

# The AROUND project: Adapting robotic disaster response to developing countries

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**Abstract** — The global climate change induces an increase, in terms of frequency and devastating power, of natural disasters (particularly in developing countries). For facing this, there is a growing need for robotic assistance, for collecting information, managing disaster situation, rescuing victims and preserve human lives. It is one of the means recommended by the UNPD (United Nations Program for Development), which consist in the deployment of on-field automated monitoring, surveillance and reconnaissance systems. This paper outlines the research performed in the AROUND (Autonomous Robots for Observation of Urban Networks after Disasters) project. This project addresses the issue of developing a search and rescue multi-robot systems taking into account specific constraints of developing countries.

**Keywords:** *Disaster response, Multi-Robot Systems, Cheap robotics, Spatial Decision Support System, Robustness, Image retrieval.*

## I. INTRODUCTION

The global climate is changing, affecting the planet with more and more frequent and devastating natural disasters. With growing confidence, scientists predict an increase in extreme weather affecting people worldwide, especially in developing countries. Vietnam, the target country for the project described in this paper, is considered as one of the most disaster-prone countries [7]. In addition, the fast pace of industrialization and urbanization shapes disaster risks through a complex association of concentrated populations and higher industrial hazards. As a consequence, in cities like Hanoi, not only are disasters (floods, storms, cyclones, fires, earthquakes, transportation and industrial accidents, or incidents stemming from hazardous substances) much more likely to happen, but these two uncontrolled dynamics make any intervention more difficult (like during the 1983 Hanoi earthquake [12]).

Reports on urban emergency relief [19] point out that the most serious difficulty is the delay of communication of reliable information between the authorities in charge, especially district authorities, which are supposed to coordinate efforts in real-time and make requests for support at the city level. Moreover, in Vietnam, the observation tools at their disposal

are still rudimentary, with low level of automatization. The collection and transmission of data are mostly done manually [21], which results in delays between the occurrence of an event, its assessment and its handling.

One of the means recommended by the UNPD<sup>1</sup> consists in the deployment of on-field automated monitoring, surveillance and reconnaissance systems. The development of such systems is viewed as one of the keys for reducing the human cost associated with disasters, especially in urban areas, where most of the victims die during the first 48 hours partly because they are not detected on time [19] and where rescuers themselves face great dangers when exploring the impacted sites. The World Conference on Disaster Reduction (WCDR) [20] stresses this necessity in points no 89 (“Advanced technologies for disaster reduction”) and no 90 (“Monitoring and modeling techniques for local communities and decision makers”) of its final report. As a consequence, a number of researches worldwide ([13], [8]) already explore automated data collection and interpretation after disasters. However, most of them (conducted in developed countries) do not consider the economical and industrial constraints under which these systems could be deployed in developing countries, which are (and probably will remain in the future) the most affected areas. As a consequence, the results of these researches are hardly ever adapted to the economical constraints and climatic context of the concerned countries.

The aim of this paper is to outline both the specificities of developing countries in terms of “search and rescue” robotics and the AROUND<sup>2</sup> project. This project aims at providing robotic solutions under developing country constraints. Our paper is organized as follows: in Section II, we highlight the necessity to adapt “search and rescue” research programs in order to take into account context specificities of developing countries. Section III gives a global presentation of the AROUND project. In Section IV, we describe in details some

<sup>1</sup>United Nations Program for Development

<sup>2</sup>Autonomous Robots for Observation of Urban Network after Disaster