Preliminary communication

INFORMATION TECHNOLOGY IN CRISIS SITUATIONS AND CIVIL PROTECTION – CROalertNet

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ABSTRACT: *The paper presents the developmental idea of the application and platform CROalertNet, which is aimed at improving the safety and awareness of the citizens of the Republic of Croatia through an innovative system for timely warning of various types of crises. Through the analysis of functionality, technological infrastructure, and user experience, it is shown how this platform can serve as a tool in the national protection and rescue system, providing key information in moments of crisis and promoting a culture of readiness and prevention among the population. By implementing the latest technological solutions and a community-based approach, CROalertNet contributes to society's resilience in responding to crises, making information accessible, understandable, and action-oriented for all users. A strong and scalable platform that uses cloud technology to ensure high availability and reliability of services is the foundation of the project. The platform uses advanced solutions for real-time data processing and analysis, ensuring the speed and accuracy of information. One of the important aspects of the application is also its focus on offline operation, and thanks to its modular design, the platform is ready for future expansions and integrations with other systems and technologies, such as AI, to improve threat detection and personalize the user experience.*

KEYWORDS: *application, citizens, CROalertNet, information, protection, safety*

1. INTRODUCTION

The aim of this paper is to present the developmental idea of the CROalertNet application and platform, which is designed to improve the safety and awareness of citizens of the Republic of Croatia in the event of crisis situations. Crisis situations, whether natural or man-made, require a quick and effective response to minimize damage and save lives. This platform provides timely information that is crucial for proper preparation and response to such situations. In particular, the paper focuses on the key feature of the platform - offline mode, and a module which is heavily reliant on it.

In today's world, where natural disasters, technological incidents, and other emergencies are becoming more frequent and intense, the need for an effective warning and information system is growing. Croatia, like many other countries, faces challenges in timely informing and coordinating between different protection and rescue services and citizens. CROalertNet is

conceived as a response to these challenges, integrating the latest technological innovations into a system accessible to all citizens.

In the past few decades, the world has witnessed an increase in the frequency and intensity of natural disasters such as earthquakes, floods, hurricanes, and fires. In addition to natural disasters, technological incidents such as industrial accidents, power supply interruptions, and cyber-attacks have become more common. These situations require a quick and coordinated response to minimize damage and save lives.

Croatia, like many other countries, faces numerous challenges when it comes to timely warning citizens and coordinating between different protection and rescue services. Existing systems often suffer from issues such as slow information distribution, unreliable communication channels, lack of integration between different services and technologies, and limited reach of information to citizens.

To successfully address these challenges, it is necessary to develop new, innovative systems that use the latest technological advances and achievements. The integration of modern technologies such as cloud computing, real-time data processing, geospatial data, and machine learning can significantly enhance the ability of the entire system to provide timely and accurate warnings of crisis situations.

CROalertNet is conceived as a response to these challenges. This platform uses the latest technological innovations to create an efficient warning and information system that is accessible to all citizens of the Republic of Croatia. The platform is designed to be scalable, reliable, and secure, enabling timely warnings and coordination between different protection and rescue services. Through an intuitive user interface, citizens can quickly and easily obtain information about current crisis situations and recommended actions.

One of the key aspects of the CROalertNet platform is the offline mode of its mobile applications, allowing access to information and other partial functionality even when there is no internet data connection. The details of the whole platform would exceed the scope of this paper, so we have decided to focus on a single module, which can be used to demonstrate the usefulness of this key feature.

2. OFFLINE MOBILE APPLICATIONS FOR CRISIS STIUATION ASSISTANCE

Smart mobile devices, such as Android and iPhone based smart phones, have become commonly used devices in first world countries, with some of them, such as the USA showing that 90% of adults own one. (Pew Research Center, 2024) Similar results are evident in most of the European Union including Croatia. (Taylor, 2024) Additionally, it should be noted that a huge percentage of these users are assumed to rely on these devices for navigation, particularly pedestrian navigation (Fonseca, et al., 2021) but also for vehicle navigation, notably via car Infotainment systems integration with applications such as Android Auto and Apple CarPlay. (Straits Research, 2023)

Reliance on vehicle and pedestrian navigation means these devices will be one of the first places an individual turns to in case of an emergency. A person might need to find a hospital, a fire station or a police station.Finding these via mobile applications such as Google Maps is easy and fast. The problem with these services is that they rely on Internet data traffic. However, during crisis situations such as the earthquake in Croatia in 2020, mobile networks

tended to get overloaded and became nonfunctional as people frantically tried to contact their families or reach emergency services. (Hina, 2020)

Mobile network overloads such as these come at the worst time, during statewide crises. Communication network unavailability will impede an individuals' ability to contact emergency services and use the aforementioned navigation applications to reach a needed emergency service. Even state sponsored services, such as SRUUK (Early Warning and Crisis Management System, hrv. Sustav za Rano Upozoravanje i Upravljanje Krizama) rely on mobile network availability (the SMS component in this case) to be able to function in a time of crisis. (Civil Protection Directorate, 2023)

This happens because mobile network providers build networks to accommodate normal peak usage times, not the theoretical maximum usage. (Gandhi & Narmawala, 2022) However, crisis situations, such as earthquakes, will exceed normal peak usage because they affect the entire population which in turn means it will affect the mobile provider's users in the affected area.

Worse yet, the network might become completely unavailable in case its infrastructure suffers damage. Such damage can be caused accidentally by earthquakes or fire or intentionally in cases of deliberate sabotage or attack. During wartime, communication infrastructures are traditionally a high priority target for both conventional (Lewis, 2023) and cyber-attacks (Pendino, Jahn, & Pedersen, 2022).

This does not mean we should not rely on mobile devices for crisis assistance. A smartphone means an individual is carrying a literal computer in their pocket. This is a powerful tool even if the network is unavailable. However, applications designed for crisis situation usage must be designed in a manner which allows offline functionality. As we have shown, a crisis situation, particularly a war situation carries with it a very high probability that mobile networks will be unavailable. For this reason while the proposed CROalertNet system will fully leverage all modern network and cloud services it is also vital that all of its mobile platform components are ready for offline work. This is the key difference between the proposed system and existing systems and mobile applications.

3. CROalertNet MODULE EXAMPLE – BOMB SHELTER MOBILE APPLICATION

As previously stated, navigation applications are common on mobile devices and the most successful ones require the availability of internet data access. A good example of this is Google Maps. (Google LLC, 2024) There are also a few commercially available offline navigation applications such as Maps.me (MAPS.ME Cyprus Ltd, 2024). Applications such as Maps.me avoid the pitfalls of data traffic congestion and unavailability which are common during crisis situations. However, these applications still assume the availability of mobile device location services, such as Android Location Services (Google LLC, 2024), which may or may not be functioning. Modules such as GPS location might be working but pinpointing the location by Wi-Fi network availability or mobile network tower triangulation might not be. GPS (more precisely GNSS) even if functional, meaning satellite communication has not been disrupted by jamming (Morrison, et al., 2023) or spoofing (Meng, Yang, Yang, & Zhang, 2022), might not be accurate due to line-of-sight issues. This is particularly problematic in urban areas with numerous high-rise buildings.

These applications are not designed for crisis use and while they usually include updated information on locations of hospitals, they might not include less available information, such as bomb shelter locations in Croatia. For example, at the time of the writing of this paper, Google Maps is not familiar with the location of any bomb shelters in Croatia. These locations are available in various documents on government and municipal web sites. For example, the city of Zagreb maintains a list of its bomb shelters on their web pages. (City of Zagreb, 2022) This list includes only the shelters managed by the city of Zagreb. It does not contain shelters maintained by residential buildings and companies. In short, this information (the location of bomb shelters) is completely unavailable in a situation where mobile networks are congested or disabled, which has a high probability of happening in wartime, during an air raid, which is the purpose these shelters.

It should also be noted that while hospital locations might be common knowledge for the local population, and even if the mobile network is unavailable one can always ask nearby individuals for directions, this is not the case with bomb shelters. Since they were last used almost 30 years ago in Croatia and far longer than that in most other European countries, many citizens are unaware of bomb shelter locations. An added issue is that while the location of these shelters should be marked on the outside of the building using a special symbol, most of the buildings capable of sheltering the population have not maintained these markings. The general populace is also usually unaware of the meaning of these symbols.

For these reasons, we consider a mobile application which is capable of offline functionality and includes the locations of bomb shelters to be an excellent example of how the proposed platform, CROalertNet, can make a meaningful contribution to the safety of the citizens of Croatia and other EU countries.

4. CROalertNet BOMB SHELTER MOBILE APPLICATION FEATURES AND REQUIREMENTS

The principal features and requirements for CROalertNet mobile application are presented in this chapter. While the chapter focuses on a single module of CROalertNet, most of the features and requirements are applicable to other modules of the CROalertNet platform and highlight the advantages of such systems.

The goal of this mobile application is to provide navigation (pedestrian or vehicular via Android Auto or Apple CarPlay) which will assist the user in reaching the closest bomb shelter. The application must be capable of providing assistance even if there are no internet data traffic or location services available.

To achieve this goal, it is critical to explain how the application functions in regard to Internet data traffic and location service availability. The basic workflow of the application is shown in Figure 1. This figure demonstrates the order of processes and data accessibility in both online and offline mode of work.

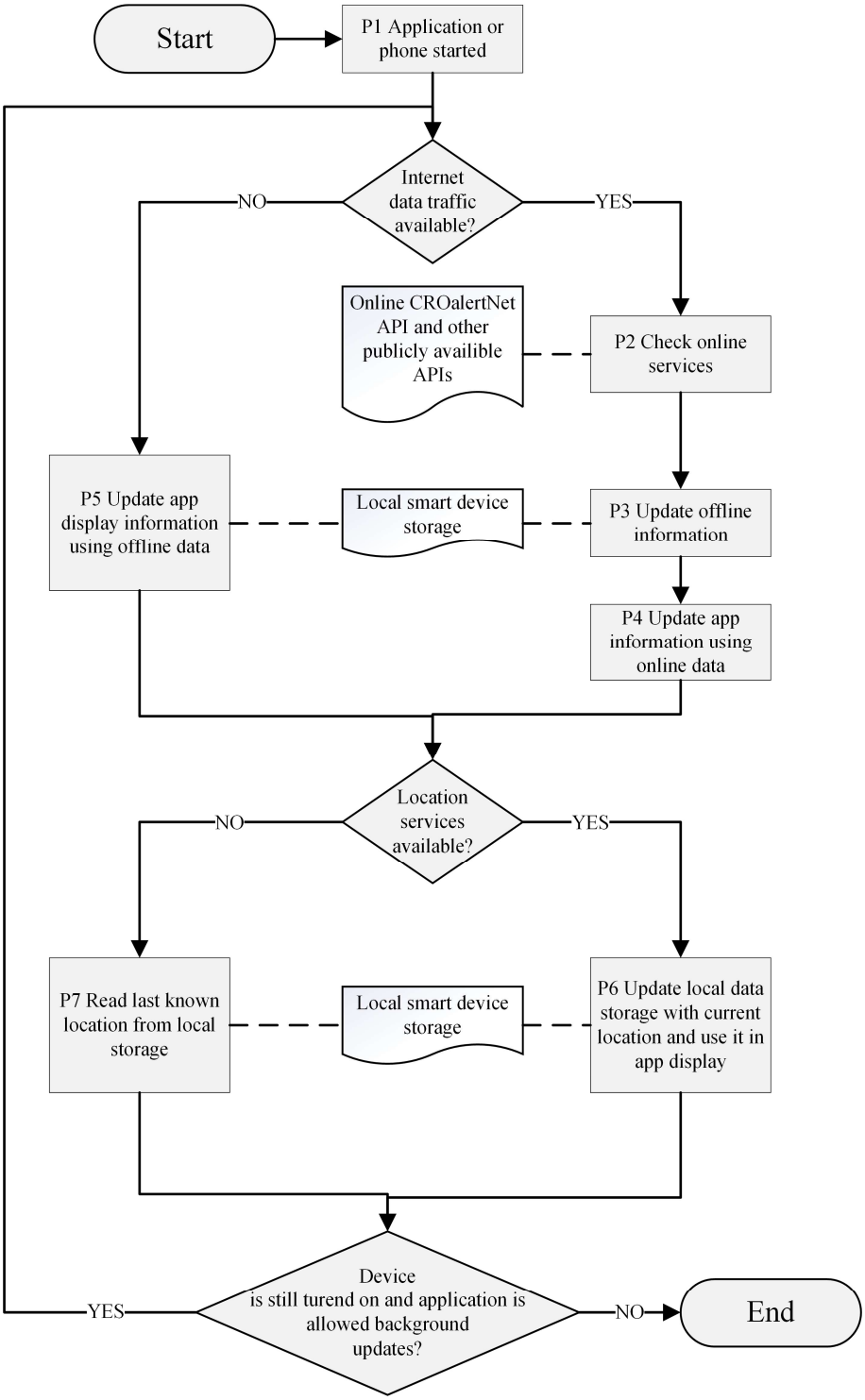

Figure 1: CROalertNet Bomb shelter mobile app workflow

While the diagram in Figure 1 is mostly self-explanatory, several of the processes warrant a more detailed explanation.

If internet data is available the device will use this to access online services (P2), both CROalertNet services and required 3rd party services, and store this information locally (P3). Storing information locally means information will physically be located on the device itself and the application will not require Internet traffic data to access this information. This information includes map updates (such as new routes and route closure due to roadwork,

damage, traffic congestion, etc..), shelter information updates (subject to availability, includes information such as new shelters opening) and general information (such as official notifications related to bomb shelters). This is the basic information the application needs in order to function – maps and shelter locations.
In addition to this the application relies on location services to pinpoint the user's location and provide real time navigation. Again, such information, depending on the type and severity of the crisis event may or may not be available. If it is available the application can function normally, as all navigation applications do, showing the fastest route to the closest bomb shelter with real time location updates. Whenever this (location) service is available the application will also note the user's latest location and record it in local storage. If the location service is not available, the application can fall back to the latest known position to use that as a starting point for offline navigation.
In offline navigation mode the application can still be used as a traditional paper map. This mode starts with the last known location and allows the user to update the location manually by observing street signs and other recognizable landmarks, as one would with a paper map.
The critical piece of information – the address and visual map location of the nearest shelter will be available whether the device can use Internet data traffic and location services or not.
To facilitate this the application needs to have an offline, background work mode. Mobile devices allow such work modes, and the only requirement is that the user allows the application to work in background. This application would use its background mode to run most of the processes in Figure 1, but of particular importance are P2 and P6 as they communicate with outside sources to update general and location information. These processes provide vital information for the offline work mode processes (P5 and P7).
As shown in Figure 1, the described background process would run continuously whenever the device is turned on. If it is disabled, the application might suffer from outdated data and be unable to estimate even the general area of the user.
Such an application must, at minimum, support the following features:

- visually display a map of the surrounding area
- display the user's (last known) location on the map,
- display the route to the closest shelter on the map,
- display general information regarding shelters,
- display public notifications regarding shelters,
- discrete background mode.

The application should also fulfill the following requirements:

- be able to function with no Internet data connection,
- be able to function with no location service,
- minimal possible battery usage in background mode,
- no user registration,
- support for Android and iPhone mobile devices,
- integration with Android Auto and Apple CarPlay,
- minimal hardware requirements.

Most of these are self-explanatory, the last requirement – minimal hardware requirements - is there to enable wide use on older devices. A minimalist user interface is proposed.

It is assumed that the proposed platform would be state or EU funded, and not commercially driven. As such it can avoid reliance on ads and user data gathering for financing. This will enable the fulfillment of the “no user registration” requirement, which would in turn encourage more use among privacy aware users. While the proposed platform might include advanced features which require user registration this should be avoided when possible. The modular architecture of the entire CROalertNet platform will enable mixing anonymous and registered user systems.

Acessibility features would also be added, as per standard EU guidelines.

A proposed additional feature is providing data to Android accessibility network for TalkBack integration. (Google LLC, 2024) TalkBack is part of Googles Android Accessibility services which enables low and no vision use of the device. An even better solution, should funds for it be found, would be to develop specialized auditory interfaces for the entire platform instead of relying on generic services.

5. CONCLUSION

The development and implementation of the CROalertNet platform signify a substantial advancement in the utilization of information technology for managing crisis situations and enhancing civil protection. In an era where natural and man-made disasters are becoming increasingly frequent and severe, the need for an effective and reliable warning and information system is more critical than ever. CROalertNet addresses this need by integrating the latest technological innovations, including cloud computing, real-time data processing, geospatial data, and machine learning, to create a robust and efficient system for timely dissemination of crucial information.

One of the standout features of CROalertNet is its emphasis on offline functionality. This ensures that essential information remains accessible to users even when traditional communication networks are compromised, which is often the case during major crises such as natural disasters, technological incidents, or wartime situations. The platform's ability to operate offline was demonstrated through the example of the bomb shelter mobile application module, highlighting its potential to provide life-saving information and guidance when it is needed the most.

CROalertNet not only enhances the operational efficiency of national protection and rescue systems but also empowers citizens by providing them with actionable information. This fosters a culture of preparedness and resilience among the population, enabling individuals to respond more effectively to crisis situations. The platform’s user-centered design and accessibility features ensure that it caters to a wide range of users, including those with special needs, thereby promoting inclusivity and widespread adoption.

The modular and scalable architecture of CROalertNet positions it well for future expansions and integrations with emerging technologies. For instance, incorporating artificial intelligence could further enhance the platform's ability to detect threats, analyze data, and personalize user experiences. This forward-thinking approach ensures that CROalertNet remains at the forefront of technological advancements, continually improving its capabilities to serve the public better.

Moreover, the development of CROalertNet is a testament to the potential of public sector innovation. As a state or EU-funded initiative, it exemplifies how government-supported

projects can lead to significant improvements in public safety and crisis management. By addressing the shortcomings of existing alert systems and integrating innovative solutions, CROalertNet not only enhances the effectiveness of crisis response but also helps to reduce public panic and secondary emergencies, which often result from a lack of available information during crises.

CROalertNet represents a significant stride toward building a more resilient society. Its comprehensive approach to integrating modern technology with crisis management underscores the importance of preparedness and timely information dissemination. By safeguarding lives and properties in an increasingly unpredictable world, CROalertNet stands as a pioneering example of how technology can be harnessed for the greater good, ultimately contributing to a safer and more informed populace.

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INFORMACIJSKA TEHNOLOGIJA U KRIZNIM SITUACIJAMA I CIVILNOJ ZAŠTITI – CROalertNet

Sažetak: *U radu je prikazana razvojna ideja aplikacije i platforme CROalertNet, koja je usmjerena na poboljšanje sigurnosti i informiranosti građana Republike Hrvatske putem inovativnog sustava za pravovremeno upozoravanje na različite vrste kriznih situacija. Kroz analizu funkcionalnosti, tehnološke infrastrukture i korisničkog iskustva, prikazano je kako ova platforma može služiti kao alat u nacionalnom sustavu zaštite i spašavanja, pružajući ključne informacije u trenucima krize i promovirajući kulturu pripravnosti i prevencije među stanovništvom. Implementacijom najnovijih tehnoloških rješenja i pristupom temeljenom na zajednici, CROalertNet doprinosi otpornosti društva u odgovoru na krizne situacije, čineći informacije dostupnima, razumljivima i akcijski orijentiranima za sve korisnike. Snažna i skalabilna platforma koja koristi cloud tehnologiju za osiguranje visoke dostupnosti i pouzdanosti usluga temelj je projekta. Platforma koristi napredna rješenja za obradu i analizu podataka u stvarnom vremenu, osiguravajući brzinu i točnost informacija. Jedan od važnijih aspekata aplikacije je i usmjerenost na offline načina rada, a zahvaljujući modularnom dizajnu, platforma je spremna za buduća proširenja i integracije s drugim sustavima i tehnologijama, poput umjetne inteligencije, za poboljšanje detekcije prijetnji i personalizacije korisničkog iskustva.*

Ključne riječi: *aplikacija, CROalertNet, građani, informacija, sigurnost, zaštita*