ಕರ್ನಾಟಕ ರಾಜ್ಯ ವಿಜ್ಞಾನ ಮತ್ತು ತಂತ್ರಜ್ಞಾನ ಮಂಡಳಿ

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Project Synopsis on

DESIGN OF A REMOTELY CONTROLLED QUADRUPED ROBOT FOR EVALUATION OF UNDERGROUND MINES

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INTRODUCTION

Underground mineral mines are dangerous and gloomy places to work at. Ground water seeping through the walls of mines can destabilize the rocks and soil constituting the wall thus leading to an imminent collapse. Also, there can be chemical reactions between mineral deposits and air or water which releases noxious fumes. Thus, inspection of mines at regular intervals is a risky task that miners have to perform.

However, use of a Quadruped Robot for inspection can minimize exposure to miners in such mines. These robots can walk like four-legged animals, which improves their ability to move in terrains that wheeled robots cannot easily travel in. Also, installation of sensors and cameras allow the mine operator to assess the state of mine remotely.

Keywords: Underground mineral mines, Quadruped robot, sensors, camera

OBJECTIVES

The main objective is to design a quadruped robot that has capability of locomotion in adverse terrain/s.

Design of parts such as legs and body using CAD software such as Sketchup Make, SolidWorks and Autodesk. The parts in the design is implemented using 3-dimensional printing technology.

The robot will be able to move in forward, backwards and sideways direction. In order to implement the controls of the robot, Arduino platform will be used.

The robot will be controlled remotely by the operator. In order to control it, Wi-Fi technology is used. The robot will be able to send sensor readings and video footages to operators on their mobile operation panel or device.

METHODOLGY

Table 1. Table of Components Required

Sl.no	Components Used	Quantity
1.	Arduino Uno	1
2.	MG996 Servo Motor	8
3.	ESP 01 Wi-Fi Module	1
4.	ESP 32 Cam	1
5.	Connecting Wires	-

6.	HC-SR04 Ultrasonic Sensor	1
7.	MQ2 Sensor	1
8.	DHT-11 Temperature and Humidity Sensor	1
9	Step Down transformer	1
10	Servo driver board	1
11	3-D Printed Body of the robot	1
12	Smartphone/Laptop with Wi-Fi Capability	2

The table 1. Shows the list of components required and their quantities for the implementation of the robot. The Fig 1. Shows the block diagram of the robot

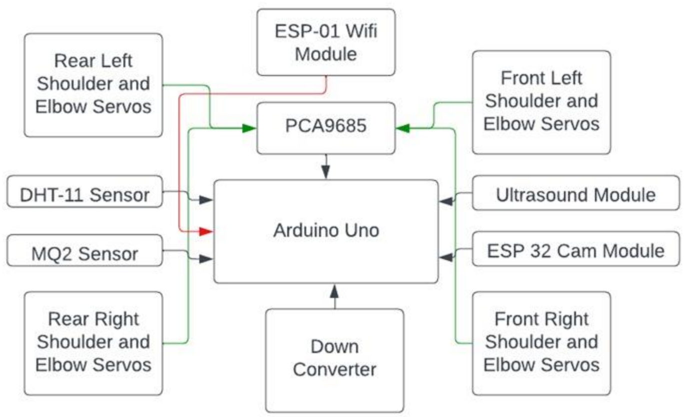

Fig 1. Block Diagram of the robot

The system uses Arduino Uno/Mega Board to control the servos of the robot. Once the system is powered on, the servo angles are set to a default position that enables the robot to “stand”. The movement of the robot occurs when the legs are lifted and placed in the direction of the movement. However, the action of the legs must be fast in order to prevent the robot from tipping. Also, the area of the foot in contact with the ground has to be large in order to provide better balance. The key advantage of a quadruped system over a rover system (wheeled) is that rover robot can clear obstructions of only half the wheel radius. Whereas the leg system can clear obstacles of up to the height of the leg. Camera on the robot allows the operator to see the obstacles in front of the robot and steer to clear. Wireless communication can be established via ESP 32 module which allows communication via Wi-Fi. Use of Ultra sound sensor allows us to detect any obstacles not visible to camera.

3-D printed Components used:

Fig 2. (left to right)Shoulder Joint, Leg, Frame

Joint represents the attachment between legs and the body. Joint enables the stable movement of the leg. The joint also moves in order to enable side to side movements.

Leg is the part that is in contact with the ground. The leg also houses servo motors which enables the movement of the robot in forward and reverse direction.

The frame is designed by keeping in mind the length of leg. The body is designed in order to maintain the weight distribution of the robot.

RESULTS AND CONCLUSION

Fig 3 shows the side profile view and front view of the quadruped robot. The quadruped robot system is much more advanced than rover based system in terms of working as well as interfacing of components. In order to make a production grade model of a quadruped robot, a huge amount of funds must be invested in R&D. It also requires testing of countless prototypes to reach that stage. This quadruped robot is an example for academic purposes and shows the potential of a quadruped based system.

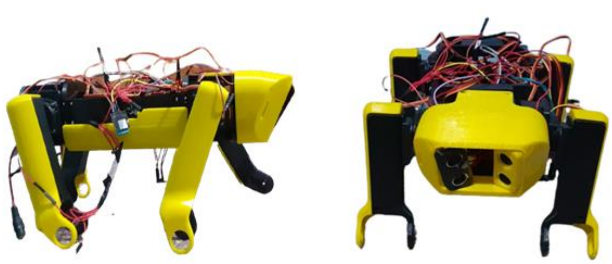

Fig 3. (left to right)Shoulder Joint, Leg, Frame

SCOPE OF FUTURE WORK

This project can be taken another notch upwards by mounting a robotic arm on the top of the quadruped robot, the range of tasks that it can perform can be greatly expanded. The arm can be used to manipulate objects, operate tools, or perform other tasks that require a high degree of dexterity and precision. This could be particularly useful in industries such as manufacturing or construction, where robots could be used to perform repetitive or dangerous tasks.

The ability to autonomously navigate and move around the environment without human intervention is one of the most critical aspects of a quadruped robot. We can focus on developing algorithms for autonomous navigation and obstacle avoidance. Developing algorithms for autonomous navigation and obstacle avoidance is crucial for the effective operation of a quadruped robot. These algorithms allow the robot to move around its environment safely and efficiently, without the need for human intervention. This can be particularly useful in situations where direct control is not possible or practical