Climate-Induced Early Onset of Grape Berry Diseases using ML & IOT

Pranav Kishor Kachave[1], Rushikesh Avadhut Patil[2], Nikita Rajendra Vairal[3], Sahil Prakash Aher[4], Prof S.V. Sinha[5]

SNJB's Late Sau Kantabai Bhavarlalji Jain College of Engineering

Abstract

The system combines IoT and Machine Learning technologies to help grape farmers monitor and manage their crops effectively. The system uses IoT sensors like temperature, humidity, and soil moisture sensors, connected to a NodeMCU microcontroller, to continuously track environmental conditions in the vineyard. This data is collected in real-time and provides valuable insights into the growing environment. Additionally, a separate machine learning-based feature allows users to upload photos of grape leaves or plants showing signs of disease. The system analyzes the uploaded images to detect specific grape diseases and provides farmers with accurate disease identification along with actionable prevention measures. By integrating environmental monitoring with advanced disease detection, the system empowers farmers to maintain healthier vineyards, reduce crop loss, and improve overall productivity..

Keywords: IoT in Agriculture, Grape Farming, Environmental Monitoring, Temperature Sensors. Humidity Sensors

INTRODUCTION

Farming grapes can be challenging, especially when it comes to monitoring the environment and preventing diseases that harm the plants. Our system makes this process easier by combining IoT (Internet of Things) technology and Machine Learning. It uses smart sensors to track conditions like temperature, humidity, and soil moisture in the vineyard. This data is collected in real time and helps farmers understand what's happening in their fields, so they can take better care of their crops.

In addition to monitoring the environment, the system also helps farmers identify diseases affecting their grape plants. Farmers can upload pictures of grape leaves or plants showing signs of problems, and the system uses advanced machine learning to detect specific diseases. It not only identifies the issue but also provides tips on how to prevent and manage it. By keeping a close eye on both the environment and plant health, this system helps farmers grow healthier grapes, avoid major losses, and boost their overall productivity. .

LITERATURE SURVEY

1. Laura Falaschetti; Lorenzo Manoni, (2021) A Low-Cost, Low-Power and Real-Time Image Detector for Grape Leaf Esca Disease Based on a Compressed CNN
2. Dounia Kawther Dihya Bourzig,2024, Black rot disease classification of apples and grapes using convolutional neural network and transfer learning

3. Ujjwal Singh; Anuj Srivastava,2020, Computer Vision Technique for Detection of Grape Esca (Black Measles) Disease from Grape Leaf Samples
4. Prathiksha BJ; Vijaya Kumar T,2024, Early Accurate Identification of Grape leaf Disease Detection using CNN based VGG-19 model

METHODOLOGY

The system works in two main parts: environmental monitoring and disease detection. For monitoring, IoT sensors like temperature, humidity, and soil moisture sensors are placed in the vineyard. These sensors are connected to a NodeMCU microcontroller, which collects data about the vineyard's environmental conditions in real time. The collected data is then sent to a central system or app where farmers can view the readings and get insights into the health of their vineyard. This helps farmers make timely decisions, such as adjusting irrigation or protecting crops during extreme weather.

For disease detection, the system uses machine learning. Farmers can take photos of grape leaves or plants showing unusual signs, such as spots, discoloration, or damage, and upload them to the system. The machine learning model analyzes these images and identifies the specific disease affecting the plant. Based on the analysis, it provides a detailed report and actionable advice for managing and preventing the disease. This combination of real-time monitoring and smart disease detection gives farmers the tools they need to maintain healthy crops and improve their yield..

OBJECTIVE

1. To monitor environmental conditions in vineyards using IoT sensors in real time.

2. To help farmers detect grape diseases early through image analysis.

3. To provide accurate and actionable recommendations for disease prevention and management.

4. To reduce crop losses and improve the health of grape plants.

5. To increase overall productivity and efficiency in grape farming.

PROBLEM DEFINATIONS

Grape farmers often face challenges in monitoring their vineyards and identifying diseases in their crops early. Environmental factors like temperature, humidity, and soil moisture play a crucial role in grape growth, but tracking these conditions manually can be time-consuming and inefficient. Additionally, diseases affecting grape plants are often detected too late, leading to significant crop losses. There is a need for a system that combines real-time environmental monitoring with accurate disease detection to help farmers take timely action, reduce crop damage, and improve their productivity.

SYSTEM ARCHITECTURE
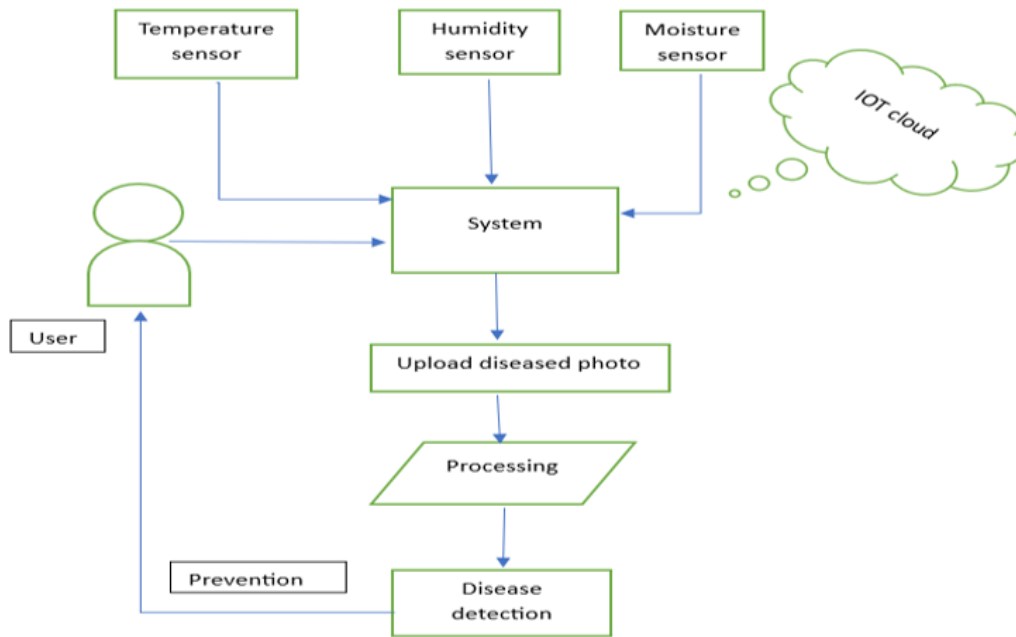
FUCTIONAL REQUIREMENTS

1. Environmental Data Monitoring: Collect real-time data on temperature, humidity, and soil moisture using IoT sensors.
2. Disease Detection: Analyze uploaded grape leaf images to identify diseases using a machine learning model.
3. Actionable Insights: Provide prevention measures and recommendations based on detected diseases and environmental data.
4. Data Visualization: Display real-time and historical environmental data through a user-friendly interface.

NON FUCTIONAL REQUIREMENTS

1. Scalability: The system should support multiple vineyards and handle increasing data volumes efficiently.
2. Reliability: Ensure consistent performance and accurate disease detection under various conditions.
3. Usability: Provide an intuitive and easy-to-navigate interface for farmers with minimal technical expertise.
4. Security: Safeguard user data, including images and environmental metrics, against unauthorized access.

RESULTS
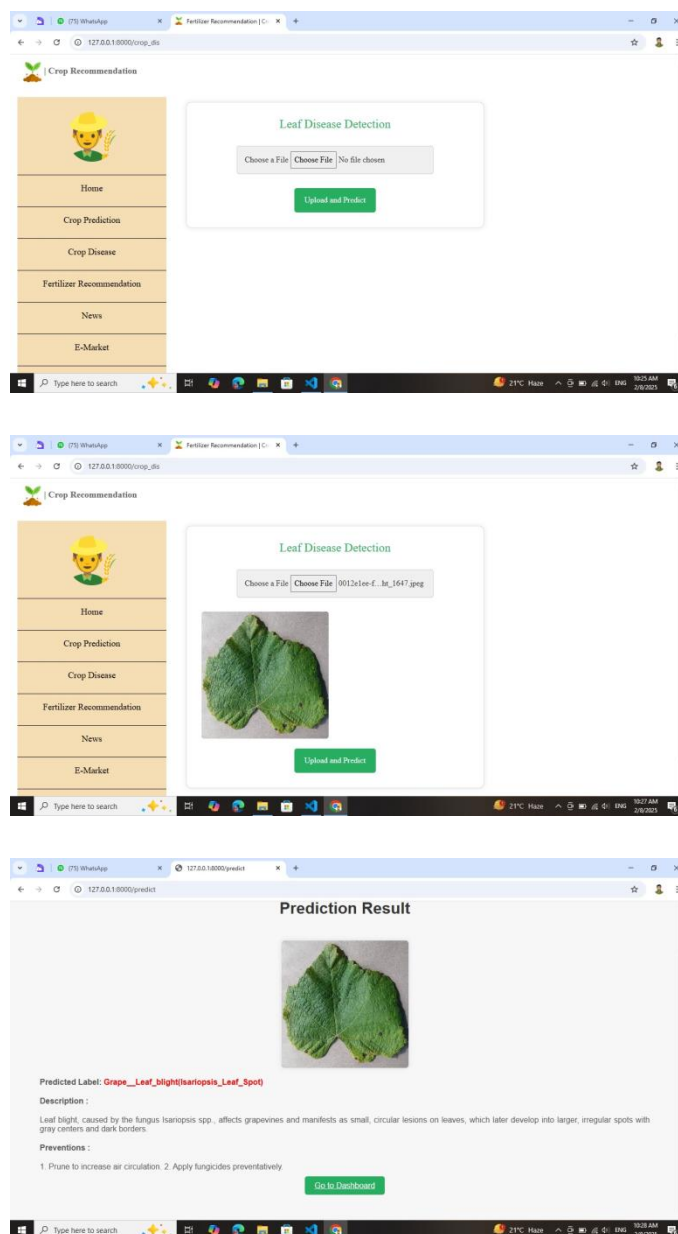
CONCLUSION

In conclusion, this system provides grape farmers with a powerful tool to better manage their vineyards. By combining real-time environmental monitoring through IoT sensors and advanced disease detection using machine learning, farmers can address issues early and make informed decisions to protect their crops. This not only helps in reducing crop losses but also improves the overall quality and yield of their grapes. With such technology, grape farming becomes more efficient, sustainable, and productive, giving farmers the confidence to grow healthier crops with ease.

REFERENCES

1. J. Smith et al., "IoT-Driven Machine Learning for Precision Viticulture Optimization," IEEE Journals & Magazine, 2024

2. A. Johnson et al., "Intelli-farm: IoT-Based Smart Farming Using Machine Learning Approaches," in IEEE Conference Publication,

3. R. Gupta et al., "Intelligent Agriculture Using Machine Learning and Internet of Things," in IEEE Conference Publication, 2024

4. P. Singh et al., "Smart Farming: IoT Applications in Agriculture," IEEE Access, vol. 9, pp. 9447103-9447112, 2021.

5. M. Kumar and S. Rajan, "IoT and Machine Learning for Crop Disease Prediction," IEEE Access, vol. 10, pp. 9534652-9534660, 2022

6. T. Lee and H. Park, "A Comprehensive Study on IoT and ML-Based Solutions for Agriculture," *IEEE Access*, vol. 11, pp. 9703268-9703275, 2023.

7. D. Tandekar and S. Dongre, "Identification of Various Diseases in Plant Leaves Using Image Processing and CNN Approach", 2023 14th International Conference on Computing Communication and Networking Technologies (ICCCNT), pp. 1-6, Jul. 2023.

8. R. Sharma, V. Kukreja, P. Sood and A. Bhattacharjee, "Classifying the Severity of Apple Black Rot Disease with Deep Learning: A Dual CNN and LSTM Approach", 2023 3rd International Conference on Advances in Computing Communication Embedded and Secure Systems (ACCESS), pp. 173-177, May 2023.