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Formal Analysis of Search-and-Rescue Scenarios

Project for Formal Methods for Concurrent and Realtime Systems course

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Abstract

This document presents a formal model implemented with Uppaal of search-and-resque scenarios. Inside a rectangular map of arbitrary size, civilians have to be brought to safety by either reaching an exit or being assisted by first-responders. Drones surveys the area and coordinate the rescue efforts by instructing civilians on what to do. The model then undergoes formal verification to highlight key behavioral aspects and identify optimal configurations for maximizing civilian safety.

1 High Level Model Description

The model adopted for the search-and-resque mission involves 3 different types of agents:

- **Civilians**: Can be in 3 different states, depending whether they find themselves near a fire or if they are following instructions
  - **In-need** (i.e. near a fire): They cannot move and needs to be assisted. After T_v time units near a fire, they became a casualty
  - **Busy**: The civilian is following an instructions and can be either assisting directly or contacting a *first-responder* to get help
  - **Moving**: When civilians are not near a fire or busy enacting some instruction, they can move towards an exit to get to safety following a some *moving policy*
- **First-responders**:
  - **Assisting**: When a civilian *in-need* is withing a 1-cell range, the *first-responder* will assist them for T_{fr} time units. After that, the assisted civilian is considered safe
  - **Moving**: When free from other tasks, the *first-responder* can move following some *moving policy*
- **Drones**: They survey their surroundings, limited by the field of view N_v of the sensors, and follow a pre-determined path moving 1 cell at each time step. When two civilians, one *in_need* and one free, the drones can assign instruct the free civilian to either assist directly or contacting a *first-responder*

2 Component Description

2.1 Design Choices

3 Properties

4 Conclusion