STEMMED GARDENS

by

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ABSTRACT

Starting a food producing garden should be easier to do successfully. Getting data related to your specific gardening conditions can be time consuming and tedious for the average person who does not have any gardening experience. In 2020 during the coronavirus pandemic, there has been an increase in food insecurities for people because of grocery supply chain fulfillment concerns. A simple yet shocking Google trends search for terms like “how to start a garden”, “food shortage”, and “food insecurity” since 2004 in the US have more than doubled in March of 2020 alone, during the beginning of the coronavirus pandemic. A search for “garden apps” has also shown more than double the interest in the same time frame on average.

People want and need to grow their food to reduce their food anxieties. Having an alternative food source can also reduce national food-related supply chain disruptions caused by climate change, natural disasters, or even global pandemics.
STEMMED Gardens was created to make gardening easier by crowdsourcing scientific data and real-life gardening success and failures. We created an iOS and Android application with an Azure based backend for users to be able to plan, maintain, troubleshoot, and share those gardening experiences. New and experienced users can easily retrieve and identify plant information and gardening techniques that can be used in each stage of their personal food garden journey.

1. PROBLEM STATEMENT

1.1 Introduction

If you have ever started a garden, especially a food producing back or front yard garden, sometimes called urban farm, you would know how satisfying it is to spend months growing, harvesting, and ultimately eating your fresh produce.

What you would also know, is that it takes an almost equal amount of time researching the needed garden elements with your specific conditions like your USDA plant hardiness zone, needed soil, sunlight, water etc. for each specific type of plant.

Although you might be able to get bits and pieces of this needed info from many different websites, social media sites, or mobile apps, we believe that none include all the needed info to minimize the amount of time spent scientifically researching the optimal growing conditions for your garden plants.

In the initial phase of our app, STEMMED Gardens, will combine information from various botanical databases pulling detail scientific information, historical and forecasted weather data, a social networking component to crowd source additional info, a garden planning calendar, and a physical garden space planner / area to make gardening as easy as possible. Future iterations could have an AI powered plant, an IoT sensor network gathering actual garden data, and a pest image recognizer and an AI powered garden planner.

We hope that lowering the barriers to producing food at home can have positive physical and mental health benefits (especially during the coronavirus pandemic), reduce the overall strain on the grocery food supply chain infrastructure, and bring home the spirit of

sustainability and positive ecological actions that can reduce the overall carbon footprint by reducing produce transportation costs.

1.2 Problem

Entry to localized food production gardening is hard. We suspect there is an inverse relationship between the ease of gardening and long-term success to home food production, because the experience needed for efficient success in gardening can take years to achieve.

1.3 Solution

For a more efficient and successful gardening experience, we propose to provide a portable gardening platform that combines gamification, research based meta-analysis, artificial intelligence, and user success distillation algorithms to isolate variables for new gardeners to easily use for their specific gardening conditions. An easier-to-use platform that leverages crowd sourced gardening experiences with a seamless technical backend can easily increase harvest yields, gardener satisfaction, increase environmental awareness, and at the same time reduce food insecurities in communities throughout the world.

1.4 Project Description

STEMMED Gardens beta will start off as a web application where users from various backgrounds can research, plan, create, troubleshoot, and maintain a garden full of various food yielding plants. A user will be able to find the best type of plants to grow within their specific environmental conditions such as USDA plant hardiness zone. The front end of the web app will be hosted in Azure and will use a combination of html,

CSS, JavaScript that will interact with a backend that consists of java, spring boot, and SQL server.

1.5 User Profile

Table 1: User Profile is a break-down of the target audience of our application that we know would benefit the most.

USER PROFILE
PROJECT: Garden planner, plant research web app.
POTENTIAL USERS: ● Home gardeners ● Farmers

SOFTWARE, INTERFACE, AND RELATED EXPERIENCE:

Software Experience: Our primary user base will center around individuals who already have gardening experience and are looking for a new method of organizing their garden workflow. Gardening tends to be a skill that few have and due to the inability to travel with it, makes it inherently difficult to learn based on social experiences. That's where our application will move to solve these issues.

- Home gardeners often vary greatly in knowledge and experience and this can create a rather large learning curve for anyone that seriously wants to pursue this as a new hobby or grow their hobby into something more.
- Farmers are generally very experienced in gardening because of the prerequisite dedication and knowledge needed to even obtain the title. As a result, we expect that for our application they would need less upfront knowledge and would be more interested in the social and logging aspects that will be provided

EXPERIENCE WITH SIMILAR APPLICATIONS:

- Primarily the app will provide our users with functions that are normally found in separate places. For example, a farmer would probably like to use the calendar and records functionality to keep track of his entire plot in the application so that they can track exactly when they started their season and when they want to end it. Being able to look back on previous year records could also help them to observe trends in an easy to digest manner.

TASK EXPERIENCE:

- The users will have the experience of using other mobile apps that have similar designs to this one so the learning curve will be very easy for those who are younger and older.
- Those who like to garden also tend to be detail oriented and making notes will be second nature to them.

FREQUENCY OF USE:

Users are encouraged to use the app before the planting process to research the type of plants that they want to grow, and to plan the planting milestones specific to each type of plant. Users can then maintain their garden while updating their gardening experience in the app as often as they like. It is anticipated that the user will primarily use the application before planting, but also checking in daily or weekly as their garden may be simple or diverse.

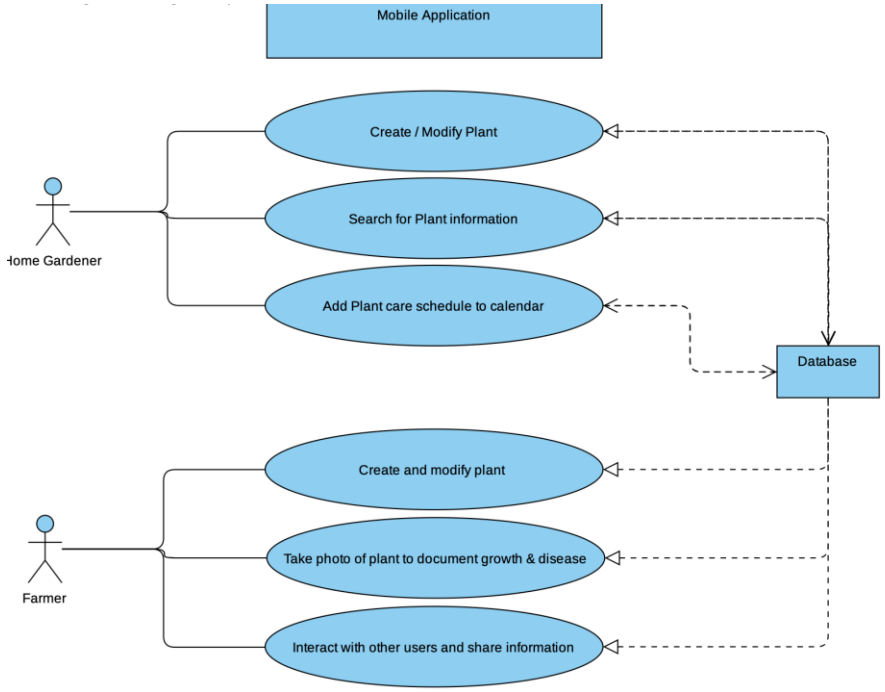
KEY PROJECT DESIGN REQUIREMENTS THAT THE PROFILE SUGGESTS:

- Visually appealing, clean flow, and easily understood and navigable UI
- Ability for a user to sign in and curate a personal garden
- Ability for user to input their zip code to determine USDA plant hardiness zone
- Ability to add or remove plants from the user's garden
- Easily search for plants and retrieve their optimal growing conditions.

1.6 Use Case Diagram

Figure 1: The following diagram demonstrates the use case for STEMMED Gardens. The diagram shows the users interaction with application and database.

Figure 1



1.6 Technical Architecture

The team made the decision to pursue a project that would be a learning experience. A website, database, and app are planned for completion. On the user end the UI will be simple and straightforward for new and experienced users to feel at home. The

application will interact with the database in a way that would allow the user to add their own plants to the database. There will also be a garden planner feature that allows users to get personalized advice on how to grow a particular type of garden.

Project Management

Table 1: Budget shows the financial requirements of the Stemmed Gardens web application. When calculating the total cost of this project we tabulated the service needs, software costs, and man hours needed (average ongoing pay rate) in the local area.

Table 1: Project Budget

	STEMMED Gardens				
#1	Hosting	Units / Hours	Unit price / Hourly cost	Count	Total
	Azure SQL Server	6	$368 / Month	1	$2208
	Azure app service B1	6	$58 / Month	1	$324
	Microsoft Azure	6	$50 / Month	1	$300
#3	Labor				
	Website Creation & Feature Integration	350	$20/ Hour	1	$7,000
	Establishing Database	367	$20 / Hour	1	$7,340
	Backend Application Development & website integration	380	$20 / Hour	1	$7,600
Total					$24,772

2.1 Project Timeline

Figure 2.1: Project timeline shows the timeline for the creation of Stemmed Gardens.

Each task is given an estimated window of time in order to be completed.

Task	Task Name	Duration	Start Date	End Date
1	Create Contract	2 hours	8/31/2020	9/1/2020
2	Research competitive landscape and provide references	2 weeks	8/31/2020	9/1/2020
2.1	Architecture Planning	1 weeks	9/1/2020	9/2/2020
3.0	Build front end of application	14 weeks	9/1/2020	11/26/2020
3.1	Setup UI	14 weeks	9/1/2020	11/26/2020
3.1a	Splash page setup	1 weeks	9/1/2020	9/8/2020
4	Start to build backend	14 weeks	9/1/2020	11/26/2020
4.1	Create Database	2 weeks	9/1/2020	9/15/2020
5	Begin Integrating features into production	4 weeks	10/29/2020	11/23/2020
5.1	User Testing	1 week	11/6/2020	11/16/2020
6	Reevaluate feature set	1 week	1/1/2021	1/8/2021
7	Integrate Plant AI with database	4 weeks	2/1/2021	2/22/2021
8	Integrate SMS	2 weeks	2/8/2021	2/22/2021
9	Integrate Garden Planner	1 week	3/15/2021	3/22/2021
10	Update Azure and Bug Testing	2 weeks	3/15/2021	3/29/2021

Conclusion

3.1 Problems Encountered and Analysis of Problems Solved

We wanted to find the best possible way to create a database with all of the pertinent plant information, so naturally we searched high and low for the best garden plant API. We found many plant type API's, but none that were specific to what our needs are. We needed the basic plant characteristics for the most common garden plants that a gardener would plant, but most API's had very detailed information for non-fruit bearing garden plants. To overcome this, we continued to search for plant APIs, but decided to create our own database with that specific garden plant info. Another challenge was finding the best source of data for USDA plant hardiness zone zip codes. We found a comma separated value (CSV) file that had this information and modified it slightly to suit our needs.

We also wanted to integrate a basic social media aspect to gardening that was through our web app, and not necessarily integrated through the more popular social media apps. Our challenge was trying to find the best possible solution to that, which we have not found.

3.2 Recommendation for improvement

We eventually want to create a mobile version of this web app. We initially started to create this in Xamarin, but the learning curve was high, and we found that we did not have the time to learn how to create the app in Xamarin under our time constraints.

A nice-to-have improvement would be an AI/ computer vision to be able to capture plant leaf images, so that it can determine what type of plant it is and what kind of plant diseases it may have. Another nice-to-have would be an IoT sensor device integration,

where a device in a garden could periodically take environmental measurements such as amount of sunlight, rain, etc. and then upload that info to our web app's cloud database. The device could be a raspberry pi zero w, with a solar panel for power, and it could utilize an Azure IoT hub to manage the data streams.

3.3 Lessons Learned

We learned to fail fast. Our initial plan to develop the mobile app through Xamarin was met with our lack of time to learn how to do so. Xamarin was not included in our instruction at UC, but we thought that we could pick it up easily. So we dropped it after many environment setups hurdles since we each use a different operating system.
Our desire to use certain frameworks was overall limited by our current experience and time available to learn that framework. Throughout the semester, we were quicker to accept this fact and limited our scope due to these constraints and create our application in C# using ASP.NET Core.

3.4 Abilities and Skills Developed throughout the project

We spent a large portion of our time learning how to build a database from the ground up and how to efficiently import data into it with an API. This was done by learning how to parse JSON data and edit fields and keeping it persistent with the user logged on. We gained a much clearer understanding of how important the framework that we choose is to a project, it started as a Java spring boot project but as we worked through it we started to realize starting over in ASP.NET core would be a much more efficient way to complete the project. We also created subscriptions, resource groups, and resources in Azure.

3.5 Spring Plans

During the spring semester we developed the user experience and user interaction, adding and enhancing our existing features. Our fall semester demo was mostly a proof of concept for the core features which needed to be enhanced. That is why during the spring semester we were able expand our core featureset by integrating the plant identification ai into our project in order to make it a more cohesive application that had more business value to offer for our end users.

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