

# Rocker Bogie Robot in Defense Applications using IOT

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**ABSTRACT** - Rocker bogie are important for conducting in-situ scientific analysis of objectives that are separated by many meters to tens of kilometers. Current mobility designs are complex, using many wheels or legs. They are open to mechanical failure caused by the harsh environment on Mars. A four wheeled rover capable of traversing rough terrain using an efficient high degree of mobility suspension system. The primary mechanical feature of the rocker bogie design is its drive train simplicity, which is accomplished by using only two motors for mobility. Both motors are located inside the body where thermal variation is kept to a minimum, increasing reliability and efficiency. Four wheels are used because there are few obstacles on natural terrain that require both front wheels of the rover to climb simultaneously. A series of mobility experiments in the agriculture land, rough roads, inclined, stairs and obstacles surfaces concluded that rocker bogie can achieve some distance traverses on field. This project is mainly used in defense applications for landmine detection with object detection features and also this robot as high definition Night vision camera for live surveillance and voice transmission features.

**Key Words:** Rocker bogie; Wheel type mobile robot; Stair climbing; Rover.

## 1. 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 [4].

When building a robot you'd like it to be as simple as possible. In most cases you'd 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.

## 2. LITERATURE SURVEY

The concept of our 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 complicity 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. In this work the proposed steering mechanism was designed and the modeling was done in CATIA (V-5) and the same was analyzed for static analysis for the proposed torque condition of the motor in ANSYS. All the results in the analysis were analyzed for static analysis [1]. The researchers discusses the concept and parameter design of a Robust Stair Climbing Compliant Modular Robot, capable of tackling stairs with overhangs. Modifying the geometry of the periphery of the wheels of our robot helps in tackling overhangs. Along with establishing a concept design, robust design parameters were set to minimize performance variation. The Grey-based Taguchi Method was adopted for providing an optimal setting for the design parameters of the robot. The robot prototype was shown to have successfully scaled stairs of varying dimensions, with overhang, thus corroborating the analysis performed [2]. An analysis method to make the rocker bogie mechanism can climb up a stair was achieved in the work. The east coast of Malaysia faced a massive flood from heavy downpour, leading to huge flood damage and caused irreparable loss to life and property. The flood carries the debris, soil and trees along their path, damaging the road and building structure, leaving the road become uneven. This situation gives difficulty to task force bearing aids during the post disaster management. The research paper proposed an intelligent inclined motion control of an amphibious vehicle while moving on uneven terrain surface [3].

### 3.OBJECTIVE

- The objective of the project is to design a small, terrain vehicle and easy to steer and handle.
- It will be designed for working on different platforms like rough terrains, smooth surfaces, overcoming obstacles in its path and climbing over obstacles of certain height.

- It can be use for live video feed and image capturing in borders.

### 4.DESIGN OF ROCKER BOGIE

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 angles of this mechanism can be changed as per requirement. In the work aim 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  $45^\circ$ . To achieve the above targets we had design the rocker-bogie model by assuming stair height 150 mm and length 370 mm. Using Pythagoras theorem, find the dimensions of the model. It have both angles of linkages are  $90^\circ$ .

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 150mm 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.

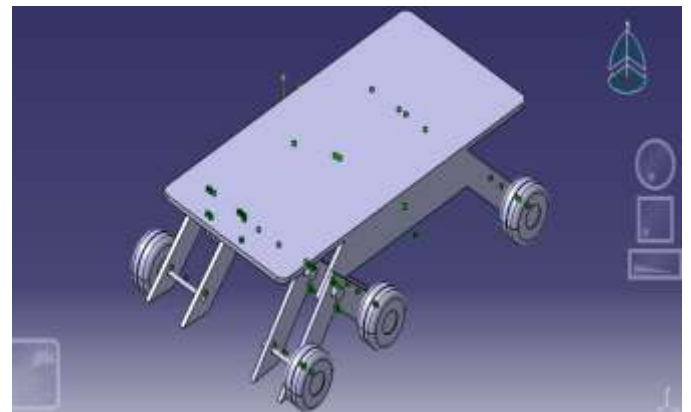


Fig-1: Design of Rocker Bogie

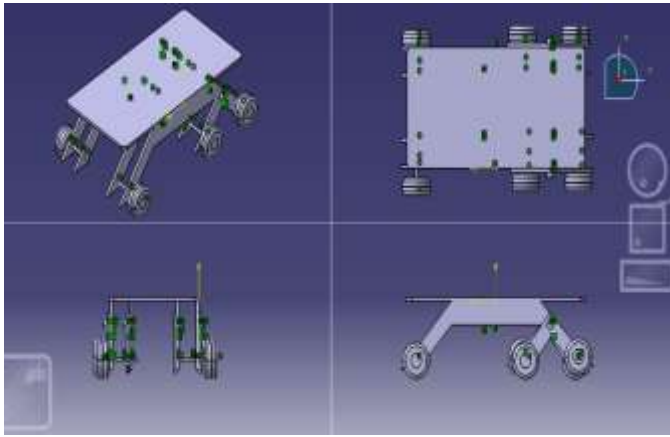


Fig-2: Design of Rocker Bogie

**5.HARDWARE TOOLS:**

**5.1 METAL DETECTOR**

A metal detector is an electronic instrument which detects the presence of metal nearby. Metal detectors are useful for finding metal inclusions hidden within objects, or metal objects buried underground. They often consist of a handheld unit with a sensor probe which can be swept over the ground or other objects. If the sensor comes near a piece of metal this is indicated by a changing tone in earphones, or a needle moving on an indicator. Usually the device gives some indication of distance; the closer the metal is, the higher the tone in the earphone or the higher the needle goes. Another common type are stationary "walk through" metal detectors used for security screening at access points in prisons, courthouses, and airports to detect concealed metal weapons on a person's body.



Fig-3: Metal Detector

The simplest form of a metal detector consists of an oscillator producing an alternating current that passes through a coil producing an alternating magnetic field. If a piece of electrically conductive metal is close to the coil, eddy currents will be induced in the metal, and this

produces a magnetic field of its own. If another coil is used to measure the magnetic field (acting as a magnetometer), the change in the magnetic field due to the metallic object can be detected.

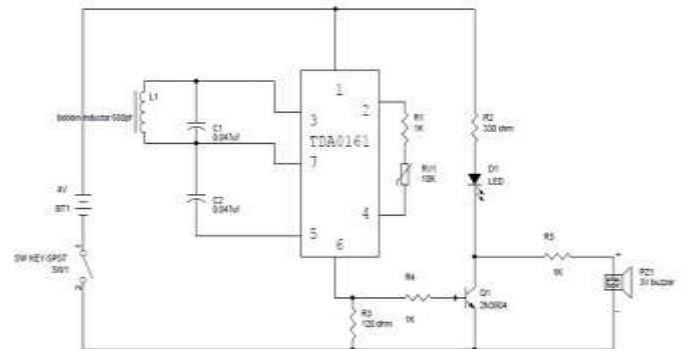


Fig-4: Metal Detector Circuit

**Battery:** The main purpose of the battery is to provide the power to the detector.

**Control Box:** The control box comprises of the electronics of the detector. When the transmit signal is generated, the receive signal is processed and transformed into a target response.

**Search Coil:** The electromagnetic field can be transferred by the search coil of the detector into the ground & receives the electromagnetic field return from a metal object.

**Electromagnetic Field Transmission:** The transmitted electromagnetic field energizes metal objects to allow them to be sensed.

**Target:** Here, a target is a metal object that can be sensed by a metal detector. In this, the target is treasure which is sensed and that is a good target.

**Undesirable Target:** These metal objects are generally attracted to a magnet like nails and also non-ferrous like bottle tops. If the metal detector is fixed to discard unwanted targets, then the response of the target will not be generated for those targets.

**Receive Electromagnetic Field:** The receive electromagnetic field is produced from energized targets & it is received by the search coil

**Response of the Target:** When the metal detector detects the metal object, then it generates an audible sound like a

beep. Various Minelab detectors also generate a visual display of target information.

### 5.2 DC Gear Motors

Almost every mechanical development that we see around us is accomplished by an electric motor. Electric machines are a method of converting energy. Motors take electrical energy and produce mechanical energy. Electric motors are utilized to power hundreds of devices we use in everyday life.

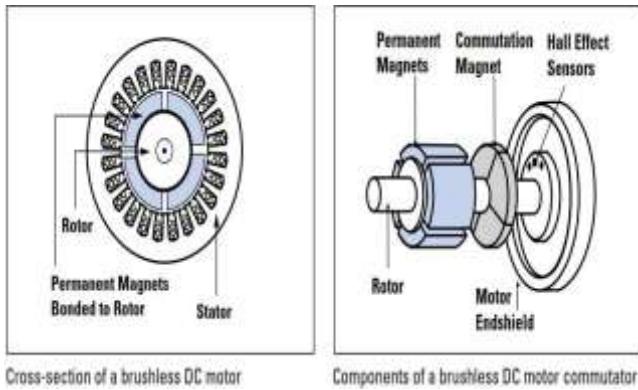


Fig-5: DC Motor

Electric motors are broadly classified into two different categories: Direct Current (DC) motor and Alternating Current (AC) motor. In this article we are going to discuss about the DC motor and it's working. And also how a gear DC motors works.

A DC motor is an electric motor that runs on direct current power. In any electric motor, operation is dependent upon simple electromagnetism. A current carrying conductor generates a magnetic field, when this is then placed in an external magnetic field, it will encounter a force proportional to the current in the conductor and to the strength of the external magnetic field. It is a device which converts electrical energy to mechanical energy.

### 5.3 DC Motor Equations:

Magnitude of flux experienced is

$$F = BIl$$

Where, B- Flux density due to flux produced by field windings

l- Active length of the conductor

I-Current passing through the conductor

As the conductor rotates, an EMF is induced which acts in a direction opposite to the supplied voltage. It is given as

$$E_b = \frac{\Phi PNZ}{60A}$$

Where,  $\Phi$ - Fluz due to the field windings

P- Number of poles

A-A constant

N – Speed of the motor

Z- Number of conductors

The supply voltage,  $V = E_b + IaRa$

The torque developed is

$$T_a = \frac{0.159\Phi IaPZ}{A}$$

Thus the torque is directly proportional to the armature current.

Also speed varies with armature current, hence indirectly torque and speed of a motor are dependant on each other.

### 6.WIRELESS CAMERA

We have introduced most advanced technology for V380 Indoor Security IP Camera, integrated with various features of HD 1080P 60fps, POE(Power Over Ethernet), P2P and Auto HD IR-CUT and so on, which bring you a very clear and vivid image and also offers a immersive illusion. Beside, with 360 degree globe panoramic IP Camera, viewing what is in range of the camera, you can also have a video surveillance in every corner of your house as well. Built-in microphone and speaker, there is no problem for talking with someone wherever the IP Camera is set up directly from your mobile device. V380 Camera also will be provided with cloud service, all of you will not worry about the loss of video and you can record all playback what you want. Moreover, V380 IP camera is for surveillance and monitoring, truly achieves families protection, it can be regard as a baby monitor when you are on business, also can use for pets in the daily life, which you can enjoy the happiness even when you are abroad. Never lose such a household artifacts.



Fig-6: Wireless Camera



### 1. Download the APP “V380”, install and register.

Register an account by phone number or Email. We recommend using mobile phone registration, sometimes the mailbox can not receive verification information.

### 2. Add and Delete a New Device

2) Add a new device ,Press "+" to add a new device. V380 helps new starters to connect the camera to WIFI easily. Power on the new camera, enter WIFI SSID & password (the same WIFI as your smartphone has connected to). Wait for connection .After hearing a ding sound from the camera, its net indicator light turns on. The camera connects to WIFI successfully. Name the camera whatever you like, for example “V380123”, enter its password”123456” (default). Press. The camera is online.

2). Add a new device by QR code.

More →Add camera by QR Code →Enter WIFI SSID & password →Next, a QR

Code emerges, scan the QR code →Heard, wait for connection → Connected

(NET indicator light on), enter the password of the camera(default 123456)

→Save the device→It is online

### 3).Manual Add

This is used to add a new camera that is already on line. (Which means the camera has already been connected to WIFI, and you know the ID and password of the camera .)

### 4). Delete a device

Android - - - - - Long - press the camera that is to be deleted, a prompt comes out, press OK.

IOS - - - Choose the camera , slide to left to delete.

### 3. Live - view and its settings

Click to live view

Attention: Position preset is a very practical function.

**【DO NOT hand-rotate the head of the camera!!】**

Rotate the camera on phone app to the place you want ,then press button 1, press OK. A camera can support 5 positions preset.

### 4. Alarm Settings

1). Defence Area Learn code with other alarm detectors  
The camera can support max. 64 channels of wireless alarm detectors. All the external detectors must learn code with the camera before normal use.

For example, to set up a door sensor as the first detector of the hall, choose

the hall, click button “1”, press“OK” to code.

Trigger the door sensor, the camera will remember the code and learning is successful. There is a blue left to button “1”.

Binding preset can be done here. Press “OK” and make the doors ensor in position 1. It means the door sensor is set to be in position 1 preset.

### 2).Alarm Settings

### 3). Alarm pushing settings

4). If you set the right alarm pushing but can not receive alarm messages, try to check here.

Set alarm in terval (default 10s)◦ Check if you blocked the camera. If yes, just delete it, then you can receive alarm messages.

### 5. Record Settings

Plug in the SD card when the camera is power off.

Normally the SD card is with capacity 8-32GB, max 128GB (If the SD card capacity is above 32GB, please format the SD card on PC as FAT32 first.) SD card in

and working well----- record indicator lights on  
Recording -----record indicator flickers.

### 7.ESP-12E Wi-Fi Module (esp8266)

ESP-12E Wi-Fi module is developed by Ai-thinker Team. core processor ESP8266 in smaller sizes of the module encapsulates Tensilica L106 integrates industry-leading ultra low power 32-bit MCU micro, with the 16-bit short mode, Clock speed support 80 MHz, 160 MHz, supports the RTOS, integrated Wi-Fi MAC/BB/RF/PA/LNA, on-board antenna. The module supports standard IEEE802.11 b/g/n agreement, complete TCP/IP protocol stack. Users can use the add modules to an existing device networking, or building a separate network controller. ESP8266 is high integration wireless SOCs, designed for space and power constrained mobile platform designers. It provides unsurpassed ability to embed Wi-Fi capabilities within other systems, or to function as a standalone application, with the lowest cost, and minimal space requirement.



Fig-7: ESP8266-12E

The ESP8266 has seen a wide adoption as a cost-effective solution for IOT and Wi-Fi-capable devices. The ESP8266 was developed by Shangai-based Espressif systems, as a Serial (UART) to Wi-Fi SoC (System on a Chip) based around a Tensilica Xtensa LX3DPU. This tiny IC includes an RF front end, RAM, and (usually) an onboard TCP/IP stack that allows it ready to connect to a nearby Access Point, to act as an Access Point itself, or both.

TABLE-1: AT Commands

Command	Description
AT	Test AT start up
AT+RST	Restart module
AT+GMR	View version Info
AT+GSLP	Enter deep sleep mode
ATE	AT commands echo or not
AT+RESTORE	Factory Reset
AT+UART	UART Configuration
AT+UART_CUR	UART current configuration
AT+UART_DEF	UART default configuration, save to flash
AT+SLEEP	Sleep mode
AT+RFPOWER	Set maximum value of RF TX power
AT+RFVVD	RF TX power according to VDD33

### 8.Blynk Cloud

Blynk was designed for the Internet of Things. It can control hardware remotely, it can display sensor data, it can store data, visualize it and do many other cool things.

Blynk is a platform with iOS and Android apps to control Arduino, Raspberry Pi and the likes over the Internet. It's a digital dashboard where you can build a graphic interface for your project by simply dragging and dropping widgets. It's really simple to set everything up and you'll start tinkering in less than 5 mins. Blynk is not tied to some specific board or shield. Instead, it's supporting hardware of your choice. Whether your Arduino or Raspberry Pi is linked to the Internet over Wi-Fi, Ethernet or this new ESP8266 chip, Blynk will get you online and ready for the Internet Of Your Things.



Fig-8: Blynk app Overview

There are three major components in the platform:

**Blynk App** - allows to you create amazing interfaces for your projects using various widgets we provide.

**Blynk Server** - responsible for all the communications between the Smartphone and hardware. You can use our Blynk Cloud or run your private Blynk server locally. Its open-source, could easily handle thousands of devices and can even be launched on a Raspberry Pi.

**Blynk Libraries** - for all the popular hardware platforms - enable communication with the server and process all the incoming and out coming commands.

Blynk was designed for the Internet of Things. It can control hardware remotely, it can display sensor data, it can store data, visualize it and do many other cool things

## 9. ARDUINO IDE

Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online. You can tell your board what to do by sending a set of instructions to the microcontroller on the board. To do so you use the Arduino programming language (based on Wiring), and the Arduino Software (IDE), based on Processing.

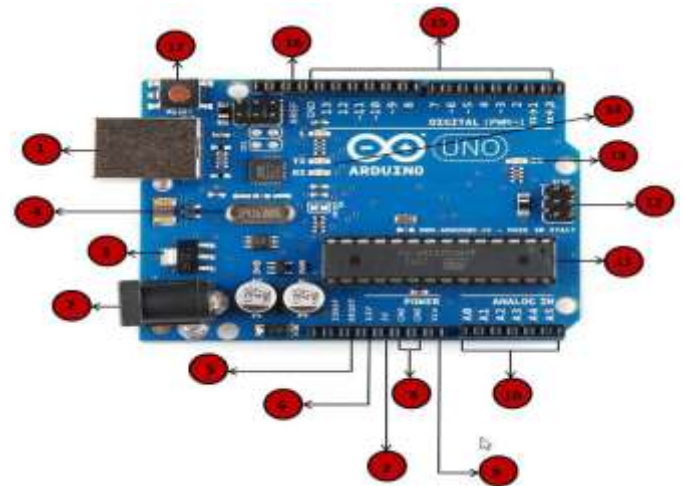


Fig-9: Arduino IDE

## 10. CONCLUSION

This work 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°. Also we tested for the Web cam with AV recording mounted on rocker bogie system and found satisfactorily performance obtains during this test camera has rotated around 360°. During stair climbing test for length less than 375 mm (15 inch) system cannot climb the stair. It can be possible to develop new models of rocker bogie which can climb the stairs having low lengths.

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