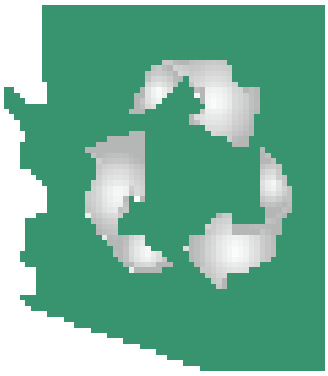
GreenAZ: Requirements Document



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Introduction

Our project is a joint effort with the Arizona Recycling Potential (ARP) team, who has talked to the Arizona Board of Regents about receiving a $1,600,000 grant for the overall project. This project will be created in four total phases over the course of 3 years. Phase 1 will be the collection of data for recyclable materials in Arizona, with phase 2 being the creation of the Arizona Recycling Potential model. Our project will be Phase 3 of the project, which will have us create a web-based visualization system for the Arizona Recycling Potential model and team.

To better understand how to promote a circular waste economy in Arizona, Dr Richard Rushforth has sponsored this capstone project because of his work and research interest in big data modeling of food, energy, and water systems to further the understanding of complex, coupled natural-human systems. He is an assistant research professor in the School of Informatics, Computing, and Cyber Systems at Northern Arizona University.

The goal of Dr Rushforth and GreenAZ is to aid in improving Arizona waste management by using Arizona Recycling Potential data and helping their team visualize that data in a more convenient process than just viewing a cluttered excel spreadsheet.

In this document, you will find information about Dr Rushforth's envisioned solution to this problem, the technologies and methods we will use to implement that solution, and a concrete plan of how GreenAZ will get this project to a minimum viable product state so that it will be ready to be passed onto future developers at the end of this course.

Problem Statement

The state of Arizona is currently one of the lowest ranking of the fifty continental states for recycling waste and waste management. According to a study performed by the organization *LawnStarter,* Arizona currently sits at the 47th worst state for recycling - with the Ball Corporation citing that the state has an 18 percent recycling rate. This problem only contributes to the massive problem in the country and world when it comes to the handling of waste and, more importantly, recycling. While some Arizona municipalities have been able to invest millions of dollars into infrastructure to avoid filling new landfills, smaller municipalities cannot meet this. It is our job to fulfill the solution visioned by our sponsor and the ARP team.

Solution Vision

Our web-based visualization system will use data gathered from the previous phases of our project. This data includes an inventory of all Arizona communities and their associated demographics, waste management and recycling service availability, and associated economic development metrics. The data also includes waste processing infrastructure and logistics of the policies, practices and partnerships in place regarding recycling services in Arizona. Accompanying this data, we will also look at the data of end markets for recycling materials, as well as the economic impact of recycling at the national and state levels. This data is critical for our system to reliably create visualizations of the recycling trends in Arizona and be able to compare Arizona's current recycling economic performance with other states and regions. Our system will be able to use the existing data and process it into data about what recycling materials are available or not available at each Arizona municipality. Using this processed data,

our system will be able to create multiple types of easy to read graphs, such as pie charts, bar graphs, and line graphs.

Our system will change the way our sponsor views and displays the data that has been collected in the previous phases of this project. By implementing an interactive map, users will be able to locate every Arizona municipality and view a visualization of its corresponding waste and recycling data. Furthermore, users will be able to view graphs comparing the data between municipalities within Arizona. Our system will aid our client's goal to decrease the amount of unused waste and coalesce a network of state, county, and community economic development organizations to co-develop and identify hotspot markets to attract recyclable materials and businesses to Arizona.

To summarize, our solution needs to have these characteristics:

- Allow users to interact with a map of Arizona municipalities.
- Each municipality should display data about what recyclable materials are available and not available in that location (specific data TBD).
- The data can be displayed via different types of charts and graphs depending on what the user chooses to display it as.

Project Requirements

Functional Requirements

1. A web-based visualization system with interactive panes to graph
    a. Multiple views
        i. Map and data charts/graphs
        ii. Only map

iii. Only charts/graphs

2. a simple map with icons representing Arizona municipalities
    a. Ability to zoom in and out
    b. Ability to move around the map
    c. Clickable icons that bring up charts/graphs of the corresponding data
3. standard chart templates: pie, stacked area, line graphs, etc.
    a. Dynamically created
        i. Variables can be changed by the user (i.e., time frame)
    b. Ability to switch between graph types
    c. Can highlight a single municipality
    d. Can compare multiple municipalities
4. A version control repository containing the project
    a. Must be well documented to allow future progress
    b. Contains complete codebase

<u>Performance (non-functional) Requirements</u>

1. Professional appearance of the web application
    a. Visually appealing color scheme
    b. Nice looking, easy to read fonts
    c. Components placed in an easy-to-use way
2. A responsive map that is intuitive to navigate
3. Charts/graphs will accurately display data
    a. Seamlessly switch type of chart/graph

b. Display the data quickly in a way the user can easily understand

Environmental Requirements

1. Web application must be hosted on a dedicated secure virtual server
2. There are no other constraints from the Client regarding the production of our web application
    a. We may choose whatever software we like that is available
    b. If a software solution requires a license, this will not be an impediment to the project

Potential Risks

As we are building a data visualization system for what will eventually be using dynamic real time data (either supplied by the ARP team or user uploaded), there are potential risks that our system could be used to accidentally misinform users of our website with false information. This could include the data itself being inaccurate, the data being displayed incorrectly, or users purposely uploading false data. As Dr Rushforth's vision for this project is to be used widely throughout the state of Arizona to increase recycling tonnage statewide, ~~its~~ it is crucial for GreenAZ to build a system that correctly displays datasets and only datasets that are approved by the ARP or some future organization that sponsors this project.

In the case that information is incorrectly displayed on the frontend, the risk there would be that companies looking to allocate more recyclable resources could be putting those resources in a location that doesn't need them as much as another location. The goal of this project is to ensure each community in Arizona has enough of each class of recyclable materials to maintain a proper circular economy. Therefore, our stakeholders will be relying on our visualization that is

accurately displayed. During development, we must do extensive testing to ensure our GIS is correlated with our datasets correctly.

The same goes for the specific data that will be inserted into our database. To prevent inconsistencies with datasets, there will be strict requirements on where datasets come from and how they are formatted. For example, at this phase of the project, datasets may only be supplied from ARP, and the formatting will need to be consistent in every set, to ensure there are no issues during migration to the database. When the time comes in development for the use of dynamically changing data, it should come from a trusted API that is actively being maintained by an approved Arizona organization. This is crucial for our stakeholders to ensure everything that they see while using our application is correct, and action they take from seeing the charts on our site will be the right decision.

Project Plan

The successful execution of our minimum viable product development will depend on a couple of key factors. Because we have already chosen the technologies needed for this project, the first obstacle will be learning the technologies that each of us in the team will mainly be using. Our frontend developer should get familiar with React and get refreshed on HTML/CSS. Our backend developer will need to learn the database system and how it talks to ExpressJS and how to get a Node server up and running. Our GIS developer will need to research how to embed interactive maps into a React web application and have those maps use the data from our database. Once that preparation is done, we will start building the application.

Once development starts, some major milestones for us to look forward to during development will include:

1. Starting a Node web server that displays a “Hello World” React page.
2. Connecting the server to a MongoDB database and displaying dummy data from that database onto the React page.
3. Importing the data from the ARP team into our database.
4. Using that data to determine which municipalities we need to hardcode into the GIS map.
5. Creating a GIS map of Arizona using the municipalities from the ARP data and allowing users to interact with it to view the data that belongs to each location.
6. Implementing charts and graphs to display the data for each municipality.

When these milestones have been completed, our project will have sufficiently met the minimum viable product requirements set by Dr Rushforth.

Conclusion

In conclusion, the Arizona Recycling Potential (ARP) team has entrusted us with creating a visualization system to aid in the use of the Arizona Recycling Potential Model. The Arizona Recycling Potential Model seeks to help clean the state of Arizona due to it being one of the lowest ranked states for recycling waste. While some parts of the state have started trying to alleviate this issue, this visualization system will be a web-based system that displays a map that houses the requisite data and displays it through varying means. Our job, as a capstone team, is to produce this visualization system and allow the Arizona Recycling Potential team to input their data into the system for further use in their project with the Arizona Board of Regents in order to help clean up the state of Arizona.

The next steps for our project include each member of our team learning the MEAN stack technologies before starting proper development on the GreenAZ website. If we were to come to a hurdle during development, we've made sure to choose approaches that are already well documented so we can hopefully clear the hurdles fast and continue going forward without any major setbacks. We also chose these well documented approaches in order to prepare any future team that handles our code, since - if all goes according to plan - the GreenAZ Recycling Potential Visualization project will be used in years to come.