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FABRICATION OF ROUGH TERRAIN VEHICLE TO DETECT AN ALIVE HUMANS IN EARTH QUAKE AREAS BY USING PIR SENSOR

Mr.Paramasamy[1],Mr.B,Mohamed Fazil[1], S.Vignesh Kumar[2], C.Vinoth Kumar[2], M.Vivek[2],
[1]Professor, [2]UG scholar,
Mechanical Department,Sethu Institute of Technology. Pulloor, Kariapatti.

ABSTRACT

The project is designed mainly to help the society by applying basic mechanical engineering knowledge and innovative ideas. During the natural disaster like earth quake, the building get collapsed and the people get stuck under the rough terrain. The information about the alive people was not able to get. Due to unidentification of alive people under the rough terrain that leads to increases in number of deaths. With the help of the project the people can be rescued who get stuck under the rough terrain that will reduces the number of deaths. Rocker bogie mechanism is a mechanism primarily used in the mars rovers to overcome the rough terrains while maintaining stability. It is favourite 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 are stable to work properly and also to increase their life spam. More vibrations and jerks lead to faster wear and tear in in sensors, circuit boards and cameras. The rocker bogie mechanism was designed keeping this in mind by providing maximum stability in all terrains. The rocker bogie was fabricated using concepts of the bogie mechanism. Hence the project fabricated a rocker bogie robot model which saves the alive human in pitfall areas.

I. INTRODUCTION

Over the past decade, the rocker-bogie suspension design has become a proven mobility application known for its superior vehicle stability and obstacle-climbing capability. Following several Technology and research rover implementations, the system was successfully flown as part of Mars Pathfinder's Sojourner rover. When the Mars Exploration Rover (MER) Project was first proposed, the use of a rocker-bogie suspension was the obvious choice due to its extensive heritage. The challenge posed by MER was to design a lightweight rocker- bogie suspension that would permit the mobility to stow within the limited space available and deploy into a configuration that the rover could then safely use to egress from the lander and explore the Martian surface.

When building a robot is like to be as simple as possible. In most cases it never need a suspension system, but there were several instances when a suspension system cannot be avoided. 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 semi-trailer 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 centre of gravity.

There is an increasing need for mobile robots which are able to operate in unstructured environments with highly uneven terrain. These robots are mainly used for tasks which humans cannot do and which are not safe. In order to achieve these tasks, any mobile robot needs to have a suitable mobile system according to each situation. Among these mobile systems, it's the rocker-bogie suspension system that was first used for the Mars Rover Sojourner and it's currently space favored design for rover wheel suspension. The rocker-bogie suspension is a mechanism that enables a six-wheeled vehicle to passively keep all six wheels in contact with a surface even when driving on severely

Uneven terrain. There are two key advantages to this feature. The first advantage is that the wheels' pressure on the ground will be equilibrated. This is extremely important in soft terrain where excessive ground pressure can result in the vehicle sinking into the driving surface. The second advantage is that while climbing over hard, uneven terrain, all six wheels will nominally remain in contact with the surface and under load, helping to propel the vehicle over the terrain. Exploration rovers take advantage of this configuration by integrating each wheel with a drive actuator, maximizing the vehicle's motive force capability. One of the major shortcomings of current rocker bogie rovers is that they are slow. In order to be able to overcome significantly rough terrain (i.e., obstacles more than a few percent of wheel radius) without significant risk of flipping the vehicle or damaging the suspension, these robots move slowly and climb over the obstacles by having wheels lift each piece of the suspension over the obstacle one portion at a time. While performance on rough
terrain obstacles is important, it should be also considered situations where the surface is flat or it has almost imperceptible obstacles, where the rover should increase its speed to arrive faster from point A to point B.

II. WORKING PRINCIPLE

Alive human detection using rocker bogie suspension system is consisting with microcontroller, Bluetooth module, motor driver, PIR sensor and robot model. Here, microcontroller is the main unit of this process the only device can monitor and control the whole process what we proposed. The microcontroller unit has quite features when comparing with the basic controller called 8051. The PIC microcontroller has internal analog to digital converter module, pulse width generation and electrically erasable programmable read only memory. The unit also control the Liquid crystal display module.

Normally, controller checks the user commands. Controller takes the command line from Bluetooth module. So, user must configure the mobile with the Bluetooth module. Once the module is configured it's ready to communicate. Bluetooth SPP is the special app which is available free of cost in play store. The application is used to send Bluetooth command. Here, many applications are available in the android play store. But, No one app allow to modify the button status and commands but Bluetooth SPP will do. The application already designed with suitable command set. When the button is pressed while Bluetooth paired it's communicate data with the microcontroller.

Microcontroller assumes the data and turn on motor driver. The controller operating voltage is not enough to control heavy loads like motor. This is the reason why the motor driver is applied. Controller activates the motor when suitable command received. Then robot model move on. Passive Infrared sensor which is also known as PIR is the sensor used to detect humans. In case the robot model find out the any human radiation then controller stop the robot model and activate the alarm. Earthquake and landslide areas are not safe to rescue humans. The robot model wills save many of the human lives

III. METHODOLOGY

PIR Passive Infrared sensors (PIR sensors) are electronic devices which measure infrared light radiating from objects in the field of view. PIRs are often used in the construction of PIR-based motion detectors, see below. Apparent motion is detected when an infrared emitting source with one temperature, such as a human body, passes in front of a source with another temperature, such as a wall.

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PIR Sensor model diagram

All objects emit infrared radiation; see black body radiation. This radiation (energy) is invisible to the human eye but can be detected by electronic devices designed for such a purpose. The term 'passive' in this instance means the PIR does not emit any energy of any type but merely sits 'passive' accepting infrared energy through the front of the sensor, known as the sensor face. At the core of a PIR is a solid state sensor or set of sensors, with approximately 1/4 inch square area. The sensor areas are made from a pyro electric material.

> The actual sensor on the chip is made from natural or artificial pyro electric materials, usually in the form of a thin film, out of gallium nitride (GaN), caesium nitrate (CsNO3), polyvinyl fluorides, derivatives of phenylpyrazine, and cobalt phthalocyanine. (See pyro electric crystals.) Lithium tantalate (LiTaO3) is a crystal exhibiting both piezoelectric and pyro electric properties.

MOTOR DRIVER

The Device is a monolithic integrated high voltage,high current four channel driver designed to accept standard DTL or TTL logic levels and drive inductive loads (such as relays solenoides, DC and stepping motors) and switching power transistors.

To simplify use as two bridges each pair of channels is equipped with an enable input. A separate supply input is provided for the logic, allowing operationat a lower voltage and internal clamp diodes are included.

Alarm model

The device is suitable for use in switching applications at frequencies up to 5 kHz. The L293D is assembled in a 16 lead plastic package which has 4 center pins connected together and used for heat sinking The L293DD is assembled in a 20 lead surface mount which has 8 center pins connected together and used for heat sinking.

MICROCONTROLLER

. A microcontroller is a complete microprocessor system built on a single IC. Microcontrollers were developed to meet a need for microprocessors to be put into low cost products. Building a complete microprocessor system on a single chip substantially reduces the cost of building simple products, which use the microprocessor's power to implement their function, because the microprocessor is a natural way to implement many products. This means the idea of using a microprocessor for low cost products comes up often. But the typical 8-bit microprocessor based system, such as one using a Z80 and 8085 is expensive. Both 8085 and Z80 system need some additional circuits to make a microprocessor system. Each part carries costs of money. Even though a product design may requires only very simple system, the parts needed to make this system as a low cost product.

BUZZER

A buzzer or beeper is a signaling device, usually electronic, typically used in automobiles, household appliances such as a microwave oven, or game shows. It most commonly consists of a number of switches or sensors connected to a control unit that determines if and which button was pushed or a pre- set time has lapsed, and usually illuminates a light on the appropriate button or control panel, and sounds a warning in the form of a continuous or intermittent buzzing or beeping sound. Initially this device was based on an electromechanical system which was identical to an electric bell without the metal gong (which makes the ringing noise).A pulley is a wheel on an axle or shaft that is designed to support movement and

Battery model

A rechargeable battery (also known as a storage battery) is a group of one or more secondary cells Rechargeable batteries use electrochemical reactions that are electrically reversible. Rechargeable batteries come in many different sizes and use different combinations of chemicals. Commonly used secondary cell ("rechargeable battery") chemistries are lead acid, nickel cadmium (NiCd), nickel metal hydride (NiMH), lithium ion (Li-ion), and lithium ion polymer (Li-ion polymer).

IV. LITERATURE SURVEY

The concept of the research work is to create a rocker bogie drive system based on those of NASA. 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 for great traction and maneuverability (Harrington & Voorhees). The rocker-bogie suspension mechanism which was currently NASA’s approved design for wheeled mobile robots, mainly because it had study or resilient capabilities to deal with obstacles and because it uniformly distributes the payload over its 6 wheels at all times. It also can be used for other purposes to

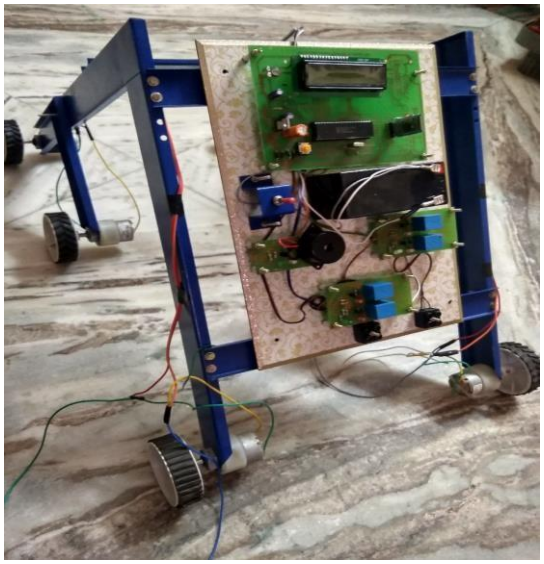
operate in rough roads and to climb the steps. It was having lots of advantages but one of the major disadvantages is the rotation of the mechanism when and where is required. The rotation can be possible by providing individual motors to individual wheels which causes arise in cost and complicacy in design. Here

an attempt was made to modify the existing design by incorporating a gear type steering mechanism which will be operated by a single motor which simplifies the design as well as the total cost and operating cost of the mechanism.

The existing research paper deals with the designing and modelling of stair climbing robot based on the well-known rocker bogie mechanism in Ansys rigid body dynamics module. The robots often suffer from undesired phenomenon slip, sticking and floating while climbing steps and stairs, which may cause instability of the mobile robot. The Taguchi method was used to chosen as an optimization tool to make trajectory of centre of mass close to straight line while all wheels keep in contact with ground during climbing stairs. Taguchi method was adopted due to its simplicity and cost effectiveness both in formulating the objective function and satisfying multiple constraints simultaneously. In the Optimization, Seven kinematic parameters of rocker bogie mechanism were optimized which include four link lengths (l1, l2, l3) and three wheel radius (R1, R2, R3). The kinematic Model of proposed mechanism was built and it was simulated in ANSYS Rigid body dynamics. Three different shapes of typical stairs were selected as user conditions to determine a robust optimal solution It was basically a suspension arrangement used in mechanical robotic vehicles used specifically for space exploration.

V. FABRICATION OF ROCKER BOGIE

The rocker bogie suspension system, which was specifically designed for space exploration vehicles have deep history embedded in its development. 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 selectively modified differential. Encounter area of rocker bogie suspension system. As accordance with the motion to maintain centre of gravity of entire vehicle, when one rocker moves up-word, the other goes down. The chassis plays vital role to maintain the average pitch angle of both rockers by allowing both rockers to move as per the situation. As per the acute design, one end of a rocker is fitted with a drive wheel and the other end is pivoted to a bogie which provides required motion and degree of freedom.



Fabricated model

Line diagram of Rocker-bogie suspension system and its motile joints. 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 semi-trailer trucks as that very time the trucks will have to carry much heavier load.

ROCKER-FRAME

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. 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.

BOGIE FRAME

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 semi-trailer trucks. Both applications now prefer trailing arm suspensions.

The rocker-bogie system is the suspension arrangement used in the Mars rovers (mechanical robot) introduced for the Mars Pathfinder 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 links on each side of the suspension system. These rockers are connected to each other and the vehicle chassis through a 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.

VI. RESULT & DISCUSSION

The proposed paper produces a novel design in pursue of increasing the rocker-bogie mobility system in conventional heavy loading vehicle behavior when high-speed traversal is required. Presented situation was faced presenting two modes of operation within same working principle which is a rocker-bogie system with a robust obstacles traverse features and another is an expanded support hexagon achieved by rotating the bogies of each side of the vehicle. The proposed modification increases in the stability margin and proved with valuable and profitable contrasting the SSF metric with the 3D model simulations done in CATIA. In future, if the system installed in heavy vehicles and conventional off road vehicles, it will definitely decreases the complexity as well as power requirements to retain bumping within it.

From rocker bogie suspension enabled rovers and tried to manufacture a similar kind with the materials available. We made a slight modification with the introduction of mechanical gear type steering system.

The materials used in the manufacturing of the rover were aluminium plates and plywood. The rocker bogie arms were made using aluminium plates of 5mm thickness and holes were punched throughout the arms to reduce the weight of the rover. The rocker and bogie were joined using bearings. Both the rocker bogie arms were connected using stainless steel rod and bearings. For the steering system plywood base was cut according to the required dimensions on which six gears were mounted (one master gear, two idlers and two wheel gears). All the gears used were of mild steel grade

MODIFICATION OF NEW TECHNIQUES

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 fire sensor installed on the rover and minimizing the size of 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 the development of a bigger model it can be used for 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.

VII. ADVANTAGES AND DISADVANTAGES

ADVANTAGES

Speed – High speed communication for BLE module 1us per instruction execution for controller.

Accuracy - Automation systems are more accurate and consistent than their human counterparts.

Production - Work cells create more because they perform applications with more accuracy, speed and tirelessness.

Reliability – The system can work 24 hours a day, seven days a week without stopping or tiring.

Flexibility – The system can be reprogrammable and possible to apply additional sensor parameters.

DISADVANTAGES

Need proper maintenance

After the realized simulation, the results has been generated and analysed which comparing the disturbances in the ATV's Centre of Gravity position in each of the two operating modes, contrasting the response of these two distinctive configurations of the rocker-bogie suspension against upcoming obstacles that can be present along the system generated. obstacles and roadblocks. The test track used for these experiments is a 10 square meters platform with one cylindrical bumper. The simulated rover has a total mass of 260 Kg. Shot circuit. Electrical shocks Continuous data may hang controller module. Bluetooth communication is limit range.

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VIII. CONCLUSION

The project work has been completed successfully. The project hardware functions satisfactorily as per the design. The project work was developed after conducting a number of experiments before finalizing the design work, this reduced the bottle necks and we did not face much difficulty in the final integration process.

In general the entire development of the project work was educative and we could gain a lot of experience by way of doing the project practically. We could understand the practical constraints of developing such systems about which we have studied by way of lectures in the theory classes.

It was satisfying to see so many theoretical aspects work before us in real life practice of which we have heard through lectures and of which we have studied in the books.

The proposed project produces a novel design in pursue of increasing the rocker-bogie mobility system in conventional heavy loading vehicle behaviour when high-speed traversal is required. Presented situation was faced presenting two modes of operation within same working principle which is a rocker-bogie system with a robust obstacles traverse features and another is an expanded support hexagon achieved by rotating the bogies of each side of the vehicle. In future, if the system installed in heavy vehicles and conventional off road vehicles, it will definitely decreases the complexity as well as power requirements to retain bumping within it.

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