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Development of Mini Mars Rover

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ABSTRACT:Due to lot of pollution and natural disasters occurring in the surface of earth there is need of alternate source which are suitable for survival of humans. After conducting a lot of experiments, scientists of NASA think that mars is near to the earth and they sent the Rover to the surface of mars to know various geographical and biological conditions of that planet. A rover is a robotic machine which works under the principle of Rocker-Bogie suspension mechanism, the reason behind this mechanism is that a rover can move on any terrain surface. It also captures photographs and senses the various parameters that are useful for future aspects. The various materials that extract from mars and test them for further survival. The rocker-bogie suspension mechanism it's presently NASA's favoured style for wheeled mobile robots, primarily as a result of its sturdy capabilities to upset obstacles and since it uniformly distributes the payload over its six wheels in any respect times. although it's several benefits once handling obstacles, there's one major defect that is its low average speed of operation, creating the rocker-bogie system not appropriate for things wherever high-speed traversal hard-flat surfaces square measure required to hide massive areas in brief periods of your time, principally thanks to stability issues. The mini-Mars rover is used to find the moisture content in the soil and also water bodies that are present on the surface. In addition to this it is also used to capture the features that are present in front of the rover. The cameras are having better magnification effect and also it rotates up to straight line angle. It also finds the water bodies which are found on the mars. This robot is controlled by Bluetooth module and is easy to operate through Mobile phone and laptop. The moisture sensor arm moves about 145 degrees to and fro motion. The whole system design system is controlled by the Arduino, Bluetooth module, buck controller, motor drivers which regulates the voltage to the motors.

KEYWORDS:Arduino, Rocker-bogie suspension mechanism, Servo motor, Bluetooth module, Buck controller.

I. INTRODUCTION

Robotics is the intersection of science, engineering and technology that produces machines, referred to as robots, that substitute for (or replicate) human actions. Popular culture has continually been fascinated with robots. R2-D2. Optimus Prime. WALL-E [1]. Robot is a machine which works by using artificial intelligence and programmed data. It is designed to perform specific tasks such as it can use as bomb detector, rover, fire accident, food supply in hotels, extreme cold conditions and hot conditions, etc. It can be used based upon it's usage. Robots are often autonomous or semi-autonomous and vary from humanoids like Honda's Advanced Step in Innovative quality (ASIMO) and TOSY's TOSY Ping stink enjoying golem (TOPIO) to industrial robots, medical operative robots, patient assist robots, dog medical care robots, jointly programmed swarm robots, UAV drones like General Atomics MQ-1 Predator, and even microscopic nano robots. By mimicking a lifelike look or automating movements, a golem could convey a way of intelligence or thought of its own. Autonomous things square measure expected to proliferate within the future, with home artificial intelligence and also the autonomous automotive as a number of the most drivers[2].

1.1 MARS ROVER

A Mars rover is a type of robot which can be used at high and terrain places. It also captures the photographs of those places and also it should sense the various resources and minerals that are present on the surface of mars [3].

TYPES OF ROVERS

- i. Sojourner rover
- ii. Spirit rover
- iii. Opportunity rover
- iv. Curiosity rover
- v. Perseverance rover

i) Sojourner Rover

It is the first rover sent by NASA to the Mars planet. It is also known as path finder [3].

ii) Spirit Rover

It is the second rover sent by NASA to the Mars planet. It is used to know the water bodies that are present on mars [4].

iii) Opportunity Rover

It is the rover sent to mars by NASA to know the mineral resource [4].

iv) Curiosity Rover

The curiosity rover performs all the activities of previous rovers and also it captures the photographs of various geographic locations on mars [4].

v) Perseverance Rover

It upgraded rover as compared to previous rovers. It was having MastCam camera (an advanced camera), Mars environmental dynamics analyser, Rada Imager for sub surface of mars [4].

II. LITERATURE SURVEY

Viking on Loop Wheels (1979). This objective of this treatise is to analyse the society, economy, settlement, and culture of the territory of current Baltic State within the period of ca AD 450–1050. this era is thought in the Estonian anthropology chronology because the Migration amount, the Pre-Viking Age, and the Viking Age. This was associate degree era of fast amendment, by the end of that ancient Estonian peasant culture because it is thought till the nineteenth century had developed. Whereas in Western Europe written sources from the last half of the primary millennium AD herald the arrival of the center Ages, there's associate degree almost complete absence of written info about the prevailing conditions and events that took place within the space of current Baltic State. There are solely remains of the farms and fortresses of that point below the world, as well as cemeteries, overgrown field baulks and clearance cairns, and also the great amount of excavated ancient objects or fragments thence. several aspects of prehistoric life cannot be researched as a result of the source material isn't extant and there's no hope of finding it. Moreover, several phenomena of human life don't generate anthropology supply material. so, our overall understanding of the Estonian Middle Iron Age and also the Viking Age is inevitably fragmental and superficial [5].

The Mars Rover could be a vehicle that has been designed to traverse the rugged terrains of Mars and collect samples of assorted things on Mar's surface. Scientists over the years have tried to explore the chance of life on Mars. Such explorations are largely done victimization rovers. therefore, rovers ought to be specially designed to traverse all types of terrains and should be equipped with state-of-the-art technology. a typical style part is most rovers over the years is that the rocker bogie mechanism. The rocker bogie mechanism has quite a ton of benefits and is therefore a well-established mechanism. The most advantage is that it ensures that everyone the wheels of thereover in-tuned with the bottom in the slightest degree times. Consequently, the traction of the rocker bogie provides is equal and reliable permitting a sleek running even on the uneven terrains [5].

Marsokhod (1980's) Russia (1990-1995), In view of a planned ambitious mission the Russians developed a mini rover for Mars surface operations, called Marsokhod. The mission was repeatedly postponed and finally cancelled. The earliest notable Mars mortal, the guide, landed on Mars with a totally operate rover on Mars on July 4, 1997. The rover carried a large array of scientific instruments to research the Martian atmosphere, climate, earth science and its rock and soil composition. Sojourner, the Pathfinder's rover, created observations that answered various questions about the origin of the rocks and different deposits on Mars. Curiosity, another historic milestone within the history of alien planet exploration, was allotted the role of investigation Martian climate and earth science. It assessed whether or not the chosen field web site, wind Crater, had ever offered environmental conditions favourable for microbic life and future investigated the role of water in planetary habitability as preparation for future human exploration. In these styles of rover's solely 6-wheeled rocker bogie suspension is employed [5].

Mars Exploration Rover (2003) World powerful new Mars rovers are currently heading for the red planet. With far greater mobility than the 1997 Mars Pathfinder rover, these robotic explorers may trek as much as 40 meters (44 yards)

across the surface in a day. Each rover carries a sophisticated set of instruments to search for evidence of liquid water that may have been present in the planet's past. The rovers are identical to each other, but will land at different regions of Mars [6].

2.1 HISTORY OF ROVER

While humans have nonetheless to journey in-person to Mars, independent agency many rovers to drive around and explore the terrestrial planet for North American nation. A rover will take photos, perform experiments, and travel across the rocky parcel of land of Mars (this last half is what sets rovers with the exception of landers, that do all of them add the place they landed). Since 1996, independent agency has with success landed a complete of five rovers on Mars, and a pair of those area unit still operative these days. These independent agency missions every have a spread of objectives, however all of the rovers are accustomed assess the potential for ancient environments for all times, together with by searching for proof of liquid water within the Martian past. Over time, these rovers became ever a lot of advanced, carrying a series of high-end instruments to explore Mars. The progression of NASA's Mars rovers, whereas short, is actually a stimulating journey [7].

2.2 Robots based on Kinematics

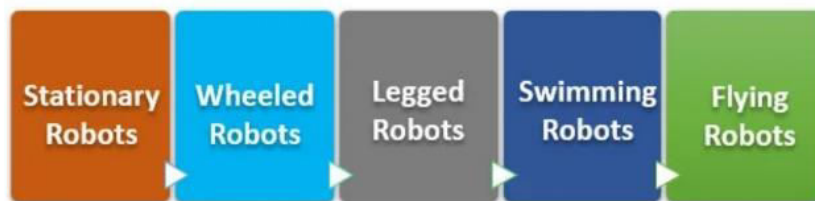


Fig 2.1: Types of robots based on Kinematics [8]

- i) **Stationary Robots:** Stationary robots are typically nothing however the robotic arm with a worldwide axis of movement [8]. we will additional divide this into a number of classes, that are as follows:
- ii) **Wheeled Robots:** Robots having wheels.
- iii) **Legged Robots:** Robots with articulated limbs [8].
- iv) **Swimming Robots:** Robots which will swim. Generally, these robots appear as if fish. Associate in Nursing example of such an automaton would be a SOFI automaton fish developed by MIT [8].
- v) **Flying Robots:** Robots capable of flying. The drone comes underneath this class [8].

2.3 WHEELED ROBOT

Wheeled robots are robots that use motorized wheels to maneuver across the ground to move. This design is further straightforward than legged robots. In flat terrain, it is easier to design, build, and program for travel using wheel-based design, because of this, they can be better controlled than other [9].

2.3.1 Types of Wheeled Robot

Wheeled Robots can use any number of wheels to navigate, with a minimum of one to required number you choose. let's see first with a single wheel and then go up higher in the number of wheels that can be added [9].

1. Single wheeled robot
2. Two wheeled robots
3. Three wheeled robots
4. Four wheeled robots
5. 5 or more wheeled robot

2.3.1.1 Single wheel robot

These robots are highly unstable and require extreme engineering and design techniques. Murata girl (Seiko) is one such Unibot which uses only a single wheel to balance and navigate.

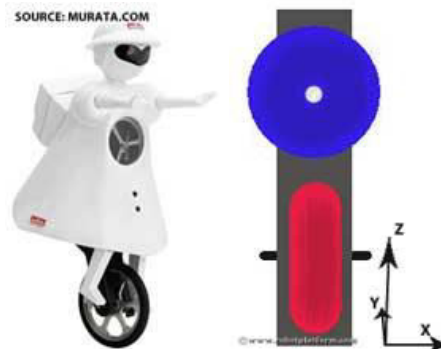


Fig 2.2: Single Wheeled Robot [9]

The best way to build a single wheeled robot is to add two wheels, one above the other such that each wheel is perpendicular to the other. If the wheel on the ground stabilizes the robot on y and z plane, the wheel on the top balances in the z and x plane. Although the concept sounds simple, the implementation is quite unfriendly [9].

2.3.1.2 Two wheeled robots

Two wheeled robots might sound simpler than one wheeled robot but are still harder to balance and keep them upright. Usually, the centre of gravity (average location of weight of object) of these robots is kept below the wheel axle and the wheels are attached parallel to each other. The battery is placed below the body of the robot to keep the centre of gravity low [9].



Fig 2.3: Two Wheeled Robot [9]

The image shows a beautifully designed two wheeled robot, which uses tilt sensors and encoders for balancing and control. The logic used is to drive those wheels in a direction such that the upper part of the robot is falling, and then control the wheels in such a way as to stay under the robot's centre of gravity which makes the robot balanced [9].

2.3.1.3 Three wheeled robots



Fig 2.4: Three Wheeled Robot [9]

Three wheeled robots are easier to build compared to the previous two. These robots do not require any specialized balancing algorithms and the reason are the most favourable choice for a beginner[9]. They can either be differentially steered or can use a tricycle approach. The wheels are normally arranged in a triangular manner and are hence balanced

(Just like a plane requires three connecting points, a robot requires at least three ground contact points to make it balanced). The image shows NASA's robot using axel rover system which is practically a two-wheel robot with a supporting wheel. Second image shows the design considerations for a three wheeled robot. The front wheel acts as steering wheel, or most of the time just a balancing wheel while the rear wheels drive the robot. If you ever want to drive and steer all three wheels, consider using Omni wheels [9].

2.3.1.4 Four wheeled robots

The best in the list. Four wheels are more efficient compared to three or two wheels. The first two of the four wheels can be used to steer and the next two to drive the robot. Balancing a four wheeled robot is never an issue.



Fig 2.5: Four Wheeled Robot [9]

Most everyday cars we use are four wheeled and the example is enough to prove its existence and capabilities. Image shows NASA's rover – Scarab which uses four wheels for navigation. The second image shows how four-wheel robots are generally designed. The front two wheels acts as steering wheels while the rear two are the driving wheels [9].

2.3.1.5 Five or more wheels

When you are happy with four wheels, why do you need a fifth wheel, or anything more than four wheels? Not really required when it adds additional cost for wheels, motors, additional power, additional computation and complex design. But if these disadvantages do not actually matter in your complex design, then you can go for it; 5 wheels, 6 wheels, 10 wheels, 20 wheels. The below images are an artist's concept of NASA's Mars rover which uses 6 wheels.

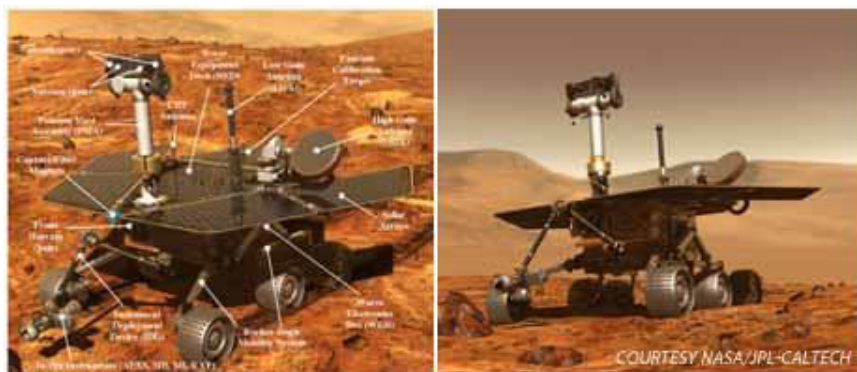


Fig 2.6: Five or more Wheeled Robot [10]

It is you to choose the number of wheels based on the requirement and the type of robot you are building. The minimum number of wheels for a stable robot is three. More than that is a choice which requires additional design considerations and increased cost [10].

III. PROBLEM STATEMENT AND METHODOLOGY

3.1 PROBLEM STATEMENT

To evaluate the moisture content of the soil and know the various water resources that are present in mars planet by using the various sensors and also capture the photographs of matter such as geographical and biological features present on mars with the help of mars rover.

3.2 METHODOLOGY

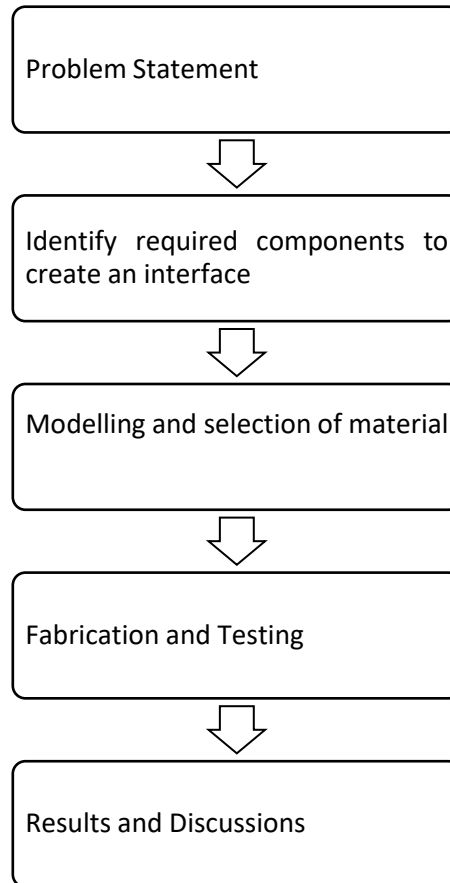
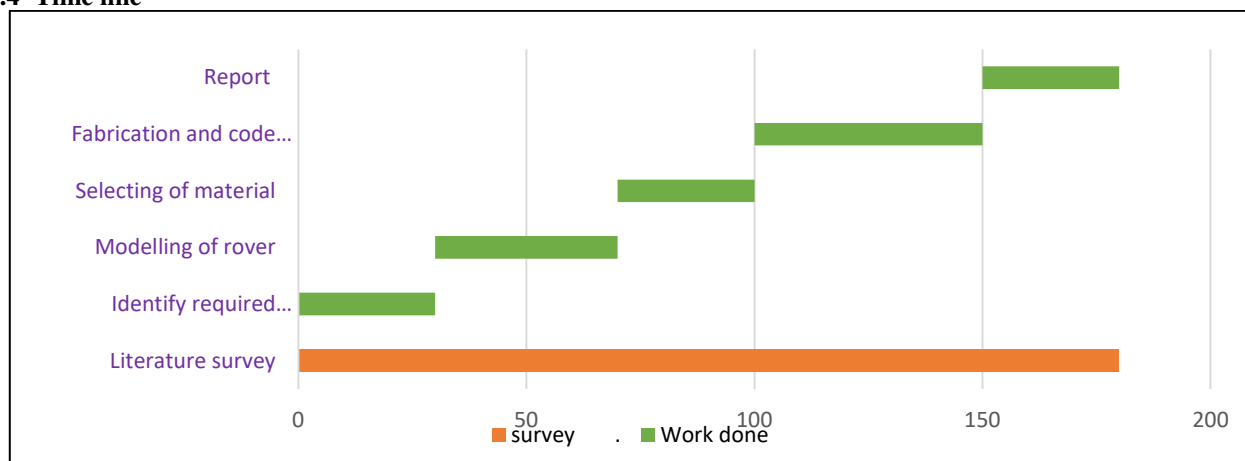


Fig 3.2: Methodology

3.3 OBJECTIVE

- To know the water bodies that present on mars by using moisture detecting sensor.
- Take the geographical and biological features photographs of mars planet.
- Able to move on any kind of terrains and roads.

3.4 Time line



IV. EXPERIMENTAL PROCEDURE

DESIGN PROCEDURE

Step 1: Chassis is the main component of the rover as all the components are mounted on it. (The chassis is the body of the Mars Rover. I made it out of a cube) So, initially we have drawn the rough 2D sketch of chassis in order to design it in a modelling software.

Step 2: Here we used solid works as the modelling software and designed the Mars Rover. At first, we have designed the chassis by the reference of 2D sketch.

Step 3: Similarly, we have designed all the remaining components and made the rover assembly in solid works.

Special Features: The special features, such as Sensors, Camera, etc are optional. We added these type or sort of special feature to make your rover design functional and unique.

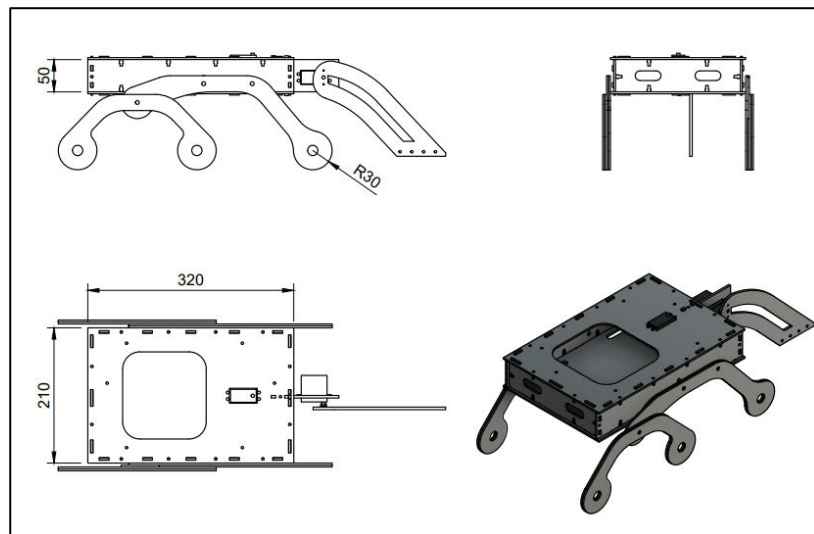


Fig 4.1: Assembly of rover

FABRICATION PROCEDURE

Step 1: Collect all the required materials and equipment's. We stockpiled all the required materials and equipment's of rover.

Step2: Make the chassis and frame for the rover, we created a basic frame using a profile as Fig 4.2.

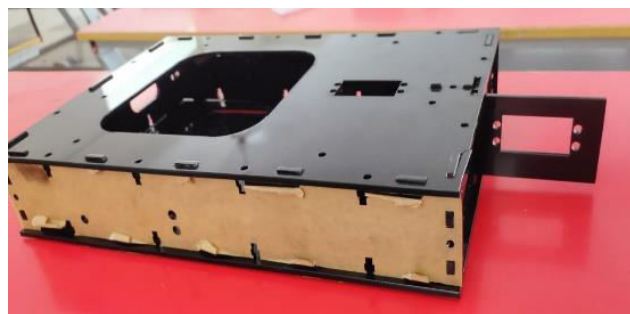


Fig 4.2: Chassis

Step 3: Fix the wheels to the chassis, which concludes the suspension system (this is where we make the suspension) for rover we assembled the joint first, attached the joint and connectors of remaining together for connecting all parts in conjointly.



Fig 4.3: Wheels

Step 4: Basically, we can say this step as Communication step here communication is nothing but relation between each other parts for doing their specific functions to make rover well balanced for making operations with it, in order to this we make use of these Arduino, Buck Controller, Bluetooth Module, Servo motor controller, servo motor.



Fig 4.4: Arduino

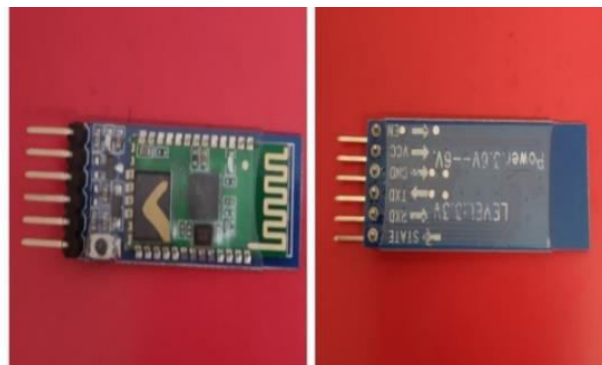


Fig 4.5: Bluetooth module

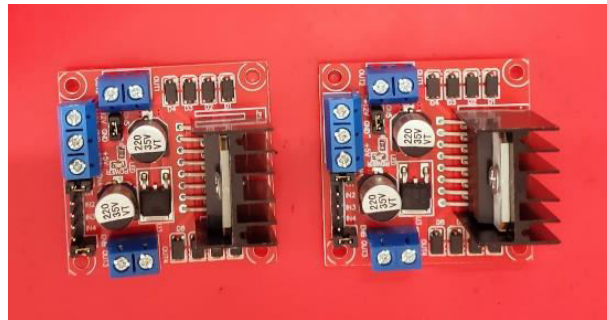


Fig 4.6: Motor driver regulator

Step 5: This is the distinctive step of the fabrication part it shows what our rover is individual and special from other types and what it good for, So, Attach camera and moisture detector sensor along with its arms to the rover, so we can say this is quirky for heterogeneous performances.

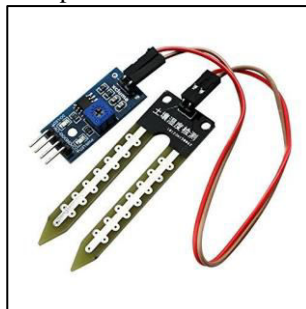


Fig 4.7: Sensor



Fig 4.8: Camera

Step 6: Connect the battery to the rover, here we are fabricated the mini mars rover model which can run by a battery if we go for the huge one, we can pick out the solar panel.

Step 7: Totasks to my rover for variety of operationsInstall the My Robo lab Robot application and connect the rover via Bluetooth and perform operations. For recording the features and capturing images, we need to download HDWIFICAMPRO from play store and connect to the camera via Wi-Fi. After connecting the camera and Bluetooth module we can perform the required operations



Fig 4.9: Rover front view

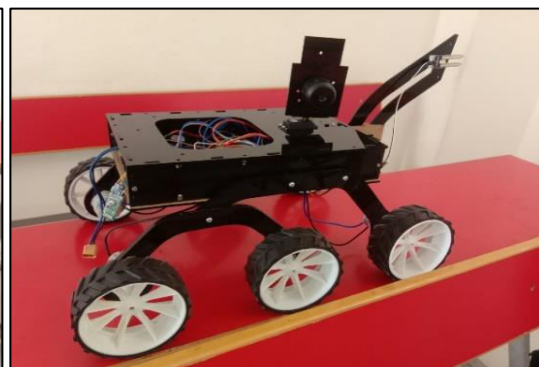


Fig 4.10: Rover side view

V. RESULTS AND DISCUSSIONS

For testing we took our rover near to a water body. Initially we have connected rover via Bluetooth module using MYROBOMAN and connected the camera using HDWIFI CAM PRO applications. Soil and water moisture detection sensor is directly related to detect the amount of area which is suitable for the survival of human persistence, and also the cameras live pull through will give the pictorial information as sensors response for biological and geological information. By using mobile phone, we operated our rover. In this rover which having cameras captured the photographs around the water body and also it captured the nearby plane land surface too. While during its operated it went near to the water body. Then it immersed the moisture sensor into the waterbody and near land surface. Then we finally found that moisture content of waterbody is more as compared to plane land surface. By this way we can detect the water bodies on Mars planet.



Fig 5.1: Moisture Detection



Fig 5.2: Terrain climbing



Fig 5.3: Climbing of rover



VI. CONCLUSION

Therefore, we can see that Robotics has touched our lives in various segments from space to our own households. As robots become more intelligent with time, we can see that it has been implemented/adopted in ROVER technology for the application like information to know on the MARS different parts of the planet are made of Mars is made up of lots of different types of rocks, and each rock is made up of a mixture of chemicals. A rover can only drive around to different areas (because of its wheel alignment), studying the different chemicals in each rock, and detects the situation to check that is there any presence thing to survive for human kind for Future scope like any disaster is occurred in Earth and there are no possibilities to survive on earth then the only option for man kind is Mars. In this rover it consists of cameras with great magnification lens which can captures the various geographic locations with required angle in required direction. We also used the moisture detective sensor to know the basic requirement water on red planet. So, by using this as reference we can do more future operations on mars planet.

FUTURE SCOPE

From this Mars Rover with moisture sensors and cameras are used to know the water bodies that are present on mars planet and also the images obtained from the cameras are used as a reference in future projects. Now a days we can observe that lot of pollution in our earth and it is required to search for another source to live. In order to live in another planet, we need to know whether the resources are available or not. In future application our robot technology can be used to detect images of features that are present and it will detect the moisture content that is present on the soil.

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