Biohouse, Volume 1: Issue 2, July-Aug 2015

Biohouse Journal of Research in Engineering

ISSN 2379-1535

Implementation of Landmine Robot using ATMEGA32 Microcontroller

Wade Ghribi, Assistant Professor
Dept of Computer Engineering
College of Computer Science, King Khalid University
Abha, Saudi Arabia
dr.wadea@gmail.com

Ahmed Said Badawy, Assistant Professor
Dept of Computer Engineering
College of Computer Science, King Khalid University
Abha, Saudi Arabia
ahmedsmb.badawy099@gmail.com

Abstract: *The purpose of this paper is to design and implement a robot which is capable of detecting buried landmines and marking their locations, while enabling the operator to control the robot wirelessly from a distance using MEGA32 microcontroller*

Keywords: *Robot, DIP Control, Landmine*

I. INTRODUCTION

The landmine crisis is globally alarming since there are presently 500 million unexploded, buried mines in about 50 countries. Governments are looking into this situation seriously since landmines are claiming the limbs and lives of civilians every day [1]. The purpose of this project is to design a robot which is capable of detecting buried land mines and marking their locations, while enabling the operator to control the robot wirelessly from a distance. A land mine detection robot is needed to be designed to employ in peace support operations and in the clearance of contaminated areas. Also the robot shall be able to detect 50-90% of landmines (Anti-personnel mines) and mark the locations of the mines within a tolerance of 5cm. For the safety of the operator, the designed robot must be able to operate remotely, moreover, must be equipped with wireless data transmitting capabilities [2,3].

.

II. SPECIFICATIONS

The specifications for the robot were taken from the requirements of the Intelligent Ground Vehicle Competition and from literary research regarding landmine detection. It was decided that an all-terrain robot with on-board image processing, global positioning system (GPS) and inertial measurement unit (IMU) powered by a battery would be a very adaptable solution. The primary tasks were that of designing the frame, power solution and wireless on the hardware side and image processing on the software side. Two frames were designed with different batteries, suspension and drive train. As mentioned before a land mine searching robot must comprise of three basic features, namely; the mine detector, a carrying vehicle and a data processing unit.

The detector:

For the past decade, landmines, both anti-personnel and anti-tank mines, are made in metal casings. Therefore, the detection of landmine by using metal detectors is a simple and workable method.

The thermal image:

A buried landmine comprises of different materials from the surrounding soil and they will react to the surrounding heat in a different manner from the soil [1,2]. They will absorb the heat slower or faster than the surrounding soil and they will release or radiate the contained heat slower or faster than the surrounding soil. Therefore, at any point of time, the land mine will possess slightly different temperature form the surrounding, due to the constantly varying heat supply from day time and night time. Therefore, thermal imaging Infra-Red camera is the best option for this project[3,7].

A carrying vehicle:

The very first proposal of transport unit is a wheel base robot. After wheeled vehicles are chosen, the next stage of the challenge is avoiding the mines. Dodging the robot around the mines in the mine field is not a smart option. Therefore, a new way of avoiding the suspected mine buried spots was thought of. The idea is to lift up the wheels on whose path lays a buried mine and another set of wheels will touch down on the ground without having to move the robot. In other words, there will be a mechanism to interchange between two sets of wheels, if there lays a mine on the original path.

The data processing unit or control unit:

A processing unit, installed on the robot, will be transmitting data from the robot to the operator, such as images from the cameras, and it will receive and process the commands from the operator to the robot. These signals will be transmitted and received through radio channels and the command signals received by the robot will be redistributed to the respective mechanisms to carry out the required processes [6,7]. Firstly, the scanner which is located at the front of the robot processes a metal detector that will scan and clear the path of 1.2m width. The scanner will stop scanning if there is no detection of a mine, and the robot will advance one step forward by activating the forward motor for 5 seconds. After which, the scanner will restart its scanning sequence. The robot would move forward again with no detection of mine. This scanning loop will continue until the scanner detects a mine. Once the scanner detects a mine, the robot comes to a standstill and sends out signals back to the operator by both illuminating the Light Emitting Diode (LED) as well as beeping. The operator will then have to decide if it is a false alarm or a real detection of a mine. If the operator takes the warning as a false alarm, he will ignore it and restart the scanning loop. If warning is taken as a real detection of the mine, the operator has to send a command to the robot to mark the location by spraying distinctive colour paint on that spot.

In conclusion, our robot comprises of three major components, namely; a carrying vehicle (wheels), a data processing unit and a mine detection unit according to the algorithm as shown in Figure (1,2)

III. Control System and Implementation

The minesweeper will use two microcontrollers, the Atmel ATMega32 and the Atmel ATMega128. Each of these chips will sit on a custom designed circuit board. The Mega32 board connects the microcontroller to the power source and the RF receivers for the emergency stop. The same board also holds the digital logic chips to implement the emergency stop. See Figure (1,2).The Mega128 microcontrollers will control the motors. They will sit on the same circuit board as the motor-driving circuits, separated by optical isolators. Some minor design modifications are made for our previous developed robot [11] and the implementation showed an improved efficiency in detection of landmines.

Fig 1: Rendering of Concept v1.0

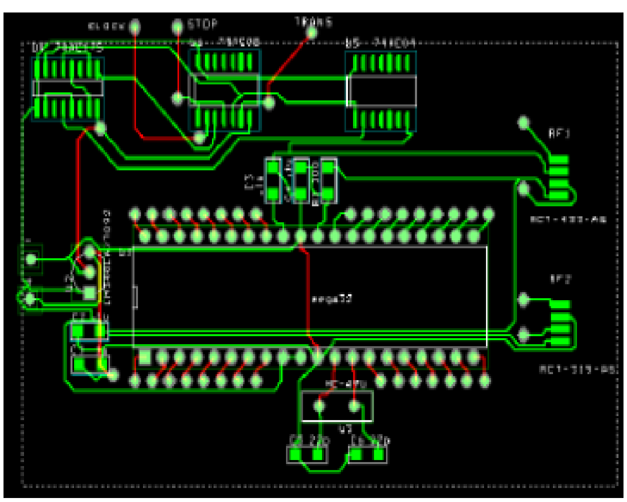

Fig 2: Final design of Mega32 board

IV. Conclusions And Future Work

It has been successfully proven through the prototype that the proposed theory and concept for a land mine exploring platform works perfectly. The detection of the buried mine is done by using metal detectors since most land mines contain metal components. The prototype is capable of detecting the buried metal piece, marking the exact location with distinctive colour paint, and controlling itself from stepping over it. It is also able to clear with 1.2m width at one go. With the use of interchangeable four wheels, the marked locations can be avoided without requiring the prototype to doge around that spot. And mostly importantly, the prototype is controlled wirelessly by the operator from a safe distance. Thus, the proposed design for landmine detection and marking module had opened up a new area of the researchers to explore

V. References

[1] Kenzo Nonami, Seiji Masunaga and Daniel Waterman‖ Mine Detection Robot and Related Technologies for Humanitarian Demining", Japan, 2008.

[2] Nyein Chann, "Landmine detection and marking robot", NUS, 2007.

[3] M. Sonka, V. Hlavac and R. Boyle, Image Processing, Analysis and Machine Vision, 2nd ed., Pacific Grove, CA: Brooks/Cole Publishing, 1999.

[4] J. A. Stuller, S. J. Qiu, and K. Das, ―Signal processing for landmine detection using a water jet,‖ in Detection and Remediation Technologies for Mines and Mine like Targets IV, vol. 3710 of Proceedings of SPIE, pp. 1330–1342, Orlando, Fla, USA, 1999.

[5] K. Bruschini, C. De Bruyn, H. Sahli, and J. Cornelis, ―EUDEM: The EU in humanitarian DEMining—Final Report,‖1999, http://www.eudem.vub.ac.be/publications/.

[6] L. Carin, Ed., ―Special issue on landmine and UXO detection,‖ IEEE Transactions on Geosciences and Remote Sensing, vol. 39,no. 6, 2001.

[7] N. Milisavljevic, I. Bloch, and M. Acheroy, ―Characterization of mine detection sensors in terms of belief functions and their fusion, first results,‖ in Proc. IEEE 3rd International Conference on Information Fusion (FUSION '00), vol. 2, pp.THC3/15–THC3/22, Paris, France, July 2000.

[8] Wikipedia contributors. Hough transforms [Internet]. Wikipedia, The Free Encyclopedia; 2007 Mar 13, 06:01 UTC [cited 2007 Mar

[9]Availablefrom:http://en.wikipedia.org/w/index.php?title=Hough_transform&oldid=114738751

[10] A. Reeves. 2006. ECE 547 Lecture 14: The Hough Transforms. Cornell University.

[11] Wade Ghribi, Ahmed Said Badawy, Mohammed Rahmathullah, Suresh Babu Changalasetty, Design and Implementation of Landmine Robot, IJEIT, Vol 2, Issue 11, May 2013