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| **Stage Activity** | **Tools** | **Outcome** | **Metrics/Rubrics** |
| PHASE - I |  |  |  |
| Stage-1:Brainstroming | GD:  Challenges – Unoptimized water usage, manual irrigation dependency, over- or under-watering risks  Opportunities – Efficient water management using IoT and ML for smart decision-making  Ideas – Develop an automated irrigation system using real-time data and predictive analytics for optimal performance in greenhouses  FLASH CARD:  Type - Tech-Driven Agri Project  Domain - Precision Agriculture / IoT System  Stakeholders - Farmers, Greenhouse Operators, Agri-tech Startups, Water Boards  Technologies – Sensors are Soil Moisture, DS18B20 (Temperature), optional DHT11 (Humidity) Processing with ESP32 + Cloud Software: ML models for scheduling, cloud dashboard, trend analysis tools Connectivity through Wi-Fi or LoRa to sync sensor data with cloud | Refined PS (Key Points): A Smart Irrigation System that can: 1. Monitor real-time soil and climate conditions 2. Use ML to analyze moisture trends 3.Forecast water needs 4.Automate irrigation scheduling 5. Improve water use efficiency and crop yield through intelligent decisions | (4) The problem is restated well with insights and outputs presented in detail (3) The problem is restated well with vague insights (2) The problem is clearly stated but lacks output detail (1) Vague problem and unclear outputs |
| Stage - 2:Idea Posting | Mind Map: | Document: |  |
| PHASE - II |  |  |  |
| Stage - 3:Customer Mapping | Questionnaire:  1.) For greenhouse farmers  2.) For agri-business operators  3.) For farm equipment suppliers  4.) Agricultural extension officers | Requirement Specification from Customer Mapping:  \* Real-time alerts for soil moisture levels, reduce labor in irrigation.  \* Cloud dashboards for multi-greenhouse monitoring, data export support.  \* Modular hardware with easy replacement, battery backup support.  \* Visualization for training farmers, ability to monitor remotely | Rubrics/Metrics:  (4) Questionnaire is exhaustive and the inferences are established well as resource requirements  (3) The questionnaire is exhaustive but the inferences are not well established as resource requirements  (2) The questionnaire is not exhaustive but the inference mapping is good  (1) The questionnaire is not defined properly and the inferences out of them are also not good |
| PHASE - III |  |  |  |
| Stage - 4:Idea Layout | Sticky Notes: | Overview: |  |
| PHASE - IV |  |  |  |
| Stage - 5: Reflection | Checklist:  Soil Moisture & DS18B20 sensors integrated.  Cloud platform (e.g., AWS IoT, ThingSpeak).  ML model trained for irrigation scheduling.  Dashboard (e.g., Power BI) for visualization. | Potential Gaps:  Sensor accuracy in varied soil types.  Dependency on stable internet for cloud analytics.  Scalability for large greenhouse networks. |  |
| Stage -6 Design of Module | Modular Architecture:  Conceptual Design  Smart irrigation using sensor data and ML-based decisions.  Real-time soil and temperature monitoring.  Cloud-based models optimize water use.  Dashboards provide trends and forecasts.  Component Level  Sensors: Soil Moisture, DS18B20 (Temperature)  Microcontroller: ESP32 (Data read & Wi-Fi)  Connectivity: Wi-Fi (Cloud sync)  Cloud: Data storage + ML irrigation model  Analytics: Power BI for visualization  Actuation: Relay + Solenoid Valve for irrigation control  Block/System Level  Input: Soil Moisture & Temperature Sensors  Processing: ESP32 + Cloud  Decision: ML-based scheduling  Output: Relay → Valve → Irrigation  Monitoring: Power BI Dashboard |  |  |
| Stage 7-Resources Identification |  | Relay Module (1-Channel)  Controls water pump or solenoid valve switching  Solenoid Valve (12V DC) Controls water flow based on irrigation logic  Power Supply Adapter Provides regulated power to ESP32 and peripherals  CO₂ Sensor Monitors carbon dioxide levels for plant health optimization |  |
| Stage 8: Planning | Wi-Fi and power are consistently available  One moisture and one temperature sensor are sufficient  Data collected is reliable for ML predictions  Constraints  Budget capped at ₹2,500  Limited hardware (single sensor per type)  Time-bound testing and deployment  Risks are  Sensor inaccuracy or failure  Power or network disruptions  Incorrect irrigation due to faulty predictions |  |  |
| Stage 9:Redesign | Soil Moisture, Temperature, Humidity, and CO sensors integrated.  ✔️ Thresholds adjustable for humidity and gas levels.  ✔️ Dashboard updated with additional sensor data.  ✔️ Alerts added for high CO levels and low humidity.  ✔️ Modular design updated to support extra sensors.  ✔️ Data used to refine irrigation logic and ventilation triggers. | Additional Re-Design Works Based on New Sensors:  🌬️ Automated fan/ventilation control based on CO readings.  🌫️ Smart fogger/humidifier control based on humidity threshold.  📊 Historical logging of air quality and humidity for trend analysis.  🧠 ML model retrained to consider humidity & air quality in irrigation decisions. |  |
| PHASE - V |  |  |  |
| Stage 10:Execution  Framework | Focused Modules  Sensor System  Soil Moisture, DS18B20 (Temperature), DHT11 (Humidity), CO Sensor, ESP32  Dashboard & Data Sync  Power BI / Blynk Dashboard, Cloud Integration (ThingSpeak/MQTT)  Actuation Control  Relay with Solenoid Valve for irrigation, Fan for CO and humidity control  Power Management  Rechargeable Battery Backup, Optional Solar Panel, Voltage Monitoring |  |  |
| Stage 11:Micromodules -Mindmap |  |  |  |
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