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Innovative Robotic Solutions for Safe Landmine Detection and Neutralization

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Abstract

Given the proliferation of weaponry in today's globe, national security is critical. It is crucial to consider the security of both army personnel and residents of places that are likely to experience conflict because of this. In essence, a landmine is an explosive weapon that the enemy has concealed underground. Anytime a person or a car passes over it, it explodes. The pressure created by people or cars on the surface where the mine is placed is what causes the explosion. *Every day, newspapers all over the world publish many news stories about injured military personnel or individuals who die while defusing bombs. Here, a robotic device is intended to safely find and defuse a bomb within a 100-meter radius while safeguarding the bomb disposal team from potential threats. The robot is meant to operate automatically (PC). When the sensor picks up a metal, the GPS and GSM send out an SMS with the bomb's position. The servo motor is triggered and the metal ball is hurled on the device to disarm it if the identified metal turns out to be a bomb. Robot design includes Adriano Nano board, DC motors, GPS, and GSM. Protest software is used to mimic the configuration at first, and a personal computer is used to operate the full hardware arrangement.*

Keywords: Robot, GPS, GSM, DC motors, servo motor, landmine

INTRODUCTION

In today's world of weapons, national security is of utmost importance. For this reason, it is imperative to take into account the safety of army troops as well as those residing in war-prone areas. A landmine is essentially an explosive device that the adversary has hidden beneath the ground. It detonates when any human or vehicle walks or drives over it. The mine explosion is triggered by pressure produced by people or vehicles on the surface where the mine is located [1–5].

Because landmine explosions can cause fatalities, it is imperative that landmines be detected before army troops or vehicles inadvertently step on them. Finding these landmines without setting off an explosion and dispersing them once found is the biggest obstacle. Technically speaking, the technique of finding landmines is called "minesweeping," while the process of demining or "mine clearance" refers to the removal or defusing of the mines. Although trained animals like dogs and rats were often used for minesweeping, more recent techniques utilize metal detectors and various tools mounted to the trucks. However, human manual intervention is inherently risky. In the industrial sector, robots are employed in many different capacities [2].

Robotic vehicles are increasingly versatile, performing a wide array of tasks and continually advancing. Currently, unmanned robotic vehicles play a crucial role in detecting landmines, ensuring safety in hazardous environments.

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When it comes to flawless detection, robots are always dependable, and no human life is in danger throughout the procedure. An autonomous robot with wireless remote control that can locate and remove landmines while allowing the user to monitor the robot from a distance. Since metal is included in the majority of land mines, metal detectors are used to locate buried mines. The robot's route will be zigzag [4]. The method lets the operator operate the robot wirelessly or remotely, allowing him to maintain a safe distance. In many real-world situations, robots are appearing increasingly frequently. Robots are frequently used in human assistance, medical support, and housekeeping. Other important fields where robotics research and application are being conducted are the military and security. Certain features are required for robots used for surveillance in terrorist and conflict zones in order to carry out their duties accurately and effectively [3]. The necessity for military robots has grown significantly in the modern era. As a result, capable robots start to develop. Hazardous tasks are carried out by robotic platform components, such as remotely operated vehicles, in both civilian and military settings.

The creation and use of such robots could replace people in a variety of hazardous tasks. The human operator receives the information about the environment that is being watched. Through teleportation, the human operator controls the machine. The biggest threat to law enforcement and military personnel is the possession of explosives. Robots and tactics for disposing of bombs have garnered renewed interest due to recent advancements. Disarming the device with little human interaction is the goal. The device needs to be securely deactivated without detonating. When detonating the device, make sure there is nothing nearby in a safe place. Here, a remotely controlled, electrically driven robot is intended to find, manipulate, and eliminate potentially dangerous items [6–8].

BACKGROUND

Every day, newspapers all over the world publish many news stories about injured military personnel or individuals who die while defusing bombs. Here, a robotic arm is intended to safely find and defuse a device within a 100-meter radius while safeguarding the bomb disposal crew from potential threats. The user uses a personal computer to manually control the designed robot (PC).The buzzer sounds when it finds a metal object. The wireless camera is used to analyze the metal in order to determine whether or not it is a bomb.

In the event that the discovered metal turns out to be a bomb, the user uses a PC to command the robot and defuse the bomb. Parts of the designed robot include an Adriano Nano board, DC motors, robotic arm, wireless camera, and buzzer. Protest software is used to mimic the configuration at first, and a personal computer is used to operate the full hardware arrangement. Prototype of Landmine Detection Robotic is shown in Figure 1.

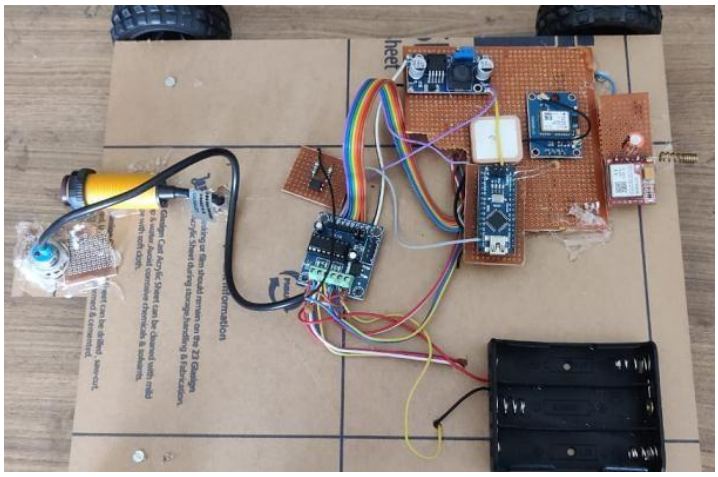

Figure 1. Prototype of landmine detection robotic.

PROPOSED SYSTEM

It can serve as a personal assistant, spies, or rescue robot. Surveillance is one usage for the robot. For example, using camera pottage, the robot may detect and alert users to any hidden bombs underneath objects. A robot that detects smoke and fire can also send out an SMS. Due to its diminutive size, the robot can be utilized for espionage. This project makes use of mobile technology, and because mobile devices have such a wide range, so does the project. Ultimately, though, it is dependent upon the cell network's coverage.

The primary goal of this robot's construction is to approximate human labor and create a self-sufficient platform for any client scenario. Regular use of technology can benefit society and make clients feel less stressed in their surroundings. For those with low vision who are enthusiastic about literature, it can be utilized to listen to audio books [9, 10].

We can also educate and teach the robot what we know. It has the ability to speak in both male and female voices.

WORKING

This proposed system uses an inductive proximity sensor to detect bombs. We have programmed the sensor to detect bombs, and if the condition is met or a bomb is detected by the sensor, the system will loop and locate itself using GPS and send an SMS with the robot's location. The robot is fully autonomous and can detect obstacles and move automatically in any area. If an obstacle is detected, the robot will move in a different direction in accordance with the programme.

Arduino Nano

The Arduino Nano is a multipurpose microcontroller-based device featuring sixteen digital pins. Almost any task, from small to large industrial-scale tasks, can be completed with it.

DC-DC Convertor

To store energy so that it may be converted, DC/DC switching circuits, properly driven electronic switches, and other components are utilized. A DC/DC power convertor that lowers the input voltage and produces a low input voltage is known as a step-down, or buck, converter. 12 V input is converted to 5 V by this DC to DC converter.

Inductive Proximity Sensor

A sensing tool that can identify metal targets both with and without electromagnetic energy is an inductive proximity sensor. An inductive proximity sensor's sensing range varies according to the kind of metal it detects.

L298N Driver

Two DC motors may be simultaneously controlled for both speed and direction thanks to the twin H-Bridge motor driver L298N. DC motors with voltages between 5 and 35 volts and a peak current of up to 2 amps can be driven by this module.

GSM Module

A GPS modules are made up of tiny processors and antennas that receive data transmitted by satellites using certain radio frequencies directly. From there, it will get other data and a timestamp from every satellite that is visible. The module's antenna can precisely determine its position and time if it can detect four or more satellites.

GPS Module

The GPS module is a wireless chip module that is built into the motherboard of a computer or mobile phone. It can establish a connection with the Global Positioning System of the United States. In accordance with the strength of a wireless network signal, it can locate and travel. One of the

global positioning system's (GPS) components uses data from satellites to pinpoint a specific location on Earth via a method called trilateration. Meanwhile, a GPS receiver measures the separation between satellites using trilateration of radio signals.

Moreover, there are similarities between trilateration and triangulation, which measure angles (Tim Gunther, 2020). The tiny processors and antennas that make up GPS modules directly receive data supplied by satellites utilizing specific radio frequencies. From there, it will retrieve further information and a timestamp from each discernible satellite. If the module's antenna is able to identify four or more satellites, it will be able to establish its exact position and time.

MARKET SURVEY

The demand for military robots has skyrocketed in recent years. As a result, capable robots start to develop. In both civilian and military environments, robotic platforms, such as remotely operated vehicles, carry out dangerous tasks. The creation and use of such robots could replace people in a variety of hazardous tasks. The human operator receives the information about the environment that is being watched. Through teleoperation, the human operator controls the machine.

The biggest threat to law enforcement and military personnel is the possession of explosives. Robots and tactics for disposing of bombs have garnered renewed interest due to recent advancements. Disarming the device with little human interaction is the goal. It is necessary to carefully disarm the device without setting it off. When detonating the device, make sure there is nothing nearby in a safe place. Here, a remotely controlled, electrically driven robot is intended to find, manipulate, and eliminate potentially dangerous things.

CONCLUSION

The lives and safety of our nation's army soldiers, who put their lives at danger to protect us from foreign foes, should come first. Numerous landmine explosions have resulted in fatalities and injuries. Numerous varieties of landmine detection robots have been produced to date, each with unique advantages and limitations, after extensive research and development. These robots vary depending on the locomotion mechanism, GPS tracking system, sensor interface, and controller/processor employed.

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