

**Net Technologies
Finland Oy**
in cooperation with
National and Kapodistrian University of Athens

Present
A Civil Protection System



Net Technologies Finland Oy

Civil Protection System

- In recent years, societies have been in the epicenter of several natural disasters, attacks of various types, as well as urban disasters of different nature, which have been increasingly catastrophic and life-threatening.
- Countries also facing frequent earthquakes, wildfires, floods and other extreme weather conditions, that sometimes result in casualties.
- Currently Europe exploits a centralized evacuation alerting system, the “112”, which is a good first step, but many improvements could be made to provide a holistic approach to the end users.

Civil Protection System - Motivation

- We aspire to create a universal, de-centralized, easy to use evacuation system, that will provide a complete service of civil protection, which in recent years has proven to be a necessity.
- The need of an efficient protection mechanism towards civilians has inspired us to develop a novel civil protection system without compromising user-friendliness and automated decision-making effectiveness. Our Civil Protection System focuses on a human-centric approach while tackling different and challenging scenarios.
- We have developed the Civil Protection System, that is easily applicable as well as adaptable to a plethora of scenarios as it has the potential to efficiently guide the civilians away from any hazardous situations.

NETFI and NKUA

- ▶ NETFI has cooperated with NKUA to exploit the Civil Protection System, initially designed in the SCAN Lab (Software Centric & Autonomic Networking Lab) of NKUA.
- ▶ A demonstration of the system will be presented having an area in Athens as pilot.

Civil Protection System

- ▶ The Civil Protection System consists of:
 1. A web interface controlled by an administrator (municipal bodies, public sector bodies, emergency departments etc.), visualizing in real time any present and/or potential future emergency events in order to proactively take actions.
 2. A smartphone application for alerting and assisting the end users (civilians) in case of an emergency event

Civil Evacuation Emergency System

Home Page

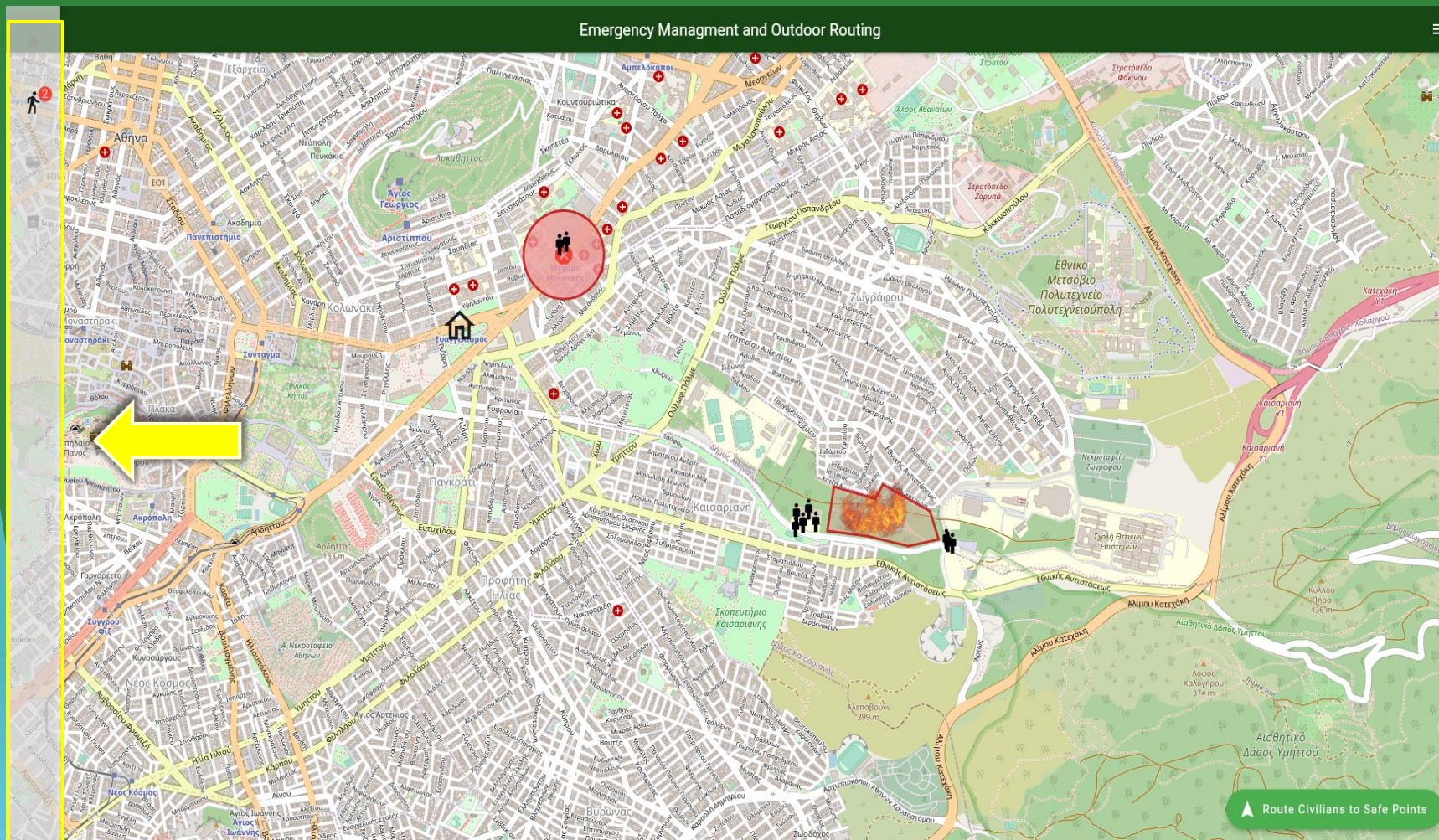
Civil Evacuation Emergency System

Welcome to administration area of Civil Evacuation and Emergency System

The Civil Evacuation Emergency System consists of:

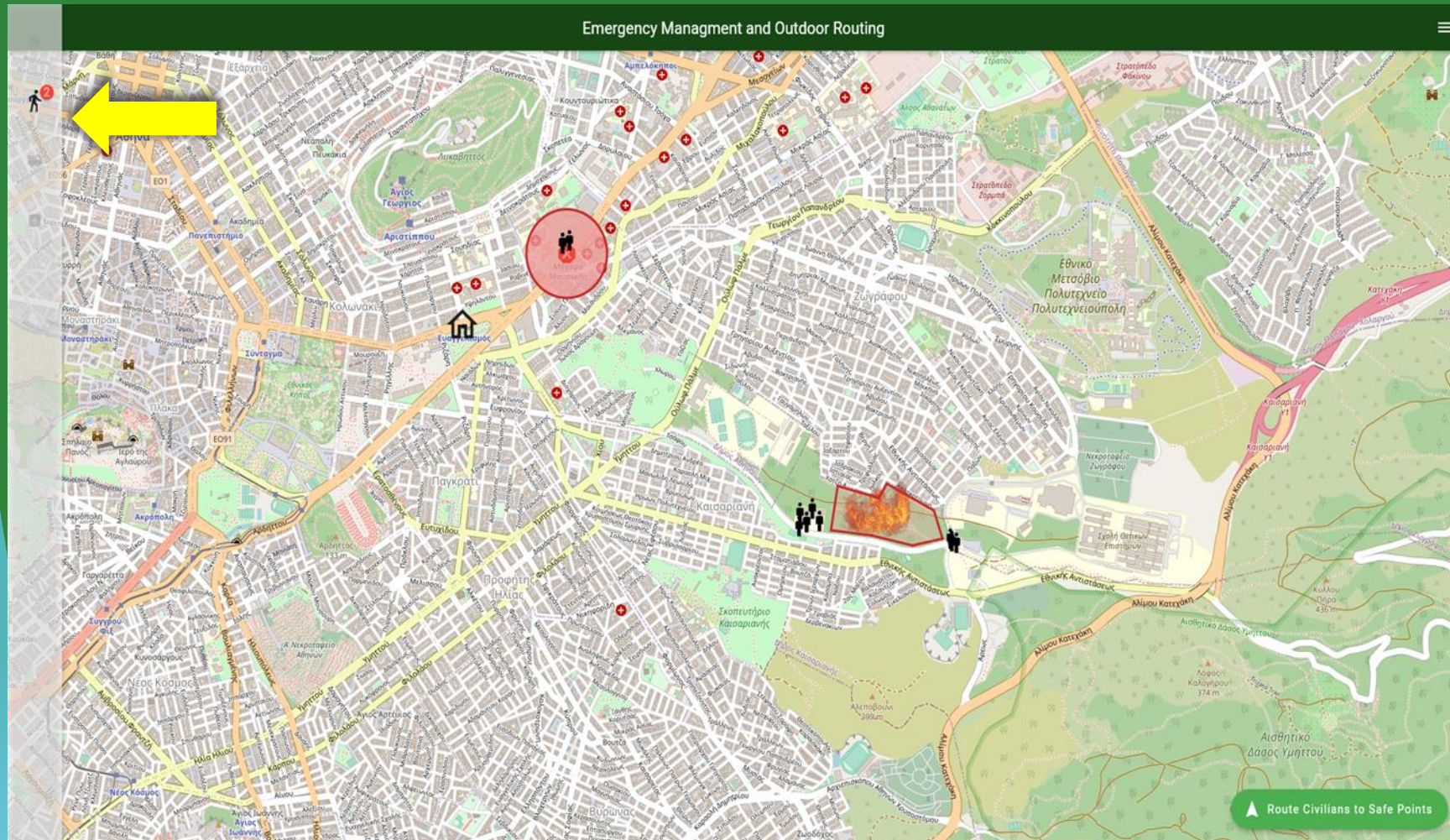
1. A web interface controlled by an administrator (municipal bodies, public sector bodies, emergency departments etc.), visualizing in real time any present and/or potential future emergency events in order to proactively take actions.
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1. Web Interface of the Civil Protection System



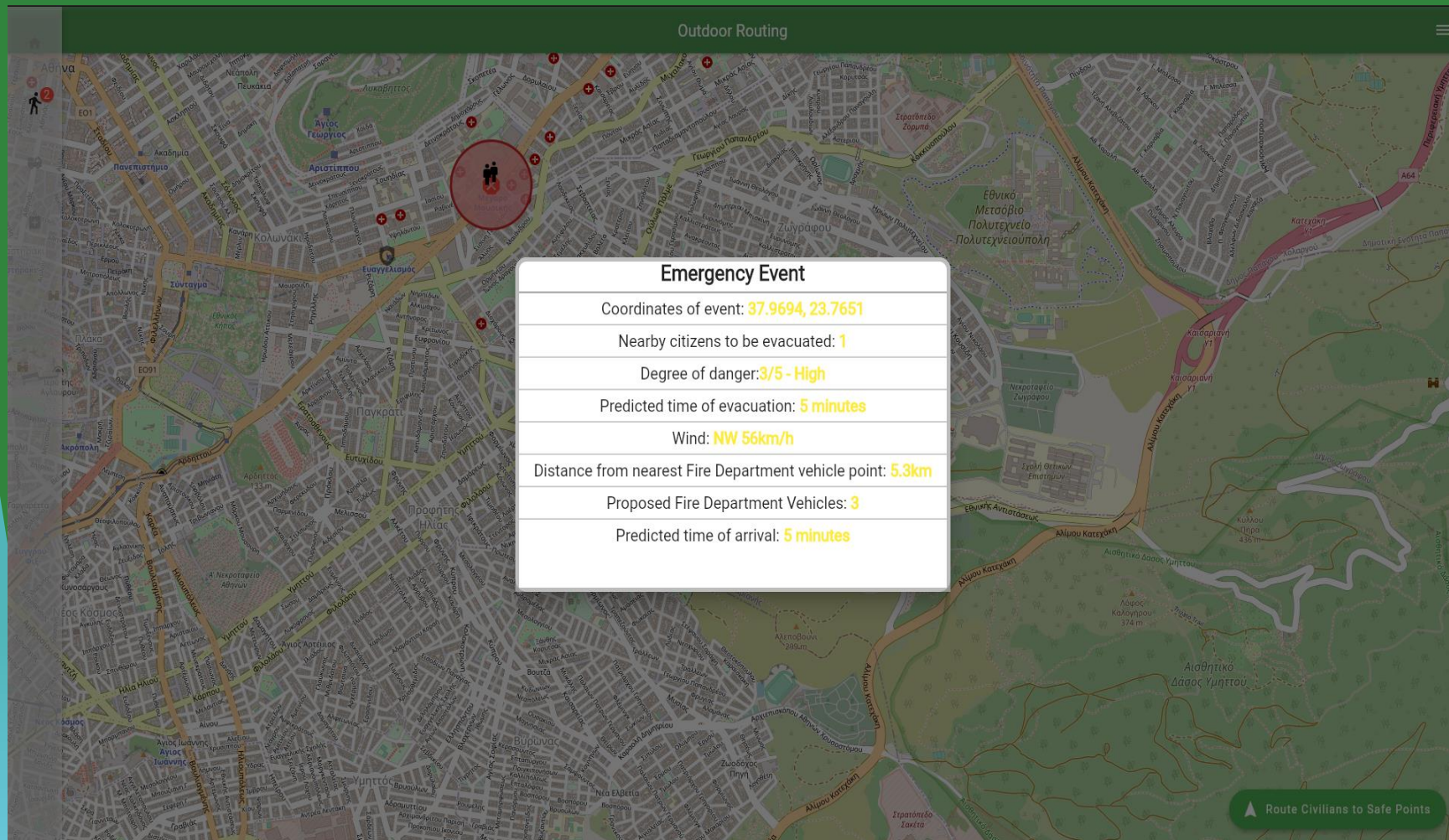
- The left side of the web interface includes the main administration panel, providing access to the set of different functionalities made available by the Civil Protection System.
- **Administration Panel Options:** Emergency Management and Outdoor Routing, Fleet Control, Emergency Request Form

1. Web Interface



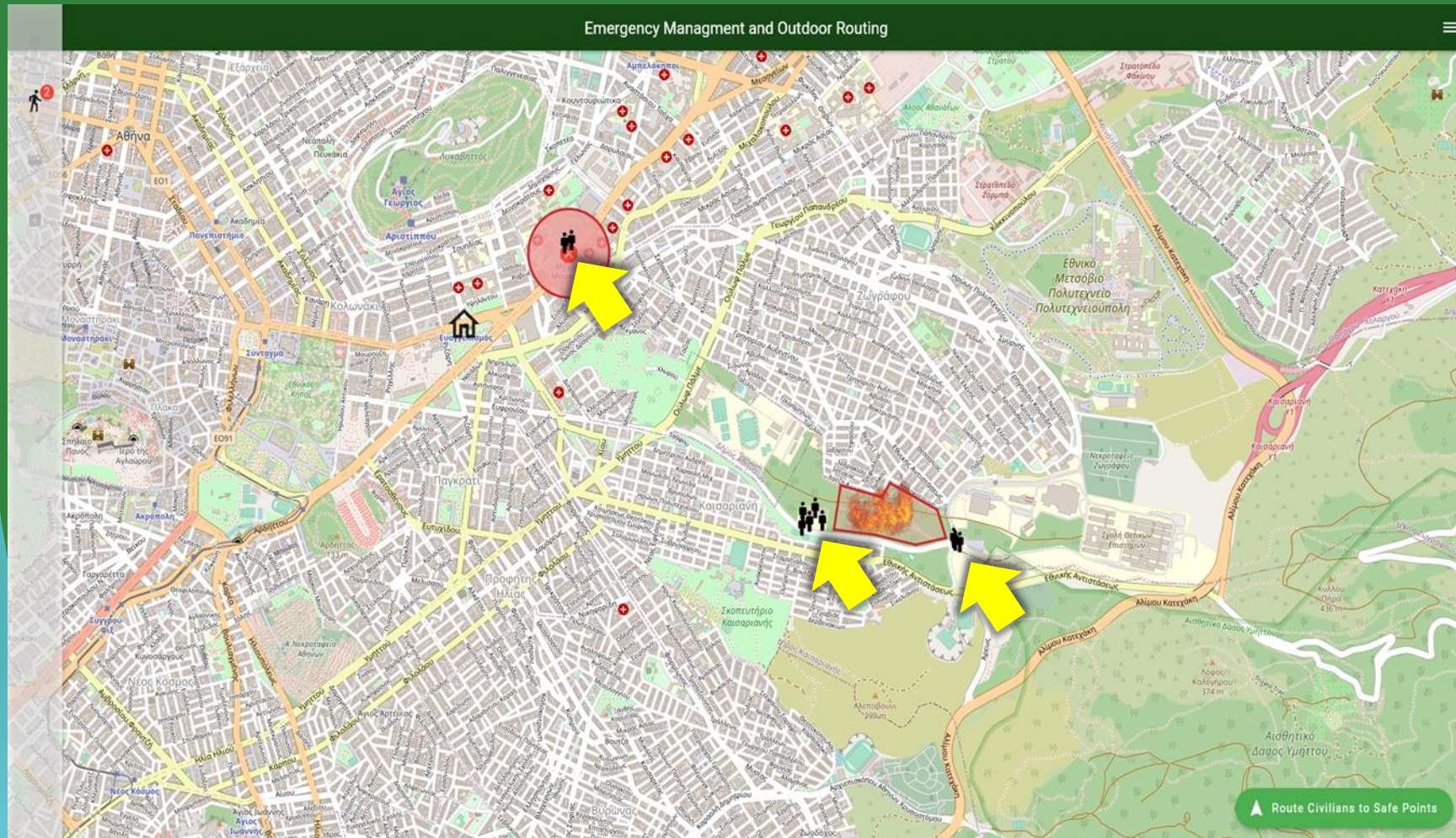
- The first option in the administrator panel is the Emergency Management and Outdoor Routing.
- This page illustrates a street map with all identified emergency events.
- The total number of the identified emergency events is indicated next to the related icon of the first option on the panel.

1. Web Interface



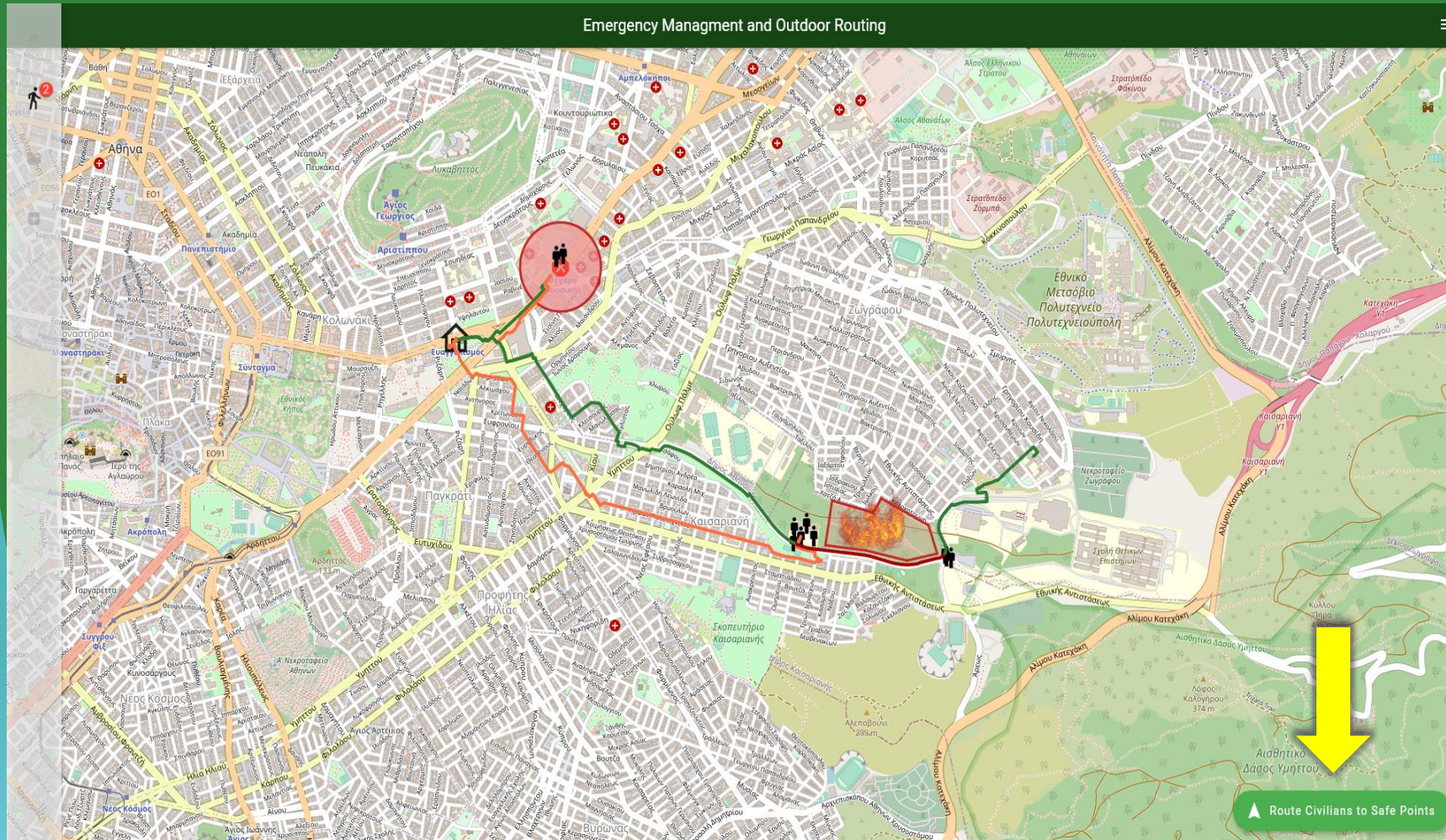
- Each emergency event is depicted as an outlined red colored area of interest along with a relevant icon representing the type of event.
- For each emergency event illustrated in the street map there is an information window, providing information with regard to the selected event (e.g. geolocation, danger severity, time of emergency identification).

1. Web Interface



- Civilians located near each emergency event are automatically grouped based on geospatial data in order for each group to be safely navigated to the closest safety point illustrated by a home icon.
- The civilians are represented by human icons in the street map, while the color of their icons is the same with the assigned safety point.

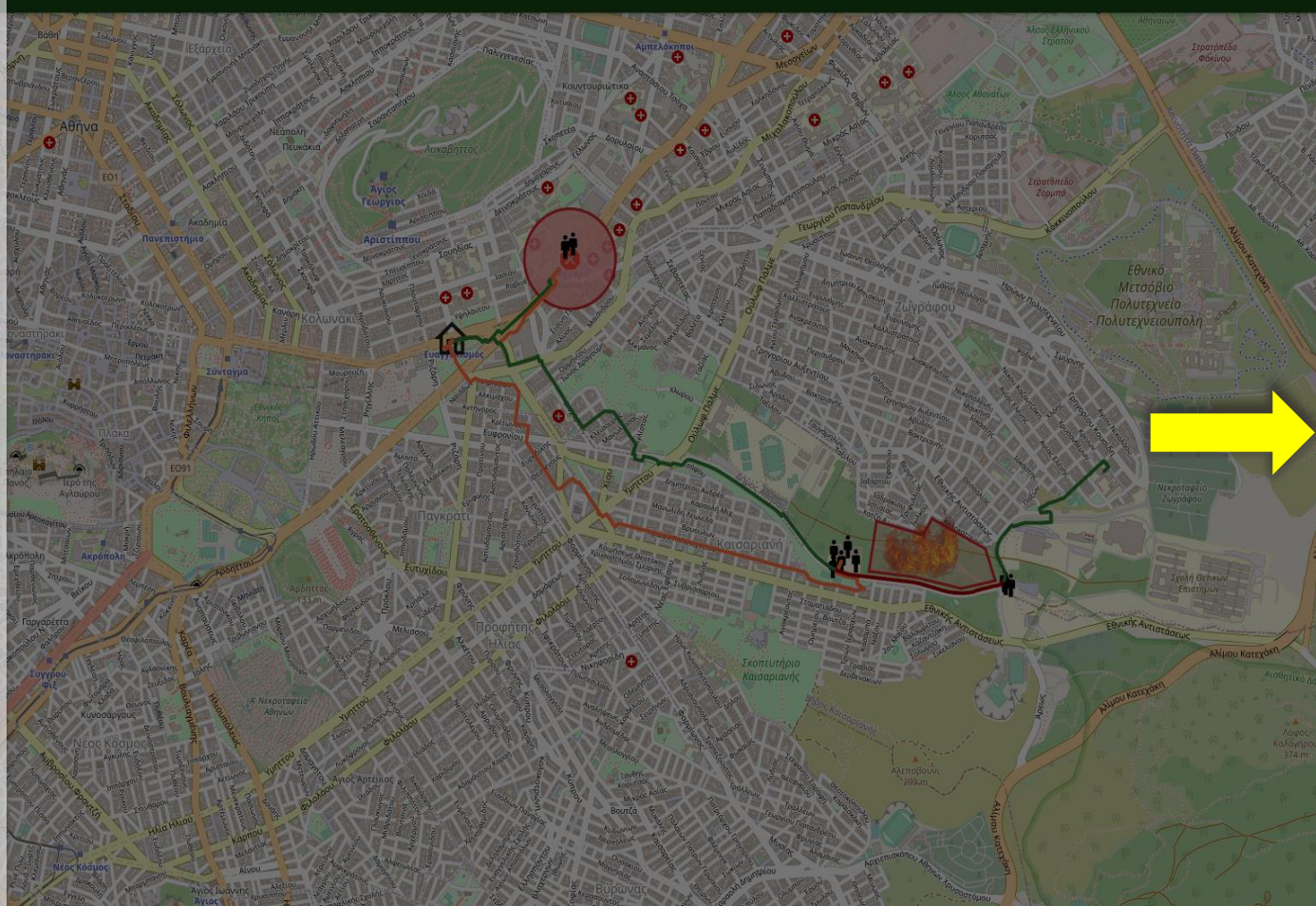
1. Web Interface



- At the bottom right side of the page there is a button named “Route Civilians to Safe Points” that automatically provides a list of the top fastest navigation options from each civilian group to the assigned safety point. The fastest routes are highlighted with green color.
- The proposed navigation instructions are then sent to the civilians’ mobile applications in the form of alert after the approval of the administrator.

1. Web Interface

Emergency Management and Outdoor Routing



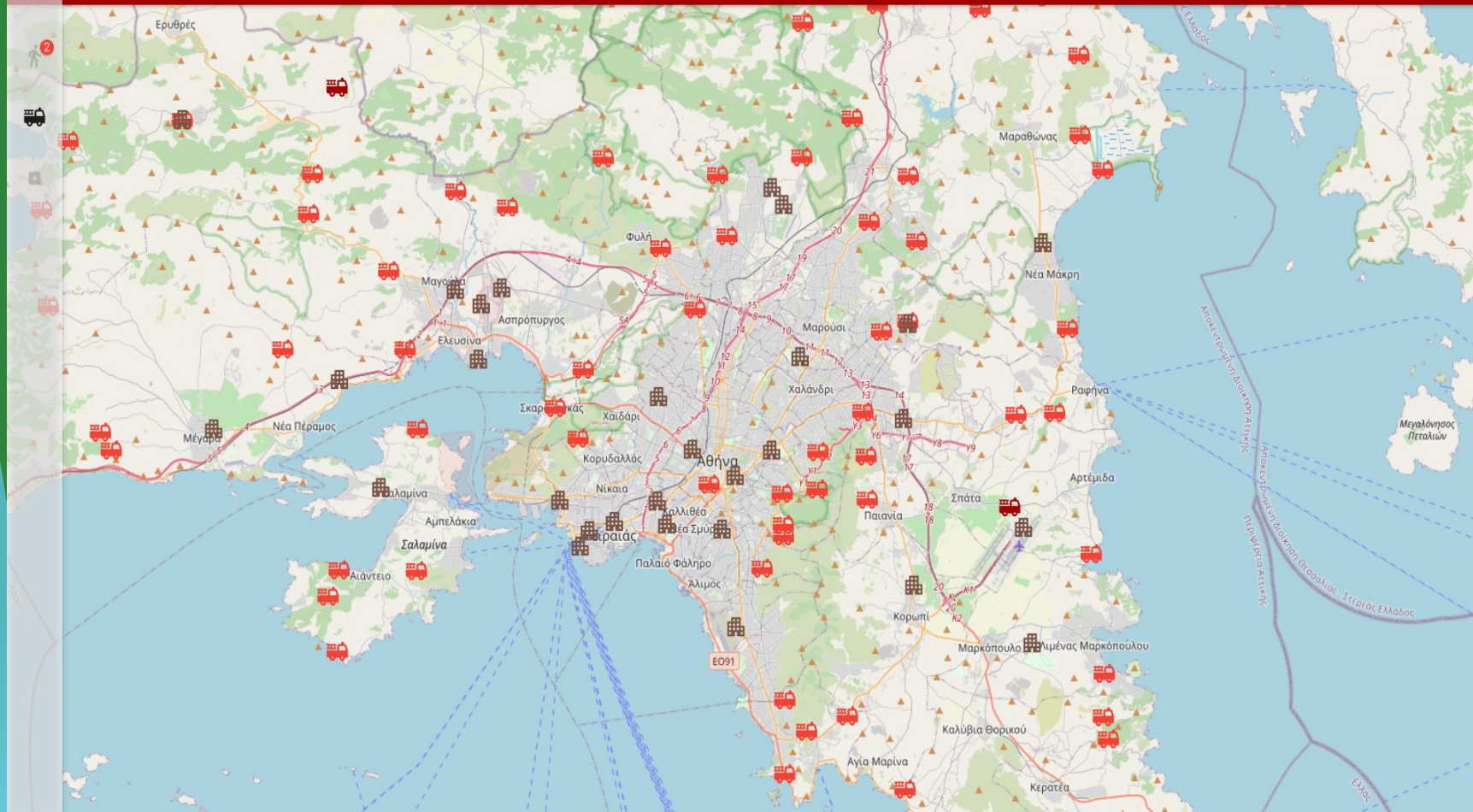
Emergency Panel

- Emergency Events**
 - Fire Emergency Event!**
Dpt. of Informatics and Telecommunications, NKUA
Coordinates: 37.96874, 23.76685
 - Potential Explosion Alert!**
Megaro Mousikis Metro Station
- Civilian Groups**
 - Group 1**
Dpt. of Informatics and Telecommunications, NKUA
Coordinates: 37.96874, 23.76685
 - Group 2**
NKUA Campus
Coordinates: 37.96733, 23.77503
 - Group 3**
Megaro Mousikis Metro Station
Coordinates: 37.97913, 23.75289
- Safety Points**
 - Safety Point 1**
Euaggelimos Hospital Metro Station
 - Safety Point 2**
Plateia Eirinis

In order for the administrator to have an overview of the emergency events, civilian groups and safety points, at the top right side of the page there is an emergency panel which contains information with regard to the number, type and location of each emergency event, the name and location of each civilian group and the name and location of each available safety point

1. Web Interface

Emergency Departments Fleet Control



- The second option of the Administration Panel is the Emergency Department Fleet Control.
- This page illustrates the location of the available emergency departments that can immediately act in case of an emergency event.

1. Web Interface

Request Assistance

Fire Department Vehicles

Police Department Vehicles

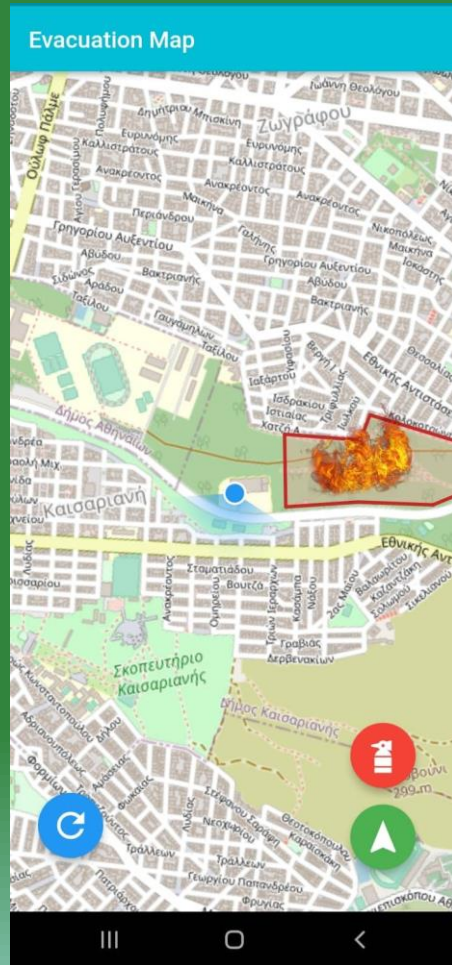
Healthcare supplies

Healthcare personnel

Submit

- The third option of the Administration panel provides the ability to the administrator body to request for assistance in case of an emergency.
- A form is provided in order for the administrator to request assistance from emergency forces, for supplies, as well as healthcare personnel.

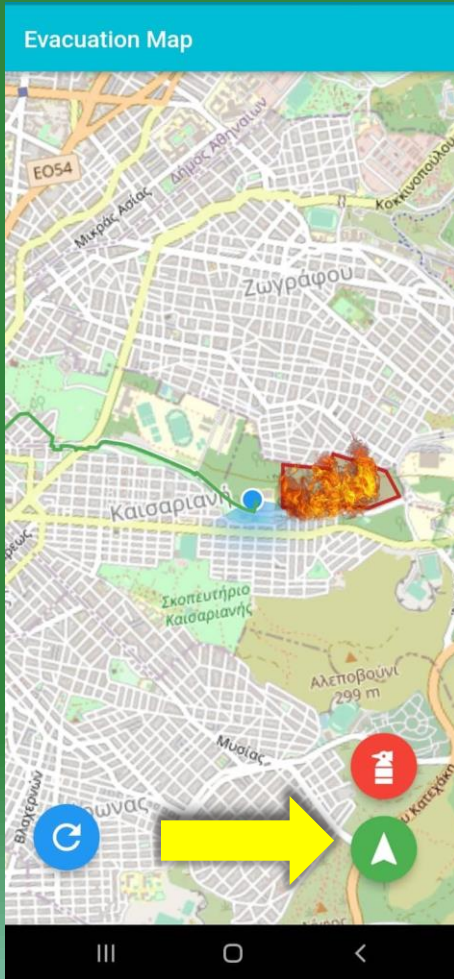
2. Smartphone Application Interface



The mobile application of the end user (civilian) consists of 3 basic functions to assist the civilian to safely evacuate the dangerous area.

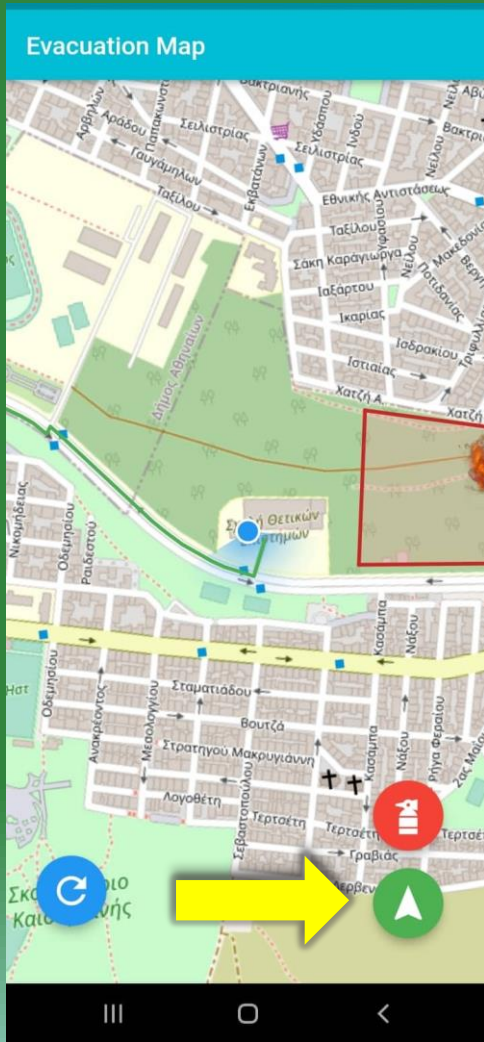
1. Emergency alerting system for real time emergency notifications by the Civil Protection System in case of a new emergency event along with a safe outdoor routing plan.
2. Visualization of the proposed route along with event information, as produced by the Civil Protection System.
3. Built-in function to re-route the user in case of unregistered event.

2. Smartphone Application Interface



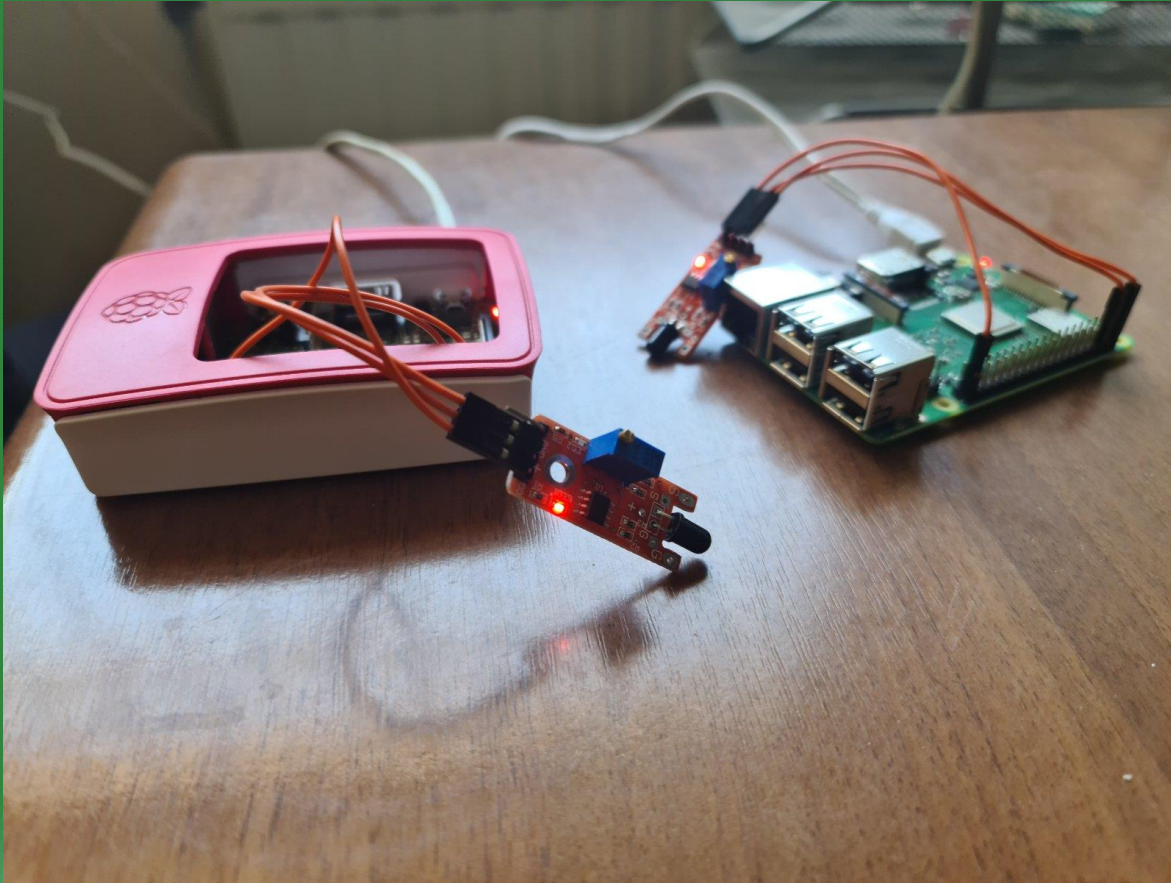
- The Civil Protection System, after determining the fastest and safest route for a group of users, sends an emergency notification to the respective users for safe area evacuation.
- The Civil Protection System sends the selected route to each end user, in order to safely routing them to a Safe Point, previously determined by the respective Civil Protection Department.

2. Smartphone Application Interface



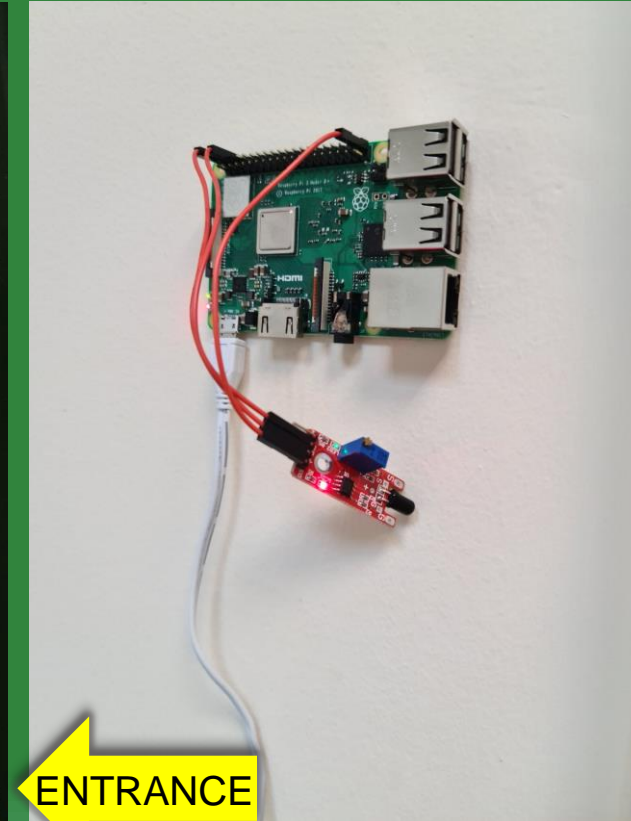
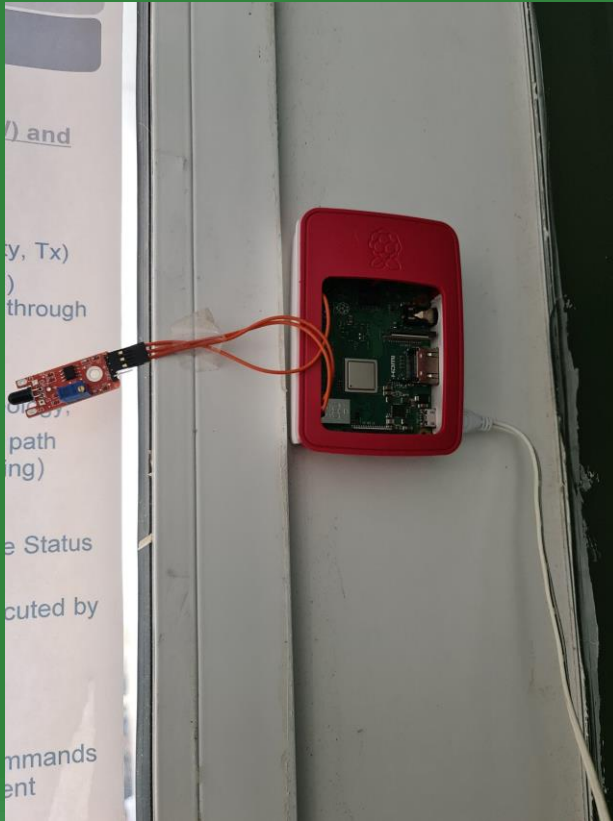
- The third function provides the ability to dynamically register an area as blocked or dangerous, and reroute the user, to the same Safe Point if possible, avoiding that area.
- This function is triggered when the Avoid Area button (red) is pressed, where the user manually selects a new blocked area and a re-calculation of a new safe route to the already selected Safety Point is taken place, avoiding the blocked area.

3. Indoor Routing mobile Application



- An indoor evacuation routing application has been implemented for any emergency event that takes place inside of a building.
- As an example, when a fire event occurs, a set of sensors connected to mini computers (raspberry pi) are triggered and an AI-driven process takes places for emergency event identification and a Wifi-based indoor positioning in conjunction with an alert system that sends emergency notifications to the mobile app, guiding the user to the nearest safe exit.

3. Indoor Routing mobile Application

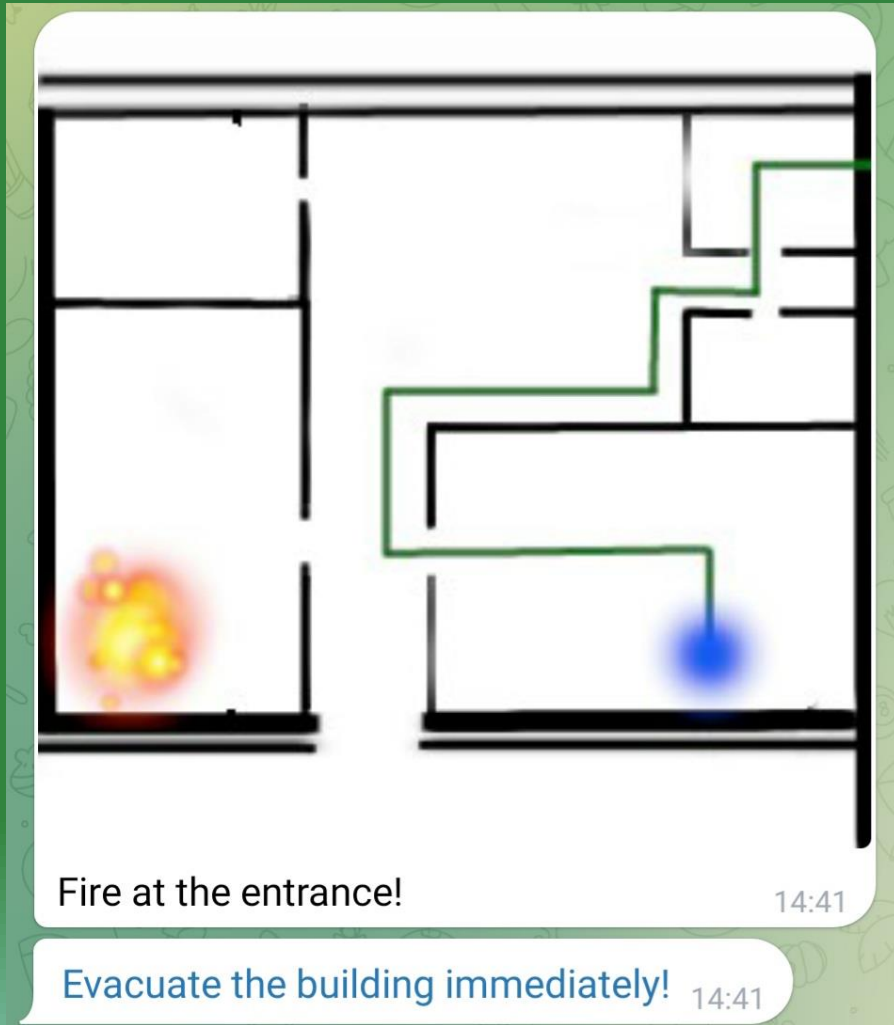


ENTRANCE

KITCHEN

- Multiple sensors are installed inside the building in different areas of interest (where an emergency event may occur)
- When an emergency event is identified an indoor route to the nearest exit point is calculated based on each user's location (Wifi based indoor positioning system) and the blocked area of the emergency event.

3. Indoor Routing mobile Application



- When a fire sensor is triggered, the Civil Protection System sends immediately a notification to the end users being inside a building.
- The end user application for indoor routing visualizes an alert message including:
 - A top view of the building for safe indoor navigation to the nearest safe exit point.
 - A link that opens the Indoor Routing application.

3. Indoor Routing mobile Application



The application is an interactive, augmented reality software that visualizes the spatial parameters of the building and visualizes the route to the safest exit avoiding the emergency event (e.g. fire).



The user follows the arrows illustrated in the application as he moves inside the building.

3. Indoor Routing mobile Application



Eventually, the user has been safely navigated to the nearest exit of the building.

Hardware/Software requirements

- The system requires a cloud infrastructure to host services for monitoring, managing and alerting different user roles (Municipalities, civilians, emergency service personnel).
- The services can be distributed in multiple Virtual Machines (VMs) in the infrastructure to provide high availability (redundancies or fail-overs, backups etc).
- The User Cellphone Interface requires a cellphone device, which supports Android (6.0+) or iOS (10+).

How to operate the system

- The mobile interface has to be downloaded by the end users from the respective app provider. The application is implemented in order to run as a background service with little to none user input.
- In case the application crashes or the cellphone is rebooted, the application is automatically relaunched.
- After the cloud infrastructure is configured by a professional system administrator, the web interface is constantly running in order to detect any potential emergency events.

Technical Characteristics and System Features

- ▶ Advanced features are developed in the system.
- ▶ These features include AI techniques, Machine Learning algorithms, Heterogenous data fusion and complex-aware analysis, neural nets and DSS
- ▶ Moreover, beyond state of the art parts are embedded and give a clear leadership as compared to the competition

Beyond state of the art features

- **Real time environmental monitoring** using low power on field sensors (e.g. humidity, temperature, air pollutants sensors, smoke detector, UV lights sensor, gas sensor), terrestrial imagery (using drones and satellites) and observational meteorological data
- **Heterogeneous data fusion and context-aware analysis,** towards zero-touch emergency event identification

Beyond state of the art features

- **Time Series data correlation analysis**, towards proactive detection of potential future emergency events in a pre-defined time period (e.g. minutes, hours, days, weeks) exploiting a variety of Artificial Intelligent (AI) - driven techniques (e.g. Recurrent Neural Networks (RNNs), advanced regression techniques, Ensemble Learning).
- **Proactive emergency alerts** in conjunction with **Decision Support System (DSS)** for holistic and early access evacuation planning (decision-making actions).

Beyond state of the art features

- **Decision Support System (DSS):**
 - **Clustering analysis** (Agglomerative Hierarchical Clustering, k-Means, Hierarchical Density-Based Spatial Clustering of Applications with Noise (HDBSCAN)) using geospatial data for automated civilians group forming and Safe Indoor/Outdoor Route Planning (SIRP/SORP)
 - **Safe Indoor Route Planning (SIRP):** Civilians indoor positioning based on Wifi Received Signal Strength Indicators (RSSIs) and indoor navigation planning of each civilian group to the nearest building exit.
 - **Safe Outdoor Route Planning (SORP):** Based on proactive emergency event detection, real time monitoring for blocked, overcrowded and unsafe routes, an AI-driven SRP is produced towards providing navigation directions to each civilian group to the closest safety point along with information related to the estimated time of arrival and distance in Km (from the centroid of the civilians group to the geolocation coordinates of the safety point).

Beyond state of the art features

- **Decision Support System (DSS):**
 - Fleet Control: System for automated emergency analysis and management. Severity level identification and estimation of the number of the mandatory emergency forces required to control and eliminate the hazardous event. Immediate notification alert for intervention from the nearest necessary emergency departments.

Benefits of our system

- Provides a real-time monitoring of all events/disasters occurring in a certain area.
- The interconnection of multiple emergency departments, enables an homogeneous coordination of heterogeneous resources.
- The user can update the environment with real time data on new events.
- An easy to use administrative part and on the end user side, which is vital in emergency scenarios.
- Being a cloud based service, it has almost 100% up-time and can be configured and updated easily and quickly.

Civil Protection System

- In summary, our platform could pave the way towards novel civil protection systems that could redefine the way actions are taken in hazardous situations.
- By taking into account the lessons learned from the experience of natural disasters, accidents and attacks in many places, our solution offers an integrated holistic framework towards civil safety.

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SCAN Lab