

Plant Health Monitoring AI Robot

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Abstract—The agricultural sector is moving towards automation and intelligent systems to enhance crop productivity, particularly for plant health monitoring. This project presents the design and development of an Eggplant Health Monitoring Robot, an autonomous system that uses advanced image processing and Internet of Things (IoT) technologies. The robot is based on a line-following navigation mechanism using Infrared (IR) sensors and is controlled by Arduino UNO and NodeMCU (ESP8266) microcontrollers. Image acquisition and analysis are performed using Convolutional Neural Networks (CNN), implemented via the TensorFlow framework, to classify plant leaves as healthy or diseased. The system integrates with the Blynk application to provide real-time monitoring, control, and alerts to the user. Additionally, an automatic spraying unit is incorporated to dispense fertilizer or pesticide upon disease detection. The pro-posed system effectively reduces human intervention, enhances precision in plant health assessment, and contributes to the development of smart agricultural practices.

Index Terms—Plant Health Monitoring, AI Robot, Convolutional Neural Networks (CNN), Internet of Things (IoT), Blynk, Precision Agriculture, Eggplant Disease Detection.

I. INTRODUCTION

Agriculture remains a vital global sector, but it faces significant challenges such as the substantial economic loss and food scarcity caused by plant diseases. Traditional manual monitoring is time-consuming, labor-intensive, and prone to error. To address this, there is an increasing demand for automation and technological intervention, leveraging advancements in Artificial Intelligence

(AI), image processing, robotics, and the Internet of Things (IoT). Automated robotic systems can perform repetitive agricultural tasks like monitoring, disease detection, and targeted pesticide spraying, thereby minimizing human error and workload.

This work focuses on developing an autonomous robotic platform specifically for Eggplant Health Monitoring. The system utilizes vision-based image processing to detect disease symptoms based on color and texture variations in the leaves. The robot's dual-mode navigation (line-following and manual) is controlled by an Arduino UNO and NodeMCU, with real-time feedback and control facilitated through the Blynk IoT platform. A crucial component is the integrated spraying mechanism that administers targeted treatment immediately upon disease identification, promoting optimal resource usage and a reduced environmental impact. This project aims to bridge the gap between conventional practices and modern technology for a more sustainable and automated farming environment.

II. SYSTEM ARCHITECTURE AND METHODOLOGY

The overall system architecture is composed of three inter-connected modules: the Robot Navigation System, the Disease Detection Unit, and the IoT Communication and Control Module.

A. Robot Navigation and Control

The robot platform employs a line-following mechanism for autonomous navigation along predefined crop rows. This is achieved using an

array of Infrared (IR) sensors which feed-back data to the Arduino UNO microcontroller. The Arduino manages the DC Gear Motors via an L298N Motor Driver to steer the robot. The system also includes an override for a user-controlled manual mode, which is managed via an HC-05 Bluetooth Module (or the NodeMCU for Wi-Fi control).

B. Disease Detection Unit

The core intelligence of the system lies in its vision-based disease detection capability.

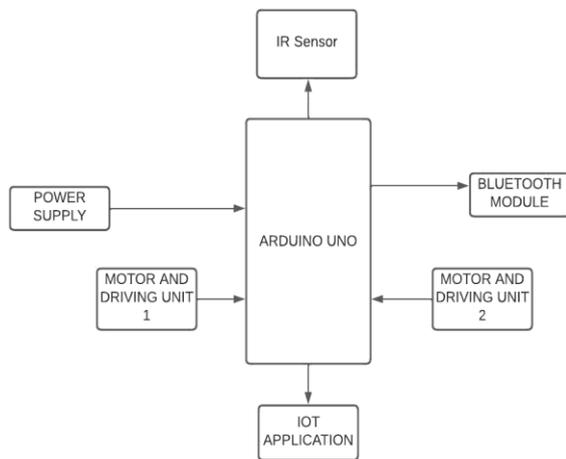


Fig. 1. Work Flow

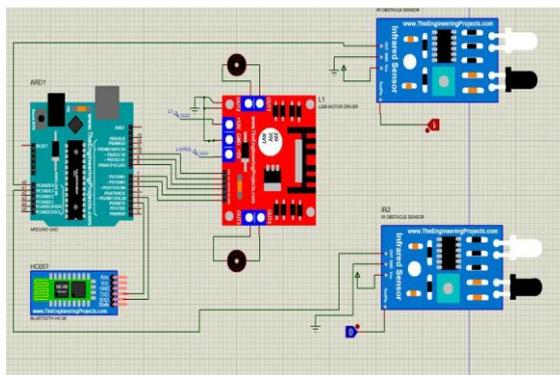


Fig. 2. Navigation Part

- 1) Image Acquisition: A camera mounted on the robot captures high-resolution images of the eggplant leaves as the robot moves.
- 2) Image Processing: The image processing is handled by a Raspberry Pi 3 Model B Plus, which hosts the trained Convolutional Neural Network (CNN) model.
- 3) Classification: The CNN, implemented using the Ten-sorFlow framework and specifically utilizing the Mo-bileNet architecture, analyzes color, texture, and pattern variations to classify the plant’s health status (Healthy or Diseased). MobileNet is chosen for its efficiency and low

computational demands, making it suitable for edge deployment.

- 4) Targeted Spraying: Upon positive detection of a disease, the Arduino triggers the integrated mechanical spraying unit to dispense a precise quantity of pesticide or fertilizer, ensuring immediate and targeted treatment.

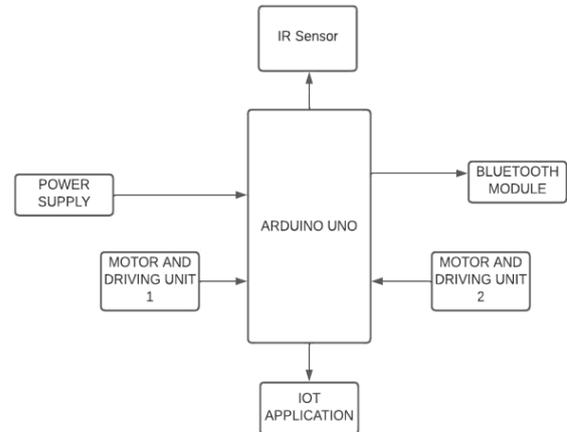


Fig. 3. Navigation Block Diagram

C. IoT Integration and User Interface

The NodeMCU (ESP8266) module provides the Wi-Fi connectivity, linking the entire system to the Internet of Things. It communicates with the Blynk IoT platform, which serves as the user’s dashboard. This interface allows the user to:

- View the real-time health status and location of the robot.
- Control the robot manually (start/stop/direction).
- Receive instant notifications and alerts when a diseased plant is identified and treated.

III. CONCLUSION AND FUTURE WORK

The Eggplant Health Monitoring AI Robot successfully demonstrates an integrated, autonomous solution for modern precision agriculture. The system effectively combines a line-following robotic platform with CNN-based image processing for accurate, real-time disease detection and an IoT interface for remote monitoring and control. This approach significantly minimizes the need for manual inspection, optimizes the use of agricultural chemicals through targeted spraying, and improves overall crop management efficiency.

Future work will focus on two primary enhancements: transitioning from line-following to a

more flexible AI-based autonomous navigation system (e.g., using GPS and visual odometry), and extending the CNN model's training to achieve accurate disease detection across a wider variety of crop types beyond just eggplant.

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