DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING
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PLANT WAYS
SMARTPLANTER

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REVISION HISTORY

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1   INTRODUCTION

The SmartPlanter is a product intended to ease plant maintenance by monitoring the plants environment and automating the watering process. The SmartPlanter will require a mobile application that allows users to pair their SmartPlanter device to the internet. Using the mobile application, the users can set the sensor calibration data for the specific plant they are planting. The SmartPlanter device will be able to monitor the plant's environment using the sensors and the calibration data in order to automate the watering process when the soil is too dry.

2 SYSTEM OVERVIEW

The SmartPlanter has three layers which consist of the SmartPlanter Layer, the User Interface layer or Phone Application Layer, and the Cloud Layer. The SmartPlanter layer consist of the physical plant pot and includes the micro-controller, water tank, sensors and LCD screen. The SmartPlanter layer monitors the plant's environment and provides automatic watering. This layer also provides data to the Cloud Layer for storage. The User interface layer consist of a mobile phone application where the settings for the pot can be selected. This settings can be applied directly to the SmartPlanter Layer by communicating by Bluetooth. The User Interface layer can also access the SmartPlanter through the cloud layer using WiFi.
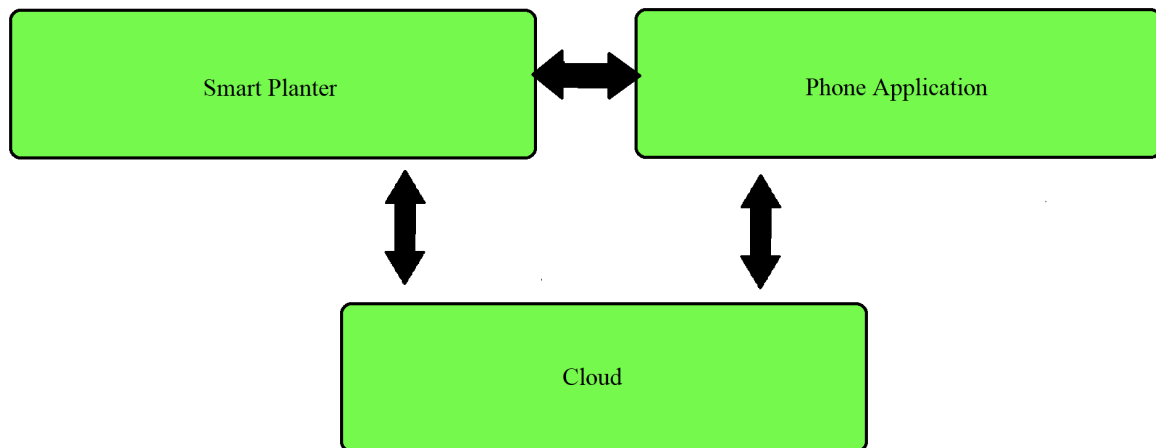
Figure 1: SmartPlanter architectural layer diagram

2.1 SMARTPLANTER

The SmartPlanter will have a display on the pot, that will let the user switch the display to show the current time. The SmartPlanter pot will have WiFi and Bluetooth. The WiFi is used to connect to the database and to upload data collected from the sensors. The Bluetooth feature will be used for the initial setup to connect it to the WiFi. The SmartPlanter pot will have a water pump used to water the plant when the soil moisture is detected low. The SmartPlanter will also include a light detector, a humidity and temperature sensor to monitor the average environment the plant is currently in and will upload the average data to the database. A water level detector will also be used to monitor the water tank level and assure it does not run below the minimum threshold. An LCD screen will also be included in the front of the SmartPlanter pot that displays either the name of the plant or the current time.

2.2 USER INTERFACE

The User Interface layer consist of mobile phone application that interfaces with the SmartPlanter via Bluetooth and the cloud via WiFi . The main usage of Bluetooth consist of the initial device set up to connect the SmartPlanter to the home network. The application will consist of an account subsystem to allow the user to change settings. The phone application can also change the calibration data of the SmartPlanter by adding custom settings catered to the plant they are growing. This is performed by allowing the user to connect to the cloud layer and view a database of plants. When this information is selected, it will store those calibration settings in the database and into the local storage of the Smart-

Planter. The application can also view the current environmental conditions of the plant by connecting to the cloud through the network and then accessing the SmartPlanter.

2.3 CLOUD

The Cloud Layer consist of a database used to store plant sensor data from the SmartPlanter and user account settings from the User Interface Layer. The database will also store hard-coded plant information that the user will be able to retrieve via the mobile phone application.

3   SUBSYSTEM DEFINITIONS & DATA FLOW

The user would be able to connect to the smart planter through Bluetooth whenever they press the new device button in their application once connected they can set up their planter with their home WiFi. Once their account and planter are set up both devices are connected to the network where they can send and receive data from the database.
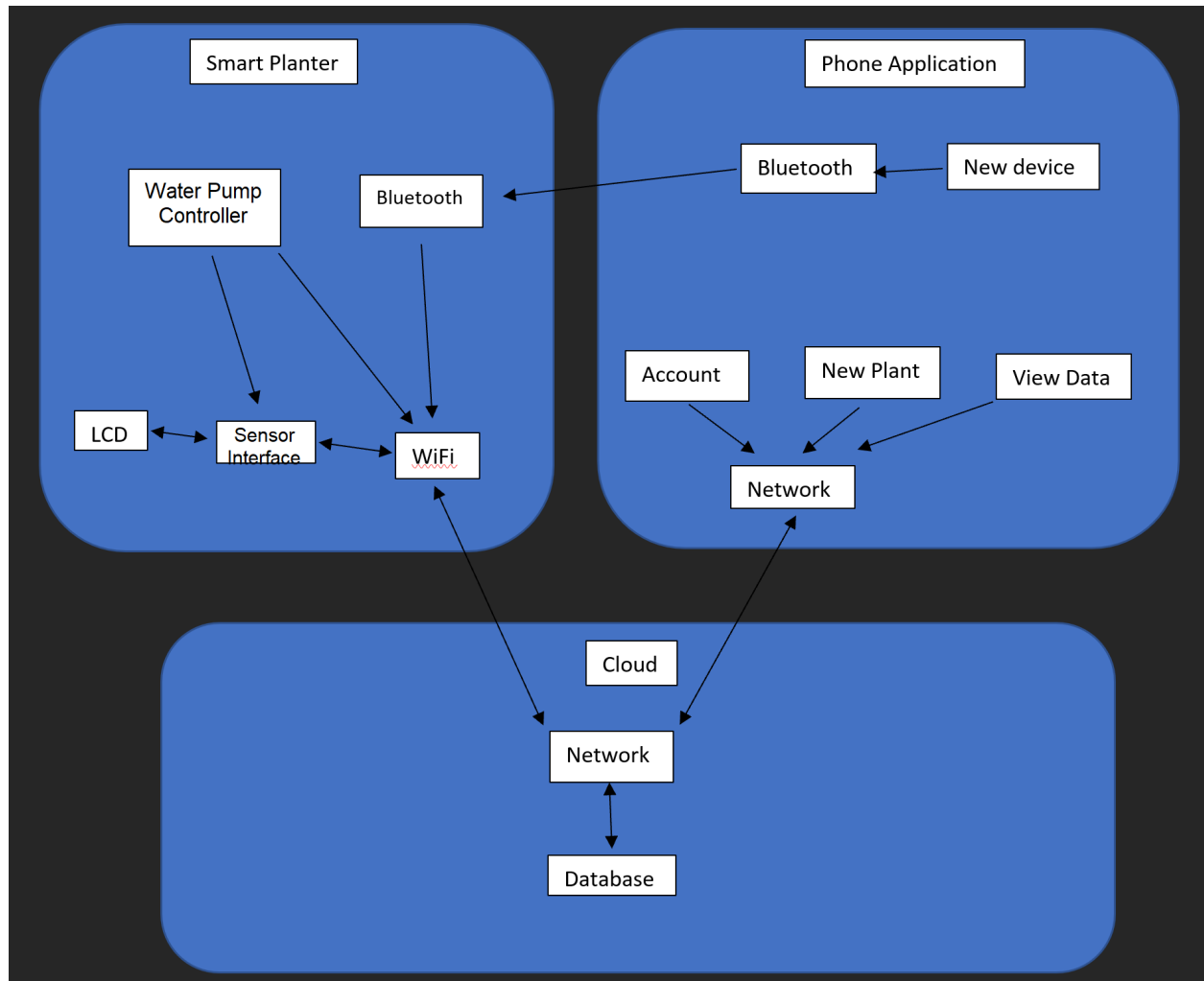

Figure 2: Sub-system overview

4 SMART PLANTER SUBSYSTEMS

The Smart Planter layer is made up of 5 different subsystems which gather information, communicate with other important functions like watering and online data, and display information to the user. The subsystems are the following: auto water pump system, sensor system, Bluetooth, WiFi, and the LCD screen.
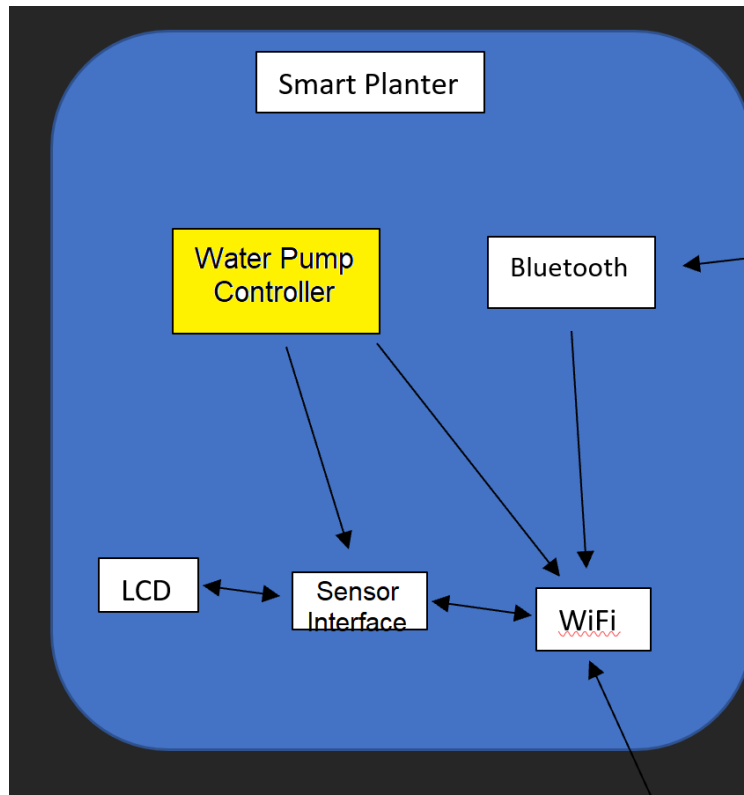
Figure 3: Subsystem description diagram

4.1 AUTO WATER PUMP

The auto water pump subsystem is in charge of watering the plant and keeping the plant at a sufficient level of moisture. It communicates with the sensors in the planter, receiving the instruction to pump water.

4.1.1 ASSUMPTIONS

We assume the water pump successfully receives the signal to water the planter from the moisture sensor.

4.1.2 RESPONSIBILITIES

This water pump subsystem is responsible for keeping the plant at a sufficient level of moisture. When the soil runs too dry, the water pump will receive a signal from the moisture sensor, which will initiate the process of pumping the water into the soil.

4.1.3 WATER PUMP INTERFACES

Table 2: Water pump interfaces

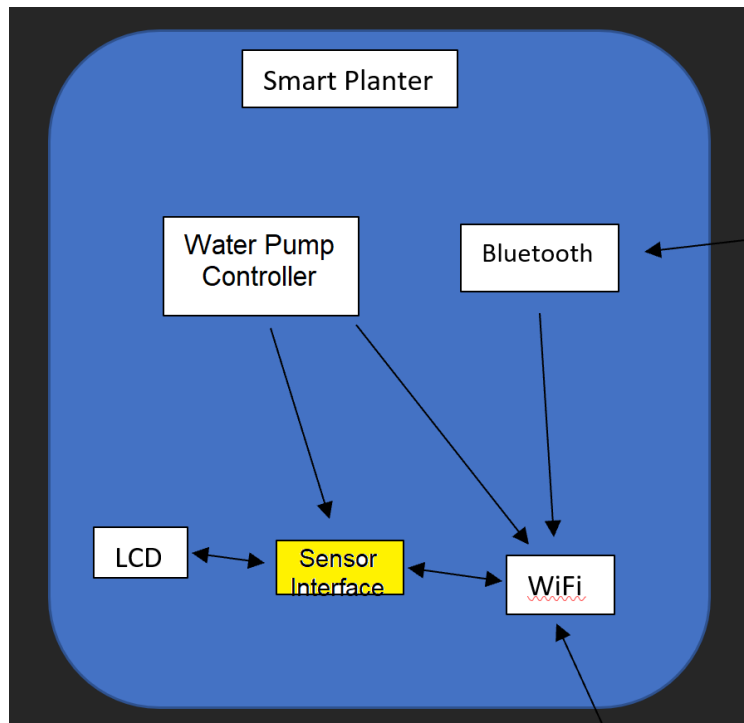| ID	Description	Inputs	Outputs
#01	Moisture Sensor	moisture level	water instruction

Figure 4: Subsystem description diagram

4.2 SENSORS

The sensors in our smart planter collect external and internal data which is used to monitor the current status of the plant. The sensors include: light, humidity, temperature, and soil moisture. The soil moisture sensor communicates with the water pump, telling it when to pump water, and the other 3 sensors send their data through WiFi to our cloud.

4.2.1 ASSUMPTIONS

We assume all of the sensors operate accurately, and correctly record data on the external and internal environments.

4.2.2 RESPONSIBILITIES

The light sensors are responsible for gathering data from the smart planter's light environment, recording the light exposure on the plant. The humidity and temperature sensors are responsible for recording the humidity and temperature of the environment. The soil moisture sensor is in charge of keeping track

of the moisture levels of the soil, notifying the water pump to water when the soil is too dry. All of these sensors communicate with our cloud database through WiFi.

4.2.3 SENSORS INTERFACES

Table 3: Sensors interfaces

ID	Description	Inputs	Outputs
#01	Water Pump	power on for pump	water the planter
#01	WiFi	Humidity, Temperature, Light Exposure Data	send data to cloud

Figure 5: Subsystem description diagram
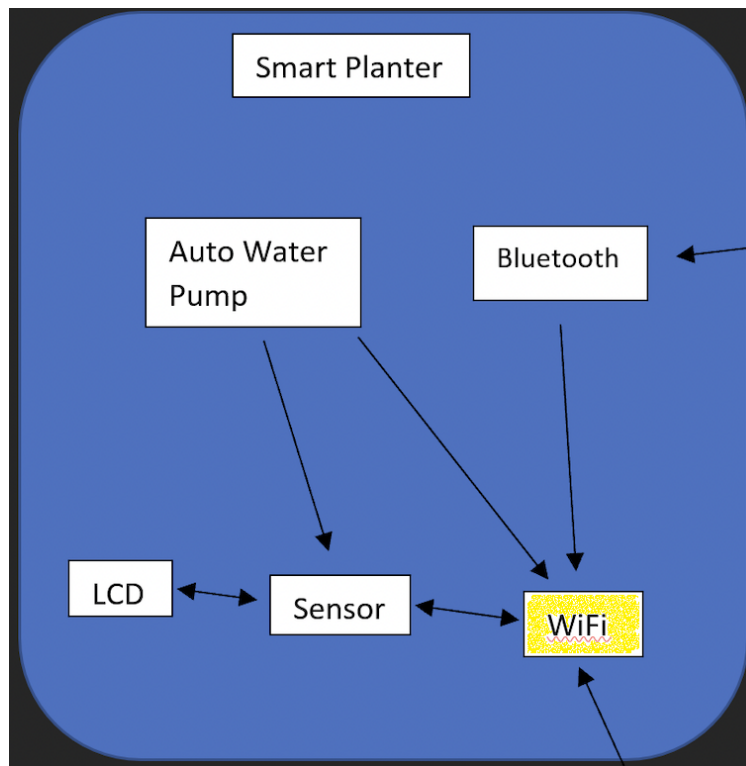
4.3 WIFI

The WiFi component of our smart planter deals with receiving all of the data from the external and internal sensors, and then sending that data off to the cloud database. The WiFi communicates with the sensor subsystem and the LCD screen.

4.3.1 ASSUMPTIONS

We assume the networks are up and fully operational, and that there are no obstructions to the transmission of data.

4.3.2 RESPONSIBILITIES

The WiFi system is responsible for receiving the light exposure, temperature, and humidity levels, and sending them over to the cloud database. It is also responsible for receiving the current time from the network and sending it over to the LCD screen.

4.3.3 WIFI INTERFACES

Table 4: WiFi interfaces

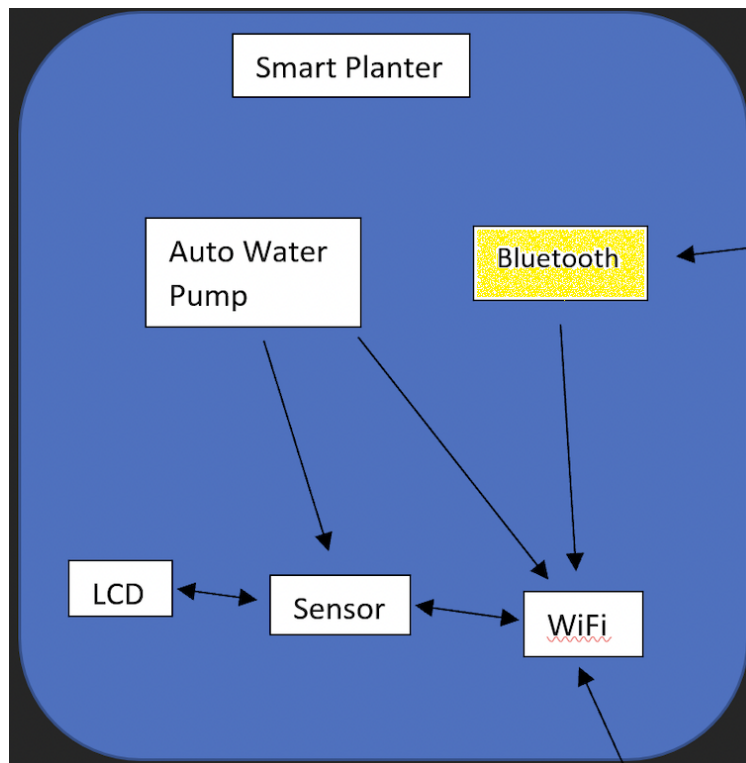| ID	Description	Inputs	Outputs
#01	Light Sensor	exposed light	lumen value
#02	Humidity Sensor	environment humidity	humidity percentage
#03	Temperature Sensor	environment temperature	degrees Fahrenheit
#04	LCD Screen	current time or plant name	current time or plant name on the screen

Figure 6: Subsystem description diagram

4.4 BLUETOOTH

The Bluetooth system is there to establish a connection between the smart planter and the network, via your smart phone. The Bluetooth communicates with the WiFi subsystem.

4.4.1 ASSUMPTIONS

We assume the Bluetooth technology is properly establishing connections between the smart planter and network.

4.4.2 RESPONSIBILITIES

The Bluetooth is responsible for establishing the network connection between the smart planter and WiFi, by using your smart phone to input the required information.

4.4.3 BLUETOOTH INTERFACES

Table 5: Bluetooth interfaces

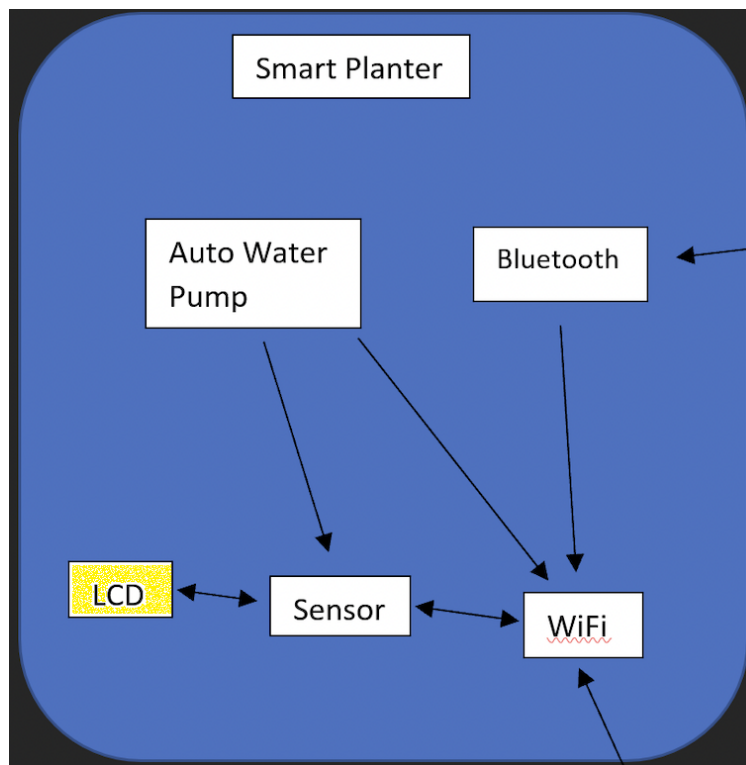| ID	Description	Inputs	Outputs
#01	Smart Phone	Bluetooth credentials	WiFi credentials

Figure 7: Subsystem description diagram

4.5 LCD SCREEN

The LCD screen is used to display either the current time or the name of your plant. The LCD screen communicates with the WiFi subsystem, receiving necessary data.

4.5.1 ASSUMPTIONS

We assume the LCD screen is posting the accurate plant name choice from the user, or the current time.

4.5.2 RESPONSIBILITIES

The LCD screen is responsible for displaying the current accurate time or name of the plant. It's responsible for communicating with the WiFi, in order to receive the data it needs to display.

4.5.3 LCD SCREEN INTERFACES

Table 6: LCD Screen interfaces

ID	Description	Inputs	Outputs
#01	WiFi	name created by the user or time chosen	Plant Name or Current Time

5   USER INTERFACE LAYER SUBSYSTEM

In this section, the user interface is layout where user can observe and optimize the smart planter pot. This is an application layer from the main system where users are required to create an account, where user must acknowledge and accept term and conditions to use the application in their mobile devices and its features. The application will be a GUI mobile app or mobile website GUI application the user can visit to have a unique experience.
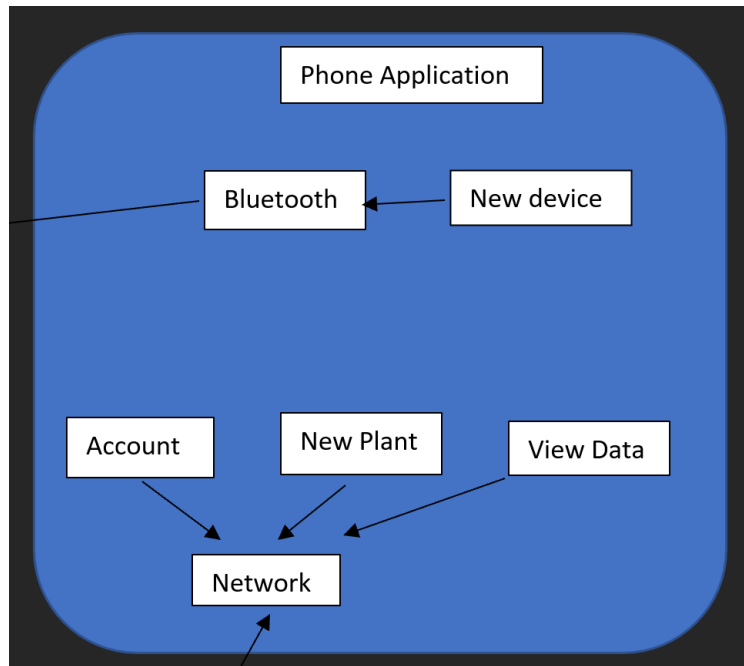

Figure 8: Setup subsystem description diagram

5.1   SETUP LAYER SUBSYSTEM

This subsystem is a setup process for a user to use smart planter pot. The user is required to agree the smart planter terms and condition so that user can register and setup their account with smart planter. The user is given registration form where user is required to input some information while other information could be optional which gives user personalized system setting while using the application.

5.1.1   ASSUMPTIONS

The user is assumed to have a device which is WiFi and Bluetooth enable which should be running recent Android (Version 13.0) or iOS (Version 16.0) operating system can should be capable to connect to the internet. We also assume that user read all terms and conditions before registering and using the smart planter service.

5.1.2   RESPONSIBILITIES

This sub-layer is responsible creating a account for a user so they can use the smart planter pot. The account creation is important for the process to have control over. After the account is created it will interact with the pot "Smart Planter Layer" and database from the "Cloud Layer" for privacy, usage and safety of the user and the application.

Figure 9: Setup subsystem

5.1.3 Subsystem Interfaces

Since, This sub-layer is responsible creating a account for a user. The following are important inputs and outputs for the subsystem in the table entry for each labeled interface that connects to this subsystem. For each entry, describe any incoming and outgoing data elements will pass through this interface.

Table 7: Setup Subsystem Interfaces

ID	Description	Inputs	Outputs
#01	User Setup (Register Form)	User Id Username First Name Last Name Email Phone Number Password Confirm Password	User Data Created
#02	Device Setup (Register Form)	Device Id Device Name Device Picture Device Information Device Data	Device Data Created
#03	Cloud Setup (Automatic)	User Setup Data Device Setup Data	Cloud Data Created

5.2 ACCOUNT SUBSYSTEM LAYER

This subsystem is a user account after setup for a registered user to use smart planter pot. The user is required to log-in so that user can use their account with their own smart planter. The user is given login form where user is required to input user credential which gives user personalized system setting while using the application.

5.2.1 ASSUMPTIONS

The user is assumed to have the Smart Planter mobile application is downloaded from recent Android (Version 13.0) or iOS (Version 16.0) operating system which should be capable to connect to the internet from the device using WiFi and Bluetooth enable.

5.2.2 RESPONSIBILITIES

This sub-layer is responsible for logging a user so they can use smart planter pot. After the user is logged in it will interact with the pot "Smart Planter Layer" and database from the "Cloud Layer" for privacy, usage and safety of the user and the application.
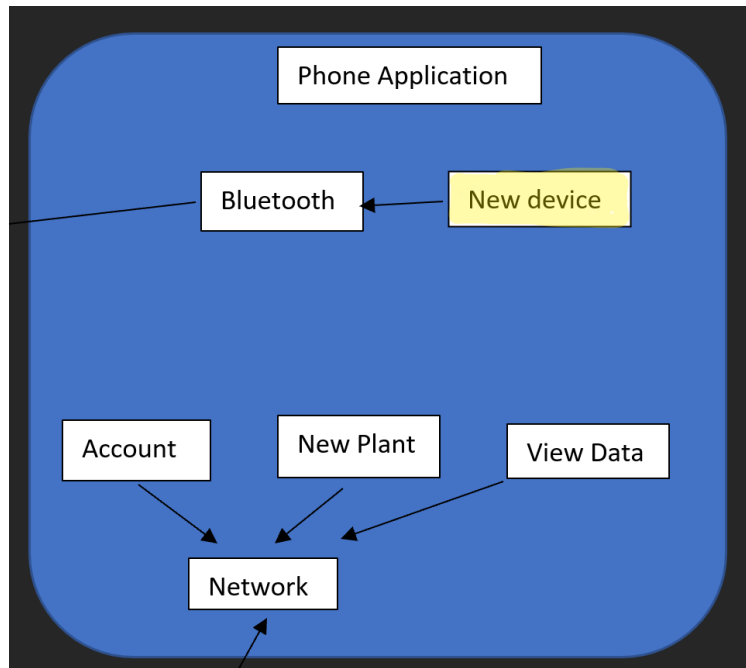
5.2.3 SUBSYSTEM INTERFACES

Since, This sub-layer is responsible logging a current account of a user. The following are important inputs and outputs for the subsystem in the table entry for each labelled interface that connects to this subsystem. For each entry, describe any incoming and outgoing data elements will pass through this interface.
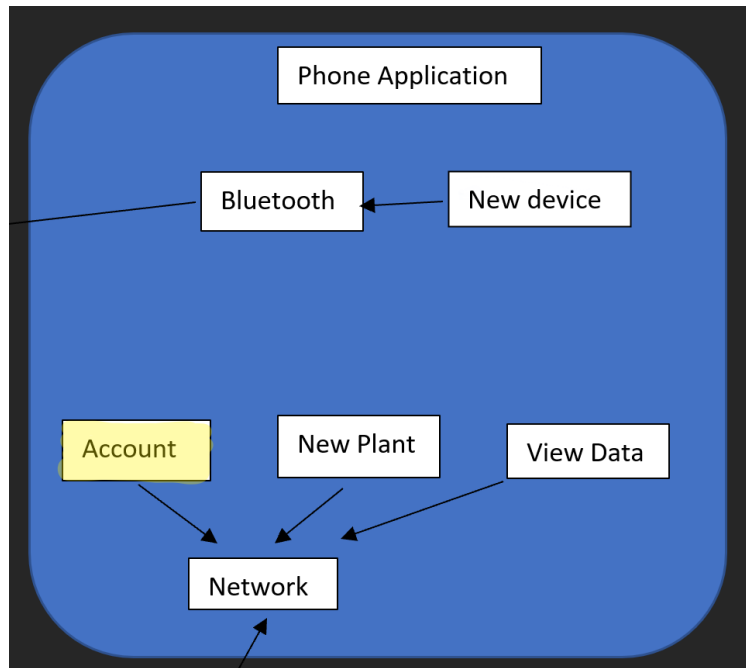
Figure 10: Account subsystem

Table 8: Account Subsystem Interfaces

ID	Description	Inputs	Outputs
#01	User Validation (Login Form)	Username or Email Password	User Authentication
#03	Pot Data (Automatic)	N/A	User Device Data

5.3 NETWORK SUBSYSTEM LAYER

This subsystem is a connection process for a user to use smart planter pot. The user will automatically fetch data from the database as well as it can calibrate and configure the device using internet via WiFi. The user is given registration form where user is required to input some information while other information could be optional which gives user personalized system setting while using the application.

5.3.1 ASSUMPTIONS

The user are assumed to have a device which is WiFi and Bluetooth enable which should be running recent Android (Version 13.0) or iOS (Version 16.0) operating system with the Smart Planter mobile application which is logged-in user which is capable of connecting to the internet.

5.3.2 RESPONSIBILITIES

This sub-layer is responsible connecting a account for a user so they can use the smart planter pot online. After the account is connected it will interact with the pot "Smart Planter Layer" and database from the "Cloud Layer" for any data exchange.
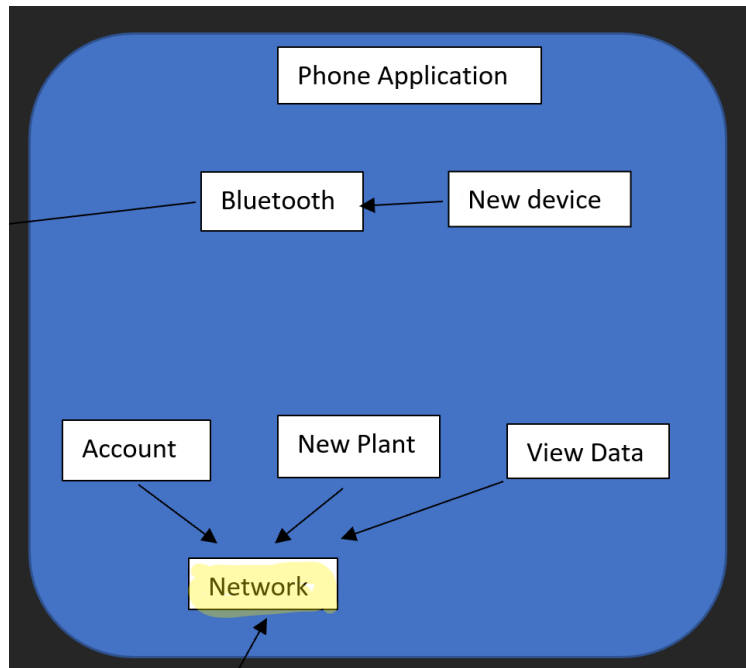
Figure 11: Network subsystem

5.3.3 SUBSYSTEM INTERFACES

Since, This sub-layer is responsible for connecting a account of a user. The follow are important inputs and outputs for the subsystem in the table entry for each labelled interface that connects to this subsystem. For each entry, describe any incoming and outgoing data elements will pass through this interface.

Table 9: Network Subsystem Interfaces

ID	Description	Inputs	Outputs
#01	User Data (Register Form)	User Id Username First Name Last Name Email Phone Number Password	User Data Added
#02	Device Data (Register Form)	Device Id Device Name Device Picture Device Information Device Data	Device Data Added
#03	Cloud Data (Added Automatically)	User Setup Data Device Setup Data	Cloud Data Added
#04	Authentication (Login Form)	Username or Email Password	User Validated
#05	Pot Data (Automatic)	Device Data Request	Device Data Received

6 CLOUD LAYER SUBSYSTEMS

The smart planter layers is made up with network and the database, the could will communicating between the database throw the network connecting to the smart planter pot system. The smart planter pot will send data from the sensor throw the network connected to the database to be store.
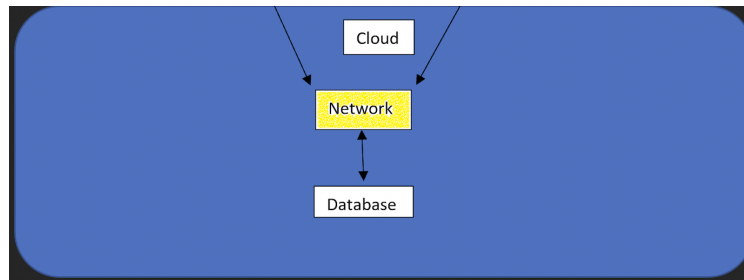

Figure 12: Cloud subsystem description diagram

6.1 NETWORK

The network is in charge of the communication between the non-sequel database(MongoDB Database), smart planter application(Mobile Application) and the smart planter system(Smart Planter Pot).

6.1.1 ASSUMPTIONS

In the cloud layer we have plug-in connection to the database network into the flutter application and the smart planter pot which will have reliable network connection via WiFi and potentially using Bluetooth. Using the network connection of cloud we send, receive and store the passing data around the network.

6.1.2 RESPONSIBILITIES

The network in responsible the communication between between the non-sequel database(MongoDB Database), smart planter application(Mobile Application) and the smart planter system(Smart Planter Pot), the network in charge making sure the data get to the database without any lost of data packet and retrieve from the data from the database when needed.

6.1.3 SUBSYSTEM INTERFACES

In the cloud network interfaces we have two type of input and output connection that gets input from two different networks. First, the critical input connection from plot data which is clearly from the Layer Smart Planter which feeds data into specific data fields. Second, the connection to the network layer is from Layer Phone Application where the database specific fields are accessible format so that it could get fetched.

Table 10: Cloud Network Interfaces

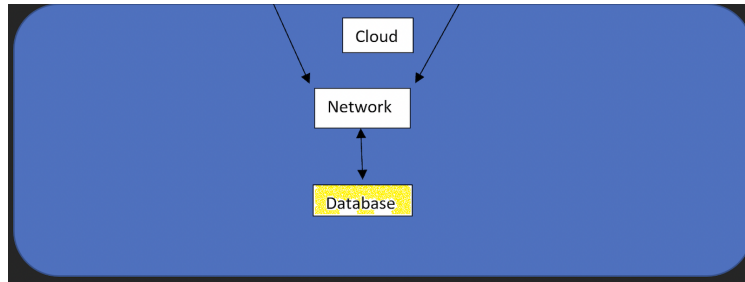| ID	Description	Inputs	Outputs
#1	SmartPlanter Pot connected to Cloud Network	Smart planter system data Database data replaced	Store new data into database wait for Fetching data
#2	Mobile Application Network connected to Cloud Network	Fetch Database data	send new data

Figure 13: Cloud subsystem description diagram

6.2 DATABASE

The cloud database we are using is server-less which basically need no version control and everything is setup in cloud database is in charge holding data from the smart planter sensor that was send from the smart planter system and the database is also in charge of sending out requested data from the user.

6.2.1 ASSUMPTIONS

The database is responsible for storing data send from the smart planter system and the database is responsible sanding out data to the user when the data is request by them.

6.2.2 RESPONSIBILITIES

The database is responsibly is hold the data for the light sensor and the humidity sensor data and the temperature sensor data and the moisture sensor data and information about plant that user could look up. The database should be able to send data when it is request from the user.

6.2.3 SUBSYSTEM INTERFACES

In the database network interfaces we have two type of input and output connection that gets input from two different networks. First, the critical input connection from network plot data which update data into specific data fields. Second, the connection to the network layer is from Layer Phone Application where the database specific fields are accessible format so that it could get fetched.

Table 11: Cloud Database interfaces

ID	Description	Inputs	Outputs
#1	Add New data	Update the database with new data fields	Sucess Message
#2	Fetch data	Fetch the database with new data fields	Sucess Message