SMARTAGRINET: SUSTAINABLE SMART FARMING WITH IOT MONITORING AND ML BASED IRRIGATION PREDICTION

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College : *BGS College of Engineering and Technology, Bengaluru*
Branch : *Department of Information Science and Engineering*
Guide : *Dr. Chaitra Naveen*
Students : *Ms. Sai Smitha*
Ms. Sai Sushmitha
Ms. Sneha M
Mr. Shankargoud Sharanabasapa Patil

Keywords:

IoT-Based Smart Farming, Smart Irrigation System, Soil Moisture Monitoring, Sustainable Agriculture, Real-Time Environmental Sensing, Water Resource Optimization.

Introduction:

SmartAgriNet is an IoT- and Machine Learning–based smart farming system designed to automate irrigation and enable data-driven agriculture.It addresses key agricultural challenges such as water wastage, manual labor, and inconsistent crop yields.The system promotes sustainable and efficient farming through intelligent automation and real-time monitoring.It uses IoT sensors to continuously collect soil moisture, temperature, humidity, and light intensity data.An ESP8266 NodeMCU processes sensor data and controls irrigation using a relay-driven water pump.The system automatically turns irrigation on or off based on real-time field conditions.All collected data is uploaded to the ThingSpeak cloud for storage and visualization.Farmers can monitor farm conditions remotely through a user-friendly web dashboard.The dashboard also allows manual control and sends alerts when required.Machine learning models analyze data to predict irrigation needs.It also recommends suitable crops based on soil and climate conditions.This combination of IoT and AI makes the system more intelligent than traditional methods.Solar energy integration ensures eco-friendly and uninterrupted operation.The system is low-cost, scalable, and suitable for rural and remote areas.The project includes hardware integration, programming, cloud connectivity, and ML model development.It uses tools like Arduino IDE, Python, ThingSpeak, pandas, and scikit-learn.SmartAgriNet improves water efficiency, reduces labor, increases yield, and supports modern precision farming.

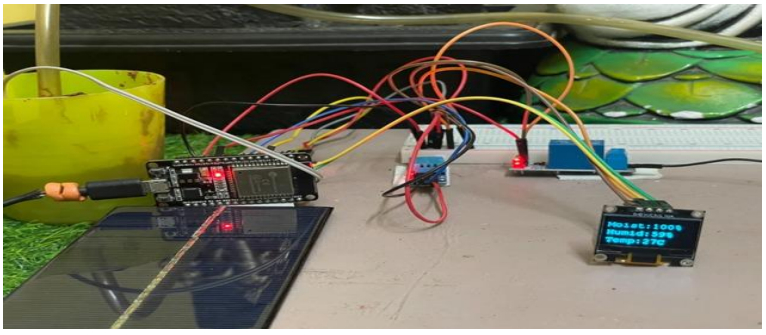


Fig 1: SmartAgriNet: Sustainable Smart Farming with IoT Monitoring and ML Based Irrigation Prediction

Objectives:

1. To design an IoT-based system for continuous monitoring of soil moisture, temperature, humidity, and light intensity.
2. To automate irrigation using real-time sensor data to minimize manual intervention and water wastage.
3. To implement a machine learning model that predicts irrigation requirements and recommends suitable crops based on soil and environmental conditions.
4. To develop a web dashboard that enables farmers to remotely monitor field conditions and control irrigation operations.
5. To utilize solar power for system operation, ensuring energy efficiency and suitability for remote agricultural areas.

Methodology:

Dataset: https://www.kaggle.com/datasets/prateekkkumar/crop-water-requirement

Step 1: Collect real-time soil and environmental data using IoT sensors
Step 2: Process sensor data using ESP32 microcontroller
Step 3: Analyze soil moisture and automate irrigation using relay- controlled pump
Step 4: Transmit sensor data to ThingSpeak cloud via Wi-Fi
Step 5: Preprocess data and train ML model (Random Forest)
Step 6: Predict crops and irrigation needs and display on dashboard
Step 7: Send SMS alerts and power system using solar energy

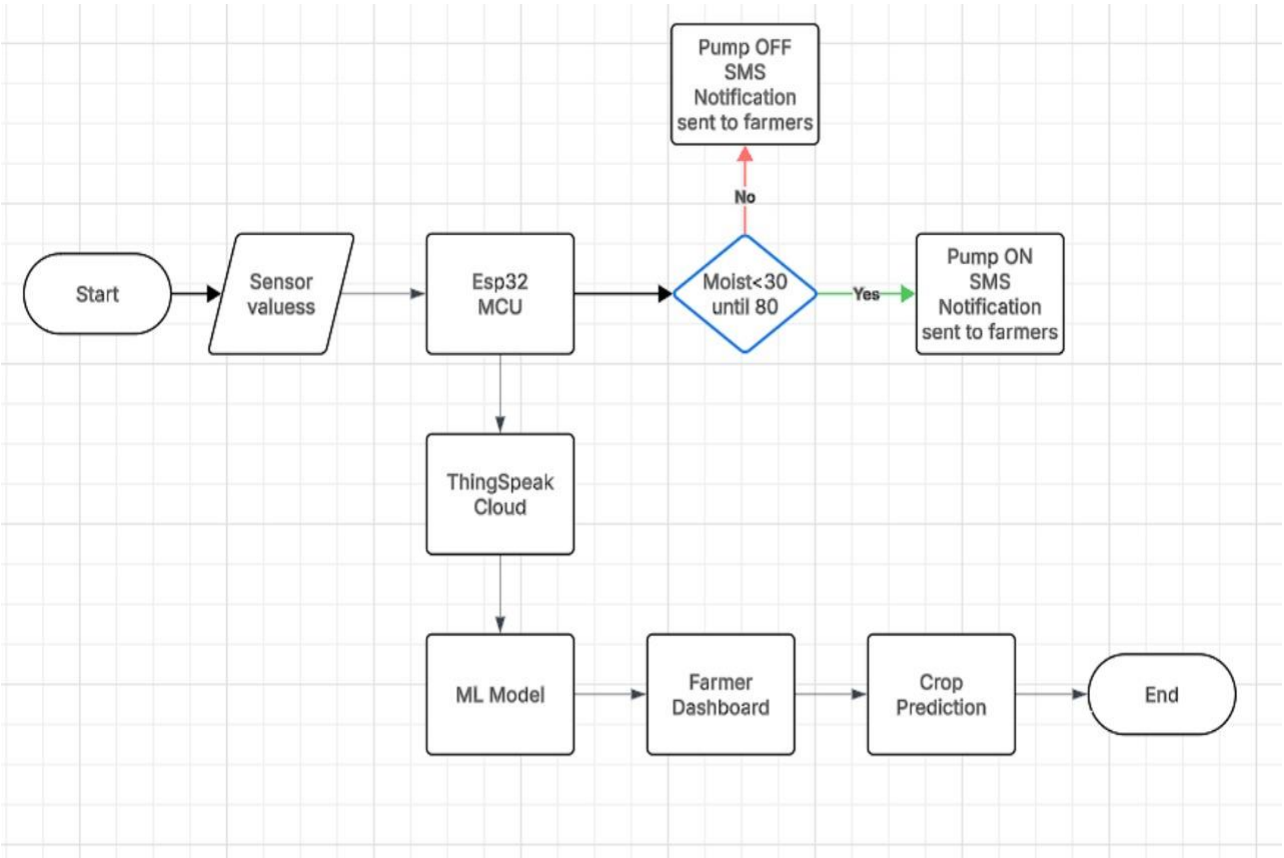


Fig 2: Block diagram of methodology

Result and Conclusion:

1. SmartAgriNet system presents an efficient and sustainable solution for modern agriculture through the integration of IoT, machine learning, and cloud computing. The proposed model automates irrigation by analyzing real-time environmental and soil data and predicts suitable crops based on conditions such as soil moisture, humidity, temperature, and nutrient levels.
2. Through experimental validation, the system demonstrated improved water utilization, enhanced crop recommendation accuracy, and reduced manual intervention. The inclusion of Twilio SMS notifications enables instant communication with farmers, ensuring prompt irrigation control and field awareness even from remote locations.
3. By utilizing renewable energy sources and intelligent automation, SmartAgriNet supports the concept of sustainable and precision farming. This project contributes to building smarter agricultural ecosystems that improve productivity, conserve resources, and empower farmers with real-time data-driven insights.

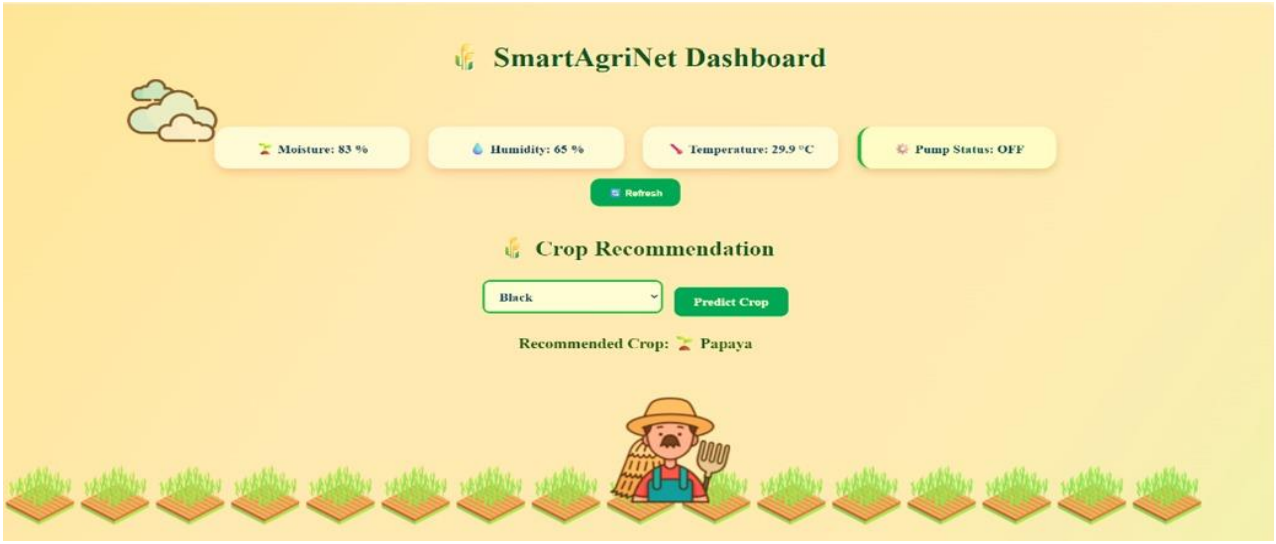


Fig 3: Snapshot Farmers Dashboard

Fig 4: Snapshot of drop-down menu where than select the type of soil and predict the type of the crop

Fig 5: Real time data visualizations on ThingsSpeak cloud

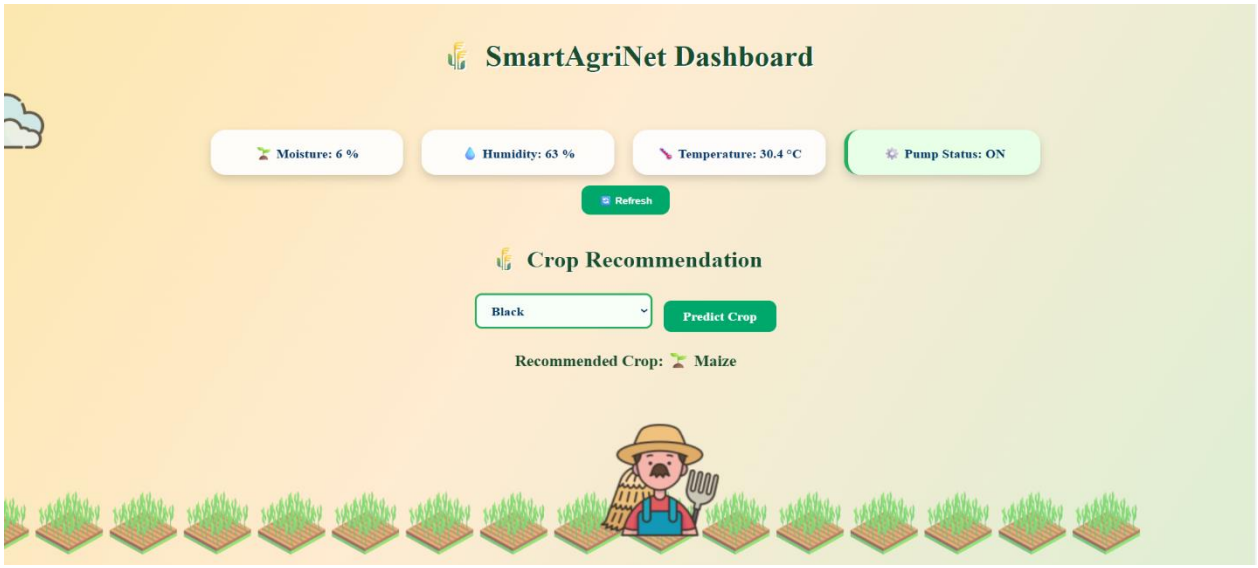
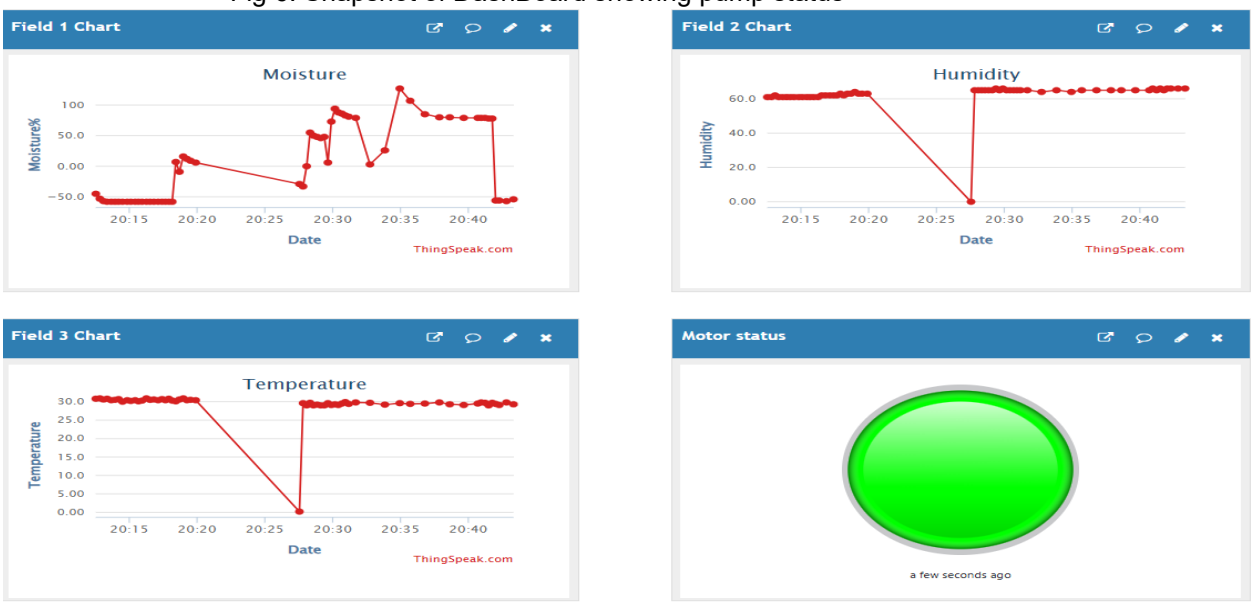


Fig 6: Snapshot of DashBoard showing pump status



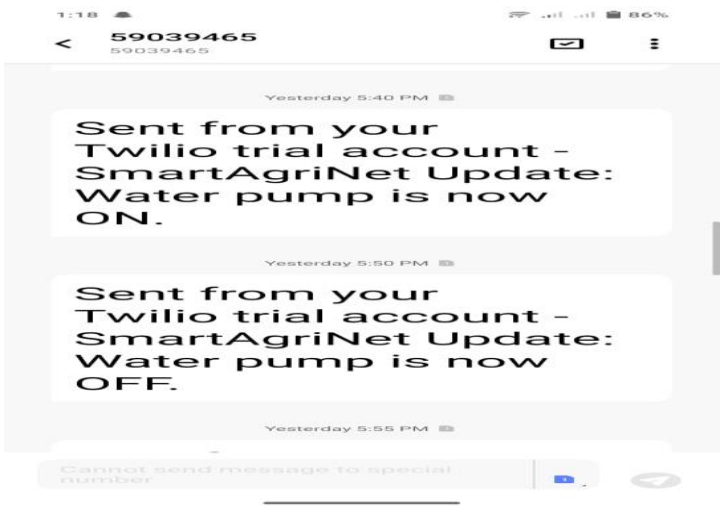


Fig 6: SMS sent to farmers mobile when Water Pump is ON/OFF

References:

[1] S. C, Boovaneswari, S. S and S. P, "Intelligent Water Management System Utilizing AI for Precision Agriculture," *2024 International Conference on System, Computation, Automation and Networking (ICSCAN)*, PUDUCHERRY, India, 2024, pp. 1-5, doi: 10.1109/ICSCAN62807.2024.10894485.

[2] Jenisha, K. J., & Kumar, R. S. (2024, February). *Smart irrigation system with real time weather monitoring.* International Journal of Novel Research and Development, 9(2), c178 –c184. https://ijnrd.org/papers/IJNRD2402220.pdf

[3] Abo-Zahhad, M. (2023). IoT-Based Automated Management Irrigation System Using Soil Moisture Data and Weather Forecasting Adopting Machine Learning Technique. *Sohag Engineering Journal*, *3*(2), 122-140.doi:10.21608/sej.2023.209528.1037

[4] Ragab, M., Badreldeen, M., Sedhom, A., & Mamdouh, W. (2022). IOT based Smart Irrigation System. *International Journal of Industry and Sustainable Development*, *3*(1), 76-86. doi: 10.21608/ijisd.2022.148007.1021

Future Scope:

The future scope of this project includes:

1. The SmartAgriNet system can be further enhanced with several advanced features and technologies to improve agricultural efficiency and sustainability. In the future, this project can be extended to include AI-based weather prediction and automated fertilizer management to assist farmers in making more informed decisions. Integration with drone technology can enable aerial monitoring of crop health and field mapping.
2. The system can also be improved by incorporating blockchain for secure data sharing and predictive analytics for yield estimation. Real-time voice alerts and multilingual support can be added to make the system more user-friendly for rural farmers. Additionally, the use of edge computing and 5G connectivity can make data processing faster and more reliable in remote areas.
3. Overall, SmartAgriNet has great potential for expansion into a complete smart farming ecosystem, combining IoT, AI, and data analytics to promote sustainable and efficient agriculture on a larger scale.