RV Educational Institutions
RV College of Engineering
Autonomous Institution Affiliated to Visvesvaraya Technological University, Belagavi
Approved by AICTE, New Delhi

Go, change the world

Department of Electronics and Telecommunication Engineering

DESIGN THINKING LAB (18TE47)

SMART CITY TECHNOLOGIES

WATER MANAGEMENT IN AGRICULTURE

REPORT

Submitted by

Pranav Sharma N 1RV20ET039
Prajwal R 1RV20ET038
Tejasvi PC 1RV20ET058
Pujith 1RV20ET015

Under the guidance of
Prof. Neethu S
Assistant Professor

In partial fulfilment for the Design Thinking Lab
2021-2022

RV College of Engineering®, Bengaluru

(*Autonomous institution affiliated to VTU, Belagavi)*

Department of Electronics and Telecommunication Engineering

CERTIFICATE

Certified that the design thinking (18TE47) work titled "Water Management in Agriculture" is carried out by Mr/Ms. **Pranav Sharma N (1RV20ET039), Prajwal R. (1RV20ET038), Tejasvi P C (1RV20ET058), Pujith (1RV20ET015),** who are bonafide students of RV College of Engineering, Bengaluru, **in** partial fulfilment for the award of degree of Bachelor of Engineering in Telecommunication Engineering of the Visvesvaraya Technological University, Belagavi during the year 2021-2022. It is certified that all corrections/suggestions indicated for the Internal Assessment have been incorporated in the Design Thinking Lab report deposited in the departmental library.

Marks (50)		
Name of the Student	**USN**	**Marks**
Pranav Sharma N.	1RV20ET039	
Prajwal R.	1RV20ET038	
Tejasvi P C	1RV20ET058	
Pujith	1RV20ET015	

Signature of Mentor
Neethu S

Signature of Head of the Department
Dr Sreelakshmi K.

External Examiners

Name of Examiners — Signature with Date

1.

2.

TABLE OF CONTENTS

ii. Design Thinking Lab Rubrics (18TE47)

		LEVEL 1 (0-1)	LEVEL 2(2-4)	LEVEL 3 (5-7)	LEVEL 4(8-10)
Empathy	**Goal**	Understanding that other People experience thinks differently	Discover non-obvious Insights	Discover deeper human- centred insights	Discover a full spectrum human centred insight (individual/group)
	Skill Level	Little experience/comfort eliciting info from others unlike themselves	Ability to develop diverse approach. Some experience eliciting info from others	Ability to understand perspective and experiences from others	Ability to understand others and the system/process in which they operate and ability to think like others
Define	**Goal**	Pick one insight/problem out of many in a very guided statement	Understand multiple insights and needs and synthesize into a single problem statement with guidance	Develop multiple deep insights and synthesize into a single problem statement with little or no guidance	Develop multiple complex problem statements with no guidance
	Skill Level	Ability to prioritize based on perceived importance of any insight/problem	Ability to synthesize information and prioritize insights based on perceived needs	Ability to synthesize info based on needs and insights originating from multiple non obvious internal and external sources	Ability to understand and synthesize deep insights based on complete system
Ideate	**Goal**	To be able to come up with lots of ideas and defer judgement	To develop over 20 ideas off a single well-crafted HMW	Develop multiple HMWs, generate a spectrum of ideas from the HMWs and narrow to a few actionable ideas	Use multiple techniques for ideation for a single insight and repeat
	Skill Level	Ability to generate and record ideas with others	Ability to build of others' ideas and develop wild ideas	Ability to lead a brainstorm through a spectrum of ideas from low hanging to wild	Ability to use multiple techniques to inspire a complete range of ideas.
Prototype	**Goal**	Create a representation of your idea that someone else can understand	Create a representation of an idea that can be evaluated by others	Create a representation that allows one to evaluate specific features of a given idea and develop multiple iterations	Create multiple representations that allow you to evaluate specific features from multiple perspectives and develop multiple iterations
	Skill Level	Ability to make a physical or visual representation of an idea	Ability to create a physical or visual representation of an idea that can be evaluated and improved	Ability to identify variables of an idea that needs to be evaluated and iterate off feedback	Ability to create more complex prototype addressing multiple approaches to solving a problem.
Test	**Goal**	To try or show a prototype to see how well it works	To try or show a prototype and efficiently solicit feedback	To create a testing scenario to specific feature and design clear team roles such as presenter, notetaker, observer.	Real world testing with a range of users and scenarios that address the needs and perspectives of the complete system.
	Skill Level	The ability to use a prototype to determine how well and idea works	Ability to set up an effective prototype test, solicit feedback, and organize feedback received into actionable results	Ability to solicit feedback about specific features, construct a representative testing situation and capture results to inform future iterations	Ability to identify best situations in the real world for testing and test with multiple representative populations and capture complex results to inform future iterations

1. INTRODUCTION

Design Thinking

Design thinking is a human-based approach to innovation that aims to establish creative ideas and effective business models by focusing on the needs of people. The basic idea behind design thinking is that you apply the approaches and methods of designers to the development of innovations while also engaging in a systematic, fact-based analysis of the feasibility and economic viability of these innovations just like what a researcher does. The shaping and design of material products is just one application area. You can use this approach for all areas in life and business. Maybe you want to enhance your customer service, introduce new ways of executing your business processes, or change the corporate culture. Then you're dealing with many-layered issues. When you have no simple solutions, design thinking helps you find an innovative solution. There are some things to keep in mind for the success of design thinking i.e., Free of prejudices about how something works, Free of expectations about what will happen, filled with curiosity to understand things more deeply, Open to a world of possibilities since we do not yet know at the beginning of our "journey" what is possible and what is not, fail early on and often; learn quickly.

The need of design thinking

- It helps to generate innovative solutions for problems.
- It also plays role in meeting the customer needs.
- It provides the modern solutions according to the needs.

There are some stages in design thinking process. They are given below in *figure 1*

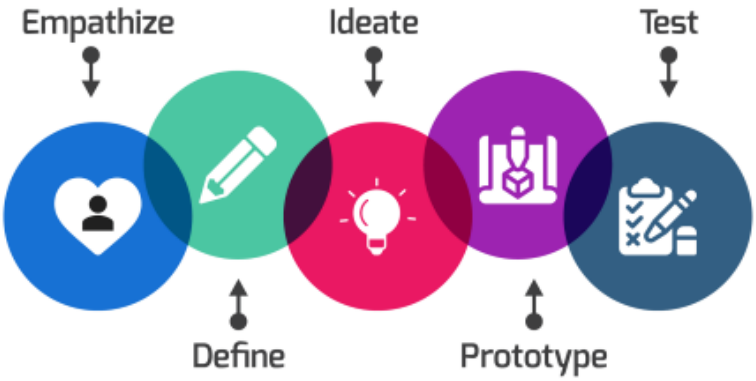


Figure SEQ Figure * ARABIC 1. Stages in design thinking

2. EMPATHY

Design thinking is more than just customer orientation. It is centered on people. People are the beginning, middle, and end for every consideration. We must begin with people by taking up a problem faced by your target users or a wish expressed by them. Our task in design thinking is not to pursue a technology or business goal, it is to satisfy the expressed needs of customers. So, the first phase of design thinking is empathizing. We did a survey to understand stakeholder's standpoint on this issue. We received some responses which are represented below.

2.1 SURVEY RESULTS AND RESPONSES

Here's what we confer from the interaction with the mentioned stakeholders:

1)The main Irrigation system followed in India are Surface Irrigation and Drip Irrigation

2)Water requirement is different for different plants

Eg: Banana plant needs to be watered frequently

Sugar cane can take more amount of water at once

Coconut tree needs at least 100L of water on daily basis

3)Water has electrolytes which helps in absorbing fertilizers and nutrients

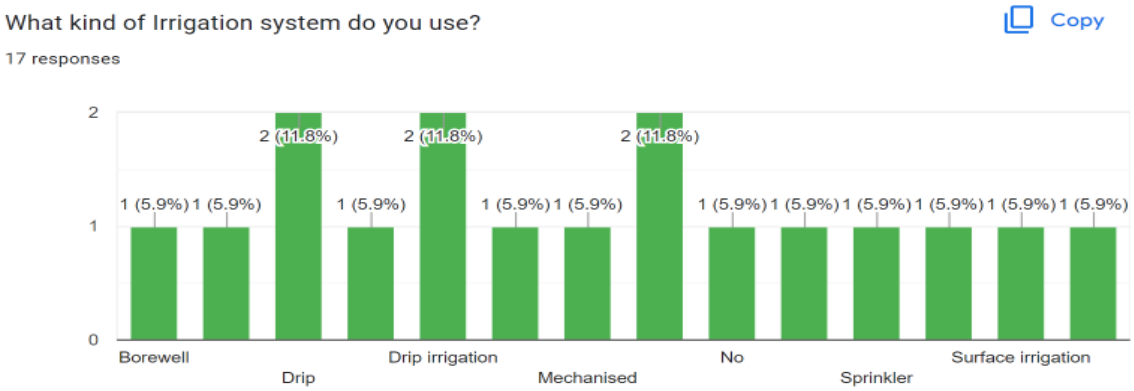
4)Irrigation also depends on the type of soil and plant physiology. For Ex: North Karnataka has got Black soil and hence water must contain more salts where in Southern part of Karnataka has more Red soil and Clay soil

5)Plants like Paddy and Ragi are grown using Surface Irrigation method and Horticulture plants are grown using Drip Irrigation

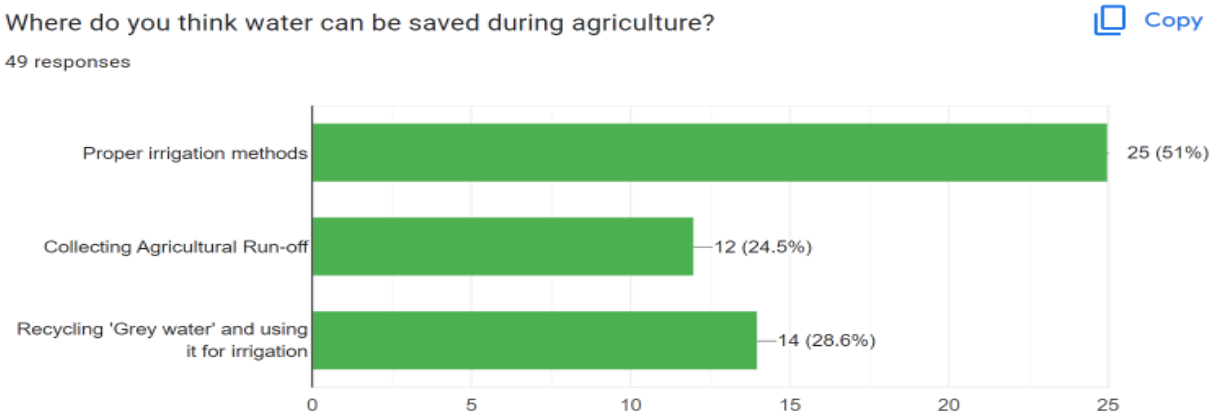
6)Drip Irrigation is the most efficient type of Irrigation

7)The length of Dripping depends upon Root length and soil type

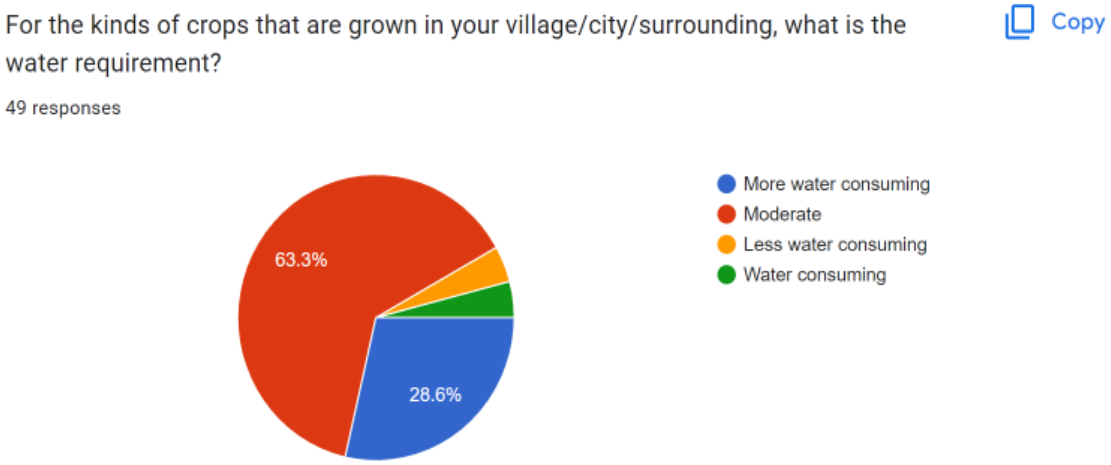
8)Fertilizers are put 5 minutes before stopping the water in drip Irrigation



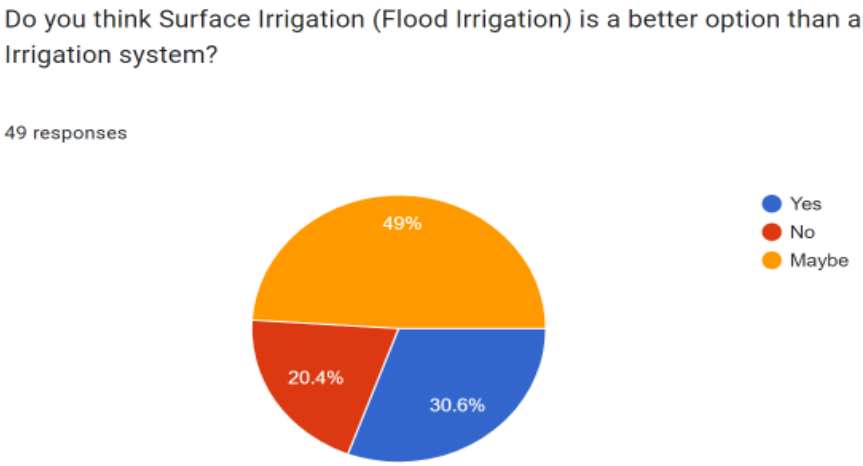
In recent times, Irrigation has become the major issue faced by farmers in India. In a country where the backbone of the economy is agriculture, problems in this field may result in damaging the economy. Water availability is the main challenge for the farmers. According to the survey that we conducted, the graph 1 shows the common Irrigation system that the farmers use.



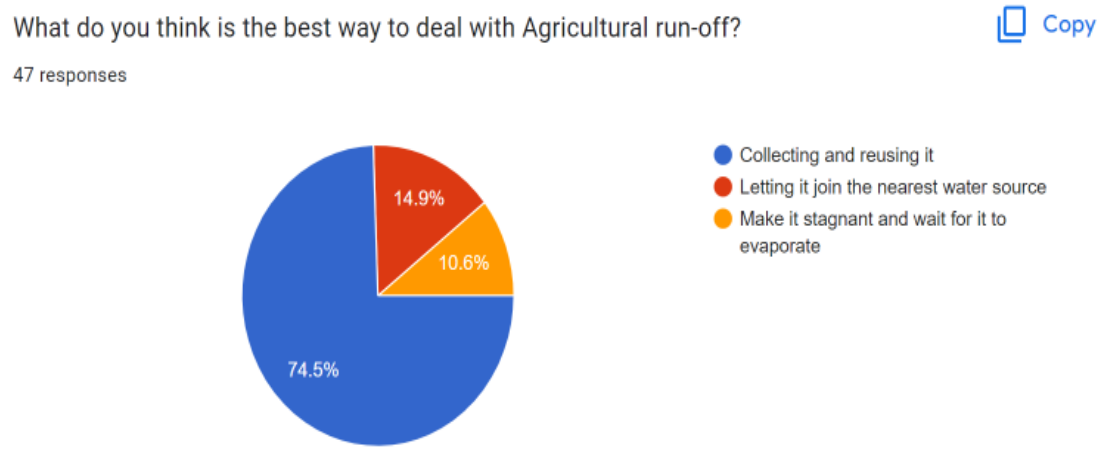
One of the most important aspects to look into is the Water management. Agricultural water management (AWM) seeks to use water in a way that provides crops and animals the amount of water they need, enhances productivity, and conserves natural resources for the benefit of downstream users and ecosystem services. The graph 2 shows the survey results on different types of water management in agriculture.



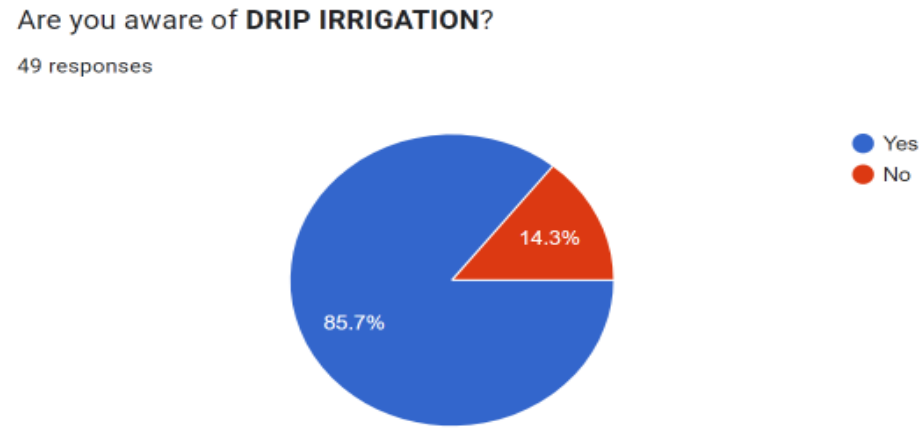
Water is a critical input for agricultural production and plays an important role in food security. Agricultural water management (AWM) seeks to use water in a way that provides crops and animals the amount of water they need, enhances productivity, and conserves natural resources for the benefit of downstream users and ecosystem services. The pie chart displays the outcome of water demanding crops that farmers needed in their land.

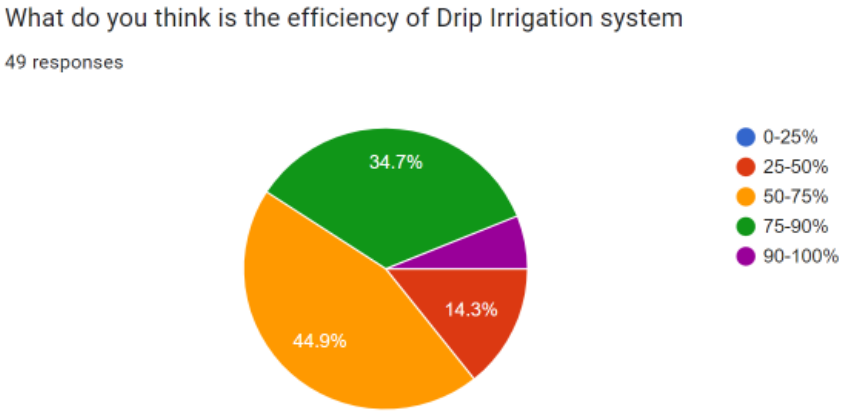


It is normally used when conditions are favourable: mild and regular slopes, soil type with medium to low infiltration rate, and a sufficient supply of surface or groundwater. Surface irrigation is widely utilized and therefore a well-known system which can be operated without any high-tech applications. The second pie chart shows that farmers believe surface irrigation is the best option among all irrigation systems.



Agricultural runoff is the surface runoff from farmland outflow, which comes from the farmland's surplus water. Its main sources of excess water are from irrigation and rainfall. The third pie chart displays farmers' perceptions about how to handle agricultural runoff.





A technical advancement for increasing productivity while using a restricted water source is drip irrigation. It saves water by 30–40% while increasing output by 25–35%. It may be used for a variety of crops, especially horticultural crops like flowers and vegetables. The fourth and fifth pie charts demonstrate how farmers are focused on the effectiveness of drip irrigation.

2.2 PROBLEMS IDENTIFIED FROM THE SURVEY

The survey presented a clear picture of the issues that stakeholders in agricultural water management confront.

Problem faced by farmers:

1)Surface irrigation has a lower O2 exchange rate and so is less efficient than drip irrigation.

2)However, drip irrigation is highly costly.

3)Rainfall in India has a large regional imbalance, therefore water supply is primarily dependent on neighbouring water sources.

4)Due to power outages, water cannot be pumped from water bodies.

Problem faced by electricity department:

1)The challenges of supplying power to rural communities are daunting.

2)High capital and running expenses derive from low population density.

3)Theft of electricity

4)Variable voltage may cause equipment damage.

5)Due to the varied terrain and climatic conditions, providing a power connection is problematic.

Problem faced by irrigation/agriculture department:

1)Project completion delays.

2)Water conflicts and a lack of money

3)Regional variations in rain.

3)Irrigation expenses are rising.

Problem faced by NGOs:

1)Trust issues

2) Lack of communication owing to farmers' lack of knowledge

2.3 INSIGHTS

After defining some of the problems we started to analyse the situation in a more distinct manner. In search of overall conclusion to the current scenario we ended up marking some points which proved to be beneficial:

1)The most effective sort of irrigation method is drip irrigation. Many of them, though, are ignorant of this.

2)Drip irrigation lowers run-off and hence prevents fertiliser loss. However, with this method, the water supply must be monitored.

3)Farmers' biggest concerns are irregular water and electrical supplies.

4)Increased irrigation costs and a lack of funds for the Irrigation Department have resulted in the failure to introduce innovative agricultural technology.

2.4 TARGETED AUDIENCE

Water is one of the most important inputs essential for the production of crops. Plants need it continuously during their life and in huge quantities. It profoundly influences photosynthesis, respiration, absorption, translocation and utilization of mineral nutrients, and cell division besides some other processes. Both its shortage and excess affect the growth and development of a plant directly and, consequently, its yield and quality. Water affects the perf ormance of crops not only directly but also indirectly by influencing the availability of other nutrients, the timing of cultural operations, etc. Water and other production inputs interact with one another. In proper combinations, the crop yields can be boosted manifold under irrigated agriculture.

1)Farmers: Farmers are the main target since the type of irrigation affects them directly and also the implementation or rejection of an idea related to irrigation is entirely left to the farmers

2) Irrigation Department: This government body plays a major role in taking the irrigation related technology to farmers.

2.5 PERSONA

shows a google image referring to a farmer whom we have considered as a person. His details are given below.

- Name: Pujarappa Ongole
- Role: farmer
- Demographics: Age 58, Farmer, takes care of family at home, volunteer at a local NGO.
- Key assumptions: he contacts a lot of people throughout the day as a volunteer. Has 2 acres of land in which he does horticulture

3. DEFINE

Agriculture water management is to use water in a way that gives crops the quantity of moisture they require, boosts production, and conserves natural resources for downstream consumers and ecosystem services. Irrigation is a part of agricultural water management, but it goes beyond merely providing water. It encompasses techniques for protecting soil, land, and ecosystems, such managing watersheds and drainage systems, as well as lifting, storing, and moving water technology. Traditional agricultural water management focused on increasing the effectiveness of water usage in extensive irrigation plans where the goal was to control rather than manage water. There is a need for better procedures since more farmers are making investments in small-scale irrigation systems and because regulation is either non existent or disorganised. In priority countries, agricultural water management has the ability to increase the earnings and food security of poor farmers.

4. IDEATION

Considering the availability of water, Smart IoTs designed to allow specific amount of water required by that particular plant on correct interval of time.

Additionally, sensors that determine the value of mineral nutrients and the quantity of water in the soil may be created for regulated fertilizer supply.

Designing sensors to identify the kind and concentration of mineral nutrients in agricultural runoff and grey water for the purpose of treating it with respective chemical and reusing it.

5. PROTOTYPE/PRETOTYPE

Interfacing Soil Moisture Sensor with Arduino

Soil Moisture Sensor and how can we save water in farmland by Interfacing Soil Moisture Sensor with Arduino and controlling the water supply to plants.

Introduction

If you have a farm land, home garden or a backyard with turf, then you might probably know how much we need to take with watering the plants and crops.

Drip irrigation and surface irrigation are two of the most often utilised agricultural irrigation methods.

But if you are planning to make an Automatic Plant Watering system, where the water supply either through sprinklers or drip irrigation system, then you have to consider the amount of Soil Moisture.

By measuring the Soil Moisture in the crop field, you can precisely control the amount of water to be supplied with the help of a simple mechanism involving a Water Pump and a Microcontroller.

In this project, we will show you how to monitor the soil moisture of a small pot by Interfacing Soil Moisture with Arduino

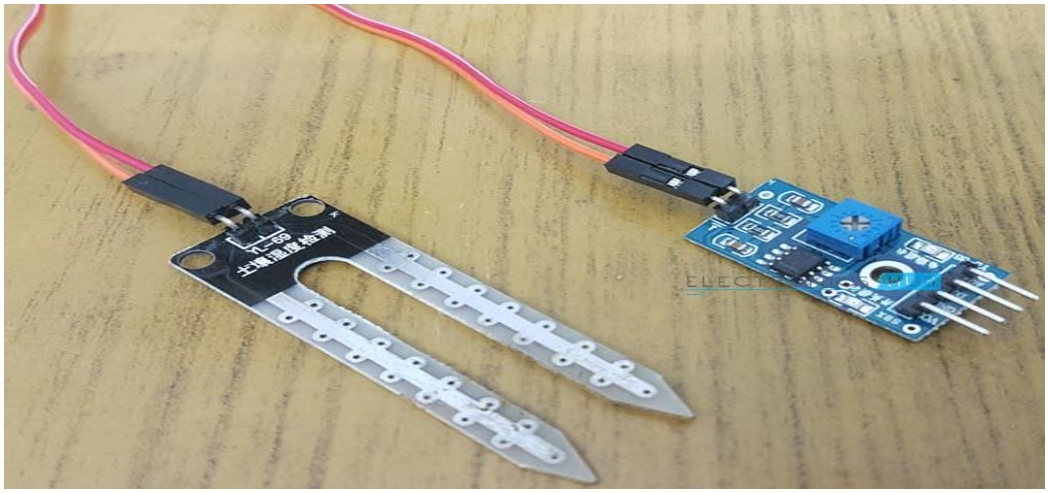
A Brief Note on Soil Moisture Sensor

The main component of the project (apart from the Arduino UNO) is the Soil Moisture Sensor. It consists of two parts: The main Sensor and the Control Board.

Sensor part of the Soil Moisture Sensor consists of a couple of conductive probes that can be used to measure the volumetric content of water in soil.

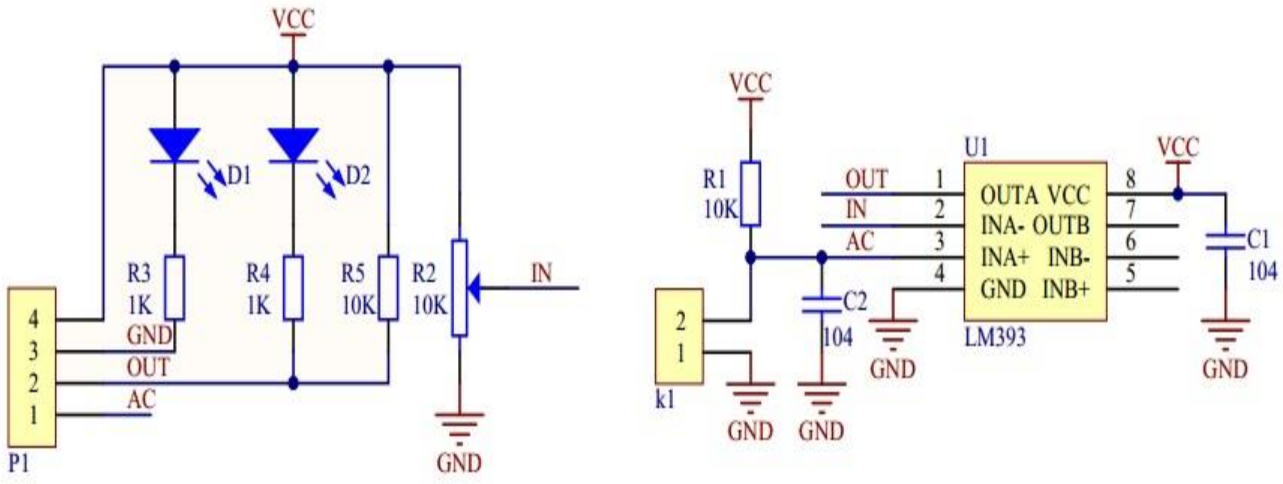
Coming to the control board, it is made up of LM393 IC, which is a voltage comparator. The board also consists of all the necessary components like connectors, LEDs, resistors etc. to measure the Soil Moisture.

Additionally, there is an option to adjust the sensitivity of the module with the help of a Potentiometer.



Working of Soil Moisture Sensor

The working of the Soil Moisture Sensor is very simple. It works on the principle of voltage comparison. The following circuit will be helpful in understanding the working of a typical soil moisture sensor.



As you can see, one input of the comparator is connected to a 10KΩ Potentiometer while the other input is connected to a voltage divider network formed by a 10KΩ Resistor and the Soil Moisture Probe.

Based on the amount of water in the soil, the conductivity in the probe varies. If the water content is less, the conductivity through the probe is also less and hence the input to the comparator will be high. This means that the output of the comparator is HIGH and as a result, the LED will be OFF.

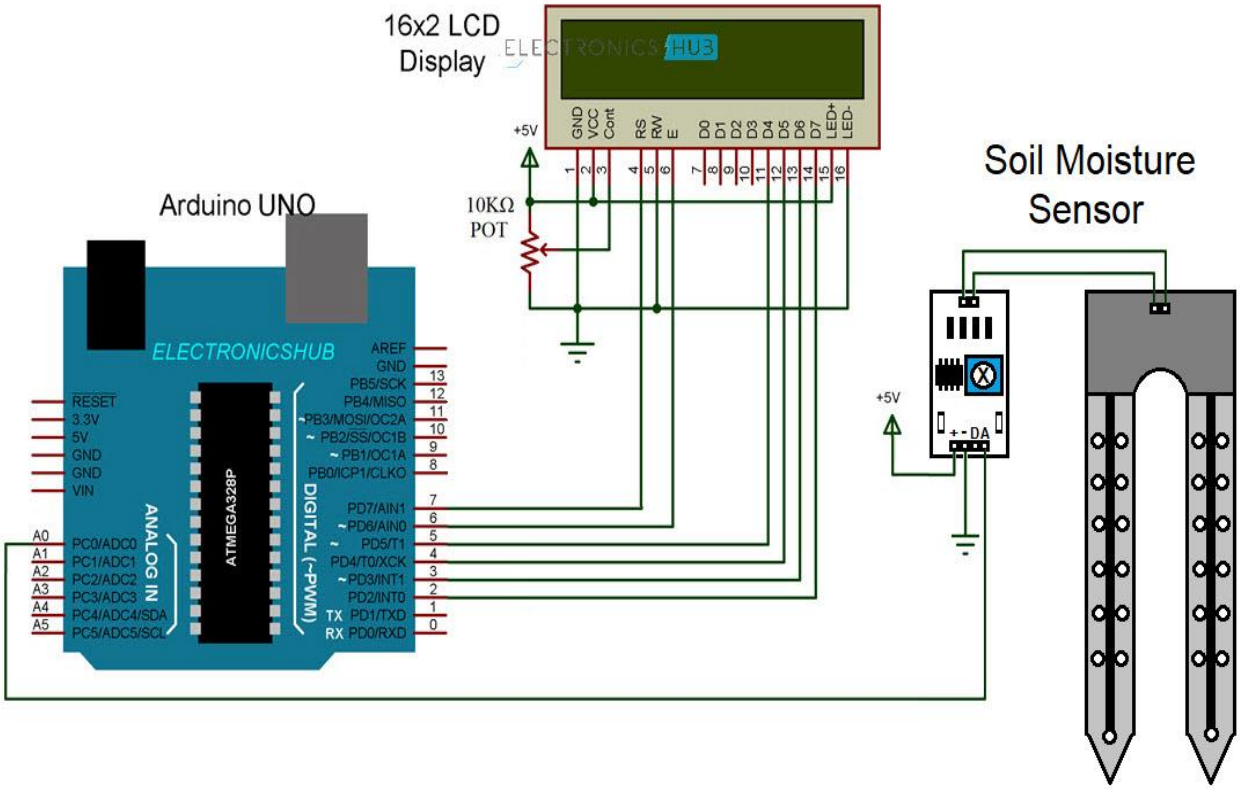
Similarly, when there is adequate water, the conductivity of the probe increases and the output of the comparator becomes LOW. The LED then starts glowing.

Interfacing Soil Moisture Sensor with Arduino

Now that we have seen how a typical soil moisture sensor works, let me take you through the steps of Interfacing Soil Moisture with Arduino. The main advantage of this soil moisture module is that you can get the analog output from it. By using this analog signal and giving it to the Analog IN of Arduino, you can precisely calculate the percentage of moisture in the soil.

Coming to the setup for testing the project, I have used to plastic cups filled with soil from my garden. The amount of water in each cup is more than the previous one.

Circuit Diagram



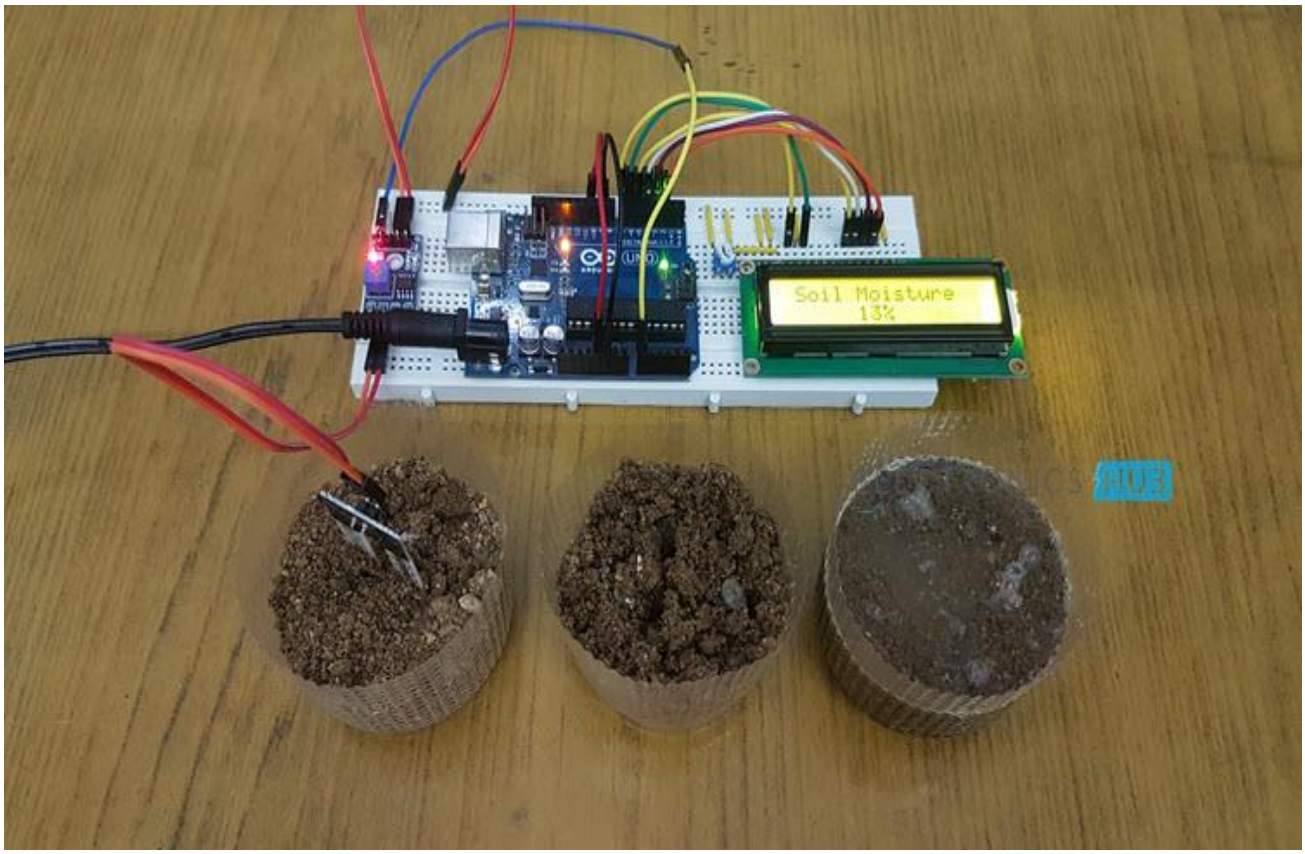
Components Required

- Arduino UNO
- Soil Moisture Sensor Module
- 16×2 LCD Display
- 10KΩ Potentiometer (for LCD)
- Breadboard
- Connecting wires
- Power Supply
- Test setup with 3 cups of soil

Circuit Design

The design of the circuit is very simple. Connect the probe to the board and provide power supply to the board. Take the analog out pin from the board and connect it to Analog IN pinA0 of the Arduino.

To view the results, I have used a 16×2 LCD Display, where I have connected its data pins D4 – D7 to Arduino Pins 5 – 2. All the additional connections are mentioned in the circuit diagram.



code

```
#include <LiquidCrystal.h>

const int rs = 7, en = 6, d4 = 5, d5 = 4, d6 = 3, d7 = 2;

LiquidCrystal lcd(rs, en, d4, d5, d6, d7);

int j=0;

int prev=0;

int pres=0;

void setup()

{

  lcd.begin(16, 2);

  lcd.setCursor(0,0);
```

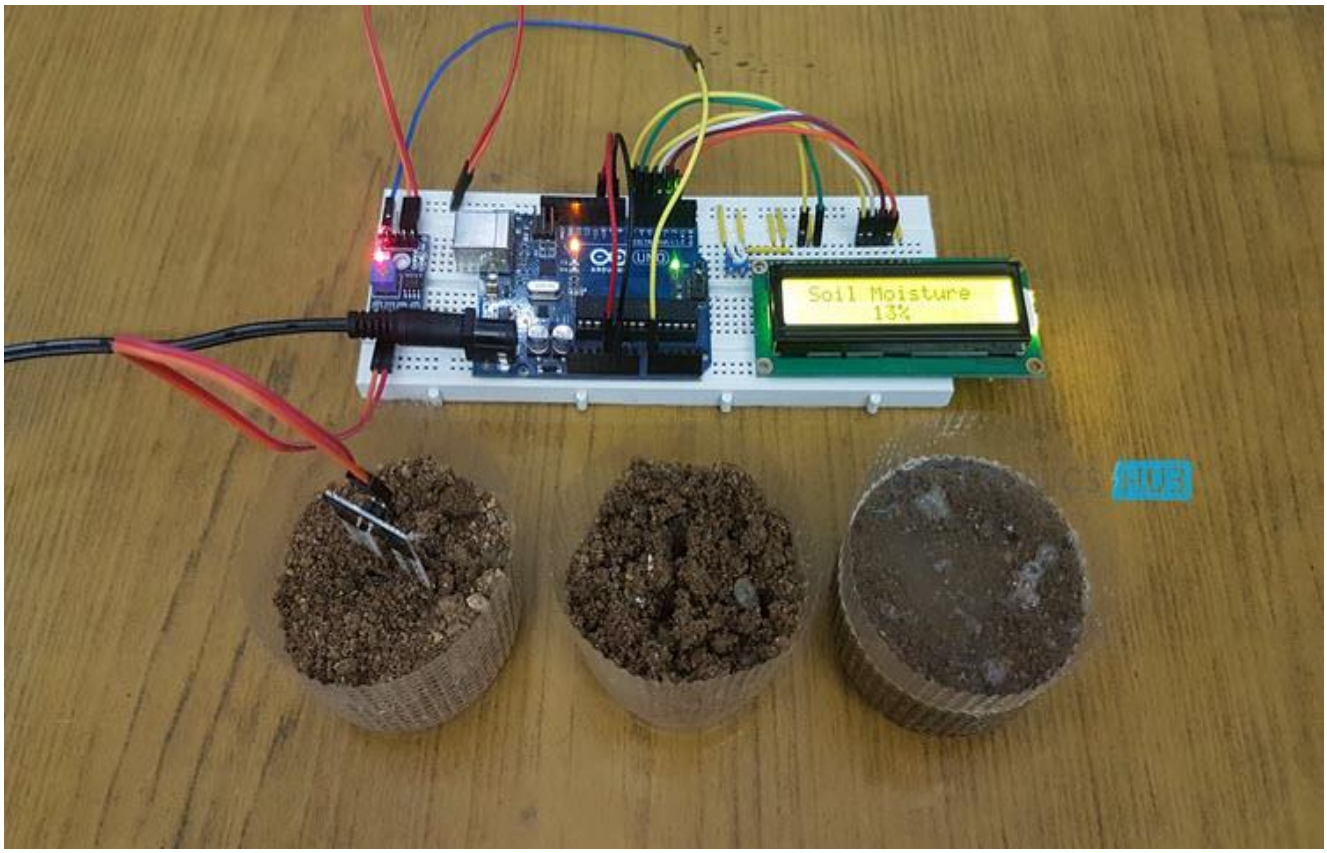
```
  lcd.print(" Soil Moisture  ");
  Serial.begin(9600);
}

void loop()
{
  j=analogRead(A0);
  j=map(j,0,982,148,0);
  pres=j;
  if(j>100)
  j=100;
  else if(j<0)
  j=0;
  lcd.setCursor(6,1);
  lcd.print(j);
  lcd.print("%  ");
  prev=j;
  delay(500);
  }
```

6. TEST

How to Measure Soil Moisture with Arduino?

- Make the connections asper the circuit diagram and upload the code to Arduino.
- Place the soil moisture probe in a “dry” pot and check for readings. In my case, it was around 13%.
- Similarly, place the probe in other pots (after properly cleaning the probe) and check for readings.
- You can adjust the sensitivity of the sensor with the help of the potentiometer on the board of the sensor.



7. CONCLUSION

By the process of design thinking we experienced the divergence in the over all activity of finding the solution to a problem. It was an innovative journey with small stepped phases. This approach helped us to invest most of our concerns on the grievances of the targeted audience which in turn broadened our thoughts and assisted in gaining a superior outcome. By narrowing our problem statement, we proceeded with finding a better and a creative solution. In this world of automation, a device which can robotically identify the mismatch and handles the things according to the guidance provided to it is much more useful. This provides an escape route to people who have to stand in line and work in any case and circumstances.

RV COLLEGE OF ENGINEERING®
(Autonomous Institution affiliated to VTU, Belagavi)

Department of Electronics and Telecommunication Engineering

DESIGN THINKING LAB (18TE47)

WEEKLY PROGRESS REPORT

WEEK	STATUS
Week -1&2	Topic Finalization
Week - 3	Empathy and Define Phase: In this, we conducted a survey, did data analysis and identified problems and got insights
Week - 4	Ideation Phase: We tried to figure out a solution for the problem defined and came up with the block diagram.
Week- 5,6&7	Prototype development: Virtually simulated the pretotype and created a 3D sketch.
Week -7,8&9	Testing Phase: We optimized the code based on the results form virtual simulations.
Week – 10	Final Presentation: Recorded and uploaded final presentation
Week – 11&12	Submission of Reports & Poster

MINI REPORT

RV Educational Institutions
RV College of Engineering
Autonomous Institution Affiliated to Visvesvaraya Technological University, Belagavi
Approved by AICTE, New Delhi
Go, change the world

SUMMARY REPORT ON DESIGN THINKING LAB

Pranav Sharma N (1RV20ET039), Tejasvi PC (1RV20ET058),
Prajwal R(1RV20ET038),Pujith (1RV20ET015)

THEME – Smart City Applications

TITLE – WATER MANAGEMENT IN AGRICULTURE

INTRODUCTION:

It involves the monitoring of water application for crops or yard. It usually will be used for more extensive properties that need a system to help manage the volume, rate, and timing of water application in order to match with water holding capacities and soil intake. In order to promote optimum crop yields, it's especially important to monitor soil moisture without runoff or deep percolation losses. With your irrigation management, you'll be able to properly adjust your water with tools that can, later on, be adjusted to ensure properly yielded results.

PROBLEM IDENTIFIED:

The main problem most of the stake holders facing the rainfall in India is highly unpredictable and varies regionally, the farmers have to rely on irrigation and the existing irrigation methods are either ineffective or expensive. Hence there is a huge difficulty to manage the water sources.

PROPOSED SOLUTION:

Considering the availability of water, Smart IoTs designed to allow specific quantity of water required by that particular plant on correct interval of time

Also for regulated supply of fertilizers, sensors to calculate the value of mineral nutrients and water level in soil can be designed .

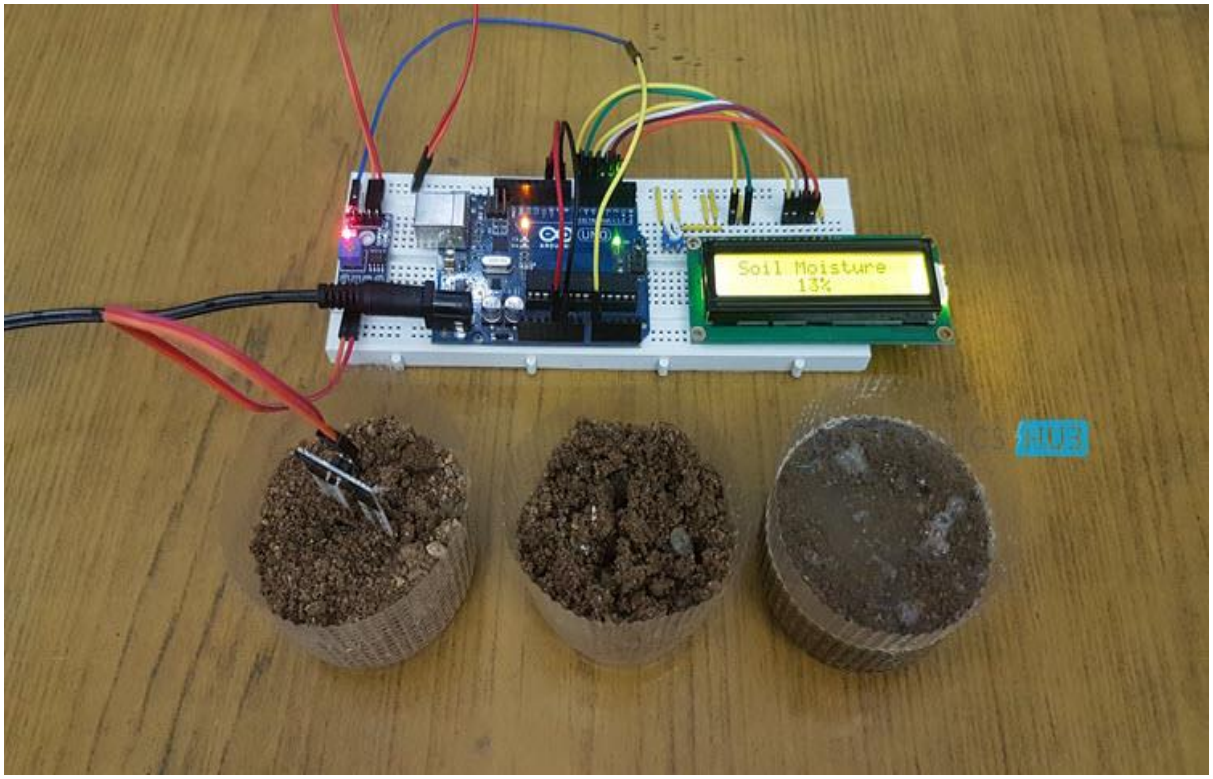
If you have a farm land, home garden or a backyard with turf, then you might probably know how much we need to take with watering the plants and crops.

Drip irrigation and surface irrigation are two of the most often utilised agricultural irrigation methods.

But if you are planning to make an Automatic Plant Watering system, where the water supply either through sprinklers or drip irrigation system, then you have to consider the amount of Soil Moisture.

By measuring the Soil Moisture in the crop +field, you can precisely control the amount of water to be supplied with the help of a simple mechanism involving a Water Pump and a Microcontroller.

In this project, we will show you how to monitor the soil moisture of a small pot by Interfacing Soil Moisture with Arduino

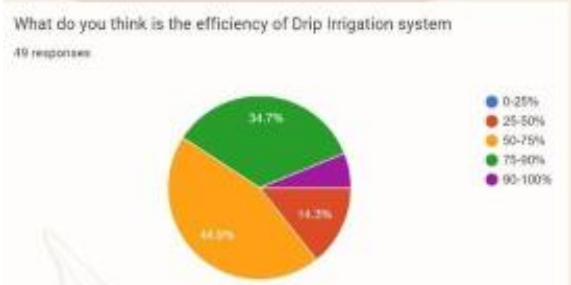


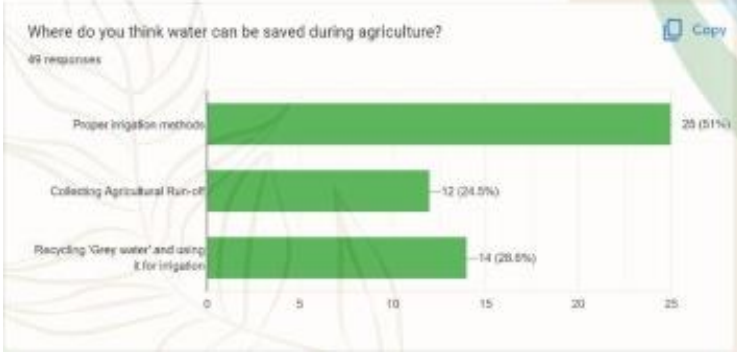
DISIGN THINKING LAB

WATER MANAGEMENT IN AGRICULTURE

EMPATHISE

In order to give farmers an effective water management system. We surveyed a number of stakeholders, including the agriculture & irrigation dept, farmers, electricity dept & NGO





DEFINE

Agricultural water management aims to use water in a way that gives crops the amount of water they require, boosts productivity, and conserves natural resources and ecosystem services.

IDEATE

The idea to develop sensors to measure the value of mineral nutrients and soil water level for a controlled delivery of Water.

PROTOTYPE

It senses and detects the mineral nutrients and water level present in the soil
This uses series of sensors and Aurdino

TEST

We developed the concept for a tool that evaluates the value of mineral nutrients and water level in the soil in real time.

PRAJWAL | PRANAV | TEJASVI | PUJITH