Diverse Makers

Requirements Specification

Version 2.0

05-03-2024

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Overview

The purpose of this document will describe our projects functional, non-functional and environmental requirements to be fulfilled during our continued development. It will analyze our solution, potential risks, and project timeline as our framework

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1.0 INTRODUCTION

Diversity is an important subject in science and technology. Leveraging different backgrounds, experiences, and points of view enriches STEM and brings unique insights to solving problems and making breakthroughs. Over 40 million Americans have a disability; however, research shows that disabled people are severely underrepresented in STEM fields, So much so that only 3% of people in the STEM workforce have a disability. People with disabilities tend to learn best in hands-on and individual learning environments, which can be difficult to accommodate in today's education system. Makerspaces can provide the resources to create this environment for STEM learning.

It is apparent from the workforce and college statistics that there are clear underrepresentation and support systems to aid those with disabilities in a career in STEM. Dr. Jared Duval aims to increase awareness and opportunities for those with disabilities with a social app designed to connect makerspaces to people of all disability backgrounds.

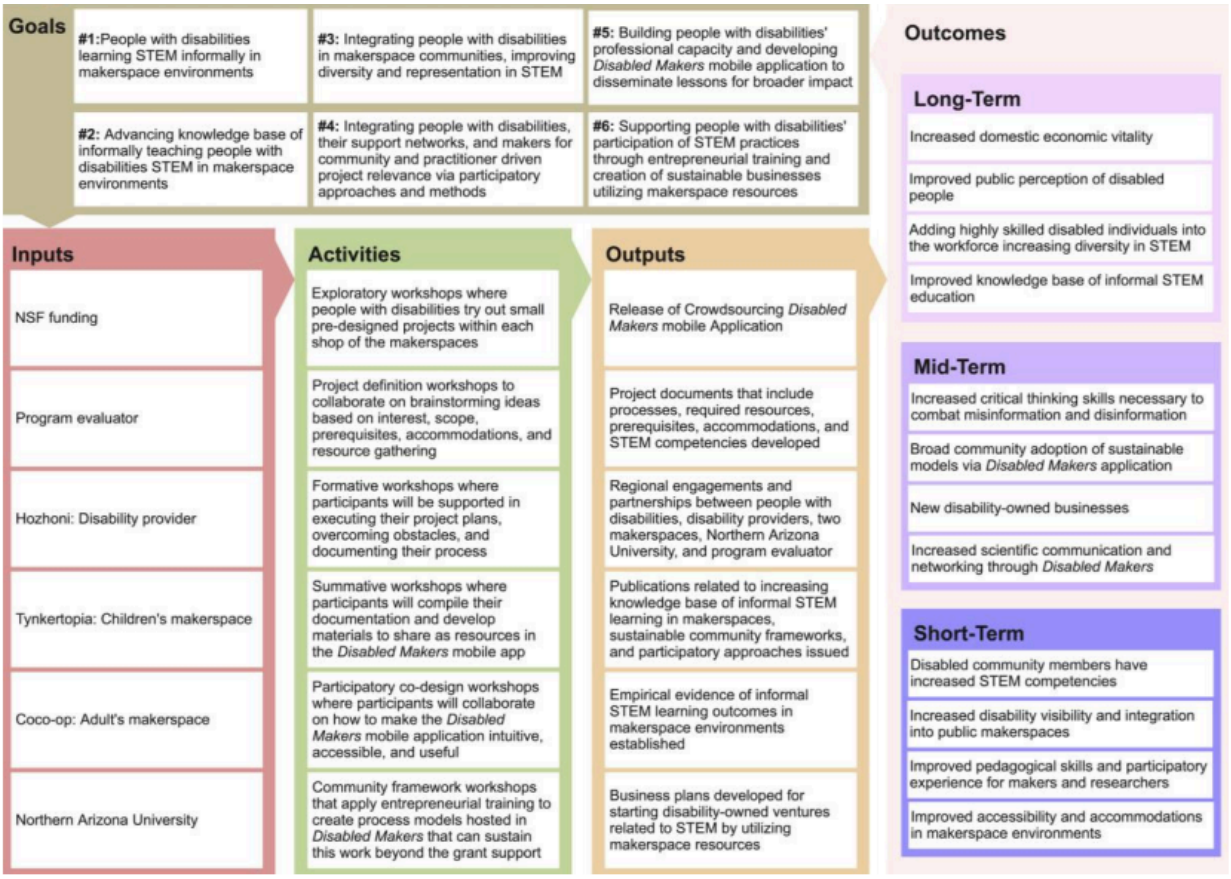
Dr. Jared Duval is an assistant professor at the School of Informatics, Computing, and Cyber Systems at Northern Arizona University. He is also the director of the Playful Health Technology Lab, an interdisciplinary research team whose mission is to design, implement, and study human-computer interaction technologies that enhance the experience of improving and maintaining one's health. Dr. Duval utilizes research through design to develop therapy games and playful applications that make health more motivating and sustainable.

Additionally, Dr. Duval's work specializes in serious games for health that emphasize human-computer interaction with assistive technology. Working with Dr. Duval and prioritizing accessibility, we can empower those with disabilities to explore their passions and aspirations in STEM by creating a collaborative and supportive environment built around makerspaces.

In this document, we will delve into the deeper accessibility and development concerns involving the project, then propose a solution to said issues. In subsequent sections, we will delve into further detail about the functional, performance, and environmental requirements of our proposed solution, address any potential risks of said solution, and then propose a project timeline that we plan to achieve going forward.

2.0 PROBLEM STATEMENT

Given that our client's project is concerned with connecting makerspaces to individuals with disabilities to provide additional STEM learning resources outside of traditional learning, [Figure 1.0] of our client's proposed logic model gives insight into the basic workflow of his project.



It is apparent that a bottleneck exists in the basic development of the application, particularly concerning accessibility, networking, and requirements:

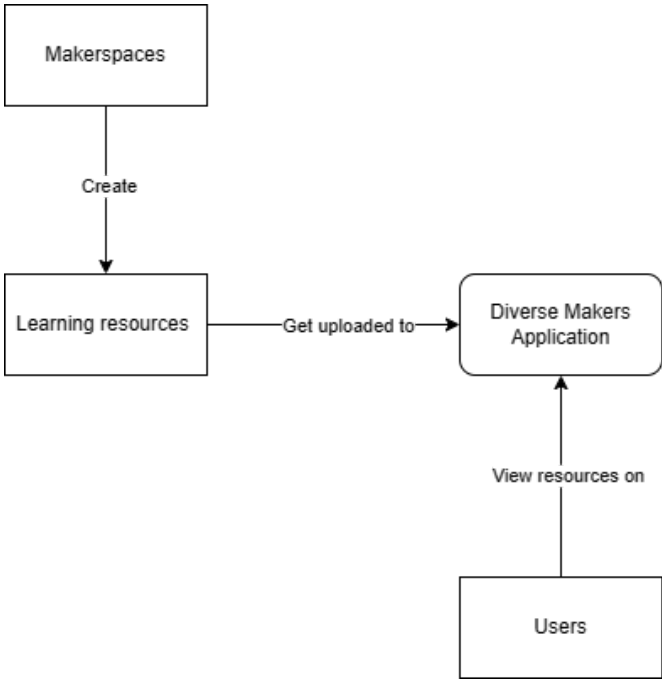
- Integrating people with disabilities and their subsequent support networks
- Advancing the knowledge of informal teaching of STEM concepts in makerspaces
- Developing a moderation system that filters irrelevant content uploaded into the application

3.0 SOLUTION VISION

To address the previously stated problems, we will create a crowd-sourced mobile application that will act as a centralized hub for sharing STEM resources, projects, and training for those with disabilities. This application will connect people with makerspaces and allow them to easily access projects, resources, and information that makerspaces provide. Our application will provide a number of services to users, including:

- Hosting STEM-related resources, accommodations, community contributions, and processes.
- Utilizing makerspace resources to create community frameworks for those with disabilities.
- Creating a network to connect makerspaces and support discourse around these resources.

Our application will work closely with makerspaces to provide relevant resources. In addition to this, makerspaces will be able to upload their own resources to be hosted on the application; these resources could be a video, picture, or text. While this introduces more work for makerspaces, the trade-off is worth it, especially if it causes STEM resources to become more accessible to those who need them.



4.0 PROJECT REQUIREMENTS

The project requirements section will delve into our functional, performance, and environmental requirements needed for the development of our project, provided by our client. The functional requirements will include the outcomes we must complete to have a successful application that meets the needs of our users. Moreover, the performance requirements are objectives we will add to enhance the overall usage and aesthetics within the app. Lastly, the environmental requirements will cover the restrictions placed on development plans and team members by software barriers or constraints outside our control.

4.1 Functional Requirements

4.1.1 Secure User Authentication and Login System

Our application will require users to create an account using a unique identifier, such as their email address and a password, which they will use to log in to the application. The implementation of user authentication protects sensitive data and allows users to access the application securely.

There are a couple of ways we can implement this feature. Firebase offers two different options for signing users in, including FirebaseUI Authentication or Firebase SDK Authentication. The main difference between these two is that FirebaseUI allows users to choose whether they sign in via email, phone number, Google Sign In, or other popular federated identity providers. On the other hand, Firebase SDK authentication offers essentially the same sign in methods, but requires each method to be manually integrated into the app.

4.1.2 Resource Hosting for STEM Content

Since our application is meant to act as a central hub for makerspaces, a key requirement of the system is allowing makerspaces to upload STEM resources, projects, and other training materials onto the application. These resources must be easily accessible by users, include appropriate content, and easily stored on our application.

In order to satisfy this requirement, we must use a database in order to store resources. This database must be large enough to store all of the learning resources, searchable so users have access to the resources they need, and easy to implement with our application. Fortunately, Google Firebase offers their own form of database that can be implemented with any application built with Firebase. In addition to storing these resources, they must also be appropriate for our application. We must have some form of text, image, and video moderation for each resource available on the application. To do so, we will take advantage of the numerous moderation frameworks that are available for Google Firebase.

By satisfying this requirement, our application will be able to host and provide STEM learning resources to users. These resources will be easily accessible, relevant, and appropriate to those who use them.

4.1.3 Accessible User Interface for Multiple Disabilities

Another key requirement is to provide an accessible user interface that enhances usability for all our users, including those with low vision, blindness, hearing impairments, cognitive impairments, motor impairments, or situational disabilities. With an accessible UI, users will be able to navigate and interact with the application's content intuitively. By providing an accessible interface that supports accessibility standards and caters to a variety of users, we not only meet the needs of our users but allow them to develop interactions that enable a better learning experience.

To satisfy these requirements, we will implement Nielsen's Heuristics and the Material Design framework to create a UI that serves a large disabled user base.

4.1.4 Connection to Local Makerspaces

One primary requirement for our application is to allow users to easily connect with makerspaces. Ideally, users will be able to message these makerspaces through our application via a messaging system. In addition to providing a chat feature, another way to connect users with makerspaces is by showing them any makerspaces nearby. By providing this connectivity, many aspects of our application will be improved, such as: there will be more relevant resources

available, any resources currently available could be improved, and makerspaces will be more connected to other people.

In order to satisfy these requirements, we must build a system that allows users to directly chat with makerspaces on our application. To do so, we will take advantage of the user accounts requirement that was discussed previously; this will allow users to communicate with makerspaces directly from their own account on our application. In addition to this, we can use location data to determine nearby makerspaces. After viewing local makerspaces, users can then contact them through our application. By showing the contact information for local makerspaces, users will also be able to connect with them through email, phone, or by visiting them directly.

By satisfying this requirement, our application will connect users to local makerspaces. In addition to helping users directly, this connectivity will improve our application by providing makerspaces with more data to improve any resources they wish to host on the application.

4.1.5 User Profile creation and management

To enhance user engagement and personalization, the application should allow users to create and manage social-media style profiles. They should be able to share details such as their name, location, and areas of interest in STEM. If they then choose to make their profiles public, others on the app can find and connect with them. This ties into the earlier mentioned messaging system for makerspaces. When users reach out to Makerspaces, those Makerspaces will be able to view aspects of the user's profile that the user has chosen to make public.

4.1.6 Search and Filter functionality

Given the amount of resources and information that will be available on the application, it is crucial to implement search and filter functionality. Users should be able to search for specific topics, keywords, and project types and receive relevant results. The search feature should support advanced filtering options, such as resource type (e.g. text, video,) difficulty level, and required supplies.

4.2 Performance (Non-Functional) Requirements

Now that we have analyzed what our system is expected to accomplish via functional requirements, we must look at how those requirements are expected to perform under specific criteria. There is a clear priority for non-functional performance requirements to ensure that our framework is as easy for clients to use as possible, as such we will prioritize the following performance requirements: **usability, accessibility, optimization & maintainability.**

4.2.1 Usability

The application itself is expected to work with minimal issues when it comes to its usability. We must account here for not only individuals with disabilities, but also the makerspaces who could potentially be hosting their learning resources on our platform.

- Makerspace Use: Our framework should be as simple as possible for makerspace representatives to upload content onto our platform. This should be accomplished with an interface that is easy to navigate, and have necessary identifiers so contributors to the platform can easily navigate the interface accordingly to either upload or view resources.
- Remote Setting: To align with the goal to extend and provide STEM learning opportunities to those who may not be able to access a local makerspace area due to any reasons, it's important the full functionalities of the application are easily usable in a home setting.

4.2.2 Accessibility

Since our application is catered towards those with disabilities, it should be highly accessible to use. By satisfying the previously discussed requirement in 4.1.3, there should be a minimal learning curve when it comes to learning our application. This means that users will be able to quickly learn how to access any relevant STEM learning resources that they desire, connect with local makerspaces, and easily manage their account. In addition to general users, makerspaces will be able to easily provide their own resources to be hosted on our application as well as connect with their primary audience.

4.2.3 Optimization

Since our application heavily focuses on data retrieval, it should be able to quickly and easily provide data to users. By taking advantage of the Firebase Database, we will be able to optimize our database's performance and improve its performance as much as possible. This means that users will be able to quickly and easily access any learning resources they desire from our application.

Since we are using Google Firebase as our deployment platform, our application will also be optimized for both iOS and Android devices. By choosing to use a cross-platform like Firebase, we ensure that our application will operate similarly across devices and operating systems.

4.2.4 Maintainability

Maintainability is an essential requirement for updating, modifying and sustaining our application over time. As our project develops and grows overtime, we want to ensure the longevity of our framework and reduce complexities for developers.

- Coding Standards: As with any project involving code of sorts, you want the code to be easily readable and be able to understand what individual components are doing to prevent confusion and wasted time. It will be important to ensure we comment on all functional aspects of our code while also avoiding overly complex logical solutions to create a solid foundation for potential future features.
- Documentation: Having proper documentation on our project (such as this document) will be important in adding additional context to certain parts of our program and their intended purpose or goal.
- Version Control: Creating and maintaining a repository on Github will be the safest way to maintain our code and avoid any conflicting issues that may arise during development. Using a version control system will allow us to keep a documented trail of potential bugs or issues run into during development, and where they occurred in our version history. It also allows us to add features in a controlled version without overwriting older versions of our application.

4.3 Environmental Requirements

Having reviewed the necessary capabilities of our system, and how such components will operate to meet our desired criteria, we must delve further into some of the environmental constraints encompassing the project. The subsequent sections will look at potential software and hardware requirements that the team must consider throughout the development of our framework.

4.3.1 Firebase

We will develop a backend framework within Firebase, which is a specific restraint imposed by our client because it provides detailed documentation and cross-platform app development SDKs to help build and ship applications.

5.0 POTENTIAL RISKS

In a project that considers many angles, both technical and social, there are bound to be risks to consider. Likely, most of the time risk will occur as a result of human error, and our mistakes may cause our client a significant amount of time and resources lost while conducting research. This section will acknowledge potential risks that may occur in this project's development.

5.1 System Inefficiencies for Makerspaces

All of the resources uploaded to our application with our framework will presumably be designed to be as user-friendly and functional as possible so that users can upload relevant material onto our database. If both the front and backend are poorly designed and optimized for the user, then the number of makerspaces that would be willing to contribute their learning resources to our application may suffer as a consequence of poor user experience and system optimization.

5.1.1 Cause of Risk

Negligence: As we move forward in the initial framework development of our application, frequent quality control should be conducted to ensure that the user experience is simple and accessible for anyone to use. Failure to conduct these concurrent tests may result in a slow and unoptimized user experience.

5.1.2 Likelihood

High: When developing an application with accessibility and user experience as the forefront concern, mistakes will be made in making the user experience as intuitive as possible and it's not realistic to get it right the first time. Through iteration and feedback, we can improve our product and make it as accessible to users as possible.

5.1.3 Future Steps

The reality of this risk is that ultimately it is an inevitable pitfall we will encounter as we develop this application. While we would otherwise wish to avoid this by any means, the logical steps to take is to keep communicating with our client and subsequent stakeholders, and constantly improve our system to our client's needs and specifications. This will cost a significant amount of time and resources to both the team and the client, but developing a proactive feedback & communication system will help mitigate resource waste and avoid this pitfall as much as possible.

5.2 Disability Negligence

To strive for maximum accessibility by all users who access our application, our framework must be as intuitive as possible. Since our application mainly concerns integrating people with disabilities into the STEM ecosystem, many design considerations must be accounted for to ensure we are accommodating those with impairments. However, in the process of designing the application to accommodate a specific type of impairment, we run the risk of

neglecting other disabilities creating an apparent accessibility problem. Indeed there is much concern regarding balancing the design of our application without over-engineering our solution.

5.2.1 Cause of Risk

Negligence: In the design review for our application, it's entirely likely that certain accessibility considerations for people with specific impairments may be overlooked and subsequently left out in the initial layout of our application. Failure to address these accessibility concerns will result in an inclusive environment that does not align with the project statement.

5.2.2 Likelihood

High: The accessibility requirements for this application have many considerations that must be met to align with the client's objectives and purpose with this project. As we work through the initial designs of the application, we will likely unintentionally neglect accessibility support for a certain disability due to focus on accommodating another.

5.2.3 Future Steps

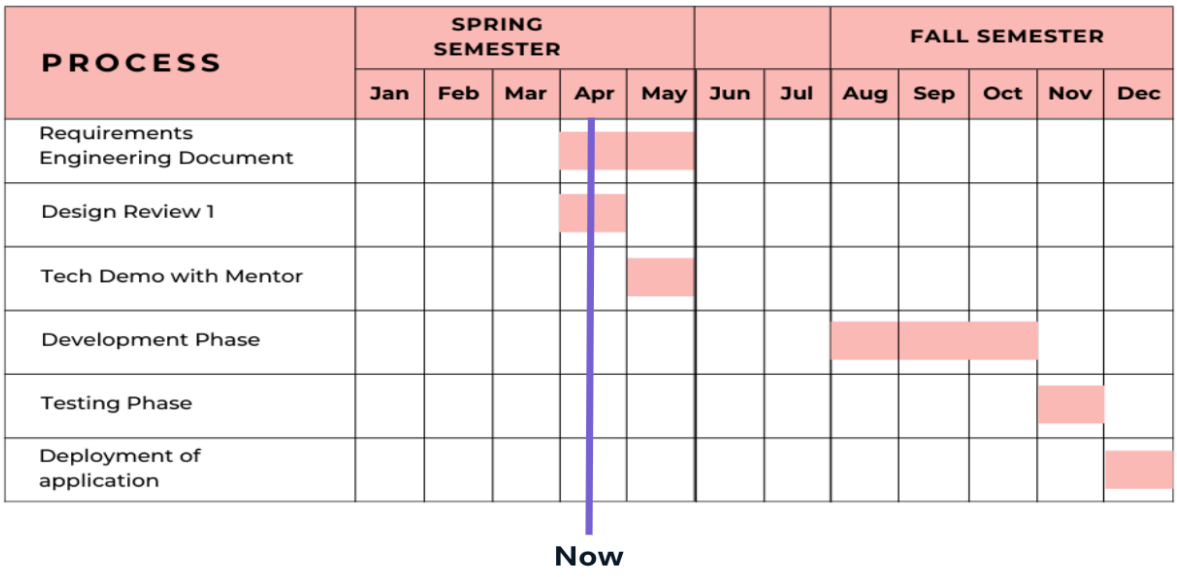
It is crucial to ensure proper communication with stakeholders and the client to avoid this pitfall and ensure we are developing an application that is accessible to anyone regardless of their disability. By following proper design principles such as WCAG can we ensure we are making our product as user friendly as possible for anyone regardless of their impairments.

6.0 PROJECT PLAN

As aforementioned in the previous section, our project will span the course of two semesters: from the spring semester of 2024 to the fall semester of 2024. Considering the length of this project, it's important to identify current milestones accomplished and look ahead to milestones we as a group want to tackle.

- **Requirements Specification Document:** This document is responsible for addressing the expected functional, non-functional, and environmental requirements the team is planning to satisfy with selected technologies.
- **Design Review Presentation:** This will be a presentation the group will deliver live in class, communicating our progress on our project thus far, the current status of progress, and providing a schedule looking forward to outstanding tasks to be accomplished.
- **Project Info Mini-Video:** This video created by the group will be responsible for acting as an elevator pitch for our product with the idea of selling the concept to a larger audience. The video will be roughly 2 minutes long, but will be concise in its delivery.
- **Technical Prototype Demonstration:** The purpose of this prototype demo will be to address our proof of concept solutions to the technical challenges we explored in our technological feasibility study.

The graphic provided below offers a rough timeline of the project and subsequent milestones.



7.0 CONCLUSION

To summarize, diversity is crucial in STEM fields in order to provide unique insights to solving problems. While there are millions of people with disabilities in the United States, they are still underrepresented in STEM. Because these people tend to work best in a hands-on environment, makerspaces are a vital aspect in enhancing their learning experiences. However, not all makerspaces are accessible to everyone; because of this, our crowd-sourced mobile application will act as a central hub for providing STEM learning resources for those who do not have access to a makerspace.

This document discussed the numerous technological challenges that we must overcome throughout the development of our application. These challenges consist of: back-end challenges, developing for multiple platforms, developing an accessible UI for users, and maintaining learning resources on the application. In order to accommodate back-end challenges, we will adopt Firebase, a Google-owned development platform that handles deployment, storage, and managing our application. Fortunately, Firebase offers a suite of tools that will handle resource management. These tools include text/image moderation and a database system that will be able to store and manage our resources. In order to create an accessible UI, we will adopt React Native, which also integrates with Firebase. Throughout the development of this application, we will communicate with Dr. Jared Duval, people with disabilities, and those who attend makerspaces. This constant communication will ensure that our application will be as efficient, beneficial, and accessible as possible.

Moving forward, we will start communicating with the stakeholders of our application in order to build a suitable plan and foundation. By doing so, we will be able to learn more specifically about certain priorities. After doing so, we will be able to start developing a prototype application. While we develop this, we will continue to communicate with stakeholders in order to ensure we stay on track, receive feedback, and successfully address the issues discussed previously.

8.0 GLOSSARY

Makerspaces: a place in which people with shared interests, especially in computing or technology, can gather to work on projects while sharing ideas, equipment, and knowledge.

Google Firebase: Google Firebase is a set of cloud-based development tools that helps mobile app developers build, deploy and scale their apps.

SDK: a set of tools for third-party developers to use in producing applications using a particular framework or platform.