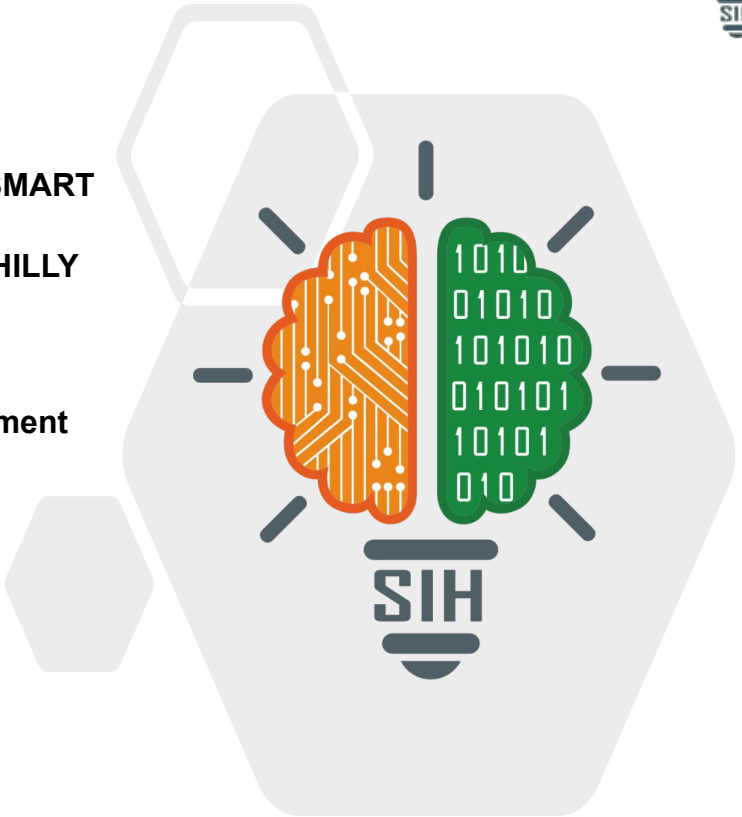
SMART INDIA HACKATHON 2025

- **Problem Statement ID – 25062**
- **Problem Statement Title - IMPLEMENTATION OF SMART AGRICULTURE FOR EFFICIENT CULTIVATION IN HILLY REGIONS**
- **Theme- Agriculture, FoodTech and Rural Development**
- **PS Category- Hardware**
- **Team ID-**
- **Team Name- SmartAgro**



SmartAgro

Demo Video

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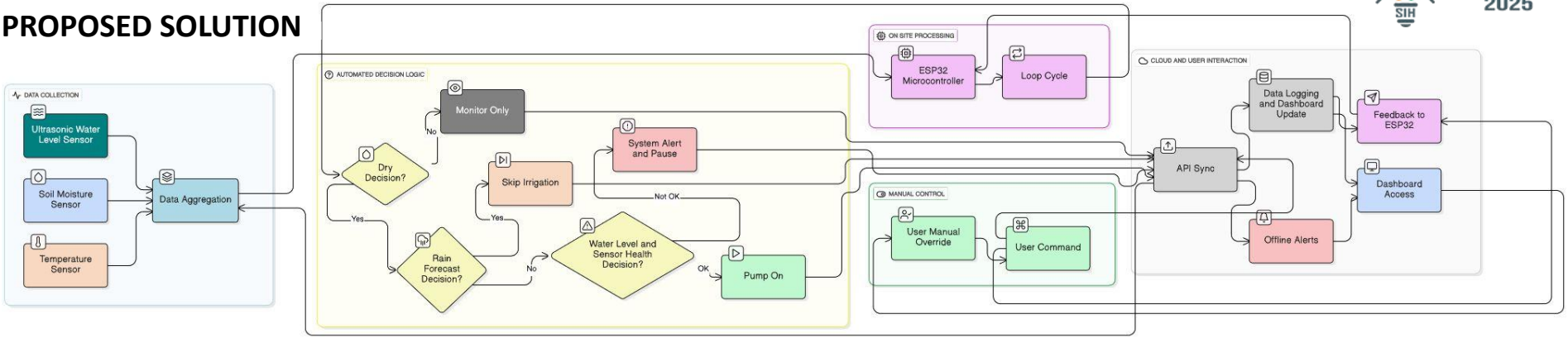
PROPOSED SOLUTION



How it Addresses the Problem

Automated Irrigation: The system waters crops only when soil moisture is low, reducing manual effort and ensuring plants receive the right amount of water.

Weather-Aware: By checking weather forecasts, irrigation is skipped if rain is predicted, saving water and preventing overwatering.

Precision Farming: Real-time data from soil, temperature, and humidity sensors allows precise irrigation tailored to current field conditions.

Remote Monitoring: Users can track soil and system status and control irrigation remotely, increasing convenience and efficiency.

Resource Efficiency: Optimizes water and energy use, ensuring sustainable and cost-effective farming.

Innovation & Uniqueness

Smart Decision-Making: Combines real-time soil and weather data to automate irrigation efficiently.

Low-Cost Automation: Uses ESP32 with multiple sensors for affordable, scalable deployment.

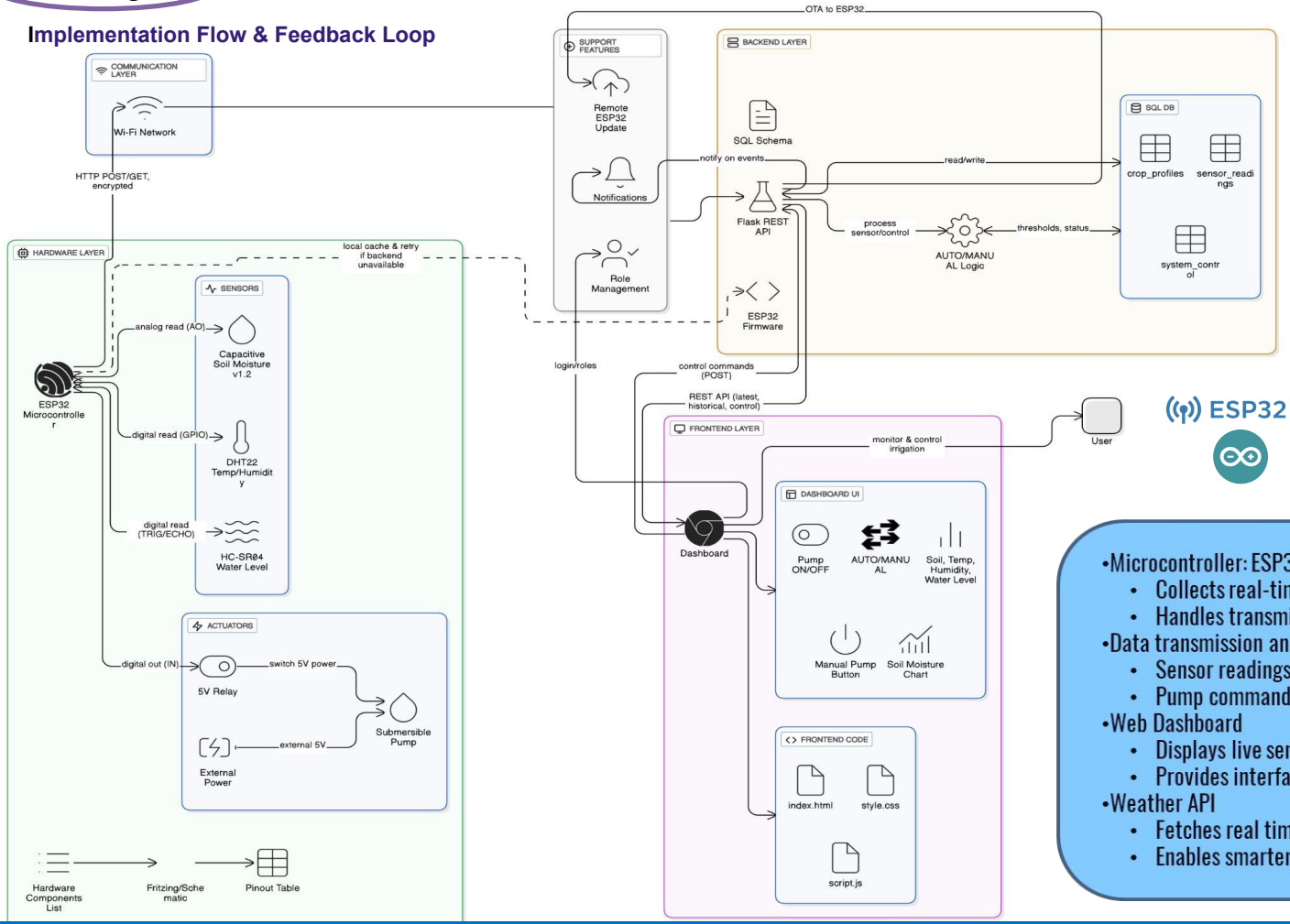
Remote Control: Software interface allows monitoring and managing irrigation from anywhere.

Water Efficiency: Prevents overwatering, unlike traditional timers or manual systems.

Sustainable Design: Eco-friendly setup reduces water wastage.

TECHNICAL APPROACH

Implementation Flow & Feedback Loop



Software Stack

- Python
- Flask
- SQL
- HTML/CSS/JavaScript
- Jinja
- Flask-Login & Werkzeug

Hardware Components

- ESP32 Microcontroller
- Relay Module
- DHT22 Sensor
- Ultrasonic HC-SR04
- Soil Moisture Sensor
- 5V DC Pump

ESP32

SQL

HTML CSS {/}

Jinja

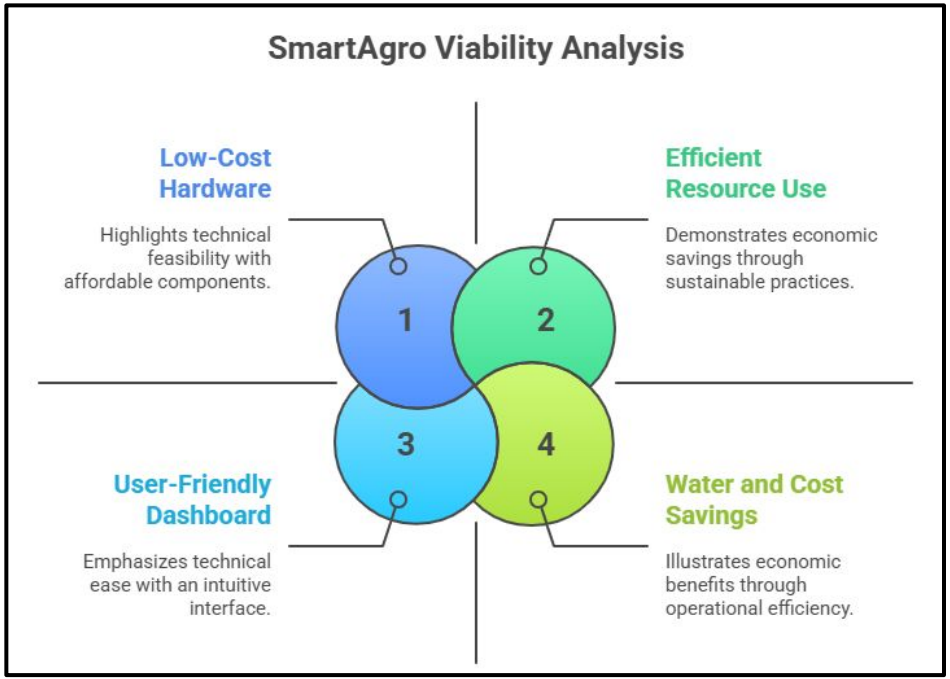
Flask Login

WERKZEUG

- Microcontroller: ESP32
  - Collects real-time sensor data.
  - Handles transmission and receival of data from server.
- Data transmission and server
  - Sensor readings sent to Flask server using HTTP POST.
  - Pump commands sent to ESP32 using HTTP GET.
- Web Dashboard
  - Displays live sensor and weather data.
  - Provides interface for manual and automatic pump control
- Weather API
  - Fetches real time weather data.
  - Enables smarter irrigation based on external conditions.

FEASIBILITY AND VIABILITY

Potential Challenges & Risks	Solutions & Strategies	Analysis of Feasibility
Integrating multiple sensors with ESP32 without data conflicts.	Designed a structured data collection and communication protocol.	Tested successfully on a small setup; scalable to larger systems.
Ensuring accurate irrigation decisions with variable weather conditions.	Incorporated real-time weather API into the microcontroller logic.	Works reliably in simulations and real-time testing.
Managing software-hardware communication efficiently.	Used Flask backend with clear API endpoints for sensor data and control.	Smooth data flow achieved; responsive web interface confirmed.
Preventing pump overuse or malfunction.	Implemented feedback loop using soil moisture readings to stop irrigation	Controlled successfully in prototype tests without hardware issues.
Making the system user-friendly for non-technical users.	Developed a simple web interface with remote monitoring and control	User testing shows easy accessibility and minimal learning curve.

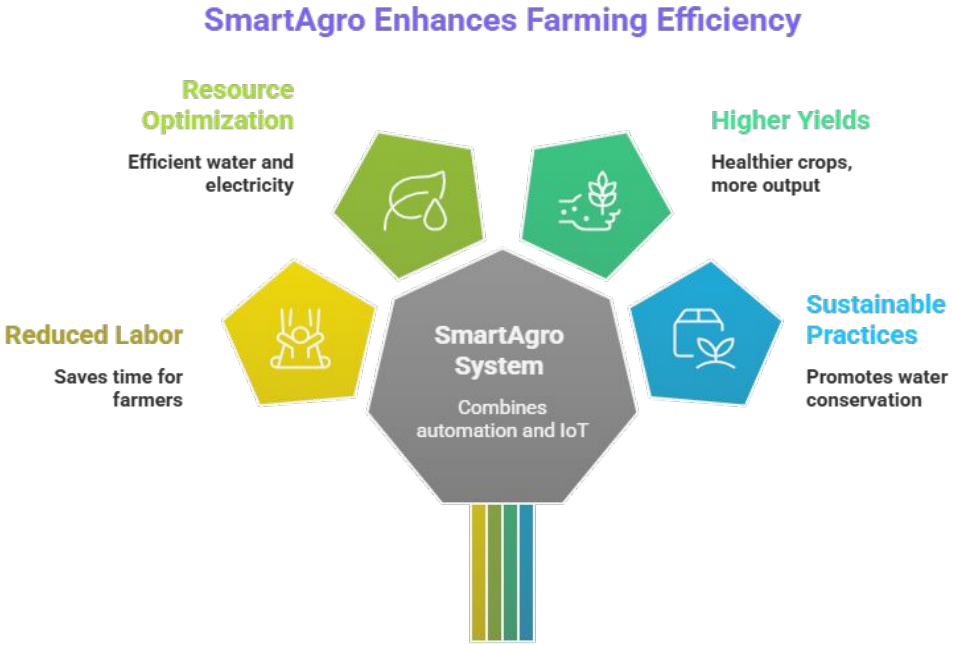


IMPACT AND BENEFITS

Potential Impact on Target Audience

- **Empower Farmers** — Hilly/remote regions
- **Reduce Manual Labor** — Ease of farming
- **Increase Crop Yield** — optimized irrigation
- **Promote Tech Adoption** — Rural areas

Benefits of SmartAgro



Efficient resource usage: Optimizes water and energy, reducing costs and waste

Enhanced crop yield: Data-driven irrigation improves productivity and quality

Time-saving automation: Reduces manual labor and daily monitoring effort.

Real-time insights: Monitors soil moisture, weather, and crop conditions for timely interventions

Adaptable & scalable: Suitable for various farm sizes and crop types.

RESEARCH AND REFERENCES

1. Soil Moisture Analysis (Research & Monitoring)

- The National Coordinated Soil Moisture Monitoring Network (NCSMMN) features multi-agency, high-quality soil moisture data, tools, and research for better agricultural monitoring.
  https://www.drought.gov/drought-in-action/national-coordinated-soil-moisture-monitoring-network
- Indian Space Research Organisation (ISRO) provides high-resolution operational soil moisture products for agriculture.
  https://www.isro.gov.in/High-Resolution_Operational_Soil_Moisture_Product.html

2. Crop Pattern Review (Differences and Trends)

- Statistical and analytical government resource for cropping pattern change and productivity using climate, water, and crop yield models.
  https://www.agriscigroup.us/articles/IJASFT-6-150.php
- India government's climate data service portal offers data for crop and climate analysis.
  https://www.india.gov.in/website-climate-data-service-portal-cdsp

3. Weather Data Evaluation for Agriculture

- India Meteorological Department (IMD) Agriculture Meteorology Division provides weather forecast, agro-met advisory, and climate information for agriculture.
  https://imdagrimet.gov.in
- Ministry of Agriculture weather resource system, advisories, forecasts, and agromet services in India.
  https://www.india.gov.in/topics/agriculture/weather

4. IoT Systems Evaluation and Design for Agriculture

- Ministry of Science & Technology press release: Government activities, national missions, and research on IoT and AI for agriculture.
  https://www.pib.gov.in/PressReleaseIframePage.aspx?PRID=1885193
- Recent government note on adoption of AI and IoT for crop productivity, sustainability, and agricultural system improvement.
  https://www.pib.gov.in/PressReleasePage.aspx?PRID=2146922

5. Guidelines and Design for Irrigation Schedules

- Ministry of Jal Shakti's Central Water Commission guidelines for improving water use efficiency, irrigation scheduling, and canal command management.
  https://nwm.gov.in/sites/default/files/Final%20Guideline%20Wateruse.pdf
- Central Water Commission's repository of guidelines and technical publications, including design and planning for efficient piped irrigation networks.
  https://cwc.gov.in/guidelines-and-guide-book-publications