

Lean Robotics For Humanitarian Mine Sweeping

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Abstract— The robot mine clearing, based on cheap farming equipment, aims at transforming the terrorist anti-personnel mine into useless practice, after that the land reclamation is readily fulfilled by standard means. The paper addresses the following lines: • to conceive and implement low-cost robotic equipment, assuring effective, safe and reliable demining; • to allow simple equipment integration, with resort to low-cost and widely available agricultural fixtures; • to provide the basis for on-duty assessment and training assistance by alarm (warning, emergency) effective management; • to make easier the operators groundwork, involved in self-learning and up-grading duties. The mixed-mode automation, through remote-steered robotic effectors, grants balanced resources use on the strategic, tactical and execution horizons.

I. INTRODUCTION

THE humanitarian demining is impending duty of developing countries, when ethnical, religious or political motivations oppose the local communities into guerrillas actions. Mostly, the warriors have the ability to take territory, but holding it proves difficult [9], thus, the ceaseless burial of new landmines is routine, making demining endless. The robots are questionable aid. Chiefly, they work well for clean and reliable tasks. When the price to performance ratio is too high, they are academic toys. The technology might be winning, on condition to become locally appropriate setting.

The study addresses the Sri Lanka case, where the endemic warfare characterises by serious on the field conditions [4], [8], [10], and grave economic course [6], [3]. The lean robotic aids [7], have to satisfy a series of requirements, such as:

- to exploit simple, sound and low cost devices, locally easy to find, to assembly and to maintain;
- to limit the in situ manufacture/adaptation tasks, within widely existing competencies;
- to involve front-end indigenous operators, directly interested in the mine clearance success;
- to promote the familiarity with the equipment, requiring active co-operation commitment.

Manuscript received March 12, 2009.

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If the conditions are met, the instrumental and workforce aids are available on place, removing the need to hire expensive rigs and foreign specialists.

The resort to neighbouring resources permits saving money (foreign deminers are paid ten or more times the native ones), and motivating the on-place workers to collaborate at reclamation duties, with time-limited salaries.

The native population's technical knowledge is poor; the access to high technology component is almost nonexistent. Nevertheless, to successful outcomes, the *in situ* materials, manufacture, and manpower should be used to perform demining operations and to maintain the all equipment. At fault, the land recovery becomes the business of unrelated NGOs, with biasing effects on the native social commitment.

The *in situ* existing know-how and professionalism need to be charily weighed up. The rural area is adequately developed, and widespread agricultural machines are available and nearby up-kept or adapted. The Universities of Moratuwa and of Peradeniya are working in the domain, and suitable investigations are successfully fulfilled [5]. The support of indigenous skill and operators is crucial aspect, from where to move, to build dependable solutions.

The devised proposal distinguishes because the robotic demining framework is entirely based on hardware devices of Sri Lanka origin and deeply rooted in the native habits. The software additions are suitably established to achieve robotic protection and effectiveness. The mine sweeping remains job needing the express workers' contribution, so that they directly feels to have total responsibility, should the process be inadequate.

The robot aid is introduced for two incentives [1]:

- to avoid risky conditions, by the remote steering of appropriate demining effectors;
- to transfer the education ability, enabling intelligent work organisation proficiency.

Both derive from recent technological deployments, where the focus is in the integration of skill and diligence, to require co-operative problem-solving attitude and willingness, so that the initiative and ingenuity of the operator are crucial enabler of the task success.

II. ROBOT-AIDED EQUIPMENT

The conventional robot demining resorts to armoured vehicles, to get rid from risky outbreaks, and to sophisticated sensors, to detect and classify the buried weapons. The intended duty is, here, limited, because only personal mines, left in laboured lands, are addressed,