# Farmbot Project Home

## Project Overview:

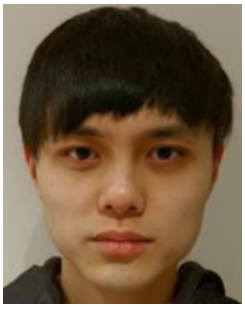
### Project Overview

- The overall gaol of our part of the project is integrating a thermal camrea to a robot named farmbot, so that the users could collect thermal data of plants remotely. Users should access the camera on farmbot web-app and can take thermal pictures if they wish. Once there is an emergency (for example threatening temperature) the system could send alarms to user.
- click here for detailed project information

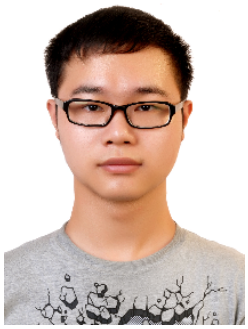
### Goals of the Whole Project

- Integration of an e-nose sensor within the web-app controlling the robot
- **Integration of an thermal camera within the web-app controlling the robot (our part)**
- Integration of AI solvers that automatically control the robot.

## Client and Supervisor

| | |
|---|---|
|  |  |
| Nir Lipovetzky<br>Client<br>Nir Lipovetzky | Lin Li<br>Supervisor<br>Lin Li |

## Team Members

| | | | | |
|---|---|---|---|---|
|  |  |  |  |  |
| Dikai ZHU<br>Scrum Master<br>Dikai ZHU | Chengtian Jiang<br>Software Developer<br>Chengtian JIANG | Yuxi He<br>Product Owner<br>YUXI HE | Tingzheng Ren<br>Test Leader<br>Tingzheng Ren | Zhiyu Chen<br>Software Developer<br>Zhiyu Chen |

## Resource Links:

**Team work space:**

- github repository
- trello board
- conference home
- goodle drive

**Confluence Shortcuts:**

- requirements
- meeting minutes
- project product

**Other Resources:**

- Farmbot Control
- Farmbot Training
- Farmbot Official Github
- Farmbot Previous Project

# RoadMaps and Plans:

### Project Plans:

- Our goal is to finalize the project development during Sprint 2 and Sprint 3. To achieve that, we have reorganized the user stories into user cases, meanwhile taking into account their priorities of the user cases. Our team has created a well-defined development plan, which can be viewed on Trello: FA-Boxjelly development plan.
- Click here for detailed project plan

### Road Map:

| | |
|---|---|
| **Inception Sprint** | Friday, March 31st 2023 Team Building and Project Design |
| **Sprint 1** | Friday, April 28th 2023 Finish Half Stories and First Release |
| **Sprint 2** | Friday, May 26th 2023 Finish Project Release and Final Present |
| **Sprint 3** | Friday, June 9th 2023 Review and Self-Reflection |

# Recent updates:

## Recent space activity

**Dikai ZHU**

Farmbot Project Home updated 9 minutes ago • view change

**YUXI HE**

Farmbot Project Home updated 12 minutes ago • view change

**Dikai ZHU**

PROJECT PLANNING updated 39 minutes ago • view change

PERSONAS updated 46 minutes ago • view change

SCOPE updated about an hour ago • view change

## Space contributors

No contributors found for: authors on selected page(s)

# PROJECT PRODUCT

# REQUIREMENTS

# PERSONAS

| Type | Bio | Goals | Frustrations |
|---|---|---|---|
| Sustainable Farm Owner | Samantha is 36-year-old lady, and owns a small-scale sustainable farm that grows a variety of fruits and vegetables. She is passionate about using environmentally friendly methods and wants to ensure that her crops are free from pests and diseases without the use of harmful chemicals. | 1. Avoid using harmful chemicals<br>2. Reduce the amount of time spent monitoring farm manually<br>3. Quickly detect any pests or diseases | 1. Focus on Cost and Time<br>2. Competing against larger farms with more resources and funding<br>3. Provide healthy and chemical-free produce |
| High School Teacher | Yamanaka Sawako is a 35-year-old high school teacher in Tokyo who devoted to teaching agriculture. Grown up in coutryside, she worked at sakura high school as a teacher after complete her degree, . She is responsible for leading the school's agriculture program, which provides students with hands-on learning experiences by allowing them to plant and harvest real crops. | 1. Ensure the crops are well-cared<br>2. Give student better understanding of farming and agriculture<br>3. Enable students stay update to latest agricultural technologies. | 1. Large class size to manage<br>2. Student not proper care the crops<br>3. Not familiar with robots |
| Agrcultural Researcher | Dr. John Smith is 39-year-old agricultural researcher based in Australia. Growing up on a family farm in rural New South Wales, John developed an early interest in the natural world. After completing a degree in agricultural science at the University of Sydney, John went on to earn his Ph.D. in plant genetics from the University of Melbourne. His research has focused on developing new plant varieties that are resistant to pests and diseases, as well as improving crop yields through precision agriculture techniques. | 1. Develop new plant varieties that are resistant to pests and diseases<br>2. Improve the quality and nutritional value of crops through precision agriculture techniques<br>3. Increase the efficiency and productivity of farming practices through the use of innovative technologies | 1. Limited time and resource to collect data from crops.<br>2. Lack of effective alarm that can quickly notify crop emergencies.<br>3. Currently equipments are not precise enough. |

# Yamanaka Sawako

*"Education is not about filling a bucket, it's about lighting a fire."*

Age: **35**
Work: **High School Teacher**
Family: **Married**
Location: **Japan**

## Personality

| | |
|---|---|
| Introvert | Extrovert |
| Thinking | Feeling |
| Sensing | Intuition |
| Judging | Perceiving |

Friendly | Hardworking

## Goals

- Ensure the crops are well-cared.
- Give student better understanding of farming and agriculture.
- Enable students stay update to latest agricultural technologies.

## Frustrations

- Large class size to manage.
- Student not proper care the crops.
- Not familiar with robots.

## Bio

Yamanaka Sawako is a 35-year-old high school teacher in Tokyo who devoted to teaching agriculture. Grown up in coutryside, she worked at sakura high school as a teacher after complete her degree, . She is responsible for leading the school's agriculture program, which provides students with hands-on learning experiences by allowing them to plant and harvest real crops.

# Samantha

*"We have not inherited the earth from our ancestors, we have borrowed it from our children."*

Age: **36**
Work: **Sustainable Farm Owner**
Family: **Married**
Location: **India**

## Personality

| | |
|---|---|
| Introvert | Extrovert |
| Thinking | Feeling |
| Sensing | Intuition |
| Judging | Perceiving |

Hardworking | Enthusiastic

## Goals

- Avoid using harmful chemicals
- Reduce the amount of time spent monitoring farm manually
- Quickly detect any pests or diseases

## Frustrations

- Focus on Cost and Time
- Competing against larger farms with more resources and funding
- Provide healthy and chemical-free produce

## Bio

Samantha is 36-year-old lady, and owns a small-scale sustainable farm that grows a variety of fruits and vegetables. She is passionate about using environmentally friendly methods and wants to ensure that her crops are free from pests and diseases without the use of harmful chemicals.

# John Smith

*"The future of agriculture is not about better recipes, it's about a better understanding of ecology."*

Age: **39**
Work: **Agricultural researcher**
Family: **Married**
Location: **Australia**

## Personality

Introvert — Extrovert
Thinking — Feeling
Sensing — Intuition
Judging — Perceiving

Professional | Enthusiastic

## Goals

- Develop new plant varieties that are resistant to pests and diseases.
- Improve the quality and nutritional value of crops through precision agriculture techniques.
- Increase the efficiency and productivity of farming practices through the use of innovative technologies.

## Frustrations

- Limited time and resource to collect data from crops.
- Lack of effective alarm that can quickly notify crop emergencies.
- Currently equipments are not precise enough.

## Bio

Dr. John Smith is 39-year-old agricultural researcher based in Australia. Growing up on a family farm in rural New South Wales, John developed an early interest in the natural world. After completing a degree in agricultural science at the University of Sydney, John went on to earn his Ph.D. in plant genetics from the University of Melbourne. His research has focused on developing new plant varieties that are resistant to pests and diseases, as well as improving crop yields through precision agriculture techniques.

# PRODUCT BACKLOG

## *Versions*

| | | |
|---|---|---|
| 1.1 | Rename column user case ID into task ID, rename column user description to task description | 2023-03-24 |
| 1.0 | Initialize user cases based on user stories version 2 | 2023-03-22 |

**Some rules for this table:**

**1 Story point equals around 0.5 days of work (3 hours)**

**Small-sized user case is less than 1 day. (1 to 2 points)**

**Medium-sized user case is 2 to 3 days (3 to 6 points)**

**Large-sized user case  is 4 to 5 days ( 7 to 10 points)**

| User Story ID | User Stories | Story Priority | Story theme | Estimate Story Points In Total | Task ID | Task Description | Supplementary notes | Story Points | Size | Status | Assigned Sprint |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.1 | As a teacher /researcher /farmer, I want to use the camera to capture pictures of different stages of crops, so that the students can learn the lifecycle of crops. | MEDIUM | Capture pictures, CPP | 21 | 1.1.1 | The camera should be attached to the robot so that the camera could move with the robot | By moving the robot arm. we can adjust the position of the camera | 1 | SMALL | *TO DO* | Sprint 2 |
| | | | | | 1.1.2 | Insert a UI to the front end of a web app that users can access and could configure the camera | Configuration includes starting and stopping, configuring camera settings, and taking pictures with the camera. | 8 | LARGE | *TO DO* | Sprint 2 |
| | | | | | 1.1.3 | After clicking the take picture button, the system could set the camera to real picture mode and take a picture | | 4 | MEDIUM | *TO DO* | Sprint 2 |
| | | | | | 1.1.4 | The web app should be able to visualize data from farmbot | | 8 | LARGE | *TO DO* | Sprint 2 |
| 1.2 | As a teacher, I want to show the students the automated process of planting, watering, and harvesting crops, so that they can understand how technology works in agricultural production. | MEDIUM | Documentations,<br><br>DOC | 5 | 1.2.1 | Detailed introduction document to the technology for the robot | | 4 | MEDIUM | *TO DO* | Sprint 3 |
| | | | | | 1.2.2 | Attach to video for educational purposes | | 1 | SMALL | *TO DO* | Sprint 3 |
| 1.3 | As a teacher, I want to deploy the Farmbot in class so that students can gain hands-on experience in high-tech farming. | HIGH | Deployment, DPL | 16 | 1.3.1 | Users can run scripts provided to deploy the whole system automatically. | | 8 | LARGE | *TO DO* | Sprint 2 |
| | | | | | 1.3.2 | Provide a directly accessible web app and demo account for users to deploy and test | | 1 | SMALL | *TO DO* | Sprint 2 |
| | | | | | 1.3.3 | packer the whole project with docker so that all dependencies could be prepared for deployment. | | 5 | MEDIUM | *TO DO* | Sprint 2 |
| | | | | | 1.3.4 | Detailed ReadMe file and user manual so that the users could know what to do when they have the project. | | 2 | SMALL | *TO DO* | Sprint 2 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.4 | As a farmer /researcher /teacher, I want to farm remotely so that I can reduce costs and get more time. | **HIGH** | Remote Access, RMA | 20 | 1.4.1 | Control movement of the robot based on data including thermal data | Keep detecting; ai planning for abnormal status | 8 | **LARGE** | ***TO DO*** | Sprint 2 |
| | | | | | 1.4.2 | Support ssh to get connect remotely | | 4 | **MEDIUM** | ***TO DO*** | Sprint 2 |
| | | | | | 1.4.3 | Thermal camera auto-connects to the network | Plug and play | 8 | **LARGE** | ***TO DO*** | Sprint 3 |
| 2.1 | As a teacher /researcher, I want to receive alarms when the crops are dry so that I can remind students that they forgot to water the plants. | **LOW** | Alarms, ALM | 8 | 2.1.1 | Set the drying threshold based on the data returned by a thermal camera | | 4 | **MEDIUM** | ***TO DO*** | Sprint 3 |
| | | | | | 2.1.2 | If dry plants are detected, an alert is immediately sent to the person in charge by email | | 4 | **MEDIUM** | ***TO DO*** | Sprint 3 |
| 2.2 | As a sustainable farm owner, I want to use the thermal camera to detect whether the crops are infected with pests and diseases so that I can timely detect and treatment of pests and diseases. | **LOW** | Disease Detection, DTC | 20 | 2.2.1 | Data pre-processing of data on plant body surface temperature distribution | | 8 | **LARGE** | ***TO DO*** | Sprint 3 |
| | | | | | 2.2.2 | Analysis of changes in plant body surface temperature to determine the presence and extent of pests and diseases | | 8 | **LARGE** | ***TO DO*** | Sprint 4 |
| | | | | | 2.2.3 | If any pests and diseases are detected, an alert is immediately sent to the farm owner by email | | 4 | **MEDIUM** | ***TO DO*** | Sprint 4 |
| 2.3 | As a sustainable farm owner, I want to use thermal cameras to help me accurately control the irrigation water quantity so that I can accurately control irrigation volume, thereby improving crop growth efficiency. | **MEDIUM** | Thermal Based Controls, TBC | 20 | 2.3.1 | Use Farmbot software to set up the irrigation program, including irrigation time and water volume. | | 4 | **MEDIUM** | ***TO DO*** | Sprint 4 |
| | | | | | 2.3.2 | Set up the camera program in Farmbot software to automatically capture thermal images of plants during irrigation. | | 4 | **MEDIUM** | ***TO DO*** | Sprint 4 |
| | | | | | 2.3.3 | Analyze the thermal images of plants captured automatically during irrigation to determine their water status. Thermal images can display the surface temperature of plants, and based on the temperature changes, it is possible to determine whether the plants need irrigation. | | 8 | **LARGE** | ***TO DO*** | Sprint 4 |
| | | | | | 2.3.4 | Based on the thermal images and the irrigation program settings, Farmbot can automatically control the irrigation water amount. If the plant needs more water, Farmbot will increase the irrigation water amount, and vice versa | | 4 | **MEDIUM** | ***TO DO*** | Sprint 4 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2.4 | As a farmer /researcher, I want to use the infrared imaging function to detect the temperature of the environment including the plant and the soil so that I can improve the quality and nutritional value of crops through precision agriculture techniques | **HIGH** | Thermal Picture Analysis, TPA | 17 | 2.4.1 | Continuous monitoring of soil conditions with stream data from a thermal camera. | | 4 | MEDIUM | *TO DO* | Sprint 3 |
| | | | | | 2.4.2 | Identify each plant on the thermal picture with computer vision algorithms. | Ensure that each plant is individually recognized through image-processing techniques | 4 | MEDIUM | *TO DO* | Sprint 3 |
| | | | | | 2.4.3 | Analyzing the thermal energy of each plant's leaves using a thermal imaging camera. | Help to assess the environmental stress on the plants. | 8 | LARGE | *TO DO* | Sprint 3 |
| | | | | | 2.4.4 | Calculate the environmental stress on each plant and save the data. | This data can be used to guide other processes and research. | 1 | SMALL | *TO DO* | Sprint 3 |
| 3.1 | As a teacher /researcher, I want to collect thermal data through farmbot so that it could be used for further study. | **HIGH** | Data Auto Collection , DAC | 12 | 3.1.1 | The thermal camera should be able to take thermal pictures automatically. | | 2 | SMALL | *TO DO* | Sprint 3 |
| | | | | | 3.1.2 | The user should have access to control the frequency of auto-collection. | | 4 | MEDIUM | *TO DO* | Sprint 3 |
| | | | | | 3.1.3 | The camera would categorize data and send the data to the web app so that it could be saved and the user could download it. | | 8 | LARGE | *TO DO* | Sprint 3 |
| 3.2 | As an agricultural researcher, I want to manage my database related to the plants so that I have a clean and reliable dataset for my study. | **HIGH** | Database Management, DBM | 10 | 3.2.1 | The data collected from farmbot should be stored in a database | A database that could hold all data including the raw image data. | 4 | MEDIUM | *TO DO* | Sprint 2 |
| | | | | | 3.2.2 | The data, including the results of any analysis and raw images, should be well-organized and interconnected. | The design of the data structure should be clear and accepted by the client. | 2 | SMALL | *TO DO* | Sprint 2 |
| | | | | | 3.2.3 | The web application should have the capability to select, create, update, and delete any data that has been stored. | This should be accessed through a simple UI on the front, do not need to support multiple users at the same time (maybe in the future) | 4 | MEDIUM | *TO DO* | Sprint 2 |

# PROJECT INFORMATION

## Project Overiew

- The overall goal of our part of the project is integrating a thermal camera to a robot called farmbot, so that the users could collect thermal data of plants remotely. Users can access the camera on farmbot web-app and can take thermal pictures at will. Once there is an emergency (for example threatening temperature) the system could send alarms to users.

## Project Backgound

- The farmbot project is an open-source project started in 2011 by Rory Aronson and aims at making farming automatic. The FarmBot system is made up of a robot mounted on a raised bed or greenhouse controlled by web-based software. Through the web app, users could ask the robot to plant seeds, clean weeds, water plants, and many other farming processes. Since the whole system is open-sourced, researchers could self-hold the web app and integrate different tools to customize their robot to fulfill their research interest.

## Client Goals

- Integrate a thermal camera into the farmbot.
- Use the thermal camera to collect and analyze the thermal data of the plants.
- Use the thermal data to fulfill other requirements such as detecting pests or giving alarms.

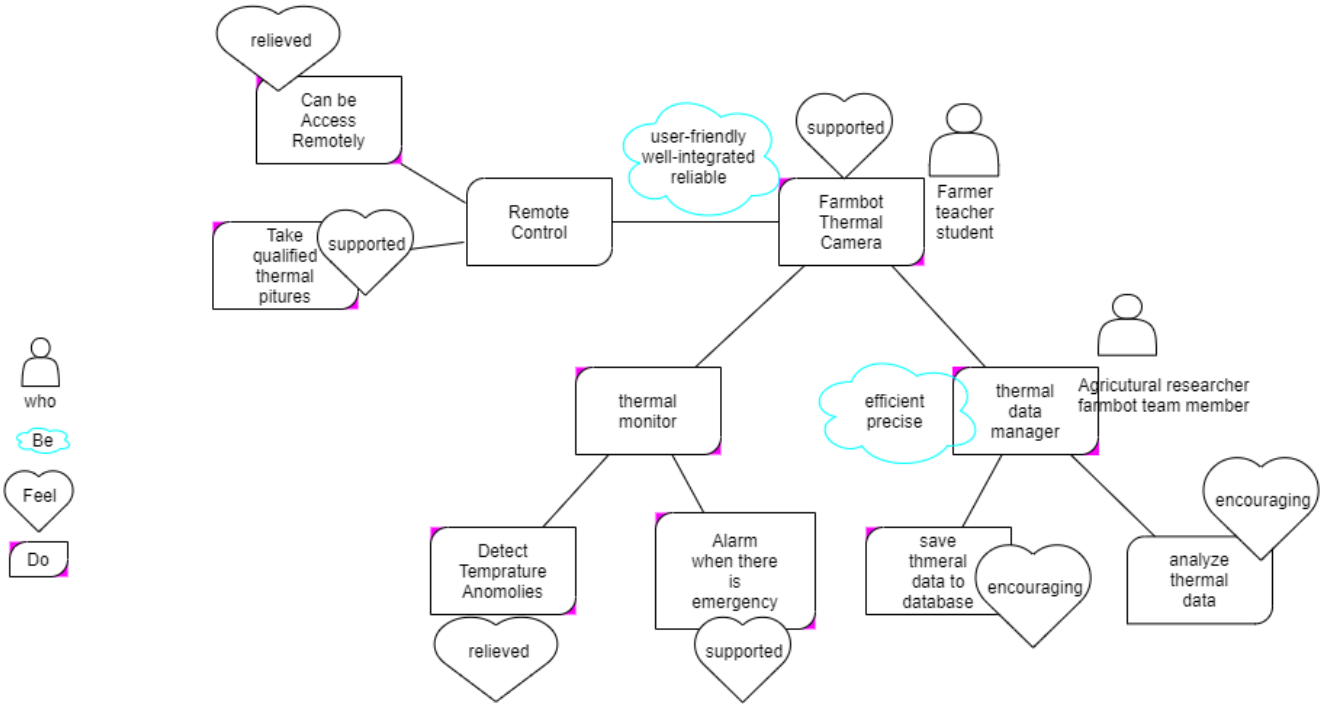
## Technique Details

- Deployment with docker and shell scripts
- Backend implemented with flask
- Frontend implemented with TypeScript
- Camera controlled with python script
- Camera connected with farmbot through Ethernet

## Do-Be-Feel List

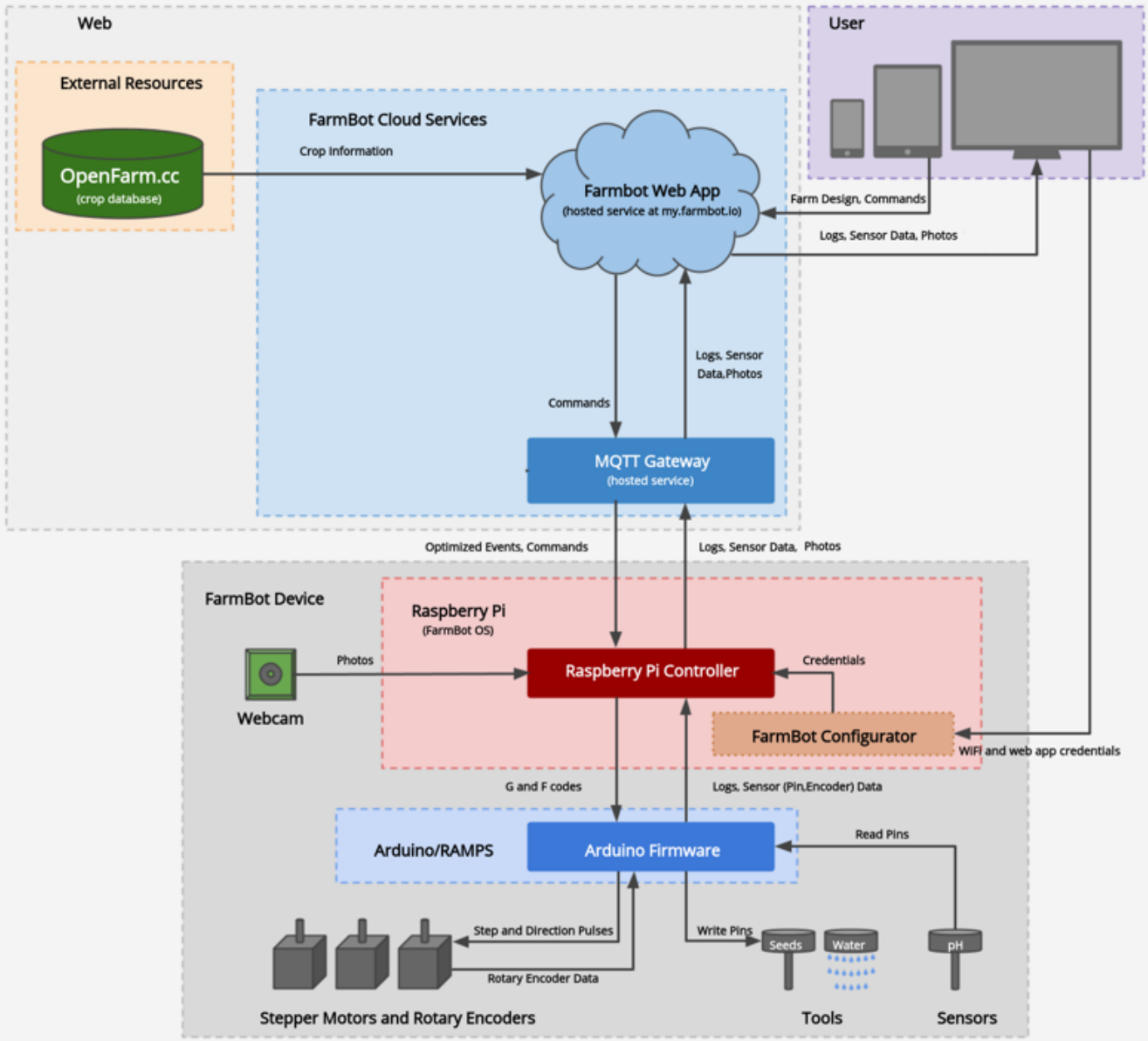
| WHO (Roles) | DO (Functional Goal) | BE (Quality Goal) | FEEL (Emotional Goal) |
|---|---|---|---|
| Farmer | Can be accessed remotely | User-friendly | Encouraging |
| Agricultural Researcher | Detect temperature anomolies | Precise | Supported |
| Teacher | Alarm when there's emergency | Efficient | Relieved |
| Student | Take qualified thermal picture | Well-integrated | |
| Farmbot Team Member | Save thermal data to database | Reliable | |
| | Analyze thermal data | | |
| | | | |

## Motivational Model




## Project Structure Diagram

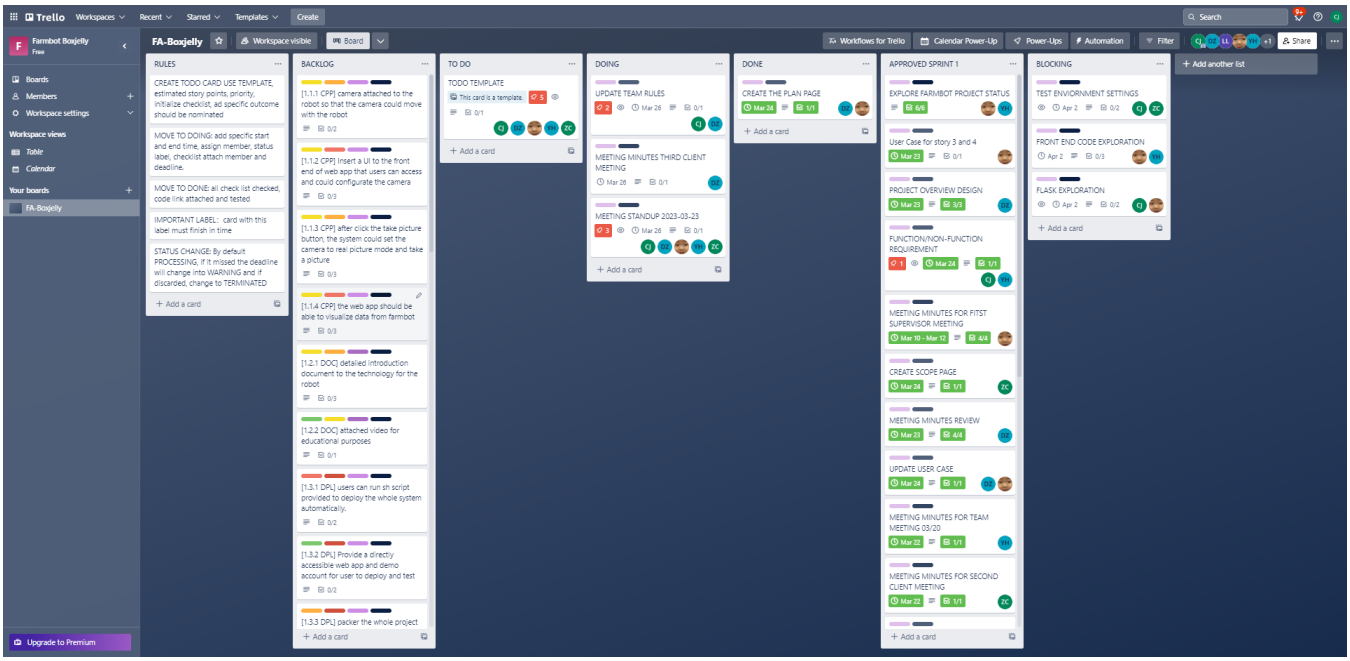
# FarmBot Software High Level Overview



# PROJECT PLANNING

## Introduction

- Our goal is to finalize the project development during Sprint 2 and Sprint 3. To achieve that, we have reorganized the user stories into user cases, meanwhile taking into account their priorities of the user cases. Our team has created a well-defined development plan, which can be viewed on Trello: FA-Boxjelly development plan.




### Sprints

- Sprint 2:

| Time Period | Plans |
|---|---|
| week 5 | 1. Familiar with the source code from web-app and find a way to test the web-app without compose<br>2. Control the camera with python script on PC<br>3. Design and pruchase tools to attach camera to the robot<br>4. Find a way to register farmbot to self-host web-app |
| week 6 | 1. Insert code into web-app to create our own UI on the web-app<br>2. Design and set up database for the thermal data and connect the database to web-app<br>3. Find a way to attach the camera to the farmbot<br>4. Find a way to connect the camera to the raspberry pi and control it with python code |
| week 7 | 1. By clicking the UI on the frontend, run python code implemented inside the webapp to control camera<br>2. Set up python code to fully control the camera (set up configuration, caputring and real-time data streaming)<br>3. Try save thermal data to database |
| week 8 | 1. Test deployment and transfer data into shell and pack in docker.<br>2. Write and test the system with designed test cases<br>3. Documentation review<br>4. Release the product version 1.0. |

- Sprint 3:

| Time Period | Plans |
|---|---|

| | |
|---|---|
| week 9 | 1. Bug fix for previous release<br>2. Preprocess thermal image data<br>3. Familiar with computer vision algorithms |
| week 10 | 1. Set up controls for auto-picture taking<br>2. Set up auto picture process and save analyzed data to database<br>3. Distinguish each plants on the picture with computer vision algorithms |
| week 11 | 1. Set up dry soil definition according to thermal data and set up alarms<br>2. Set up plant stress definition<br>3. Set up movement mode to auto-water dried plants |
| week 12 | 1. Test deployment and transfer data into shell and pack in docker.<br>2. Write and test the system with designed test cases<br>3. Documentations review<br>4. Release the product version 2.0. |

# Infrastructure to deploy the project

### Deployment plan process

| Scope | 4 days |
|---|---|
| Establishing project's scope | 1 day |
| Identifying main resources | 3 days |

| Scope | 4 days |
|---|---|
| Camera check and review | 1 day |
| Web-app check and review | 2 days |
| Deployment check and review | 1 day |

| Scope | 5 days |
|---|---|
| Camera evaluation and improvement | 2 days |
| Web-app evaluation and improvement | 2 days |
| Deployment evaluation and improvement | 1 day |

# SCOPE AND REQUIREMENTS

# FUNCTIONAL REQUIREMENTS

## Version1

| Epic | Features | User stories | Story Points |
|---|---|---|---|
| Integration of Thermal Camera in Farmbot | The user should be able to control the thermal on the web app with interface operations | 1.3 As a teacher, I want to deploy the Farmbot in class so that students can gain hands-on experience in high-tech farming. | 16 |
| | The photos taken by the thermal camera should be able to transmit to the web app | 1.1 As a teacher/researcher/farmer, I want to use the camera to capture pictures of different stages of crops, so that the students can learn the lifecycle of crops. | 21 |
| | The web app should have a user interface for camera data visualization | 2.4 As a farmer/researcher, I want to use the infrared imaging function to detect the temperature of the environment including the plant and the soil so that I can improve the quality and nutritional value of crops through precision agriculture techniques | 17 |
| Camera Monitoring | The web app should have an interface for plant monitor and can control the movement accordingly | 2.3 As a sustainable farm owner, I want to use thermal cameras to help me accurately control the irrigation water quantity so that I can accurately control irrigation volume, thereby improving crop growth efficiency. | 20 |
| | The web app should be able to control the farmbot by sending instructions remotely | 1.4 As a farmer/researcher/teacher, I want to farm remotely so that I can reduce costs and get more time. | 20 |
| | An alarm should be able to send from farmbot to the web app if an emergency show up | 2.1 As a teacher/researcher, I want to receive alarms when crops are dry, so that I can remind students that they forgot to water the plants. | 8 |
| Data Management | The data collected from farmbot should be able to transmit to the database | 3.1 As a teacher/researcher, I want to collect thermal data through farmbot so that it could be used for further study. | 12 |
| | The users should have an interface to search for the data stored | 3.2 As an agricultural researcher, I want to manage my database related to the plants so that I have a clean and reliable dataset for my study. | 10 |
| | The web app should have an interface for data processing or data visualization | 2.2 As a sustainable farm owner, I want to use the thermal camera to detect whether the crops are infected with pests and diseases so that I can timely detect and treatment of pests and diseases. | 20 |
| | The web app should have a module to display a detailed introduction document of the technology for the robot and an educational video | 1.2 As a teacher, I want to show the students the automated process of planting, watering, and harvesting crops, so that they can understand how technology works in agricultural production. | 5 |

# NONFUNCTIONAL REQUIREMENTS

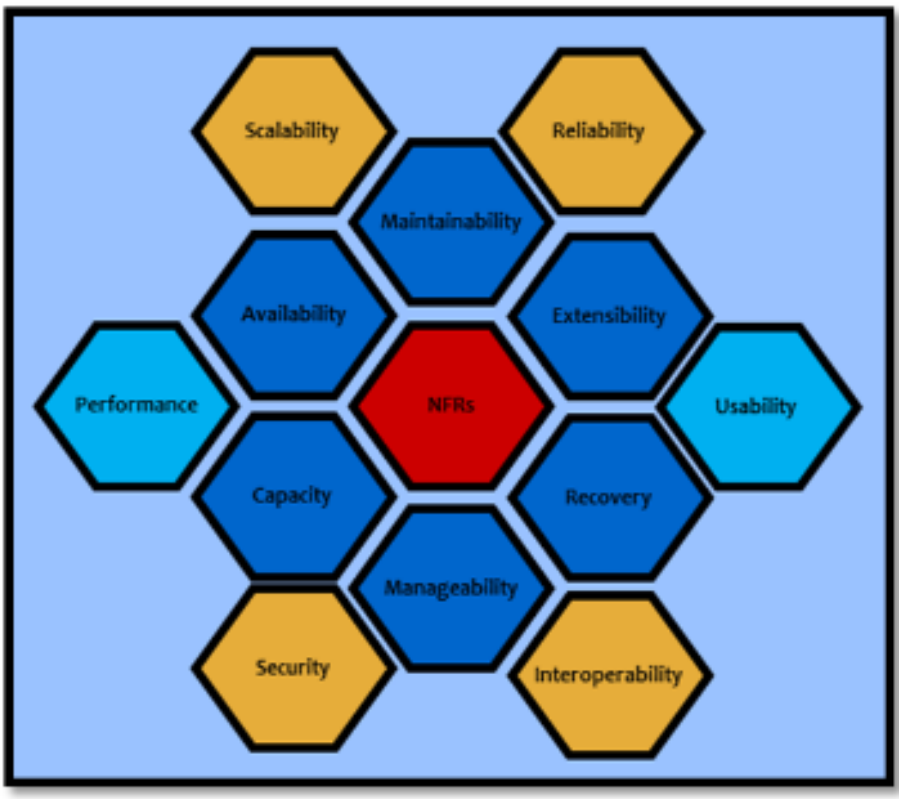



*Figure 1: Key non-functional requirements (Paradkar. 2017)*

For non-functional requirements, we referenced the book *Mastering Non-Functional Requirements:*

## Performance

- The data obtained by the thermal camera should be clear, accurate, and credible.
- Farmbot's remote access should be accurate.

## Scalability

- The thermal camera should be able to monitor data from multiple plants at the same time.

## Availability

- The farmbot web app should be able to be used by users at any time.

## Security

- Users' private data should be protected by encryption.
- Regulate the use mechanism of farmbot to avoid unnecessary loss of personnel and property.

## Maintainability

- Thermal imaging cameras must be regularly tuned and maintained to ensure their stability and accuracy.

## Manageability

- The web app interface should be able to manage the farmbot, including actions control, camera monitoring, data analysis, and so on.

- The database is supposed to be managed by the users for data management.
- Users should have access to download any data from the database.

## Reliability

- The operating system and interface of the web app should be reliable for farmbot control
- The database should be reliable for data storage and operations

## Extensibility

- The web app structure should be flexible for extensions in the future
- The database should be scalable for future usage.

## Recovery

- The database should have the ability to recover after crashes
- The web app should be able to recover from network interruption

## Interoperability

- The thermal camera should be able to seamlessly integrate with the Farmbot web app, ensuring a seamless and efficient experience for users.

## Usability

- Instead of a complex command terminal, the web app should feature a user-friendly and intuitive interface to enhance users' clarity and ease of use.

## References:


- Paradkar, S. (2017). Mastering Non-Functional Requirements [electronic resource] / Paradkar, Sameer. Packt Publishing.

# SCOPE

## Requirements in scope

| Function | Description |
| --- | --- |
| Camera management | • Users can access and could configure the camera<br>• The system could set the camera to real picture mode and take a picture when the user clicks the "take a picture" button |
| Data management | • Data are visible on the web app for users<br>• Users can access to select, create, update, and delete any data that has been stored. interconnected. |
| Plant drying detection | • Users will hear an alarm if the plant drying data is lower than the threshold. |
| Receiving email | • If dry plants or pests and diseases are detected, an alert is immediately sent to the user in charge by email |
| pests and diseases detection | • If any pests and diseases are detected, an alert is immediately sent to the user by email |
| irrigation program | • Users can set up irrigation time<br>• Users can set up irrigation volume |

## Requirements not in scope

| Function | Description |
| --- | --- |
| Multiple users operate a component at the same time | • Concurrency issues are addressed in future development |
| Uploading customized avatar | • we do not develop customized uploaded avatars. |
| Fix the previous team's bug | • The current step sometimes cannot work as expected in the create task which is designed by the previous team. We have not fixed this bug. |

# USER STORIES

latest version for user stories

# USER STORIES VERSION 2

## Versions

| | | |
|---|---|---|
| 2.2 | Reset story points according to the product backlog and story themes | 2023-02-24 |
| 2.1 | Reset Priorities and the color of priority and status | 2023-02-23 |
| 2.0 | Merge user stories according to guidance from the client, rewrite some user stories, reorder the IDs | 2023-03-22 |
| 1.0 | Initialize a user story table based on the current understanding of requirements, goal model, and persona. | 2023-03-21 |

- The user stories were first created in March 2023 after the meeting with the client. As the team got started on coding partial functions and we followed the agile developing approach, some user stories were updated and optimized. Also, new user stories were created after a discussion with the client.

| Feature | Global ID | Local ID | User Stories | User Story Themes | Priority | Story Points | Remarks | Update | Version | Status |
|---|---|---|---|---|---|---|---|---|---|---|
| Control | 1 | 1.1 | As a teacher/researcher/farmer, I want to use the camera to capture pictures of different stages of crops, so that the students can learn the lifecycle of crops. | Capture pictures, CPP | MEDIUM | 21 | | 2023.03.22 | 2.1 | TO DO |
| | 2 | 1.2 | As a teacher, I want to show the students the automated process of planting, watering, and harvesting crops, so that they can understand how technology works in agricultural production. | Documentations, DOC | MEDIUM | 5 | | 2023.03.22 | 2.1 | TO DO |
| | 3 | 1.3 | As a teacher, I want to deploy the Farmbot in class so that students can gain hands-on experience in high-tech farming. | Deployment, DPL | HIGH | 16 | | 2023.03.22 | 2.1 | TO DO |
| | 4 | 1.4 | As a farmer/researcher/teacher, I want to farm remotely so that I can reduce costs and get more time. | Remote Access, RMA | HIGH | 20 | | 2023.03.22 | 2.1 | TO DO |
| Monitor | 5 | 2.1 | As a teacher/researcher, I want to receive alarms when the crops are dry so that I can remind students that they forgot to water the plants. | Alarms, ALM | LOW | 8 | | 2023.03.22 | 2.1 | TO DO |
| | 6 | 2.2 | As a sustainable farm owner, I want to use the thermal camera to detect whether the crops are infected with pests and diseases so that I can timely detect and treatment of pests and diseases. | Disease Detection, DTC | LOW | 20 | | 2023.03.22 | 2.1 | TO DO |
| | 7 | 2.3 | As a sustainable farm owner, I want to use thermal cameras to help me accurately control the irrigation water quantity so that I can accurately control irrigation volume, thereby improving crop growth efficiency. | Thermal Based Controls, TBC | MEDIUM | 20 | | 2023.03.22 | 2.1 | TO DO |
| | 8 | 2.4 | As a farmer/researcher, I want to use the infrared imaging function to detect the temperature of the environment including the plant and the soil so that I can improve the quality and nutritional value of crops through precision agriculture techniques | Thermal Picture Analysis, TPA | HIGH | 17 | | 2023.03.22 | 2.1 | TO DO |
| Data | 9 | 3.1 | As a teacher/researcher, I want to collect thermal data through farmbot so that it could be used for further study. | Data Auto Collection, DAC | HIGH | 12 | | 2023.3.22 | 2.1 | TO DO |
| | 10 | 3.2 | As an agricultural researcher, I want to manage my database related to the plants so that I have a clean and reliable dataset for my study. | Database Management, DBM | HIGH | 10 | | 2023.3.22 | 2.1 | TO DO |