

## A DEVELOPMENT OF SEMI AUTONOMOUS ROVER

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### Abstract

*This paper represents the method undertaken for the developments of a Semi Autonomous space rover. That could be used for all terrain surfaces and also in various complex environments by tracking a given target autonomously through android image processing technique. We have produced experimental models of the Rocker Bogie planetary rover with 6-wheel suspension system (says "ROVO"). This system can be controlled and accessed by means of Bluetooth and Image processing. This system embedded with two pair of ping sensors for avoiding obstacles and two Android mobiles, among which one is to survey the surroundings through wireless video transmission by Wi-Fi and other is to provide a directions to its wheel through image processing application, which was designed earlier.*

**Keywords:** *Space; Semi Autonomous; Rocker Bogie; Suspension; Wifi; Image Processing.*

### Introduction

Natural satellite or planet investigation is one of the most effective methodologies to analyze the possibility for humanity's existence and survival. In this project we are trying to establish both wireless communications between the Rover and the Base Station shown in Fig 1.1. The Base Station requires an Application and also the rover ("ROVO") needs to be hardwired with the Bluetooth (HC05) controller, for wireless control. Our aim is to control the Rover wirelessly by the Application shown in Fig. 1.3. The main process of our project is to program the AVR microcontroller through Arduino platform on rover shown in Fig. 1.4 and the Controller in Fig. 1.3 is interfaced to the Bluetooth module which would enable us to wirelessly control the Robot. As the result of those many missions, we were able to get an acknowledgement or sending a command from and to the rover for a delay of 20 minutes transmission time (says NASA) now, it can be said that the task of our rover can be fastened through Autonomous decision on its target. Almost all countries had to upgrade their future rovers the because of their transmission delay problems. In order to provide faster decision making rover with low-cost, using an unmanned roving vehicle (shown as 'ROVO' hereafter), which has a high degree of mobility, is one of the fascinating ideas.



**Fig:1.1**

## **Literature Review**

The development of our proposed paper ignited when it was known that the major issue for controlling and protecting the planetary rover for NASA is a tedious task due to the communication delay up to 20 minutes as stated in its official website. So the team Rovo decided to develop an experimental model says a Prototype which would takes a single command from the base station and completes the whole target by follows the object based on its color instead of moving a Rover from base station by several commands for moving Left, Right and Forward ( Each command takes 20 minutes for sending and 20 more minutes reception of acknowledgement ).

This paper mainly focused on developing a Highly suspended mobile platform says "Rocker Bogie" for a complete Semi Autonomous system. In the paper named " An Image Based Path Planning Using A - Star Algorithm", the author stated is that at rover can found a reliable path using an algorithm says Star Algorithm, "Modified A\* Algorithm for Safer Mobile Robot Navigation" in 2013 by Basem M. ElHalawany, Hala M.Abdel-Kader, AdlyTagEldeen, Alaa Eldeen Elsayed was prepared to upgrade the features of star algorithm, baseds on the reference "The Mars Exploration Rover Surface Mobility Flight Software: Driving Ambition", Jeffrey J. Biesiadecki and MarkW. Maimone, Jet Propulsion Laboratory Pasadena, CA USA gave a solution and conclusion to construct the body dimension and suspension mechanism.

## **Proposed work**

The proposed work is to construct or develop a hardware platform to be sustained in all surface says a rocker bogie carried processing system, this processing can be accessed by a pre-designed image processing android application used here as a color detector. This color detector communicates with the chasis through Bluetooth. It could replace the existing rovers, it takes commands from the user initially for a target to follow or reach hence it is named as Semi Autonomous Rover.



Fig:1.2

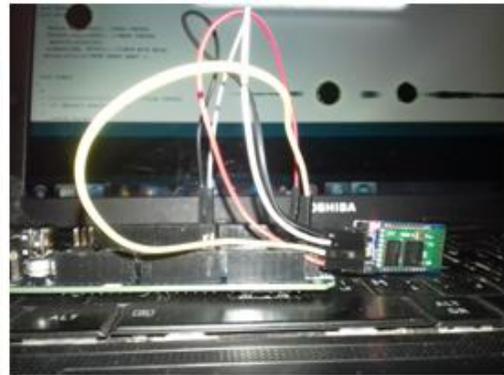


Fig:1.3

This unmanned rover is controlled through Bluetooth by the commands such as Left, Right, Forward, Backward and Stop from the specially designed android color detection application, shown in Fig:1.4



Fig:1.4



Fig:1.5

### Planetary Rover

A Planetary rover is an automated motorized vehicle that drives itself across the surface. A Rover in mars named as curiosity is shown in fig1.6. Rovers may have several benefits over the stationary robots, they examine territory, and they able to discrete to features, they can be able to place themselves in any positions. There have been several successful robotics operated rovers . The Jet Propulsion Lab have been performed the finder mission and its now inactive rover. It currently manages the Mars Rover mission's active Opportunity rover and inactive Spirit. On January 24, 2016 NASA have reported that the current studies on the planet by the rovers, Curiosity and Opportunity will now be evidencing for ancient life.

### Mobility of the System

The suspension system is the key issue of degree of mobility. And so, we have discussed a variety of mobility systems for cruising rough terrain. In this chapter, we'll see some typical systems to know what essential points are for improving mobility.

### **Conventional 4-Wheel Drive Train System**

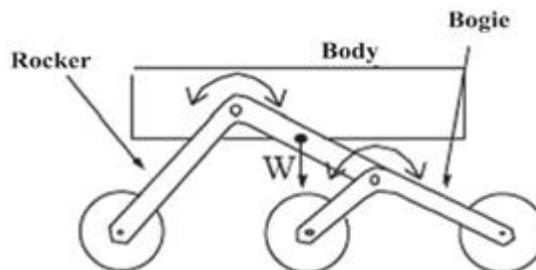
Four-wheel drive, 4×4 ("four by four"), and 4WD, is a form of drive train capable of providing power to all wheel ends of a two-axled vehicle simultaneously. It may be full-time, or on-demand, and is typically linked via a transfer case which provides an additional output drive-shaft, along with additional gear ranges. A four-wheeled vehicle with power supplied to both axles may sometimes be described as "all-wheel drive" (AWD). However, "four-wheel drive" typically refers to a set of specific components and functions, and/or intended offroad application, which generally complies with modern use of the terminology.



**Fig:1.6**

### **Rocker Bogie Drive System**

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 [clarification needed] 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. 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.



**Fig:1.7**

### Bluetooth Module HC05

HC-05 module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. Serial port Bluetooth module is fully qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband. It uses CSR Blue core 04-External single chip Bluetooth system with CMOS technology and with AFH(Adaptive Frequency Hopping Feature). It has the footprint as small as 12.7mmx27mm. Hope it will simplify your overall design/development cycle. The entire Earth space communication are demonstrated by Bluetooth control (Says Direction control and video surveillance control).

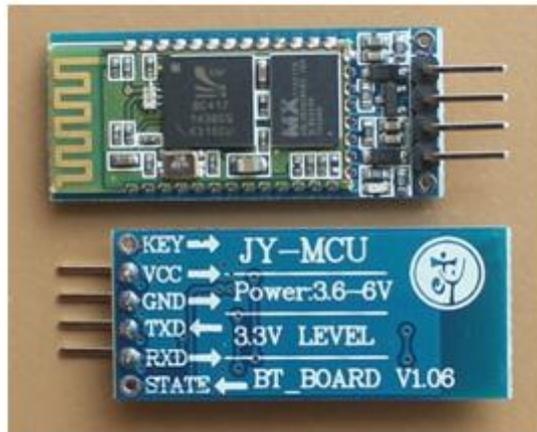


Fig:1.8

### Ping Sensor HSCR04

Ultrasonic sensors are based on the measurement of the properties of acoustic waves with frequencies above the human audible range, often at roughly 40 kHz . They typically operate by generating a high-frequency pulse of sound, and then receiving and evaluating the properties of the echo pulse.

Three different properties of the received echo pulse may be evaluated, for different sensing purposes.

#### They Are:

- Time of flight (for sensing distance)
- Doppler shift (for sensing velocity)
- Amplitude attenuation (for sensing distance, directionality, or attenuation coefficient)

#### Mode of Operation

- Time of Flight

### Reflection Mode

In reflection mode (also known as “echo ranging”), an ultrasonic transmitter emits a short burst of sound in a particular direction. The pulse bounces off a target and returns to the receiver after a time interval  $t$ . The receiver records the length of this time interval, and calculates the distance travelled  $r$  based on the speed of sound  $c$  ( $r = c * t/2$ )

Very often, separate transmitting and receiving transducers are placed immediately next to each other, housed as a single unit. (The PING) Range Finder, Omega flow meter and Migatron high-accuracy sensor below are all designed this way.) In these cases, the distance calculated will be twice the distance from the sensor to the target. Using proper coordination, a single transducer can be used for both emitting the pulse and receiving the echo. Note that it takes time for the transducer to change modes, presenting a challenge to short-distance measurement.

### Direct Measurement Mode

In this mode of operation the transmitter and receiver are two separate units that move relative to each other. For example, the receiver can be fixed to a target that moves relative to a stationary transmitter, or vice-versa. Multiple transmitters can be used to increase the directionality of the transmitted pulse. Lima et al. 3) placed multiple ultrasonic transmitters on a performer, whose signals were received by multiple receivers in the performance space, enabling a computer program to triangulate the performer's position. This system behaves as a self obstacle avoidance one by means of this sensor.

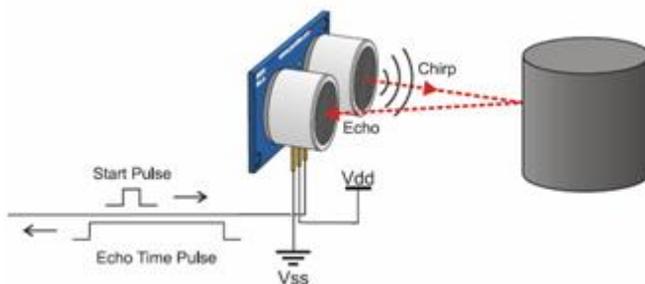
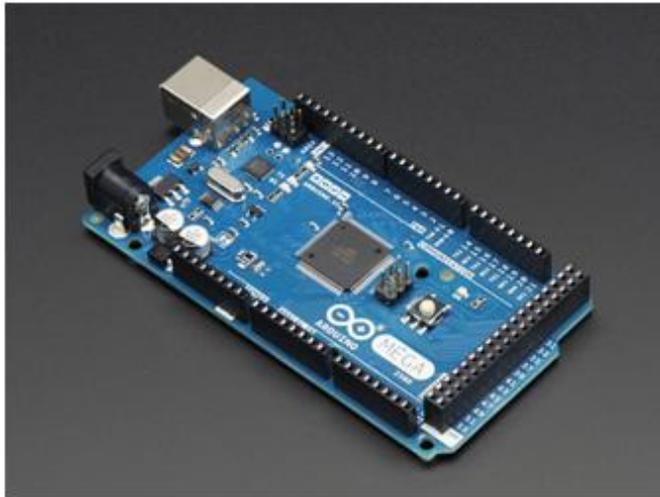


Fig:1.9

### Arduino Mega 2560

The figure 2.0 shows the Microcontroller used in the proposed system. The system offers many GPIO pins and provides 4 serial communication ports. The Arduino Mega 2560 is a microcontroller board based on the ATmega2560. It has 54 digital input/output pins (of which 15 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Mega is compatible with most shields designed for the Arduino Duemilanove or Diecimila.



**Fig:2.0**

## **Conclusion**

Today it seen that wireless controlled rover have some limitation on time, as per the report unveiled by NASA it would take 20 minutes for a command and acknowledgement to be sent or receive from earth station and rover correspondingly. The control of our proposed system involves four distinct phases: reception, self deciding, processing and action. Generally, the preceptors are sensors mounted on the robot, processing is done by the on-board microcontroller or processor, and the action is performed using motors. So the motive is that to develop an Automatic decision making rover.

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