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Design and development of high accuracy bomb detection robot defence application

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Abstract: Countless news stories are handled of injured trained personnel or soldiers losing their lives while defusing bombs. It appears daily in newspapers around the world. Here the robotic arm is designed to safely detect and dispose of a bomb up to 180 meters away. and to provide protection against hazards to the bomb disposal force. The designed robot is manually controlled by the user through a personal computer. Buzzer alarm when the sensor detects a metal. The metal is inspected with the help of a wireless camera to check whether it is a bomb or not. The detected metal is a bomb, and then the user controls the robot through the computer to dispose of the bomb.

Keywords: Bomb detection, Robotics, Design and production

I. INTRODUCTION

Terrorism is a real and growing threat in the world, and more than 60% of terrorist attacks are carried out through the use of improvised explosive devices (IED)[1]. The need for new security tools is a reality; The Anit-bomb robot project provides a new tool for creating a safe distance for IED detection. Terrorism is a real thing as proven by tragic events all over the world. And attacks using improvised explosive devices (IEDs) appear in the news almost every day[2-4]. Almost 70% of terrorist attacks are carried out using such explosives. Defense forces are demanding new tools to fight. The industry has been making great efforts over the past few years to provide such tools.

Every year a number of new products to detect and identify concealed explosives reach the market but the usefulness and deployment of these products is limited and restricted to some specific applications (airports and checkpoint applications for example), because these new systems do not meet the full operational capabilities demanded by the end[5&6].

For any method to be widely applicable for standoff explosives detection, it has to fulfil the highly set requirements for explosives trace detection; to provide a high degree of species selectivity as well as detection sensitivity[7].

Collection of pine straw is done manually. Baling is done mechanically using hydraulic balers connected to the tractor's hydraulic system or simple hand-operated box balers. Movement palnning is done dynamically. Based on the automaton's current state and feedback[8&9].

The architecture is closed loop which enables the vehicle guidance from any point/state to any configuration at rest and motion in presence of obstacles. The initial condition, the algorithm incrementally build a tree of feasible trajectories and adds a new branch and a noode to the tree. Current systems are limited to the manual harvesting of the forest products. There is no system available in the market that can serve the purpose on uneven terrains and dangerous zones for humans to reach[10].

II. EXPERIMENTAL PROCEDURE

In order to sweep the hilly forest area, the robotic machine should have:

i. Flexible locomotion system to maneuver over rough terrains, troughs and holes.
ii. A method of avoiding obstacles to avoid colliding with Tres along the way.
iii. System to recognize pine straw/needles.
iv. Mechanism to pick pine straw from the ground.
v. Power backup to run the machine and its accessories.
vi. Sensing system to enable and control machine operation and avoid hazards.
Hence, according to the requirements a robotic multi terrain prototype has to be designed and fabricated which has features such as:

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a. Equipped with rocker bogie locomotion and suspension mechanism with variable ground clearance. This enables the rover to maneuver over terrain.
b. Path Planning and Path restoration algorithm needs to be developed for Obstacle Avoidance while maneuvering through forest.
c. An advance needle/straw suction mechanism with retractable facility.
d. DC high torque geared motors to facilitate the rover to move uphill and downhill without slippage.
f. Smart sensory circuit of six sensors which helps in avoiding the obstacle while negotiating the path through woods.

The design of a mobile platform for a multi-terrain robot requires several considerations, such as height, length, width, weight, and easy access to assembled parts. Load capacity draws attention to select a material that has the strength to carry component loads.

Rocker Bogie locomotion unit is generally link mechanism that consists of number of rigid elements connected through joints of some number of Degree of Freedom helping the structure to move through rough terrain without tilt or losing ground contact.

After all the analysis, market research and components availability, the fabrication of the has been done with the components specified in. The rocker bogie suspension cum locomotion unit has been made with the cast iron square tubular section to reduce weight & enhanced capacity to carry the twisting torque and hence welded specified angle with the motors fixed with bolts along with the wheels at the end of the axle.

The aluminum core box is mounted on axles connected to a differential averaging mechanism and accommodates a suction mechanism with up/down movement, which includes the micro-controller, motor driver and storage unit.

The obstacle avoidance sensors have been placed on the outer corner of the central box. A picture of actual structure has been shown below: square tubular section to reduce weight & enhanced capacity to carry the twisting torque and hence welded specified angle with the motors fixed with bolts along with the wheels at the end of the axle. The aluminum central box has been fixed on the axles attached with the differential averaging mechanism, also it is accommodated with the suction mechanism with up/down motion, controlling unit which includes micro-controller, motor driver and storage section.

The obstacle avoidance sensors have been placed on the outer corner of the central box. A picture of actual structure has been shown below: The observations taken as shown in, on the basis of seven day trials taken at each location for three hours on each day. The start point was randomly generated while the robot followed the serpentine path planning. The used serpentine path planning method has been compared with conventional path planning method while avoiding obstacle and path restoration. The applied path planning algorithm has covered the maximum within the stipulated time frame before the draining of the battery power bank.

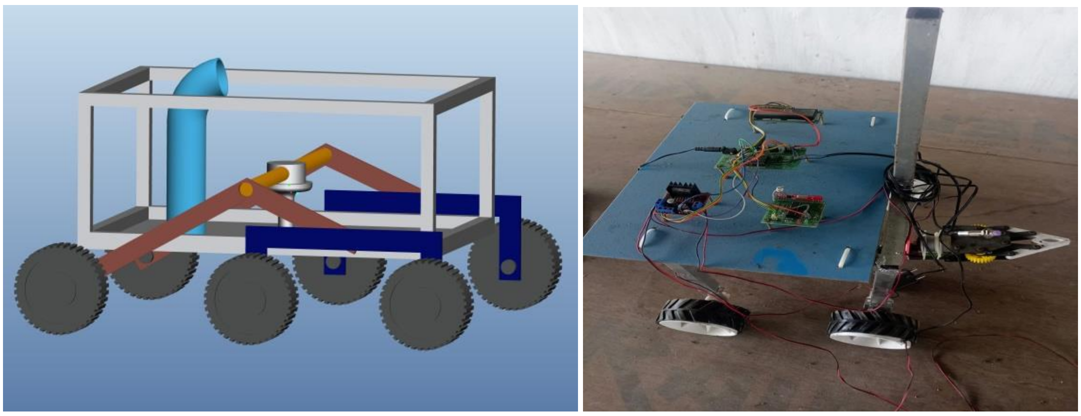

Figure 1: Design of Anit-bomb robot left side, Anti-bomb robot prototype right side

The decrement pattern shown by the in the collection of pine needles and area covered by the anti-bomb robot with the increment in the angle of elevation of terrain is because of the power consumed by the motor during the uphill and downhill movement of the structure with the stored pine needle and load of the structure.

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This dimensional constraint in the built structure has the limitation, which can be improved by using low power high torque motor and battery power bank of enhanced capacity. The power consumption by the various component Anit-bomb robot, which affects the run performance and recharging time of the battery power bank. The power supply in the robot is achieved by using six dry batteries of 9000 mAh (11Ah) capacity, which provides uninterrupted power supply to the structure for three hours of continuous operation

III. CONCLUSION

The objective of the design of pine needle collection robot with on board storage mechanism on a mobile robotic platform is successfully achieved.

The conclusions can be derived as:

1. One supervisor is enough to carry out the work for the whole day
2. The only operating cost is charging the battery packs
3. Electronic circuitry & components remain unaffected even at temperatures of 60°C.
4. The built-in activity of cutting and cutting needles results in a large collection of pine needles
5. The cost per hectare of bomb-proof-robot harvesting is comparatively lower than manual harvesting in hilly areas.
6. A mechanical pine needle collection robot is flexible in operation, cost effective, time efficient and requires no/minimal human intervention in its operation.

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