

# CSC 4301

## Embedded Systems

Final Project Proposal:  
A.R.T | Automated Rescue Team

American University of Cairo  
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# THE BLUE TEAM

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## ABSTRACT

Our project idea is to create an automated urban rescue system, where a patrolling car scans city blocks, localizes itself by detecting road intersections and comparing them to its pre-existing map of the city's intersections, and detects emergency alert signals, which can be images of fires, robbery crimes or medical emergencies. Based on the emergency type, the patrolling car alerts a suitable rescue car; a firefighting truck, police car or ambulance, of a new mission and coordinates its best path to the emergency location.

## TECHNOLOGIES AND TOOLS

The tasks of the system will be divided between the patrolling car and the rescue ones, where the patrolling car is the master of the system, controlling most of the rescue cars' decisions.

### Patrolling Car

Operated by a Jetson TX1 board and equipped with an extra USB camera, IMU sensor and Arduino board for serial interfacing with the IMU. This car's duty should be capable of the following:

- Navigating through road tracks accurately using PID and computer vision
- Detecting and classifying flag signs from buildings during its cruises around the city blocks using deep learning
- Detecting road intersections for map localization purposes
- Coordinating the states of slave rescue cars, which includes assigning missions to them as well as their path routing
- Handling possible errors and deadlocks, which may occur at intersections

### Rescue Cars

Each operated by a Raspberry PI board and equipped with an extra USB camera and IMU sensor. This car's duty should be capable of the following:

- Navigating through road tracks accurately using PID and computer vision
- Communicating with the master patrolling car to receive new rescue missions and valid routes.

- Detecting road intersections for navigation guidance during missions

Therefore, the system will have 5 moving dagu platforms, with a Jetson TX1 board as the main computing platform alongside five Raspberry PI and an Arduino board. There will be a high dependency on computer vision for the analysis of video feeds from the patrolling car in order to detect emergency alert images, which will be classified using deep learning, in addition to the application of PID for the road navigation of all cars. The patrolling car will act as a server to the slave rescue cars, which will act as clients on the network as they interact with their environment during their rescue missions. The patrolling car will also be responsible for the synchronization between all rescue cars, as well as the network streaming.

## REQUIRED EQUIPMENT

- 5 Dagu robot platforms + Batteries
- 5 Pololu TReX Motor Controllers
- 1 Jetson TX1 board + Battery
- 4 Raspberry PI boards + Cases + Power Banks
- 5 Arduino Boards
- 5 USB Cameras
- 5 MinIMU sensors

## PROJECT MILESTONES



### First Milestone: Wednesday, 28 March

The following to be delivered:

1. Map creation and scenario envisioning (*John*)
2. IMU calibration on Raspberry PI (*John*)
3. Finding an emergency alerts training image dataset (*Aley + Sara*)
4. Understanding client-server python networking using Raspberry PI (*Aley + Sara*)
5. Color segmentation of road track (*Karim + Yasmin*)
6. PID testing on road track (*Karim + Yasmin*)



### Second Milestone: Sunday, 15 April

It is intended that the full project should be functioning modularly on the patrolling car and the firefighter car only.

1. Networking between the patrolling car and the firefighter car
2. Road navigation using PID and computer vision
3. Emergency detection using Darknet training
4. Localization using QR Codes



### Third Milestone: Sunday, 29 April

The project should be fully integrated and functional on all 5 dagu cars, pending final testing on the finalized city model for the embedded day demo.