

# *Abstract*

In the recent years, many researchers show interest in developing search and rescue systems composed of one or multiple robots, which have the mission of finding victims and identifying the potential hazards. To enhance the robotic systems there is a growing trend of integrating wireless sensor networks (WSNs) to robots and multi-robot systems, to give more awareness of the environments. In this thesis, we present a state of the art of robotic systems and multi-robot systems and we present the different wireless sensor network(WSN) applications for search and rescue activities. Moreover, we expose a system that integrates WSN with a robotic system and we discuss the remaining open issues in all these fields.

This thorough state of the art study, lead us to propose an overall system that helps to coordinate between WSNs and wireless robots in a search and rescue operations. This system aims to help a group of robots to rescue immobilized victims. For this, we propose a fully distributed solution that is composed of mobile robots and WSN. The proposed system considers a new design of the monitored area and Alert dissemination. This design considers a new grid-based architecture for sites monitoring over WSNs for enabling search and rescue applications.

To disseminate efficiently and promptly data exchanged in the proposed network model, the proposed system considers a new scheme for data dissemination. No-Collision Grid Based broadcast scheme (NCGB) is the scheme that we propose for data dissemination. The information that the broadcast scheme disseminates helps in state notification and path construction and also helps in guiding the robot through the safest and shortest route in a distributed manner. To start the navigation the robot first schedules the sequence of victims to rescue in a way to increase the number of saved victims. For this, we proposed to use Ant Colony System with Victim Lifetime Window (ACS-VLW) to solve the problem of navigating robot. The required navigation will browse immobilized victims using the shortest and safest path. This ensures an increase of the rescued victims number.

The use of ACS-VLW considers only the existence of one robot to rescue a group of victims. To consider the case of multi robot where they try to move to the same group of victims we proposed a distributed decision making process that helps in guiding a set of robots to efficiently execute a rescue task. The proposed process makes only the most suitable free robot / agent moves to the nearest and urgent target.