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IMPLEMENTATION OF AN INTELLIGENT PLANT MONITORING SYSTEM USING GSM TECHNOLOGY

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ABSTRACT:

Agriculture is a critical sector that significantly contributes to food security and economic development. Early detection of plant diseases is essential to prevent crop losses and improve productivity. This paper presents the design and implementation of an intelligent plant monitoring system using GSM technology. The system is based on a Raspberry Pi platform integrated with a camera module, machine learning model, TFT display, and GSM module. The camera captures real-time images of plant leaves, which are processed using image processing and machine learning techniques to detect diseases. The results are displayed locally on a TFT screen and simultaneously sent to farmers via SMS using a GSM module. The system provides real-time monitoring, reduces dependency on manual inspection, and enables timely corrective actions. Experimental results demonstrate reliable disease detection, fast response time, and effective communication, making the system suitable for smart agriculture applications.

KEYWORDS:

PLANT DISEASE DETECTION, RASPBERRY PI, GSM MODULE, MACHINE LEARNING, SMART AGRICULTURE, IMAGE PROCESSING, IOT, EMBEDDED SYSTEMS, CROP MONITORING.

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INTRODUCTION

Agriculture plays a vital role in the economy of developing countries, where a large portion of the population depends on farming for their livelihood [1]. However, plant diseases significantly affect crop productivity and quality, leading to economic losses [2]. Traditional methods of disease detection rely on manual inspection, which is time-consuming and prone to human error [3].

Advancements in image processing and machine learning have enabled automated detection of plant diseases with improved accuracy [4]. Techniques such as deep learning and Convolutional Neural Networks (CNNs) have shown promising results in identifying disease patterns from leaf images [5]. The integration of Internet of Things (IoT) technologies allows real-time monitoring and data collection in agricultural systems [6].

Embedded platforms such as Raspberry Pi provide a cost-effective solution for implementing smart agricultural systems [7]. Communication technologies like GSM enable remote alerts, ensuring that farmers receive timely notifications even in areas without internet connectivity [8]. Despite these advancements, many existing systems lack integration of real-time detection and communication features [9].

Therefore, there is a need for an intelligent, automated, and cost-effective system that can detect plant diseases and notify farmers in real time [10]. This paper presents a GSM-based plant monitoring system that addresses these challenges.

MATERIALS AND METHODS:

The proposed system was developed by integrating hardware and software components into a unified plant monitoring platform. The system consists of a Raspberry Pi as the central processing unit, a camera module for image acquisition, a TFT display for local output, and a GSM module (SIM900A) for remote communication. The camera captures real-time images of plant leaves, which are processed using image processing techniques and a pre-trained machine learning model implemented using TensorFlow and Keras.

The software is developed in Python using libraries such as OpenCV for image processing, NumPy for numerical operations, and PySerial for GSM communication. The captured images are preprocessed and fed into the trained model to classify the plant condition as healthy or diseased. The results are displayed on the TFT screen, and in case of disease detection, an SMS alert is sent to the farmer using AT commands through the GSM module.

The system follows a continuous workflow: image capture → preprocessing → disease detection → display output → SMS notification. All components were integrated and tested to ensure reliable performance, accuracy, and real-time operation under different conditions.

RESULTS:

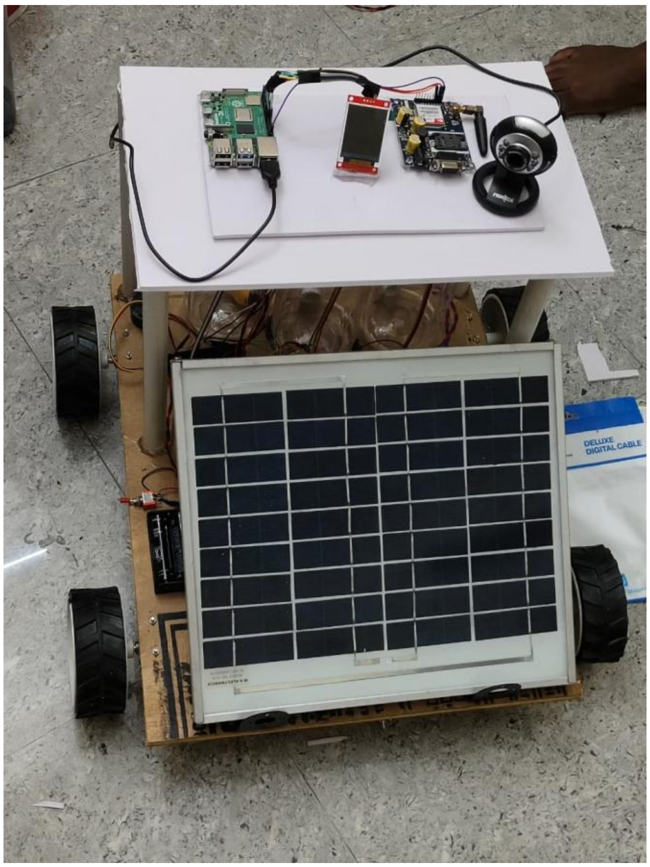

FIG. 1: IMPLEMENTATION OF AN INTELLIGENT PLANT MONITORING SYSTEM USING GSM TECHNOLOGY.

The developed system was tested under various conditions using both healthy and diseased plant leaf samples. The system successfully captured images, processed them, and classified plant conditions in real time. The machine learning model demonstrated good accuracy in detecting diseases such as leaf spots and discoloration. The TFT display clearly showed the plant status, including whether the plant was healthy or diseased, along with the disease name. The GSM module effectively sent SMS alerts to the farmer whenever a disease was detected, ensuring remote monitoring capability.

The system exhibited fast response time, processing each image within a few seconds. The overall performance indicates that the system is reliable, efficient, and suitable for real-time agricultural applications.

DISCUSSION:

The proposed system effectively integrates image processing, machine learning, and GSM communication for plant disease detection. Compared to traditional methods, the system provides faster and more accurate results while reducing manual effort. The use of Raspberry Pi ensures a low-cost and portable solution, making it suitable for rural applications. The GSM module enhances usability by providing real-time alerts without requiring internet connectivity. However, the system performance depends on the quality of the training dataset and proper lighting conditions for image capture. Future improvements may include expanding the dataset to support more crops and diseases, integrating cloud-based monitoring, and implementing advanced deep learning models to improve accuracy

CONCLUSIONS:

This paper presents an intelligent plant monitoring system using GSM technology that enables real-time disease detection and farmer notification. The system successfully integrates hardware and software components to provide an efficient, cost-effective, and user-friendly solution for smart agriculture.

The results demonstrate that the system can significantly reduce crop losses by enabling early detection of diseases and timely intervention. The proposed system contributes to the advancement of smart farming technologies and sustainable agricultural practices.

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