# AASMA Project Proposal

Emergency responses - Group 31

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## 1.ABSTRACT

In this proposal we wish to present and develop the theme for the first project delivery, which is related to the implementation of a multi-agent system. Our chosen theme is theme 6.2.3, which corresponds to Emergency responses.

## 2. INTRODUCTION

### 2.1 Problem definition

Our project aims to create a system that effectively dispatches ambulances and resources in order to respond to emergencies. The problem arises in managing the distribution of the available emergency transports, so that the response times are minimized and there are as few shortages of resources as possible.

### 2.2 Relevance

The relevance of our system resides in the fact that emergencies take place every day and that they can take people's lives or harm them in terrible ways. However, proper management of resources can do a lot to avoid these problems and by prioritizing the right emergencies first, according to their types and severity, lives can be saved faster and in a more effective way.

### 2.3 Motivation

Taking all of this into consideration, our motivation comes from wanting to build a system that maximizes the usage of the available resources, so that lives will not be lost due to poor management.

## 3. APPROACH

The agents in our system will be Communication Emergency centers that will be implemented as deliberative agents i.e., following a Beliefs, Desires, and Intentions model (BDI).[1] These centers will be able to receive emergency calls and manage the various hospital's resources, namely, allocate which emergency transports should be sent to which emergencies. The communication centers can also communicate with each other, coordinating their approach in the distribution of resources.

As a basic response, Communication Emergency center's will be able to determine the location, type, severity, and the number of patients involved in an emergency and decide the type and number of the resources that need to be sent.

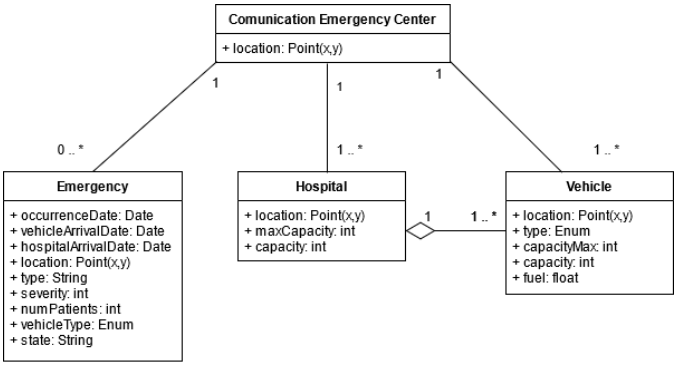
For this purpose, we defined the following types of emergencies and vehicles:

- Types of Emergencies:
  - Transportation of Patients
  - Basic Life Support
  - Intense Care Support
- Types of Vehicles:[2]
  - Vehicle for transportation of patients
  - Basic Medical Aid Ambulance
  - Intense Care Support Ambulance

Vehicles and hospitals have a maximum capacity of patients they can take, so it can be necessary to send more than one vehicle to one emergency and a vehicle will not be able to take patients to the nearest hospital if it is full. The hospital also has the ability from time to time to discharge patients, lowering their current capacity.

The utility function of the system prioritizes emergencies with higher severity, vehicles with shorter distance to emergencies and hospitals with shorter distance to emergencies.

### 3.1 Architecture




### 3.2 Requirements

- Each communication center can only detect an emergency if it receives an emergency call.
- Each communication center must have full access to the emergency information and all hospital's data and vehicles which are updated with the collaboration of other communication centers.
- Each type of vehicle is specified for certain types of emergencies.

- There is a maximum capacity of patients for each hospital.
- Each vehicle has a maximum capacity of patients that it can carry.
- Emergency calls will function as events that will be alerting communication centers along the program execution.
- A vehicle cannot drive if the fuel level is under the fuel reserve limit.
- The longer it takes for a vehicle to respond to an emergency and reach back the hospital, the higher the probability that the emergency will not be handled successfully.

### 3.3 Environment Properties [3]

- Inaccessible: The agents cannot obtain complete, accurate, up-to date data about the environment's state since it does not know where an urgency is developing next until a call is made.
- Non-deterministic: An action does not have a single guaranteed effect since an emergency response is not guaranteed to be successful.
- Dynamic: The world changes while the agent is deliberating, since new emergencies evolve with time, as well as hospital's vacancies.
- Discrete: The number of possible actions and percepts our agents can execute in the environment are finite.
- Non-episodic: The world cannot be divided in a series of intervals (episodes) independent of each other, since emergencies, communication centers, vehicles and hospitals are dependent on each other.

### 3.4 Agent Properties [3]

- Reactive: Our agents maintain an ongoing interaction with its environment, responding to its changes such as new emergencies.
- Rational: Our agents act to maximize the defined utility function.
- Coordinate and Cooperative: Collaboration is necessary between our agents in order to optimize the resources and response time.
- Autonomous: The agents are able to act independently and determine how to achieve their own goals.

### 3.5 Agent Sensors

- Detects Emergency: Receives a signal of an incoming emergency call.
- Emergency Data: Identifies the emergency's type, severity, occurrence date, location, and number of patients.
- Vehicle Data: Detects the location, type, current capacity, maximum capacity, and fuel level of a vehicle.
- Hospital Data: Identifies the hospital's location, current capacity, and maximum capacity.
- Needed Vehicle Type: Identifies the type of the vehicle needed for the emergency.
- Vehicle Arrival Date: Gets the arrival date of the vehicle to the emergency.
- Hospital Arrival Date: Gets the date of the arrival of the emergency's patient(s) to the hospital.
- Emergency State: Checks if the emergency was successful or not.

### 3.6 Actuators

- Handle Emergency: Process the emergency's data.
- Select Vehicle: Selects the appropriate vehicle(s) to get to the emergency according to type, severity, location, vehicle capacity and fuel level.
- Select Hospital: Selects the appropriate hospital for a vehicle to drop the patient(s) according to severity, hospital capacity and location.
- Refuel Vehicle: Sends vehicle(s) to nearest hospital when fuel is running low.

### 3.7 Communication

- Broadcast Message: Broadcasts to other communication centers when it assigns vehicles to emergencies and when vehicles drop the patients at the hospital.
- Ambulance Message: Sends messages to active ambulances.
- Receive Message: Updates the Emergency Communications center's environment with emergencies that are already being handled by the other centers and dropped patients at hospitals, i.e., hospitals' current capacity.

## 4. METRICS

In order to test our system's goals, the following metrics will be evaluated:

- Rate of successfully handled emergencies.
- Time taken to handle an emergency.
- Effective prioritization of emergencies according to type and severity.
- Impact of shortages of resource levels.

## REFERENCES


[1] Deliberative Agents - slides provided at the course page https://fenix.tecnico.ulisboa.pt/downloadFile/1689468335703219/06%20DeliberativeAgents.pdf

[2] Auto Ribeiro - Tipologias de Ambulâncias https://autoribeiro.com/tipologias-de-ambulancias/

[3] Agent and environment properties - slides provided at the course page https://fenix.tecnico.ulisboa.pt/downloadFile/1970943312353657/02AgentProperties.pdf