IOSR Journal of Computer Engineering (IOSR-JCE)
e-ISSN: 2278-0661,p-ISSN: 2278-8727
PP 61-65
www.iosrjournals.org

Thermal Landmine Detector

Amogh R. Vaidya[1,] Prof. Kimaya Ambekar[2]
[1](P.G. Student, Masters of Computer Application, K. J. Somaiya Institute of Management Studies & Research Mumbai, India)
[2](Assistant Professor, K. J. Somaiya Institute of Management Studies & Research, India

Abstract: *Landmines are the devices which are usually concealed under the ground, near or on the ground which when stepped on are intended to kill or harm the opponent; may it be persons, animals or enemy tanks, vehicles. Since the landmines are buried approximately 3 to 10cm deep in the ground; they are not very visible. Detection of such landmines is very important to save innocent human beings and animals. This paper gives a model of Thermal Landmine Detector which can detect the mines from the distance. The idea is to eliminate the need for human mine sweeper for detecting the landmines and to provide the accurate position of the mine with its depth and size. This paper includes the technology,design,and working of the drone. This drone could minimize the loss of lives of mine sweepers who risk their lives for detecting the mines.*

Keywords: *Landmines, Thermal Detector, Sensors*

I. Introduction

Landmines are the marks left behind after the World Wars ended. They were designed to protect territories and its people, but soon it turned out to be a threat to the same people they were invented for. Even though these landmines killed its enemies, it also claimed the lives of innocent people and animals. One of the problems faced by the armies of the world was to clean these landmines.

Landmines are seen as an everyday threat in the countries like Bosnia, Afghanistan, Cambodia, Croatia, Yemen, Somalia and many others.International Campaign to Ban Landmines (ICBC) has statedapproximately 15,000 to 20,000 casualties because of landmines in every year[1].In Cambodia, 111 casualties were reported in 2013[2]. Handicap International organization claimed that approximately 20 individuals step on landmines every month in Mozambique. According to Government reports, more than 40000 Cambodians have undergone amputation as a result of mine injuries from 1977.[3] Looking at the data, we can analyze that detecting the landmines are very significant need for many countries.

The main task in thedemining process is to find the location of the mines. The detection process consists of two types.

1. To locate the potential mine field globally.
2. To locate the mines in the identified areas.

Both these types have its own challenges. A global search must be done rapidly and accurately in order to start the demining process, whereas the local search must more precisely locate the mine in order to eliminate it using the existing ground robots.

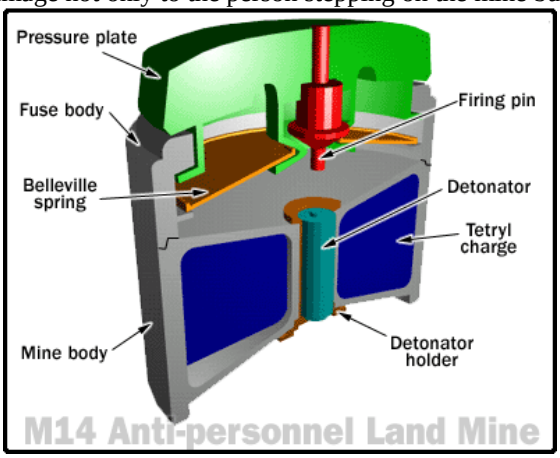
The mines can be divided into following

1 Anti-personnel mine.

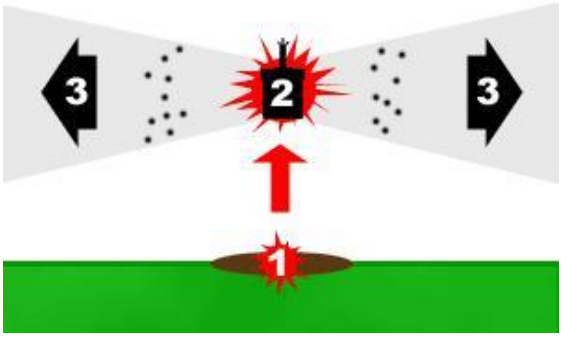
2 Anti-Tank mine.

1. **Anti-personnelmines:**are further divided into 3 types
   1.1. **Blast**: This mine is buried near the surface and is triggered as soon as the pressure plate is pressed. The mine explodes and causes serious injuries to the person.

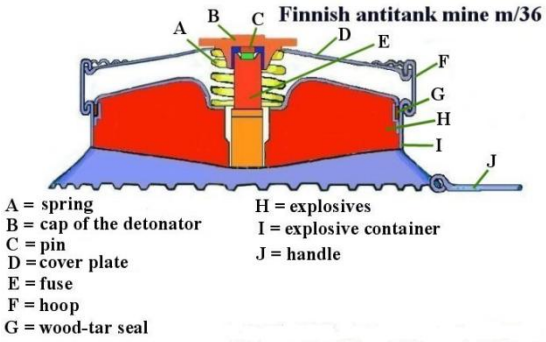
1.2. **Fragmentation**: This type of mine causes the maximum damage and is the most dangerous. It contains small fragments of metal. These fragments spread in all the direction when the mine is exploded causing damage not only to the person stepping on the mine but also to the people near him.



1.3. **Bounding**: This is the minetype which is designed to harm a person's head or chest. This mine lifts itself to a height of up to 1 meter and explodes in theair causing the metal fragments to hit the target in head or chest.[4]



1. **<u>Anti-Tank mines</u>**:This type of mine is used to disable the tanks of the enemies by destroying the belt of the tank on contacting the mine. This type of mine contains a large amount of explosive in order to disable/destroy the tank.



In this paper, we are describing a method which can be used for detecting landmines more efficiently and which is cheap as compared to the existing systems. The method described in this paper will be using drones. These drones are equipped with a thermal camera and are used for capturing real-time videos which then can be viewed on the operator's screen.

II. Available Technologies For Mine Detection

2.1 Traditional Technique (Prodders)

This is the most common technique used for detecting landmines. In this technique, a metal detector is used for scanning a specific area. A person uses a metal detector mounted on a rod with a handle. This rod is hovered over the ground to detect the mines buried in the ground. The metal detector produces sounds of a particular frequency if it hovers over an object. This has been the traditional technique used for detecting

landmines. The problem with this technique was many times the person handling the metal detector triggered the landmine causing death or severe injury to the person.

2.2 Acoustic Sensors:

In this approach, the acoustic wave is projected on the area that is being scanned. The waves are reflected and these reflected waves are captured by the sensors. Using this data the difference in amplitude helps in locating the object. The study revealed that this technique works well with thewet and heavy ground. But the technique is unable to identify the objects in sandy soils.

2.3 Nuclear Magnetic Resonance:

According to this method, the target needs to be placed inside a coil. This method doesn't work if the landmine is buried at a certain depth. Although this method can be used to sensethe hidden landmines, the results are hard to interpret as the obtained DC and RF fields are weak and non-uniform.This technique cannot be used with handheld devices as it consists of superconductor coil, which requiresonboard cooling system and high power source. The main drawback of this technique is that it cannot be used to detect metallic mines hence it should be used along with metal detectors. [5]

2.4 Electric Impedance Tomography:

This technique uses conductive distribution. The system is efficient and economical. The bi-dimensional array setup of electrodes is placed on the groundwhich enables us to receive signals. This data acquired is eventually used for locating the mine. This technique works well with thewet and heavy ground. But is unable to identify the objects in sandy soils. The limitation of thismethod is the sensor needs to be near the ground in order to detect the mine. This limitation causes theexplosive to trigger the mine.

III. Available Technique For Mine Cleaning

The Digger D-3: This is a mine cleaning robot which sucks and detonates the mines. This robot is fitted with a spinning metal roller which digs up to a quarter meter into the ground, turning everything they touch into mulch. This kind of robot is used in an open field. But the limitation of this robot is that it destroys the path on which it is used. So if a military convoy uses this type of robot they won't be able to move forward.[6]

Huskies UGV: This is a mine detecting robot which moves on caterpillar track. This robot is fitted with a metal detector which is used for detecting the mines. The limitation of this robot is that it accidentally triggers the mine because of the vibrations produced by the movement of the robot causing the mine to blow up the robot.[7]

IV. Proposed Technique:

Thermal Landmine Detector is the solution to many such problems. It will be carrying 2 type of sensors to avoid obstacles. The drone will be fitted with a high-resolution thermal camera. The camera will capture real-time video of the area which is being monitored. The operator of the drone can view all the details sent by the camera on a screen of the controller. These videos will be further analyzed for locating the accurate position of the landmine which are buried under the ground at a particular depth. Once the analysis has been done the operator can send the already existing robot for defusing the landmine. This will reduce the loss of robots caused because of early detonation of the mine because of the vibrations produced by the robot.

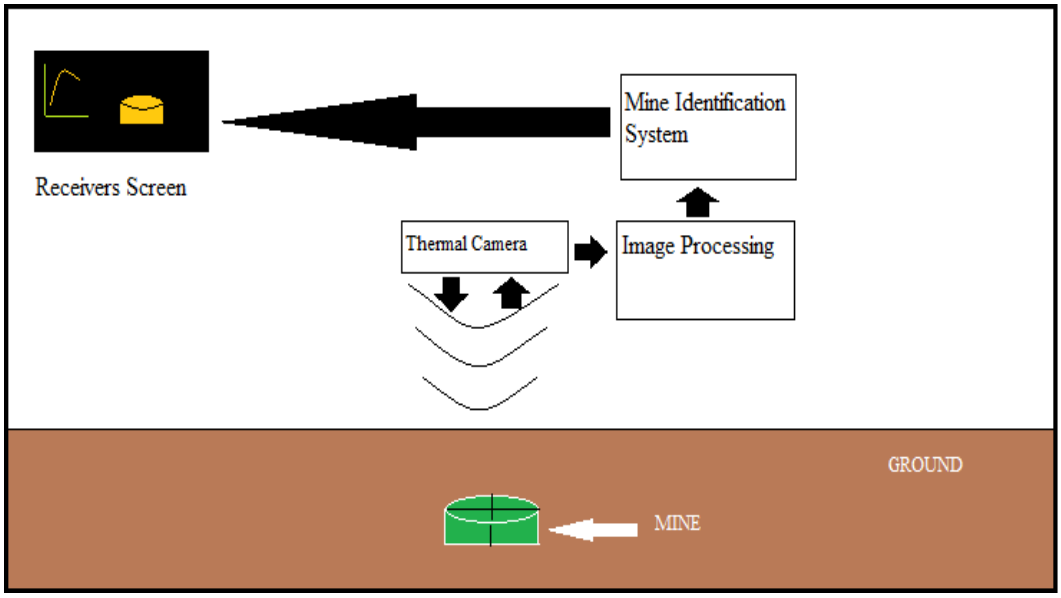


Fig1: Block diagram of thermal imaging system

V. Components:

- **High-resolution thermal camera:** The high-resolution thermal camera is used for getting the accurate information about the mines. The information includes
  1. The depth of the mine.
  2. The size of the mine.
  3. The accurate position of the mine.
  4. Type of mine.
- **Sensors:**
  1. **Ultrasonic sensor:** This sensor would be used to detect any nearby obstacles in the route of the drone while it is scanning the area.
  2. **Altimeter Sensor:** The Altimeter sensor is used to accurately measure the height of the drone at which it is flying. This will help in maintaining the accurate height for scanning the area.

VI. Future Enhancements

The model described in this paper is used only for detection and identification of the type of mine that is present in the ground. However, the drone can be further upgraded by fitting it with arobotic arm which can be used for defusing the mine. This upgrade will eliminate the use of UGV. But it will also introduce new challenges regarding the stability of the drone while it is defusing the mine. And it will also increase the cost of the drone.

VII. Conclusion

The number of people killed and wounded by landmines and improvised explosive devices has hit an alarming 10-year high, as international funding to clear mines has sunk to the lowest level in a decade, a new report finds. Armed conflict in Afghanistan, Iraq, Libya, Syria, Ukraine,and Yemen led to the "sharp spike" in deaths, according to the Landmine Monitor 2016 of the International Campaign to Ban Landmine. In 2015, the organization recorded 6,461 victims, a 75 percent increase from the year before and the highest recorded total since 2006. The majority of those victims, 78 percent, were civilians.The Thermal Landmine Detector would be a solution to all the problems faced and it would be a relief for all the militaries around the world.

References

[1]. Kathleen Harris, Deaths, injuries from landmines and IEDs hit 10-year high in 2015, report finds, http://www.cbc.ca/news/politics/landmines-deaths-injuries-increase-1.3861825, Accessed on 1/10/2017 at 9pm
[2]. Land mines in Cambodia, https://en.wikipedia.org/wiki/Land_mines_in_Cambodia, Accessed on 2/10/2017 at 5:00pm
[3]. Rushfan , 10 Countries With The Most Landmines, http://listverse.com/2008/08/11/10-countries-with-the-most-landmines/,August 11, 2008
[4]. Fawzy Abujarad, "Ground penetrating radar signal processing for landmine detection", 2007, Ph.D. thesis, Accessed on 3/10/2017 at 10:00pm
[5]. M. Nolte, A.Privalov, J. Altmann, V. Anferov and F. Fujara," 1H – 14N cross relaxation in trinitrotoluene: A step toward improved landmine detection", Accessed on 3/10/2017 at 10:30pm
[6]. Evan Ackerman, Unstoppable Robot Eats Landmines for Breakfast, https://spectrum.ieee.org/automaton/robotics/military-robots/unstoppable-robot-eats-landmines-for-breakfast, Accessed on 3/10/2017 at 11:00pm
[7]. Evan Ackerman, Robot Takes on Landmine Detection While Humans Stay Very Very Far Away, https://spectrum.ieee.org/automaton/robotics/military-robots/husky-robot-takes-on-landmine-detection-while-humans-stay-very-very-far-away, Accessed on 3/10/2017 at 11:15pm