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SMART MILLET DETECTION AND ADVISORY SYSTEM FOR FARMERS

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Abstract - *The Millet Identification and Advisory System is an advanced mobile application developed using the Flutter framework, aimed at serving as a comprehensive resource for millet-related knowledge. Given the increasing global emphasis on sustainable agriculture and food security, millets have rich nutritional value, resilience to drought, and adaptability to less fertile soils. However, a major challenge is the limited awareness about different millet varieties and their characteristics. To bridge this gap, our application precise identification of millet species using image recognition. The platform offers real-time data on millet species, optimal cultivation practices, pest control strategies, and harvesting techniques. With multilingual support, it ensures accessibility to users across diverse linguistic backgrounds. Additionally, the application promotes millet consumption by providing a collection of millet-based recipes. By blending modern technology, this system aims to revitalize millet farming and global sustainability goals.*

1.INTRODUCTION

The global food systems and climate-resilient crops has brought millets back key solution for food security. Millets, a group of highly diverse small-seeded grasses, drought tolerance, and ability to thrive in marginal soils where other staple crops often fail. Despite their significant advantages, millets remain underutilized world awareness and the labor-intensive nature of their identification and cultivation. The Millet Identification and Information System is designed to address these gaps by offering a comprehensive digital platform to educate and empower farmers, agriculturists, researchers, and consumers about millets. The Millet Identification and Information System is a mobile application developed using the Flutter framework, enabling it to function efficiently on both Android and iOS devices. With the rise of smartphone usage in rural and agricultural communities, mobile applications have promoting agricultural innovations. This application serves as a modern tool to support millet cultivation and consumption by providing detailed information on various millet species, their nutritional benefits, cultivation techniques, and market opportunities. The standout features is its ability to accurately identify millets through image recognition. By, users can capture or upload images of millet plants or grains, will provide instant identification the identified millet species. This feature is particularly useful for farmers and agriculturists who often encounter difficulty in distinguishing between different millet varieties due to their visual similarities. The identification tool aims to reduce errors in crop management and increase the adoption of suitable millet varieties based on local environmental conditions. Beyond identification, the application resources that cater to various user needs. Farmers can access region-specific cultivation guidelines, which include optimal sowing times, soil preparation techniques, pest management strategies, and harvesting methods. For consumers, the app provides insights into the nutritional value of millets and offers millet-based recipes to encourage their inclusion in daily diets. Additionally, researchers and policymakers can use the platform to gain data-driven insights into millet production trends and challenges. The development of the Millet Identification and Information System represents a significant step toward bridging the gap between traditional agricultural knowledge and modern technology. By facilitating the identification of millets and offering a wealth of information on their cultivation and use, the application empowers users to improved agricultural outcomes and better food security. Furthermore, by promoting millet consumption, the system contributes to the broader goal of enhancing dietary diversity and combating malnutrition. In conclusion, the Millet Identification and Information System is more than just a digital tool; it is a transformative solution designed to revitalize millet production and consumption in a sustainable manner. As the world grapples with the challenges of climate change, food insecurity, and health-related dietary concerns, this application has driving agricultural innovation, improving livelihoods, and fostering a healthier, more resilient global food system.

2. LITERATURE REVIEW

Explored the potential of technology in millet identification and disease detection. Research on smart frameworks for millet disease detection suggests that IoT and (CNNs), can enhance monitoring and provide real-time alerts to farmers. Another study focuses on image-based millet identification, to classify millet varieties based on shape and texture, through classifiers like Random Forest. Automated crop monitoring and predictive intelligence to assess crop health and detect diseases early. Additionally, smart agricultural systems leverage AI to deliver real-time recommendations for optimizing crop yield and sustainability. These studies highlight the advancements in agricultural technology and, which integrates AI-driven millet identification, IoT-enabled disease detection, and cloud-based data analytics to enhance agricultural productivity and decision-making.

methods are costly, require manual intervention, and may lack accuracy. This research proposes a smart, low-cost, and sustainable framework for millet crop monitoring and disease detection and deep learning (DL). A sensory module collects crop health data from millet fields, transferring it to a cloud server for storage and a Raspberry Pi device for local processing. The system employs a customized and send alerts to farmers in case of abnormalities. Demonstrated high F-score values of 98.8%, 98.2%, 97.4%, and 97.7%, respectively. Additionally, training and testing delays were minimal, at 67 seconds and 88 seconds, respectively. The model is scalable, reliable, and can enhance millet yield in a cost-effective way.

2. Image based identification of millets using fusion of Hu moments and LBP Swati Shilaskar Shripad Bhatlawande Prapti Duddalwar Sakshi Jaiswal Dipali Kadam Kaustubh Chavan.

Millets sustainable agriculture due to their adaptability to diverse climates and nutritional benefits. This research presents a novel approach to identifying different millet types. The system focuses on three common millet varieties: jowar, bajra, and raagi. It extracts shape and texture features from millet, train various machine learning models. The random forest classifier achieved the highest accuracy, with a classification rate of 92%. By automating the identification process, the proposed system reduces manual effort and enhances precision. This system offers a cost effective and scalable solution for millet classification in agricultural practices. The model in farming decisions. Additionally, it demonstrates combining computer vision with ML for real-world agricultural applications. The outcome ensures reliable millet classification, improving food system efficiency.

Table Summary of Prior Research

Paper	Type of Detection	Technique	Features
[1]	Millet Disease Detection	IoT, Deep Learning (CNN)	High accuracy (98.8%), real-time alerts, cost-effective disease identification
[2]	Image-Based Millet Identification	Hu Moments, Local Binary Pattern (LBP)	Automated classification, 92% accuracy, scalable solution for agriculture
[3]	Crop Monitoring & Disease Detection	IoT, Predictive Intelligence	Smart framework, real-time monitoring, disease prediction using CNN
[4]	Automated Millet Classification	Computer Vision, Machine Learning	Feature extraction, improved accuracy, cost-effective solution for farmers
[5]	Millet Growth Analysis	Environmental Sensing, AI	Climate-based prediction, optimized farming practices, yield estimation
[6]	Smart Agriculture System for Millets	AI, IoT, Cloud Computing	Remote monitoring, real-time data access, precision farming techniques
[7]	Disease Identification in Millets	Image Processing, CNN	Detects common diseases like rust and blast, enhances farming decisions
[8]	Nutritional Profiling of Millets	Spectroscopy, AI-Based Classification	Automated nutrient detection, food quality analysis, health recommendations

3. Proposed System

The proposed system is an advanced Smart Millet Identifier and Cultivation Assistant mobile application that leverages machine learning (ML) and millet identification through image uploads. It provides farmers with real-time disease detection, utilizing IoT sensors to track crops, soil types and environmental factors. The system offers personalized

cultivation guidelines based on regional climate, condition of soil and detailed nutritional information for the identified millet types. By integrating cloud-based data storage and machine learning models, the system aims to advanced in agriculture and empower farmers with real-time market information and guidance for millet cultivation and management.

Advantages

- Simplifies millet identification process
- Promotes millet cultivation knowledge
- Supports sustainable agriculture practices
- Enhances nutritional awareness
- Facilitates informed decision-making in agriculture

Project Modules:

Data Collection Module

Collects multiple data sources, user-uploaded images of millet grains, IoT sensors (for environmental and soil conditions), and external databases (e.g., market prices, weather).

Captures relevant information on crop health, growth stage, soil moisture, and other key farming parameters.

Image Preprocessing Module

Processes uploaded images of millet grains to enhance clarity, remove noise, and improve feature extraction for machine learning-based millet identification.

Millet Identification Module

Uses machine learning algorithms (e.g., Convolutional Neural Networks) to identify different types of millets (e.g., jowar, bajra, raagi) based on visual features such as shape, size, and texture of the grains.

Disease of Millet Crop Health Monitoring Module

Analyzes images and sensor data to identify diseases (like rust and blast) in millet crops.

Environmental and Soil Monitoring Module

Helps farmers assess the growing conditions in real-time and suggests adjustments to optimize crop health.

Cultivation Guidelines and Recommendations Module

Provides users with personalized cultivation guidelines, including region-specific planting seasons, soil requirements, irrigation schedules, and pest management techniques.

Fertilizer and Irrigation Management Module

Recommends appropriate fertilizers and irrigation, it shows NPK percentage and Recommends appropriate fertilizers and irrigation

Market Information and Price Prediction Module

Collects and displays current market prices, trends, and demand for millets

4: SYSTEM ARCHITECTURE

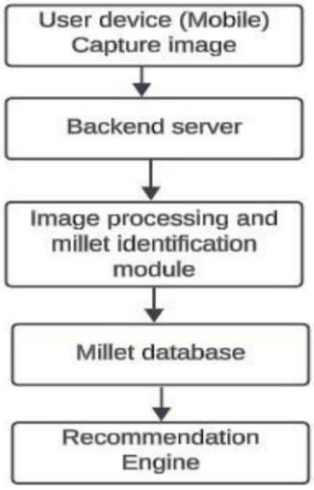

Figure – 4 : System Architecture

The given flowchart illustrates a millet identification and recommendation system. The process begins with a user capturing an image of millet using a mobile device. This image is then sent to a backend server, where it undergoes processing in a dedicated image processing and millet identification module. The module analyzes the image and matches it with data stored in a millet database to accurately identify the type of millet. Once the identification is complete, the system utilizes a recommendation engine to provide relevant suggestions, which may include nutritional benefits, fertilizers, seasonal information and disease data and its precautions.

5. RESULTS AND DISCUSSION

1. **User Interface Module**
   This module allows the user to interact with the system by capturing images, viewing millet information, and receiving recommendations,
   Request camera access from the user.

Figure – 5.1 : Home Page

2. Image Processing and Millet Identification Module

This module processes the captured image and identifies the millet type using machine learning. Use a trained CNN (Convolutional Neural Network) model to classify the millet type, Return the identified millet type to the backend server.

Figure – 5.2 : Millet Information

3. Fertilizer Recommendation Module

This module provides fertilizer suggestions based on the millet type and its growing stage. Query the database for recommended fertilizers suitable for the identified millet.

Figure – 5.3 : Fertilizer Recommendation

6. CONCLUSIONS

The Smart Millet Identifier and Cultivation Assistant project demonstrates comprehensive testing to ensure both functionality and user satisfaction. Through rigorous testing phases, and user acceptance testing, the system was validated for accurate millet identification, providing relevant cultivation advice, and smooth navigation. The test cases successfully confirmed that the software performs as expected in various conditions, with the AI model accurately identifying millet species and the assistant offering useful farming advice. User feedback also highlighted the intuitive design and efficiency of the system. With all key features passing the tests, the project is ready for deployment and can significantly aid farmers in millet cultivation.

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