Rough Terrain Robot

T. Balachander, M. Manikandan, T. Sasikumar, N. MohanaSundaram

***Abstract:** The technological advancements have created a drastic change in delivering different versions of robots for varying applications. Research on developing robots that can replace the challenging work done especially by military people is still on progress.In this context, the proposed idea is to develop a robot with a special leg design, suitable for movement over rough and rugged terrains. Additionally, through a camera and RF module, the surroundings can be recorded and transmitted to the user. Along with the support of GSM and GPS module fitted with the robot, the exact location can be easily tracked from remote places.The hardware setup have been developed for this model using economically viable materials for robot body and the movement controls are achieved using Arduino Programming. The results obtained shows that this arrangement will be helpful for military people in virtually monitoring a location and take appropriate decisions.The distinct feature of this robot also makes it suitable for applications like wild animal census, rescue operations during calamities.*

***Keywords:** Robot, rough terrain, image recording, virtual monitoring*

I. INTRODUCTION

With machines replacing human labor swiftly in many industries, search is on for device that can work independently and intelligently.Robot is a machine which can be controlled by human and also, replaceable in the area or field where human feels unsafe to work. Robots are small computer which will perform the command given to it. Robots will work more efficiently than humans. And also cost of manufacturing reduces because of robots. Many of the foreign industries have become fully robotized.

RHex, the Rough terrain robot, was initially constructed using open aluminium frame with the legs coupled directly to the output shafts of motor. [1] A simple embedded system controller is used for controlling the actuators through a suitably designed board. But this setup weighed about 7 Kg making it to walk only for about 0.5 m/s speed on one full battery charge.This has few problems like failure of legs, motor shaft disconnection and other connectivity problems. In [2], the three axis laser gyro along with on board vision system was added for providing a feedback and optimized control.

Though this helped in reducing the weight and increasing the speed of the robot, the open aluminium frame structure made it not suitable for uncontrolled environments like rain, mud, sticks, sands etc.

To overcome these problems, a sealed RHex's body was introduced, which makes it feasible for walking over rough surfaces, water and slippery rocks too.

The most common disadvantage in all the above research areas is the economic viability.In a bid to reduce the cost, it is proposed to use acrylic sheets for body structure.The BLDC motors used can be replaced with a Servo Motor, which helps in cost reduction and also more accurate position control than other motors.Along with these capabilities, virtual monitoring is aided by fitting a front camera with the robot.The recorded video or images can be viewed at remote locations quickly, that also helps in making instant decisions.

II. PROPOSED MODEL

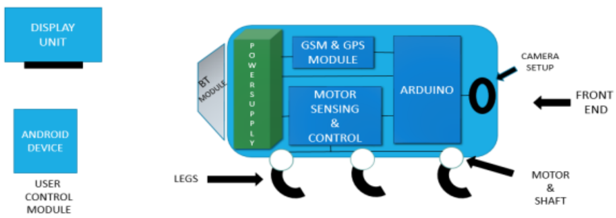

Fig. 1.Block Diagram Of The Proposed Robot

Arduino, a microcontroller used here can be coded to control the robot operation.The sensor values are sensed and sent to the controller using Motor sensing and control.The GPS and GSM are used to locate the robot and pass on the information to the user.The power supply provides the required power for the functioning of the robot.A Bluetooth module used connects the robot with the Android mobile and the robot movement can be controlled by mobile.It acts as a remote controller.The live video recorded is transmitted to the user and displayed on the display unit. The idea of facilitating movement on rough surfaces can be achieved by designing the leg in a semi-circle fashion.This helps in the leg to smoothly rotate in forward, backward and sideway directions.The movement control of legs is done by sensing the position of leg using suitable sensors.The novelty lies in employing 'V' type control, to obtain a perfect balance. In addition to this, a video camera attached to the front of the robot helps in viewing the travelling path virtually.

Video can be transmitted to the user via RF transmitter and receiver, GPS-GSM arrangement.Thus this model can act as a non-living warrior especially for military people in their operations.

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III. WORKING METHODOLOGY

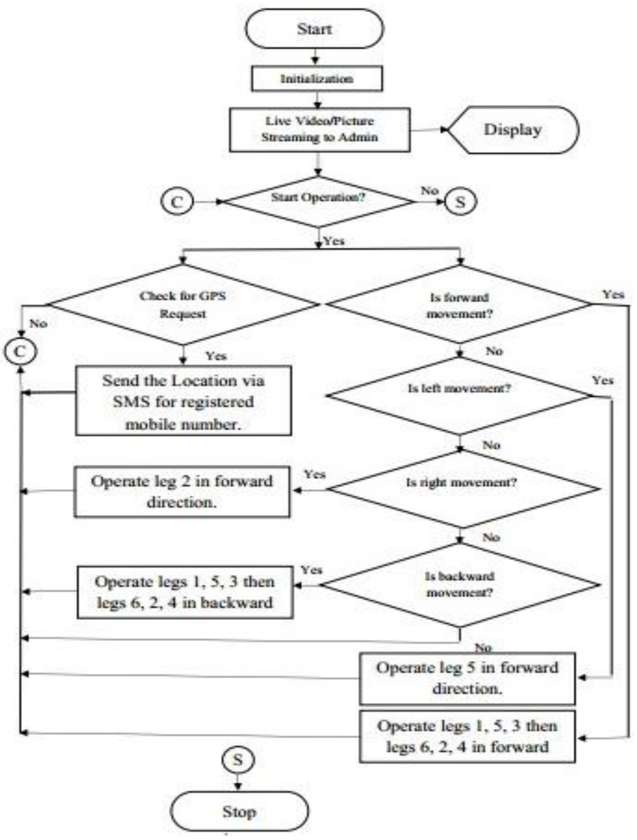

Fig. 2. Overall Operation Flow

Fig. 2.represents the entire operation of the proposed robot, in a pictorial form.The circuit diagram for the work is shown in Fig. 3 and Fig. 4.

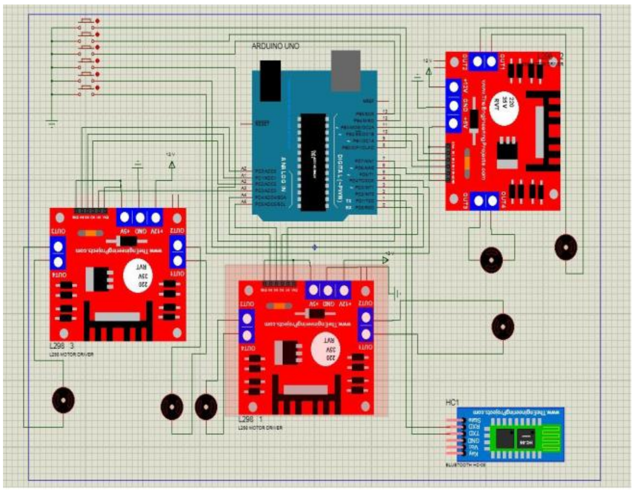

Fig. 3.Circuit diagram of Robot

The Arduino UNO is used to control the entire robot. The 6 Analog pins and 6 PWM pins of the Arduino Board are used to control the motor driver logics. The limit switches are connected to the remaining 6 digital pins, which receives only HIGH or LOW signals from the switches. The Bluetooth Rx is connected to the ArduinoTx and Bluetooth Tx is connected to Arduino Rx.

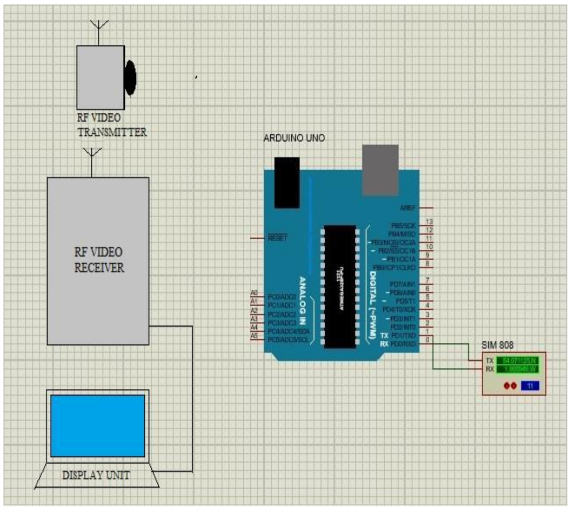

Fig. 4.Circuit diagram of GPS, GSM & Camera Module

The Motor driver is given 12V DC supply from the power supply module and the motor logic is controlled via Arduino. The robot movement is controlled via Android supported Bluetooth communication. The position of the robot and the live broadcasting of the video are achieved using the IR Camera module and GPS, GSM modules.

Initially the video is transmitted through IR receiver and displayed in the monitor and the location of the robot is tracked with the help of GSM and GPS module. The location is messaged to the mobile phone coded in the Arduino board.

The video transmission is done by the IBALL software with the help of laptop. The RF transmitter and Camera module will be supplied by the 9V constant power supply. And other power requirements are met with the help of 9V HW battery.

IV. HARDWARE SETUP AND RESULTS

A. Selection of Materials

The following materials are considered for designing the body of the robot. The selection criteria are discussed below:

a. Metal Sheet

One of the common choices is Iron Metal sheet, which is stronger, heavier and harder than aluminium. But it blunts tools more easily. High range of heating and cooling may change the characteristics of the material, which may not be suitable for robots working in varied environments. Hence this may not be a good choice.

b. Synthetic Materials

There are varieties of synthetic materials available in large groups. Like steel, most synthetic materials can be bent into required shape when they are heated with the hot air gun. Drilling and sawing of these materials requires low speeds or they have to be cooled with water so the material doesn't melt. Soft plastics can be cut with a utility knife. Hence this also may not be a good choice.

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c. Acrylic Sheet

Acrylic plastic refers to a family of synthetic, which has high composition of acrylic acid. The acrylic sheet is highly transparent material with excellent resistance to ultraviolet radiation, highly formable, durable, chemical and impact resistance and weathering. So it can be colored, molded, cut, drilled and formed easily. Hence the sheet is chosen for the developing the robot.

B. Hardware Dimensions

The leg for R-Hex is chosen to be of semicircle fashion.This is because; it provides good robust torque, low mass and no sliding friction. The body is designed in such a way, the top plate of the robot is made from a single sheet of Acrylic. The motor mount assemblies are anchored at the ends of each cross piece and functions as structural elements connecting the bottom and top frames. This configuration increases the overall structural stiffness of the frame by increasing the second moment of inertia with a minimal increase in frame mess.

Leg Dimensions	125mm x 90 mm
Material	Acrylic sheet
Shape	Semicircle
Total Numbers	6

Table IDimensions Of Robot Legs

Base Dimensions	470mm x 300 mm
Thickness	5mm to 10mm
Material	Acrylic sheet
Shape	Rectangle Sheet
Cutting type	Laser Cutting

Table 2 Dimensions Of Robot Base

Voltage	12V DC
Speed	40 rpm
Torque	15kg/cm
Type	Geared
Dimension	80mm x 35mm
Shaft Length	20 mm
Shaft Diameter	6 mm

Table 3Dimensions Of Motor Chosen

C. Overall Assembling

The hardware developed and their working is shown in phases.

Fig. 5.Robot fitted with GPS & GSM module

Fig. 6.Robot While Moving

Fig. 7.Live Video Transmission

In addition to surveillance purposes, it can also be used to find the victims in ruins, recording animal census in the forest.

V. CONCLUSION

An overview of the design and development of R-Hex have been presented in this paper.The Mechanical design and controlling strategy of R-Hex will improve its dynamic capabilities when compared to previous platforms. Together these characteristics make R-Hex a high-level intelligence of a robust legged platform in Rough terrain. As an additional feature the location and video are recorded and sent to the controller. By analyzing the robot’s efficiency, run-time duration, and dynamic capabilities, we can gauge the effectiveness of our design choices.

REFERENCES

1. U. Saranli, M. Buehler, D.E. Koditschek. "RHex: A Simple and Highly Mobile Hexapod Robot", The International Journal of Robotics Research 20, July 2001.
2. J. D. Weingarten, G. A. D. Lopes, M. Buehler, R. E. Groff, D. E. Koditschek, “Automated Gait Adaptation for Legged Robots.” IEEE Int. Conf. On Robotics and Automation (ICRA) Vol. 3, New Orleans, LA, April 2004, pp.2153-2158
3. U. Saranlı, A. Rizzi, and D. Koditschek, “Model-based dynamic self-righting maneuvers for a hexapedal robot,” The International Journal of Robotics Research, vol. 23, no. 9, p. 903, 2004.
4. C. Prahacs, A. Saunders, M. K. Smith, D. McMordie, and M. Buehler, “Towards legged amphibious mobile robotics,” Journal of Engineering Design and Innovation, vol. 1P, 2005.

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5. N. Neville, M. Buehler, "Towards Bipedal Running of a Six Legged Robot." 12th Yale Workshop on Adaptive and Learning Systems, May 2003.
6. E. Z. Moore, D. Campbell, F. Grimminger, and M. Buehler, "Reliable stair climbing in the simple hexapod 'RHex'," in Proceedings of the IEEE International Conference on Robotics and Automation, vol. 3, 2002, pp. 2222–2227.
7. J. D. Weingarten, D. E. Koditschek, H. Komsuoglu, and C. Massey, "Robotics as the delivery vehicle: A contextualized, social, self paced, engineering education for life-long learners," in Robotics Science and Systems Workshop on "Research in Robots for Education, 2007.
8. Boston Dynamics, "RHex Datasheet," 2007
9. V.Vanitha, V.P.Sumathi, J.Cynthia and B.Illakia, "Next Generation Vehicle Diagnostic Systems", International Journal of Pure and Applied Mathematics (IJPAM), ISSN: 1311-8080, vol. 116, no. 11, 2017, pp. 251-259.
10. N.Suganthi, R.Arun, D.Saranya and N.Vignesh, "Smart Security Surveillance Rover", International Journal of Pure and Applied Mathematics (IJPAM), ISSN: 1311-8080, vol. 116, no. 12, 2017, pp. 67-

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