Chapter 45
Safer and Faster Humanitarian Demining with Robots

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ABSTRACT

The need to clean almost 1 million landmines on the Turkish border poses a great challenge to the Turkish military, both as a safety and a feasibility issue. In order to achieve this task, an Explosive Ordnance Disposal (EOD) robot has been designed and a prototype has been manufactured. The robot has the capability of working in task space. The uniqueness of this research is that the design criteria and the prototype procedure is explained in detail. After the testing of the prototype, the research results are concluded—which functions the future EOD robots should have and how these functions can improve the performance and ease of use of this type of military robots. Autonomy, use of an advisory system, and automatic camera manipulation can improve the future EOD robots dramatically.

INTRODUCTION

Landmine Monitor reports that there are 984313 landmines in 678 km of Turkish borderline to be cleaned by the year 2014 where the estimated cost for cleaning these mines is around 1 billion US dollars.

Even without considering the cost issue of this very dangerous task, around 674 mines need to be cleaned every day in 4 years. Moreover, considering the fact that almost half of the year this region is under a blanket of snow, which makes it impossible to locate and deactivate the mines, it is impossible to achieve this cleaning task without robots.

Table 1 shows the size of the landmine problem where the number of of casualties caused by the landmines is listed (Landmine Monitor, 2011). It is important to remember that the social and economical effects are even harder to calculate.

Apart from the robotic systems there exists mine clearance systems where the field is swabbed with a truck which carries a roller in front of it (Habib, 2007; Havlik, 2008; Habib, 2008; Habib, 2010). The roller carries chains to beat the area and any explosive is disturbed and exploded. This

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Table 1. Number of casualties caused by landmines

Countries with 1,000 casualties or more from 1999-2008	
Afghanistan	12069
Cambodia	7300
Colombia	6696
Iraq	5184
India	2931
Russia	2795
Angola	2664
Somalia	2354
Myanmar	2325
Loa	2295
Pakistan	1969
Ethiopia	1947
Sudan	1748
Congo	1696
Vietnam	1545
Sri Lanka	1272

type of explosive cleaning is good in clear areas, especially for clearing the area for farming or later development for housing. This type of cleaning cannot be employed around roadsides or at urban areas, since the cleaning itself will cause too much damage to the road.

The mine clearance task is carried out mostly with manpower (Trevelyan, 2008; Furihata, 2005). The experts, first of all, search the area with metal detectors and try to locate the antipersonnel and antitank mines. After the mine is located, a water gun is used to eliminate the electronics or trigger the mine in a controlled environment.

If the clearance team suspects that there is a possibility of mines after a metal detector search, a plow is used to turn over the dirt and possible explosives in it either decreasing the chance of explosion or setting them off. These type of plows are either specially designed to protect the driver or they are remote controlled.

When the speed is also important and the user is only interested in the use of an area, not total clearance, a vehicle with a blade attached can be utilized. In this type of cleaning, the vehicle with the blade just pushes the explosive material away from the specified area. This can be very useful if the people are only interested in using the area or the road, and when a quick cleaning is necessary for the mission. An explosion can occur, but it is more important to clean the road for the vehicles, the damage on the road can be sacrificed.

The necessity of using a robot rises from the fact that it not always possible to use heavy duty mine and explosive clearance machines in an urban area. Both the military and the police forces want to disengage the explosive rather than detonating it, because the damage from the explosives is not acceptable most of the time. The disengaging is achieved by eliminating the triggering mechanism, the electronics, of the explosives. Especially a high-pressurized water gun, a disruptor (Figure 1), is used to break down the electronics of the explosives. The fact that the water spreads and covers a greater area than a bullet increases the chances of successful deactivation.

Apart from the devices designed for safer neutralizing of an explosive ordnance, existing robotic systems for demining can be categorized

Figure 1. A water gun is used to deactivate an explosive device