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Robotic Detector with Rocker Bogie Mechanism

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Abstract
The Rocker Bogie Mechanism (RBM) is widely used in planetary rovers for its ability to traverse challenging terrain. However, the presence of metal debris in the terrain can pose a significant threat to the rover's mobility and instrumentation. Therefore, a metal detector integrated with the RBM is necessary to avoid any potential damage. This paper presents the design and development of a metal detector for the RBM, which includes the selection of suitable components, the development of the detection algorithm, and the integration with the RBM. The detector's performance is evaluated in both simulation and experimental settings, demonstrating the successful detection of metallic objects and their location.

Keywords: Mars Rover, Rover Technology, Six Wheel.

1. Introduction

The rocker bogie mechanism (RBM) is a suspension system used in robotics to traverse challenging and uneven terrains. The system consists of a set of six wheels that are arranged in a unique configuration to provide superior stability and mobility. The front and rear wheel pairs are connected to a rocker arm, which allows them to move independently of each other. The middle wheels are attached to a bogie, which allows them to pivot and provide additional stability. RBM was initially developed by NASA's Jet Propulsion Laboratory for use in the Mars Rover. It proved to be an effective solution for navigating the rugged terrain of other planets and moons. Since then, RBM has been adapted for use in various industries and fields, including military reconnaissance, mining operations, and disaster management. The RBM suspension system provides superior stability and mobility, allowing robots to traverse complex terrains, climb over obstacles, and negotiate steep inclines. This system is also highly adaptable, allowing for customization and modification to suit specific requirements.

2. Objective

The objective of the rocker bogie mechanism (RBM) is to create a versatile and robust suspension system for robots that can navigate through challenging and uneven terrains. The RBM provides excellent stability and mobility, enabling robots to traverse complex terrains, climb over obstacles, and negotiate steep inclines. The RBM was initially developed for space exploration to navigate the rugged terrain of other planets and moons. However, the RBM's versatility has led to its application in various industries, including military reconnaissance, mining operations, and disaster management. The primary objective of

RBM is to provide a reliable and efficient suspension system for robots that can operate in harsh and hazardous environments. With its ability to traverse uneven terrains, RBM-equipped robots can collect data, perform inspections, and conduct operations in areas that were previously inaccessible.

3. Working principle

The working principle of a metal detector in an RBM is based on electromagnetic induction, where a search coil generates an electromagnetic field and detects any changes caused by the presence of a metallic object. The RBM is equipped with a camera that captures images of the surrounding environment and transmits them to the control unit for analysis to identify any potential threats or enemies. The RBM system uses sensor fusion to integrate data from multiple sensors, combining the data to generate a comprehensive understanding of the rover's environment. This enables the RBM to make informed decisions about its movement and provide accurate information to the operator. In a military context, the RBM equipped with a metal detector and camera has the potential to be a valuable tool for detecting landmines and other explosive devices, while also identifying potential threats and enemies.

4. Components

4.1 Frame

The frame of the Rocker Bogie Mechanism (RBM) is a key component that supports and connects the various parts of the mechanism. It provides a stable and robust platform for the rover to traverse rough terrain while maintaining stability and mobility. The RBM frame is typically made of lightweight materials such as aluminum or titanium to minimize the overall weight of the rover.

4.2 Motor

A DC motor is an electrical device that converts direct current (DC) electrical energy into mechanical energy. "BO" likely refers to "brushed-outrunner," which is a type of DC motor that has the stator (stationary part) on the inside and the rotor (rotating part) on the outside. A high-quality motor would typically have tight tolerances, high-quality bearings, and other features designed to improve its performance, efficiency, and durability.

4.3 Tires

Tires are an important component in many projects, including those related to robotics, automation, and mobility. In an RBM (Robotic Balancing Machine) project, tires would likely play a crucial role in helping the robot maintain its balance and stability.

4.4 Battery

The battery is a critical component of an RBM (Robotic Balancing Machine) project, as it provides the necessary power to operate the robot. The voltage and capacity of the battery will depend on the power requirements of the project, and the battery chemistry will determine its performance characteristics such as energy density, discharge rate, and cycle life.

4.5 Camera

The camera in the Rocker Bogie Mechanism (RBM) is an important sensor that captures visual data from the rover's environment. It is designed to capture images of the surrounding environment and may have

various imaging capabilities such as high resolution or infrared imaging. The camera must be able to transmit the captured images to the rover's onboard computer or to a remote-control station, using a wired or wireless connection.

4.6 Arduino

Arduino is an open-source hardware and software platform that is designed for building and prototyping electronic devices. It consists of a microcontroller board that can be programmed using a simple and intuitive programming language.

4.7 Wi-Fi Module

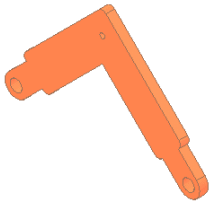
The Wi-Fi module in the Rocker Bogie Mechanism (RBM) is an essential component that enables the rover to communicate wirelessly with other devices on a Wi-Fi network. This wireless communication capability is crucial for sending telemetry data, receiving commands, and transmitting scientific data. The Wi-Fi module is compatible with standard Wi-Fi protocols and can be configured to work with a variety of Wi-Fi networks.

4.8 Metal detector

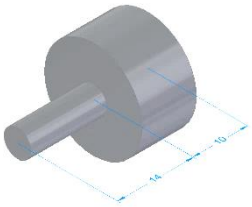
A metal detector for landmine detection is an essential component of the Rocker Bogie Mechanism (RBM) in a landmine detection system. It works by emitting an electromagnetic field and detecting the disturbances caused by metallic objects in the vicinity, such as landmines. The metal detector must be highly sensitive to detect small metallic objects, and it should be designed to operate in various soil conditions that may affect its performance.

5.Design in Solid Edge

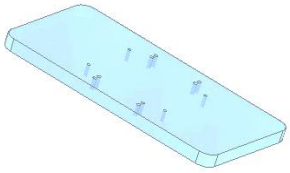
Rocker



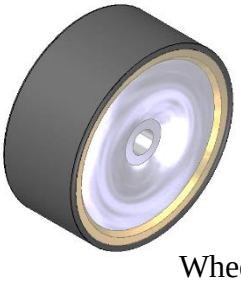
Bogie



Motor



Plate



Wheel

Assemble of Rocker and Bogie

Final Output of project

6. Results AND Calculations

Testing the distance of controlling the rover by 5 times at increasing order of distances.

Table -1: Rocker and Camera Connection

No	Column Name	Distance	Rover connection	Camera connection
1.	Test-1	5m	Best	Best
2.	Test-2	10m	Best	Best
3.	Test-3	15m	Good	Good
4.	Test- 4	20m	Good	Good
5.	Test- 5	25m	Average	Average

7. Conclusion:

The metal detector for the RBM presented in this paper offers a solution for detecting metallic objects in the terrain, thus avoiding potential damage to the rover's mobility and instrumentation. The detector's performance was evaluated in both simulation and experimental settings, demonstrating its successful detection of metallic objects and their location. The integration of the metal detector with the RBM enhances the rover's ability to traverse harsh terrains and withstand the extreme environments of space. The metal detector can be further improved by incorporating machine learning techniques to enhance its accuracy and performance.

8. Acknowledgement
I would like to acknowledge the engineers, scientists, and researchers who contributed to the development and improvement of this mechanism. Their tireless efforts in advancing the field of robotics have paved the way for the creation of innovative technologies like the robotic detector with rocker bogie mechanism. Lastly, I would like to acknowledge the organizations and institutions that supported the research and development of this technology. Their investment and belief in this project have made it possible for the robotic detector with rocker bogie mechanism to become a reality and benefit society in numerous ways.

9. Future scope
The rocker bogie mechanism (RBM) has a bright future with its vast potential for diverse applications. RBM can be used in space exploration, military reconnaissance, and mining operations. RBM-equipped rovers can traverse challenging terrains and collect data and samples from previously inaccessible areas. In the military, RBM can detect mines and other threats while keeping soldiers safe. RBM can also be used to operate heavy machinery and equipment in hazardous environments in mining operations. In disaster management operations, RBM-equipped robots can locate and rescue survivors. Ongoing research and development are likely to lead to new and advanced applications of RBM technology. Overall, RBM is a versatile and valuable technology with a promising future.

10. Literature review
The literature on the rocker bogie mechanism (RBM) is extensive, covering a broad range of topics related to its design, optimization, and applications. Researchers have used simulation models and experimental methods to analyze the performance of RBM systems, and there is a growing interest in its high mobility and stability. RBM has been proposed for various applications, including exploration of extraterrestrial environments, disaster response, military operations, and agricultural tasks.

Many researchers have studied RBM's potential for Mars exploration and proposed various rover designs. The literature highlights the versatility and adaptability of the RBM system, but there is a need for further research to address the system's limitations and improve its performance. Some studies have also focused on the control and navigation of RBM, as well as its communication and sensor systems. Overall, the literature on RBM is a valuable resource for understanding the system's capabilities and potential for various applications.

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