EEL 4914 SENIOR DESIGN I:
Divide and Conquer Version 1.0

Department of Electrical Engineering and Computer Science
University of Central Florida

Smart Herb Garden

Sponsor: DC Carpet

<u>Group 11</u>

Marcus Fernandez Decastro	Computer Engineering
Jordyn Hayden	Computer Engineering
Lucas Jaramillo	Computer Engineering
Charlee Mione	Computer Engineering

Table of Contents

Project Narrative

The interest in growing one's own fresh herbs is a desire that may easily be left unpursued due to a variety of inconveniences such as the guesswork involved in growing plants, a busy schedule, or a window that doesn't receive an optimal amount of sunlight. A garden that offers features for automated watering and plant lighting provides an easy-to-use solution to bring fresh herbs to your fingertips year-round taking green thumb out of the equation.

Our smart garden will offer multiple modularized features which allow the consumer to choose a smart garden setup which involves the features that make sense for their specific needs. The base model will feature an automated watering system which waters the herbs depending on the moisture level detected in the soil. Once the soil moisture level reaches a low reading, the herbs will be watered without any assistance from the consumer. This is perfect for those times one will find themselves absent from home for an extended period, as well as a solution for those who find themselves busy or forgetful.

The automated water feature is composed of an XY Motion robot attached above the planters. The software will plot the positions of the plants in an XY grid, while the mechanism will move the hose using stepper motors. This motion will be dictated by the moisture sensor which will give an alert once a low moisture level has been reached. This will initiate the motion of the robot moving the hose and watering the plant until it has reached a sufficient moisture level. The hose will be connected to a water pump submerged in a tank that will need to be refilled by the user every 1-3 weeks based on the number of plants in the garden.

Prefer your garden housed indoors? No natural light available? Our product offers the ability to attach an automated plant light to the garden, which runs on a schedule. Namely, this lighting will be on for the proper number of hours to ensure adequate sunlight for the plants. This way, one can grow any herb year-round without the dependence of access to the outdoors, or changes in season or weather. And since this lighting component is an optional attachment, if there come times where it is preferred the plant be outdoors or under natural sunlight, the plant lighting module to the garden can be easily removed.

Conveniently, our smart garden comes with a companion web application that allows a user to view the historical and live data gathered from the garden such as soil moisture. Also, one can opt in for SMS push notifications for a variety of different important notices. This includes but is not limited to when the watering system is going off, or when the water tank needs to be refilled. This is another feature perfect for those who find themselves away from the garden but still desire to be up to date with their herbs.

Thanks to our sponsorship DC Carpet, a local flooring and tiling company, this project is made possible. DC Carpet plans on donating the necessary tools and materials needed to complete this project. This company is interested in the project because they are dedicated to creating more convenience in the home.

Specifications

Requirements for Hardware

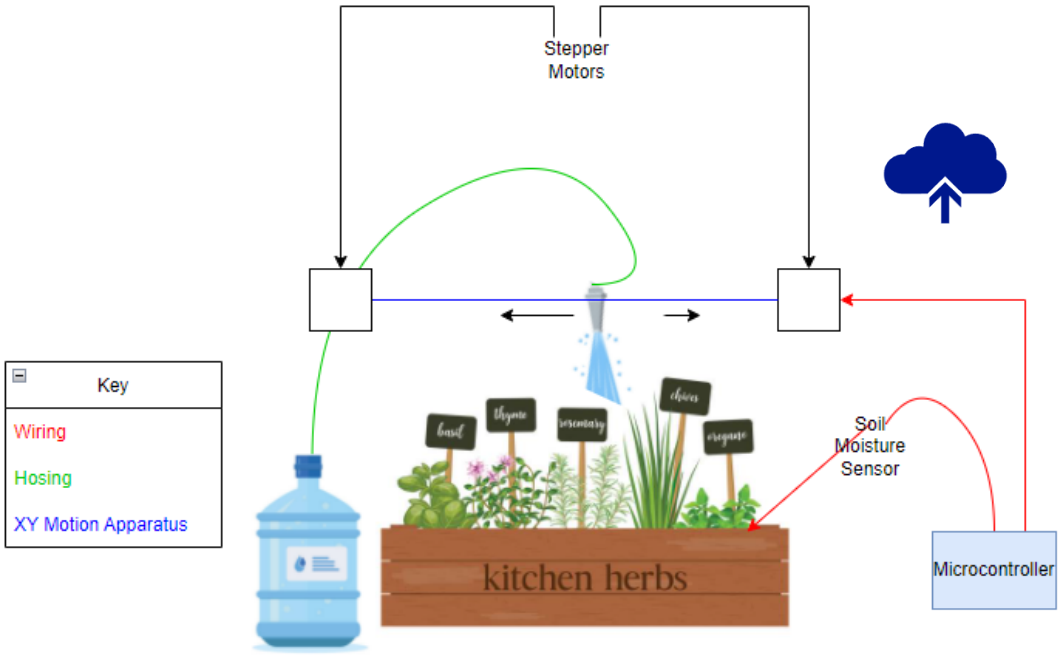
1.1	Moisture sensor shall be accurate
1.2	Stepper motors will carry tubing in both x and y bringing water to plants as determined by moisture sensor
1.3	Stepper motors will respond to input given by the user or different sensors and move to different plants accordingly
1.4	Lighting module will be able to operate according to data inputted by the user
1.5	Two moisture sensors will be implemented to ensure all readings are accurate and eliminate random errors
1.6	The system will have communication capabilities with a web application
1.7	The sensors and motors will have the ability to be remotely operated through the web application
1.8	The system will be resistant to water
1.9	The sensors will include a light sensor to give user information

Requirements for Software

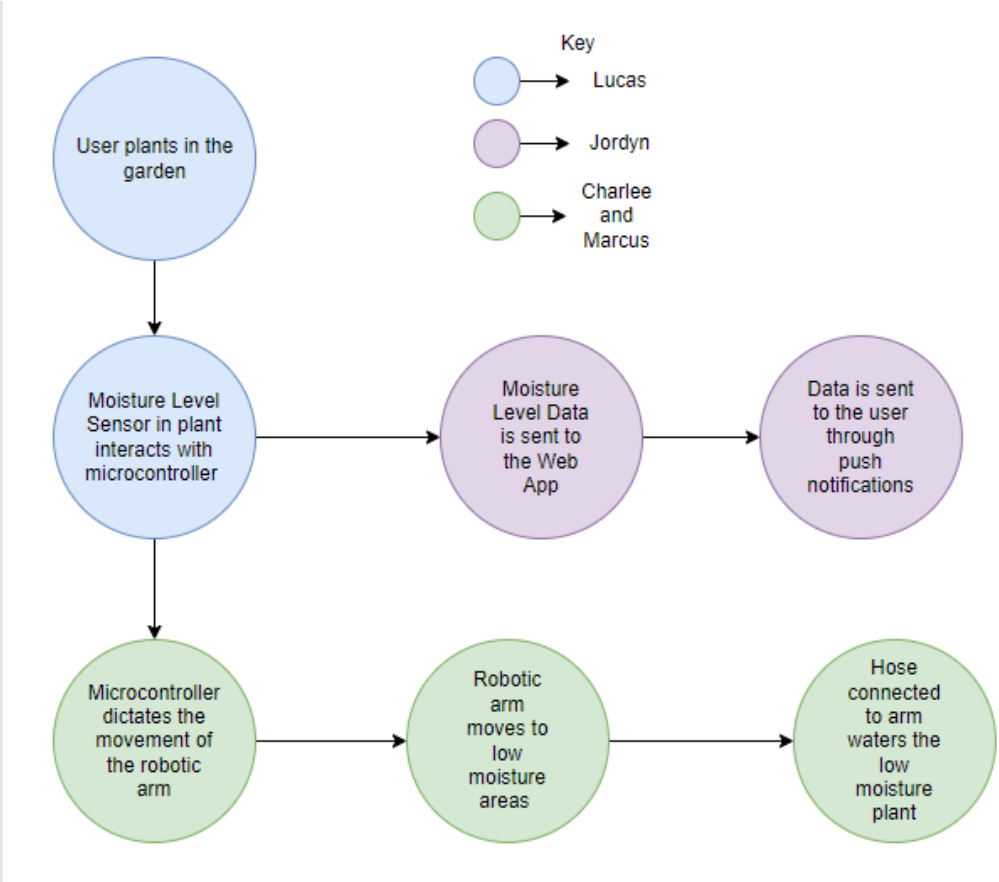
2.1	The web application shall be synced with the hardware via wireless network
2.2	The web application shall be able to read information from the moisture sensor(s)
2.3	The web application shall be able to read information from the water level sensor
2.4	The web application shall be able to send an SMS notification
2.5	The web application shall be able to display information gathered from sensors
2.6	The web application shall be able to connect to and manage more than one garden
2.7	All communications with the API shall be done with the HTTPS protocol
2.8	All interaction with the web application must have immediate feedback, even if it is only showing an operation is in-progress
2.9	The database shall never be out of date with the user interface
2.10	The user interface must not have direct access to the database

Block Diagram

Prototype Illustration



Project Block Diagram



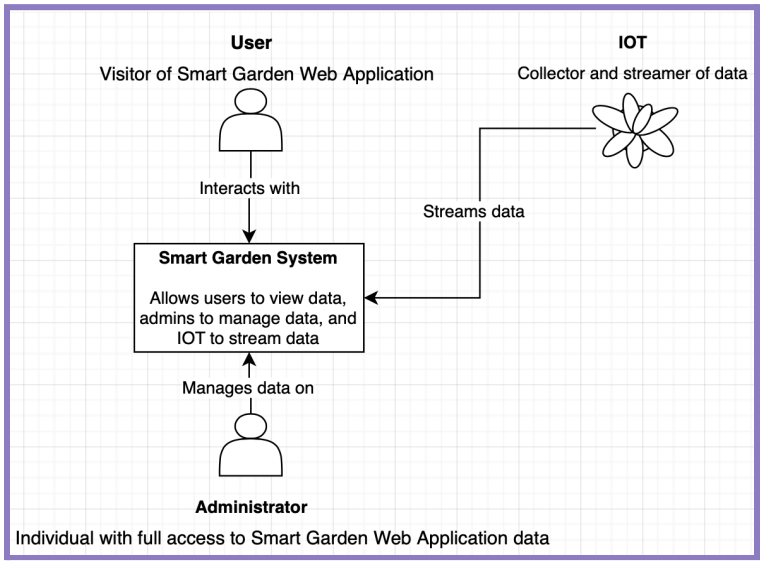
Status of each block as of 02/03/2022:

- Moisture Level Sensors have been purchased
- Supplies for planter has been donated
- XY Motion Robot still being researched and designed
- Web Application is being researched and designed
- None of the blocks have been completed or prototyped

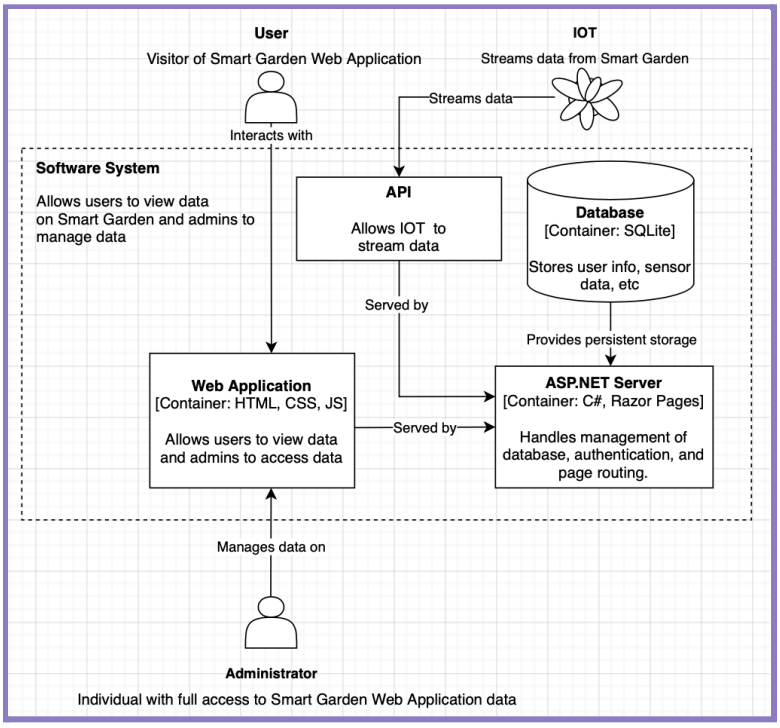
Web Application Block Diagram

(Responsible for this section: Jordyn Hayden)

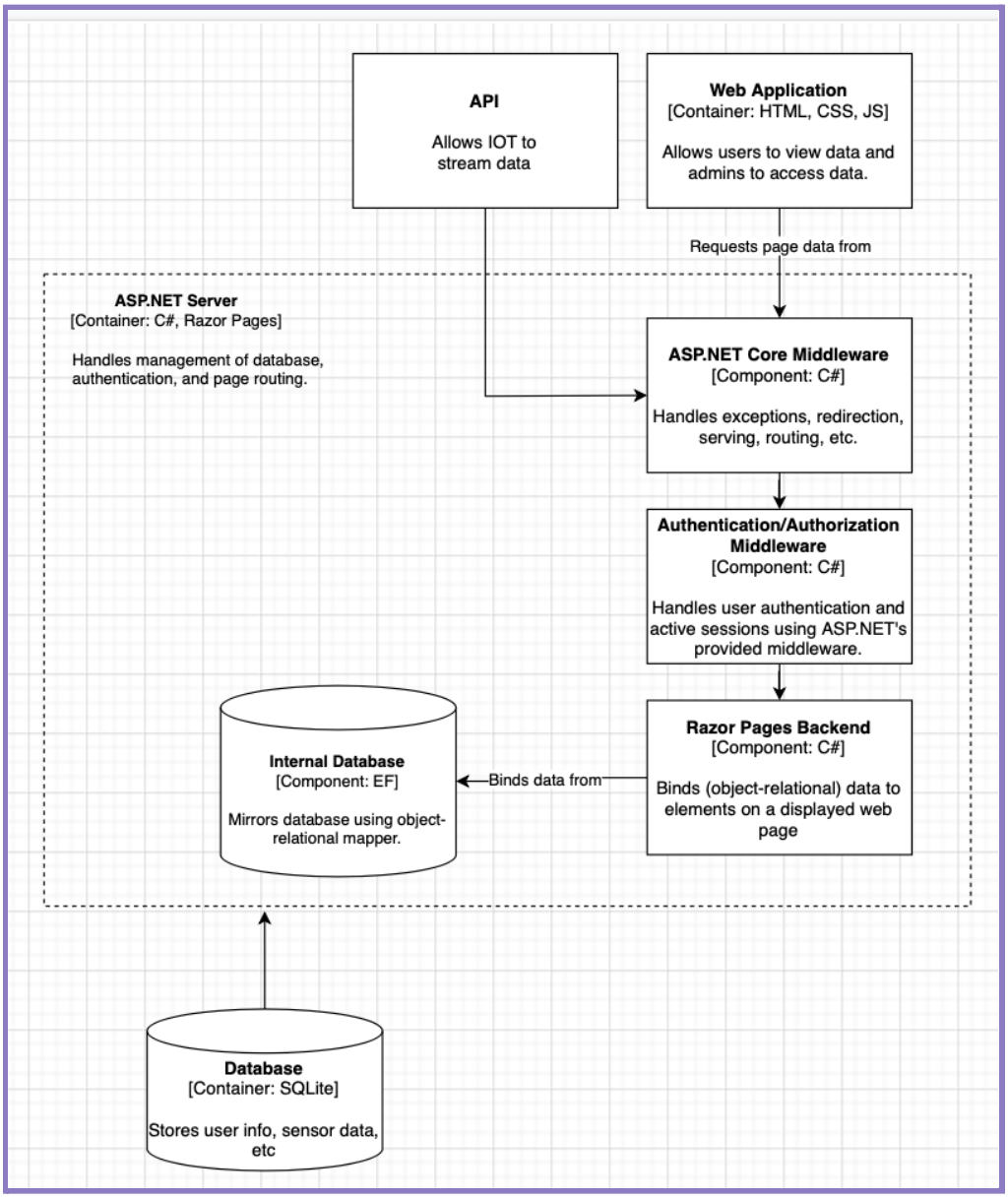
Web App System Context Diagram



Web App Container Diagram



Web App Component Diagram



Acronym Legend:
API – Application Programming Interface
EF – Entity Framework
IOT – Internet of Things

Budgeting and Financing

Estimated project budget and financing.

Item	Quantity	Price
Moisture Sensor	3-4	$6-$20
Hose Tubing	1-2	$4-$10
Microcontroller with wireless communication capabilities	1	$20-$40
Power Source	1	$20-$40
Stepper Motors	2	$14-$28
Stepper Motor Driver	1	$20
Bluetooth Module	1	$14
Custom PCB	1	$30-$50
Plants	2-3	$5-$10
Plant Growth Light	1	$30-$80
Total (Estimated)	N/A	$153-$302

Project Milestones

Initial project milestone for both semesters

Specification	Milestone	Planned Date of Completion
1.1	Sensor-Microcontroller Interface	TBD
1.2	Moisture Sensor/Hose Interface	TBD
1.3	Robotic Arm Implementation	TBD
2.1	IOT-API Connection	TBD
2.2	IOT-API Connection	TBD
2.3	IOT-API Connection	TBD
2.4	Software System Features	TBD
2.5	Software System Features	TBD
2.6	IOT-API Connection	TBD
2.7	Software System Features	TBD
2.8	Software System Features	TBD
2.9	Software System Features	TBD
2.10	Software System Features	TBD

Citations/Research

Information on light sensor -
https://desertsucculents.com/light-sensor-measuring-plant-light-levels/

Moisture sensor research -
https://www.mentalfloss.com/article/581946/verdmo-plant-soil-moisture-sensor

https://maker.pro/arduino/projects/arduino-soil-moisture-sensor#:~:text=How%20Does%20the%20Arduino%20Soil,to%20measure%20the%20moisture%20value.

XY Robotic Arm implementation -
https://www.instructables.com/How-to-make-a-XY-plotter-with-Makeblock/

Hose Tubing Research -
https://learn.eartheasy.com/articles/drip-irrigation-vs-soaker-hoses-which-is-better-for-your-garden/
Smart Garden Research -
https://blog.constellation.com/2021/06/14/smart-devices-for-managing-and-automating-your-garden/#:~:text=What%20is%20smart%20gardening%3F,producing%20food%20or%20decorative%20plants.