EPS-Everyday Planting solutions

DIRTS

Direct Interface for Rapid Testing of Soils

Team Members:

- Mehar Rehill
- Francis Chui
- Kyle Granville
- Shravan Gupta
- Gurparkash Singh

COMPANY-2

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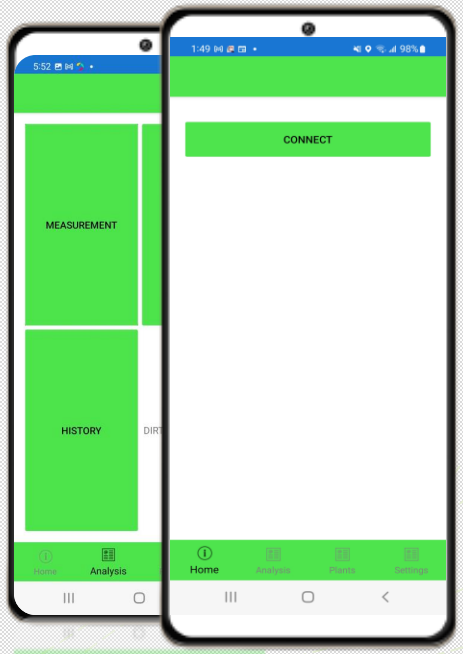
Product Description-DIRTS

DIRTS- Direct Interface for Rapid Testing of Soil

- Measures humidity, temperature and pH level of the soil.
- Comes with both iOS and Android app to present the data for simple understanding.
- Provides you with, many option of plants to grow in recorded conditions.
- Shares data between the hardware and software using Bluetooth 4.0
- Comes with additional capability to water your plants automatically.



Team Introduction

Team Members

Mehar Rehill

(CEO)

Created plant database and did validation for soil samples

Soldering of the final Assembly

Francis Chui

(CAO)

Brains behind the App Design and UI design.

Involved in hardware and software side of BLE

Kyle Granville

(CSO)

Tested each and every sensor and wrote whole hardware code.

Documentation

Shravan Gupta

(CTO)

Replicated the Android app design to iOS

Perform debugging and helped in documentation

Gurparkash Singh

(COO)

Involved in structural design of the device. Sourced all the components

Worked on PPTs and other docs.

Motivation

The Issue

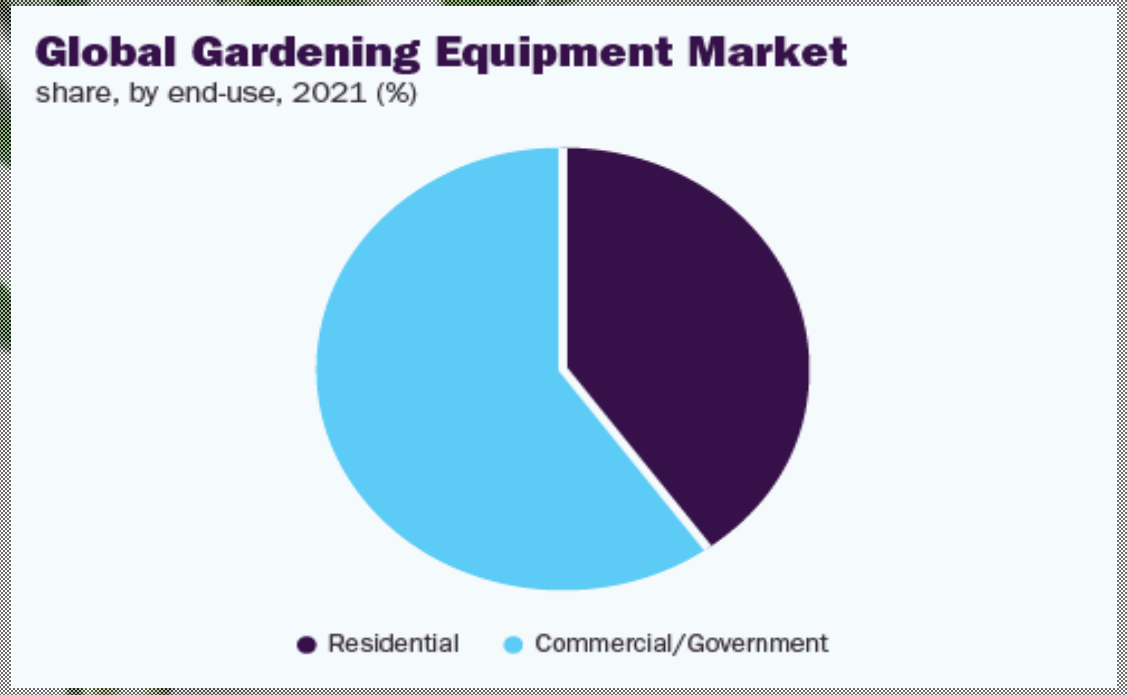
- Plants dying due to undesirable soil conditions
  - General Public, Amateur Gardeners
- No readily available way device to test soil in third-world countries
  - Farmers, Agricultural students

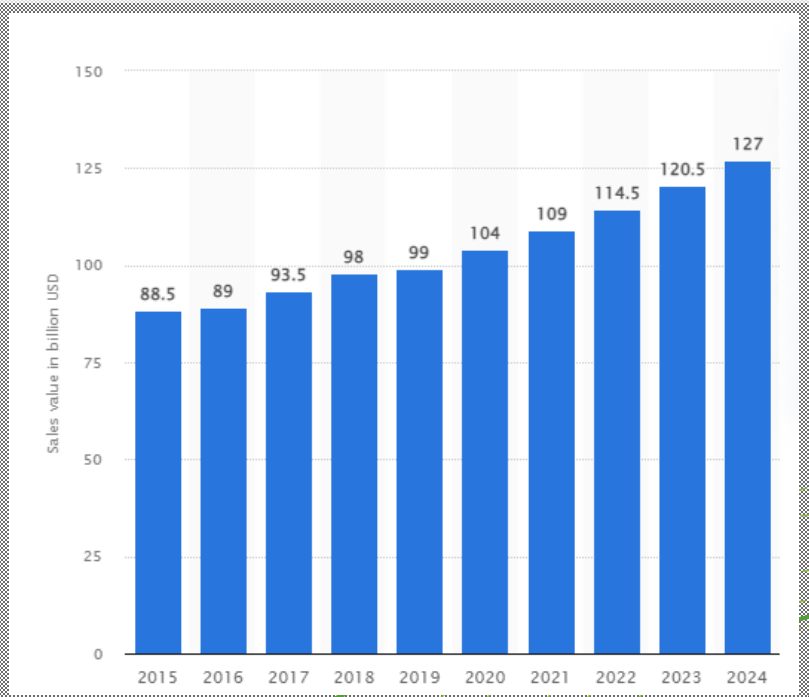
We Know more about the movement of celestial bodies than about the soil underfoot

-Leonardo Da Vinci

Market Analysis

- Global gardening market valued at CAD $114.91 billion in 2021
  - CAD $44.96 billion of above being residential.
- Projected increase of 5.9% between 2022 and 2030.
- Competitors include companies like ScottsMiracle-Gro, Central Garden & Pet, Lebanon Seaboard, etc.
- Most of them don't sell digital devices because of that gap we can compete.
- Our Largest selling factor is capability of performing multiple tests at once still hard work is must.





Market Research- Competitions

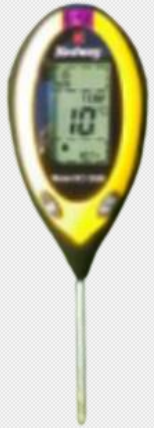
A few companies are out there, selling similar products but are very difficult to locate

E-Greet Shopping

- Doesn't specify how it measures fertility
- No pH information
- Conduction sensors are used which are not accurate

PlantCare Tools

- Standalone device, but doesn't provide Bluetooth connectivity
- Conductive sensors are used



Renke Plant sensor

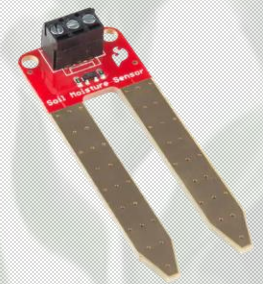
- Very complicated to connect to an Arduino
- Values are not accurate for any measurements
- Manufacturer warning: should be used for experiments but not consistent soil measurement

Technical Overview

Hardware Overview

Moisture Sensor

- Spark Fun Moisture Sensor part# 13637
- Signal sent directly to Arduino analog

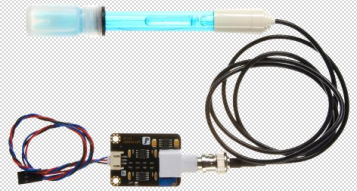


Temperature Sensor

- TEWA Sensors PT1000 Probe Thermistor
- Voltage divider to help linearize output data
  - 10kΩ used
  - Conversion to Celsius required

pH Sensor

- pH Sensor part# SEN0161
- Need to convert in pH

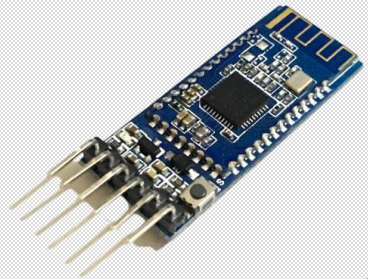


Bluetooth

Bluetooth Module HM-10

Transmits digital sensor data from Arduino to mobile app

Works with both iOS and Android

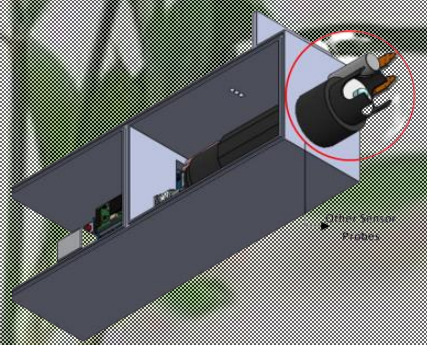


Water Pump

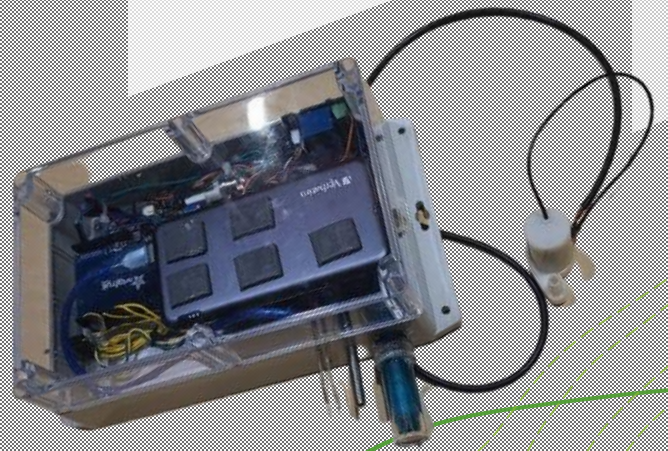
Supplies water to the plants when needed.

Takes the value from moisture sensor and check with the data base for threshold.

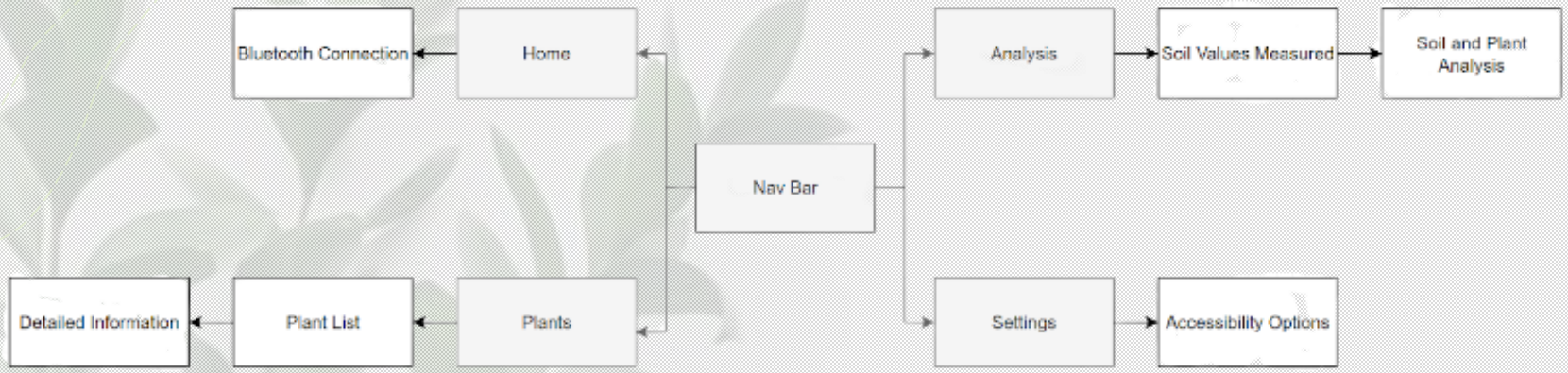
Also works on command via App

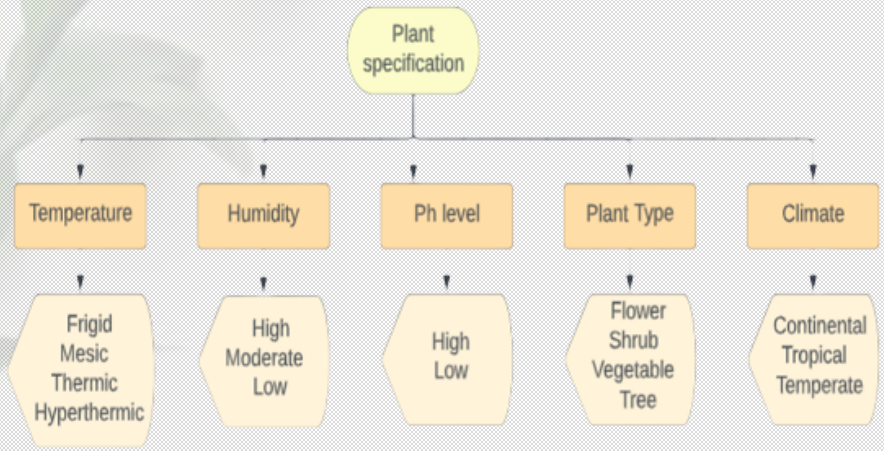


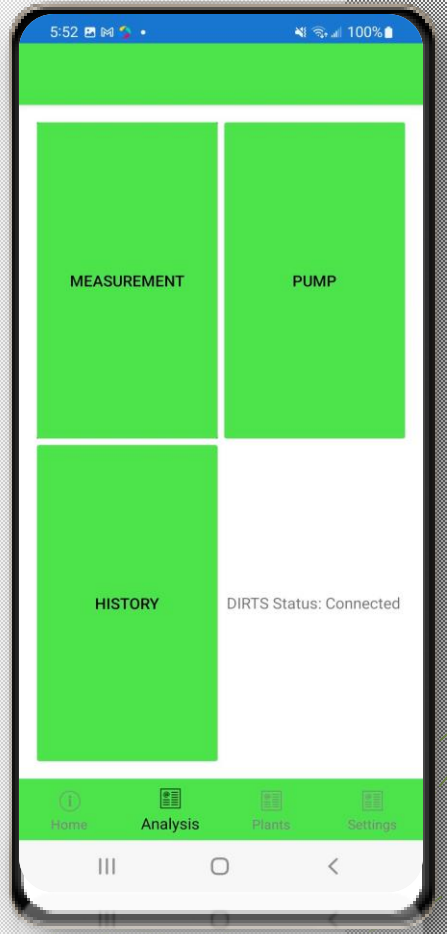
Final Design



Software Overview







Design Optimization-Electronics and Wiring

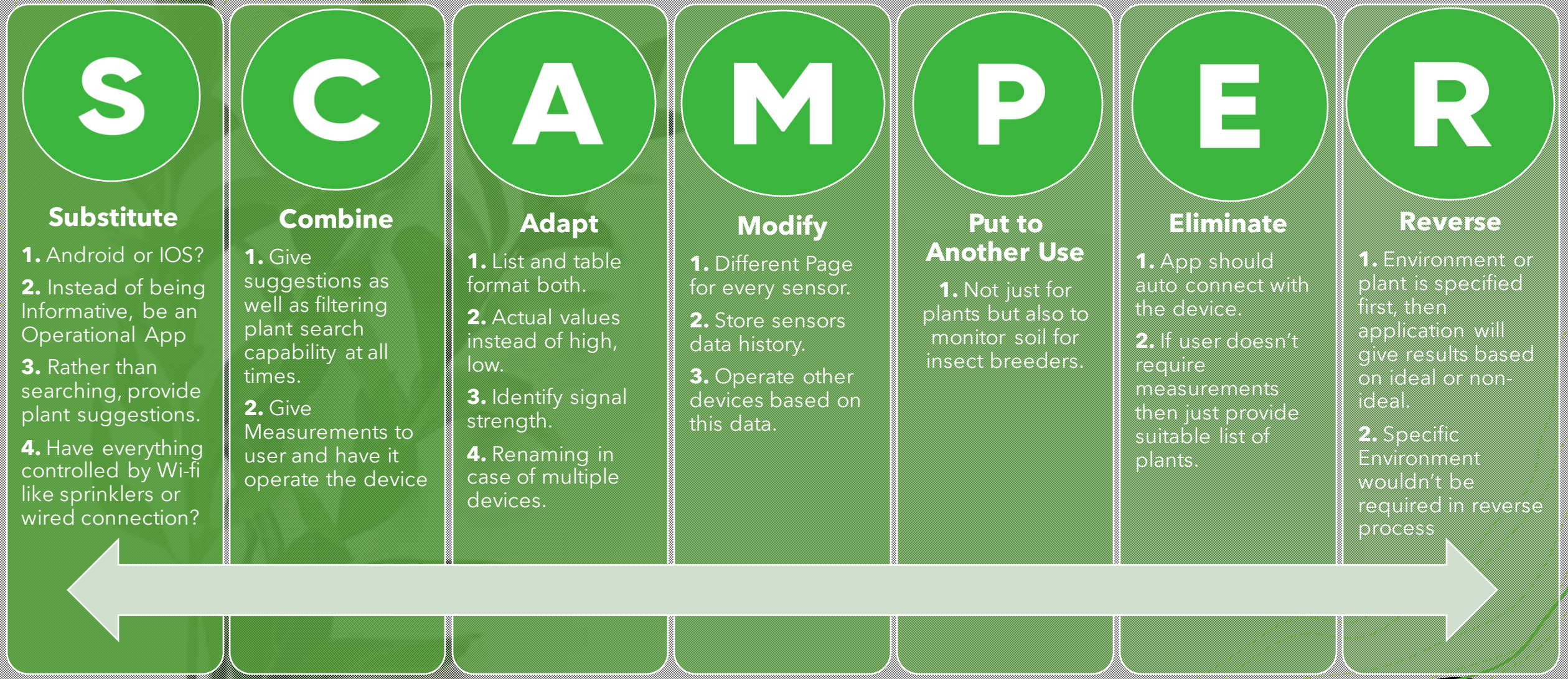
- Solderable Breadboard
  - Multiple connectors will be soldered for sensors connectivity.
  - Implementation of user LEDs to tell battery status.
  - If required, the circuitry will be designed on PCB.
  - Button for hard reset, if necessary.
- Battery and Internal wiring
  - Simplify using a single 9V rechargeable battery to power entire device.
  - Cable-ties used instead to manage the wiring inside the case.

Criteria	Baseline	PCB	solderable board
Functionality	0	-1	1
Reliable	0	-1	1
Debugging	0	1	-1
Cost	0	1	-1
		0	0

Design Optimization-External Casing

- Earlier the case was meant to be 3-D printed but later we got a pre-built case.
- The case is made from polycarbonate and has a transparent finish on the top
- Rain and Dustproof body for preventing electronics from any damage.
- Gasket and O-rings will be used to prevent any moisture entering the casing.
- Light-weight with multiple ports for sensors, charging and powering on/off.

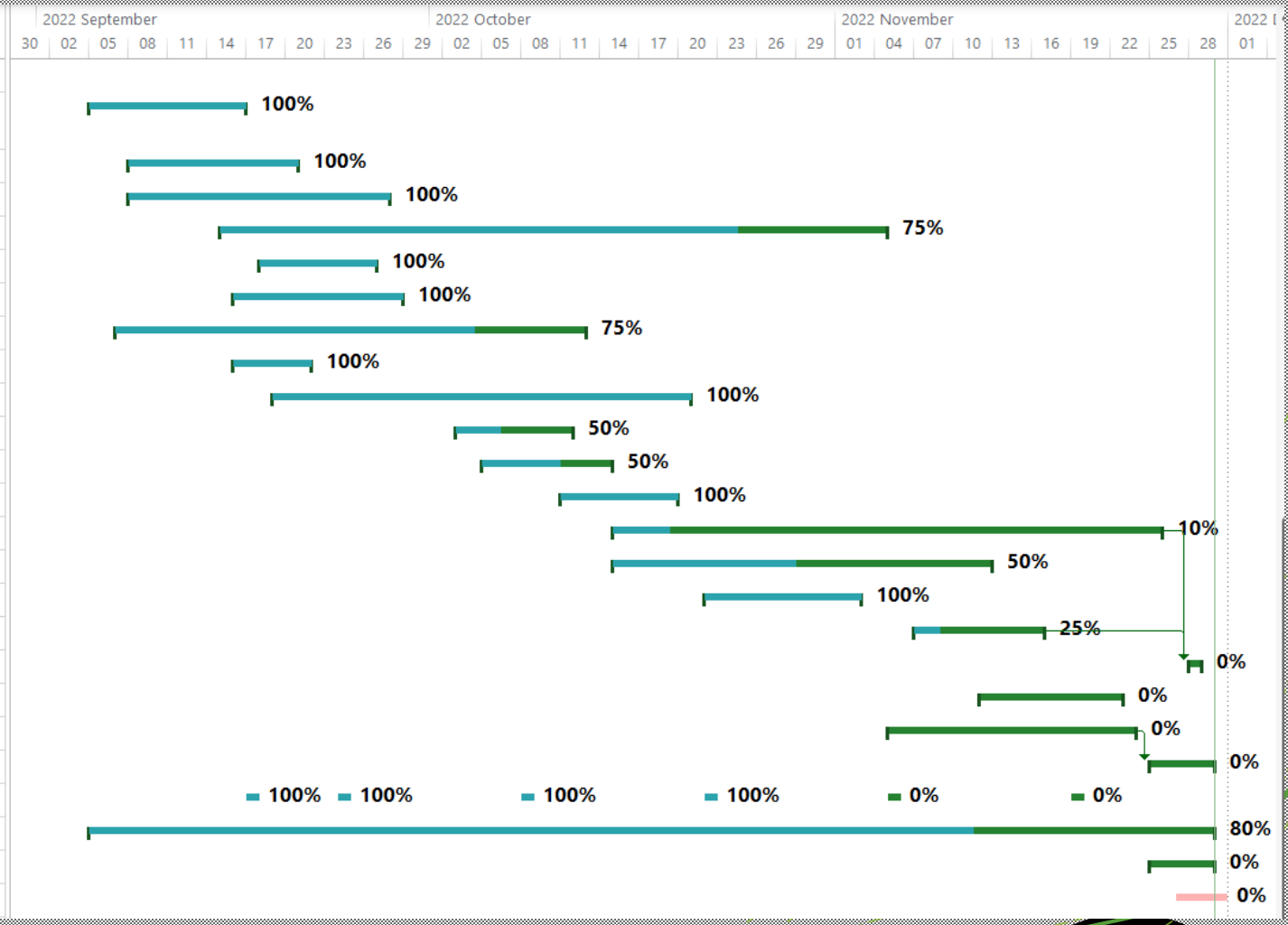
Software Optimization



Gantt Chart-Estimated

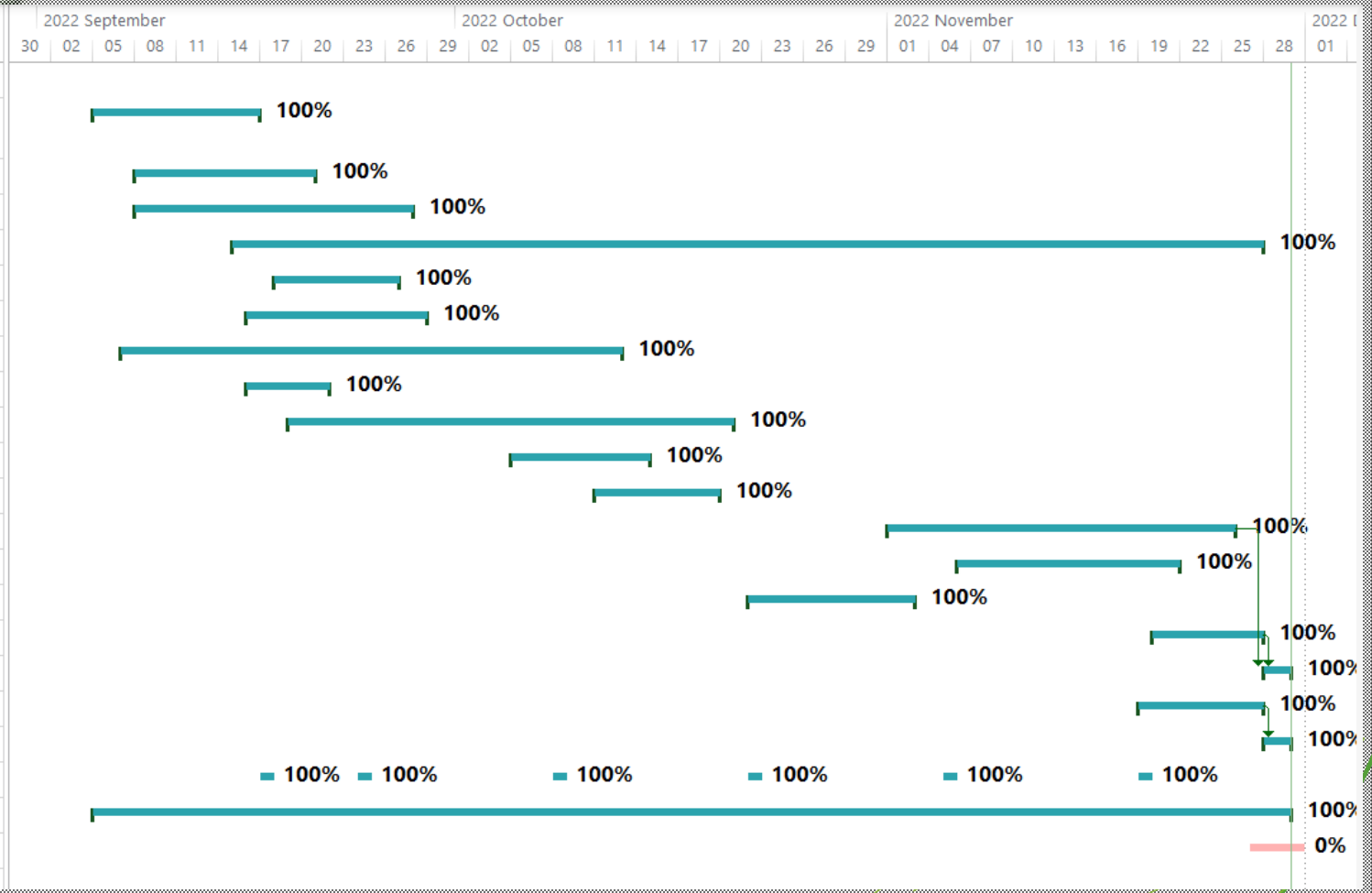
TRACKING GANTT

	Task Mode	Task Name	Duration	Start	Finish
38					
39	✓	Looking over PoC remarks and suggestions	10 days	Mon 22-09-05	Fri 22-09-16
40	✓	Planning for ENSC 440	9 days	Thu 22-09-08	Tue 22-09-20
41	✓	Irrigation system research	14 days	Thu 22-09-08	Tue 22-09-27
42		Solderable Breadboard	37 days	Thu 22-09-15	Fri 22-11-04
43	✓	pH Sensor Callibration	7 days	Sun 22-09-18	Mon 22-09-26
44	✓	Ordering new parts	9 days	Fri 22-09-16	Wed 22-09-28
45		Software functionality changes	26 days	Wed 22-09-07	Wed 22-10-12
46	✓	Prototype Refinement	4 days	Fri 22-09-16	Wed 22-09-21
47	✓	NPK sensor validation	24 days	Mon 22-09-19	Thu 22-10-20
48		Testing standalone watering system	7 days	Mon 22-10-03	Tue 22-10-11
49		Intermediate Testing	8 days	Wed 22-10-05	Fri 22-10-14
50	✓	Future Proofing	7 days	Tue 22-10-11	Wed 22-10-19
51		Starting User Manual	31 days	Sat 22-10-15	Fri 22-11-25
52		Refining software UI	22 days	Sat 22-10-15	Sat 22-11-12
53	✓	Buisness Pitch	9 days	Sat 22-10-22	Wed 22-11-02
54		Assembling all parts together	8 days	Mon 22-11-07	Wed 22-11-16
55		Product User Manual	1 day	Mon 22-11-28	Mon 22-11-28
56		User testing	8 days	Sat 22-11-12	Tue 22-11-22
57		Video shoot and editing	14 days	Sat 22-11-05	Wed 22-11-23
58		Video	3 days	Fri 22-11-25	Tue 22-11-29
59		**Team Meetings**	**61 days**	**Thu 22-09-01**	**Thu 22-11-24**
66		Engineering Journals	62 days	Mon 22-09-05	Tue 22-11-29
67		Prototype Poster	3 days	Fri 22-11-25	Tue 22-11-29
68		Final Demostration	4 days	Sun 22-11-27	Wed 22-11-30



Followed Project Schedule- Gantt Chart

Task Mode	Task Name	Duration	Start	Finish
	Looking over PoC remarks and suggestions	10 days	Mon 22-09-05	Fri 22-09-16
	Planning for ENSC 440	9 days	Thu 22-09-08	Tue 22-09-20
	Irrigation system research	14 days	Thu 22-09-08	Tue 22-09-27
	Solderable Breadboard	53 days	Thu 22-09-15	Sun 22-11-27
	pH Sensor Callibration	7 days	Sun 22-09-18	Mon 22-09-26
	Ordering new parts	9 days	Fri 22-09-16	Wed 22-09-28
	Software functionality changes	26 days	Wed 22-09-07	Wed 22-10-12
	Prototype Refinement	4 days	Fri 22-09-16	Wed 22-09-21
	NPK sensor validation	24 days	Mon 22-09-19	Thu 22-10-20
	Intermediate Testing	8 days	Wed 22-10-05	Fri 22-10-14
	Future Proofing	7 days	Tue 22-10-11	Wed 22-10-19
	Starting User Manual	19 days	Tue 22-11-01	Fri 22-11-25
	Refining software UI	12 days	Sun 22-11-06	Mon 22-11-21
	Buisness Pitch	9 days	Sat 22-10-22	Wed 22-11-02
	Assembling all parts together	7 days	Sun 22-11-20	Sun 22-11-27
	Product User Manual	2 days	Mon 22-11-28	Tue 22-11-29
	Video shoot and editing	7 days	Sat 22-11-19	Sun 22-11-27
	Video	2 days	Mon 22-11-28	Tue 22-11-29
	Team Meetings	**61 days**	**Thu 22-09-01**	**Thu 22-11-24**
	GitLab update	62 days	Mon 22-09-05	Tue 22-11-29
	Final Demostration	4 days	Sun 22-11-27	Wed 22-11-30



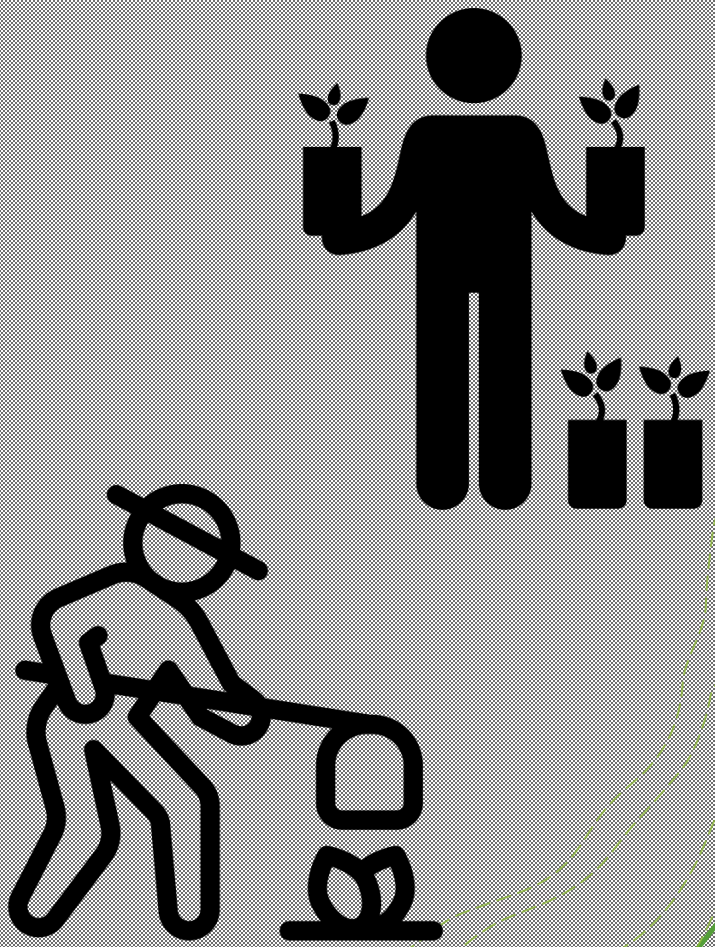
Video Demonstration

Video

Business Case

Ideal Customer

- The device is suited for someone:
  - Who wants to buy some plants but don’t know exactly which ones to get.
  - Who likes gardening but don’t know how to take care of plants
  - Who has a lot of plants but don’t have much time to devote in their caring
- The device simple design is suited for people of all age groups

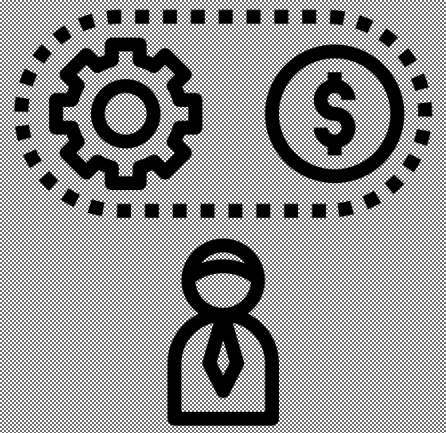


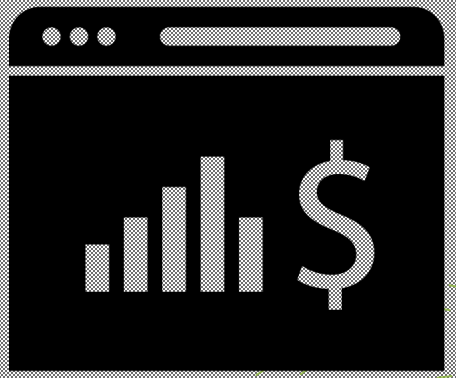
Customer Base

- The size of market stays consistent throughout whole year.
- Significant portion of users will be inexperienced gardeners (mostly millennials).
  - Picked up gardening as hobby.
  - Started during pandemic to create fresh environment indoors.
- Even younger audience is excited about the combination of gardening with technology.
- Market stats in previous slides ensures us to have a steady cash flow.
- Integration of mobile app is sort of a risk for selling within the elder audience.
  - Tackled by creating a 4-click UI consisting- opening, connecting, gathering and selecting.
  - Marketing will focus on promoting simplicity in our user experience.

Financing

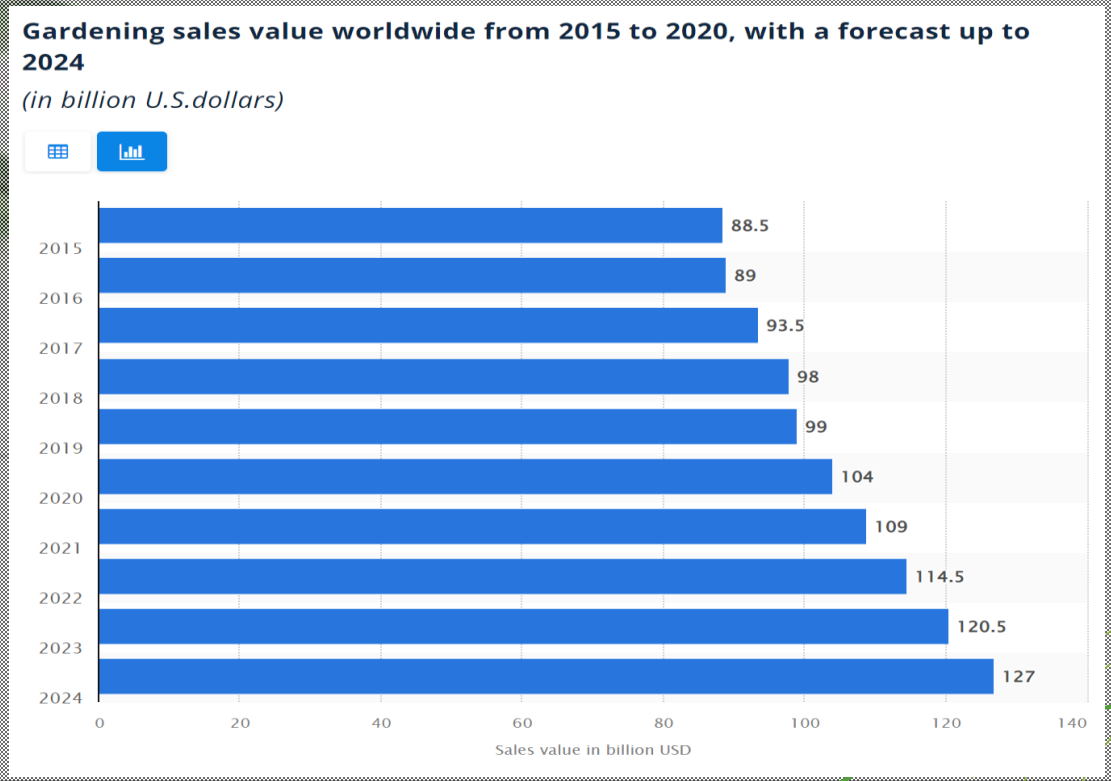
- Enroll in programs like Business Incubators, Futurpreneur Canada and more to get investors.
- Pitch product online and start fundraising
- Contact local grocery stores and nurseries to collaborate in providing sources and later selling.
- Reach out to SFU entrepreneurship program and Venture prize
  - Provide money to work on our product and help us promote among the public.
  - Get in touch will investors who promote new start-ups.
- At last, reach companies like Walmart, Home Depot, Canadian Tire to make collaboration on larger scale.





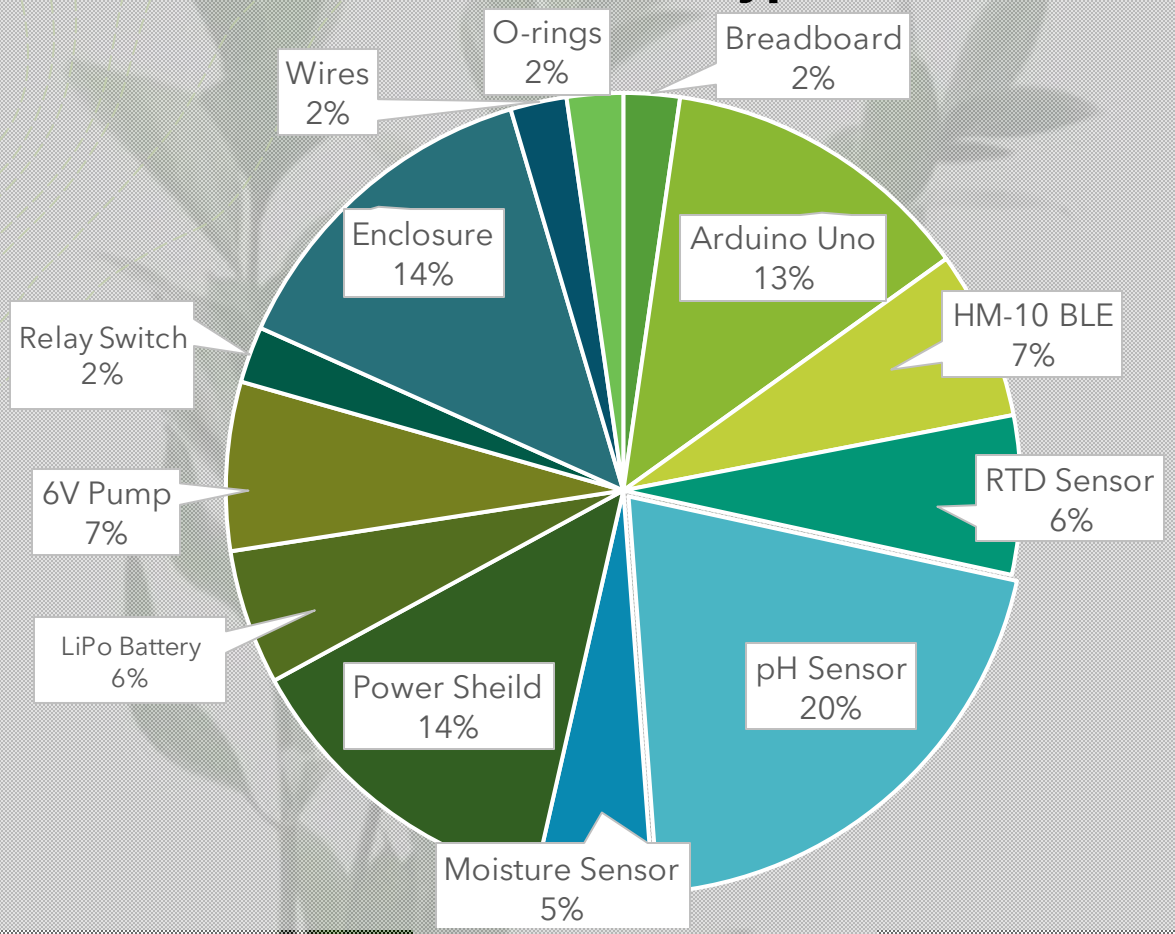
Sales Strategy

- Covid promoted the popularity of new gardeners of about 18.3 million in US alone.
- The market size reached $109 billion in 2021 and that's a great time for a launch.
- Survey said that one in three gardeners are looking for a community and our device will help that.
- Number of Gen-Z gardeners are growing, and they will prefer technology over traditional methods.



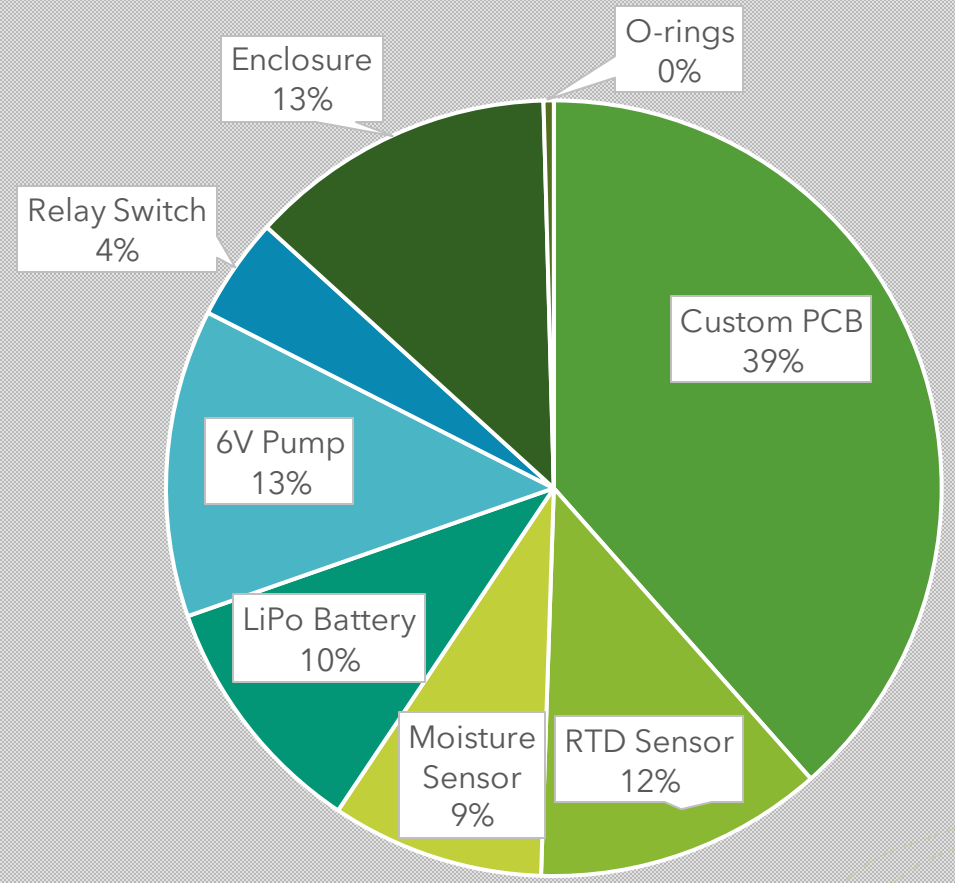
Cost Analysis

Gamma Prototype Cost



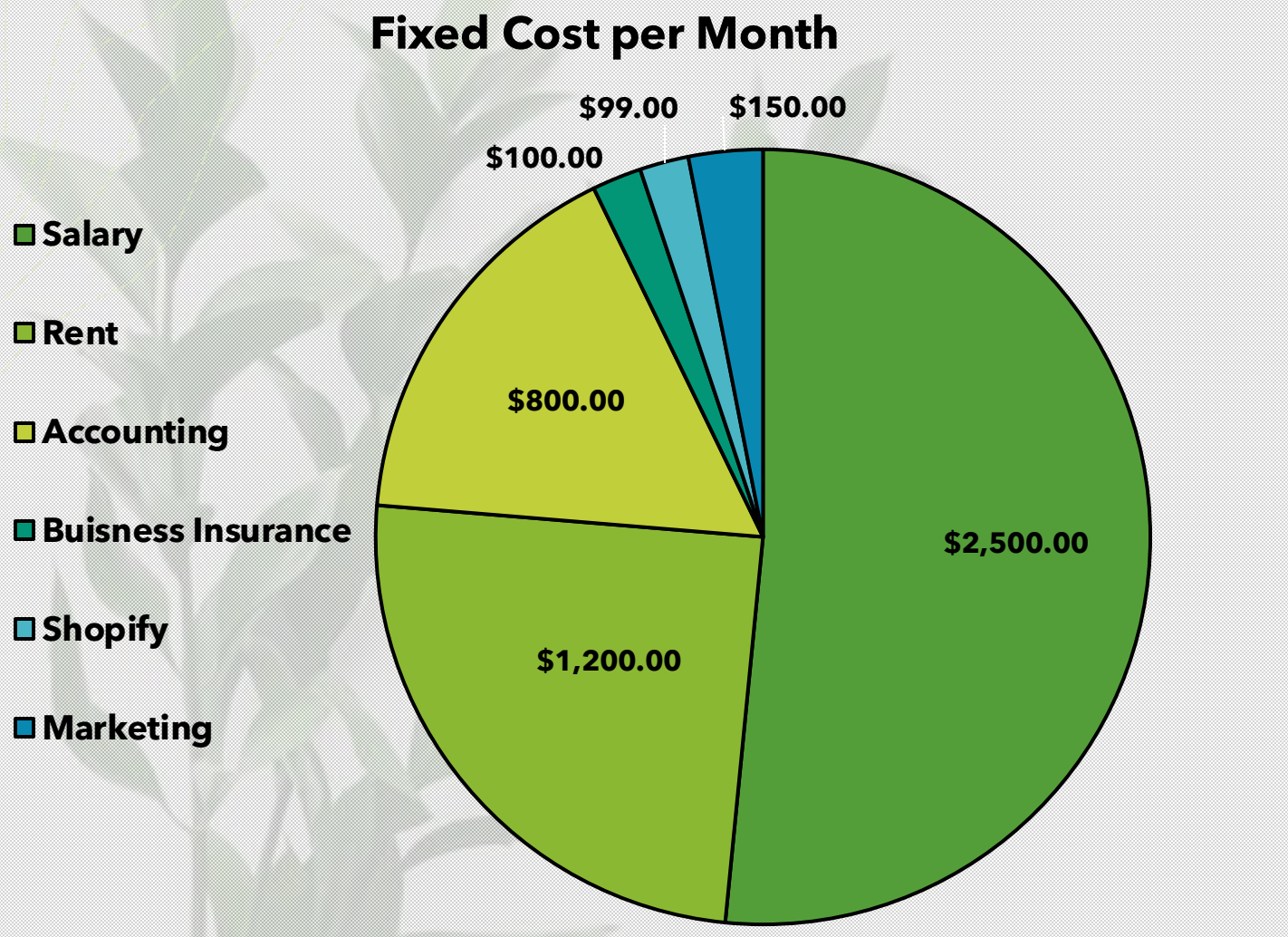
Total Cost- $218.61

Mass Production Cost



Total Cost- $161.16

Break-Even Analysis



$$Mass\ Production\ Breakeven\ Point = \frac{\$5049}{\$299 - \$161.11} = 36.61 \rightarrow 37\ units$$

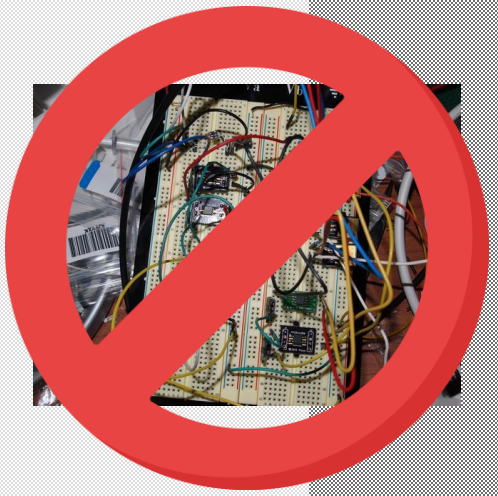
Our company need to sell at least 37units at a price of $299.00 to break-even the market in our first two years.

Total Cost/month- $5049.00

Risk Analysis and Management

Risk Analysis

- **Circuitry Management**
  - Went with solderable breadboard than PCB as circuit is simple.
  - Eliminated all the risks like shortage of parts and waiting time
  - Parts were distinguished on basis of their type
  - Wires tied together and heat-shrinks provided protection from short-circuiting



- **Enclosure and irrigation attachment**
  - Due to irrigation system, the risk of leakage increased as an extra cutout will make a huge difference
  - That is minimized by using O-rings around the circular cut-outs and hot glue afterwards.
  - Also, we tried to keep the cut-outs as small as possible.

Risk Analysis

- **Data transmission and Results Reliability**
  - BLE has limited range, so it's required that software handle sudden disconnections
  - Disconnections will be handled easily by device and the irrigation system
  - Software will be implemented with a listener to continuously check the connection.
  - Software should accept new Bluetooth connections
  - Configuration with irrigation is important as if that disconnects, the system will water the plants incorrectly.

- **Stand-by Mode**
  - Power switch is added to make it work whenever the user wants.
  - If unreachable, Bluetooth can send a signal to change the device status to low power mode.
  - A possible risk is either a delay or cancelation the data from sensors
  - That has been resolved by setting a specific length of time for standby mode.

Risks for the Users

Amateur Usage

Users May be unexperienced to use and maintain the device properly. This will decrease the effectiveness.

Inaccurate Data

Inability to get correct data would ruin the credibility and might damage plants

Framework fails

Water and dust damaged will be more highly possible if structure is not tested properly

Product Adoption

If people won't initially rely on the product then it would be difficult to be used in future.

Product Testing

Lack of test cases would leave some areas untouched

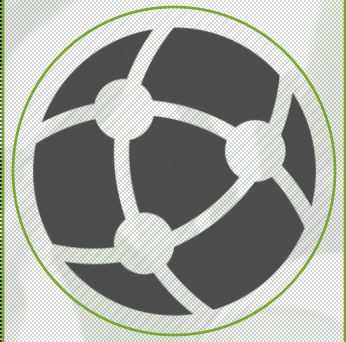
Overspending

While upgrading the device, cost can increase considerably

Risk Management

Better Usage

Users will be provided a user manual in simple language tested by our team members .



Adoption

The product will be supplied to local nurseries and would be recommended as the first resource.

Testing

All the sensors are tested separately before combining them together. Later, the system is tested in different conditions.

Data Accuracy

The data collected is validated with chemical test kits and published research papers.

Water & Dust proofing

The device will be enclosed in a NEMA 4X case with O-rings installed

Funding Sources

Funds can be applied from financial aid programs, SFU Venture Prize, etc.

Plan-B

If for some reason our device doesn't reach out to the public, then we have different areas from where we can get out of the market at minimal loss

Hardware

- Irrigation system will be implemented as stand alone device, scaled for larger areas.
- Stand-by mode technology will be shared.
- Hardware code will be open-sourced for collaboration among people.

Software

- Both Android and iOS app will be sold out of competing companies.
- Merge with companies like Soil Scout and Agrivi to introduce 3-in-1 integrated sensor as their product.

Database

- The database will be sold to different companies.
- This is where a big money is as none of other companies have their own database.

The device could go towards the research purposes or to the labs for quick testing of soils

Engineering Standards

Engineering Standards

- **CAN/CSA-C22.2 No. 94.2-07 (R2012) Enclosures for Electrical Equipment, Environmental Considerations**
  - Used for all the electrical enclosures indoors and outdoors in accordance with CEC, CSA, and other electrical codes.
  - Our Enclosure type 3SX which is applicable for indoors and outdoors.
  - Provide protection against rain, sleet, and windblown dust.
  - The parts will be mounted and compartmentalized based on its type.
  - While purchasing the housing, environmental requirements will be kept in mind.

TABLE 110.28 ENCLOSURE SELECTION

Provides a Degree of Protection Against the Following Environmental Conditions	For Outdoor Use									
	Enclosure Type Number									
	3	3R	3S	3X	3RX	3SX	4	4X	6	6P
Incidental contact with the enclosed equipment	X	X	X	X	X	X	X	X	X	X
Rain, snow, and sleet	X	X	X	X	X	X	X	X	X	X
Sleet*	—	—	X	—	—	X	—	—	—	—
Windblown dust	X	—	X	X	—	X	X	X	X	X
Hosedown	—	—	—	—	—	—	X	X	X	X
Corrosive agents	—	—	—	X	X	X	—	X	—	X
Temporary submersion	—	—	—	—	—	—	—	—	X	X
Prolonged submersion	—	—	—	—	—	—	—	—	—	X

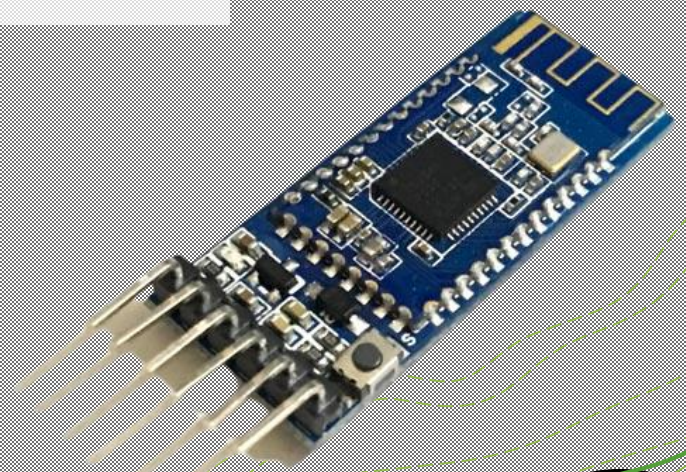
*Mechanism shall be operable when ice covered.

Although these enclosures are for outdoor use, they can also be installed indoors.

Section and Table 110.28 applies to enclosures of switchboards, switchgear, panelboards, industrial control panels, motor control centers, meter sockets, enclosed switches, transfer switches, power outlets, circuit breakers, adjustable-speed drive systems, pullout switches, portable power distribution equipment, termination boxes, general-purpose transformers, fire pump controllers, fire pump motors and motor controllers [110.28].

Engineering Standards

- **IEEE 802.15.1 Standards for WPAN/Bluetooth**
  - This provides information for implementing Wireless Personal Area Network (WPAN).
  - Approved for fixed, portable and moving devices in personal operating space.
  - Standard frequency provided in standard is 2.4GHz ISM band
  - HM-10 Bluetooth module is used which is an upgrade from HC-03 used in PoC
  - HM-10 provides connectivity with Apple devices too because of iBeacon ability.



Engineering Standards

- **ISO/IEC TR 24774 Standards for developing a software project lifecycle process**
  - Describes common characteristics that needs to be followed by development team.
  - Standard ensures to reduce the ambiguity in describing the software processes.
  - Used in our project to ensure all the processes have met the standard

- **IEEE 829 -2008 IEEE Standard for Software and System Test Documentation**
  - Standard to keep common framework for all the test purposes.
  - Software will incorporate testing plans to achieve desired software quality.
  - We ensure that software have quality control on all processes.
  - Able to define consequences of failures.

Adherence to Standards

- Environmental
- Engineering
- Adhering to engineering standards ensures DIRTS can be used by customers in Canada.

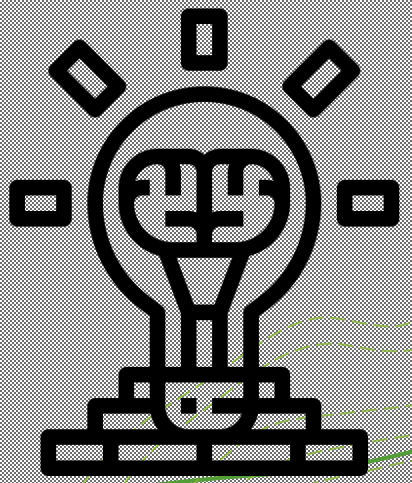
Self-Reflection

Feedback Implemented

+ Added Irrigation System ✓
+ Pump control via app ✓
+ Switched from 3D printed case to prebuilt case. ✓
+ Removed NPK sensor because seemed unrealistic now. ✓
+ Added more variety of plants in database. ✓
+ Multiple filtering options for plants in database. ✓
+ Record for previous measurements. ✓
+ App not only available on Android but on iOS. ✓

What more we would have done?

- Miniaturized product- less space, more easily to handle.
- Pump as attachment rather than fixing it with the device.
- History of measurements represented in form of graphs.
- Structured for more drastic weathers.



Conclusion

Summary

- Five Engineers from different fields come together to solve the issues novice gardeners faced
- Created company EPS-Everyday Plant Solutions
- Prototyped our first product, DIRTS- Direct Interface for Rapid Testing of Soils
- Gather soil information and displays over the app and suggest plants based on those readings.
- Comes with additional capability of watering the plants when moisture goes down.
- The project went through different stages:
  - Requirements & Design -> Proof of Concept -> Hardware & Software Changes -> User Feedback -> Prototype
- Worked for 6 months on the device which is ready to use among public.
- Responses we got from user testing among friends and colleagues are satisfying.

We think, that we have the capability of Revolutionizing the Smart gardening tools Industry

Lessons Learned

- Identify and utilize the unique skills that teammates bring to this project.
- Time is MONEY.
- Being transparent with goals and expectations
- Talking and discussion solves 90% of the problem.
- At times of setbacks, STOP- **S**it, **T**hink, **O**bserve and **P**lan.

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Questions??

Thank you!!