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SURFACE EXPLORATION ROVER using Arduino Mega

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ABSTRACT: The aim is to build a multipurpose rover that moves manually and can be used in areas such as exploration, rescue operations, meteorology, and surveillance. This rover is made to carry out quick surveys in areas where human reach is considered to be risky. Nowadays, the development of rovers is increasing rapidly. As a result, it can help in the areas like tunnels, places affected by calamities, and dense forests. It consists of six-wheel drive, which is possible to travel on multiple terrains. One can communicate with it with the help of a wi-fi-based local server, which can detect the motion of any human or animal, metal, temperature, or gas and locate with GPS to pick the nearer objects with the help of a robotic arm. It also has a camera which is used to capture the video. It is solar-powered, so whenever the battery is low, it will charge by itself, showing all the outputs on an app.

KEYWORDS: Rover, exploration, robotic arm, Wi-Fi and Surveillance

I. INTRODUCTION

The exploration of the unknown and survival has always been a general tendency of human nature. To the best of our knowledge of available technology, exploration across the horizon to planetary search in our Gal axial neighbors, that provides sustaining artificial ecosystem and optimal infrastructure. Rover is a surface exploration model which is designed to move on a solid surface. They have partial or complete autonomy. They have a lot of features that help in many areas of research and rescue operations. Our project helps inspect, locate objects, collect samples, manage materials, and supply resources.

When this technology is available, the remote control is likely to use, rovers in the practical applications, but monitoring mobile robots is more attractive. Eliminating the overhead of human operators and maintaining a continuous communication link is desirable for continued operational efficiency and survival.

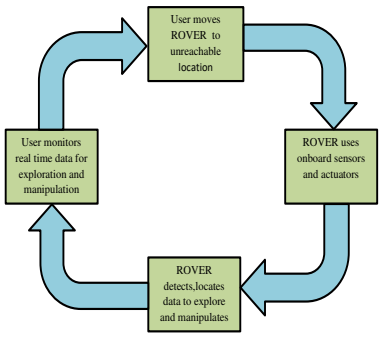

Fig.1: Block Diagram

These rovers will be usable for performing tasks in an environment that is hostile to humans. Some examples are geological and petrological investigations in deserts and polar areas. Rover technology will be extended in the future to machines of greater sophistication. This is used for more everyday applications in environments of greater complexity.

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Household servants, robots to perform maintenance of nuclear power plants, security guard robots, and automatic cars are examples of distant benefits of rover research.

II. RELATED WORK

In [1] authors used internet to control Mobile Robot. This system that consists of a mobile robot, controlled by Internet, which has camera mounted and a PIR sensor for detecting the living bodies. User will be able to control the robot through internet, thus, providing the wireless control of robot. Also information regarding the detection of living bodies will be given to the user on the webpage from the PIR sensor and simultaneously user will be able to access the video transmission from the robot. In [2] authors used Android based Technique. It is an autonomous intelligent robot which identifies trespasser using PIR motion sensor, alerts security personnel by short messaging service using GSM and captures image of the trespasser using camera in Android device and mails this image to specified e-mail id using Android based application. In [3] authors, built Surveillance Rover. This Rover serves as a security monitoring device which replaces the human security at less critical areas where humans are really not necessary. The recorded evidence also hence take necessary action with automatic alerts from the robot when unusual activity occurs. In [4] authors design and researched intelligent safety monitoring robot for coal mine shaft construction. This study analyses the main causes of accidents in the period of coal mine shaft construction and the shortage of the existing safety monitoring technology, puts forward the intelligent safety monitoring robot technology based on shaft construction, and deeply investigates the functions that the safety monitoring robot should have. Besides, the research objective of intelligent safety monitoring robot for shaft construction is pointed out, and the research is carried out from such aspects as the robot body structure, walking mechanism, adsorption mechanism, control, communication, intelligent sensing, hazard source recognition, recognition of explosive detonators, and software platform development. As well, this study designs the technical device of intelligent safety monitoring robot for shaft construction, defines the characteristics of this technology, expounds the important significance of studying this technology, and indicates the development trend of this technology.

III.PROBLEM IDENTIFICATION

Many places on earth are dangerous for human beings to explore. Areas affected by calamities can be specifically dangerous for humans to conduct rescue operations. These places require constant monitoring and surveillance. To overcome these challenges, we proposed a project called Surface Exploration Rover.

IV. PROPOSED METHODOLOGY

The user sends the rover to a location where a person cannot go. It has the Rocker-buggy mechanism to overcome obstacles and move on all types of terrain. The six Wheels are attached to the rover and run by 6 Johnson geared motors of 300 RPM. These are operated via L298N motor drivers, these motor drivers give appropriate voltage and current to run the motors when the user gives the commands. These motor drivers are connected to Arduino. After reaching the location, the rover collects the data using the sensors connected to the rover. There are many sensors connected to the rover. PIR (Passive Infrared) motion sensor can detect human or animal movements within its range. The Ultrasonic sensor, which detect the object using sound wave, has a range of 4-6 meters and an angle of detection of 30°. It is attached to the SG90 servo motor, which has a sweep function from 0-180°. The inductive metal detector is attached to the arm in front of the rover. It generates an electromagnetic field and detects metal. The DHT11 sensor is the temperature and moisture sensor, detects environmental changes such as temperature and humidity. The proximity sensor detects the distance between the rover chassis and the ground surface. It is mounted at the bottom of the rover. The other sensors attached to the rover are the Gyro sensor which indicates the inclinations (in degrees) of the rover. Gas sensor senses the presence or concentration of gases in the atmosphere. It also has an ESP32 camera which serves its HTML page through which it broadcasts live video capturing.

Robotic Arm is made up of 3D printed parts. The 3 axis that are: the waist, the shoulder, and the elbow, the MG996R servos are used and for the other 3 axis: the wrist roll and wrist pitch as well as the gripper SG90 servos are used. These six servo motors are controlled using the Node MCU which picks up and carries back the object to the user within the compartment present on the rover.

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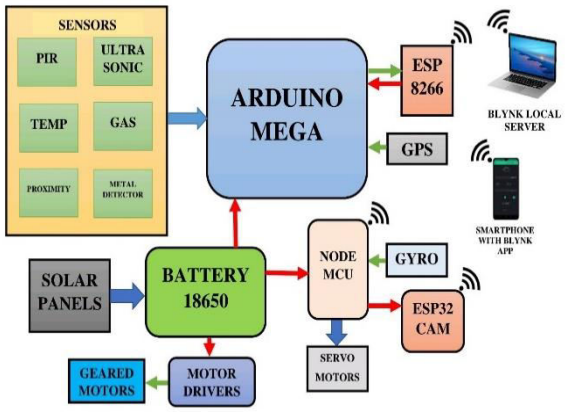

Fig. 2: Block Diagram of Rover

All these sensors and motors are connected to the analog and digital pins of the Arduino Mega 2560 R3 and Node MCU. The ESP8266 is the Wi-Fi module is connected to the Arduino that helps form communication between the rover and the user. The LM2596 which is a step-down buck converter that converts 11.1V to 6.2 Volts which is fed to all servo motors of the rover with the help of a Lithium-ion battery. The 2 Solar Panels of size 70x70mm help in generating electricity from sunlight which charges the battery whenever the battery is low and sends the indications to the user through the BLYNK server. The data collected with the help of various sensors are sent to the server that updates all the values on the user's device in the BLYNK application. The delay between all the communications to the rover is between 10-40 milliseconds. At the users end all the data is displayed on the BLYNK app, which also helps in the movement of the rover and the Robotic-Arm. The communication takes place through the Blynk local server.

V. IMPLEMENTATION

We started working on our project from December and since then we have spent more time in knowing the project rather than working on it. After having a thorough knowledge on what we were supposed to do, we started focusing on the next step that is choosing the most appropriate components for our project and as per the applications we purchased them.

After purchasing all the components the next step was to assemble them.Once all the components were assembled we had to choose an app called Blynk to operate and read the values from the rover. A Blynk is an application that is needed to operate the rover and taking live updates using the sensors present on the rover. It runs on a smartphone device that is available with the user. This app uses a local server that is present in laptop and enables wireless communication between the rover and application.We experimented with rover as discussed and we concluded that this rover would serve as a good foundation for our nature exploration, disaster management and security systems. It has desired capabilities of handling real time monitoring such as low battery indication, low GPS signal, hazardous gas, human and animal motion detection etc.

After complete setup we had outlined a few plans to accomplish our project and the first onewas to check for the working of the rover consisting of Radar mode.Radar Mode: we first started testing ultrasonic sensor then moved on to mounting the ultrasonic sensor on the servo motor which will work as the radar that shows the output on the app.

Later we also tested the rover's ability to go over the obstacle using Johnson geared motors which has ability handle more torque and can carry weight compared to normal DC motors. This feature was necessary to test, so that in case of uneven ground Rover could easily move. The chassis of the rover is designed in a rocker buggy mechanism - a way that it can climb any obstacle. The main reason for choosing this design is that it can move to the places where it is harmful to the human or places where human can't reach.

After testing the movement of the rover we focused real time monitoring of the sensors which consists of many sensors like Passive Infrared sensor (PIR), temperature and humidity sensor, gas sensor, gyro sensor, camera etc. Testing these sensors individually we connected the output of these sensors to the Blynk application via the local server.

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The main feature our project is the Robotic arm. We 3D printed the robotic arm attached the metal geared motors and tested to move the robotic arm as per the requirement of the user which can pick and place the small objects and place it in the compartment present on the rover. We made the operation of the robotic arm manual so that it will be easier to pick objects present on the ground. But as a beginner the robotic arm operation must be practiced a lot to accurately pick the objects.

The final task of our project was to setup a camera which could send us the live video feedback. A camera was installed successfully and the transmission for the video and images were checked on the application.

Once the drone was successfully able to move, sense and locate, the next step was to assemble these sensors and the robotic arm to the chassis of the rover and examining all of them once again.

After testing assembling the mounted parts, we created a small scenario where the rover is moved via the application to a certain location passing obstacles and then uses onboard sensors, picks objects present on the ground and drops it in the compartment, explores and sends all these real time values to the user in the application then moved the rover back to the initial user's location.

VI. RESULTS AND DISCUSSION

Results and Discussion explain about the output of the model. Every model has certain applications and also some advantages. When particular model has some advantages there will also be certain drawbacks of the model. So this chapter contains results, applications, advantages and disadvantages of our project.

Results: Results are obtained using Rover and Blink server app. The Rover collects information of located area using various type of the sensors and send the data to the Arduino Atmega328 controller. This is connected to Wi-Fi module for wireless communication which is takes place through the BLYNK local server. Using this server blink app helps to monitor the rover. Below figures shows outputs of our project.

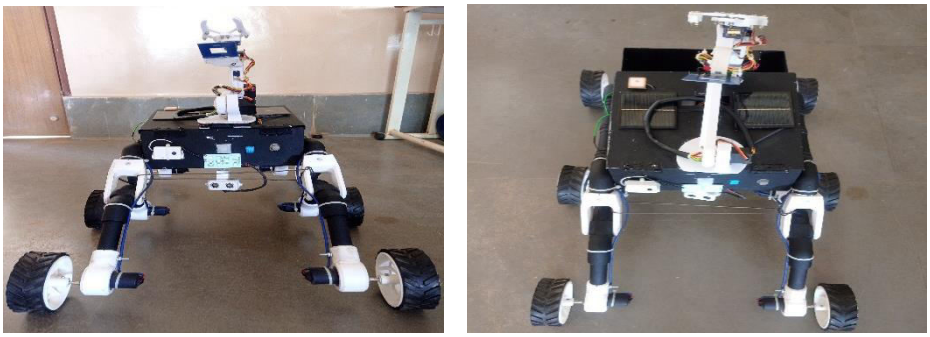

Fig. 3: Surface Exploration Rover

Outputs of Project:

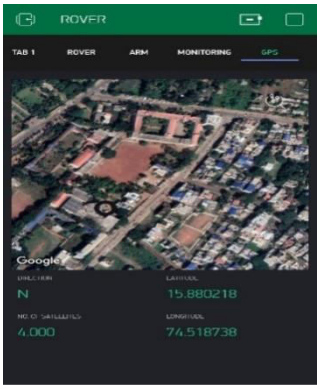

Fig. 4.1: Tracking location through GPS Module

Fig. 4.2: ARM handling

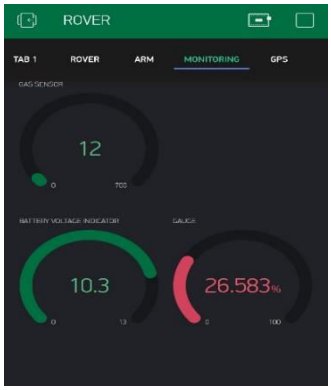

Fig. 4.3: Gas detection and Battery voltage

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Fig. 4.4: Moving rover by maintaining its Speed and detection of moving object through proximity sensor

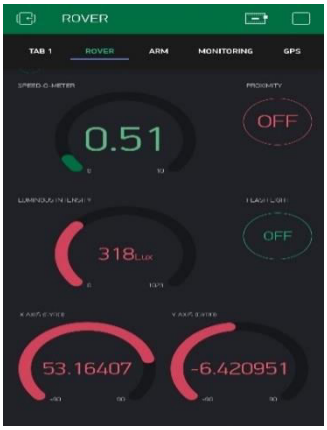

Fig. 4.5: Inclination of wheels and LED and

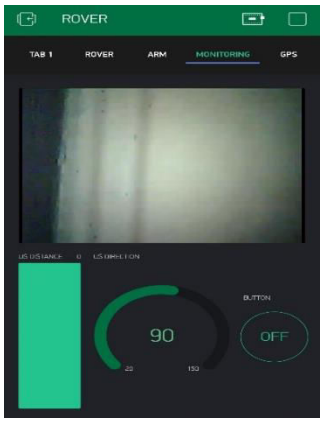

Fig. 4.6: Video capturing and detection of the object nearer to rover

Fig. 4.7: human motion detection and temperature in degree Celsius

VII. CONCLUSION AND FUTURE WORK

In this proposed system the rover can helps in exploration of areas like tunnels, places affected by calamities and dense forests. It can travel multiple terrains at a long range. With the advent of Internet of Things (IoT) we can easily control this device from any computer with a simple Internet Connection. We can use this device to can serve a great deal in sectors like Defence, Non-Governmental Organizations which help people in time of crisis, Security, Research for understanding deep forests, volcanic eruptions and other environmental sites and Exploration like Wildlife Photography, Nature Exploration, etc.

In Future work, this system will be improved using the different type of high-quality circuits and components, which gives high performance with accurate output. We can use this rover to inspect tunnels and damaged buildings to understand the situation and minimize the impact or risk of any catastrophe.

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