AUTOMATED AGRICULTURE

Design Thinking Project

Submitted By
★ Annie Suzan E C
★ Anshul Singh
★ Anuvarshini S R
★ Oleti Deekshitha
★ Parthiban C

Submitted To
Dr. V. VIDYA
Assistant Professor-II, SASHE
SASTRA Deemed-to-be University
Thanjavur 613401

Declaration

I hereby declare that the following project is a joint initiative, and a qualitative outcome of our perseverance, applied design thinking skills, and team spirit. This work was not published elsewhere and does not bear traces of plagiarism.

Signature of the Project Team

_____

_____

_____

_____

_____

Signature of the Guide   **Signature of the External Examiner**

_____   _____

<u>Table of Contents</u>

SCENARIO

Agriculture was the key development in the rise of sedentary human civilization and a challenging task because of its unpredictable affecting factors and because of doing the work manually. Today most of the processes in agriculture like irrigation, fertigation, and removal of weeds are done manually which makes agriculture less efficient and also increases its dependence on environmental changes. This problem is caused by all the processes right from soil preparation to weeding. So to make the process of agriculture more efficient it lead to the emergence of automated agriculture.

ABSTRACT

The project aims to develop a real-life model and a UI/UX design which helps farmers to do agriculture more efficiently. The model includes automation which makes the work of a farmer simpler. The process of irrigation, fertigation, and monitoring the ripening of fruits has been taken into major consideration.

To build all these processes a design thinking approach has been ingrained. The phases of design thinking have been used to think of an idea and implement it as a prototype. To expand, a detailed empathizing phase was carried out to understand the issues in the currently existing agriculture system from the farmers as well as agriculturalists. Looking into this, a prototype has been created using a few scientific concepts. This will not only attract the farmers but also the government as it is less time-consuming. So the government can make major use of it in producing and retailing agricultural products.

Design thinking

What is Design thinking?

Design thinking is a non-linear, iterative process that teams use to understand users, challenge assumptions, redefine problems and create innovative solutions to prototype and test. Involving five phases—Empathize, Define, Ideate, Prototype, and Test—it is most useful to tackle problems that are ill-defined or unknown. It is used for problems that haven't quite yet been defined. It is beneficial in product design, business design, leadership, organizational change, etc. If you're not trying to solve an open-ended problem, it's probably not the best option. At its core, design thinking is based on designing to meet the user's needs.

When to use design thinking

- A solution has not yet been proposed
- Facing a human-centered challenge

Why is Design thinking so important?

The times that we live in demand innovation. A business can't make waves without innovating. Design Thinking is the tool kit for innovation. And yet, it's laser targeted to focus on the core problem. Too many once massively successful companies have disappeared into oblivion by believing what worked before will work. Times have changed. Customers have changed. Lifestyles have changed. The way we communicate has changed. For a business to stay current, it must move with these changes. It's impossible to predict the future. Design Thinking is like a map…you may not know exactly where it will take you from the beginning, but you can be confident that the destination will be innovative, relevant, and amazing!

The five different stages of design thinking that will help users apply the process effectively to solve complex problems:-

EMPATHIZE

Empathizing is the first and foremost stage of design thinking. It has a fixed aim, which is to understand the objectives, needs, and requirements. When you are looking to build a psychological and emotional connection, you must start observing and engaging with people.

DEFINE

The second stage in the Design Thinking steps is all about defining the actual problem that needs to be solved. At this phase of the process, all the information gathered in the previous stage is analyzed and identified.

IDEATE

Ideating is the third phase of design thinking. At this stage, the designers are all set to come up with ideas and solutions. With the solid background that you now have because of the previous two steps you, along with your team members can now start thinking out of the box to come up with new and innovative solutions.

PROTOTYPE

Here, in the 4th phase, we can begin to get experimental to convert ideas into products and services. Here, you work towards building a dummy version of your product using the solutions that we ideated in the previous phases.

TEST

The final stage is the testing stage. However, keep in mind that your design thinking steps do not wrap up here. Once you execute the testing phase, you must introspect all the above steps once again so that you can come up with new and improved ideas that probably didn't cross your mind at first.

EMPATHIZING

## TARGET USERS - FARMERS

COLLECTING FARMER'S NEEDS

Empathy is considered the starting point for any design project and constitutes phase one of the Design Thinking process. During the empathize phase, the designer spends time getting to know the user and understanding their needs, wants, and objectives. The empathize phase requires us to set aside our assumptions. It's human nature to assume that others will think and feel the same as us in particular situations, but of course, this isn't always the case.

The first step in empathizing with our users is to suspend our view of the world around us to truly see it through users' eyes. When it comes to Design Thinking and human-centered design, it's time to stop guessing and start gathering real insights about the users'.

We started with the empathizing phase and decided to create questions regarding the farmer's needs. Nearly 4 closed-ended questions and 12 open-ended questions were created. The questions were focused on the problems they are facing in agriculture and the methods that they carried out in their day-to-day life.

We collected answers from 15 farmers regarding their requirements and their objectives. Using these answers we created response charts, insight capture grids, and personas. From these answers, we found that problems in agriculture are yet to be resolved.

Now, we can get an idea of how our product should be and what will be farmer's expectations of the product. With the findings from this empathizing phase, we are moving forward to the defining phase of the design thinking process.

Points scored
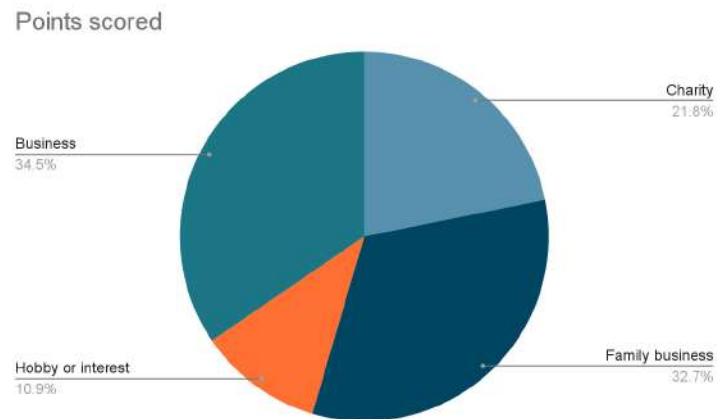
The survey indicates that most of the farmers are doing farming as a business

● Are you able to get maximum yield as expected
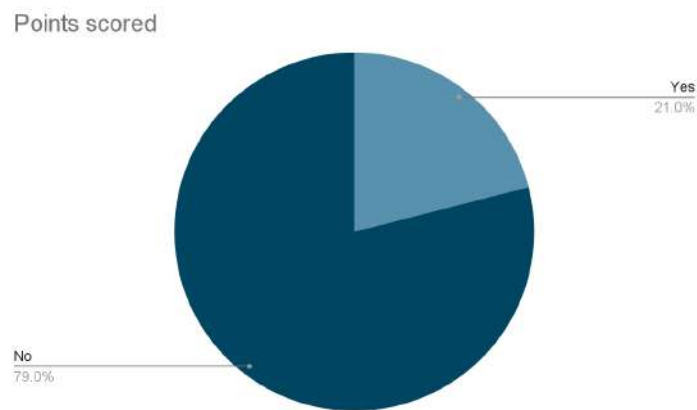
Points scored

From the survey, we can conclude that more farmers are not getting maximum yield

● Why do you think you couldn't get a maximum yield

Points scored

Natural disasters
21.8%

Water scarcity
34.5%

Unnecessary weed
32.7%

Pest Infestations
10.9%
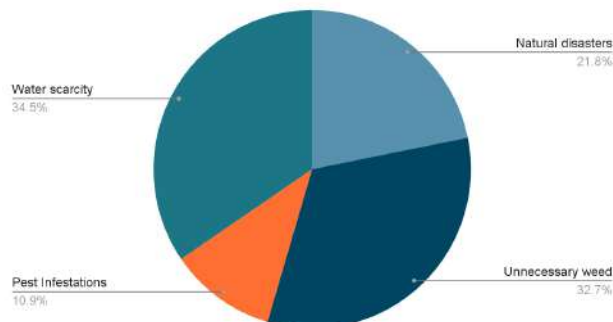
● How long does it take for you to irrigate the entire field

Points scored

7-8 HOURS
10.0%

4-5 HOURS
10.0%

3-4 HOURS
30.0%

5-6 HOURS
38.0%

12-15 HOURS
12.0%
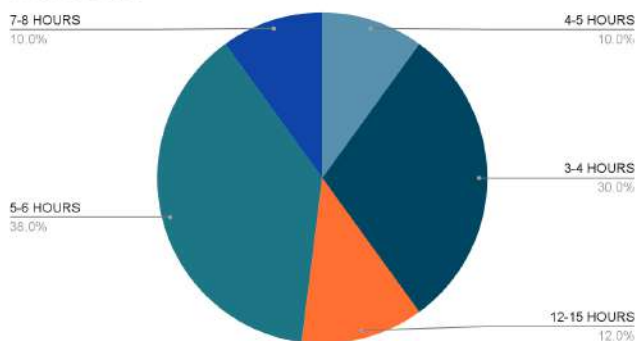
● What methods do you use for irrigation

Points scored

Surface irrigation
10.5%

Drip irrigation
28.8%

Localized irrigation
25.6%

Sprinkler irrigation
35.2%
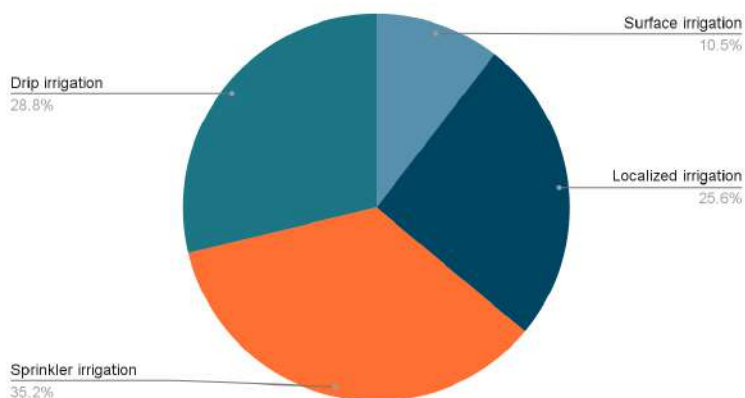
●   Do you get water to irrigate perennials

Points scored

YES
40.0%

NO
60.0%
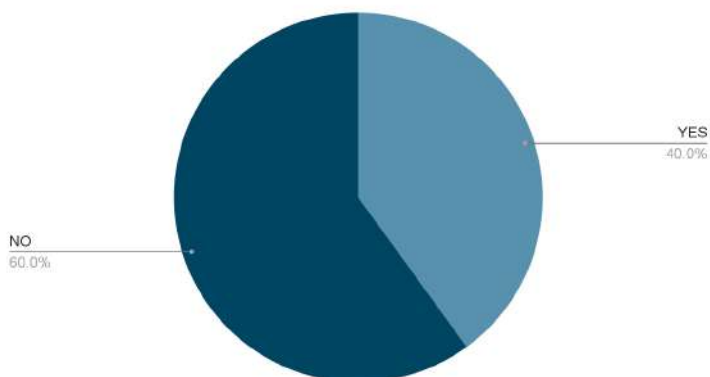
●   In what phase of agriculture do you need betterment

1.   **Protection of plants, saving water.**

2.   **Adding manure to the land, irrigation, storage, and betterment are needed.**

3.   **Improvement needs to be done in adding the manure phase and irrigation phase.**

4.   **Improving storage facilities**

5.   **Harvesting**

●   In which season do you face water scarcity

Points scored

WINTER
0.4%

SUMMER
99.6%
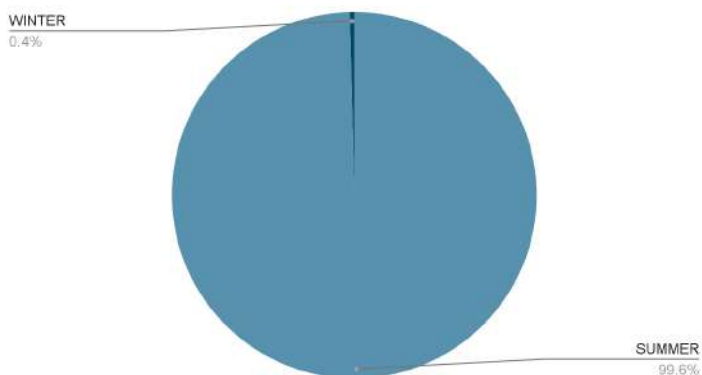
● How do you identify ripe fruits/vegetables in a tree

1. **There are various methods to identify if a fruit/vegetable is ripe which depends on the respective fruit/vegetable. The most common ways of identifying are checking the colour, smell, and by its appearance**
2. **I used to pull off the stems and check the underneath colour but identifying the ripeness of fruit/vegetable is a complex process to define. They relate to the time when the fruit/vegetable is in an appropriate state for eating.**
3. **By checking the colour.**
4. **By smelling.**

● A device automatically finds soil moisture and irrigates it without human intervention. Is it helpful?

Points scored

If the device is cheap
26.1%

YES
52.2%

NO
21.7%
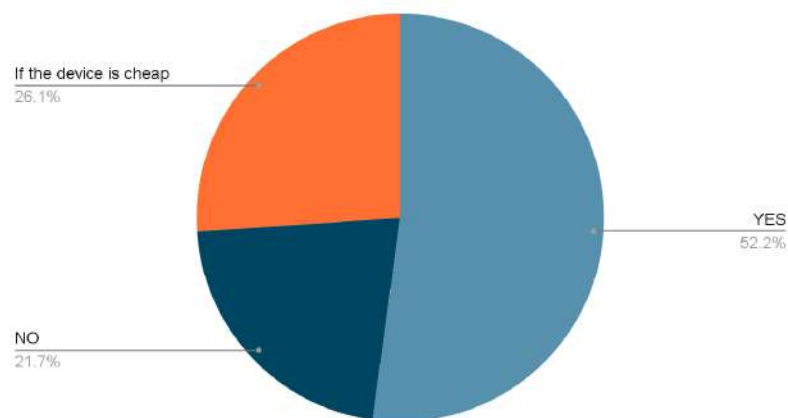
● Do you need any betterment in this method?

Points scored

NO
16.7%

YES
33.3%

MAYBE
50.0%
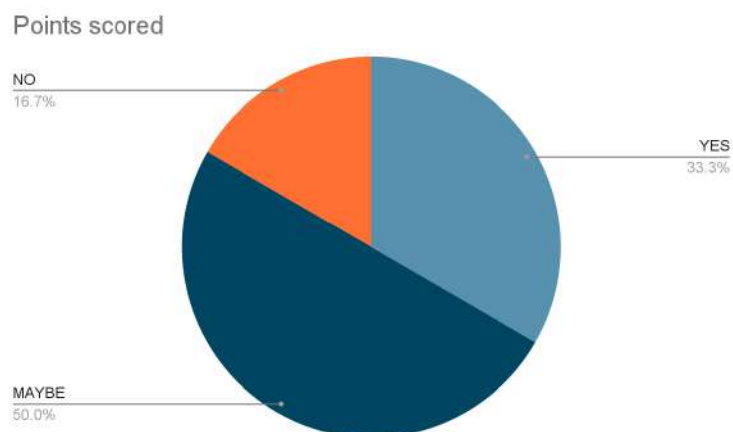
● Will it be better if you get a method for the ripening of fruits?

Points scored

NOT NESSECARY
20.0%

YES
80.0%

CAPTURE INSIGHTS

SAYS

1.My father is a farmer so agriculture has become our job by heredity

2.I have 12 acres of land

3.I am not getting water to irrigate

4.Need betterment in irrigating quickly

THINKS

1.Due to water scarcity ,climate changes i couldnt maximize yield

2.A device that identifies soil moisture and irrigate accordingly.

3.A device to monitor ripening of fruits would help to do better

NAME: CHINNADURAI

LOCATION:KULITHALAI

User

AGE:54

DOES

1.using canals to irrigate the field

2.it takes around 4 hours each morning and evening to irrigate completely

3.i would find if the fruit is ripen or not by seeing it

FEELS

1. finding it difficult to get maximum yield

2. i face water scarcity in summer season

3.it would be good if the words you say become a prototype

4.water scarcity,lack of expected production are my major problems

KAPWING

SAYS

1. This a job that suites my living

2. I have 6 acres of land

3. I am not getting enough water till the end of year

4. Need betterment in fertilizing , managing storage

THINKS

1. Due to no proper watering, proper protection to the yield

2. A device that identifies soil moisture and irrigate accordingly

3. A device to monitor ripening of fruits would help to do better

NAME: SARAVANAN

LOCATION: KULITHALAI

User

AGE: 38

DOES

1. using water channels to irrigate my field

2. it takes 4hours in the morning and 2 hours in the evening to irrigate the entire field

3. identifying the ripening of fruits by viewing it periodically

FEELS

1. Finding difficult to store the production

2. it is difficult to irrigate in summer

3. After using the device i would suggest few changes for betterment

4. i face problems in irrigation, storage

KAPWING

SAYS

1. My husband is a farmer so I used to help him in farming which then got converted into our family business.
2. I have 12 acres of land.
3. Scarcity for water is faced in summer.

THINKS

1. Need devices that make the irrigation and fertigation process to be carried out efficiently.
2. Cannot work efficiently because of being ignorant about the technologies growth towards agriculture

Name: Rani
Age: 48
Location:Trichy

DOES

1. Use manual methods to do irrigation
2. It takes around 4 hours to irrigate the field both morning and evening
3. Use canal irrigation method.

FEELS

1. Not able to get maximum yield.
2. Need a prototype to judge the device whether betterment is needed or not
3. Soil erosion and difficulty to adapt to new technologies is really challenging in agriculture.

SAYS

1. Agriculture is our family business
2. I have 12 acres of land.
3. Scarcity for water is faced in summer.

THINKS

1. Need devices that make the irrigation and fertigation process to be carried out efficiently.
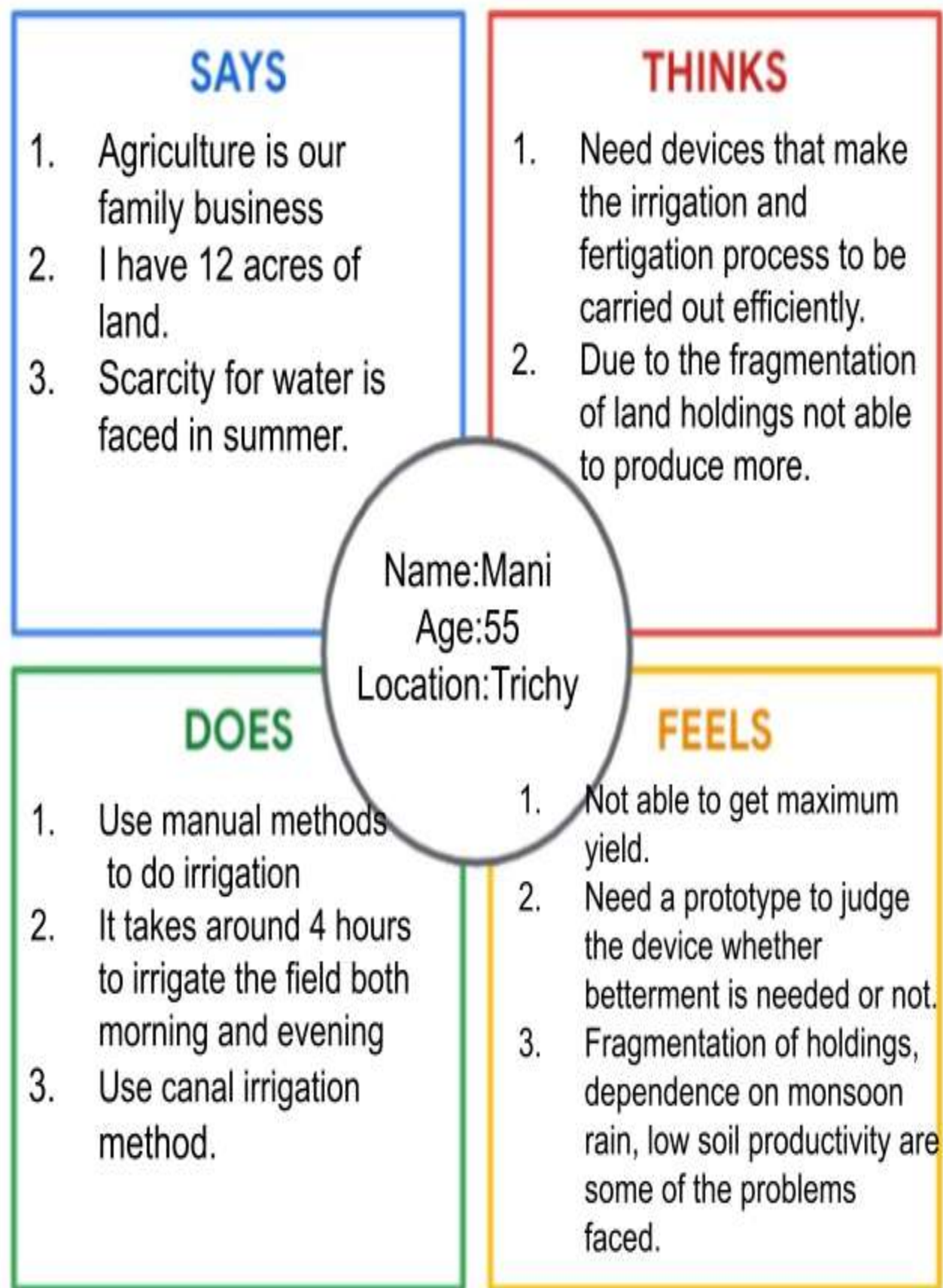2. Due to the fragmentation of land holdings not able to produce more.

Name:Mani
Age:55
Location:Trichy

DOES

1. Use manual methods to do irrigation
2. It takes around 4 hours to irrigate the field both morning and evening
3. Use canal irrigation method.

FEELS

1. Not able to get maximum yield.
2. Need a prototype to judge the device whether betterment is needed or not.
3. Fragmentation of holdings, dependence on monsoon rain, low soil productivity are some of the problems faced.

SAYS

1. Got motivated towards agriculture so left my IT profession and started to do agriculture
2. I have 6 acres of land.
3. Scarcity for water is faced in summer.

THINKS

1. Need devices that make the irrigation and fertigation process to be carried out efficiently.
2. Need devices to monitor the market price and need an app to have contact with farmers
3. Need devices to calculate the yield and monitor the ripening of fruits.

Name:Ashok
Age:29
Location:Trichy

DOES

1. Use manual methods to do irrigation
2. It takes around 1 hours to irrigate the field both morning and evening
3. Use sprinkler irrigation method.

FEELS

1. Set a timer to detect when to stop irrigating the field/ let it automatically stop after finishing irrigating the entire field.
2. Agricultural labor shortage, uncertainty in market price for the produce and finally the gambling nature of agriculture.

SAYS

1) I realized that agriculture is charity So, I am excited to do it.

2) I have 4 acres of land.

3) I am getting water to irrigate perennial.

4) I need a better process to save water and protect plants.

THINKS

1) I am thinking that due to natural disaster and water scarcity I couldn't get maximum yield.

2) A device that automatically identifies and irrigates land will be helpful.

3) A device to monitor ripening of fruits/vegetables will be helpful.

User

Name : Gopi

Location : Lalgudi , Trichy

Age : 48

DOES

1) Using surface irrigation (flow cutting method) for irrigation purpose.

2) It takes 4 to 5 hours to irrigate my complete land.

3) Identify ripe fruit/vegetable by seeing Its colour and other characters.

FEELS

1) I do not get maximum yield.

2) I face water scarcity in summer season.

3) After using the device made by you if I feel any changes need to be there I will suggest it.

4) I face problems such as irrigation crisis, pest infestations and unnecessary weed.

SAYS

1) Due to my interest I am doing agriculture.

2) I have 3 acres of land.

3) I am getting water to irrigate perennial.

4) I need improvement in adding fertilizer to land , irrigation.

5) The modern technological device should be easy to learn and easy to adapt.

THINKS

1) Due to climate changes , not providing proper nutrient to soil , water scarcity I couldn't maximize yield.

2) I think a device that automatically identifies and irrigate land will help me to avoid save water.

3) I think a device to monitor ripening of fruit / vegetable will help me to increase my yield.

User

Name : Kumar
Location : Keelamullakudi, Trichy
Age : 29

DOES

1) I will use either tank irrigation or surface irrigation for irrigation purpose according to the need.

2) It takes 2 to 3 hours to irrigate my complete land.

3) It is difficult to identify ripening of fruit/vegetable. They related to the time at which the fruit/vegetable is in appropriate state for eating. I use to pull off the stems and check the underneath colour.

FEELS

1) I couldn't get maximum yield.

2) I usually face water scarcity in summer season.

3) I have various problems in my agriculture field such as weeds can create insects and crop disease, poor irrigation facility etc.....

4) The device made by you will be helpful for many farmers to save water and make harvesting an easy process.

SAYS

1. I love working and spending time in fields.
2. I like to work more and more if the weather conditions are suitable.
3. I would rather work more and more if the profit is more.

THINKS

1. Can we increase the soil fertility artificially?
2. Can't we overcome the problem of insufficient water supply?
3. Why can't the government make farmers aware of all the policies available for them?
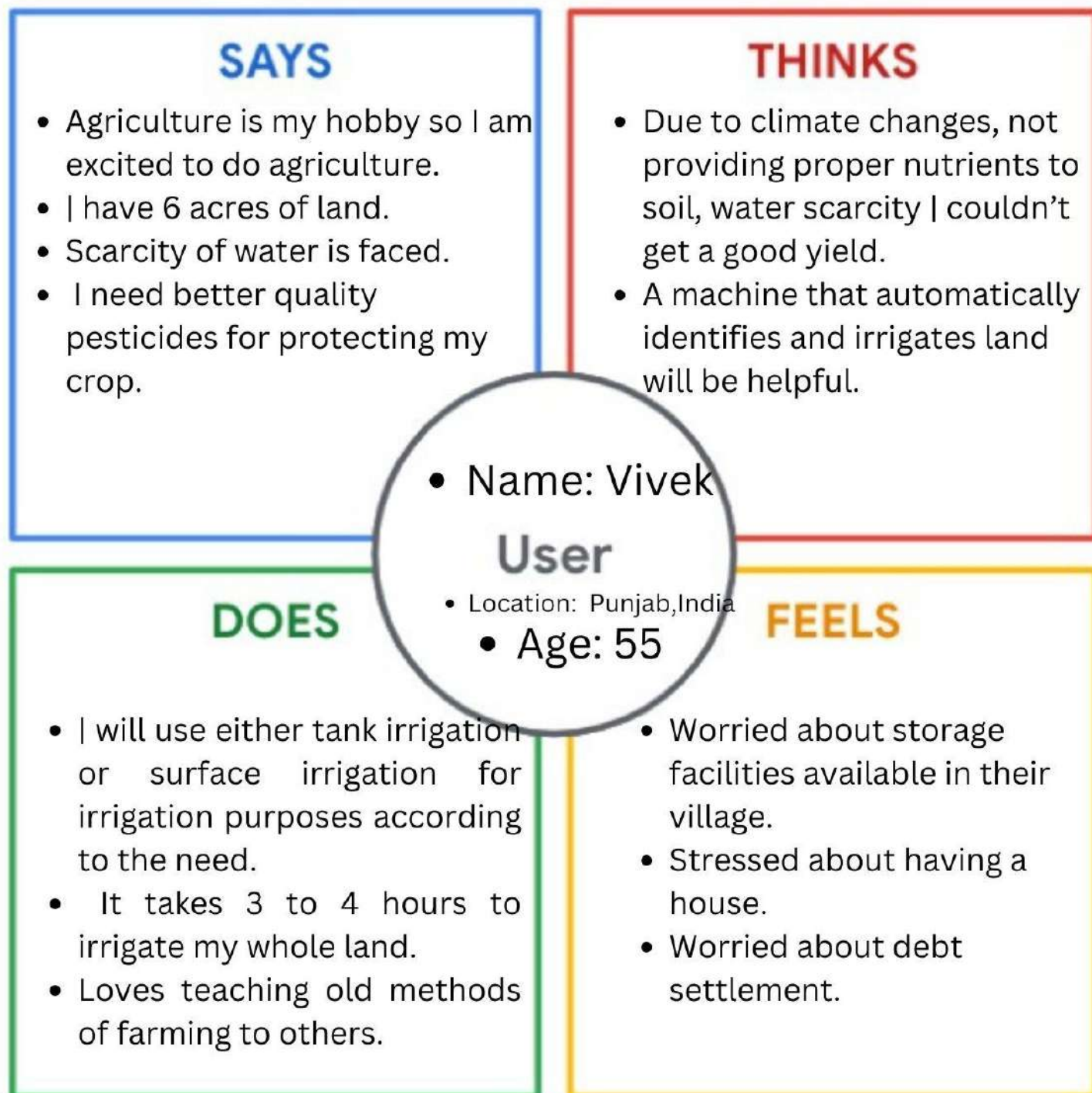
Name:Ramayya
Age:55
Location:Trichy

User

DOES

1. Tries to cultivate different crops on every rotation.
2. Prefer to buy good quality pesticides and seeds.
3. Loves teaching old methods of farming to others.

FEELS

1. Stressed about the yields of the crop.
2. Frustrated on the uncertain climatic conditions.
3. Irritated for not getting profit from the last few months.

SAYS

- Agriculture is my hobby so I am excited to do agriculture.
- I have 6 acres of land.
- Scarcity of water is faced.
- I need better quality pesticides for protecting my crop.

THINKS

- Due to climate changes, not providing proper nutrients to soil, water scarcity I couldn't get a good yield.
- A machine that automatically identifies and irrigates land will be helpful.

- Name: Vivek

User

- Location: Punjab,India
  - Age: 55

DOES

- I will use either tank irrigation or surface irrigation for irrigation purposes according to the need.
- It takes 3 to 4 hours to irrigate my whole land.
- Loves teaching old methods of farming to others.

FEELS

- Worried about storage facilities available in their village.
- Stressed about having a house.
- Worried about debt settlement.

SAYS

- Agriculture Is our business and our main source of income
- I have 8 acres of land.
- Scarcity of water is faced in summer.
- I am not getting enough water
- Need betterment in fertilizing , managing storage

THINKS

- A device that identifies soil moisture and irrigates accordingly
- A device that monitor the ripening of fruits would help to do better
- Software can be used for generating the best price for the crop

Name: Krishna
User
- Location: Punjab,India
- Age: 49

DOES

- Use Drip irrigation for irrigation purposes.
- Identify ripe fruit/vegetable by seeing Its color and other characters.
- It takes 5 to 6 hours to irrigate my whole land.
- Prefer to adopt new farming methods.

FEELS

- I face water scarcity in the summer season.
- I face problems such as irrigation crises, pest infestations, and unnecessary weeds.
- Various problems in my agriculture field such as weeds

PERSONAS:

Personas are fictional characters, which you create based on your research to represent the different user types that might use your service, product, site, or brand similarly. Creating personas helps the designer to understand users' needs, experiences, behaviors, and goals. Usually, personas are created by dividing users into manageable groups and representing each with a typical embodiment. Here we come up with personas by dividing people based on their lifestyle.

PERSONA 1-SHIVA

DEMOGRAPHICS

40 years old,living in pudukkottai,doing agriculture when he was at the age of 17.Married and he is having 2 children.

HAPPY MOMENTS

Working with his family in the field,Getting profits by using modern technology in farming.

HOBBIES AND INTERESTS

Likes to know more about modern farming techniques and implements it frequently.

PAIN POINTS

Worried about his lifestyle,stressed about having a own house,irritated about the insects,weeds and others that are spoiling his crop.

GOALS AND OBJECTIVES

Introducing more and more latest farming technologies in his village.

MOTIVATION

Constructing a own house,Family and friends.

OTHER OBSERVATIONS

For the sake of earning,he is also selling tea in his locality.He is searching for a modern equipment that helps in harvesting the crop.

PERSONA 2 – CHINNADURAI

DEMOGRAPHICS

54 years old, 30 years of experience in farming, has 2 children who also involve themselves in agriculture, doing agriculture since it's a heredity job.

HOBBIES AND INTERESTS

Loves doing farming work, spending time with family, listening to music, playing cricket.

GOALS AND OBJECTIVE

To produce more yield, sustain in agriculture industry for long period.

MOTIVATION

The experience he got from 30 years was the biggest motivation, Along with this his family and friends.

HAPPY MOMENTS

Doing farming work, chatting with friends, spending time with family, when he gets yield as result of his hardwork.

PAIN POINTS

There is no proper irrigation facility, production management and water scarcity, climate changes reduce the yield.

OTHER OBSERVATIONS

He feels happy about the automatic irrigation system and identifying ripeness of fruit/vegetable idea and he is early waiting for the prototype to test it.

PERSONA 3-RAMAYYA

DEMOGRAPHICS

55 years old,living in Trichy, occupation is farming,he was married to seetha and he has a son and a daughter.

HOBBIES AND INTERESTS

Loves to do farming and cultivates variety of crops eveytime and enjoys spending time with family.

GOALS AND OBJECTIVES

Expanding his land and earning more profits.

MOTIVATION

To clear all the debts and expand his farm.

HAPPY MOMENTS

When he get good profits on his yield, Spending time with his children,talking with his friends.

PAIN POINTS

Stressed about his health, irritated about the climatic conditions and insufficient water supply,worried about the crop yield.

OTHER OBSERVATIONS

He is having some health issues, Interested in doing agriculture using modern equipment.

PERSONA 4 – KUMAR

DEMOGRAPHICS

29 years old, living in kelamullakudi village in trichy, has 3-year-old kid, youngster who has interest in doing agriculture, living happy life with doing what he loves.

HOBBIES AND INTERESTS

Loves reading books, Loves spending time with his family, Have interest in using new technologies for agriculture.

GOALS AND OBJECTIVE

Keep his family happy and get more yield from farming.

MOTIVATION

his family, friends, parents.

HAPPY MOMENTS

Doing the job he loves, going family trip, playing with child.

PAIN POINTS

could not get maximum expected yield due to climatic changes, water scarcity and facing many problems in agriculture such as lack of storage facility, weeds that create insects and crop diseases.

OTHER OBSERVATIONS

Needs a special device that automatically irrigates land and modern device for identifying ripeness of fruit or vegetable. The modern technologies should be easy to learn.

DEFINING: Issues faced by farmers in agriculture

Defining is the second stage in the design thinking process which takes place after the empathizing stage. In the defining stage, we will be first able to identify the problem we are trying to solve. This keeps everyone in the group oriented toward the same solution. This stage also helps to define the problem in the most beneficial way: it should be broad but not too obscure and narrow but not too limiting. At this stage we define the problem statements after analyzing the user's needs, wants and their feelings which is collected at the empathizing stage.

A great definition of the problem statement will guide to kick start the ideation process (third stage) in the right direction.In this phase we empathized the farmers and noted briefly what problems or issues were faced by them, which was made easy by asking them both open-ended and closed-ended questions.

POV Problem statements:

1.Shiva is a 40 year old man who has been farming right from his 17 years and he lives in Pudukkottai with his wife and two children.

● He needs continuous electricity supply for carrying out irrigation,threshing and crop drilling because he is unable to irrigate the entire field by using the electric motor due to adequate power shutdown.He is also using machines for threshing and crop drilling which needs continuous electricity supply.

● He is facing a decrease in agricultural productivity and diminishing economic activities available due to land fragmentation which is a process of decreasing the average size of farm holdings, increasing in the scattering of each farmer's land and decreasing in the size of the individual plots in a farm holding.Therefore he needs a way to consolidate all the farms thereby increasing agricultural productivity.

● He is facing a low soil productivity crisis ie,. the ability of the soil to support crop production determined by the entire spectrum of its physical, chemical and biological attributes is low.So he needs a device to detect these various characteristics of the soil which gives him an idea about the kind of crop need to be cultivated,amount of fertilizers to be used and so on thereby reducing soil erosion.

2. Chinnadurai is a 54 year old farmer living in a village in kulithalai locality.He is procuring farming to be his job by heredity.

● He needs a source of water which can help him to irrigate the field throughout the year because He is unable to get water throughout the year as there is no proper rains and

he couldn't get the expected yield and he needs an alternate to irrigate his field in a short period because he has huge land and finds it difficult to water the entire field in a day.

●   He is facing difficulties in finding the ripening of fruits and collecting those when they are ripening because the harvest is huge and different fruits ripe at different times he is unable to monitor them collectively.

●   He is depressed because he is unable to get the expected price for the quality yield he has produced and also he is unable to access big markets where he could get good retailers because he is old he couldn't reach all those marketplaces to sell his goods.

3. Ramayya is a 55 years old farmer living in Trichy. He has been farming for the past 30 years.

●   Ramayya was not happy these days. The yields are not up to the mark and there are so many debts to clear but there is no profit, Ramayya needs a technology that predicts the environmental conditions and also informs about the natural calamities because his yield is reducing day by day and the crop is getting worse and he is not able to choose which crop has to be grown in his land.

●   Seetha, Ramayya's wife, needs a unique and productive way to improve their yield that will give more yield and profits because she is not happy with their living conditions, they are not getting proper food to eat these days and they are having a lot of debts to clear, needs to educate their children.

●   Ramayya has no idea what amount of fertilizer a plant requires and he doesn't know that the amount varies from crop to crop. This is badly affecting the crop and washing away the nutrients in the soil and polluting the environment. So he needs a technology that tells the amount of fertilizer to be used for a specific crop because he doesn't want to spoil the crop because of his negligence.

   4. Kumar is a 29 years old farmer living in the keelamullakudi locality. He is a youngster doing agriculture as his interest.

●   He needs some way to stop growing weeds or methods to remove them because too many weeds create insects and crop diseases and due to these weeds he feels that he couldn't make the proper expected yield and the crop couldn't get proper nutrients, water and it also compresses crops from growing further by occupying more space.

- He requires some betterment in the storage facility since he couldn't store harvested crops and The warehouses that store harvested crops lack proper ambience such that there is no proper temperature or moisturizer to store the harvested crop This makes him sell his surplus at throwaway prices and he loses his yield.

- He needs a device that should be easy to learn and easy to use because these days many modern technological devices are introduced but mostly many of them are not affordable and most farmers find it difficult to adapt to them.

NEEDS:

1. Needs continuous electricity supply for irrigation, threshing and crop drilling.
2. Need a way to consolidate the fragmented land thereby increasing agricultural productivity.
3. Need a device to detect the physical, chemical and biological characteristics of the soil thereby increasing soil productivity.
4. Using modern technology to reduce the amount of water and amount of time spent on irrigation.
5. A method to find the ripening of fruits and pick them automatically.
6. To predict the price of the yield according to its quality and to show the markets to the farmers where there is increased demand.
7. A device to predict environmental conditions and inform about natural calamities in advance.
8. A unique and productive way to increase the yield of the crop.
9. Technological device to find and inform the amount and type of fertilizers to be used for a specific crop.
10. Using modern methods to remove weed or the proper way to stop its growth.
11. Better method to store harvested crops.
12. Technological devices that are easy to learn and implement in an affordable manner.

<u>IDEATING</u>

Ideation is a creative process where designers generate ideas in sessions (e.g., brainstorming, worst possible idea). It is the third stage in the Design Thinking process. Participants gather with open minds to produce as many ideas as they can to address a problem statement in a facilitated, judgment-free environment.Ideation is often the most exciting stage in a Design Thinking project, because during Ideation, the aim is to generate a large quantity of ideas that the team can then filter and cut down into the best, most practical or most innovative ones in order to inspire new and better design solutions and products.

After analyzing the problems from the farmers through the empathizing phase, the problems have been defined in the second phase.Now the team has gathered to have brainstorming sessions for resolving the problems in creative ways. The following are the various ideas that are being generated for the above mentioned problems.

<u>HOW MIGHT WE:</u>

1. <u>Needs continuous electricity supply for irrigation,threshing and crop drilling</u>
   ● How might we provide continuous electricity supply?
   ● How might we provide an alternative that provides continuous electricity supply?
   ● How might we manage during current shutdowns?
   ● How might we find a way that provides an alternative method for irrigation,threshing and crop drilling during current shutdowns?
   ● How might we make harvesting of crops easier through electricity?
   ● How might we find a way that provides continuous electricity supply that also reduces the electricity bill?
   ● How might we make farming activities easier with continuous power supply?
   ● How might we efficiently use solar and wind energy in providing electrical supply?
   ● How might we get increased production with an alternative method for continuous electricity supply?
   ● How might we reduce the power leakages in electric motors used for irrigation?

2. <u>Need a way to consolidate the fragmented land thereby to increase agricultural productivity.</u>
   - How might we consolidate the segregated farms?
   - How might we compromise the owners of the segregated lands in consolidation of the farms?
   - How might we segregate the land among the heirs of the owner so as to avoid issues in agriculture due to fragmentation of land holdings?
   - How might we enhance agricultural productivity in fragmented lands?
   - How might we enhance the economic activities available for fragmented lands?
   - How might we resolve conflicts in buying and selling the fragmented land?
   - How might we enhance the ways of carrying out agricultural activities in segregated lands?
   - How might we solve issues in making the farmers with fragmented lands get the concession provided by the government?
   - How might we consolidate the existing land records?
   - How might we find ways such that small farms can be combined and leased out to producers and corporations?

3. <u>Need a device to detect the physical, chemical and biological characteristics of soil thereby increasing soil productivity</u>
   - How might we detect the different characteristics of the soil?
   - How might we enhance soil productivity?
   - How might we reduce soil erosion by identifying the characteristics of soil?
   - How might we detect the type of crop needed to be cultivated based on the characteristics of the soil?
   - How might we detect the type and amount of fertilizers to be used based on the characteristics of the soil?
   - How might we find ways to improve the nutrients in the soil so as to increase soil productivity?
   - How might we suggest ways to improve soil moisture?
   - How might we avoid crop rotation from affecting soil productivity?
   - How might we efficiently choose the crop at the time of crop rotation such that it increases soil productivity?
   - How might we use organic products to improve soil productivity?

4. <u>Using modern technology to reduce the amount of water and amount of time spent on irrigation</u>
   - How might we reduce the usage of water during irrigation?
   - How might we manage the water availability in summer?
   - How might we water the plants accurately?
   - How might we water all plants equally?

- How might we find many water resources in and near the field ?
- How might we water the large field in a short period?
- How might we divide the water and land to irrigate efficiently, and quickly?
- How might we decide the cropping pattern to save water?
- How might we irrigate the field without manpower?
- How might we irrigate the field when there is no water available?

5. A method to find the ripening of fruits and pick them automatically
- How might we find the ripening of fruits?
- How might we find the ripening of fruits from a distance?
- How might we find the ripening of a collection of fruits?
- How might we collect the fruits?
- How might we plan to collect the fruits?
- How might we arrange labour for picking the fruits?
- How might we decide to sell these fruits?
- How might we preserve all these fruits until we get a bunch of fruits?
- How might we collect the fruits in a short period?
- How might we pick the fruits systematically with minimal labour?

6. To predict the price of the yield according to its quality and to show the markets to the farmers where there is increased demand
- How might we fix the price of the yield?
- How might we measure the quality of the yield?
- How might we fix the proper price for the obtained quality?
- How might we convince the buyers with the price being fixed by farmers?
- How might we predict the price of the yield at the beginning of the season?
- How might we predict a price which would convince both farmer and buyer?
- How might we find the nearest market to the farmer that he could reach soon?
- How might we find the marketplace which has a high demand for a particular product?
- How might we make the farmer access farther markets?
- How might we check the increase in demand?

7. A device to predict the environmental conditions and inform about natural calamities in advance
- How might we predict the environmental conditions day to day?
- How might we inform about natural calamities in advance?
- How might we invent a cost-effective device for this problem?
- How might we create the environmental conditions artificially for good growth of a crop?

- How might we analyze the environmental conditions accurately?
- How might we inform about precautions needed to be taken for a particular natural disaster?
- How might we come up with a technical device that should be easy to carry and cost-effective?
- How might we suggest the crops that need to be grown according to the predicted environmental conditions?
- How might we involve other things that will help the farmer to get a good yield?
- How might we suggest the time period for a particular phase(sowing, irrigation, harvesting..)?

8.<u>A unique and productive way to increase the yield of the crop</u>
- How might we check the quality of seeds before growing?
- How might we analyze the soil fertility and nutrients available in the soil?
- How might we control the weeds, pests and insects?
- How might we know about several plant diseases and their treatment?
- How might we make farmers aware of the importance of crop rotation?
- How might we provide the farmers with a good-quality of fertilizers and pesticides?
- How might we use modern irrigation methods effectively?
- How might we monitor crop growth effectively?
- How might we accurately predict climatic conditions?
- How might we use organic methods for the quality growth of the crop?

9. <u>Technological device to find and inform the amount and type of fertilizers to be used for a   specific crop</u>
- How might we know the quality of a fertilizer?
- How might we inform the amount of fertilizer to be used for a specific crop?
- How might we make fertilizers less toxic and chemical?
- How might we come up with a cost-effective device?
- How might we accurately predict the amount of fertilizer to be used?
- How might we effectively use fertilizers so that the soil fertility will not decrease?
- How might we make the government provide fertilizers to farmers at a low cost?

- How might we make the crops grow faster, and bigger and produce more yield by using fertilizers?
- How might we effectively use organic fertilizers for maximum crop yield?
- How might we make the plants easily absorb the fertilizers?

10. <u>Using modern methods to remove weed or proper way to stop its growth</u>
- How might we stop the growth of weeds?
- How might we analyze the growth of weeds?
- How might we reduce the growth of weeds?
- How might we make devices to remove weeds from other crops?
- How might we differentiate weeds from other crops?
- How might we get to know about the places where weeds will grow frequently?
- How might we find that weeds create insects and crop diseases?
- How might we analyze the effects of weeds from various perspectives?
- How might we monitor the growth of weeds?
- How might we make improvements in existing weed removal methods?

11. <u>Better method to store harvested crops</u>
- How might we store harvested crops in a better way?
- How might we find the effects of not storing the harvested crop properly?
- How might we resolve issues in previous storage methods?
- How might we increase the storage facility?
- How might we use modern technology to store harvested crops?
- How might we increase the ambiance of the storage room?
- How might we store different food crops in the same storage room?
- How might we protect harvested crops from insects?
- How might we collect different harvested crops from farmers from different locations?
- How might we protect harvested crops in different seasons?

12. <u>Technological devices that are easy to learn and implement in an affordable manner</u>
- How might we produce a device with affordable cost?
- How might we produce quality products at a low cost?
- How might we make farmers learn the device easily?
- How might we make the product reach out to the farmers?
- How might we give technical support to the farmers when they face difficulty in using the product?
- How might we create a simple device that farmers can learn by themselves?

- How might we create a small device that can be handled easily?
- How might we make the device small size instead of large size?
- How might we introduce new modern technology among farmers?
- How might we change farmers to adapt to the modern world?

DOODLING

PROTOTYPING

After thinking about the problem and the solution, we decided to integrate both hardware and software solutions to develop a working model which can be monitored through a web application or a mobile application. We used multiple modern technologies to make the work of the farmers very simple and automated.

ABOUT OUR SERVICE:

After analyzing and brainstorming several ideas, we came up with a service named **"KRSHI"**. The service aims to provide the farmers with easy access to the market and make the work of farmers simple.
1)Firstly the farmers have to install the application and sign up with an account.
2)Select any preferred language.
3)The farmer needs to select any of the options displayed below,

- Display the soil contents
- View the moisture content and irrigate
- View the nutrients content and choose the fertilizer
- View the colour, and condition of the fruit and pick it
- Price prediction and market access
- Weather prediction

Display the soil contents

When the farmer selects this option. The soil integrated sensor is used which can simultaneously monitor soil temperature, soil moisture, soil pH, soil electrical conductivity (EC), soil nitrogen(N), phosphorus(P) and potassium(K). The following 5 values are calculated and displayed in the application.

(1)Soil temperature detection: Soil temperature determines the living environment of the plant to create a standard greenhouse for your soil. It is measured in degrees Celsius.
(2)Soil pH test: Soil pH affects plant growth and protects your soil's acid-base balance. It is measured on a pH scale of 0-14.
(3)Soil NPK detection: Soil NPK is an important nutrient element for plant growth and promotes plant growth. It is measured in mg/kg.
(4)Soil conductivity test: Soil conductivity reflects soil salinity and affects soil nutrient conversion and effectiveness. It is measured in us/cm.

(5)Soil moisture detection: Soil moisture determines the living environment of the plant to create a standard greenhouse for your soil. It is measured in percentage.

View the moisture content and irrigate

The farmer selects this option when he/she wants to irrigate the field. Either sprinkler or drip irrigation can be integrated with soil moisture and fertilizers. The automatic irrigation system carries out regular and quantitative irrigation according to the scheme.

Through the information collected by the sensor, the soil water demand is judged and analyzed and the irrigation is automatically stopped when the set threshold is reached to achieve the purpose of saving water and precision irrigation. It supports manual control, automatic control, and timing control which can control all irrigation equipment and save manpower. The details of the amount of time taken to irrigate and moisture content are displayed in the application.

View the nutrient content and choose the fertilizer

After selecting this option, the type of fertilizer to be used, the amount of fertilizer needed and the cost of fertilizer is displayed in the application. These are calculated from the NPK, conductivity, and pH values of the soil sensor. If there is a requirement of nutrients in the soil, then the fertilizers are mixed in a proper ratio in the water and are dispersed during irrigation.

View the colour, and condition of the fruit and pick it

The colour of the fruit is monitored on a day-by-day basis. Here the colour sensor is used to detect if the fruit is ready to be picked for sale or not. A colour sensor can detect the received light intensity for red, blue and green respectively which makes it possible to determine the colour of the target object. The expected colour of the fruit is set as the threshold by the farmer and it is monitored daily. Finally, when the colour of the fruit turns to the expected colour it is marked as ripe fruit and an option is enabled to pick this fruit.

Berryminator is a device which can be used to pick fruit from the plant. After predicting the colour of the fruit, if it is ripe then we have to pick them from the plants for sale. A berryminator has a mechanical arm which rotates with the help of servomotors. When the plant with the ripened fruit is detected, the berryminator with the wheels moves near a plant and the arm picks the fruit and puts it in the basket below.

<u>Weather prediction</u>

This option is selected to view the weather and environmental conditions. The temperature, wind speed, wind direction, humidity, and atmospheric pressure are displayed with the help of various sensors. These values can be sometimes used to predict natural calamities as well.

<u>App features</u>

- The entire system is **IOT integrated.**
- It works on the basis of **Wifi connectivity.**
- The application is made **user friendly** especially the help tab makes it easily accessible to all the farmers.
- The soil contents are calculated **very accurately.**
- Through this application **precision irrigation** was achieved.
- The sensors used are **very sensitive** and made up of **high quality alloy.**

<u>APP PROTOTYPE</u>

HARDWARE IMPLEMENTATION OF THE ABOVE TAB

FERTILIZER MIXED WITH WATER TO IRRIGATE

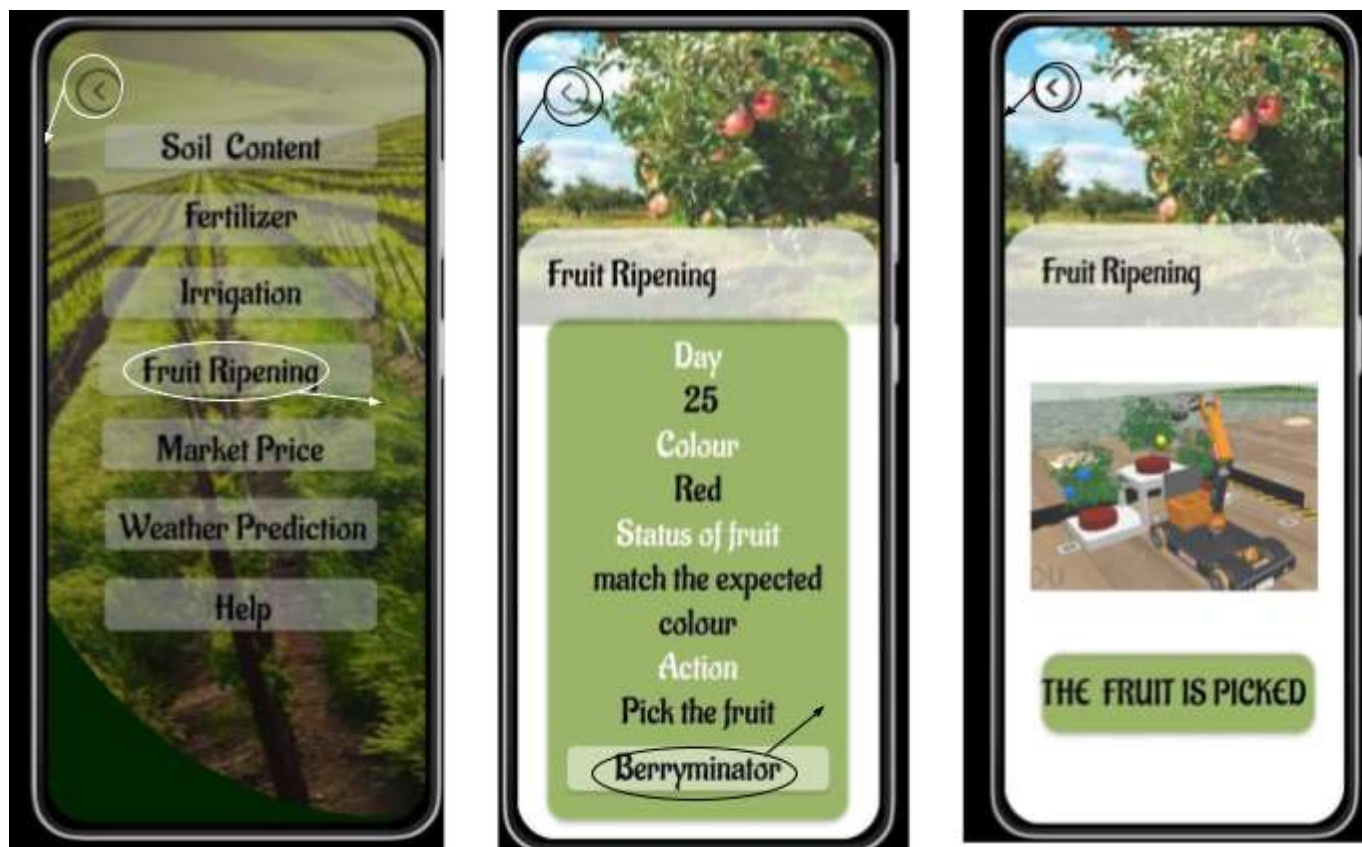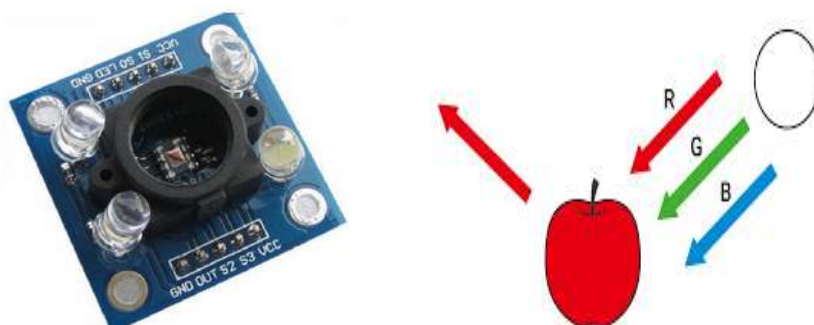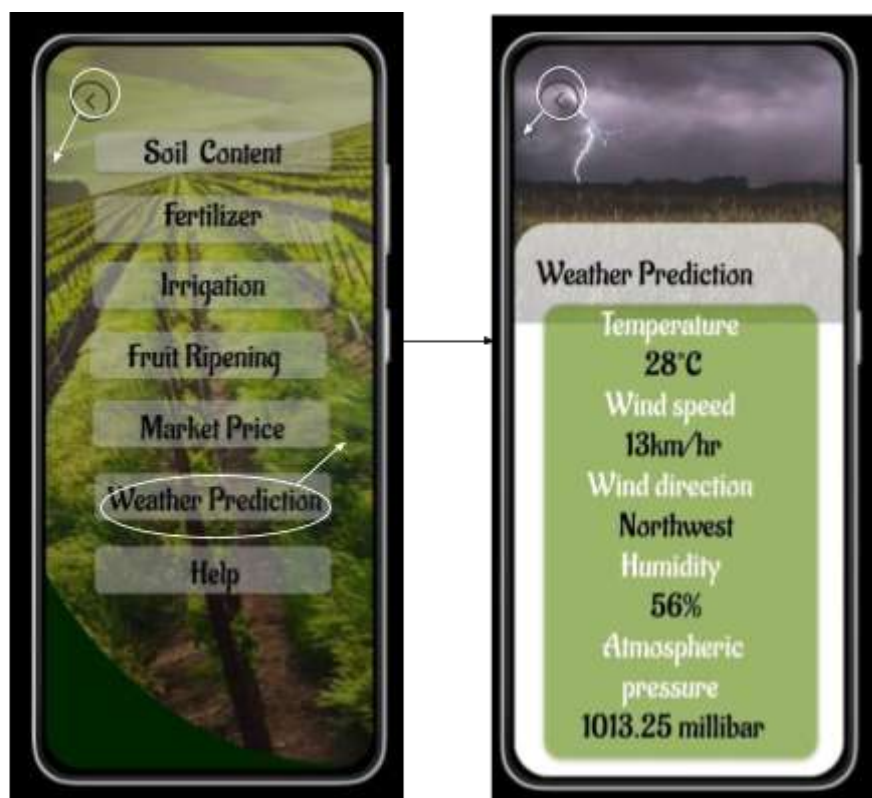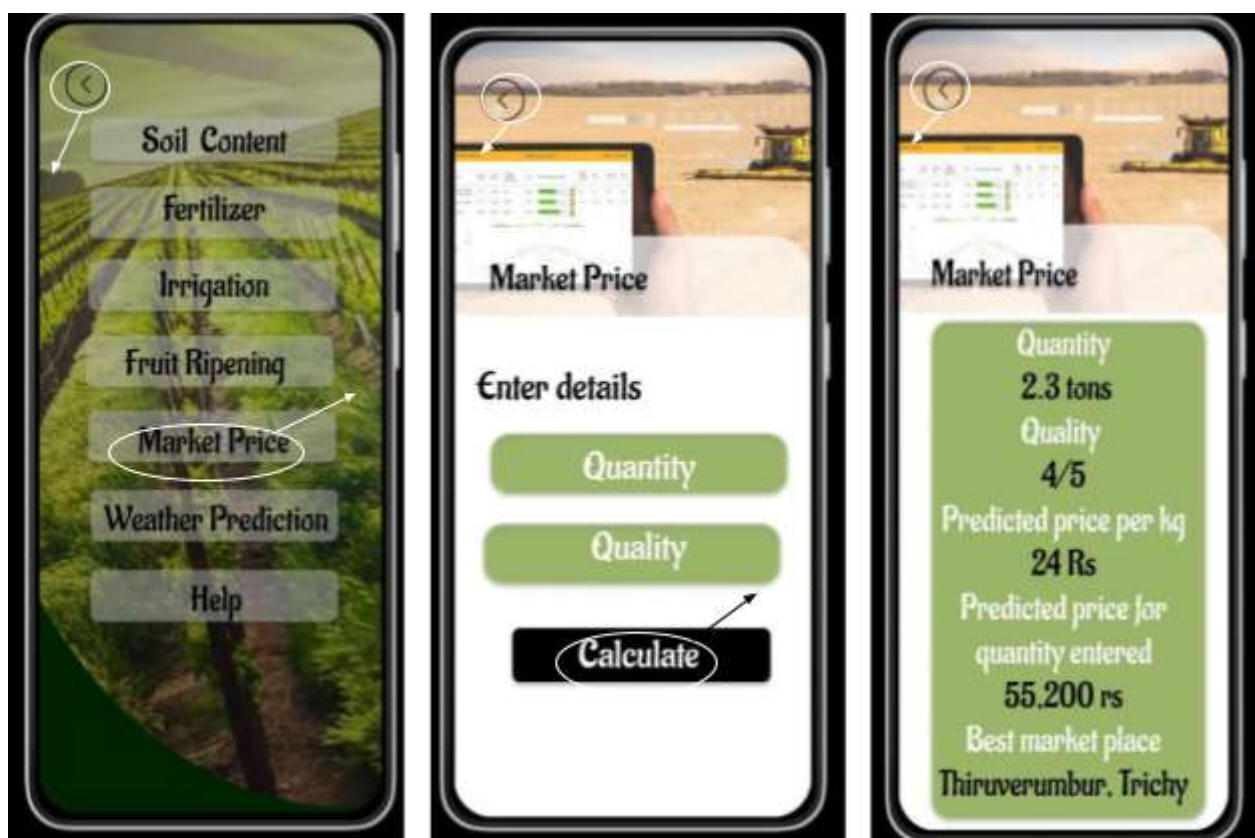# SPRINKLE IRRIGATION
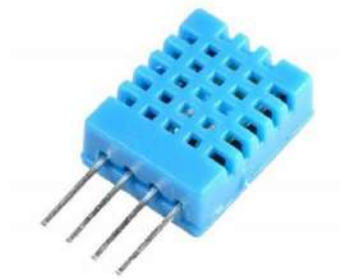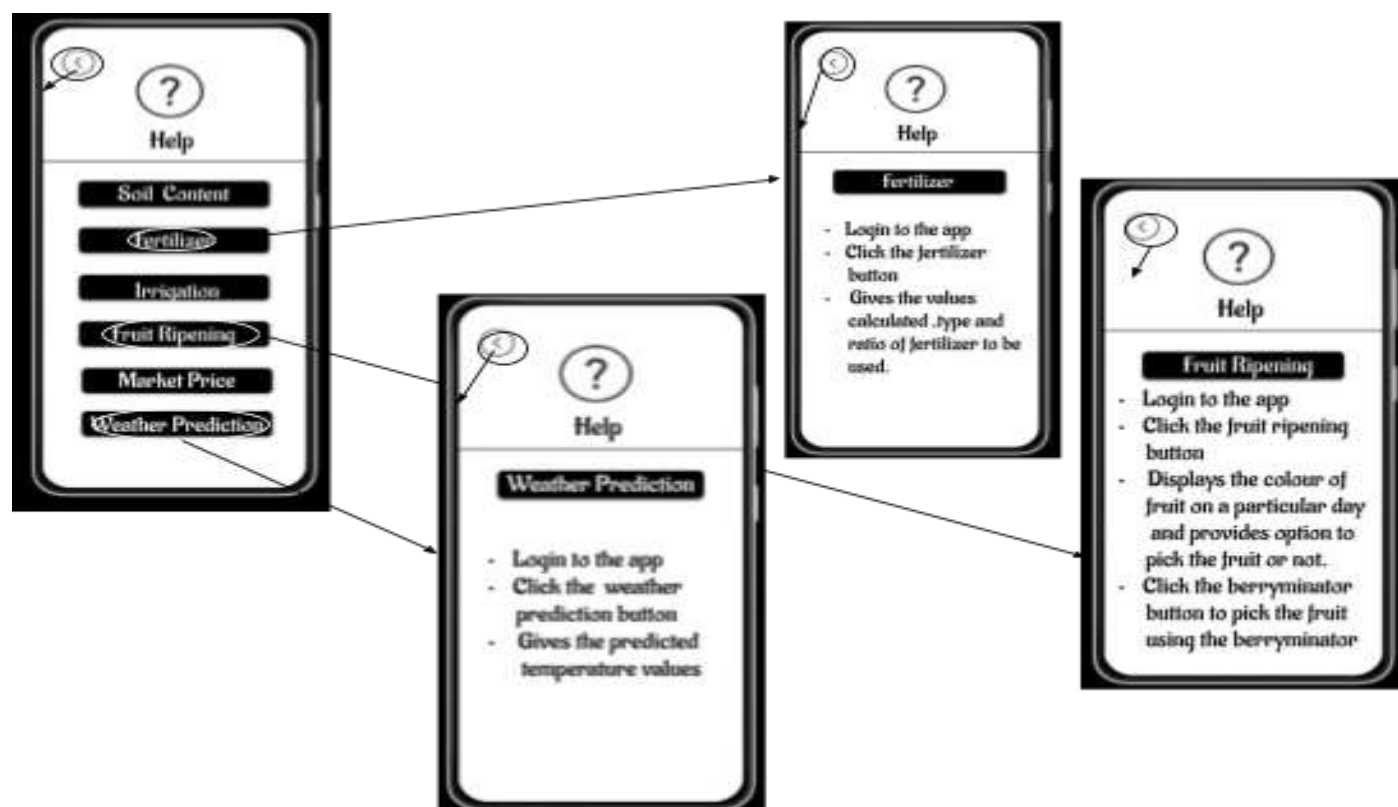

DRIP IRRIGATION

COLOR DETECTION USING A COLOR SENSOR

BERRYMINATOR PICKING THE FRUIT

SENSORS TO DETECT WEATHER

Help

- Soil Content
- Fertilizer
- Irrigation
- Fruit Ripening
- Market Price
- Weather Prediction

Help

Soil Content

- Login to the app
- Click the soil content button
- Gives the five different measures of soil content.

Help

Market Price

- Login to the app
- Click the market price button
- Gets data from user, calculates price and suggests best market to sell our products.

Help

Irrigation

- Login to the app
- Click the irrigation button
- Gives the values calculated ,type of irrigation and hours to irrigate

Help

- Soil Content
- Fertilizer
- Irrigation
- Fruit Ripening
- Market Price
- Weather Prediction

Help

Fertilizer

- Login to the app
- Click the fertilizer button
- Gives the values calculated ,type and ratio of fertilizer to be used.

Help

Weather Prediction

- Login to the app
- Click the weather prediction button
- Gives the predicted temperature values

Help

Fruit Ripening

- Login to the app
- Click the fruit ripening button
- Displays the colour of fruit on a particular day and provides option to pick the fruit or not.
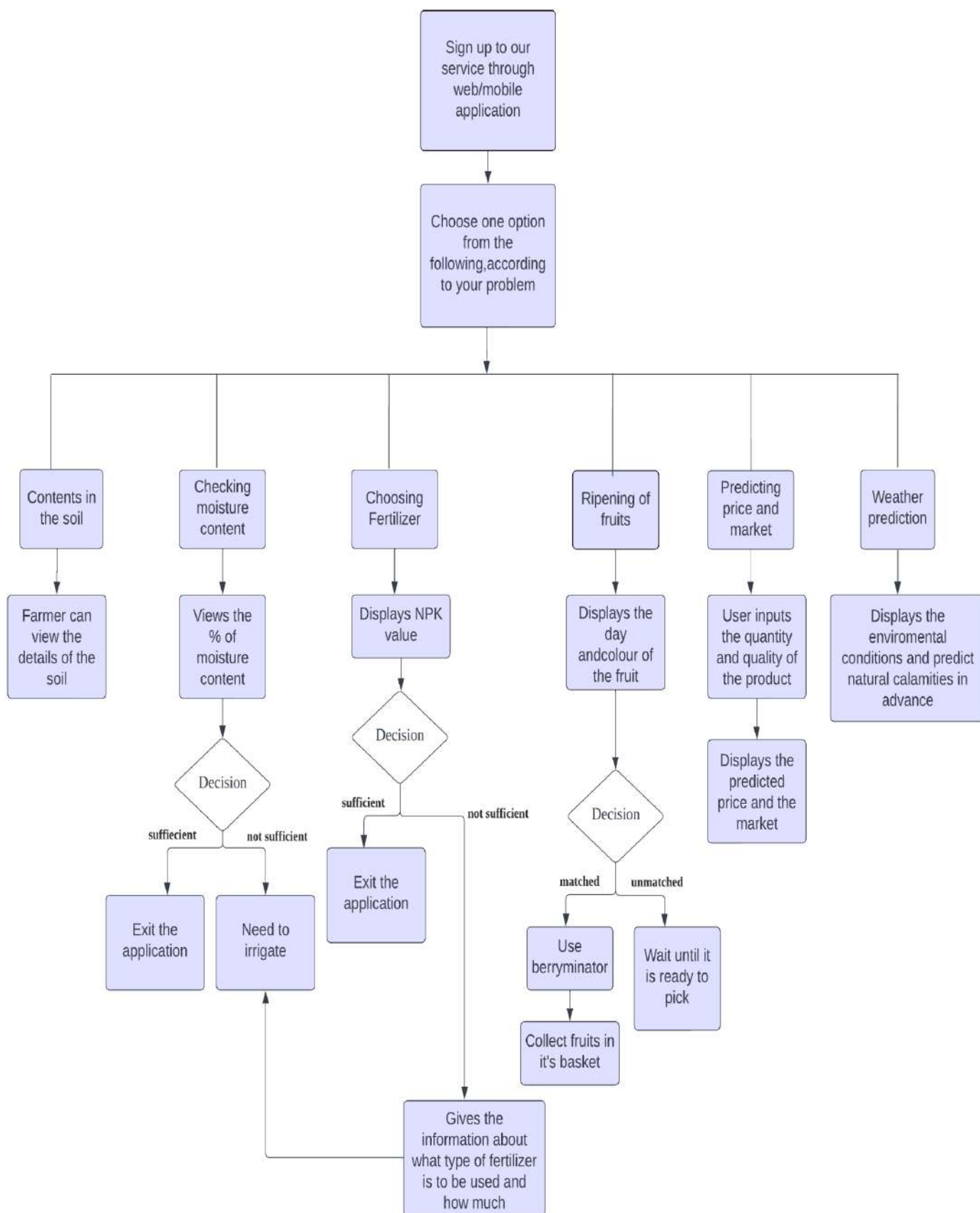- Click the berryminator button to pick the fruit using the berryminator

STEPS INVOLVED IN THE APP

VALUE PROPOSITION

A value proposition is a place where a company's product intersects with the customer's desires. It's the magic fit between what we make and why people buy it. The value proposition is the crunch point between business strategy and brand strategy.

While starting a new project, or a new company, we need practical **tools** to help us focus on executing things faster and better. Good strategy tools exist only to help us focus on getting the right things done. The value proposition canvas is a fairly simple tool that quickly gets us to the 'minimum viable clarity' required to start building and testing a product or service.

A value proposition sits at the pivot point of an entire business model. Mapping the business model of a new product or service is one of the most important parts of building an overall business strategy. Strategy **frameworks** have traditionally been the domain of MBAs and consultants but they are so important that these days the tools have been democratized for use by entrepreneurs, designers and technical teams.

Value proposition
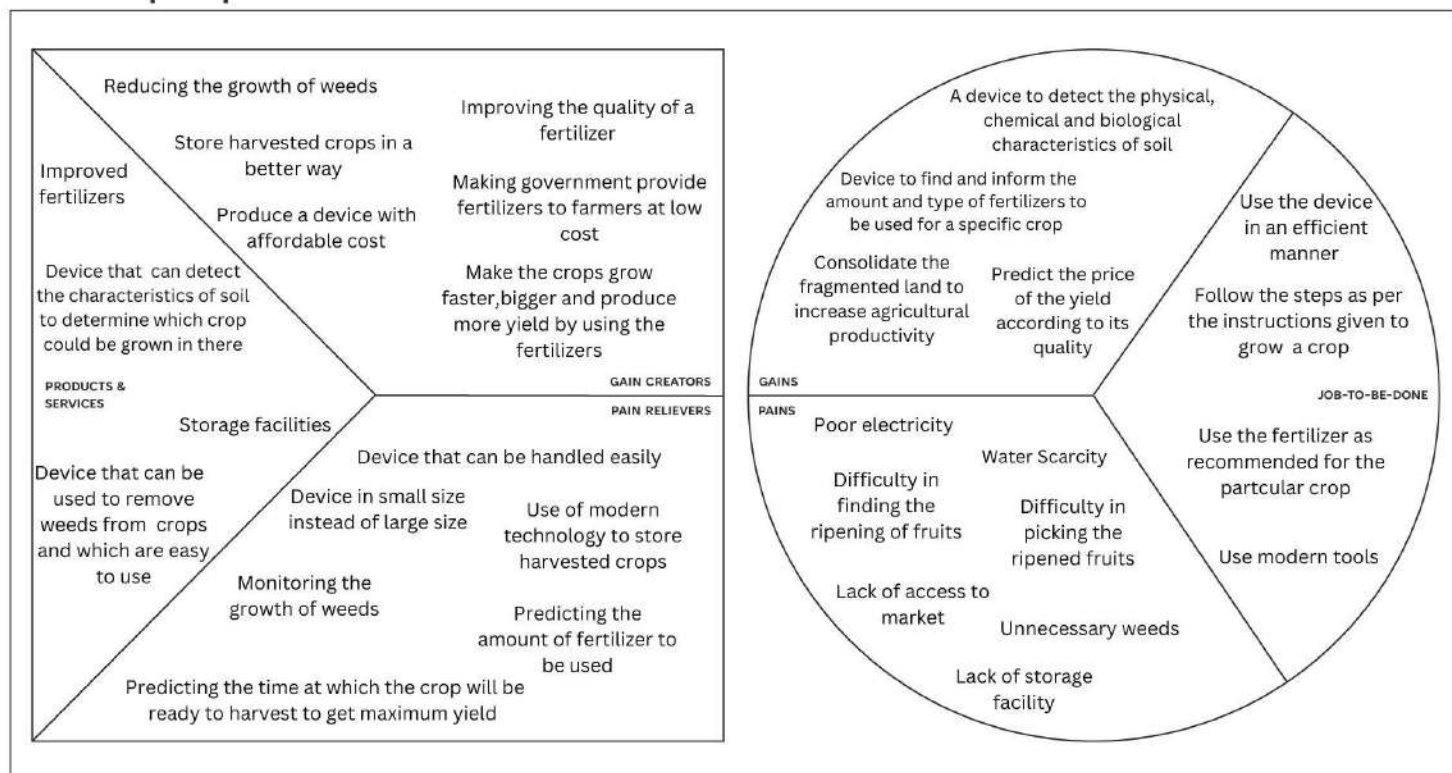
<u>TESTING</u>

Testing is a crucial part in the design thinking process, it helps to validate the prototype whether it works or may not work. The prototype is considered as best after getting the feedback from the end users and the customers. The result of this phase may be in a positive or in a negative way which determines the success of the prototype. If a user faces issues in the prototype then the design thinking process will be repeated according to the user's needs.

We collect reviews of the prototype from five users and proceed further to create a feedback grid to know about the exact user needs and make our product valuable to the user.

User 1 : I am excited to use this prototype as an original product. This will make my work easier. This application combines different functionalities. All works are handled by a single application. I want to know whether this product will be affordable. The performance of the overall application is good and well-structured.

User 2: This application is easy to use, and it is attractive. The main purpose of this application is to make farming work easier using modern technology. It connects with hardware to do certain work. Since it connects with hardware, won't it be repaired during the rainy season? This application also shows current prices in the market to get more yield. I will insist all farmers should use this product to reduce their work and increase their yield.
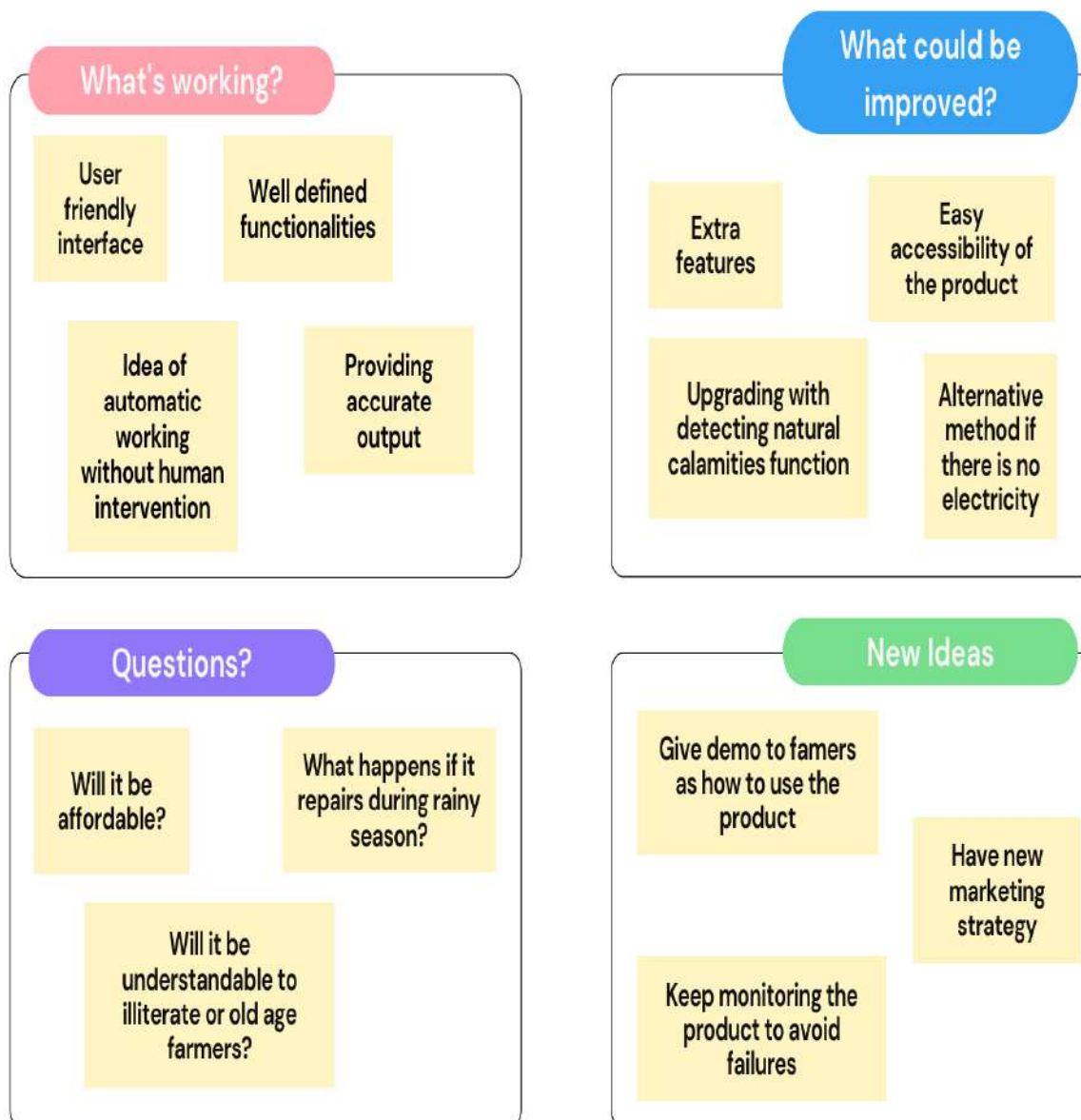
User 3: I feel that this is a perfect application for farmers like me which helps us in different ways. It makes work automatic without human intervention. I can just install the application and view irrigation made in the field, fertilizers used, weather conditions, price in the current market, and ripening of fruit. Along with this if it can detect natural calamities it will be helpful for me. Other than this the existing features of the application are great and well-developed.

User 4: This application contains a well-defined user interface. Each function in the application is designed well. I encourage the idea behind this application as integrating both hardware as well as software with various functions and giving them a useful product. If there is no electricity the hardware components cannot work. So I suggest if there is any alternative method for producing electricity it will be helpful. Overall features of the application are perfect and useful.

User 5: I feel that this application makes my day-to-day work simple. This application gives accurate output. Since many hardware components are connected to software the

setup will be difficult and illiterate farmers or old-age farming people cannot understand this product effectively. So I feel it will be better if there is a solution to this issue.

FEEDBACK CAPTURE GRID

What's working?

- User friendly interface
- Well defined functionalities
- Idea of automatic working without human intervention
- Providing accurate output

What could be improved?

- Extra features
- Easy accessibility of the product
- Upgrading with detecting natural calamities function
- Alternative method if there is no electricity

Questions?

- Will it be affordable?
- What happens if it repairs during rainy season?
- Will it be understandable to illiterate or old age farmers?

New Ideas

- Give demo to famers as how to use the product
- Have new marketing strategy
- Keep monitoring the product to avoid failures

I LIKE, I WISH, WHAT IF

I Like...	I Wish...	What If...?
Make the crops grow faster,bigger and produce more yield by using the fertilizers	Device that can detects the characteristics of soil to determine which crop could be grown in there	Device maintenance is expensive
User friendly interface and Durability of gadgets	Someone gives demo to famers how to use the product	Received device is damaged
		Hard to operate

TESTING PARAMETERS

➢ **Does this product and application minimize your work?**
   Yes, This makes our work simple.

➢ **Is this product and application reliable?**
   Yes, It is reliable.

➢ **Are you facing any security issues with this application?**
   No, there are no security-related issues. It doesn't require many of our details.

➢ **Whether this application updates changes in current value every second?**
   Yes, All changes are updated frequently.

➢ **Are you able to connect hardware and software easily?**
   Yes, hardware and software can be connected easily.

➢ **Is this application user-friendly?**
   Yes, The application's UI is in a user-friendly manner but it requires a few updates
to make it more feasible for illiterates.

➢ **Are you facing any server lag issues?**
   No, Till now I haven't faced any server lags.

➢ **Do you have any recommendations for the betterment of the product?**
   The present product is efficient and easy to use. It should be updated frequently
with new features and functionalities according to the farmer's needs.

<u>REFINING STAGE</u>

After testing the application with the farmers, agriculturalists and common people, feedback and drawbacks of the application were collected. The flaws were analyzed and changes were made to the existing version.

QUERY 1: How would we maintain electronic devices in the rainy season? Is the entire application available at an affordable cost?

SOLUTION: The hardware devices are made up of high-quality alloys like alumina, zirconia, and yttria. So, they can withstand any weather conditions for a longer period after installation. It costs less than the labour cost which we spend in a cultivation period. Hence it is very much affordable for all the farmers.

QUERY 2: It would be helpful if we could know about the natural calamities in advance.

SOLUTION: The parameters in the weather prediction tab (wind speed, wind direction, atmospheric pressure, humidity, temperature) can be used to predict natural calamities as well. A warning message will be displayed if there is any possibility of a natural calamity. Additionally, an accelerometer is installed to have a look at earthquakes as well.

QUERY 3: How would we operate the service in the absence of electricity? Is there any alternative for the source of power?

SOLUTION: Instead of using electricity from transformers, solar panels can be installed to convert solar energy to electric energy. Which can be used as an alternative to direct electricity. Windmills can also be installed to convert wind energy to electrical energy.

QUERY 4: Old-age farmers and illiterates find it difficult to use the application.

SOLUTION: A help tab is added to the service to guide the user. All the details about the app in their respective language are added to that feature. The details of how to use, what's new, help center, and report an issue are added to make the app very simple to use for the farmers.

<u>CONCLUSION</u>

The project involves agriculture as the major problem statement to be looked at. We as a team used a design thinking approach to do betterment in the way of agriculture. This problem statement was selected because many farmers are facing difficulty in multiple ways in different phases of agriculture. The five phases of design thinking were executed as follows,

In the first phase, we started empathizing with the farmers, agriculturalists and common people. It is very important to see the problem through the user's eyes. Surveying contact or via phone helped us in listing out the problems faced by the farmers in the agricultural field. The responses were represented in graphs, pie charts etc…

In the second phase, we proceeded with defining the problem. By analyzing the insight grids, and personas we were able to define the problem statement. Various points of view (pov's) of the farmers were summed up. Finally, the problem statements which were faced by farmers were listed.

In the third phase, we continued with Ideating. The creative ideas were produced to address the problem statements in a facilitated manner. Around 120 how might we (HMW) questions were created for the problem statements. Our creativity was shown through doodling as well.

In the fourth phase, we began prototyping our ideas. Our ideas were implemented as real-life working models. We used both hardware and software solutions to monitor and simplify the work of farmers.

In the fifth phase, the prototype was tested among the farmers. We got various feedback from the users. There were a lot of acclaims but a few critics as well. We then put our hands again in refining the prototype which we made before. We added a few features and improved our application as per user feedback.

The project made us realize that there is never an end to learning. Rather, we found a new way of solving the problem statements through a design thinking approach. It can be applied in all daily life problems of different fields like technical, social, scientific etc… It helped us to solve the problem in a more effective as well as customer-centric way.

References:

Berryminator -https://www.youtube.com/watch?v=5chk9Sory88&t=53s

Types of sensors-https://www.electronicshub.org/different-types-sensors/

Color detection -https://www.keyence.co.in/ss/products/sensor/sensorbasics/color/info/

Weather-sensor-https://www.renkeer.com/top-16-weather-sensors/#:~:text=What%20are%20weather%20sensors%3F,become%20a%20complete%20weather%20station.

Prototype Application Link:

▸ Krshi App (figma.com)