Anti-person Landmine Sweeper

A State of the Art Review -Save the Life

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***Abstract*- Landmines have been considered as biggest threat even after war. So it is needed to be clean. As a robotics technology has experiencing emerging trend, in military sector, there is very vast room available for robot in demining. As described in this paper ,the effects of landmines on human, it is required to research more in this sector and find out the way through which we can introduce robot for cleaning of mines and reduce casualties.**

I. INTRODUCTION

Landmines are now a daily threat in Afghanistan, Angola, Cambodia, Chechnya, Croatia, Iraq, Mozambique, Nicaragua, Somalia, and many other countries. Mines recognize no cease-fire and long after the fighting has stopped they continue to maim or kill. Mines also occupies large tracts of agricultural land unusable , wreaking environmental and economic devastation. Refugees returning to their war ravaged countries face this life-threatening obstacle to rebuilding their lives. Mine deaths and injuries in the past few decades total in the hundreds of thousands [1]. Those who survive the initial blast usually require detruncating, long hospital stays, and rehabilitative services. In Cambodia alone there is over 35,000 amputee's injury by landmines--and they are the survivors. . Mines can deny the use of agricultural land or riverbank. They can even prevent tourism bringing in valuable foreign currency through denying access to cultural heritage sites. Development project personnel who are not warned of the dangers can become casualties [2].According to International Mine Action Standards (IMAS) [3], a land mine is a munition designed to be placed under, on or near the ground or other surface area and to be exploded by the presence, proximity or contact of a person or a vehicle [4]. There are mainly two types of landmines. 1. Anti-person landmine, 2.Antitank Landmine. This research is predominately for Demining of Anti-person landmine. Although the history of mines can be traced back as far as Roman times [5] it was the introduction of tanks in the First World War that led to the development of the first modern mines. Anti-tank mines were introduced to provide defending troops with the means to create an obstacle to armored vehicles that were seemingly unstoppable by the conventional barriers of ditch and wire. Later, as attacking troops learned to pick up these anti-tank mines in the path of their tanks, the anti-tank mines were protected in turn by the introduction of antipersonnel mines. These would slow down the progress of engineers sent into the minefields to breach paths through the minefield and their detonation would also alert the defenders to the fact that an attack was in progress. Mine warfare reached its peak in the North African campaign in World War II when the desert provided few other obstacles to maneuvering armies, and huge minefields, extending many miles, were built. The lessons of mine warfare were well learned by post war armies, and the armies of both NATO and the Warsaw Pact incorporated tactics of employing minefields and also breaching them under fire mine clearance techniques are covered below.

Paul Jefferson, one of the earliest humanitarian demines said "a landmine is the perfect soldier: Ever courageous, never sleeps, never misses". The simplicity and cost-effectiveness of mines are major factors in explaining the widespread use of mines throughout the numerous countries that are now faced with dealing with the mine contamination problem.

Detection and removal of antipersonnel landmines is, at the present time, a serious problem of political, economic, environmental and humanitarian dimension. As this map shows, there is still a long way to go before the world is free of anti-personnel landmines.

II. STATIC DATA OF LANDMINE

It is estimated that there are 110 million active landmines. This means that there is one landmine for every 17 children in the world. Or, in other words, one landmine for every 52 people. Another 110 million landmines are stored ready to be used. Landmines are found in over 70 countries. 2,000 people are involved in landmine accidents every month - one person every 20 minutes. Around 800 of these will die. 1,200 will be maimed.

Clearing mines is very dangerous work. For every 5,000 mines that are removed, one person is killed and two people are injured, About 100,000 mines are removed each

year. At this rate it would take 1,100 years to clear all the landmines in the world (assuming that no new mines are laid) [6].

The most common mines are cheap - between $3 and $30 - but it can cost 50 times as much to remove each one. In 1996 the UN Secretary General estimated that it would cost more than $50 billion to remove landmines throughout the world. However, in the same year, less than $150 million was available for removing mines. Landmines cause many other costs: land that cannot be used, roads that cannot be used, loss of trade, and the costs of treating injured people. Egypt has the most landmines in its land: 23 million. Many of these were left over from World War Two. (Fortunately, these mines don't cause many injuries because they are only found in areas near Egypt's borders.)

Most of the people injured and killed by mines are men, often soldiers. 87% of the people killed in Cambodia, and 76% in Afghanistan are men. But in some countries more than 30% of the people killed and injured are women and children. In some situations, however, most of the casualties are civilians - particularly when people return to areas where lots of mines have been placed. For example, in Namibia 88% of casualties after 1980 were civilians; in Mozambique (1994) 68%; and in Georgia (1994-95) 80%. The deaths of many children may not be recorded: it is thought that 85% of people die before reaching a hospital, so the numbers we have may be much too low. In Hagias in northern Somalia (1991) for example, 75% of mine victims were children. Children, especially, are in danger because they often play with things they find when they are taking care of animals [6].Providing medical care when there is a

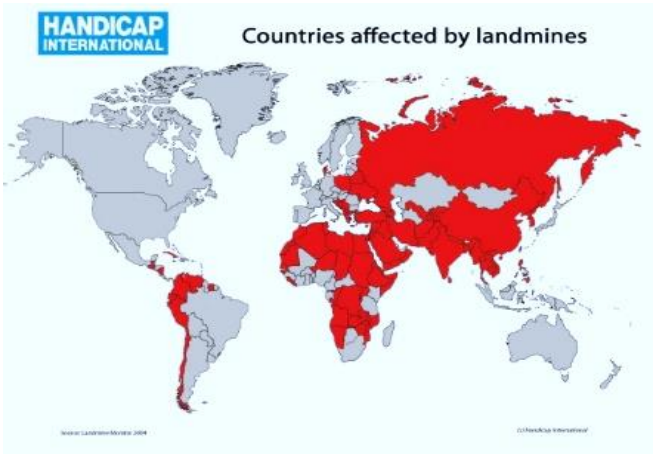

Figure 1 Landmine affected countries

war is very difficult. But landmine injuries create even greater problems. The surgery that is required is very difficult and expensive. In 'developing' countries it costs at least $3,000 to give someone an artificial limb. The UN believes there are about 250,000 amputees worldwide; it would cost around $750 million to give them all artificial limbs. In Cambodia 61% of mine victims went into debt to pay for their medical treatment. In Afghanistan even more did, 84%. A growing child's artificial limb should be replaced every six months; adults need a new limb once every three to five years. These artificial limbs cost around $125: for a child of ten with a life expectancy of another 50 years, the total cost is about $3,125. There are very few facilities for helping victims learn to live more normal lives. There is no care for their psychological problems [6].

III. INJURIES DUE TO LANDMINE BLAST

The force of the explosion attenuates as the distance from the explosion's centre increases (the explosive force is inversely proportional to the cube of the distance from the explosion's centre [7]) and thus it is very possible to sustain a major injury from a small explosive charge in close contact (such as an antipersonnel mine under the foot) whilst experiencing much less injury from a much larger explosive charge several meters away. There is hence an enormous variety in the range of explosive injuries from landmines and UXO. Nevertheless, the International Committee of the Red Cross (ICRC) has been able to identify three main patterns of landmine injury [8].

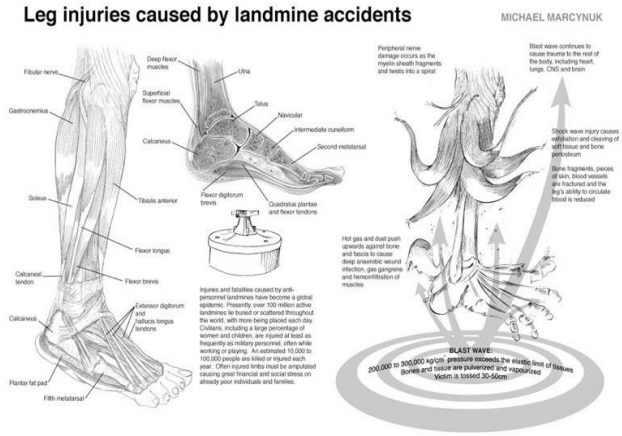

Figure 2 Leg injury due to blast of mine

IV. DEMINING (REMOVAL OF LANDMINE)

Demining or mine clearance is the process of removing land mines from an area, while minesweeping describes the act of detecting of mines. There are two distinct types of mine detection and removal: military and humanitarian.

The core element of an effective mine action programmed is the clearance of mines and unexploded ordnance. No matter what effort is spent on mine risk reduction education, survey, victim assistance or campaigns to ban mines, the mines and UXO that are in the ground must at some time be removed in order to remove the threat that they pose. The large-scale clearance of land of mines and/or UXO is called 'mine clearance' or 'demining'. However, in order to make demining cost-effective, and maximize the effect of limit resources available to most demining programmers it is necessary to carry out several other ancillary activities. The list of conventional instruments are stated below.

1. Ground penetrating radar and Dual-sensor
2. Acoustic detection
3. Mine rollers

4. Mine flails
5. Tillers
6. Mine plough
7. Armored plate excavators

In addition to these, some non-conventional methods are there for detection and removal of mines are Honeybees, Dogs, Rat and Bacteria. Use of these animals are seems to be cruel and it takes long time to train them.

One another wind propelled device is there named mine kafon made by Afghani Massod Hassani. Hassani has designed and built, by hand, a wind-powered ball that is heavy enough to trip mines as it rolls across the ground. Each $50 device looks like an artwork inspired by a starburst. In the middle of the Kafon is a 17kg (37lb) iron casing surrounded by dozens of radiating bamboo legs that each have a round plastic "foot" at their tip. Inside the ball is a GPS unit to map where it has been – and in theory cleared of mines. Around the iron ball is a suspension mechanism, which allows the entire Kafon to roll over bumps, holes and so forth. In all, it weighs a little more than 80kg (175lb). The idea is that it is light enough to be pushed by the wind, but heavy enough to trip mines. Hassani thinks that

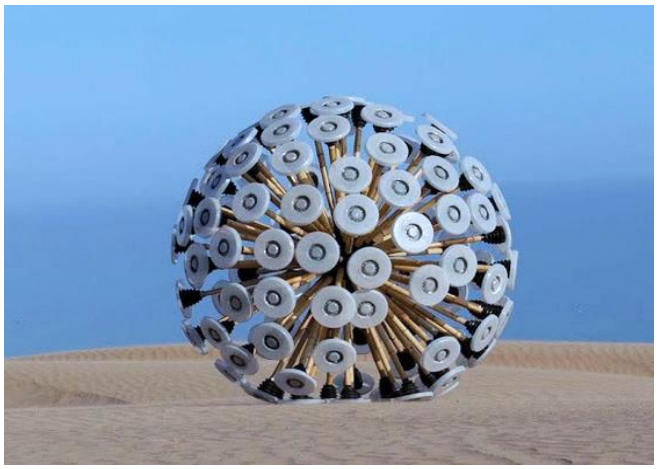

Figure 3 Mine Kafon

humanitarian organizations could take Kafons with them into areas suspected of being mined, and then let the wind do the dangerous work[9].

The Kafon was recently selected as a finalist for the 2012 Design of the Year award at the Design Museum in London. And he says he's working to improve the design of the bamboo-legged device, and is talking with engineers to improve both the form and function of it. He also says he's also working on another, more cylindrical version that could potentially detonate more mines at a time [A1, 2].

V. LANDMINE SWEEPER

I made in depth research on this and found that, if wind direction is on the opposite side of the land which is to be sweep then this device does not work. So I went for making it works under human control and to do so I designed a mechanism, which would help to operate mine kafon against wind. This mechanism is situated at the core of this ball. The detailed explanation is described below.

It works on lever principle and gyroscope principle. The forward- backward motion is common in both principle but the rotation method differed in this method as shown in Figure 4. The center lever is used for turning, if it tilt right ward ball steer on the right side and same for the left side.

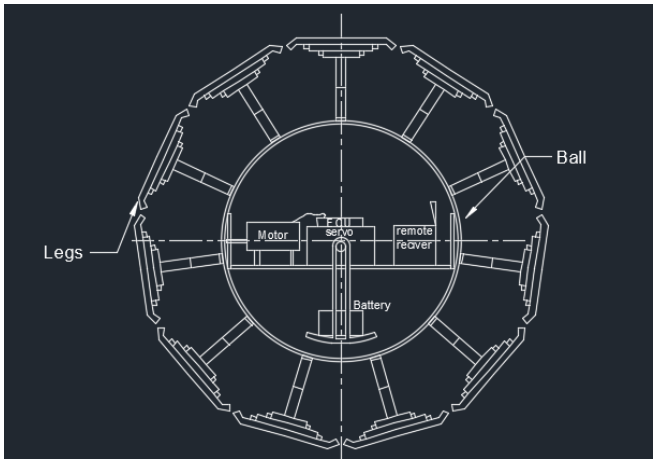

Figure 4 Inside Mechanism of minesweeper ball

As shown in above figure the force mg*COSϴ acting downward, thus it rotate ball in forward motion. During turning central lever is tilted any side to take turn in respective direction. Here torque

$T=mg*COS\theta * l$…… (I)

Where, T= Torque, Nm
l= distance of force from C.G., m
mg= hanging load, N
ϴ= Angle of inclination of lever, rad

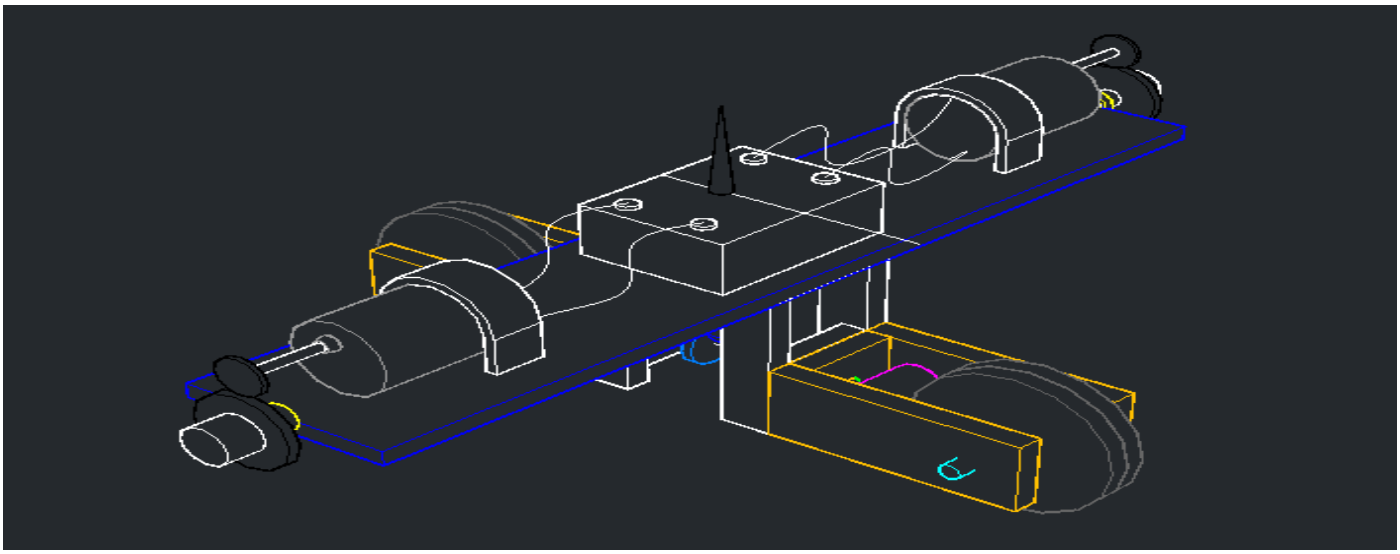

Figure 5 Mechanism of Gyroscope principle for device

Here two resistance are,

1. Rolling resistance=C*F
=C*mg…… (II)

2. Aerodynamic resistance= 0.5*Cd*A*v2*δ…… (III)

Where, C= Coefficient of friction
Cd= Aerodynamic drag coefficient
A= Frontal area, m^2
v= Ball Velocity, m/s
δ= Air density, kg/m3

This resistance should be overcome by applied torque.

VI. SUMMARY

It can be seen that this is an excellent device. Which is portable and easy to operate; it is like playing game or playing with remote car. It costs very low so, in case it would be destroyed in explosion, then on the better side it save valuable life. In addition it has enormous future application like surveillance, guides bomb and marine application. In short it is such a valuable device. Which will serve in humanitarian work in the future.

VII. ACKNOWLEDGEMENT

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VIII. REFERENCES

[1] According to the International Campaign to Ban Landmines (ICBL) www.icbl.org/
[2] 2. For the purposes of clarity, the terms ‘mine action’? And ‘mine clearance’ include clearance of unexploded ordnance (UXO).
[3] IMAS Glossary of Terms
[4] IMAS definition 3.120
[5] “The History of Landmines” by Mike Croll
[6] International Committee of the Red Cross [ICRC] document Anti-personnel Mines: An Overview, 1996
[7] AV Smith: posting on “blast effects” on the MgM
[8] Source: ICRC Video: “Anti Personnel Mine Injuries Surgical Management (1993)”
[9] www.minekafon.org
[10] www.landminefree.org

Articles

[1] Wind blow landmine clearance by Clark Boyd 18 November 2014, BBC
[2] Mine Kafon: The low-tech, high-design tumbleweed minesweeper, 12 July 2013, CNN