* 1. K.L.N. COLLEGE OF ENGINEERING , MADURAI – NEDUNKULAM ROAD, POTTAPALAYAM – 630612,

SIVAGANGAI DISTRICT, 04522090971, [principal@klnce.edu](mailto:principal@klnce.edu) , 9940125238

* 1. PRADEEPKANNAN , MANAGER , pradeepkannand@gmail.com , 9894770741
  2. STUDENT
  3. SHYAM J
  4. TAMIL NADU
  5. MADURAI
  6. [shyamjk10@gmail.com](mailto:shyamjk10@gmail.com)
  7. 6380254785
  8. Category
  9. Male
  10. No 11E, Joseph Nagar 2nd Cross Street, Thirunagar, Madurai – 625006

**2.1** AI and IoT based Crop Recommendation System.

**2.3**

* **Mobile Sensor Units:** The use of manually transported mobile sensor units allows for flexible and comprehensive data collection across an acre of land, capturing variability in soil conditions.
* **Real-Time Data Processing:** The system collects and processes real-time data from both fixed sensors and mobile units, providing timely and relevant crop recommendations.
* **Integration of Data Sources:** Combining soil data with weather information from APIs creates a holistic approach to crop recommendations, enhancing accuracy.
* **Adaptive Machine Learning Model:** The model can learn and improve over time based on collected data and user feedback, leading to increasingly accurate recommendations.

**2.4**

**Concept of the Project**

This project aims to create an AI and IoT-based crop recommendation system that utilizes fixed and mobile sensors to collect real-time data on soil conditions and weather patterns. By analyzing this data through a machine learning model, the system will provide farmers with tailored crop recommendations, accessible via a user-friendly web interface.

**Objectives of the Project**

1. **Real-Time Data Collection**: Implement sensors to gather comprehensive data on soil and environmental conditions.
2. **Accurate Crop Recommendations**: Develop a machine learning model to analyze data and suggest suitable crops.
3. **User-Friendly Interface**: Create an intuitive web application for easy access to data and recommendations.
4. **Sustainability**: Promote resource-efficient farming practices to minimize environmental impact.
5. **Adaptability**: Enable continuous improvement of the system through learning from historical data and user feedback.

**2.5**

**Precision Agriculture**: Tailored crop management using real-time data to enhance yields and optimize resource use.

**Smallholder Farming**: Providing accessible, data-driven tools to improve productivity for small-scale farmers.

**Agricultural Research**: Supporting studies on crop performance, soil health, and environmental impact assessments.

**Agribusiness Consulting**: Assisting agribusiness firms with data-driven solutions for crop planning and resource management.

**Government and NGOs**: Aiding agricultural development programs aimed at food security and sustainability in rural areas.

**2.6**

**Agritech Growth**: The global agritech market is projected to reach approximately **$22.5 billion by 2025**, growing at a CAGR of about **12.5%**. This growth is driven by the increasing demand for food due to the growing population and the need for sustainable farming practices.

**IoT in Agriculture**: The IoT in agriculture market is expected to grow from **$14 billion in 2021 to over $30 billion by 2026**, reflecting a CAGR of around **15%**. This growth is fueled by the adoption of smart farming technologies that enhance data collection and analysis.

**Precision Agriculture Market**: The precision agriculture market is anticipated to grow at a CAGR of **13.5%** from **$7.0 billion in 2021 to $12.9 billion by 2026**. The increasing use of data analytics and IoT devices is a significant contributor to this growth.

**3.1**  8 kits - ₹ 2,50,000, 1 kit - ₹ 30,000

**5**

This project develops a smart crop recommendation system that uses fixed sensor units across farmland to collect environmental and soil data. Data is wirelessly transmitted to a central device, where it’s processed and analyzed to provide crop recommendations through a web app interface. This approach enhances agricultural productivity by allowing data-driven, efficient crop choices based on real-time field conditions.

**6a)** no

**6b)** Yes, there is similar prior art, including IoT-based precision agriculture systems like Microsoft’s FarmBeats and Libelium’s Smart Agriculture Kit that use sensors, LoRa networks, and machine learning for crop management and recommendations.

**7)**

This solution arose from several pressing problems in agriculture:

1. **Lack of Real-Time Data**: Farmers often depend on outdated methods, leading to poor decision-making regarding resource use, such as fertilizers and water.
2. **Resource Management Challenges**: Rising costs for inputs necessitate more efficient resource management. Farmers frequently struggle to optimize usage, resulting in financial strain and waste.
3. **Environmental Concerns**: Inefficient agricultural practices can lead to soil degradation and water pollution due to fertilizer runoff, highlighting the need for sustainable methods.
4. **Market Demands**: Increasing consumer awareness about sustainability pressures farmers to enhance productivity while minimizing environmental impact.

**8)**

**a)**

This project is for:

1. **Small to Medium-Sized Farmers**: To help them use data for better crop management and increased yields.
2. **Agricultural Cooperatives**: To support collective data gathering and improve resource management among farmers.
3. **Agronomists and Consultants**: To enhance their advisory services with real-time soil data.
4. **Research Institutions**: To study soil health and sustainable practices through collected data.
5. **Government and NGOs**: To promote agricultural development and sustainability initiatives.

**b)**

**The project will:**

1. **Collect Soil Data: Continuously measure soil moisture, pH, and nutrient levels (NPK).**
2. **Optimize Resources: Help farmers use water and fertilizers more efficiently to save costs.**
3. **Transmit Data: Send collected information wirelessly to a Raspberry Pi for processing.**
4. **Support Decisions: Provide insights and recommendations to guide farming practices.**
5. **Promote Sustainability: Encourage eco-friendly farming methods to benefit both farmers and the environment.**

**c)**

The project includes several unique features:

1. Real-Time Data Monitoring: Unlike traditional farming methods, this system continuously collects and analyzes soil data, providing immediate insights for timely decision-making.
2. Wireless Data Transmission: Using LoRa technology, the system ensures reliable data transfer over long distances, making it suitable for large agricultural fields where Wi-Fi might not reach.
3. Decision Support System: The integration of machine learning models enables personalized recommendations for crop management based on real-time soil conditions, improving yield and resource efficiency.
4. User-Friendly Web Interface: The collected data is accessible through an easy-to-use web application, allowing farmers to monitor their fields and receive alerts and suggestions from any device.

**9)**

**Execution Complexity**

* **Moderate Complexity**: The project involves sensor integration, establishing a LoRa network, data processing on a Raspberry Pi, web application development, and field deployment.

**Risk Factors**

* **Technical Failures**: Sensor inaccuracies can compromise data quality.
* **Communication Issues**: LoRa connectivity might face environmental challenges.
* **Weather Impact**: Sensors could be damaged if not adequately protected.
* **User Adoption**: Farmers may resist adopting new technologies.
* **Data Security**: Wireless data transmission poses security risks.

**10)**

**Current Status (TRL 3)**

* **Working Model**: You have a functional machine learning model that can process data and generate predictions.
* **Controlled Environment**: The model has been tested in a controlled lab environment but not yet in a real-world application.

**Steps to Move Forward**

1. **Integration**: Combine your machine learning model with sensors and other hardware (like the Raspberry Pi) to create a complete system.
2. **Initial Field Testing**: Test the integrated system in a small, controlled outdoor environment to gather real data.
3. **Adjustments**: Analyze the data collected during field tests to refine and improve the system.

**Timeline for Implementation:**

* **Integration Phase (2-3 months)**: This includes setting up the sensors, Raspberry Pi, and ensuring they work well with the machine learning model.
* **Field Testing (1-2 months)**: Conduct tests to see how the system performs in a real-world scenario.
* **Refinement and Full Deployment (2-3 months)**: Make any necessary adjustments based on the testing phase and prepare for broader deployment.

In total, it could take **5 to 8 months** to move from TRL 3 to a more operational stage, such as TRL 4, where your system would be tested in a relevant environment.

**11)**

For prototyping your IoT-based crop recommendation system, you would need an estimated budget of around **₹29,000 to ₹36,000**, which includes costs for quality sensors, Microcontrollers, power supply components, and miscellaneous materials. This budget ensures you have reliable equipment for your project development.

**12)**

Currently, I haven't protected my idea or intellectual property (IP) related to the IoT-based crop recommendation system. To safeguard my innovation, I plan to explore various IP protection methods, including filing for a patent to protect the unique aspects of my system, especially the technology and algorithms involved. Additionally, I may consider trademarking the brand name and logo associated with the project.

**b)**

This project aims to address the pressing need for enhanced crop management through the integration of IoT technology and data analytics. Current solutions, such as **CropX**, have demonstrated the effectiveness of soil monitoring systems in optimizing agricultural practices by providing farmers with actionable insights based on real-time data. Research indicates that machine learning can significantly improve crop yield predictions by analyzing environmental variables like soil composition and weather conditions (Kamilaris & Prenafeta-Boldú, 2018; Liakos et al., 2018).

The project's goal is to combine real-time data collection from fixed sensors with advanced predictive analytics to facilitate better decision-making for farmers. By leveraging IoT technology, the system will continuously monitor soil moisture, pH levels, and nutrient content, providing farmers with valuable information that can lead to improved crop health and yield. This innovative approach not only addresses current gaps in precision agriculture but also contributes to the growing body of research that supports the use of technology in sustainable farming practices.

Moreover, as precision agriculture continues to evolve, the incorporation of machine learning and IoT solutions can lead to increased efficiency and sustainability in farming operations, making this project relevant in the context of modern agricultural practices.

**References:**

* Kamilaris, A., & Prenafeta-Boldú, F. X. (2018). "Deep learning in agriculture: A survey." *Computers and Electronics in Agriculture*, 147, 70-90.
* Liakos, K. G., et al. (2018). "Machine learning in agriculture: A review." *Sensors*, 18(8), 2674.

**13)**

The project integrates IoT technology and machine learning for agricultural data collection and analysis.

**1. System Components**

* **Sensors**: High-quality soil sensors will be installed to measure moisture, pH, and NPK levels.
* **Data Transmission**: Data will be collected and transmitted wirelessly using low-power communication technology.
* **Processing Unit**: A central processing unit will analyze the data and run machine learning models.
* **Power Supply**: Solar panels will be used to provide energy to the sensor units.

**2. Deployment Process**

* **Site Preparation**: Identify key points for sensor installation across the acre of land.
* **Sensor Installation**: Embed sensors in the soil and ensure they are calibrated correctly.

**3. Data Collection and Analysis**

* **Real-Time Monitoring**: Sensors will continuously collect data and transmit it to the processing unit.
* **Data Processing**: The central processing unit will analyze the data and generate actionable insights for farmers.

**4. Usage**

* **Decision Support**: Farmers will receive real-time insights to optimize farming practices, enhancing crop yield while conserving resources.

This project aims to provide a practical, data-driven approach to modern agriculture, leveraging existing technologies to improve crop management.