Advanced Mine Detecting Robot

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ABSTRACT

Gold, Platinum and other rare earth elements sustained our humanity for centuries. Finding of these metals under the earth crust is really a challenging and risky task for the mine workers. If mining equipment could be automated we can reduce human exposure to the dangerous environment. This provides enormous opportunities for robotics developers. Our paper describes about the development of a novel automated robot for underground precious metal mining. The robot has high sensitive sensor for metal ore detection, drilling unit for deep and hard drilling, automated arm for widening the mine and also to collect the sample, high definition camera to monitor and control all aspects of an operation in real-time, and it has a sensible system composed of several kinds of external sensors for hazardous gas sensing. The robot itself can furnish a certain task by acquiring and dealing with the external information given by us. By this machine we can able to detect other rare earth metals like 4f and 5f elements, which are frequently thrown out as waste.

1. INTRODUCTION

This paper explains the benefits of using robotic method for the detection of concealed mines. Robotics is bringing Innovatory changes in the world by introducing new technologies. The basic aim to employ a robotic method is to ascertain human safety and lessen human efforts. It is very rational to build such a wireless robot that could detect land mines without the human involvement that helps in reducing Causalities in any kind of defence field. The reason of designing this robot is to detect hidden mines, the robot has specified sensors that detect and locate the underground mines and avoid obstacles, without human contribution through wireless control.

2. ARCHITECTURE

This project has a very simple working architecture. The robot use NRF for wireless transmission, metal sensor for metal detection, drilling machine is used to drill the underground, Robotic arm is used to pick the metal. Camera module is installed in robot to broadcast the location of the robot. Microcontroller is fixed on control unit takes commands from the control pilot. The NRF receiver module works according to the instructions of the NRF transmitter module placed in the transmitter side of the remote control unit.

3. CONSTRUCTION PARTS AND MODULES

These sections explain about all the parts and modules of this project that are used in the fabrication of the projects. The modules which are used in the project are controller module, wireless module, sensor module and camera module, drilling machine and arm module. These modules are used to bring this idea into reality. The significant components of this project are DC motors, protection circuit, front and back wheels. These are the components that are habituated for the output of the project. The core of the project is an arduino controller that controls all the working which includes mine detection and the DC motors, ultrasonic sensor, camera module etc. This part of the paper demonstrates each and every step of the construction and the reason for using the particular module for the production of prototype.
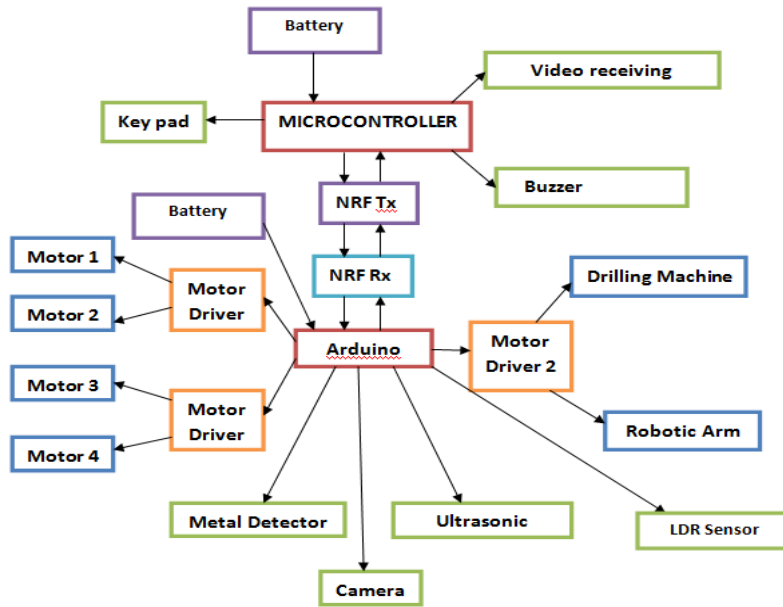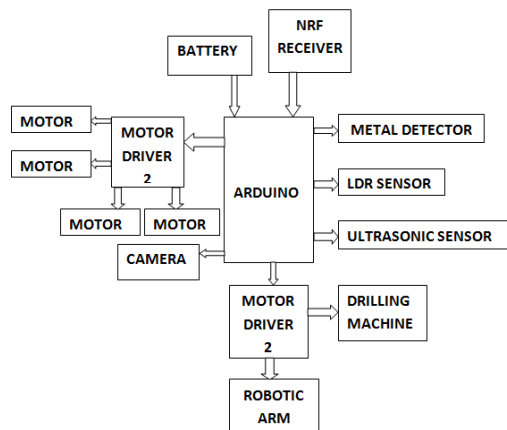
Fig. 1 Architecture of robot
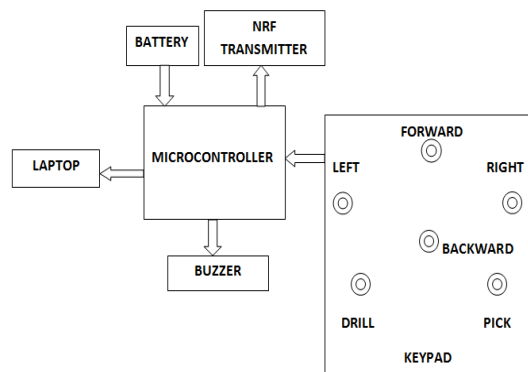

Fig. 2 Block diagram of receiver side

Fig. 3 Block diagram of transmitter side

3.1. TRANSMITTER CIRCUITRY

The transmitter side of the robot consists of 4×4 matrix keypad buttons that are used to control the movement of the robot. The NRF is used to connect the transmitter side with the receiver side. It has an Arduino that controls all the working. The transmitter side directs the receiver end by sending a predefined code using wireless transmitter NRF

and on the receiver side, the receiver NRF receives the signal, decode it, and follow the instructions that are being given to it.

3.2. SENSOR MODULE

A sensor is used to sense the outside environment and updates the controller. In our project, we have used two sensors which are ultrasonic sensor and metal detector.
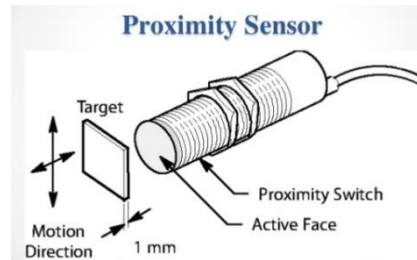

Fig 4.Proximity Sensor

3.3. CAMERA MODULE

For the competent working of the remote control, there was a need to attach a wireless camera so that we could see the accurate location of the robot, because in battle fields humans cannot go securely. Therefore, we installed a camera module.

3.4. DRILLING MACHINE AND ARM MODULE

Drilling machine and robotic arm is attached with the arduino microcontroller in the receiver side. Drilling machine and arm operate according to the key pressed. When the drill key is pressed, drilling   machine start drilling the underground where the metal is detected. When pick key is pressed, the robotic arm starts moving to pick the metal.

3.5. MOTOR DRIVER

Medium power motor driver used to drive dc motor and stepper motor. It used the popular L293D h-bridge motor driver IC .It can drive 4 DC motors in one direction, or drive 2 DC motors in both the direction with speed control. We are using 3 L293D Motor drivers. Motor 1 is used for drilling motor, Motor 2 is Gripper (open /close), Motor 3 is Left side wheel, Motor 4 is Right side wheel, Motor 5 is Gripper (up/ down), and Motor 6 is driller hand (up/down).

3.6. DC MOTORS

Here, 30 rotations per minute (RPM) Centre Shaft Economy Series DC Motor are used and it is high in quality as well as low cost DC geared motor. These precision gear motors are incredibly tough and feature full metal gears help to drive wheels, gears, or almost anything else that needs to turn. They have a gear ratio operate up to 12 volts and deliver a stall torque of 1.2kgcm. And a max speed of 100 RPM. Each precision gear motor sports a 6mm diameter Centred shaft that protrudes from them.

3.7. FRONT AND BACK WHEELS

Wheels are used to drive the vehicle. They can move in all direction and planes. They can revolve a vehicle to 360 degree. These wheels have a 6mm hole for a shaft with the screw for fitting making it very easy to mount on Gear motors. One piece of 7X2 Plastic wheel- 6mm Shaft wrapped with Rubber Track belt for maximum Grip. Weight of the robot wheels is 37g.
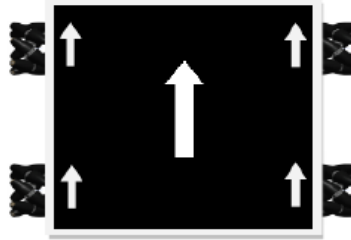

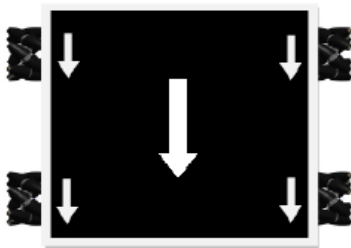Fig. 5 wheels for moving the vehicle in the forward steering

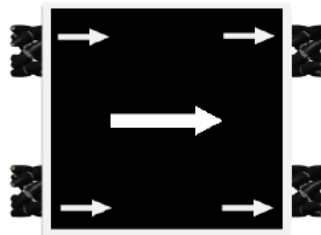Fig. 6 wheels for moving the vehicle in the backward steering

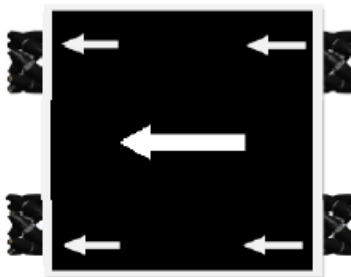Fig.7 wheels for moving the vehicle in the right side steering

Fig. 8 wheels for moving the vehicle in the left side steering

4. PROGRAMMING

The programming plays an important role in any project because without the proper programming, we could not use the hardware and implement on it. The core of the project is Arduino ATMega 32. Its programming is very easy because Arduino provides open source software for its programming that is easy to work with Arduino. There is much other software like Proteus, Fritzing, Circuit Wizard, etc. That are being used to check the proper working of the project, but the coding is only performed by using Arduino software.

5. WORKING OF ROBOT

When the operator turns on the remote, the NRF of transmitter side searches the NRF present in the receiver side. Once it is connected, it would start working. At the transmitter side, there are 12 push buttons; is used for control the robot. key '1' is robot moving in reverse direction ,key '2' is forward direction, key '3' is robot spins in 360o,key '5' is arm moving in downward direction ,key '6' is arm moving upward direction ,key '7'is driller moving in downward direction ,key '8' is driller moving in upward direction ,key'9' is gripper is open, key '0' is gripper is closed ,key '*' is drilling start to run ,key '#' is drilling stops respectively.
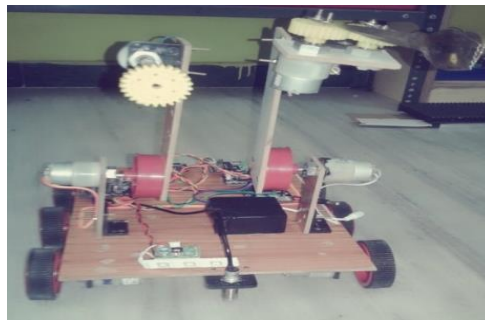

Fig. 9 Front view of Robot

Fig.10 Transmitter side

Fig.11 Robot Drilling

The robot will operate according to the key pressed. When the forward key is pressed, the robot starts moving in the Forward direction. When any hurdle or mine comes, the robot senses the metal via metal detector sensor.

Fig.13 Overall Output

6. CONCLUSION

In this paper, we presented a framework for designing mine detection unit based on a beat frequency oscillator (BFO). The robot has reduced the human effort. The robot is designed with high accuracy in movement section. All the objectives of the project were accomplished with high accuracy. More features can be summed in the robot to make it useful. The robot also included a servomotor that we placed the mine detection unite on it so we can expand the range of search by exploring various angles. Programming of Arduino controller was uncomplicated and easy. Execution speed of code was efficient and free of mistakes. The project has completed all the mentioned objectives.

7. FUTURE SCOPE

It is used for military application, under water mining etc. We can add in the robot to build it a bomb disposal robot simply by changing the required programming so that it can autonomously go to the spot where a bomb is present The automaton can be programmed to either dispose it or carry the bomb to a safer position. We can even add a fire shielding apparatus to the robot to deliver it from flame. The robot can also deliver a fire fighting. Robot mechanism can also have a password protection feature. Electrical equipments are linked in the machine via wires, which may be damaged when exposed to wet or extreme levels of temperature. The robotic arm will help to take the required samples and come back to the control unit.

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