Earthquake Guardian

<DOMAIN> | CAPSTONE PROJECT
HONOURS BACHELOR OF APPLIED COMPUTER SCIENCE (MOBILE COMPUTING)

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ABSTRACT

Earthquakes are one of the most dangerous natural disasters that can occur over a large area and effectively destroy buildings, homes and network infrastructures. During and after a disaster, effective communication is vital to coordinate response efforts in order to limit secondary deaths and injury. This project is aimed at developing an application to restore communication in these affected areas. The project can work with Bluetooth, Wi-Fi direct or regular infrastructure Wi-Fi. Various features in this app facilitate communication between civilians (Victims) and first responders which include; sending broadcast notifications, sending 1 to 1 encrypted messages, asking about user's injury state, storing user location and other information locally in a database or on the cloud, providing a list of affected civilians to the first responder within any area, display that list of civilians on a map to help first responder respond quicker, enable chat to send message, images, or send alerts. also track the user by using augmented reality view and wearable devices to get the civilian location with guided directions. The focus on developing a local mesh network and wearable computing will aid in accomplishing the application's main goals. The project is versatile enough to adapt to other disasters in the future such as tsunami or even blackouts.

ABOUT CAPSTONE PROJECTS

TIMELINES • PROGRAM • SCHOOL

- **January 2019 – April 2019**: Capstone Project Inception, 3-credit course (9 hours / week)
- **September 2019 – December 2019**: Capstone Project, 6-credit course (18 hours / week)

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HONOURS BACHELOR OF APPLIED COMPUTER SCIENCE
(MOBILE COMPUTING)

PROGRAM • SCHOOL

- Hons. Bachelor of Appl. Computer Science (Mobile Computing)
- Applied Computing, Faculty of Applied Science and Technology

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INTRODUCTION

The purpose of this document is to generate the project outline and its requirements. This document describes the baseline of the project such as domain and industry, determined functional areas and solutions for each area related to the industry and community, provided the information about what kind of platform will be used, how cloud computing is collaborated with these platforms, moreover further explained which advanced areas of computer science have selected and soaked into this project.

Revision History:
-01/27/2019: Project Abstract and Overview
-02/04/2019: Project Plan
-03/24/2019: Project Requirements and the Project Architecture
-04/20/2019: Testing and Conclusion
-10/21/2019: Refined the document
-11/29/2019: Updated the document
-12/11/2019: Final update

PROJECT OVERVIEW

The name of our project is Earthquake Guardian. The project's scope is based around restoring communications and finding any civilians who needs help whether injured or not after an earthquake strikes. Any civilians who needs help (even when they are trapped inside the building) can use the project to hook up their devices to others in order to manage their communication to the outside world. When the devices detect an earthquake, the application will ask about injury condition to the user and the first responder will get the user information such as their location with injury condition. Those who are unconscious and have the project installed on their device will be sent alerts and notifications regarding their condition. If they fail to respond in time the project will try to send their location and status to their emergency contacts and services. The first responder can use an Android watch to see the direction where civilians are which will help first responder to find civilians even better. The team members of this project will consist of Ahmed Elmohelshy, Joo Hyun Park and Kenji Casibang.

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DOMAIN AND INDUSTRY OVERVIEW

This problem would fall into Emergency and Other Relief Services (62423). This industry comprises establishments primarily engaged in providing food, shelter, clothing, medical relief, resettlement and counselling to victims of domestic or international disasters. The industry currently has around 440 establishments around Canada with an average revenue of $335.100. The Canadian government website provides several information regarding earthquake preparation. The problem that currently exists is delivering this information to users that live in earthquake zones efficiently and improve locating civilians in inaccessible areas. For emergency services information is important during a disaster and if the project can provide them the approximate location of victims than it can improve their response time.

PROBLEM DESCRIPTION

This problem mainly affects people who are in earthquake prone areas. Let's say that an area experienced an earthquake and multiple buildings were affected and collapsed afterwards, people might get trapped under the rubble while still having a connection to the outside world whether it be their voice being heard if they're able to shout, data on their phone connecting to nearby cell towers or Wi-Fi connections or any other means. Other people may not be so lucky and might not have any kind of connection to the outside world to inform them that there's still someone trapped under there. When the rescuers do eventually arrive, they might not even know of the fact that there're some people still trapped under the rubble until it is too late. Information is a vital component for preparation and emergency response. Restoring communications and aiding in response time during an earthquake are the two main problems that this project aims to mitigate. Emergency and rescue services would benefit being informed of how many users are in an area. In order to reduce emergency response time, one of the main features of the project will use the smartphone as an AR beacon to improve search and rescue. The other core feature in this project is the ability to form a local mesh network. The mesh network ultimately connects all the devices and will be able to communicate each other by forming its own network system. After an earthquake has happened, contacting someone for help can be tricky. For example, when a user got trapped inside building, a user's phone might not be able to connect to the network. Moreover, earthquake might damage to the entire city therefore it might hard to call for help due to lots of people might also call for help.

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SOLUTION DESCRIPTION

The solution here is an app that gets installed on smartphones and smart watches, the app senses when a sudden rapid movement occurs and displays a message afterwards to ask the user whether or not they're in an emergency situation, if so the app automatically enables all possible connections (Bluetooth, Bluetooth low energy, Wi-Fi, Wi-Fi direct) and connect to other smartphones in case this one loses connection and it will also alert the proper emergency units that there's a person here who's trapped inside the building. This will help emergency responders approximate the number of people still stuck inside that building and adjust their rescue plan accordingly. Moreover, for civilians, they can use the app to send message to the other users either first responder or other civilian, that will increase the chance of getting rescued by notifying their presence. For civilians that are unconscious that app will use its various sensors described previously to determine if an earthquake has occurred and ask for user input. The app will have different features depending on the user. First responders will have more functionality compared to a civilian user. In the event a first responder loses their device they can get a civilian's device that also has our app and continue their search.

Mobile Computing

Mobile devices are the main target for this application. Mobile devices were selected because according to a recent survey conducted by the IDC, 79% of people have their phone on them 22 hours per day which is crucial since people tend to use their phones and have their phones with them a lot of the time, mobile devices are the best platform to use for a project like this. In order to reach a greater number of users the project will be developed for Android devices. Most of these devices also have several sensors such as GPS that can be used for context awareness. Depending on where the user is currently the application can provide a warning if they are in an earthquake zone. It can also be used to notify them of nearby emergency evacuation centers. For mesh network, android has wireless APIs enable communication with other devices on the same local network, and even devices which are not on a network, but are physically nearby. This is available because of using NSD (Network Service Discovery) by allowing an application to search the services from other application. To use combination in NSD and mesh network, this will make the user's device enables to detects the nearby application services whether the devices are connected to the network or not. There is another reason why mobile computing is important in this project. Mobile devices tend to have a variety of sensors that can help detect an earthquake accurately in not time like for example an android smartphone may contain all or some of the following sensors (Accelerometer) which determines the orientation of


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the device as well as its acceleration In a three-dimensional space which can be used to detect shaking, also (Gyroscope) which measures the movement of the device calculating the rate of rotation around each axis, there're also a couple more software based motion sensors namely (Gravity – Linear Acceleration and Rotation Vector).

Cloud Computing

Google Cloud Platform or similar service to store a user's last known location and safe exits. Should the user lose network connection and be in an active earthquake zone the information can be sent to emergency contacts or services. Once the user regains connection it can send their last known location to the database. First responders with no internet connection can get their local database updated by users who do have an internet connection.

Advanced Areas of Computer Science

This project will utilize two main advanced areas of computer science. Firstly, IoT and wearable computing, first responders with smart watches in the future will be able to use the sensors in these devices to find nearby the civilians and act accordingly. The app for the smart watch will have similar functions to the original app. It will include features such as viewing connected devices in the mesh network, sending predefined messages, trigger and alarm and a pointer to the civilian's device. Mesh Network is the secondary advanced area of computer science that will support this project. It will be used as the backbone of our application to connect users with or without internet into a local mesh network for communicating. The combination of these two areas of computer science will provide the user with a more intuitive experience.

Mesh Network (Hype SDK)

Using the Hype SDK, we can create our own local mesh network using most of the available transports on a smartphone. Depending on the transports available a user with only Bluetooth enabled and a user with only Wi-Fi-direct enabled will be able to communicate if there is another user with both. Each user will be able to communicate with others in a fast and efficient manner compared to traditional Bluetooth and Wi-Fi Direct methods. Broadcasting messages will also be possible to relay information to all connected users. The SDK supports user authentication, end to end encryption and network segregation. It is also available on multiple platforms such as Windows, iOS, and Linux which can be used for future work.

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SOLUTION IMPACT

This solution will help emergency responders quickly determine within a small margin of error the number of trapped people inside the building and assist them in devising a rescue plan according to the information they received. First responders will benefit from the mesh network and chatting system to effectively reduce the amount of time searching for civilians. The civilians get benefit from the chatting system to increase the chance of survivability to contact with nearby civilians or first responders. One core function is to locate other users of the application using AR who are stuck in inaccessible areas. This should be feasible within the Capstone timeframe and more features can be added to improve the application's usefulness.

SOLUTION FEASIBILITY

Design and Construction

The design is highly feasible considering it will not require any extra hardware to be involved, the solution requires only an app on the software side and a back end to help keep the application running as intended. Construction of the AR component of the project should be feasible as documentation is included with the AR software development kits for mobile platforms. The risk of mesh network still has some connection reliability issue. The application is supporting multi transport (Wifi infrastructure, Wi-fi direct, Bluetooth, Bluetooth low energy) which has an ability to maintain more than one communication technology simultaneously. However, besides the Bluetooth low energy transports, other methods of transport still having an issue to discover other devices and send messages compared to Bluetooth low energy.

Deployment

Once the application is successfully tested, deployment should not be a problem at all given that it will be easily accessible from Google's play store just like any other regular app. Adjustments will be made to the project to allow for better scalability.

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Adoption

Adoption should not be a problem as well since the application is not data heavy and will probably be used once or twice max per user, according to a recent study conducted by “Earthquakes Today”, there are 1400 earthquakes occurring each day only around 200 of these can be felt and only 2 major earthquakes can occur each month so the usage for the application will not be daily and will only be data heavy in a single location.

PROJECT PLAN

This section describes the work that will be done throughout the project development. Each iteration phase for the project will run for two weeks and each member are assigned a task to complete. This section will also describe the risks involved with the project during development and how they will be mitigated.

ITERATION PLAN

Iteration Overview:
Early iterations will focus on research, looking for existing related applications and resources that may aid the project. The core functionalities of the project will be narrowed down after initial research is complete. Each iteration will have a weekly meeting, followed by work on each use case stories. The user stories worked on will be towards the completion of the primary use cases of the project. These use cases are divided into functional areas that each member will be responsible for. Current functional areas include earthquake detection, mesh network and augmented reality.
Potential uses cases for earthquake detection include:

- Detect and notify the user whenever an earthquake is detected in his proximity using on board sensors
- Alert emergency responders with user's information and responsiveness
- Notify user of safe areas he could hide in

Potential use cases mesh network connection includes:

- Enable user to chat with nearby users. User able to send either images or text.
- First responder sends broadcast message to all the users’ devices that being connected to.

- The civilian's device will send their information (such as their location and injury state) to the first responder side.

Potential use cases for augmented reality and wearable include:

- Use GPS and location framework to get the user's position
- Display AR marker on user location
- Use AR to map out an area and mark key points (Evacuation points, Medical Tents, etc.)
- Android watch to display the Civilian's location.
- The watch will also include the ability to send predetermined messages

These use cases will be worked on by team members throughout each upcoming iteration during the project's development cycle.

Team member tasks:

Ahmed Elmoselhy will be responsible for earthquake detection functionality including using hardware sensors on Android devices to detect and alert the user about a potential earthquake, as well as alerting the proper emergency services about a potential user that's currently in danger and whether he's responsive or not to help rescuers assess the situation properly and accurately develop a rescue plan to help those in need. Other use cases include adding a distinct sound to alert nearby first aiders of the user's current position this technology was first commercially used by apple in their (Find my iPhone) application in which u could lock and trace the phone remotely in case of the phone being lost and if needed play a sound to guide you to it. Ahmed also will dedicate to work on the mesh network area since mesh network is the base and biggest portion.

Joo Hyun Park will be responsible for mesh network functionality during the iterations. Functionality that includes getting two or more devices to connect each other and forming a mesh network. Each iteration will expand on this main functionality by adding more useful features. Features like adding chatting system, allowing for media transfer, sending a broadcast messages and send the user's data to the first responder. Joo Hyun will be responsible for managing the following risks: Incorrect researching, Low User adoption, no budget for support project, Unavailable to contact domain expert in need, Incorrect requirements (Not useful), and Poor Software Quality.

Kenji Casibang will be responsible for AR related functionality and smartwatch version of the project throughout each iteration. Such as displaying AR markers on the user's location and key points in an area. Research will be done for

more potential use cases during and after an earthquake. Smart watches and other wearables will be researched to determine their viability for the project. This member will be responsible for mitigating the following risks: Technology that is not common for Android (API, Library etc.), Requirement Changes, Team member unavailability, Unsustainable User Growth, Underestimate Schedule planning, and User privacy concerns. Kenji also will dedicate to work on the mesh network area since mesh network is the base and biggest portion.

RISK MANAGEMENT PLAN

The link to the risk management plan is: https://app.asana.com/0/1103709051170926/list
The risks are divided into 7 parts: Estimation, Organization, People, Requirement, Tool, Technology and End user risk.

Estimation risk refers that the team members are over or underestimate different aspects of the project. The major risk in estimation is “underestimating schedule planning” that gives task to each team member that it is impossible to finish within each iteration planning. To manage this risk, make sure assigning the task to team members based on their skills and capability.

Organization risk refers that potential for losses due to uncertainly effected by an organization. The major risk in this section would be “no budget for support this project” that a company is unavailable to support the project anymore during development. Since it is responsible for organization to manage their budget, there is no solution for team members to prevent this kind of risk.

People risk refers that the any kinds of conflict between team members. The major risk is “Team member unavailable” because they have an emergency. To deal with this risk, reschedule the planning and reassigning tasks to the other team members until the team member comeback.

Requirement risk refers that is the potential for losses due to a wrong requirement management process. The major risk in this section is “Requirements change” due to demanding different requirements by the company or end users. To manage this risk, team member needs to identify the exact wants from end users through solid communication with them.

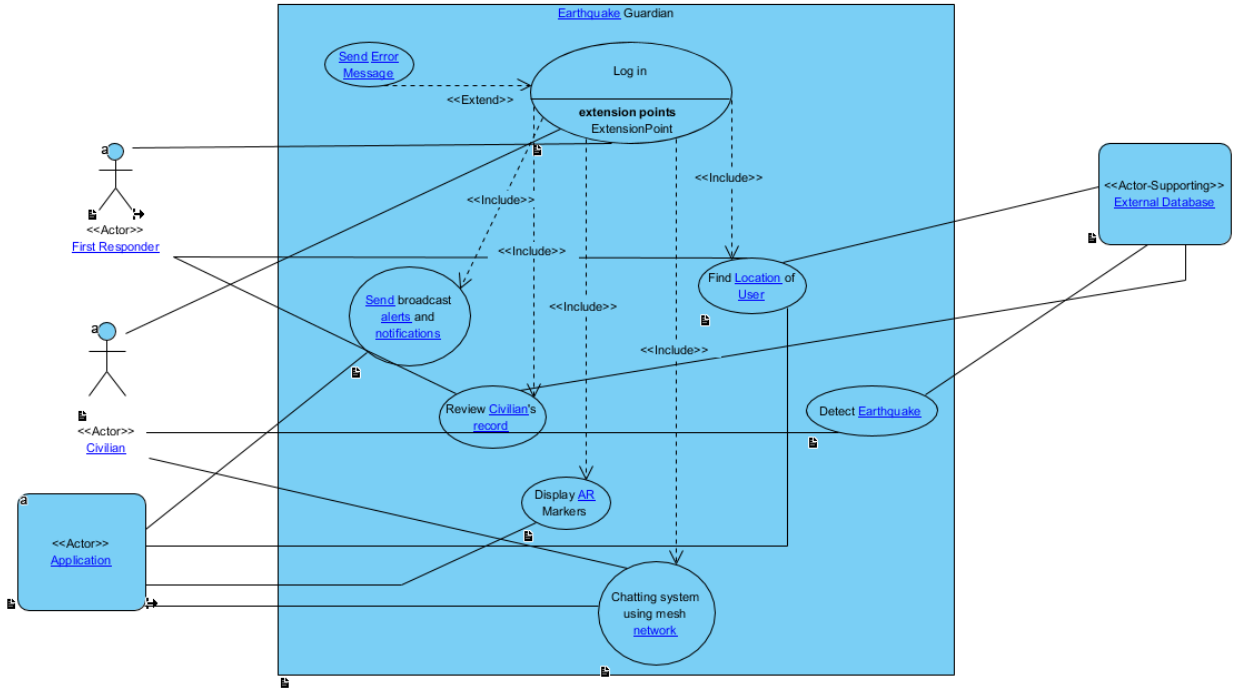
Tool risk refers to any risks that related tools being used in this project. The major risk in this section is “Database corruption” which is catastrophic risk when it happened. If database is corrupted, then every information that shown in an app are incorrect and will make potential problems. To overcome database corruption in tool risk, it is important to make a copy and keeping backup file is a great solution. Another major risk is losing access to the Hype SDK which would greatly reduce the project’s performance and even prevent certain features from working.

Technology risk could prove disastrous if android won’t allow p2p connections between them. Since this type of software becomes better when more people use it, having a powerful operating system with an astounding 84.8% market share and not being able to communicate would hinder the performance of the whole project and affect the success rate in life or death situations. If an android user is stuck with no service unable to reach any connection, we must be able to connect them somehow and alert the authorities to the android’s user location and status otherwise the whole project has failed.

End user risks are many depending on each specific user but one of these risks stands above all else which Is PRIVACY. Lately many smartphone users are becoming more and more worried about the security risks that comes with having your smartphone know everything about you from your personal images to your contacts, your habits and your location they even monitor the number of steps you take. According to a recent statistic by TrustArc nearly two-thirds of all smartphone users have concerns about their privacy due to their smartphones. Lots of people might not be comfortable with sharing their every movement all the time and wouldn’t allow the application to monitor their location which could be a problem when we want to confirm whether the user is in an earthquake prone area or not.

PROJECT REQUIREMENTS

SYSTEM CONTEXT



The system context diagram includes three main actors: First responder, Civilian and Application. First responder is our main stakeholders that can be anyone who is working in emergency services and rescue civilian such as firefighters, nurse and police. Civilian actor can be anyone who is living in earthquake zone or affecting by an earthquake. Application is an app itself (system) and helping other main actors to achieve their goals through this app. The Hype SDK can be application actor to provided mesh network infrastructure, enable users to discover and chat each other. The supporting actor is an external database which helps to save and gained all the information

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from our main system (user information, location etc.). The external database will provide information when the system has requested.

USE-CASES

In system context diagram, there are seven main use-cases exist:

1. Log-in: It is a log in system which user needs to do before accessing to main service. It will distinguish between first responders and civilian and depends on who they are, the app will provide different screens and services.
2. Send Broadcast alerts and notification: First responder can send broadcast message to all civilian who are joined the channel. The broadcast message will also send as a notification.
3. Display AR markers: Application displays an AR marker (beam) overt the Civilian's location.
4. Chatting system using mesh network connection: Civilian and first responder enabled to chat and send pictures to other users by using mesh network connection supported by Hype SDK.
5. Detect Earthquake: Application detects earthquake and recognized there is an earthquake in specific area based on the data collected from multiple civilians that they confirmed they are in danger. Application send alerts and notification to Victim when detects the earthquake and ask them whether they are safe or not.
6. Find location of User: Application trying to find the location of user after Civilian confirmed the danger alerts.

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USER INTERFACE

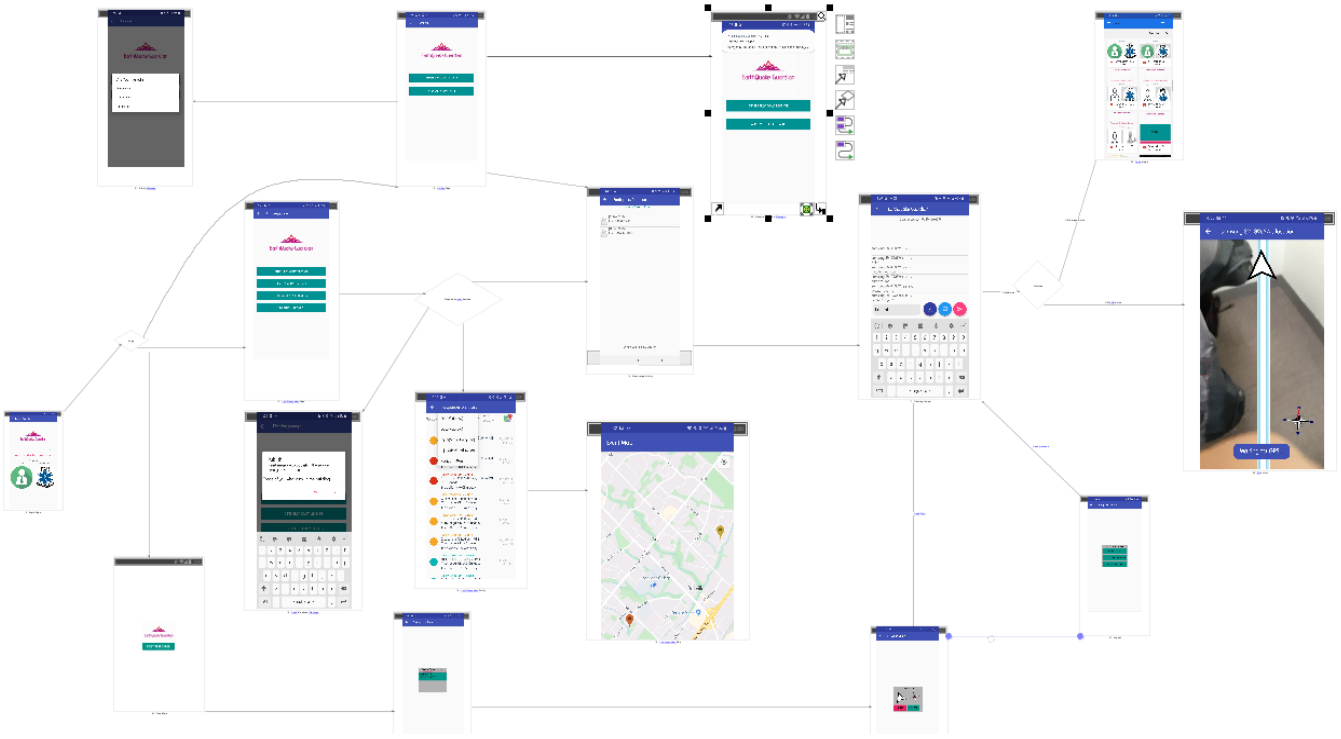

Fig. Overall Wireframe Diagram.

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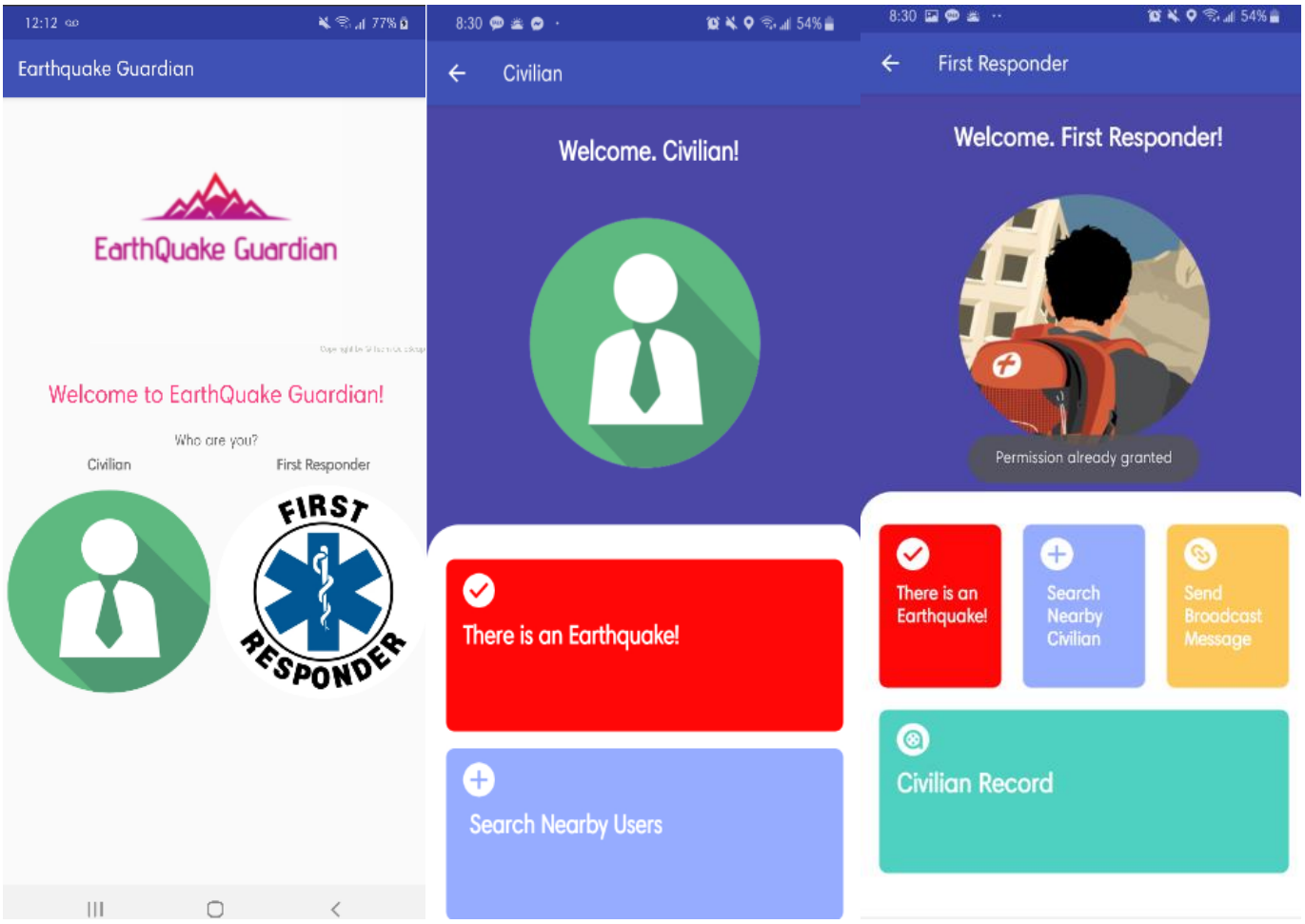

The login page is the application's main method of determining the status and rank of the user whether he's a civilian or a first responder.

Depends on the user's rank (either one of Civilian or First Responder), there are more features are can be accessed to first responder.

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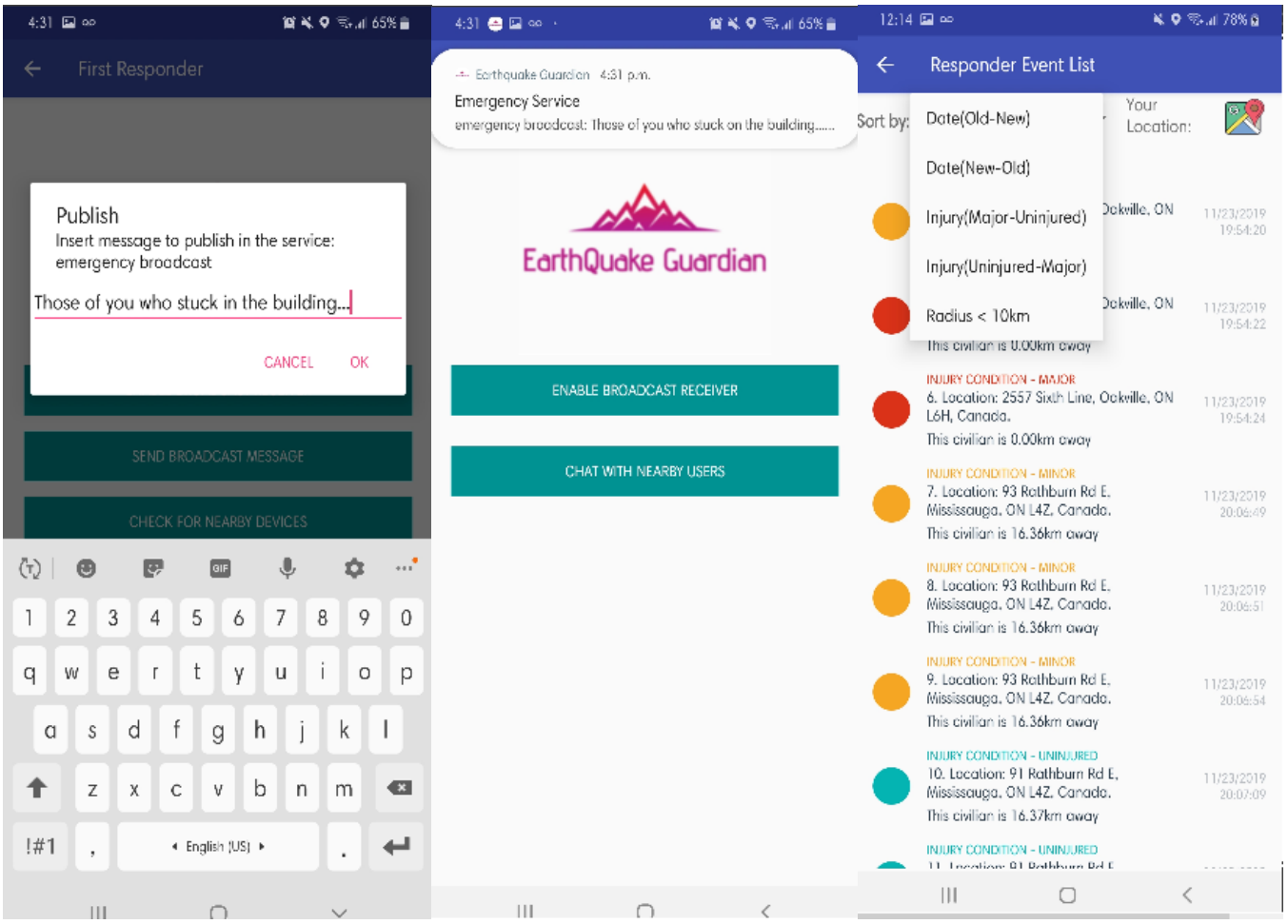

The first responder can search for other devices like Civilian can do. But they can use more features than Civilian. One of the features just for first responder is send a broadcast message. They can send broadcast message once they joined the network and all the Civilian will get the message if they are joined in the same network.

The other one of the feature that first responder can only access is responder activity(display civilian's record), which is the list of API data retrieved from the database with eye catching UI design with the information of civilians, such

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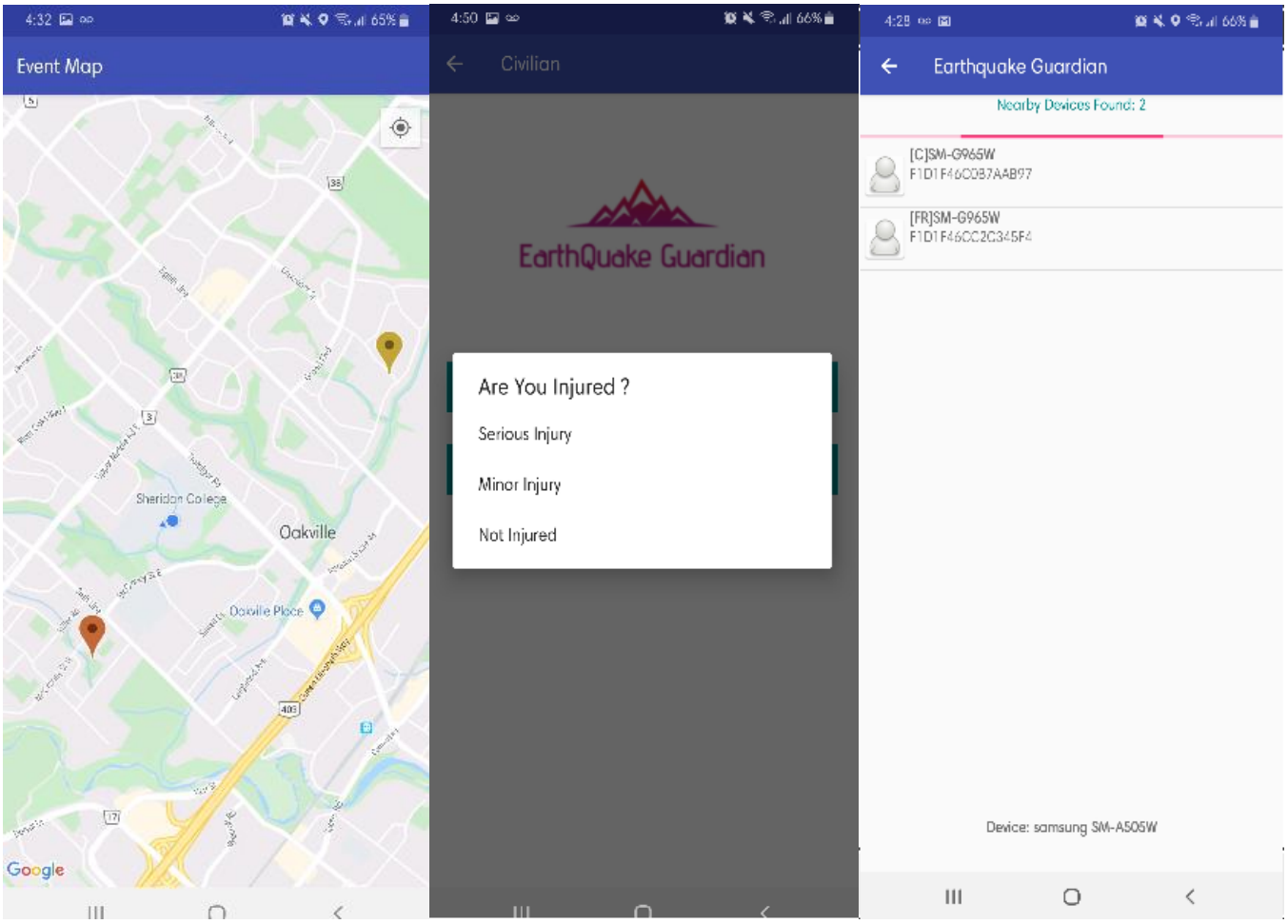
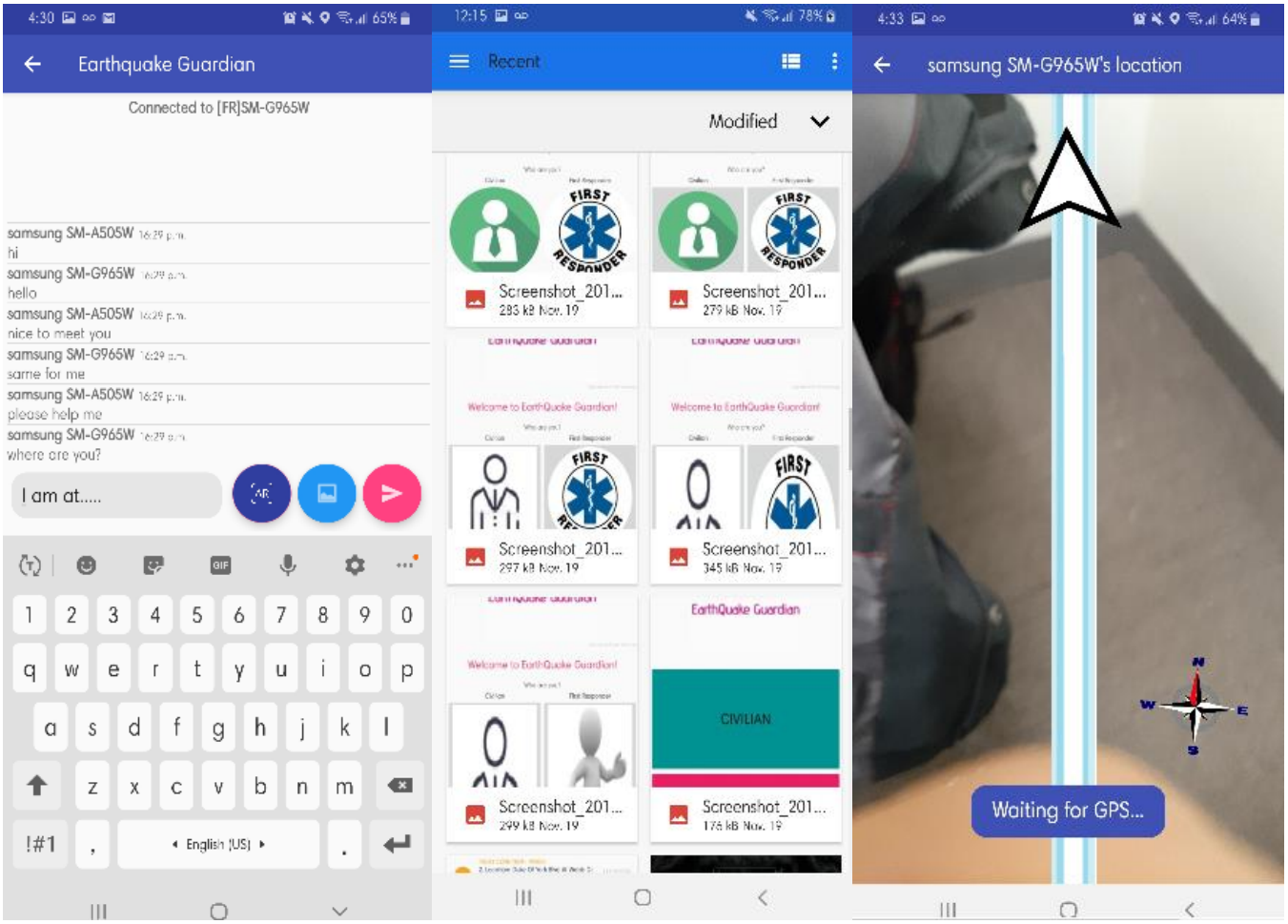
as display their location address, how far away from first responder device, injury state, the time and date that the data has been sent.



First Responder can access to the map and can see all the Civilian as a pin. Each pin displays the user's injury state and the date of user's data. Depends on user's injury states, the pin color changes.

The discovering page which contains the mesh network mechanism which allows the user to quickly detect and connect to nearby devices.



Once the devices found nearby user, the user able to chat with them. They can send pictures and text and only for first responder, they can trigger alarm in Civilian's phone.
From that page, you could access the AR environment to find other user's location with the distance.

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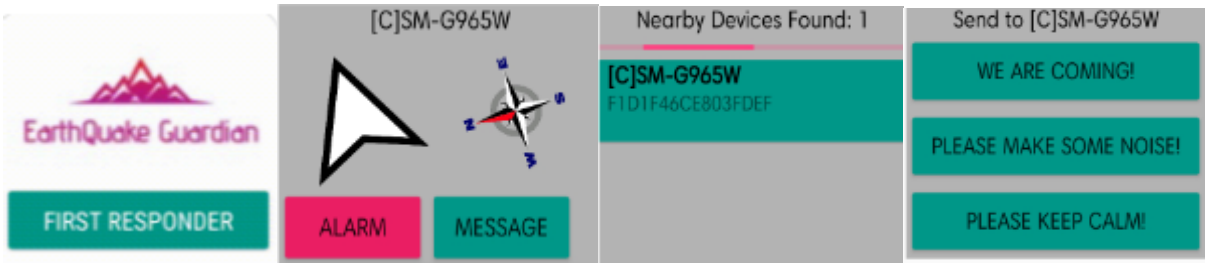

The wearable device can be used in our application. The watch is only access to first responder. The watch has implemented Hype SDK therefore first responder can find the nearby devices through the watch and watch indicates the direction of the user with the arrow and compass. Through the buttons, first responder can send a message to civilian's device.

PROJECT ARCHITECTURE

This section describes the projects overall system architecture and system components. This section will define the structure, behavior, and views of our system. The architecture overview will discuss the type of software system, reference application architectures and architectural pattern. The system components will describe the main components of the system, their roles and responsibilities in carrying the architectural significant requirements of the system. The deployment model will describe the computational resources being used (e.g. mobile devices, servers, cloud platforms, networks, etc.)

ARCHITECTURE OVERVIEW

The type of software system we are developing is an information management system. The system will monitor the sensors within a user's smartphone to try to detect potential earthquake activity. Once an activity is detected it is then sent to an API for decision-making, if the API has received substantial amount of data it will decide whether it is considered an earthquake and notify all users in the area. A possible reference application architecture that could be suitable for the system is an event processing system. An event processing system combines data from multiple sources to infer events or patterns that suggest more complicated circumstances. The goal of an event processing system is to identify meaningful events (such as opportunities or threats) and respond to them as quickly as possible.

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The architectural pattern for our project is layered architecture because each component of the project is isolated only having requests past between each component or layer.

SYSTEM COMPONENTS

The system consists mainly of 5 parts the UI, External server (API), earthquake detection mechanism, mesh network mechanism and AR technology software. The user interfaces are part of the presentation layer to allow the first responders and civilians to communicate with the application. Earthquake detection mechanism is calibrated to use a smartphone's sensors to detect sudden movements which could indicate an earthquake. The external server (API) is used to store possible detected earthquake data which it will use to determine if one occurred in the area. The mesh network of the application is used to allow first responders and civilians to communicate with each other. The AR technology framework is used to aid first responders with search and rescue, as well as facilitate evacuation setup within the area.

DEPLOYMENT MODEL

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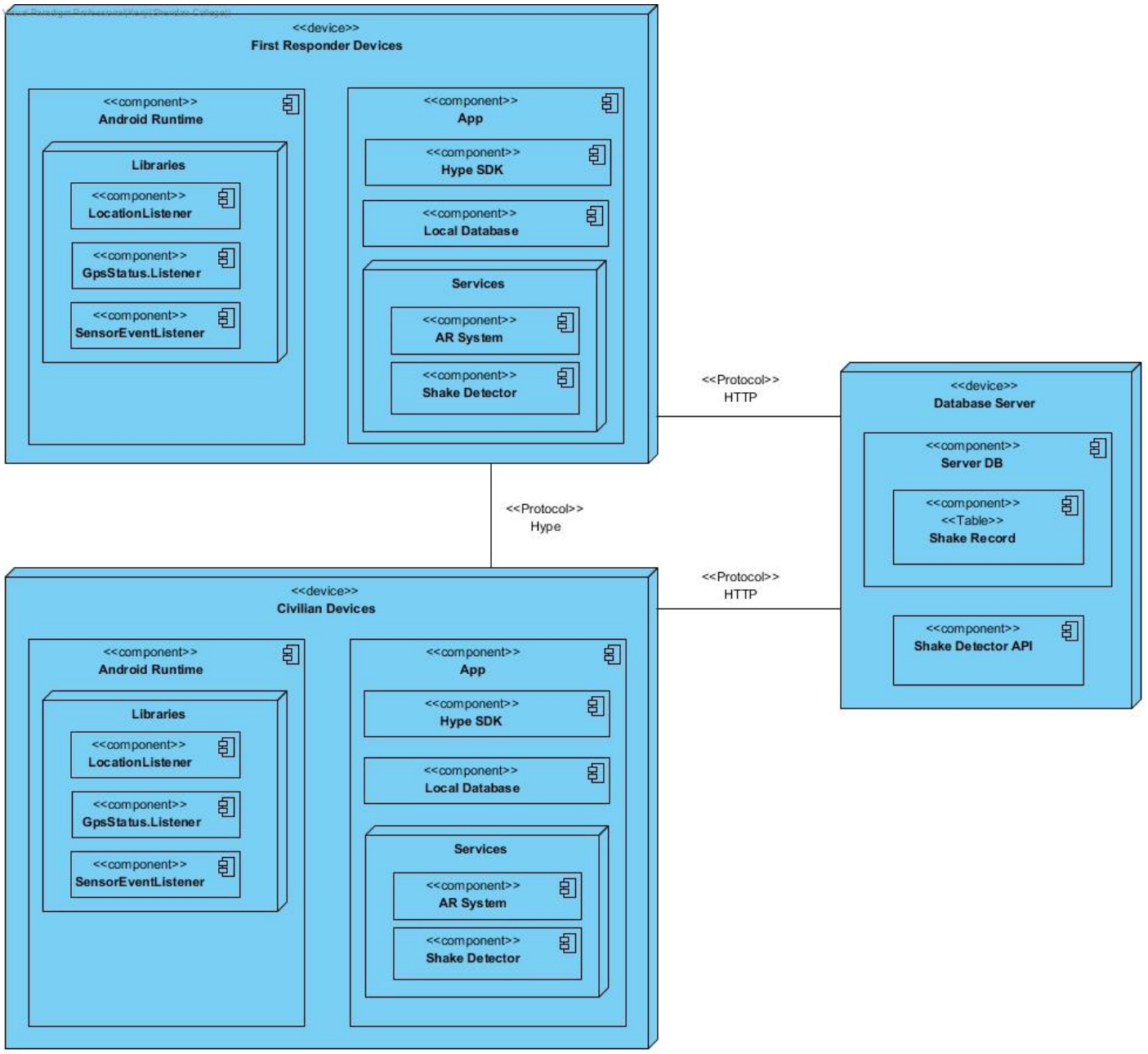

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Deployment model contains three main nodes: First Responder Device, Civilian Device and Database Server

1. First Responder Device is any smartphone that runs the Android OS runtime with access to the following libraries: LocationListener, GpsStatus.Listener and SensorEventListener. The device needs to have an accurate GPS and a variety of sensors such as motion, accelerometers, gyroscope and compass. For the project to be deployed our app needs to be installed on the device. The app itself will contain the Hype SDK for mesh network communication and a local database to manage all offline events. Developed services will also be included in the app to detect shake events and provide and AR view to aid in search and rescue.
2. The Civilian Device is identical to the first responder device. Both devices can communicate with each other easily through the Hype SDK. Hype manages the transports on the devices and ensure they're only visible to other devices that also have our app.
3. The Database Server is hosted on Google Cloud where it also contains our shake detector API. The server receives all shake event records and stores the data. The API determines whether an earthquake has occurred based on the shake records it receives. Based on parameters that can be adjusted the API and decide whether an earthquake did occur and send the records to the first responder's devices.

TESTING

The system testing strategy will be described in this section and how testing is integrated throughout the development process. Identified tools and frameworks used and their results will also be included.

Link to repository in BitBucket: https://bitbucket.org/quicscape/quicscapealpha/commits/branch/Beta_Release_1

TESTING STRATEGY

Current tests that were preformed included manual back-end testing, which was done on our API to test the input of the shake and GPS data from the application. Visual Studio debugger was the tool used to determine any issue related to the API functions. Initial compatibility testing was done on a few android devices that ranged from low, mid and flagship. Android studio debugging was the tool primarily used to test any possible compatibility issues. Future manual testing will involve graphical user interface and usability testing to ensure first responders and civilians can navigate the application with ease. Performance and stress testing will also be done to accommodate the influx of user activity that is bound to happen during an actual disaster.

CONCLUSION

The problem to solve is to provide first responders with a faster way of locating civilians trapped during an earthquake. We have attempted to solve this problem by utilizing the smartphones that many people already carry to help locate them.

Link to the demo video:
First link: https://drive.google.com/open?id=17auZW1zfSHTsNP9nY2M8ruDTJjf5u87s
Second link: https://drive.google.com/open?id=1Lo2c4JsL5Ns0h-tqA2IqYwGMkRxr9IY7
Third link: https://drive.google.com/open?id=1GX5zOpx-lWQDLWkyuv5oX_Ah1tXP1ScD

PROJECT SUITABILITY

This project is suitable for an emergency to be able to effectively rescue the Civilian by an Earthquake via combine the features of peer to peer connection, Augmented Reality system and Shake detection. The peer to peer connection enables victim to chat with other victims or first responders. Besides chatting system, our team will research and work with the Hype SDK to form a mesh network and will find out how to effectively gather the information of victims and send it to the first responders. With augmented reality view, once a first responder got the information of users, they will be able to see the location of the victims through the AR which will helps to find where victims are trapped. The shake detection and notification features will help gathering user's information and will determine whether the earthquake happened, but it will also check whether the user is injured therefore first responder should know which victim in the earthquake zone needs to be rescue first. The idea of injury condition is suggested by supervisors Kevin and he wants to add features to check the injury conditions of victim after the application detects an earthquake and depends on their answers, change the pin color that indicates the location of victims on the map. Our domain experts agreed with rescuing the injured victim first because it is important to treat injured victim as soon as possible to prevent to bigger injury.

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DOMAIN EXPERT EVALUATION

Our domain expert Joo Hye Park who is Joo Hyun Park's sister has studied nursing and will be providing us with her input. Her input will be valuable in helping us identify what type of early medical observation we should be asking injured civilians. She will evaluate our project outcomes throughout our development and validate them. Validating will begin in the summer and fall once our project outcomes have been finalized for evaluation. Research was also done to determine the need for a post-disaster communication among civilians and first responders. The following papers discuss the need for some form of communication to be deployed in disaster-stricken areas where local network infrastructure have been destroyed. Relaying information is vital to first responders in order to efficiently perform their duties. Civilians and victims affected by a disaster seek help and comfort from other individuals through any communication available. We have concluded that building a local mesh network using mobile smartphone devices would help solve this real-world problem.

- Ray, N. K., & Turuk, A. K. (2017). A framework for post-disaster communication using wireless ad hoc networks. Integration, 58, 274–285. https://doi.org/10.1016/j.vlsi.2016.11.011
- Saha, S., Nandi, S., Paul, P. S., Shah, V. K., Roy, A., & Das, S. K. (2015). Designing delay constrained hybrid ad hoc network infrastructure for post-disaster communication. Ad Hoc Networks, 25, 406–429. https://doi.org/10.1016/j.adhoc.2014.08.009
- Fouda, M. M., Nishiyama, H., Miura, R., & Kato, N. (2013). On Efficient Traffic Distribution for Disaster Area Communication Using Wireless Mesh Networks. Wireless Personal Communications, 74(4), 1311–1327. https://doi.org/10.1007/s11277-013-1579-9
- Nishiyama, H., Rodrigues, T. G., & Liu, J. (2018). A Probabilistic Approach to Deploying Disaster Response Network. IEEE Transactions on Vehicular Technology, 67(12), 12086–12094. https://doi.org/10.1109/tvt.2018.2872542

FUTURE WORK

Our team will research and work more with the Hype SDK and how to send message more efficiently. Each device will be registered in local service in a background with unique number or string, therefore the device only detects other devices only if they have our application has installed. Once Earthquake happened, the devices will search and connect nearby devices and send their user information such as location, latitude and altitude and send it to the host

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(host is determined by device's capabilities such as battery usage, API level etc.). The host gather the information of guests (nodes) and pack the information and send it to the first responder side. Our team believed that this will prevent the network congestion and broadcast storm although first responder got many user information at once. Once First responder got the information, it will update to the map and add points in AR system therefore first responder can rescue them as soon as possible. Once we figured out this mesh network by using Hype SDK, our team also want to add features for android watch. First responder might hard to use a cell phone when rescuing victims therefore if android watches displaying the direction of victims, it would be more effectively rescue the victims in an emergency. Focus on scalability for the project to handle a large number of users will also be worked on. With the Hype SDK being available on other platforms adds porting a version of the project is another possibility.

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