

Chapter 7

Overview of Wireless Sensor Network, Robotics, IoT, and Social Media in Search and Rescue Activities

Sarah Allali

University of Science and Technology Houari Boumediene, Algeria

Mahfoud Benchaiïba

University of Science and Technology Houari Boumediene, Algeria

ABSTRACT

In recent years, many researchers have shown interest in developing search and rescue systems composed of one or multiple robots. To enhance the robotic systems, wireless sensor networks and internet of things (IoT) were integrated to give more awareness of the environments. Additionally, data exchanged in social media during emergency situations can help rescuers, decision makers, and the public to gain insight into the situation as it unfolds. In the first part of this chapter, the authors present a review of robotic system and their environments in search and rescue systems. Additionally, they explain the challenges related to these systems and the tasks that a robot or a multi-robot system should execute to fulfil the search and rescue activities. As a second part, the authors expose the systems that integrates WSNs and IoT with robots and the advantages that brings those. Furthermore, they expose and discuss the remarkable research, the challenges, and the open research challenges that include this cooperation.

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1. INTRODUCTION

Search is the activity of finding survivors, victims or a searched object; while rescue is the activity of extricating survivors, victims or a searched object. The search and rescue activities start when the rescue center sends a team of rescuers to inspect the disaster area. In this step, the team search for victims via a systematic or a random search and collects other information about the disaster area that may affect the rescue operations for example: obstacles, falling debris, toxic gases...etc. After this step, the rescue center plans the rescue activity by creating a map of the disaster area that contains the location of victims. This helps them to excavate rubbles and rescue victims. Finally, victims are transferred to hospitals and the disaster area is put under surveillance for any changes.

To execute these tasks, researchers proposed to add robot to help in the search and rescue activities. Then, to achieve this mission quickly, efficiently and accurately a cooperation between robots was proposed. This way of search and rescue activities will fulfil in a team mission. This team cooperation could replace the need for human presence in the disaster site for almost all the steps of search and rescue operation cited previously. However, there are some challenges that this system faces, these challenges are related to the mobility, communication, control, robot's sensors, power and the human robot interaction (HRI). Also, there are some challenges related to the reliability of the system such as: optimizing mission times, robot localization, creating the disaster area map, decision making, improving robots reliability, finding the maximum number of victims, sending the maximum of information to the rescuers (see Murphy (2008)).

To overcome some of these challenges, an inclusion of stationary sensors in the system was proposed; those sensors help to coordinate between robots and make them more aware of the surrounding environment. These sensors do several tasks to help robots in their missions. They could be relays that send the information collected from robots to the operator. They could be also coordinators that transmit the data between robots to extend robots coverage. They could help to have a distributed tasks allocation (For example, one sensor choose the robot that move to a destination). The use of sensor network could help to solve the problem of resource conflicts by routing data in different paths. Additionally, having a wireless sensor network (WSN) is the best way to monitor the whole disaster area and to detect the different events that might happen at any time. Furthermore, the WSN track victims and robots to communicate their location in real time to the rescuers. However, this wireless sensor network has several challenges related to the hardware of sensors used, to the energy consumption, to routing protocols, to the degree of autonomy and to the quality of services.

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