Call For Code

Design Document

May 2019 - Project 40

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List of Definitions

.NET: The Microsoft utility library used commonly with C#

Xamarin: A C#, cross-platform mobile development toolkit

XAML: C# UI Templates based on/similar to XML/HTML

ECE/ECPE: ISU Department of Electrical, Computer, and Software Engineering

MVVM: Model-View-ViewModel, a frontend design pattern commonly implemented when using XAML and C#

1 Introduction

1.1 Acknowledgement

We would like to convey our gratitude towards Dr. Diane Rover, our advisor that will be guiding us through this entire project. Her project management expertise has been monumental in helping us get on track and stay on track. We would also like to thank Dr. Nicholas Fila, who is assisting us on developing user requirements. His knowledge of the subject has not only helped us tailor our requirements, but Nic is also helping us understand his thought process so we can apply this knowledge in the future.

This project was inspired by IBM's Call for Code challenge, which is "a rallying cry to developers to use their skills and mastery of the latest technologies to drive positive and long-lasting change across the world with their code." Unfortunately, the timeline of the class did not allow for our team to be involved, but this challenge helped stem the idea for this project.

1.2 Problem and Project Statement

Problem Statement

With natural disasters being as common as they are, ways to provide relief to these victims are becoming more and more necessary. The goal of Call for Code project is to design a tool to improve preparedness for natural disasters and relief when they hit in order to safeguard the health and well-being of communities. There are millions of people affected every year and without the proper tools and education, the recovery effort is slow.

Problem Solution

Our solution to this project is simple. Our first step will be to conduct user research and compile user requirements. This will be done over the course of a few weeks with the help from one of our advisors, Nicholas. After compiling user research and requirements, we will spend some time creating software requirements from the user stories. This will help us streamline what features we want to get done first and when we get into the development process we will be able to complete and test features faster. After developing and testing code, more vigorous code reviews and user tests will help us wrap up and finalize the software.

1.3 Operational Environment

The operating environment for this product will all be either server-side or on a physical device such as a cell phone. We plan on supporting multiple platforms such as Windows, Android, and iOS using Xamarin. Since we are writing software using cross-platform support, the environment doesn't play a major part in what we are doing. We will be taking advantage of the EcE servers, which are not only out of our reach, but are very well maintained.

1.4 Intended Users and Uses

We have a wide variety of intended users, however the key commonality is that they're victims of natural disasters. We will have users of different ages, cultures, and mental statuses. We do not know how the disaster will affect each of our users, and we will focus on helping them out as best as possible. Our main focus, if we had to choose, would most likely be families with children, therefore, we are focusing most on the general natural disaster relief plans that aid families, such as shelter, food, clean water, and medical assistance. Knowing how dangerous hazardous conditions are to children and the elderly will also be a very high priority. We need the elderly to be able to easily handle using our application so that they can get to safety as soon as possible.

Our intended use is pretty self-explanatory, we are creating an application to aid those being affected by natural disasters. This application will be used as a guide for finding the relief stations that will help save our users' lives. Our application will allow users to safely route their efforts to get to the nearest shelters for food, medical assistance, and a place to rest with a roof over their heads.

1.5 Assumptions and Limitations

Assumptions:

- The EcE system will be available 24/7 and will not have any technical problems regarding loss of data or downtime.
- The software will be used in a location that has Google maps data
- The software will be used in a location that has access to NOAA/other government organization disaster evacuation maps.
- The user knows how to use a smartphone and doesn't need assistance in using any of the features.
- The user is proficient in english enough to utilize the software.
- People utilizing specific features (e.g. shelter hosting / energy hosting) are not malicious in their intent during a natural disaster.

Limitations:

- Server limitations. If the EcE system isn't sufficient, then we will have to find a different server solution and possibly receive resources from IBM.
- Network connectivity, especially in times of disaster, will not always be available.
- The system will be a mobile application used on mobile devices that can properly run a mobile application distributed through the play store/iTunes.

1.6 Expected End Product and Deliverables

CallForCode Mobile Application

The client will be delivered a mobile app with that fulfills the specified user need statements and functional requirements specified in the team's initial research. It will provide users access to maps showing closed roads, hazardous areas, and information pertaining to relief centers and supplies. This will be delivered two weeks before the end of Spring semester 2019. (April 26th, 2019)

CallForCode Administrator Tool

Another tool that we'll provide is an application for administrators to update information seen by the users. This tool will have direct access to the database and the users will be responsible for updating data relevant to different areas affected by disasters. It will also be delivered two weeks before the Spring semester ends. (April 26th, 2019)

CallForCode Documentation

We will deliver the detailed documentation. The application will be delivered with documentation for a new software team to continue development of the project, as well as documentation for an administrator to run the app, and proper documentation for a user to use the app. It will detail how administrators will be able to update databases and troubleshoot issues. It will also have details about how the main application is laid out and how users can access all the information. To be delivered two weeks before the end of the Spring semester. (April 26th, 2019)

This product will not be commercialized.

2. Specifications and Analysis

2.1 Proposed Design

The current design is based on several ideals based on user research. Cross-Compatibility, Lightweight on System Storage, use in areas with little-to-no access to internet, capabilities that solve common problems for people.

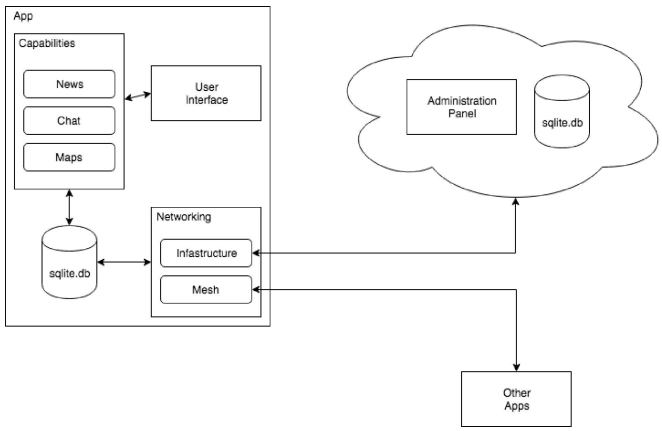
Cross-Compatibility is solved by using Xamarin. Xamarin is a library for C#/.NET that allows for easy cross platform development. It has proved its worth over several years. During some initial research we found that it has been used for many apps with similar functionality, including a prototype with mesh networking capabilities.

Lightweight on system storage is solved by using sqlite, a database system that is extremely light weight.

Use in areas with little-to-no-access of internet is solved using our plan for a networking component that will leverage normal internet as well as internet over ad-hoc networking. This is still in the research and viability phase.

Capabilities to common problems were create using user research to discover if we were correctly anticipating our users needs. After analysis of common large scale disasters we looked at the response that was needed by humanitarian relief efforts and what else could be used. We determined that we should create three components initially: news, chat, and maps. The news app will include a way to easily send important, validated updates over the air to the masses quickly. The chat app will include a way to send messages and SOS pings over the air using all network capabilities asynchronously. The Maps app will include offline maps with updates to roads and routes of exit over the air.

2.2 Design Analysis



The diagram to the right describes the application architecture in a large grain. We have condensed what we believe user needs are into the “Capabilities” box in the diagram. All other features of the drawing support the capabilities listed in the “Capabilities” box . We looked into how natural disasters are handled from a humanitarian point of view and tried to create a solution to some of the problems we believe that existed. We also looked into the plausibility of a mesh network using Wifi Direct, BlueTooth, and/or other communication interfaces using Xamarin. The peer-to-peer (Mesh) network brings with it a discussion about security that we have yet to solve. For example how can we prevent Alice from looking at Bob and Jane’s conversation although due to the nature of peer-to-peer Alice has the possibility of transporting the latter messages between Bob and Jane. We think a peer-to-peer network could be very powerful in helping communities communicate, but security could be a large weakness of our design. Another weakness we may have is that our research on natural disasters and our solutions may not work well when applied in a real natural disaster situation.

3 Testing and Implementation

3.1 Interface Specifications

Software-Software

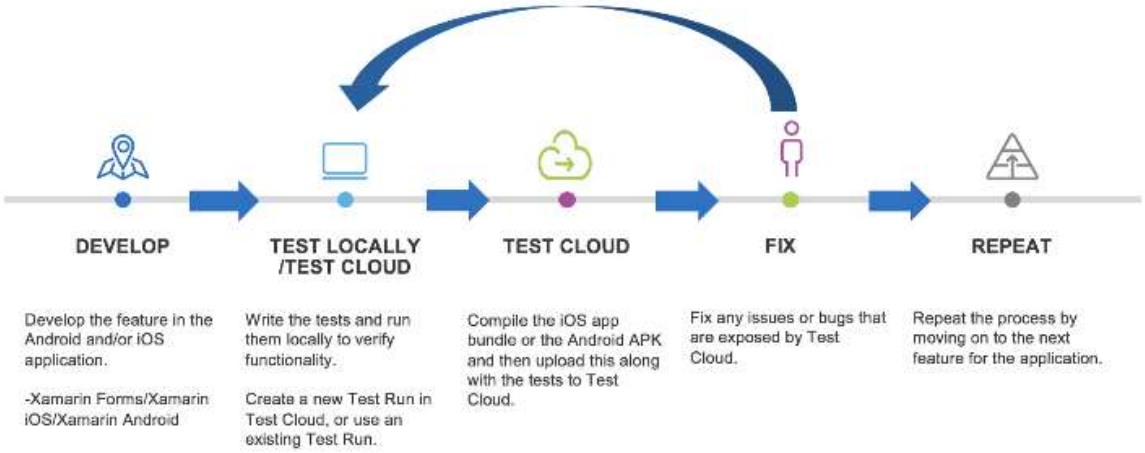
Since we don't have any hardware, we will be using exclusively software-software interfacing testing. We will be writing all of our tests in-house to test connections between our devices and make sure that our devices are communicating and passing data correctly. Below are the different tests that we will have to implement throughout the course of our development process.

- Application to Cloud (client to server)
- Cloud to Application (server to client)
- Mesh Network - Application to Application (client to client)

3.2 Hardware and software

Xamarin
We will most likely not need any additional software to run tests in Xamarin. We will be able to write tests locally to verify their functionality, and be able to implement them either as standalone tests or test them on something like a test cloud that will test the code on a number of devices at the same time. Eventually, as I said we might implement some software to help us run these tests on a number of virtual devices. A service or software like the one mentioned would be in the future and is not necessarily needed as we have a number of devices to test on, as I touch on below.

We will be our own phones that each one of team members have as hardware. We have a wide range of devices that will help to deal with version control. This way, we can make sure that whether a client's phone is Android or iOS, or various different versions of these operating systems, that we will able to provide those people with the full functionality of our application.



3.3 Functional Testing

Black Box Testing

We will almost exclusively be using black box testing techniques as they are not only easier to implement but also play more to what our applications focus is: to provide users with an experience that is easy to navigate and works 100 percent of the time.

Unit Tests

These will be made as the development process is going on, and will be written by either our test engineer or the developer that makes the function whose test it is for. These unit tests will be the smallest part of our software package and will only have a few inputs and only a single output, as most unit tests should operate. These are self explanatory. An example of a unit test for our project would be a quick test to see if the news function can correctly pull relevant, recent and appropriate news sources and display them to the user when prompted. We would make a request and check the

Integration Tests

These will also be made as the development process is going on, along with the unit tests. The difference between these and the unit tests is that these will be tested as a group. The purpose of these will be to test faults on the interaction between specific functions. An example of this would be to test the evacuation route. This will test to make sure that the map function successfully uses the map API's to grab the map, then successfully passes it to the evacuation route maps provided by government organizations to create fastest and safest routes.

Integration Tests

These will be made towards the end of the development process, as this is to make sure that our functions and applications fully work with the systems that we are running them on. An example of this would be to run specific tests to make sure that specific functions work when using

Android and iOS API's on different phones. That way we know that it doesn't matter what phone the user is using, they will be able to use the application to its fullest.

Acceptance testing
This is a type of testing that our team most likely will not be using.

3.4 Non-Functional Testing

Usability
The applications usability is a major focus point, with a lot of the target audience having less technological knowledge. Along the design process several tests will be implemented to maintain an adequate usability level. User surveys will be the most beneficial from our target audience, providing us with feedback to take action accordingly within our next sprints to address certain problems. Giving users specific tasks while monitoring their process and level of difficulty, will help analyze this process.

Security
With the application being user to user communication based, security is a big concern. Every time the application gains a feature or update the reassurance of security will need to be confirmed. The connection between the application and the cloud will also have an encryption to ensure user privacy. Manual testing will be used to make sure all connections are sound and cannot be translated or intercepted.

Performance
The performance testing will revolve around accurate data being translated between users. The accuracy as well as efficiency will determine the effectiveness of the application. Since timely communication of data is the whole basis of the app, there will need to be many tests implemented to assure that. Establishing performance metrics is key to make sure there is no bottlenecking or false information.

3.5 Process

At the moment we have nothing developed, therefore nothing tested. These are tentative methods.

Features

The features will be tested using unit tests and the black box model when applicable. There will also be a heavy focus on the performance and usability aspects of the features, to make sure they incorporate successfully into the project plan.

Cloud/Database

This will be a mixture of unit tests for the backend framework, and security testing the communication between the individual's application.

User to User Communication

Security testing will be very important to assure privacy.

3.6 Results

At this point in our process we have not started any development work. All initial work has been focused on user research.

Future

All results of functional and non-functional testing will be displayed by write ups or modeling.

4 Closing Material

4.1 Conclusion

Thus far in the project, we have researched natural disaster relief efforts, formulated user requirements, built a project plan, and gathered all necessary tools to begin constructing the application. Our next step is to communicate with experts in the natural disaster relief field, and hear their opinion regarding whether our idea for this application would be effective/beneficial. Another next step will be researching mesh networking with Xamarin, creating mock UX/UI designs, and completing other necessary research to better understand how we are going to build this application.

As for our plan on building this application, we will split up into teams based on our expertise. Some of our members focus on front-end, and others on the back-end, therefore we will be splitting up into teams of 2-3 and each team will focus on the full stack implementation of a specific functionality. Outside of the functionality teams, we will have leads that will be in charge of specific areas of the overall development. The leads will be responsible for answering any inquiries that functionality teams may have, for example, Austin will be responsible for answering any UI/UX inquiries, while Justin is responsible for answering any testing inquiries. It is important to have these leads, because having consistency is crucial to reducing/locating problems in the application.

This is the best course of action because it will allow our team members to maximize their productivity by focusing their specializations, as well as not having too many programmers working on the same problem. Also, less programmers editing code within each functionality will make it easier to find problems.

4.2 References

This will likely be different than in project plan, since these will be technical references versus related work / market survey references. Do professional citation style(ex. IEEE).

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4.3 Appendices

Any additional information that would be helpful to the evaluation of your design document.

If you have any large graphs, tables, or similar that does not directly pertain to the problem but helps support it, include that here. This would also be a good area to include hardware/software manuals used. May include CAD files, circuit schematics, layout etc. PCB testing issues etc. Software bugs etc.