3. Planning & Task Clarification

(Planning, identifying users, collecting need statements, and generating initial problem statement)

This phase of product development is crucial as all the planning, identification of users, understanding the need of the users, and generating an initial problem statement that helps in directing the design toward one that solves the problem of the users, is understood and documented.

There are multiple steps that are followed to get the required data that will allow the development of the solution to start.

Fig 3.a Planning

3.1 Planning & Scheduling:

In this step, all the tasks that need to be done are listed and a timeline is put down so that the Agile methodology can be used in conjunction with design thinking and engineering design to create independent tasks that can be accomplished in sprints.

The following steps are followed in design thinking:

1. **Identification of users and creating user stories:**
   In this step, the team members approach people that could help them better understand the problem that the team has decided to solve.

After interacting with many people, users are identified. There are people that are really in need of a solution to the problem and are willing to help the team by giving a description of the problem and how it is affecting their quality of life.

Following are the user stories that were generated after identifying users:

Name: Dr. Y B Palled
Age: 66
Occupation: Retired Assistant Director of Expansion at UAS,Dharwad
Location: Dharwad

Frustrations:
Time-Consuming
Labour-Intensive

Goals:
Organic Produce
Irrigation solution
for his garden

As an elderly individual, he desires a less labour-intensive and time-consuming way of irrigating his garden to hence grow organic produce

Need Statement:
The user needs a way to irrigate his garden so that he may grow organic produce

Fig 3.1.a User Persona 1

Name: Dr. Pushpa Bharathi
Age: 61
Occupation: Retired Dean of UAS,Dharwad
Location: Dharwad

Frustrations:
Gardening turns out to be physically taxing
Stressfull

Goals:
Aesthetic garden which promotes self-sustenance
Contribute to improvement of eco-system

As an elderly individual,she needs a stress-free and effortless way to nurture an aesthetically pleasing garden which not only makes her self-sustaining but should also contribute to improvement of the environment

Need Statement:
The user needs a way to effortlessly grow an aesthetic garden so that she may contribute to improving her immediate environment

Fig 3.1.b User Persona 2

Name: Poornima Joshi
Age: 47
Occupation: Works as a volunteer at Spastic society
Location:Banglore

Frustrations: -
Lack of irrigation to garden when we go out of town. Over irrigation
The pain of putting a lot of effort into maintaining the garden.

Goals:
To experience an effortless gardnening.

As an middle aged gardening enthusiast . She wants an effortless way to maintain the garden in her house, as the plants she grows, regular maintenance and nourishment is required which is laborious job to her.

Need Statement:
The user needs to overcome the tedious process involved in gardening so that she may have a well maintained and nourished garden.
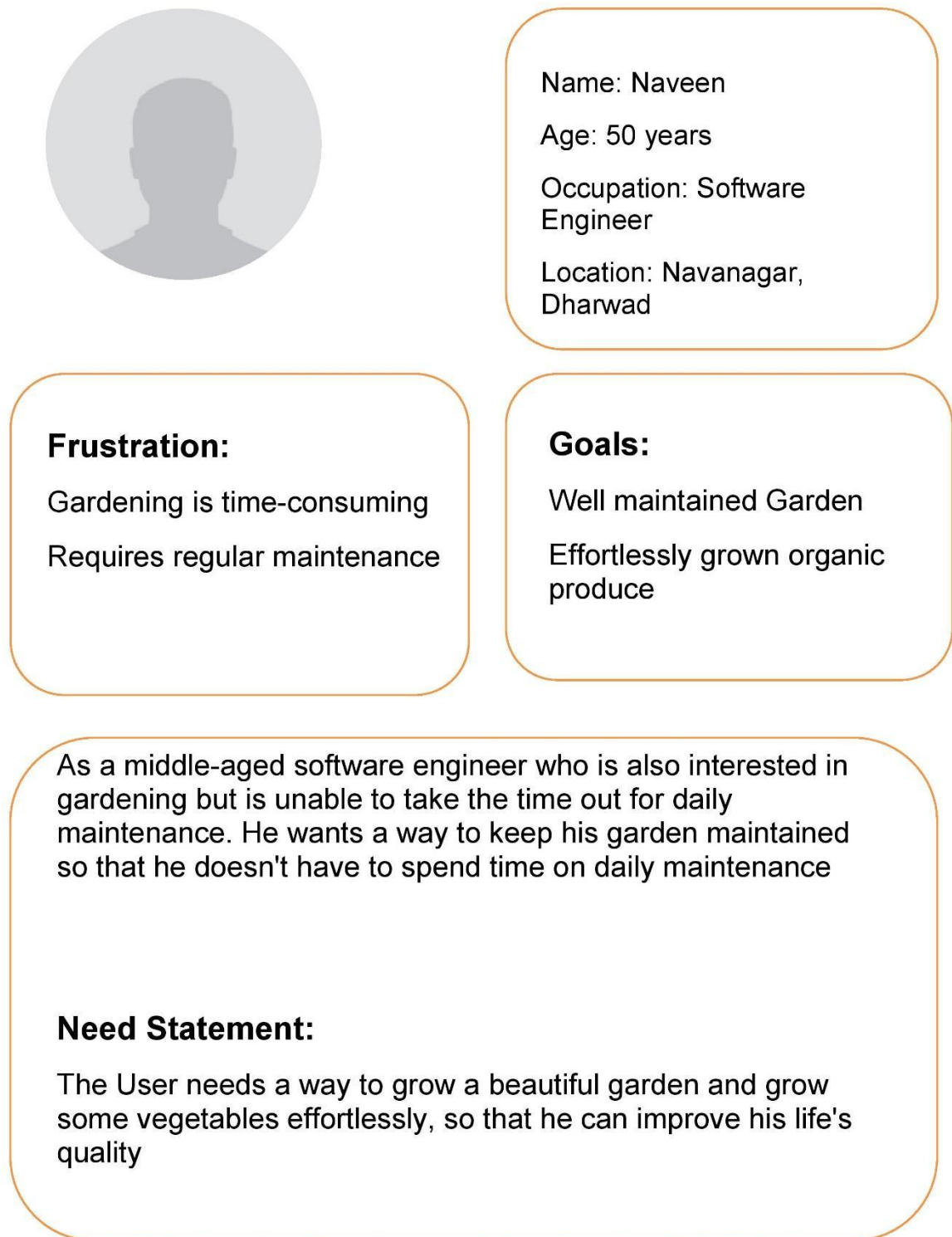
Fig 3.1.c User Persona 3

Name: Naveen

Age: 50 years

Occupation: Software Engineer

Location: Navanagar, Dharwad

Frustration:

Gardening is time-consuming

Requires regular maintenance

Goals:

Well maintained Garden

Effortlessly grown organic produce

As a middle-aged software engineer who is also interested in gardening but is unable to take the time out for daily maintenance. He wants a way to keep his garden maintained so that he doesn't have to spend time on daily maintenance

Need Statement:

The User needs a way to grow a beautiful garden and grow some vegetables effortlessly, so that he can improve his life's quality

Fig 3.1.d User Persona 4

Name: Nandish Patil

Age: 24 years

Occupation: Software engineer

Frustrations:

Improper irrigation of plants

Requires daily maintenance

Goals:

Sustainable irrigation solution Making gardening experience stress-free

User story:
As a young permaculture enthusiast. He wants a way to get more time for developing a sustainable ecosystem consisting of a variety of plants instead of doing repetitive maintenance tasks.

Need statement:
The user needs a sustainable irrigation solution to make his gardening experience stress-free.

Fig 3.1.e User Persona 5

2. Empathy map:

By looking at these user stories an empathy map is created which helps the team empathize with the user's situation

The empathy map consists of these sections' pains, gains, thinks & feels, sees, and hears all these sections together give us an understanding of the user's situation. It is essential to understand the user's situation or the environment they live in so that the product or solution that is being designed can best fit their needs.

Below is the picture of the empathy map that was created after going through the user stories:
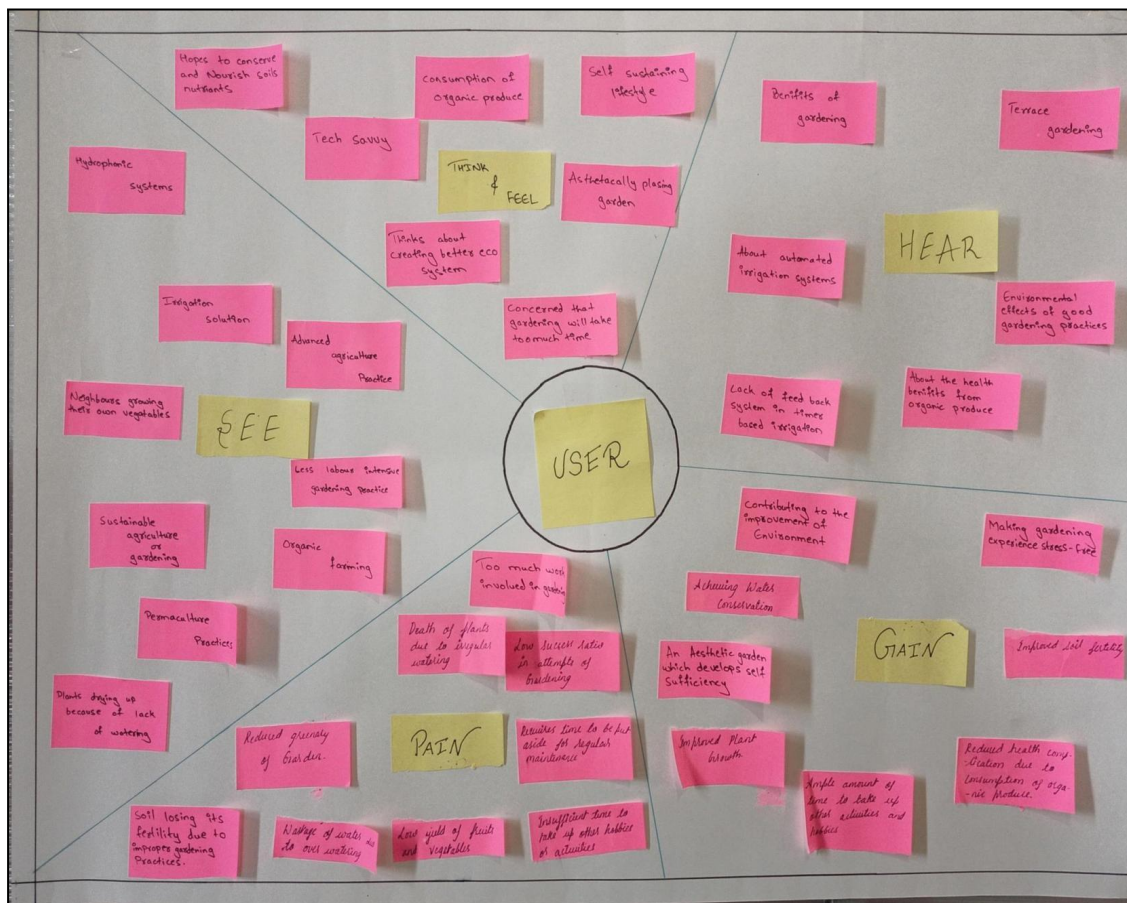

Fig 3.1.f Empathy Map

3. User stories:

The next step in design thinking is to create user stories that only address one point so that they can be prioritized and worked on. These user stories address all the entities that are going to be interacting with the solution or product that includes the end users as well as entities that are involved in the transportation, repair, installation, sales, and customer care.

Multiple aspects of the product need to be addressed so that the customers find value in the product or solution. In order to address all the aspects of the product or solution the user stories with their acceptance criteria are split up into reach, acquisition, activation, retention, and loyalty.

Below are the user stories:

Reach: -
US-01: Cost: -
   While searching for a solution the users need a cost-effective
   solution that is financially viable for them.
   Acceptance criteria:
   When the user goes to buy the product Then they must find the
   product to be cost-effective.

US-02: Aesthetic features: -
   While looking for a solution the user needs the solution to be
   aesthetically pleasing so that it improves the overall aesthetic of
   the garden.
   Acceptance criteria:
   When the user looks at the product Then they must find the
   product aesthetically pleasing.

US-03: Product packaging: -
   While looking for a solution the user needs it to be packaged well
   so that the product is delivered undamaged.
   Acceptance criteria:
   When the user observes the packaging of the product Then they
   must find the packaging sturdy and the product undamaged.

US-04. More features compared to other competitors: -
  While looking for a solution, the user needs the product to have
  more features compared to its competitors so choosing the product
  turns out to be beneficial for them
  Acceptance criteria:
  When the user compares the product to other solutions then the
  user must find the product to be more endowed with features.

US-05. Satisfy the user's basic needs: -
  While looking for a solution, the user needs the product to satisfy
  their basic requirements so that their needs are fulfilled.
  Acceptance criteria:
  When the user utilizes the product then their basic need should be
  fulfilled

Acquisition: -
US-06: Build quality: -
  The user while acquiring the product needs it to have a sturdy
  build quality so that it can withstand heavy /rough usage.
  Acceptance criteria:
  When the user goes to buy the product, then it must have good
  build quality.

US-07: Handy to use/Ergonomic: -
  The user needs it to be ergonomic so that it is handy to use.
   Acceptance criteria:
  When the user goes to buy the product Then the product must have
  good ergonomics.

US-08: Can be used in various situations: -
  The user needs a versatile solution so that it can be used in various
  applications
  Acceptance criteria:
  When the user goes to buy the product Then the product must be
  versatile in nature.

US-09: Compact:
  The user needs a compact solution so that it does not take up too
  much space in their gardens.
  Acceptance criteria:
  When the user installs the product in their garden then it must take
  up less space.

3. Planning and Task clarification

US - 10: Capability: -
The User needs the product to have the capability to perform its intended functionality so that the user's initial requirement is fulfilled.
Acceptance criteria:
When the product begins operation then it must be able to perform its expected functionality.

US - 11: Modularity: -
The user needs the product to be modular so that the parts can be easily replaced, should something go wrong.
Acceptance criteria:
When a component in the product is faulty then it needs to be easy to replace.

Activation: -
US -12: Easy installation
After Acquiring the product, the user needs the product to be easy to install so that it is easy to accommodate in their existing garden.
Acceptance criteria:
When the user buys the product Then the product must be easy to install.

US - 13: Easy to use
After Acquiring the product, the user needs the product to be easy to use so that it can be used effortlessly.
Acceptance criteria:
When the user buys the product Then the product must be easy to use/operate.

US - 14: Easy to understand the user manual: -
After Acquiring the product, the user needs the user manual to be easily understood so that they can use the product properly.
Acceptance criteria:
When the user buys the product Then the user manual must be easy to understand.

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<u>Retention: -</u>
US - 15: Reliable operation
  While using the product, the users need the product to be reliable
  so that it does not intervene with their daily routines.
  Acceptance criteria:
  When the user uses the product Then the product should not
  disturb their daily routines.

US - 16: Less human interaction/Automatic: -
  While using the product, the user needs the product to require
  minimal interaction so that they can focus on other activities.
  Acceptance criteria:
  When the user uses the product Then the product must require
  minimal human interaction.

US - 17: Conservation of resources: -
  While using the product, the user needs the product to work
  effectively so that it conserves their overall resources.
  Acceptance criteria:
  When the user uses the product Then the product must utilize
  minimal resources (Time, Water, & Money).

US - 18: Less maintenance: -
  While using the product, the user needs the product to require less
  maintenance so that they don't have to regularly put in service
  requests.
  Acceptance criteria:
  When the user uses the product Then the product must require
  minimal maintenance.

Loyalty: -

US - 19: Good customer service: -

  After having used the product for a prolonged time, the user needs
  the product to have good customer service so that they receive
  regular assistance on queries related to their product.
  Acceptance criteria:
  When the user has a query regarding the product Then the
  necessary customer service must be provided.

3. Planning and Task clarification

US - 20: regular maintenance: -
   After having used the product for a prolonged time, the user needs
   the product to undergo regular maintenance so that it functions
   ideally throughout its operating lifespan.
   Acceptance criteria:
   When the product is being utilized by the user Then the product
   must be regularly maintained so as to avoid faults in the product.

US - 21: Regular upgrades to the product: -
   After having used the product for a prolonged time, the user needs
   the product to have regular upgrades so that it stays up-to-date so
   as meet the users' needs.
   Acceptance criteria:
   When the product is being used by the user Then the product must
   receive regular upgrades so as to meet the users' requirements
   effectively.

3. Planning and Task clarification

4. Categorizations into demands and desires

The user stories are sorted into two categories demands and desires. The demands are usually the basic needs of the users, and the product or solution must satisfy them. Desires are usually luxuries that make interacting with the product or solution a pleasant experience.

Below is the list of demands and desires:-

Table No. 3.1.a Demands and Desire

Demand	Desire
US - 01	US - 02
US - 03	US - 04
US - 05	US - 07
US - 06	US - 08
US - 09	US - 13
US - 10	US - 16
US - 11	US - 21
US - 12	
US - 14	
US - 15	
US - 17	
US - 18	
US - 19	
US - 20	

5. Requirement generation:

In this phase the user stories are converted into requirements this is done by evaluating the acceptance criteria in each of the user stories. In addition to user stories, acceptance criteria can also be used as a tool to generate requirements for a system. Acceptance criteria are specific, measurable, and testable conditions that a system must meet in order to be considered "done" or ready for acceptance. These criteria are typically derived from the user stories and provide a clear and objective way to determine whether the system meets the requirements of the end user.

To generate requirements from user stories using acceptance criteria, the first step is to identify the specific goals or actions that the user wants to achieve, as described in the user stories. Once these goals or actions have been identified, the next step is to define acceptance criteria that describe the conditions that must be met in order for the system to be considered ready for acceptance. For example, if the user story is "As a customer, I want to be able to purchase products online so that I can shop from the convenience of my own home," the acceptance criteria might include:

The system must have a secure payment system.
The system must have a catalogue of available products.
The system must have the ability to track and fulfill orders.
The system must be easy to use and navigate.
These acceptance criteria can then be used as the basis for generating the specific requirements that are needed to support the goals and actions described in the user stories. In addition to providing a clear and objective way to determine whether the system is ready for acceptance, the use of acceptance criteria can also help to ensure that the system being developed meets the needs of the end user and supports the desired functionality.

Table No. 3.1.b Requirement generation

R.No	Source	Requirement
1	Survey	The price should be less than 10000 Rs
2	Team	Should be priced at less than 15% of competitors
3	Client	No Compromises must be made in the build quality due to low pricing
4	Client	Smooth surface finish
5	Client	Glossy appearance
6	Client	The product should have Unique colors
7	Team	The product must consist of a unique Geometry
8	Survey	Packaging should withstand any situations
9	Team	Packaging should handle at least 4ft. fall without causing any damage to the product
10	Team	Easy to hold and move by a single person
11	Survey	Packaging should be light in weight & cost-effective
12	Team	Should be easy to Carry/Handle
13	Team	Should have no sharp edges and should be child-friendly
14	Survey	Should not cost more than 10000 Rs
15	Team	Should cost 10% less than its competitors
16	Team	Should conserve at least 15% fewer resources compared to competitors
17	Client	Safe to use
18	Client	Should Work in required Conditions
19	Team	The product should withstand heavy/rough usage
20	Team	The product should be made up of good-quality materials
21	Team	The product should at least handle a 3 ft fall without any substantial damage
22	Survey	Should be easy to hold
23	Survey	Should have minimal sharp edges
24	Team	Should be installable in any garden
25	Survey	Suitable for smaller gardens
26	Survey	Size should be less than 2 cubic feet
27	Team	Maintains Moisture level of soil

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28	Client	Aids in the growth of plants
29	Client	Consumes fewer resources
30	Team	Replacement parts should be readily available

6. Requirements are classified based on metrics, these metrics can be used to measure the success of the project, and to determine if the requirements have been adequately met. Additionally, metrics can be used to prioritize requirements, with higher-importance requirements having more stringent metrics, and lower-importance requirements having less stringent metrics.

The below table is created which categorizes the requirements: -

Table 3.1.c Requirement categorization

Requirement	Importance	D/W	Category
The price should be less than 10000 Rs	4	Demand	Cost
Should be priced at less than 15% of competitors	4	Demand	Cost
No Compromises must be made in the build quality due to low pricing	7	Demand	Quality Control
Smooth surface finish	5	Wish	Material
Glossy appearance	5	Wish	Material
The product should have stand-out colours	5	Wish	Material
The product must consist of a unique geometry	5	Wish	Geometry
Packaging should withstand any situations	5	Demand	Transport
Packaging should handle at least 4ft. fall without causing any damage to the product	5	Demand	Transport
Easy to hold and moved along by a single person	5	Demand	Transport
Packaging should be light in weight & cost-effective	5	Demand	Transport
Should be easy to Carry/Handle	6	Wish	Ergonomic
Should have no sharp edges and should be child-friendly	10	Wish	Safety

Should not cost more than 10000 Rs	4	Wish	Cost
Should cost 10% less than its competitors	4	Wish	Cost
Should conserve at least 15% less overall resources compared to competitors	7	Wish	Energy
Safe to use	10	Demand	Safety
Should Work in required Conditions	7	Demand	Operation
The product should withstand heavy/rough usage	6	Demand	Ergonomic
The product should be made up of good-quality materials	5	Demand	Materials
The product should at least handle a 3 ft fall without any substantial damage	7	Demand	Quality Control
Should be easy to hold	6	Wish	Ergonomic
Should have minimal sharp edges	6	Wish	Ergonomic
Should be installable in any garden	6	Wish	Ergonomic
Suitable for smaller gardens	7	Demand	Operation
Size should be less than 2 cubic feet	5	Demand	Geometry
Maintains Moisture level of soil	7	Demand	Operation
Aids in the growth of plants	7	Demand	Operation
Consumes fewer resources	7	Demand	Energy
Parts should be readily available	5	Demand	Maintenance
Parts should be easily detached	5	Demand	Assembly
Parts should be reasonably priced	4	Demand	Cost
Should have standard attachment brackets	5	Demand	Geometry
Should use fewer fasteners	6	Demand	Assembly

A technician with a medium level of expertise should be able to install it	5	Demand	Assembly
Installation should not take more than 2 hrs	6	Demand	Assembly
Should be installable by general tools	6	Demand	Assembly
No requirement of any platform base for installation	6	Demand	Assembly
Should require less than 5 user inputs to operate	7	Wish	Operation
The user interface should not be complicated so that it can be used by a variety of age groups	7	Wish	Operation
There should be a set of simple instructions for maintenance	5	Wish	Maintenance
The user's manual should not be more than 10 pages	5	Wish	Maintenance
The manual should contain mostly pictorial representations of the instructions	5	Wish	Maintenance
The manual should be available in the form of paperback as well as online	7	Wish	Ease of use
Textual content should be in English as well as in the regional language	7	Wish	Ease of use
The user should have less than two or three interactions per day	7	Demand	Operation
The interactions should not take more than 10 min of the user's time	7	Demand	Operation
The product should require minimal interaction	7	Wish	Operation
The product should not interfere with their schedule	7	Wish	Operation
At least 10% of water must be saved	7	Demand	Energy
Must consume less than 5kWatt/hr per month	7	Demand	Energy
Must require less than 2 hours to perform the operation	9	Demand	Time

Shouldn't breakdown often	7	Demand	Schedule
Facilitate simple maintenance	5	Demand	Maintenance
Provide long intervals between alternate maintenance schedules	7	Demand	Schedule
The user manual must be efficient to help the customer perform self-maintenance	5	Demand	Maintenance
The customer query must be responded to within 24 hrs	9	Demand	Time
Customer service is to be provided in English and regional languages	6	Demand	Simple understanding
Maintenance services Should be provided by the company	5	Demand	Maintenance
Pocket-friendly maintenance	4	Demand	Cost
Receive regular updates	7	Wish	Schedule
New upgrades solving additional problems	7	Wish	Operation
The product should be remotely controllable	7	Wish	Ease of use
Should notify the user when various tasks are completed	7	Wish	Operation
Should provide statistical data to the user	7	Demand	Operation
There should be safety mechanisms in place so that the components don't get damaged	10	Demand	Safety
The product should be moderately water resistant.	6	Demand	Assembly
The product should display the status of an operation	7	Wish	Operation

3.2 Final problem statement:

Final Problem Statement:

Develop a fail-proof, power-efficient, and cost-effective solution to regulate the soil moisture level of the garden to maintain the health of plants which is easy to install and operate for a layman.

Fig 3.2.a Final Problem statement

3.3: Competitive benchmarking:

Competitive benchmarking is the process of comparing products, processes, or services to those of its competitors in order to identify areas for improvement. This can help develop more competitive products, processes, or services, and identify opportunities for innovation. To conduct competitive benchmarking, key competitors are identified and information is gathered about their offerings. This information is then used to compare the products, processes, or services being developed to those of its competitors, and to identify areas where it can improve. The results of the competitive benchmarking process can inform product development decisions and help a develop a competitive product.

These are the steps that are followed to do competitive benchmarking:-

The affinity groups are identified:

Table 3.3.a Affinity groups

R No.	Sub-Category 1	Category
1	Maximum Retail Price	Cost
2	Competitive Pricing	Cost
3	Uncompromised Build	Quality Control
4	Texture	Material
5	Texture	Material
6	Colour	Material
7	Design	Geometry
8	Package	Transport
9	Ergonomics	Transport
10	Package	Transport

11	Package	Transport
12	Handling	Ergonomic
13	Design	Safety
14	MRP	Cost
15	Competitive Pricing	Cost
16	Resource management	Energy
17	Safe operation	Safety
18	Reliability	Operation
19	Build quality	Ergonomic
20	Material properties	Materials
21	Build quality	Quality Control
22	Handling	Ergonomic
23	Design	Ergonomic
24	Compatibility	Ergonomic
25	Compatibility	Operation
26	Design	Geometry
27	Regulation	Operation
28	Commensalism	Operation
29	Resource management	Energy
30	Availability	Maintenance
31	Modularity	Assembly
32	Pricing	Cost
33	Modularity	Geometry
34	Resource management	Assembly
35	Installation	Assembly
36	time management	Assembly
37	Installation	Assembly
38	Installation	Assembly
39	Inputs	Operation
40	Operability	Operation
41	Instructions	Maintenance
42	Resource management	Maintenance
43	Pictorial representation	Maintenance
44	Availability	Maintenance
45	Lucid	Ease of use

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46	Interactions	Ease of use
47	time management	Operation
48	Interactions	Operation
49	Time management	Operation
50	Resource management	Energy
51	Resource management	Energy
52	Time management	Time
53	Reliability	Schedule
54	Lucid	Maintenance
55	Service internal	Schedule
56	User manual	Maintenance
57	Customer Service	Time
58	Customer Service	Simple understanding
59	Customer Service	Maintenance
60	maintenance cost	Cost
61	Updates	Schedule
62	Upgrades	Operation
63	Control	Ease of use
64	Notification	Operation
65	Data presentation	Operation
66	Component management	Safety
67	Water resistances	Assembly
68	Notification	Operation

Then the user stories are categorized under the metrics:

Table 3.3.b Metric categorization

Metric Number	Requirement Number	Metric	Units
1	1,2,14,15,32,60	Cost	Indian Rupees
2	3,21	Quality	
3	4,5,6,20	Material	
4	7,26,33	Geometry	mm^3, mm
5	8,9,10,11	Transport	
6	12,22,24,23,19	Ergonomics	mm
7	13,17,66	Safety	Safety factor
8	16,29,50,51	Energy	Voltage, Litres, kWh
9	18,25,27,28,39,40,46,47,48,49,62,64,75,68	Operation	
10	30,41,42,43,54,56,59	Maintenance	Days and Instances
11	31,34,35,36,37,38,67	Assembly	Hours
12	44,45,63	Ease of use	
13	52,57	Time	Hours
14	53,55,61	Schedule	Days/months
15	58	Simple understanding	

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Then the competitive benchmarking table is created:

Table 3.3.c Competitive benchmarking

D S No.	Requirement Number	Metric	Importance	Units	Marginal value	Ideal value	Validation/Test Method
1	1,2,14,15,32,60	Cost	4	Indian Rupees	5,000 Rs	10,000 Rs	Quotation
2	3,21	Quality	7				Quality control, Stress analysis, and drop testing
3	4,5,6,20	Material	5				Material testing
4	7,26,33	Geometry	5	mm^3, mm	350 mm^3	200 mm^3	Drafts
5	8,9,10,11	Transport	5				Transport quotation
6	12,22,24,23,19	Ergonomics	6	Mm, number of sharp edges	2 sharp edges	0 sharp edges	On hand comparison
7	13,17,66	Safety	10	Safety factor	More than 1.75	More than 1.5	Safety ratings
8	16,29,50,51	Energy	7	Voltage, liters, KWh	220v, 2 kWh per month	220 v, 1Kwh per month	Energy ratings
9	18,25,27,28,39,40,46,47,48,49,62,64,65,68	Operation	7				On-site performance review
10	30,41,42,43,54,56,59	Maintenance	5	Days and Instances	1 month	1 month	User review
11	31,34,35,36,37,38,67	Assembly	6	Hours	2 hours	1 hour	User review

3. Planning and Task clarification

12	44,45,63	Ease of use	7		10 steps to operate	6 steps to operate	Handling
13	52,57	Time	9	Minutes	15 to 20 minutes	5 to 10 minutes	Time Logging
14	53,55,61	Schedule	7	Days/ months	Once in 2 months	Once in 6 months	Statistical time data
15	58	Simple understanding	6			Easy to understand in 20 min	User review

3.4 Identify metrics to measure success:

The metrics to measure the success of the product or solution are given by the acceptance criteria in the user stories most of the acceptance criteria can be quantified and then measured.

Most of the functional requirements are also quantifiable which means that they can be measured. Measurement of these metrics after the development of the product can give an understanding of whether the product or solution is up to the mark.

Below are the metrics that are used to measure the success of the irrigation system:

Table 3.4.a Measurement metrics

Metric
Cost
Quality
Material
Geometry
Transport
Ergonomics
Safety
Energy
Operation
Maintenance

Assembly
Ease of use
Time
Schedule
Simple understanding

3.5 <u>Design Specifications</u>:

Design specifications are detailed documents that describe how a product, system, or process should be designed and developed. They provide clear and specific guidelines and requirements for designers and developers to follow in order to ensure that the final product meets the needs of the user or customer. Design specifications can include information on materials, dimensions, performance, functionality, and other technical details. They are typically created by engineers or other technical experts as part of the design process. Overall, design specifications help to ensure that a product or system is well-designed, functional, and meets the requirements of the user or customer.

Table 3.5.a design specifications

Metric	Design specifications
Cost	cost price under 5,000 Rs
Quality	High Build quality with reliable components
Material	Acrylic
Geometry	under 350 mm^3
Transport	Easy to transport
Ergonomics	0 sharp edges

Safety	More than 1.75 safety factor
Energy	220v, 2 kWh per month
Operation	Easy and reliable operation
Maintenance	once a month
Assembly	2 hours
Ease of use	10 steps to operate
Time	15 to 20 minutes of operation
Schedule	Once in 2 months maintenance.
Simple understanding	Easy to understand and operate in 20 min

3. Planning and Task clarification