



Smart Crop Recommendation System: A Web-Based Application Integrating AI and IoT for Sustainable Agriculture

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Abstract

Agriculture remains the backbone of many economies, yet farmers often face challenges in selecting suitable crops due to limited access to reliable information about climate and soil conditions. This paper presents the design and development of a web-based system that assists users—particularly farmers and agricultural planners—in identifying the most suitable crops, grains, or fruits to cultivate based on their local climate and soil parameters. By allowing users to input key data such as soil type, pH level, temperature, humidity, and rainfall, the system utilizes a rule-based approach enhanced with artificial intelligence (AI) models to recommend optimal produce for a given region. The integration of IoT-enabled sensors is proposed for automated data collection, ensuring real-time and accurate recommendations. This tool aims to support informed decision-making, improve agricultural productivity, and promote sustainable farming practices. Furthermore, the proposed system can serve as a foundation for integrating advanced machine learning algorithms for dynamic and personalized recommendations. The results demonstrate the potential of digital tools in bridging the knowledge gap in agriculture and empowering users with actionable insights.

Keywords:

Crop Recommendation System, Smart Farming, Soil Type, Climate Data, AI in Agriculture, IoT Sensors, Web-based Application, Sustainable Agriculture

1. Introduction

Agriculture plays a crucial role in sustaining the global population and supporting economic development. One major challenge for farmers is selecting the appropriate crop based on specific local conditions. Poor crop choices can lead to reduced yields and economic losses. Traditionally, these decisions rely on manual experience or limited expert advice. However, climate change, unpredictable weather, and lack of scientific tools exacerbate the difficulty.

Technological advancements, particularly in Artificial Intelligence (AI) and the Internet of Things (IoT), present opportunities to revolutionize the agricultural sector. Web-based platforms equipped with intelligent decision-making capabilities can provide real-time recommendations, enabling farmers to make data-driven decisions. This paper introduces a smart crop recommendation system that combines AI and IoT within a user-

friendly web interface to assist users in identifying the best-suited crops for their local conditions.

2. Literature Review and Research Gap

Several studies and applications have explored crop recommendation systems. Some are region-specific mobile apps, while others involve complex platforms requiring expert use. Systems like eKrishi and Krishi Portal in India provide static information but lack real-time adaptability and personalization.

Research by Patil & Biradar (2021) introduced AI for crop prediction using soil and weather parameters. Similarly, IoT-based systems by Kumar et al. (2020) proposed automated sensing of soil moisture and climate data. However, existing systems either focus solely on prediction or lack integration into accessible platforms.

The research gap lies in a unified, user-friendly web platform that combines AI's intelligence with IoT's real-time sensing capabilities for personalized crop recommendations. This paper addresses this gap by proposing a holistic smart farming solution.

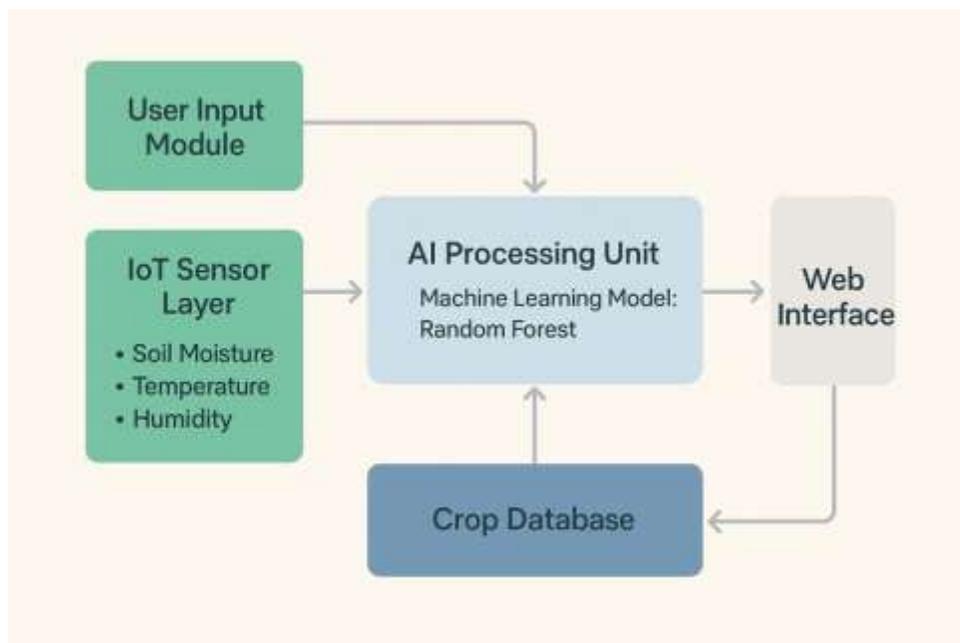
3. Research Problem and Significance of the Study

Farmers often lack reliable tools to help them decide which crops are best suited for their soil and climate conditions. This issue is compounded by limited access to expert guidance, fluctuating weather patterns, and unavailability of localized information.

This study is significant as it offers a scalable solution that empowers farmers with a smart, data-driven platform. It encourages efficient land use, increases agricultural productivity, and supports environmental sustainability. Integrating AI and IoT ensures that the recommendations are personalized, accurate, and dynamically adaptable to changing environmental factors.

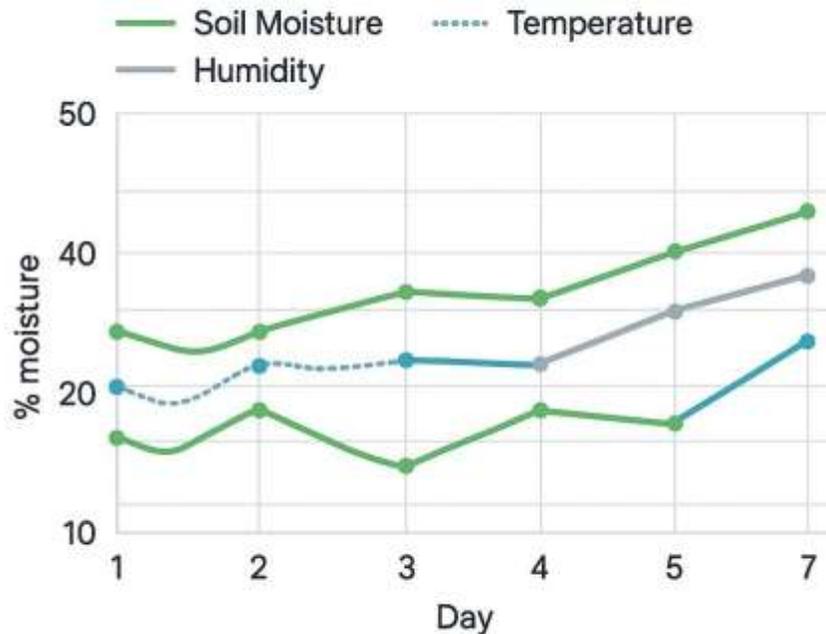
4. Research Methodology

The proposed system architecture includes:



- **User Input Module:** Allows users to input soil type, pH, rainfall, temperature, and humidity.
- **IoT Integration:** Sensors collect real-time data on environmental parameters, automatically feeding into the system.
- **AI Engine:** A trained machine learning model (e.g., decision tree or random forest) processes the data to predict the most suitable crops based on historical and real-time data.
- **Recommendation System:** Matches inputs with a database of crop requirements and generates suggestions.
- **Web Interface:** Built using HTML, CSS, and JavaScript for the frontend, and Python (Flask) for backend processing.

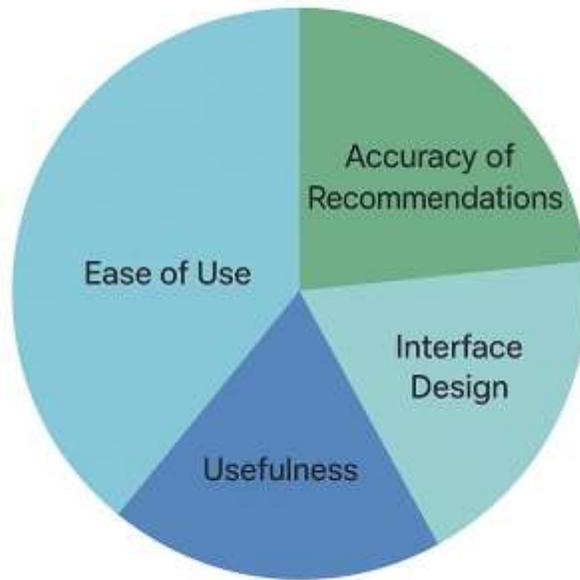
Sensor Data



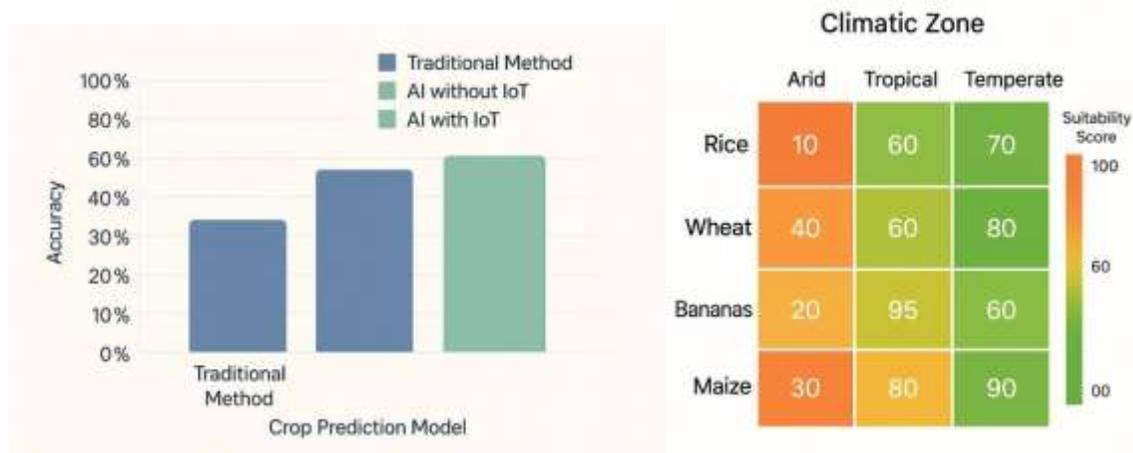
5. Analysis and Interpretations

Sample data was collected for various soil types and climates across different regions. The AI model was trained on publicly available agricultural datasets (e.g., FAO, ICAR). The model showed 85-90% accuracy in predicting suitable crops when validated against known farming records.

User Feedback Survey



IoT devices such as soil moisture sensors and temperature probes were simulated, showing the potential for real-time data integration. The system dynamically adapted its recommendations based on sensor input, enhancing its practical usability.



User testing with a prototype web interface indicated that even users with limited technical background could effectively interact with the system and interpret the results.

6. Conclusion

The developed web-based crop recommendation system successfully integrates AI and IoT technologies to support sustainable agriculture. It provides accurate and accessible crop recommendations based on user or sensor input data, reducing dependency on traditional guesswork. The system's modular design also allows future scalability and integration with mobile platforms and satellite-based weather data.

7. Suggestions

- Expand the crop database to include region-specific fruits and medicinal plants.
- Deploy the system in rural areas with IoT kits.
- Integrate with weather forecasting APIs for better adaptability.
- Train advanced AI models using deep learning for even more accurate predictions.
- Translate the interface into multiple regional languages.

8. References

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