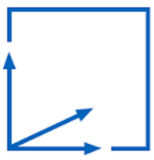
CHAIR FOR COMPUTER AIDED MEDICAL PROCEDURES & AUGMENTED REALITY

TECHNISCHE UNIVERSITÄT MÜNCHEN

Bachelor's Thesis in Informatics: Games Engineering

Development of a Collaborative and Mobile System to Enhance Overview during Catastrophic Situations as assistance for Executive Officers

Imen Hellali



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Development of a Collaborative and Mobile System to Enhance Overview during Catastrophic Situations as assistance for Executive Officers

Entwicklung einer kollaborativen und mobilen Anwendung zur Unterstützung der Führungskräfte zur Verbesserung der Lageübersicht bei Gefahrensituationen

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Submission Date:	15.05.2020

I confirm that this bachelor's thesis in informatics: games engineering is my own work and I have documented all sources and material used.

Garching b. München

15.05.2020 Imen Hellali

Acknowledgments

I wish to thank all the people whose assistance was a milestone in the completion of this project.
First I would like to pay my special regards to my supervisor Prof.Gudrun Klinker for being the head of this group that provided me with such an interesting thesis to work on.
Subsequently I wish to express my deepest gratitude to my advisor M.Sc. Sven Liedtke, that provided me with the best mentoring and pieces of advice. His constant feedback and coaching have guided me through every step, that lead to this project creation.
Additionally I wish to show my appreciation to the Fire brigade at Garching and specially to M.Eng. Hammann Claudius, for providing our department, my advisor and me with the necessary informations and continuous assessment of the system. Through his help and requirements we were able to implement an application with various features.
Eventually I would like to thank all the staff members of the chair of Augmented reality, who contributed to make a better version of this project by providing constructive critiques and comments during the presentation.
Last but not least I would like to thank the talented artists that created the icons, that I used and elaborated throughout this whole project. Project icons from [mul].
Finally I would like to present my sincere gratitude for all the encouragement i received.

Abstract

Figure 1: Australia bush-fire getting out of hand, from[EC19]

The Executive forces play a major role in keeping our safety during crisis and disasters. That is why it is primordial that the First Responders can and should intervene and resolve the incidents within a short period of time.
This Thesis presents a digital solution to help Emergency services execute their services within a shorter time span.
Although the Fire department was used as the primary client, to establish a clear goal to target the implementation, the system was implemented in a manner that is easily scalable and modifiable to address all other Federal offices for civil protection and disaster assistance.
The System consist of a digital and interactive real world map. Additionally it incorporates the deployed Tactical Graphics during the deployment and intervening, with additional helpful features.

Abbreviations and Definitions

- USA: United States of America
- USAspending.gov: is a web platform that tracks federal spending to ensure taxpayers can see how their money is being used in communities across America. From[USA20].
- iOS: Apple's mobile operating system.
- Android: mobile operating system for touch and mobile devices.
- UWP: Universal Windows Platform is Microsoft's Computing platform, used as a general application that run on Windows 10, Windows 10 Mobile, Xbox One and HoloLens.
- SDK: Software Development Kit (tools).
- VR: Virtual Reality.
- etc: Et cetera (and so forth).
- e.g: Exempli gratia (for example).
- 2D: Two-dimensional space.
- 3D: Three-dimentional space.
- rgb(.,.,.): Color Scheme with its red, green and blue values in 32bit format.
- rgba(.,.,.,.): Color Scheme with its red, green, blue and alpha values in 32bit format.
- IT: Information Technology.

Contents

1 Introduction

This chapter serves as a brief introduction to motivate the contriving of this thesis and how it is created.
First we will depict a typical and extremely simplified overview on the work flow of the fire department.
Secondly we will discuss their encountered problems on the field, which orchestrated this whole project.
Afterwards we will introduce the proposed solution and specify what we will be tackling throughout this application, and finally we will enumerate the integrated key features.

1.1 General overview on the fire department work flow

The Fire brigade is composed of two main Units:

a Executive forces (Führungskräfte).

b Operational forces (Einsatzkräfte).

The Operational forces unit is composed of firefighters and firetrucks. This unit receives information about an incident and its location. They assess the situation and send a report to the Executive forces unit.
The Executive forces unit is composed of chiefs in charge of managing the operational unit. They evaluate the situation and elaborate decisions. Afterwards they send their commands and orders back to the Operational forces unit.
The Operational forces unit dispatch their machinery and men accordingly. They also keep a real-time track of the situation on the incident location.
The Above described procedure is repeated until the incident is resolved or the situation is put under complete control.

1.2 Disadvantages of the traditional deployment method

The traditional way of approaching a Fire doesn't deem as useful during disastrous situations.
One of the main issues that may occur, is that during the time the Executive forces unit take decision the gravity on the incident site may vary, thus leading to outdated commands.
Another serious issue is the delay between receiving a report and executing the command may increase drastically, so that the operational forces unit is unable to intervene anymore.

1.3 Proposed solution

This thesis tackles the previously described problem, by creating a digital solution which will facilitate and speed up the process of data exchanging and decision making between the two units.

1.3.1 General Concept

The solution consists of a collaborative, real-time updated map, where both units can interact with the map accordingly and exchange commands and informations.

1.3.2 Description of the proposed approach

In this section we will briefly state and define the key features that constituted the system:

a Dynamically generated map: adding a map that is dynamically generated while rendering.

b Interactive Map: intuitively controlled map, with instinctive gestures and self explanatory icons.

c Tactical graphics: (Taktische Zeichen) are graphic codes. These codes are drawings composed of many symbols used by the executive officers, where each symbol delivers a different meaning. Tactical graphics originated from the military and serve as a unified „way of communication". They represent the type of incident, the forces which should intervene and how many machinery and men should be dispatched in the specified area.

d Free-hand area marking: marking and shading the area of the incident according to the incident type.

Figure 1.1: Firefighters in deployment, using an area map with Tactical Graphics, from[Ins]

2 Methodology & Used Technologies

As stated in the previous chapter, this thesis will present an interactive map-based mobile[1] application.
In this chapter we will discuss at the beginning, the choice of technologies used thought the project. First we used Mapbox 2.1 to acquire geographical and infrastructural data, instead of using an overly complex approach to incorporate the map.
Furthermore to integrate the interaction gestures and overall mechanics, we developed the project in one of the most famous game engines, namely Unity 2.2.
Finally at the end of this chapter 2.4, we will elaborate some of the used regulations by the federal organizations to construct the tactical graphics.

2.1 Mapbox: Geographical & Infrastructural Data Provider

> „Mapbox is an open source mapping platform for custom designed maps."(by MapBox, from [Map19])

Mapbox is one of the biggest providers of personalized online maps.
Its clients range from individual hobbyist developers, to social media leaders like Facebook. It is even used by the federal, state and local governments in the USA, for example by the Weather Channel and USAspending.gov.
Mapbox supports different SDKs for many operating system environments such as iOS, Android, Unity and Web, which makes it the perfect tool for targeting different building environment and platforms, where in our case it will be the UWP.

2.2 Unity 2019.2.21f: Development Environment Tool

Unity is the second most used Game engine for indie developers across the world and number one for VR development.[Pro]
Its popularity is increasing daily thanks to its vast variety of features, toolkits, assistance and support.[Gam]

[1] Here mobile refers to the ability of running this application on portable gadgets, such as mobile phones, tablets or even table tablets.

As stated above Mapbox offers an SDK for Unity, which makes it the perfect environment for this project to be born into.

2.3 Unity's new Input System 1.0.0-preview.6: Detecting & Managing the Interaction Gestures

One of things which makes Unity loved by its community, is its constant thrive for innovation and integration of new packages.
Unity's Input System 1.0.0 which is still in its preview phase in the Unity 2019.2.21f version, is the new Input System manager, that offers more intuitive and easy to use input commands. This new Package is most suited for targeting controllers for different consoles, computers, etc. Based on[Uni19]. The system also supports the pen input from a stylus with all its buttons, which is a feature that was used in the early development phases of the project.

2.4 Used Codes by the state's First Responders

The graphic codes as defined in 1.3.2, are a way of communication between the officers of the emergency services.
Tactical Graphics come in different basic shapes 2.4.2 and have a specific colour scheme 2.4.1 for representing security organizations and facilities.
These Symbols are then combined with additional characters 2.4.3 to represent units and measures. Additional text notes can be added to increase the understanding, and expand the meaning of each graphic code.
Units, measures and even notes must follow a regulated framework. These regulations were taken into account while creating the Tactical Graphics used within the application. The following points will describe some of the regulated colors, symbols and characters used throughout the project. Please note that some colors were added or removed, and regulations minimally altered to be able to construct a generalized platform.

2.4.1 Regulated Colors

a Red: rgb(255, 0, 0) Fire zone and Fire department.

b Blue: rgb(0, 0, 255) Flooded zone (high water) and Federal Agency for Technical Relief.

c Yellow: rgb(255, 255, 0) Contaminated zone (biological/chemical) (e.g. pandemic/hazardous) and Facilities of the leadership.

d Brawn: rgb(153, 102, 51) Drought zone.

e Magenta: rgb(255, 0, 255) Restrictions/failures of the supply (e.g. power failure).

f Orange: rgb(255, 160, 0) Other extensively damaged areas and Other security devices.

g White: rgb(255,255,255) Aid organizations and German Armed Forces.

h Green: rgb(0,128,0) Police, Federal Police and Duty.

i Black: rgb(0,0,0) Used for contours.

Figure 2.1: Regulated Colors used for the Tactical Graphics

2.4.2 Regulated Basic Symbols

a Command post: command post (in operation).

b Tactical formation Department.

c Executive: sign of the association or administration.

d Land-based vehicles.

e Gear: bicycle, motorcycle, etc.

f Watercraft.

g Points: supply point, Logistics Support Point, etc.

h Pendant/Tag.

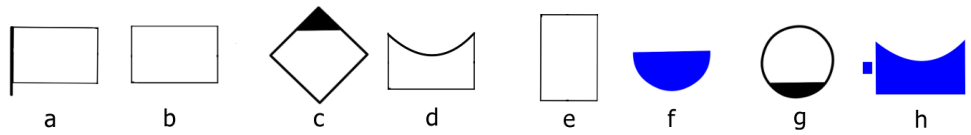


Figure 2.2: Regulated Base Symbols used for the Tactical Graphics

2.4.3 Example of Regulated Characters

a Fire-fighting/fire-fighting operations (including rescue).

b Rescue from heights and depths.

c Water supply and pumping.

d Technical assistance (including rescue).

e Lifting loads.

f Extrication/salvage.

g Clearing, removal of obstacles.

h Defusing, explosive ordnance clearance.

i Blasting.

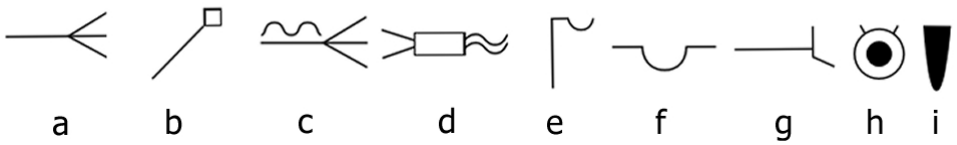


Figure 2.3: Example of some of the additional Characters used for the Tactical Graphics

More Detailed information about the characters and styling of each Tactical Graphic are available in the online book „Empfehlungen für Taktische Zeichen im Bevölkerungsschutz", delivered by the „Bundesamtes für Bevölkerungsschutz und Katastrophenhilfe (BBK)"[2].

[2]Website of the document: `http://www.katastrophenvorsorge.de`

3 System Elaboration

This chapter will thoroughly discuss the implemented features within the application. First we will depict the most important artifact constituting this project, namely the generation of a dynamic map 3.1.
Afterwards we will list the available interactive gestures and how to navigate within the application 3.2.
All the other sections will introduce the implemented features. Each feature satisfies a requirement issued by M.Eng. Hammann Claudius and elaborated by M.Sc. Sven Liedtke in order to achieve a collaborative generalized platform that facilitates the communication between Emergency services' officers.

3.1 Generating a Dynamic Map

As depicted in the previous chapters, this application is to run on tablet-like devices, which introduces a limitation on the targeted hardware, in particular it sets a big constrain on the memory space.
To address this problem, we decided that instead of storing the whole map data on the device, it would be better to fetch only the associated information of the currently visible area.

3.1.1 Dynamic Map

Mapbox Unity's SDK offers many handy features. In our case we are particularly interested in their first standard artifact included in their package, that is to dynamically generate a map while rendering.
As the developers of Mapbox call them „ Map Tiles" are chunks of the region surrounding the origin of the specified object. Generally this object is the camera or the player which the camera follows. Map tiles are dynamically generated and their data is never stored to improve the memory usage while rendering.

3.1.2 Issues

Sadly even such a diverse tool comes with its drawbacks, such as:

a Permanent internet connection: since each project requires authentication at the start, and to continuously exchange the data of each newly created map tile.

b Accuracy: some data from the map were not accurate enough, taking the example of the buildings that were detected as simple landscape.

While rendering we can distinguish buildings from landscape by color and type of elevation. For each building from real life map, Mapbox generates a 3D model similar in shape and height. These rendered buildings are colored differently, namely turquoise in our case. Landscapes on the other hand have a more subtle and real-life-related colors.
The following figure 3.1 shows the accuracy problem described above. On the left side we can see with a top down view, how the MI-Building[1] should be rendered. On the right side however, we have a snippet of the actual rendered map, which indicated that the MI-Building was indeed recognized as a landscape.

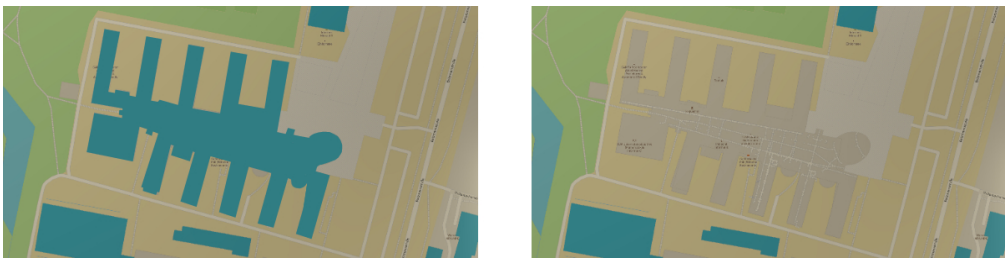


Figure 3.1: Rendered image from the project presenting the accuracy problem: rendered building (left side), rendered landscape (right side)

3.2 Navigating in the Map

In this section we will first present the different available views within the application. Afterwards we will summarize the used gestures throughout the project as shown in table 3.1 and finally discuss the ones used to control the map and navigate in it.

[1] Building of the faculties of Mathematics and Informatics on the campus Garching

3.2.1 Different Views for Different Purposes

In this project we offer the two different type of views, namely the 2D and 3D view.

a 2D view: the most basic and practical view. This View will mimic the real paper map that is currently used by the Emergency Services. In This perspective users are able to place, remove and even re-position the Tactical Graphics. They are also able to mark the Area of the incident and shade it. Furthermore they can add notes by typing a text relative to each marked zone and also delete it. Additionally they can highlight individual buildings as a way to distinct them from others. Most if not all of the interactions implemented are only available during this view.

b 3D view: provides a new and fresh look to the map. This view can be used to investigate a specific area closely by tracking dispatched gears displacement and men.

In the figure 3.2 we present the two different views. On the right side we can see the rendered image of the 2D view and a tactical graphic placed at a certain region. On the other hand, on the left side we can see a rendered image of the 3D view and check the firetruck location. This latter was generated automatically upon placement of the tactical graphic, that indicates a dispatching of a firetruck.

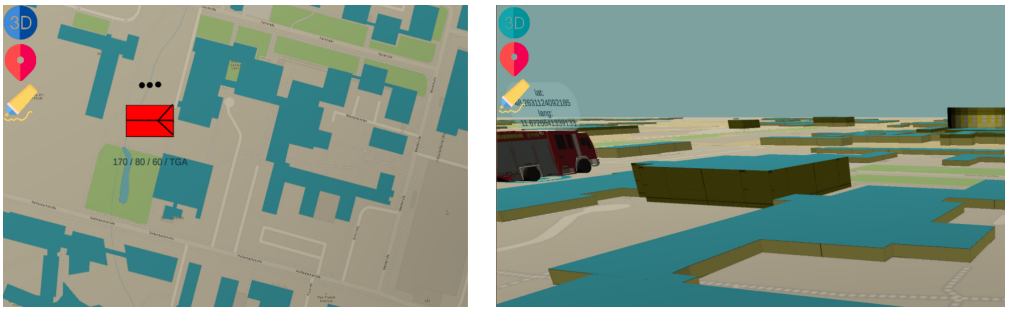


Figure 3.2: Rendered images from the project presenting the 2D view (left side) and 3D view (right side)

3.2.2 Fundamentals Behind the Touch Input

Touch screens have become almost a necessity in our daily life, if it is not our smart phones then it is our tablets or computers.
Human-beings are tactical creatures and explore their surrounding with their hands since young age, based on: [Mon71]. Almost every object that we need to interact with

needs to be touched, that is why it is more intuitive and straight froward for us to control items by holding them, pressing them, tapping them etc. based on:[Bra98].

3.2.3 Recognized Gestures in this Application and their Usage

This project target platform is the UWP. Thus logically, touch inputs were implemented following the common Touch Gestures used by Windows, and products using windows. Based on:[Mic20] the following table 3.1 describes in the first column the gestures implemented in this application. In the second column we state the commonly used activity for this specific gesture by windows applications, if it is available or predefined. In the third column we describe textually the action of how to apply the gesture. In the fourth column we visualize these actions by descriptive hand icons, and finally in the last column we present how many fingers are required to establish the movement.
Table 3.1 lists almost all used gestures within the application, such as:

a scrolling and moving objects: navigating in the map 3.2.4, and changing the placement of tactical graphics.

b Zooming in and out of the map.

c Rotating the map.

d Selecting objects and pressing on icons: selecting tactical graphics on the map to modify their position, pressing on the icons to open folders 3.5.4, selecting drawing tool 3.3.2, modifying marked areas 3.3.4 and switching views 3.2.1.

e Dragging and dropping objects: marking buildings to highlight them 3.4 and placing precombined tactical graphics 3.5.4.

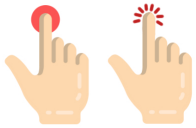
Gestures	Windows usage	Gesture action	Action	Contact
Scroll and move objects	Scroll, move and select	Press and drag 1 finger in the 4 directions		
Zoom in/out	Zoom in/out	Press 2 figers and pinch/spread		
Rotate	Not specified	Press and hold 1 finger, rotate around it with a 2nd finger		
Tap object to select it	Right click	Press 1 finger on target object		
Drag and drop objects	Panning up/down and back/forward	Press on an object then drag finger and release in desired area		

Table 3.1: Table representing the used touch gestures throughout the project, based on:[Mic20], icons from:[Sma]

3.2.4 Basic Touch Input for controlling the Map

a Zoom: pinch to zoom out of the map. Spread to zoom in the map. This feature is only available in 2D view.

b Move: while pressing on the map slide the finger to drag the map. This feature is available in both 2D and 3D view.

c Rotate: put one finger and hold it as the rotation axis, then rotate the map with another finger. This feature is only available in 3D.

3.3 Marking the Area of the Incident

In this section we will first discuss the importance of marking an area and how does it attribute to the Emergency services. Afterwards we will explain how we implemented this feature and how to come around it.

3.3.1 Usage for State's First Responders

As described in section 1.1, assessing the situation constitutes the first step of intervention. This means first detecting the area of the incident, thus marking the damaged region and approximating the zone where the fire may propagate to. To achieve this step on a regular map, Firefighters will grab a pen and draw a contour around that zone.

3.3.2 Area Marking & Shading

Users can mark and shade the area with pen input or with touch input (draw with finger).
First, user has to tap the Marker icon to open its menu. Afterwards they have to select the drawing mode, the color and the brush size. These techniques were inspired by the popular digital drawing tools, like Adobe Photoshop and Clip Studio Paint.

a Draw mode: allows you to choose the type of brush you want to use first, either opaque prominent contour, or transparent shading. The two different draw modes are represented as two circles. First circle is drawn with simple opaque contour. The second circle is filled with semi-transparent ink.

b Color palette: contains all the regulated colors mentioned in 2.4.1.

c Brush size: allows you to pick the size of the contour and filling brush. This option was added to make drawing easier and suitable for all zooming levels of the map.

After selecting the different options, the required fields will display the picked choices and user can start drawing.
Finally they can click on the validation icon to save the drawing. A Button specific to this colored zone permitting you to control and modify it as explained in section 3.3.4, will appear in the side menu holding all the marked areas.
The following figure 3.3 shows the area marking menu with the tools contained in it as described above. In the figure we can see that the user has picked contour as draw mode, magenta as color and the smallest size for the brush.

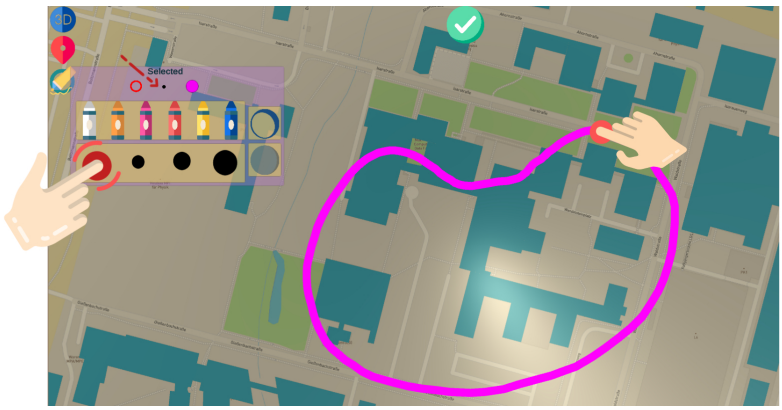


Figure 3.3: Rendered image of the Area marking menu and Contour drawing mode

3.3.3 Additional Information for the Marked Area

After assessing the situation, officers are to communicate between each other and explain the procedures accurately among each others. Therefor in addition to the tactical graphics, they can add some textual notes describing the current situation and explain in further details the intervening process.

3.3.4 Controls for the Marked Area

As stated in section 3.3.2, one of the side menu holds all marked incident zones as clickable buttons.
User can click on the desired area button to navigate (teleport) to it, as depicted in figure 3.4.
On top of each button we find different icons each responsible for a different task:

a Edit: opens the area marking menu upon click. User can add on shading or contour, if one of these is missing, as shown in figure 3.5.

b Eraser: deletes that specific area when clicked, as shown in figure 3.6.

c Note: displays and hides the text specific to that area. User can click on this icon to start writing or modify the text notes. Afterwords they have to click on this icon again to hide that text field, as shown in figure 3.7.

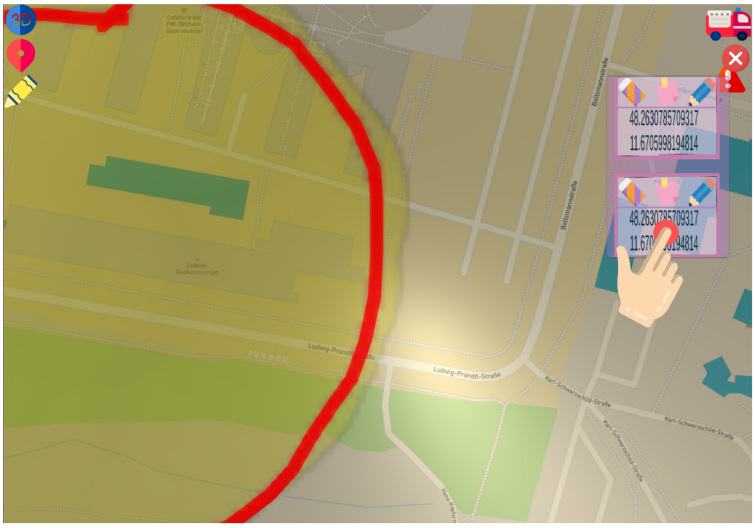


Figure 3.4: Rendered image showing the action of clicking on a specific area button

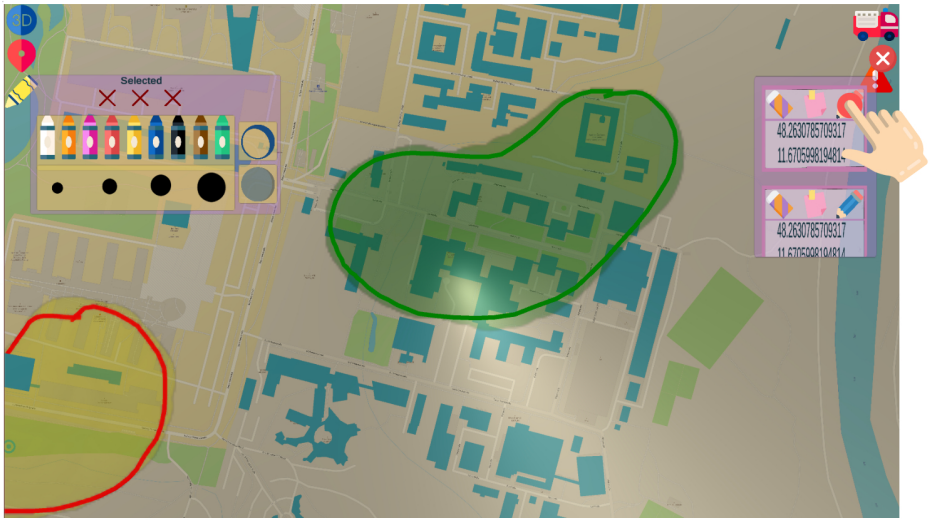


Figure 3.5: Rendered image showing the action of clicking on the edit icon

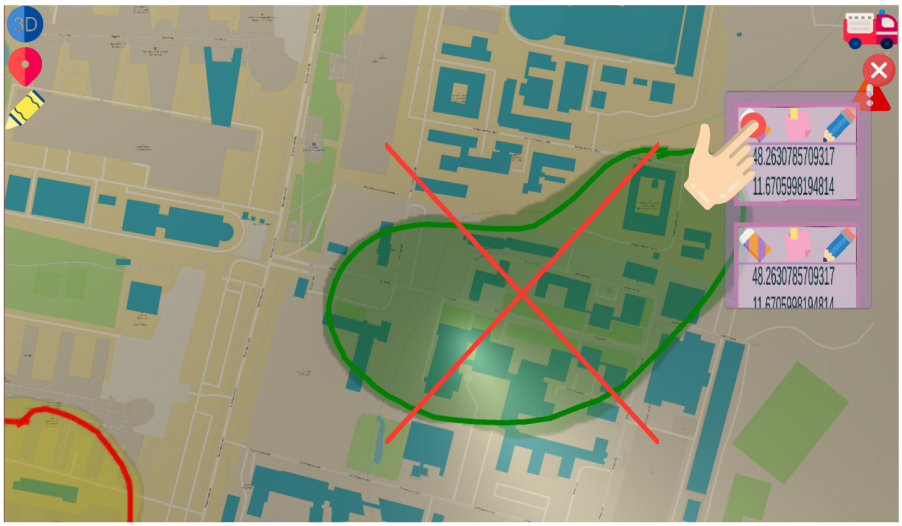


Figure 3.6: Rendered image showing the action of clicking on the erase icon

Figure 3.7: Rendered image showing the action of clicking on the note icon

3.4 Marking & Selecting Buildings

This feature was added upon request. It may not attribute directly to this application, but as we will promote in chapter 5, it is one of the cross features that might be useful for later works.
To mark a building, user has to click on the mark icon and drag it onto the desired building. Marking buildings was implemented as drag and drop gesture, as it delivers the most accurate results by avoiding mismarking. To deselect a building, the user has to drag the icon and release it on it again.

Figure 3.8: Rendered images describing step by step, how to mark a building.

3.5 Tactical graphics

In this section we will first introduce a haptic tactical graphic object and explain the fundamentals behind its creation and usage.
Later on within this section we will elaborate the different methods on how to place and create the tactical graphics following certain regulations as depicted in 2.4.

3.5.1 Haptic Object Integration

Haptic objects, are objects that we can grasp, place, move and feel, based on:[Gru08]. The haptic objects are used as complementary immersing items to the static passive interactive systems. As explained in section 2.4, Tactical Graphics are a form of customized communication codes based on combined drawings.
These codes are sold as stickers, which are ready-to-use and precombined, they are later on glued on magnets. The Emergency Services' officers place these magnets on the paper map at a desired location, indicating the procedure they want to perform at that specific incident area.

During the elaboration of this project, we tried to mimic this grabbing and positioning action by introducing a Haptic Tactical Graphic (HTG) to facilitate the transition from the used magnets to the digitally customized icons.
Henceforth we will refer to the Haptic Tactical Graphic as HTG.

3.5.2 Tactical Graphics Creation

The below presented HTG in figure 3.9 is a prototype designed and printed by my advisor M.Sc Sven Liedtke. Its front side contains a knob serving as a handle to grab and position it. This knob prevents falsely tracked gestures by avoiding an accidental screen touch when placing it. The HTG backside contains three conductive small regions. These regions act as three different fingers. Their intersection represents the estimated contact point that will be tracked and regarded as the position, at where the tactical graphic will be placed.

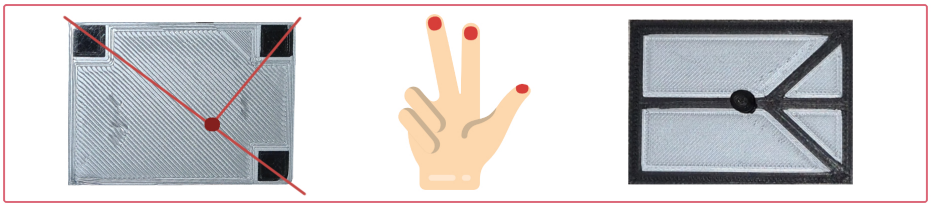


Figure 3.9: Image of the 3D printed Haptic Tactical Graphic and associated number of touches and contact points.

3.5.3 Tactical Graphics Customization

To create a tactical graphic in a specific location, the user has to place the HTG on the approximated position and a creation menu pops up.
The tactical graphic creation menu contains as shown in figure 3.10:

a Basic Symbols: are the ground shapes that constitute the tactical graphic. They come in different geometric shapes such as: rectangles, circles, lozenges, etc. Please refer to section 2.4.2 for the complete list of symbols.

b Colors: fill the basic symbol. Colour scheme represent security organizations and facilities. Please refer to section 2.4.1 for the complete list of colours and its designation.

c Unit Characters: are drawings representing size (quantity), hierarchical assignments and arrangement principles. These characters are placed at the top of the tactical graphic basic symbol. We integrated two types of unit characters:

- Tactical Units: are represented as black dots.
- Administrative levels: are represented as stars.

d Vehicle Specific Characters: are drawings used to identify the type of used gears. These characters are either white dots or a white bar placed at the bottom of the tactical graphic basic symbol.

e Symbol Specific Text Fields: are used to add specific acronyms on top of the basic symbol. Different text field compositions were added to be able to target almost every styled tactical graphic.

f Characters: are used to add additional commands to each symbol. These characters are combinable and up to two different icons can be added on top of the basic symbol. By clicking on a drawing, the user adds a character to the tactical graphic. If they select a second icon, this latter will be layered on top of the previous one. A third selection will replace the first chosen character. Consequently a fourth selection will replace the second one. Which allows the user to change and replace these additional informations.

g General text field: is located at the bottom of the basic symbol. This field represents the team size.

The user can customize the tactical graphic freely and save these changes by clicking on the validation icon.

3.5.4 Most Used Tactical Graphics

This application also offers a list of precustomized tactical graphics, which the user can drag and drop from their specified menu. These symbols are organized in individual folders making them manageable and easily reachable as shown in figure 3.11. Each folders is color coded following the color of the tactical graphics inside it. To make it even more understandable we labeled the folders with a generalization of the functionality of the contained tactical graphics.

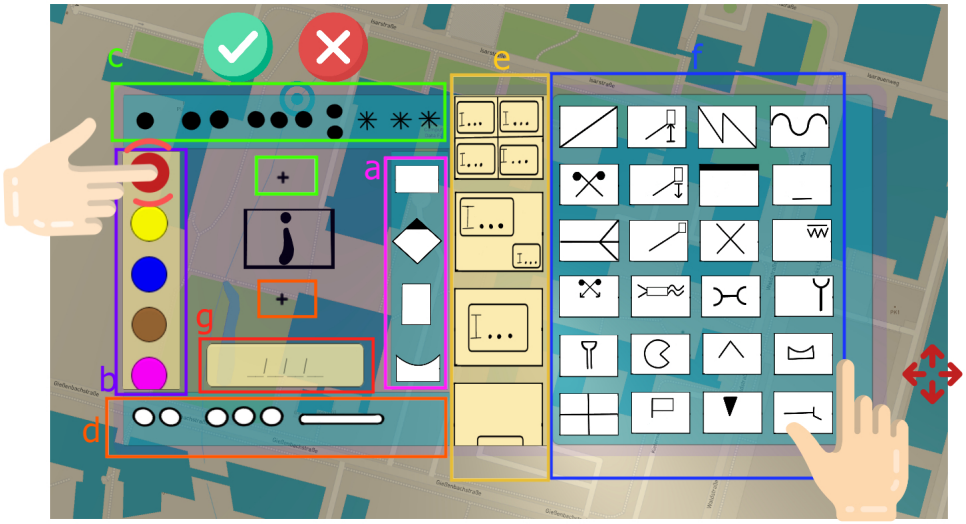


Figure 3.10: Rendered image of the Tactical Graphic Creation menu after placing the Haptic Tactical Graphic on the screen

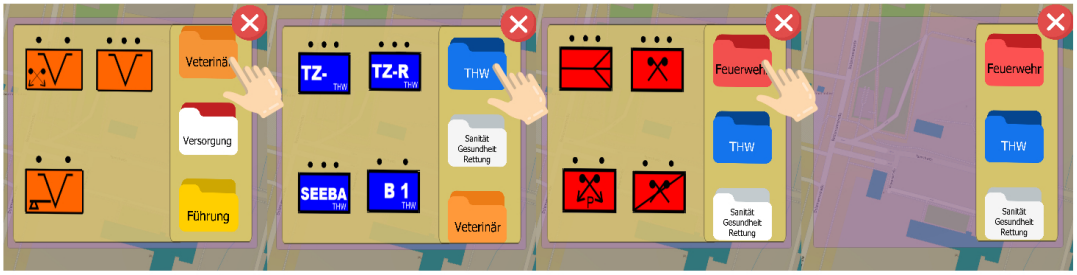


Figure 3.11: Rendered image of the Tactical Graphics Menu and clicking on different folders

4 Conclusion

This application provides a general and scalable platform for First Responders' Officers (FRO) with an interactive real-world map. This includes features imperative for communicating among themselves and visualizing their commands on the intervention site. The developed system main trait is extensibility. This was achieved by providing a general platform offering a variety of choices, where each alternative targets different executive officers, security organizations and facilities.
These different choices consist of:

a Vast variety of colors: The system offers a wide range of colors used by different organizations. From Red to white we covered almost every institution. The offered color palette is not only available for creating custom tactical graphics but also for marking the areas and shading them.

b Complete freedom to creating tactical graphics: The system offers a big collection of combinable characters and text fields, that can be layered on top of any basic symbol to customize different, unique and more understandable tactical graphics. This approach gives the liberty to the user to customize the tactical graphic as they wish and make it as clear and understandable as possible.

c Different techniques to mark an area: The system offers the ability to either draw a simple contour or shade the inside of the area for multiple reasons:

- Shading the area increases the visibility of the marked zone when the map is extremely zoomed out.
- Executive officers differentiate between the causes of the incident by highlighting and coloring these regions differently. These distinctions range from simple contours, to fully colored areas or even striped ones.

5 Future Work

> „Becoming more digitized and agile is the 21st century challenge for military leaders, intelligence services, heads of civil security and security officers responsible for critical infrastructure." by ELCA Industry Solution, from [ELC]

In this chapter we will discuss how our project can attribute to the First Responders and promote future similar projects and also available systems.

5.1 Interactive Map for Civil Emergency Services

The described system in this thesis is the first step to a bigger and more complex research topic. This application will serve as a foundation to build on, and extend it for further development. As described in the previous chapters, this application delivers an interactive platform packed with useful features for the different executive officers, organization and associations, to ease their communication and accelerate their work flow.

5.2 Collaborative Map and Real Time Data Exchange for Civil Emergency Services

Another key features discussed in the abstract page, is the collaboration and real time data exchanging between the two units: the executive forces unit and the operational forces unit. Assuring a fast response against catastrophic situations is not only primordial for the Fire department but for all other Federal organizations to insure the safety of civilians. This feature will be implemented by another student in a context of another thesis, using this project as a basis.

5.3 ELCA Industry Solution

ELCA industry solution is a company based in Switzerland, that develop IT solutions for the defense, intelligence and public safety domains.

5.3.1 MIL Office

MIL Office is an application used by the militia and the military administration in Switzerland as a tool for personnel, time and financial planning. ELCA and two other

Figure 5.1: Official MIL Office logo from[swi13].

companies(namely GARAIO and Nexplore) redeveloped the MIL Office (Version 5) completely by creating a web-based system. For more information about this tool please visit the official web site of the Swiss Army[1].

5.3.2 ECMIS

ECMIS is a system that provides an overview of the intervention in progress, by displaying relevant information such as:

a List of all tasks and emergency measures.

b Internal and external schedule of events

c Current state of planning and execution procedures

d Geographical overview of the situation, chowing the associated

For more information about this tool please visit the official web site of ELCA industry solution.[2].

> „ECMIS provides command and control personnel with a powerful set of tools that enables them to collaborate with different organisations and share and record critical information during the planning, response and recovery phase of a major incident." (by ELCA Industry Solution, Official description)

[1]Swiss Army, MIL Office article, `https://www.vtg.admin.ch/de/service/info_trp/miloffice.html`.
[2]ELCA Industry Solution, Project ECMIS, article, `https://www.elca.ch/en/ecmis`.

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