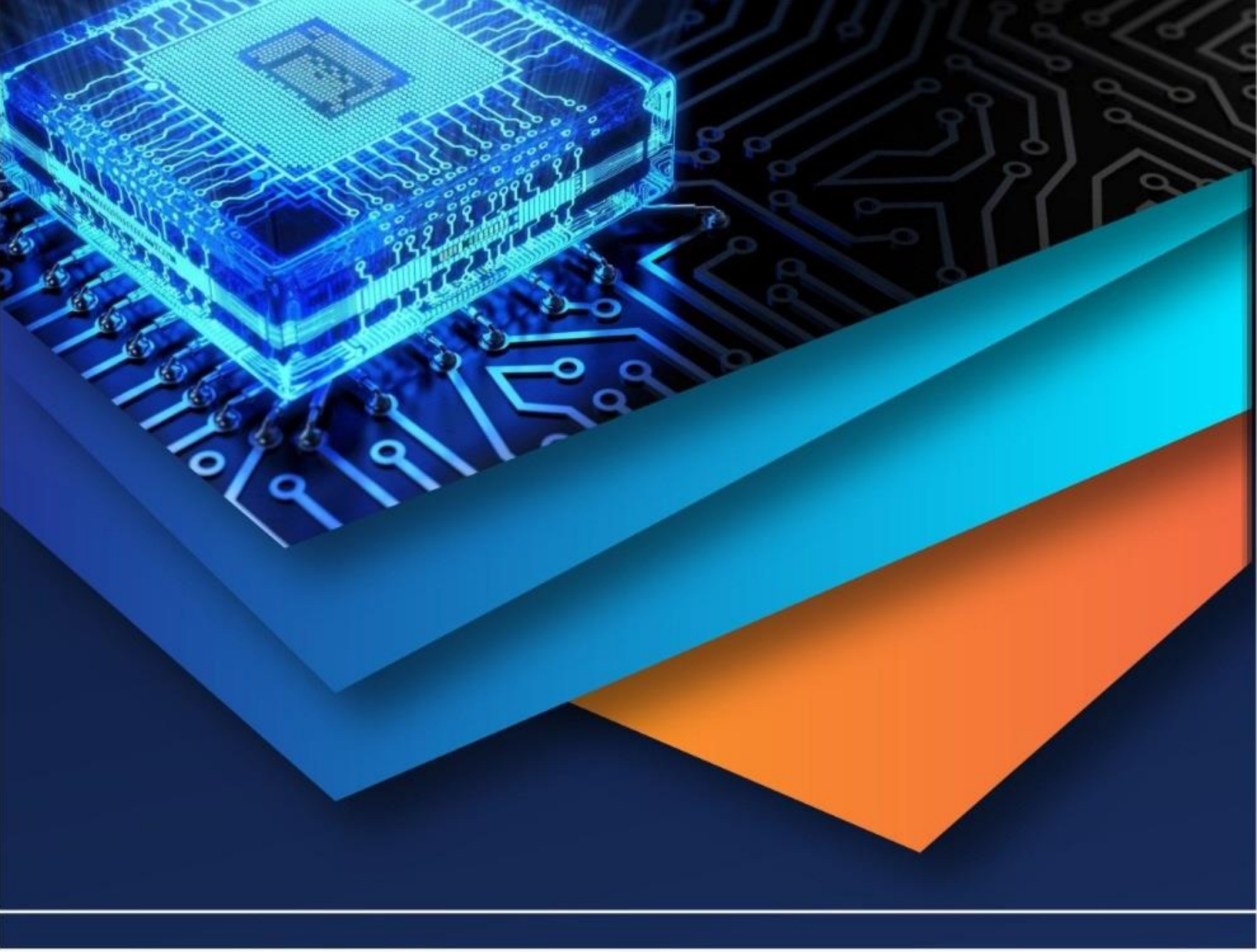
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