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Wireless Landmine Detection Robot: A Review

Vrishali Sadashiv Patil[1], Dr. Uttam L. Bombale[2],
[1] *Post Graduate Scholar,* [2]*Associate Professor, Electronics Technology, Department of Technology Shivaji University, Kolhapur, Maharashtra, India.*

Abstract: ***Many techniques are available for detection of landmine in various environments. This paper reviews on using robots in detection of landmine among various methods. Some of the landmine detection technologies as referred in [1] are Remote sensing technology ground penetrating radar (GPR), Electromagnetic induction (EMI), nuclear quadrupole resonance (NQR), Infrared detectors (IR), Ultrasound and Explosive vapour detection (EVD). An autonomous robot in minefield is being popular as it decreases the hazards in Manual detection. For detection of landmines robot consist of control unit which contains controller or processor, various sensors. Such robots can be not only used for landmine detection in Warfield but also used for surveillance purpose on border area.***
Keywords: Land Mine detection, Wireless Robot, landmine detection sensors

I. INTRODUCTION

National security is of prime importance in today's weapon studded world and therefore the need to consider safety of the army personnel and people living in war prone areas becomes very vital. A Landmine is basically an explosive device hidden underground by the enemy and explodes when any personnel or vehicle steps or drives over it. The Pressure created by the personnel or the vehicle on the ground below which the mine is laid acts as the detonator for the mine explosion. The damage caused by the Landmine explosion is fatal and hence detecting landmines becomes necessary before the army personnel or vehicle accidentally steps over it. The major challenge is detecting these landmines without causing any explosion and diffusing them once they are detected. The process of detecting landmines is technically termed as minesweeping and process of removing or defusing the mines is known as demining or mine clearance. Minesweeping was earlier done using trained animals like dogs and rats but modern methods includes metal detectors and various tooled attached to the vehicles. But any manual intervention of a human is always dangerous.

Robots are used for various applications in industrial area. Robot performs various activities and is becoming more advanced. That's the reason nowadays Landmine Detection Robotic Vehicles and unmanned robots are used to detect the landmines. Robots are always reliable in terms of perfection in detection and no human life is endangered in the process.

II. LITERATURE SURVEY

A land mine is a type of self-contained explosive device which is placed onto or into the ground, exploding when triggered by a vehicle, a person, or an animal. The name originates from the practice of sapping, where tunnels were dug under opposing forces or fortifications and filled with explosives.

1) *Rasaq Bello, Literature Review on Landmines and Detection Methods [2].*This paper has a review on landmines and detection methods, various types of landmine is explained in details such as Anti-personnel, Anti-tank, Common anti-personnel. Various landmine detection techniques mentioned in this paper are:

Back Scattered X-Ray Radiography: In this method detection of landmines is done using backscattered x-rays with the help of collimated x-ray beam and uncollimated detectors. This system works under various weather conditions.

a) Penetrating Radiation: This method is useful for material characterization of explosive materials but in case of landmine detection is requires the access to two opposite sides of an object, which is difficult to obtain in case of landmines.

b) Ultrasound Techniques: Properties of an ultrasonic pulse which can propagate through the material are measured through which the mechanical characteristics of the material are measured.

c) Acoustic Technique: It's a non-destructive testing method using flaw detection and material characterization, principle area of which is landmine detection.

d) Thermography: thermal signature of the soil is altered by the presence of shallowly buried objects is the main principle behind this method. Since landmines are shallowly buried objects this method is a topic of great interest in past few years.

e) Ground Penetrating Radars: Short Pulse, wide band low energy radars are used to probe into the earth, but this method has a problem that the dielectric discontinues at the places other than the mine.

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2) *Waqar Farooq, Nehal Butt, Sameed Shukat, Nouman Ali Baig, Sheikh Muhammad Ahmed, Wirelessly Controlled Mine Detection Robot [3].* This paper demonstrates the problem and effects of landmines in defence fields. The robot is equipped with special wheels controlled by H-Bridge module, allowing it to move in all possible directions. The robot is equipped with special range sensors that help in avoiding the obstacles in the field by specifically detecting the position of obstacles. A special type of prototype made of lightweight temperature resistant metal is used to carry all objects. A wireless camera is added to the robot, which captures and broadcasts the present location of the robot.
3) *Jebasingh Kirubakaran.S.J, Anish kumar jha, Dheeraj kumar, Sadambi Poornachandran Prakash, Mine Detecting Robot with Multi Sensors Controlled Using HC-12 Module [4].* This paper demonstrates a mine detecting robot guided by HC-12 module that allows it to scan the testing area within 1.8km and metal detector is used as mine detecting sensor placed in front of the vehicle, while GPS is used to provide the exact location of the infected area. The embedded system is based on Arduino technologies and guided by an HC -12 Module.
4) *V. Abilash and J. Paul Chandra Kumar, Arduino Controlled Landmine Detection Robot [5].* This paper demonstrates a prototype model of a land-mine detection robot which can be operated remotely using Wi-Fi. Technology. A Global Positioning System (GPS) sensor is employed, which identifies and broadcasts the present location of the robot. Path planning, obstacle detection and avoidance algorithms were used to control accurately and to navigation of the proposed path by avoiding obstacles. Arduino microcontroller is employed in this robot.
5) *Bharath J, Automatic Land Mine Detection Robot Using Microcontroller [6].* This paper demonstrates the landmine detection robot. In this he metal detector circuit is interfaced with the robot and it is left on the required search area in order to detect the metallic components used in the landmines.
6) *Michael YU. Rachkov, Lino Marques, Anibal T. De Almeida, Multi-Sensing Demining Robot [7].* The paper describes an advanced multisensory demining robot. The robot transport system is based on a simple structure using pneumatic drive elements. The robot has robust design and can carry demining equipment up to 100 kg over rough terrains. Due to the adaptive possibilities of pedipulators to obstacles, the robot can adjust the working position of the demining sensors while searching for mines. The detection block consists of a metal detector, an infrared detector, and a chemical explosive sensor. The robot is controlled by means of an on-board processor and by an operator remote station in an interactive mode. Experimental results of the transport, control, and detection systems of the robot are presented.
7) *Seong Pal Kang, Junho Choi, Seung-Beum Suh, Sungchul* The design includes a track type main platform with a simple moving arm and a mine detection sensor (consists of a metal detector and a GPR at this stage). In addition, in order to maintain the effective distance between the landmine sensors and ground surface, a distance sensing technique for terrain adaptability was developed and briefly introduced in this paper. Kang, Design of mine detection robot for Korean mine field [8].
8) *Zhenjun He, Jiang Zhang, Peng Xu, Jiaheng Qin and Yunkai Zhu, Mine Detecting Robot Based on Wireless Communication with Multi-sensor[9].* This paper put forward a control method and device of robot, Robot based on wireless communication with multi-sensor, which can carry out robot's motion control, video surveillance, temperature and humidity detection, gas detection and data exchange, etc. In a timely manner, it can also upload real-time monitoring information to the upper machine to carry on the dynamic measurement and real-time monitoring, and give security alerts.
9) *Majd Ghareeb, Ali Bazzi, Mohamad Raad, Samih Abdul Nabi Wireless. Robo-Pi for Landmine Detection [10].* The main idea is to design and implement a prototype of an efficient low cost automated mine detector that will replace the current employed human detectors in the mission of detecting and extracting mines in a suspected area of land. This detector will wirelessly communicate with a server to transmit the detected information such as the location of the metal object and captured images of the land where does it exist.

III.CONCLUSION

Nothing should be more important than the lives and safety of our country's army men who risk their lives for our safety from external enemies. There have been many cases of fatalities and injuries due to explosion of landmines. Till date a lot of research and development has been done and different types of landmine detection robots have been developed each having its own advantages and disadvantages. The variation in these robots is based on the controller or processor used, sensor interfaced, GPS tracking system and the locomotion technique used.

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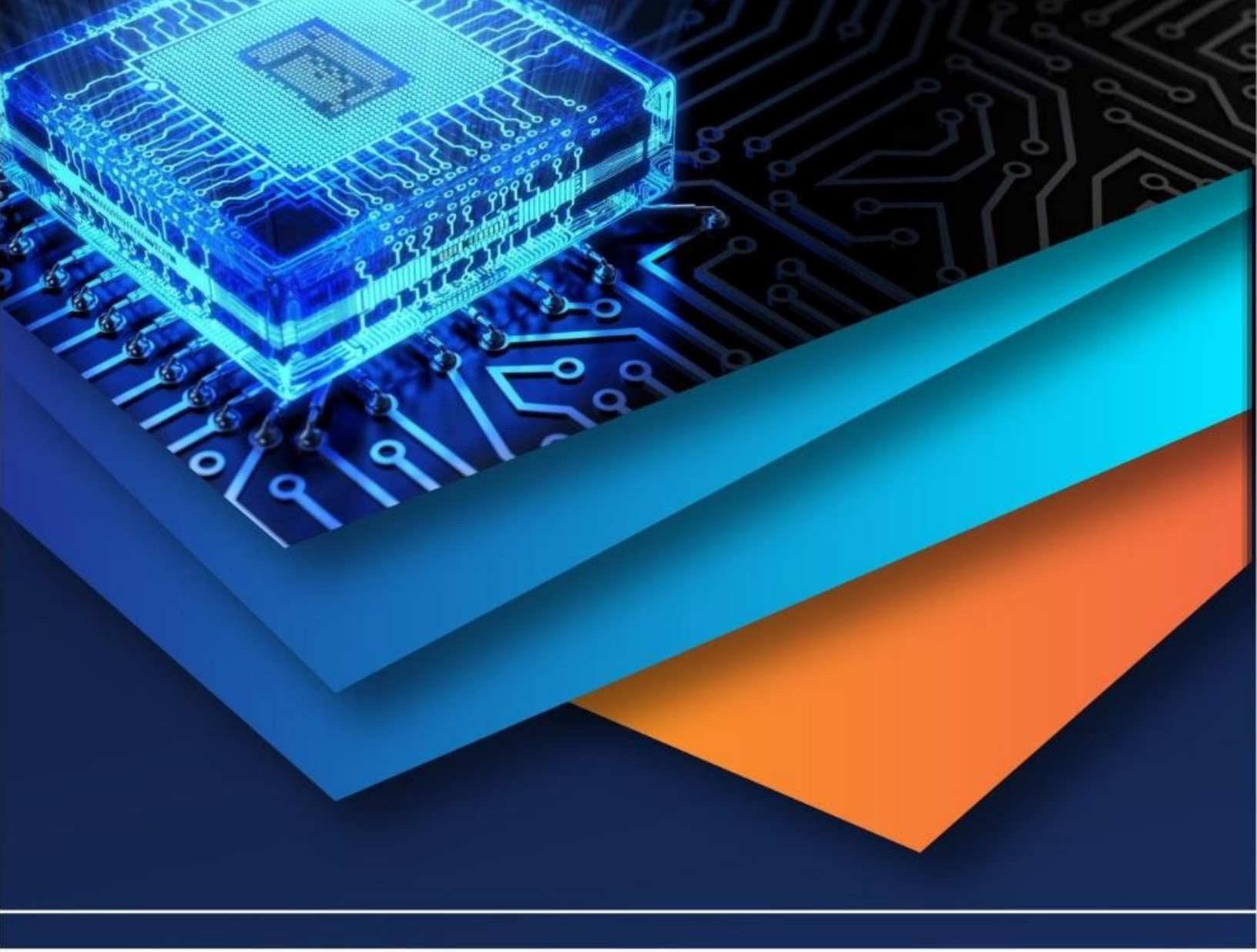

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