Team : JARVIS

PRESENTS

IoT Based Smart Agricultural Monitoring System

Related PS: IoT-Enabled Renewable Energy Monitoring

- Problem: Lack of real-time monitoring hampers renewable energy efficiency.
- Challenge: Develop IoT systems to monitor and optimize renewable energy systems such as solar panels and wind turbines.

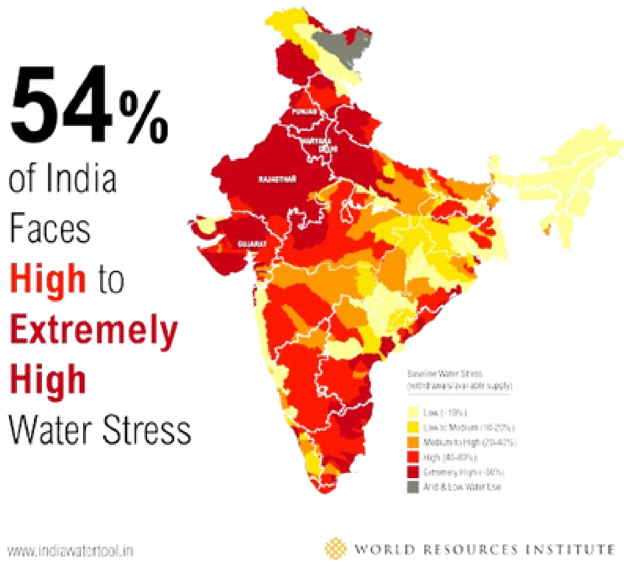
PROBLEM STATEMENT

CHALLENGES IN MODERN AGRICULTURE

Crop Losses Due to Pests and Diseases

- Annually, 40% of global crop yield is lost due to the prevalence of pests, diseases, and weeds. This staggering loss directly impacts food availability and farmer incomes.

- Improper pesticide use not only raises farmers' costs but also causes soil degradation and disrupts ecosystems, worsening agricultural inefficiency.



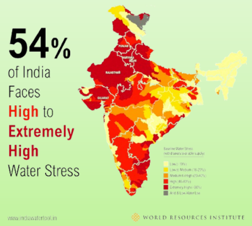
Resource Inefficiency in Water Usage

Agriculture's Massive Water Footprint

- Agriculture consumes over 70% of global freshwater, yet inefficient practices like over-irrigation, leaks, and evaporation waste up to 50% of it.

Rising Water Scarcity

- Over 600 million Indians face high water stress, worsened by inefficient agricultural water use, unpredictable rainfall, and groundwater depletion, endangering food security and sustainability.



Environmental Impact

- Excessive irrigation harms soil health, pollutes water bodies, and reduces water availability for drinking and industrial needs.

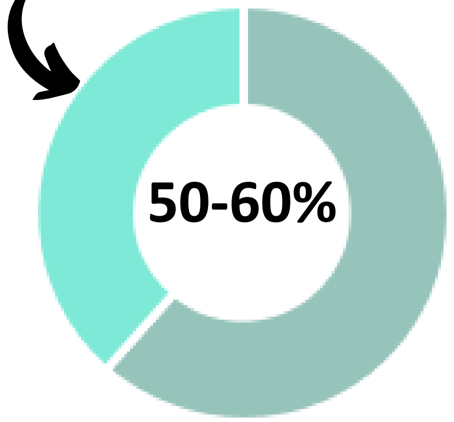
The Need for Real-Time Solutions

- Farmers often lack real-time insights into crop health, water needs, and soil conditions.
- This leads to delayed responses, resulting in preventable losses.

Imbalanced Nutrient Application

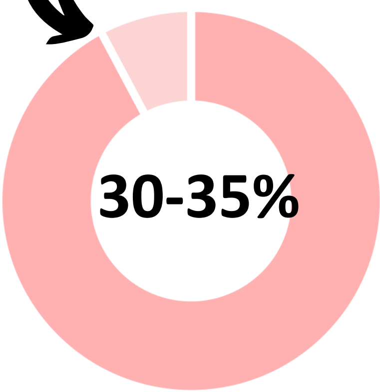
Nitrogen

Overuse pollutes groundwater and emits greenhouse gases.



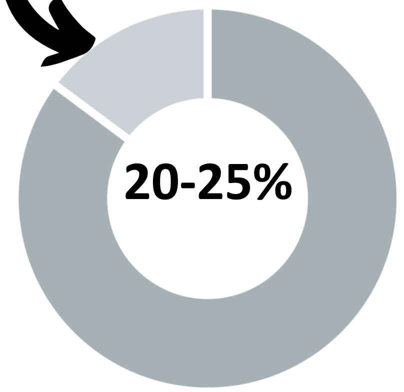
Phosphorus

Leads to waterbody eutrophication.



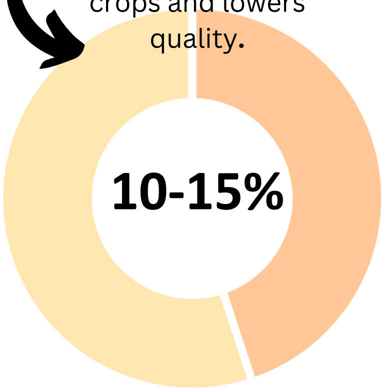
Potassium

Impacts water uptake and reduces drought tolerance.



Micronutrients like Zinc (Zn)

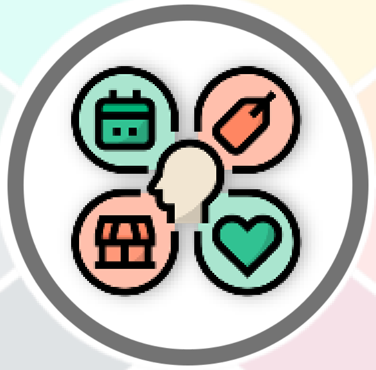
Deficiency weakens crops and lowers quality.



- These imbalances nutrient harm soil health, reduce productivity, and contribute to environmental degradation.

Climate Variability & Economic Impact on Farmers:

- **Erratic Rainfall Patterns**: Unpredictable monsoons disrupt crop cycles and limit irrigation water.
- **Increased Temperature Extremes:** Rising temperatures affect crop growth and shorten growing seasons.
- **Frequent Droughts and Floods:** Extreme events damage crops and strain water resources, reducing agricultural productivity.
- **Decline in Groundwater Levels:** Over-dependence on groundwater, coupled with climate variability, depletes reserves faster than they can recharge.



- **Reduced Profit Margins:** Inefficient practices lead to higher input costs (fertilizers, water) and lower yields
- **Debt Burden:** Failed harvests and poor resource management push farmers into a cycle of loans and financial instability.
- **Migration Challenges:** Financial instability forces farmers to abandon agriculture and migrate to urban areas in search of work.
- **Unsustainable Practices:** Inefficient resource use and low productivity jeopardize future food security amid growing global demand.

SOLUTION

OUR SMART SOLUTION

1) AI-Powered Decision-Making

- Utilize AI and Machine Learning (ML) models to analyze real-time data from the field, providing actionable insights such as optimal irrigation schedules, nutrient management, and early detection of pests and diseases.
- Predict crop health trends, allowing farmers to take proactive measures and increase productivity.

2. IoT Sensors for Precision Agriculture

- Deploy IoT sensors in soil, water sources, and on plants to monitor essential parameters such as:
- Soil moisture, temperature, and nutrient levels.
- Water flow, quality, and availability.
- Environmental conditions like humidity and weather patterns.
- Ensure real-time data transmission for uninterrupted monitoring and immediate response.

Key Benefits:

- Enhanced crop productivity and sustainability.
- Reduced costs and optimized resource use.
- Improved food security and resilience to climate variability.

3. Cloud-Based Data Processing

- Use secure cloud platforms for efficient data processing, storage, and analysis.
- Scalable solutions that can support farms of any size, maintaining cost-effectiveness and flexibility.

4. User-Friendly Platforms

- **Mobile App**: Provides farmers with user-friendly insights, alerts, and decision-support tools in simple language.
- **Web Dashboard**: Offers comprehensive reports, analytics, and visualizations for agricultural consultants and policymakers.

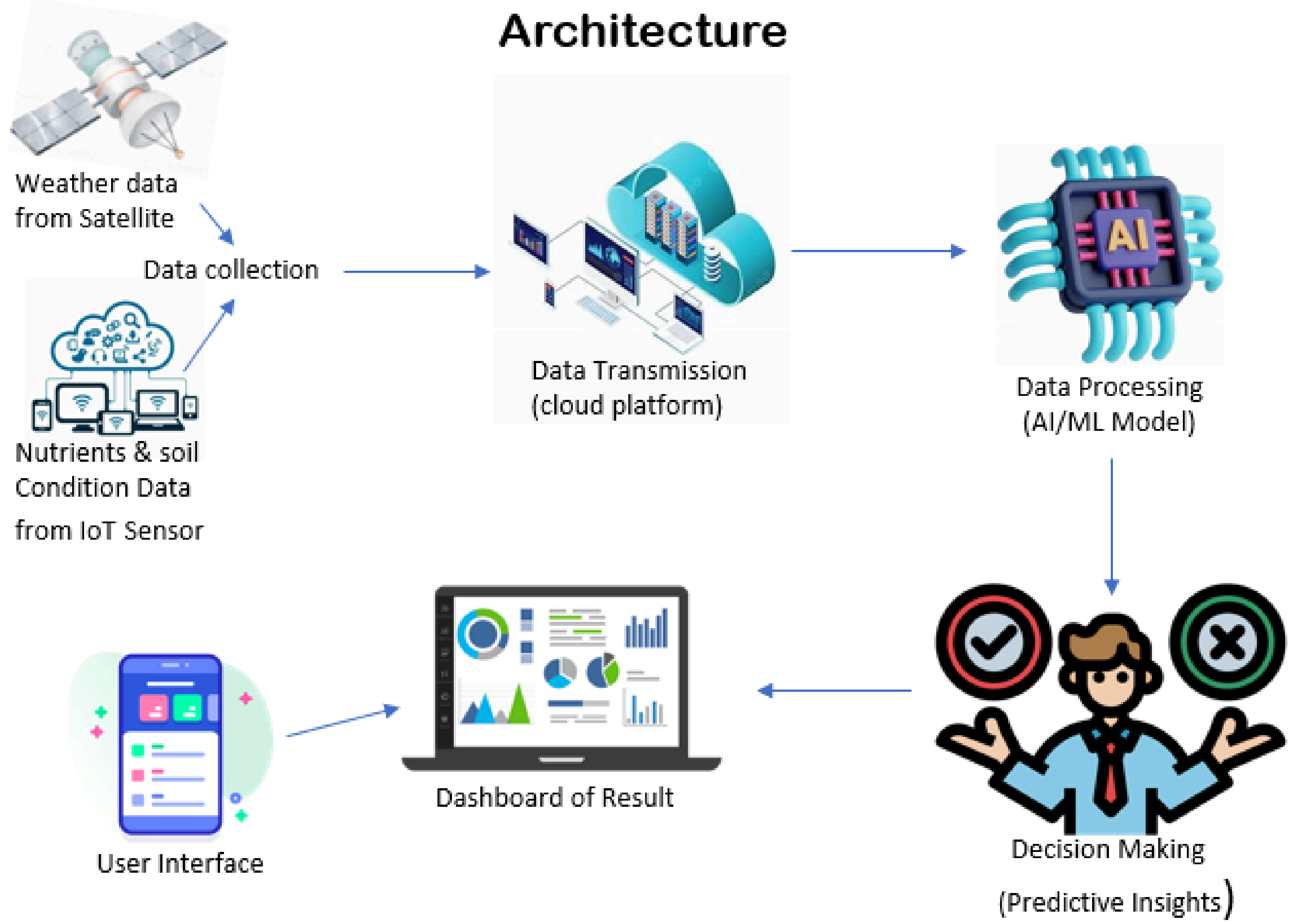
5. Automated Solutions

- Integrate with smart irrigation systems to automatically adjust water distribution based on real-time data.
- Employ drones or automated devices for precise spraying of pesticides and fertilizers, reducing manual labor and resource waste.

6. Sustainability Built-In

- Achieve 30-50% reduction in water wastage through optimized irrigation and efficient water use strategies.
- Minimize environmental impact by controlling chemical application, thus protecting soil health and reducing runoff.

FLOW DIAGRAM



PROTOTYPE DEVELOPMENT

1. Key Components and Their Selection

a) Sensors

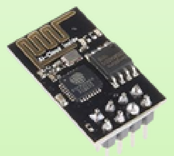
- **Soil Moisture Sensor**: Tracks soil water levels (e.g., Capacitive Soil Moisture Sensor v1.2).
- **Temperature & Humidity Sensor**: Monitors environmental factors (e.g., DHT11/DHT22).
- **pH Sensor:** Measures soil or water pH (e.g., Gravity Analog pH Sensor).
- **Water Flow Sensor:** Detects irrigation flow rates (e.g., YF-S201).
- **Water Quality Sensor:** Assesses turbidity and dissolved oxygen (e.g., DFRobot Gravity Water Quality Sensor).

b) Microcontroller/Processor

- **Microcontroller:** Arduino Uno/ESP32 for managing sensor data collection.
- **Processor:** Raspberry Pi for running machine learning models and managing real-time analytics.


c). Communication Modules

- **Wi-Fi Module:** ESP8266/ESP32 for cloud data transmission.
- **Bluetooth Module:** HC-05 for local data monitoring.




d) Power Supply & Cloud Platform

- Battery pack or solar power for sustainability
- Use platforms like AWS IoT Core, Google Cloud IoT, or ThingsBoard for real-time data processing and visualization.

2.Connection Setup

Sensors to Microcontroller

- Connect each sensor to the microcontroller's analog/digital pins based on sensor specifications.
- Use a multiplexer if there are more sensors than available ports.

Microcontroller to Processor

- For advanced computation, send sensor data from Arduino to Raspberry Pi via serial communication (USB/UART).

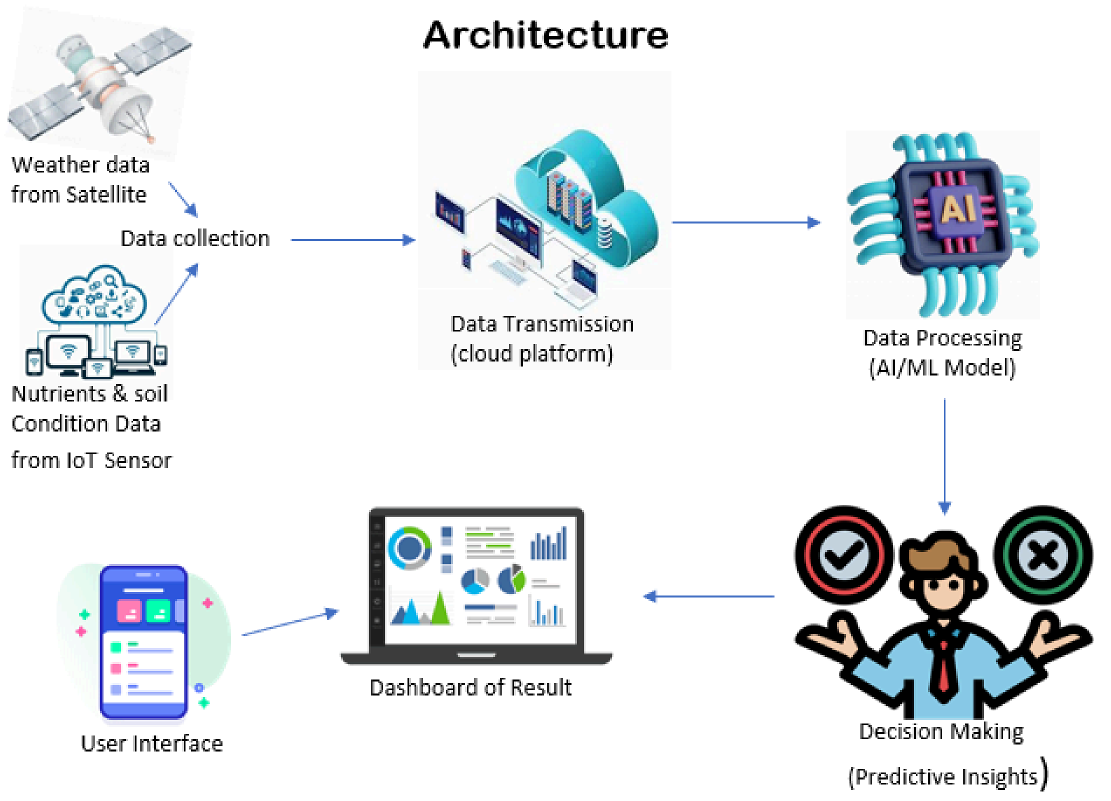
Processor to Cloud

- Use Wi-Fi modules or Ethernet connections to send data from Raspberry Pi to the cloud.

Power Supply

- Power sensors and micro controller using a 5V battery pack or a solar-powered system for sustainability.

3. Software Architecture



4.Integration Plan

- Use jumper wires and a breadboard for initial testing.
- Assemble all sensors on a single PCB for better integration.
- Ensure water-resistant enclosures for sensors exposed to the field.
- Develop a User Interface (UI) for easy interaction.

5. Prototype Testing

- Test sensors individually for accuracy and functionality.
- Validate data transmission to the cloud.
- Verify AI/ML models’ predictions with sample data.
- Ensure real-time alerts and dashboard updates.

6. Cost effective

Component	Cost (Approximate)
Soil Moisture Sensor	₹200-₹500
Temperature & Humidity Sensor	₹150-₹300
pH Sensor	₹1,500-₹2,500
Water Flow Sensor	₹200-₹6,00
Microcontroller (Arduino/ESP32)	₹600-₹1,000
Processor (Raspberry Pi)	₹1,000-₹3,000
Miscellaneous (Cables, PCB, etc.)	₹1,000-₹2,000

TECHNOLOGY STACK

Hardware Components(IoT sensor)

a)IoT Sensors:

- Soil Moisture Sensor (e.g., Capacitive Soil Moisture Sensor v1.2)
- Temperature & Humidity Sensor (e.g., DHT11/DHT22)
- Water Flow Sensor (e.g., YF-S201)
- Water Quality Sensor (e.g., DFRobot Gravity Water Quality Sensor)

b) Microcontrollers:

- Arduino Uno / ESP32 for sensor data collection and initial processing.

c) Edge Devices:

- Raspberry Pi for local computation and data transmission to the cloud.

AI/ML ALGO USED

- **Decision Tree Classifier:** For predicting soil conditions and classifying input data based on defined features.
- **Random Forest Classifier (optional for optimization):** Used for better generalization and reducing overfitting.
- **Grid Search CV:** For hyperparameter tuning to improve model performance.
- **IoT Sensor Data Processing:** For real-time monitoring and data collection.
- **AI/ML Models:** For analyzing data patterns and providing actionable recommendations (e.g., nutrient management, water requirements).

Web & Mobile Development:

a) Frontend:

- React.js: For building an intuitive user interface.
- HTML5, CSS3: For responsive design.

b) **Backend:**

- Flask / Django: For backend services and API development.

c) Mobile App Development:

- Flutter: For creating cross-platform mobile apps.

Visualization & Reporting:

a) Dashboards:

- Power BI: For real-time data visualization and analytics.

b) **Database:**

- Firebase / MySQL: For storing sensor data and user activity logs.

Integration & Automation:

a) Smart Irrigation Systems:

- Controlled using AI algorithms and connected to the IoT network.

Results

Our model achieved an impressive 100% accuracy, showcasing its effectiveness in leveraging well-defined data patterns, validated through cross-validation to ensure robustness and reliabilit

IMPACT

Impact of the Smart Agricultural Monitoring System

Impact ▶ | Economic Benefits | Environmental Benefits | Social Benefits | Scalability and Global Impact | Resilience Against Climate Change

1. Economic Benefits

- **Enhanced Yield**: Farmers can increase productivity by optimizing irrigation, nutrient usage, and pest control.
- **Cost Savings**: Reduces overuse of resources like water and fertilizers, cutting down input costs.
- **Improved Profit Margins:** Early detection of diseases and pests minimizes crop losses, leading to higher revenue.

2.Environmental Benefits

- **Water Conservation:** Efficient irrigation reduces water wastage by 30-50%, contributing to sustainable water management.
- **Soil Health Preservation:** Balanced fertilizer application prevents nutrient leaching and salinization.
- **Lower Carbon Footprint:** Controlled use of fertilizers minimizes greenhouse gas emissions.

3.Social Benefits

- **Improved Livelihoods:** Higher productivity and profitability make farming more sustainable for small and marginal farmers.

- **Food Security:** Ensures stable food production to meet the needs of a growing population.
- **Empowerment through Technology:** Provides farmers with actionable insights, fostering confidence and independence.

4.Scalability and Global Impact

- **Water Conservation:** Efficient irrigation reduces water wastage by 30-50%, contributing to sustainable water management.
- **Soil Health Preservation:** Balanced fertilizer application prevents nutrient leaching and salinization.
- **Lower Carbon Footprint:** Controlled use of fertilizers minimizes greenhouse gas emissions.

5.Resilience Against Climate Change

- **Adaptability:** Provides tools to mitigate risks from erratic weather patterns, such as droughts and floods.
- **Sustainability:** Promotes long-term resilience by integrating advanced technologies for resource management.

Feasibility of the Smart Agricultural Monitoring System

Technical Feasibility

- **Availability of Technology:**
- IoT sensors, microcontrollers (like Arduino/ESP32), and processors (like Raspberry Pi) are widely available and cost-effective.
- Cloud platforms such as AWS, Google Cloud, and Azure offer scalable data storage and processing solutions.
- **AI/ML Readiness:**
- Pre-existing datasets and accessible AI frameworks (e.g., TensorFlow, PyTorch) facilitate the development of machine learning models for crop health prediction and resource optimization.

Economic Feasibility

- **Low Initial Costs:**:Prototype development costs are manageable (₹4000-₹8,450), making it feasible for small-scale testing.
- **Potential for Funding**: Governments, NGOs, and agricultural technology grants prioritize sustainable farming projects, offering financial support.
- **Return on Investment (ROI):** Farmers can achieve ROI within a single growing season by saving water, reducing input costs, and improving yields.

Environmental Feasibility

- **Sustainability:** Promotes efficient resource use, conserving water and soil while reducing environmental impact.
- **Energy Options**: Solar-powered sensors and devices ensure energy efficiency and suitability for remote areas.

Market Feasibility

- **High Demand:**:Growing concerns about water scarcity, food security, and climate variability create a strong need for smart agricultural solutions
- **Farmer-Friendly Adoption**:User-friendly mobile apps and dashboards ensure ease of use, even for less tech-savvy farmers.
- **Scalability:** The modular system can be scaled to large farms or adapted to smaller agricultural setups.

Operational Feasibility

- **Ease of Deployment:**
- Sensors and devices are plug-and-play, allowing rapid deployment in the field.
- Cloud-based systems reduce the need for complex local infrastructure.
- **Maintenance and Support:** Minimal maintenance required for IoT sensors; cloud services handle most data processing and updates.

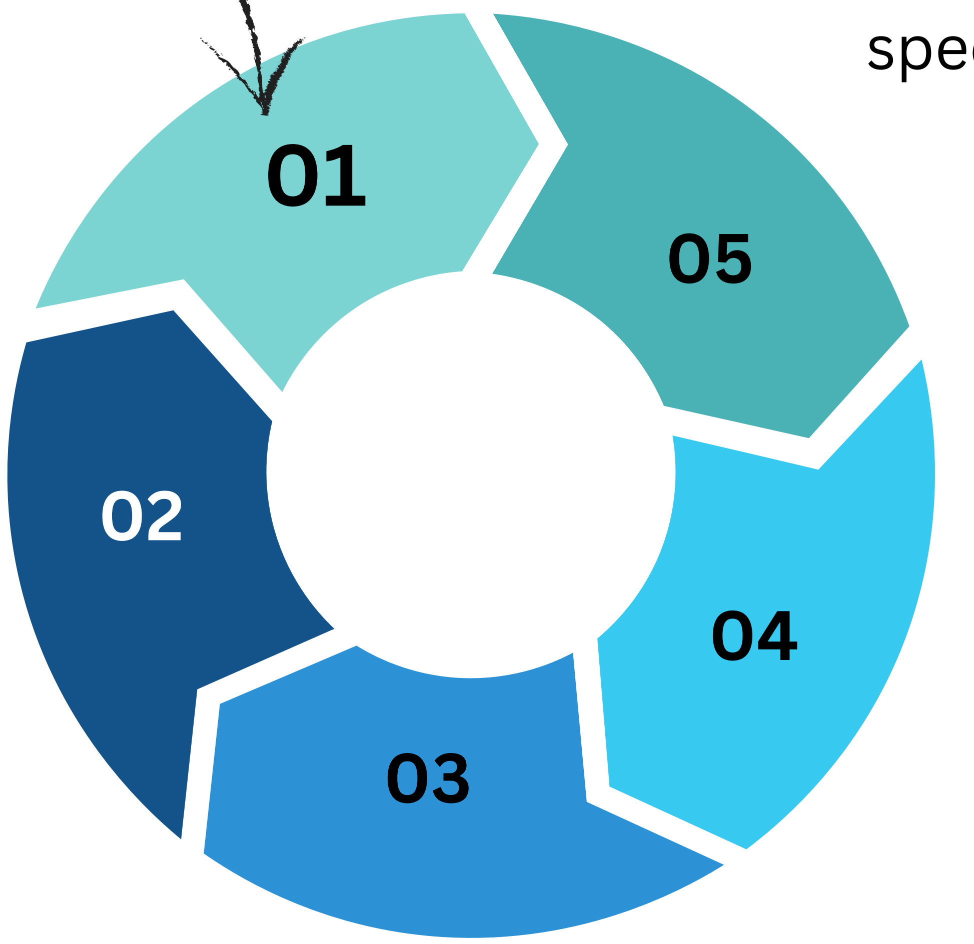
Social Feasibility

- **Impact on Farmers:**
- Educating farmers through demonstration projects can ensure better adoption and trust in the system.
- Addresses real-world issues like crop losses and resource inefficiency, making it highly relevant.

BUSSINESS MODEL

1. Value Proposition:

- **For Farmers**: Boost crop yield by 20-30%, reduce water wastage by 50%, and cut input costs.
- **For Policymakers & Agribusinesses**: Real-time agricultural data for better decisions and sustainability.



5.Scalability:

Start locally, expand nationally with crop-specific solutions, and then scale globally.

2.Revenue Streams:

- **Subscription Plans:** Basic, Premium, and Enterprise tiers.
- **Device Sales:** IoT sensor kits and bundled solutions.
- **Data Monetization:** Sell anonymized insights for research and analytics.
- **Consulting Services:** Tailored advice for governments and agribusinesses.
- **Freemium App Model:** Free basic app; advanced features at a cost

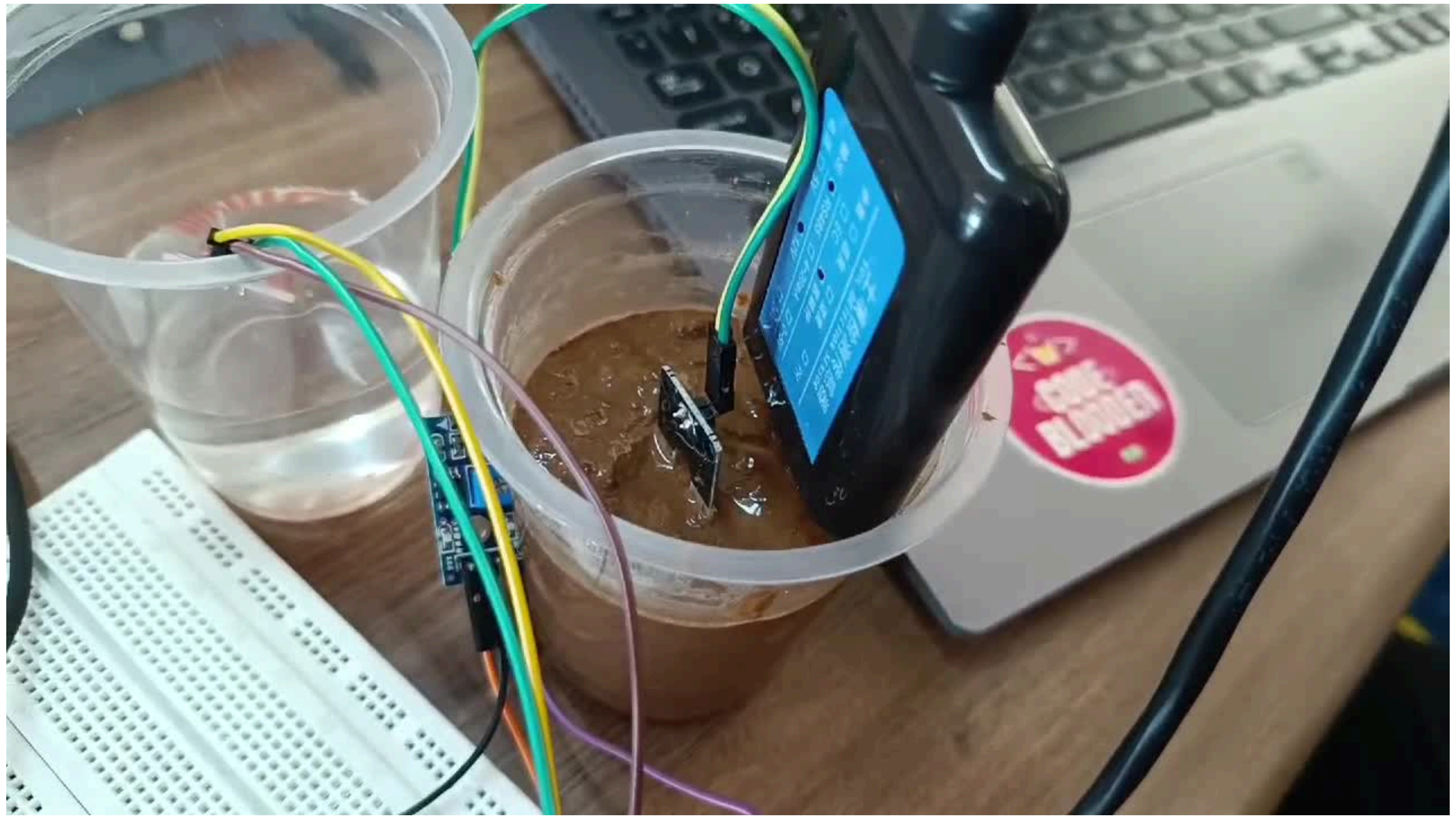
4.Cost Structure

R&D, manufacturing, cloud infrastructure, marketing, and support.

3.Target Audience:

Small and medium farmers, agribusinesses, governments, NGOs, and research institutions.

VIDEO PROTOTYPE



video link

RECOGNITION

Selection Confirmation: Finalist for Tech and Innovation fair-2025 Inbox

Innovision Shaastr... 5 days ago
to me

Dear participant,

I hope this email finds you well. We are delighted to inform you that your team **JARVIS**, has been shortlisted to the finals for the upcoming event at Tech and Innovation Fair at Shaastra, IIT Madras!

🗓️ Dates: 3rd-5th January 2025
📍 Venue: IIT Madras campus

The event begins with a closed networking session on Jan 3rd and Jan 4th is the Grand Finale of the event. Teams get to exhibit their prototype at the Exhibition stalls on Jan 5th with a 60k+ footfall.

To confirm your participation and ensure your slot for this enriching experience, please reply confirming your availability for the event dates.

Further instructions regarding your stay and event details will be shared after confirmation on our group: https://chat.whatsapp.com/E4BioHejiHkBlujc3DAxaG

Warm regards,
Rutika
Head - TIF,
Shaastra, IITM

TECH AND INNOVATION FAIR (IIT-MADRAS)

NAF's Uzhavu Hackathon results | Shaastra 2025 Inbox

Unstop Events 7:43 pm
to me

NAF's Uzhavu Hackathon | Shaastra 2025

Hi **Abhishek Singh**,

Greetings from Team Shaastra!

We are pleased to inform you that your submission for the NAF's Uzhavu Hackathon has been selected for the next ro' nc We believe your innovative approach align. pe.:.:ctly with our goal of advancing sustainable agriculture, and we are excited to see how your idea will contribute to this

NAF Uzhavu Hackathon (IIT-MADRAS)

CONGRATULATIONS-CMRCET HACKFEST 2.0-SHORTLISTED TEAMS Inbox

HOD CEER 5:11 pm
to Vaidik, alankaramsuhas, R...

Dear Participant,
We hope this message finds you well.
It is with immense pleasure that we extend our heartfelt **CONGRATULATIONS** to you and your team for successfully advancing to the final round of the Hackathon Project Competition in **HACKFEST 2.0**. Out of the **1531 teams** that registered from 20 states across the country, your team was one of them who showcased their exceptional Skills and Innovation, securing a place among the **top 121 teams**. This achievement is the testament to your hard work, dedication and vision to solve real world problems with your Innovations.

Here are some important instructions and details for the final round:

CMR CET #HYDRABAD

Result Out | Techno-Business Hackathon - Jaipuria Institute of Management (JIM), Noida Inbox

Unstop 4:46 pm
to me

unstop

JAIPURIA

Techno-Business Hackathon
Jaipuria Institute of Management (JIM), Noida

Hi **Abhishek Singh**,

Congratulations, we want to inform you that you have qualified the Startup Ideas Submission round of Techno-Business Hackathon which you played.

Round: Startup Ideas Submission

View Result

Regards,
Jaipuria Institute of Management (JIM), Noida Team

Techno Bussiness Hackathon JIM #NOIDA

GGV IDEATHON 24 Winner

National Innovation Award 24 consolation prize winner

THANK YOU