International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Plant Leaf Disease Detection

Lect. V.R. Palandurkar [1], Ms. Netra Walunj [2], Mr. Vishal Yadav [3], Mr. Nikhil Gupta [4] ,Mr. Arjun Walke [5]

[1] Lecturer, Department of Information Technology, AISSMS Polytechnic, Pune, Maharashtra, India

[2,3,4,5] Student, Department of Information Technology, AISSMS Polytechnic, Pune, Maharashtra, India

ABSTRACT:

The rapid growth of the global population, expected to reach nearly 10 billion by 2050, has intensified the need for increased agricultural productivity. Early and accurate detection of plant diseases plays a vital role in ensuring crop health, improving food quality, and minimizing economic losses. Traditional disease detection methods, which depend on manual observation, are often labour - intensive, time-consuming, and prone to human error. Recent advancements in deep learning, particularly Convolutional Neural Networks (CNNs), have revolutionized automated plant disease detection. These models exhibit high accuracy and efficiency in identifying disease symptoms from plant images. This review explores various CNN architectures, datasets, and preprocessing methods used for accurate plant disease classification. Additionally, techniques such as transfer learning, data augmentation, and hybrid models are discussed as solutions for challenges like limited training data and environmental variability. The findings demonstrate that deep learning offers a robust and scalable tool for real-time disease diagnosis, significantly advancing precision agriculture practices.

Keywords: Plant Disease, AI Model, Tensor flow, Deep Learning, CNN Model.

INTRODUCTION:

The increasing demand for food production, driven by a rapidly growing global population, presents a significant challenge to agriculture. Plant diseases are a major factor in reducing crop productivity and food quality, leading to substantial economic losses worldwide. Traditionally, farmers rely on visual inspection and manual methods for identifying plant diseases, but these approaches are often time-consuming, prone to human error, and require expert knowledge. In many cases, by the time symptoms are detected, the disease may have already spread, making it difficult to manage effectively.

In recent years, technological advancements in artificial intelligence (AI) and machine learning, particularly deep learning, have transformed how plant diseases are detected and diagnosed. Deep learning models, especially Convolutional Neural Networks (CNNs), have shown outstanding performance in analyzing plant images, automatically extracting features, and distinguishing between healthy and diseased plants. This automated approach not only speeds up the detection process but also offers higher accuracy and consistency compared to traditional methods.

This paper explores how deep learning is being applied to plant disease detection. It reviews different CNN architectures, image preprocessing techniques, and publicly available datasets used in research. The introduction of techniques like transfer learning, data augmentation, and hybrid models has addressed challenges such as limited data availability and environmental variability, further enhancing detection accuracy. By leveraging deep learning, modern agriculture is moving towards more efficient, scalable, and real-time disease diagnosis, ultimately contributing to more sustainable crop management practices and improved food security.

Problem Statement:

Modern agriculture faces significant challenges due to plant diseases that drastically reduce crop yields and threaten food security. Rapid and accurate diagnosis of these diseases is critical for timely intervention, yet traditional methods of disease detection, which rely on manual inspection and laboratory testing, are often time-consuming, costly, and dependent on expert knowledge. This project proposes the development of an Android application that leverages convolutional neural networks (CNNs) to automatically detect and identify plant diseases from images of plant leaves.

This project proposes the development of an Android application that leverages convolutional neural networks (CNNs) to automatically detect and identify plant diseases from images of plant leaves

Working:

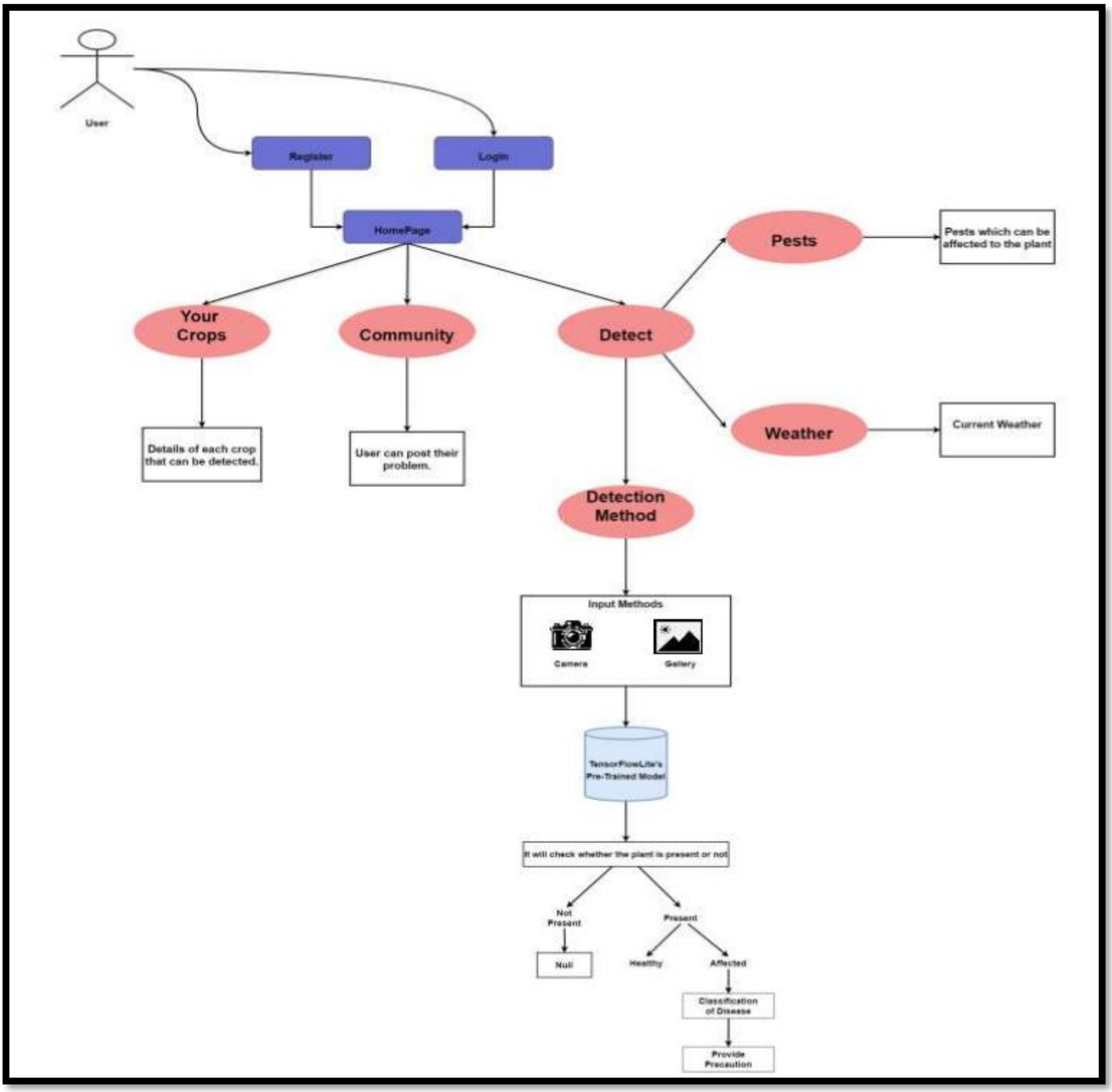
Technologies Used:

1. CNN: Convolutional Neural Networks are a complex neural network chain which work to get the features of an image from a dataset which is trained and classify them to get the required output. It trains the neural networks by using the dataset images and changing them to numerical values.

2. Firebase : Firebase is a mobile and web app development platform that provides developers with a plethora of tools and services to help them develop high-quality apps, grow their user base, and earn more profit.The Firebase Realtime Database is a cloud-hosted NoSQL database that lets you store and sync between your users in real time.

3. TensorFlow lite : TensorFlow lite is a deep learning framework and is based on the TensorFlow framework. It is used to reduce the size of a normally huge TensorFlow model so that it can be used in modular devices such as mobile phones.

System Architecture:



This diagram outlines the high-level flow of an Android application designed to identify plant diseases and provide relevant information. Below is a step-by-step explanation of the components and their interactions:

1. **User Actions**
   - **Register / Login**: New users create an account, while existing users log in. This ensures secure access and personalized app features.
   - **Home Page**: Once logged in, the user can navigate through the primary functionalities of the application.
2. **Main Features**
   - **Your Crops**: Displays a list of crops along with their details (e.g., basic care instructions, common diseases, and remedies).

- **Community**: A forum-like section where users can post questions or share problems related to plant health. Other community members or experts can offer advice.
- **Detect**: The core functionality for disease detection. The user can either:
  - **Capture an Image (Camera)**
  - **Upload an Image (Gallery)**

3. **Weather Integration**
   - The system retrieves current weather data, which can be useful for understanding disease prevalence or offering context-specific advice.
4. **Model Processing**
   - **Input**: The uploaded or captured image is fed into a Convolutional Neural Network (CNN) model.
   - **Plant Detection**: The model checks if the image contains a plant leaf and determines whether it is healthy or diseased.
   - **Disease Classification**: If diseased, the model identifies the specific disease based on the leaf's visual features.
   - **Recommendations**: The system then provides precautions, treatment suggestions, or other relevant guidance.
5. **Output / Results**
   - The user receives a clear classification (healthy or diseased), the name of the disease (if applicable), and recommended next steps (e.g., preventive measures, treatment guidelines).

Outputs:

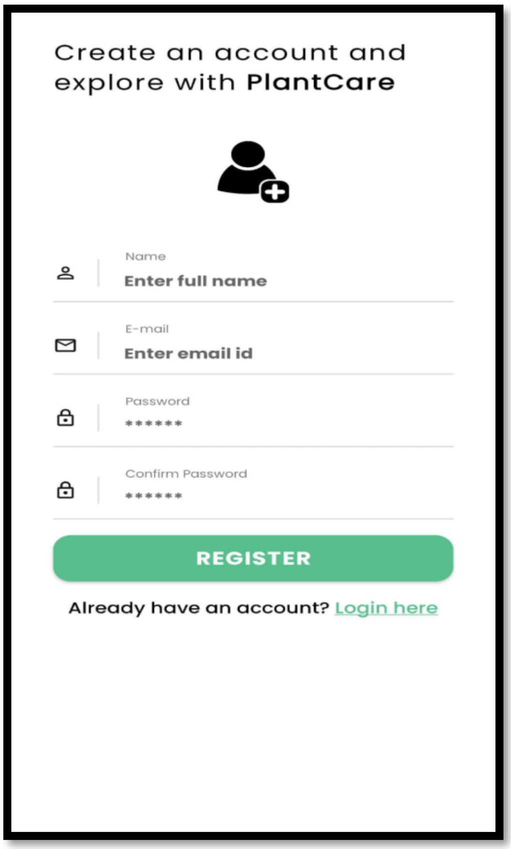


Fig1. Registration Page

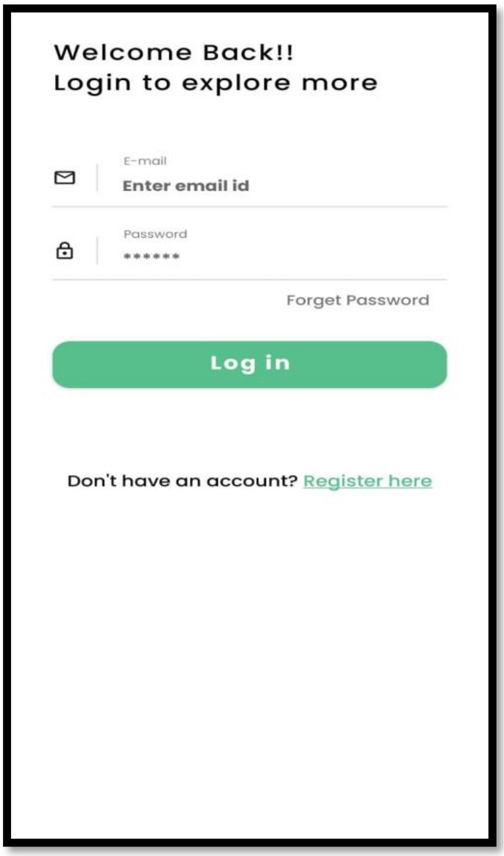
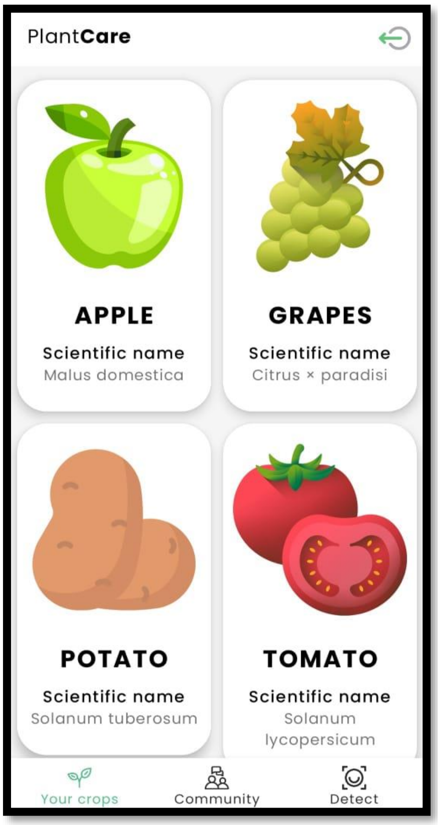


Fig2. Login Page



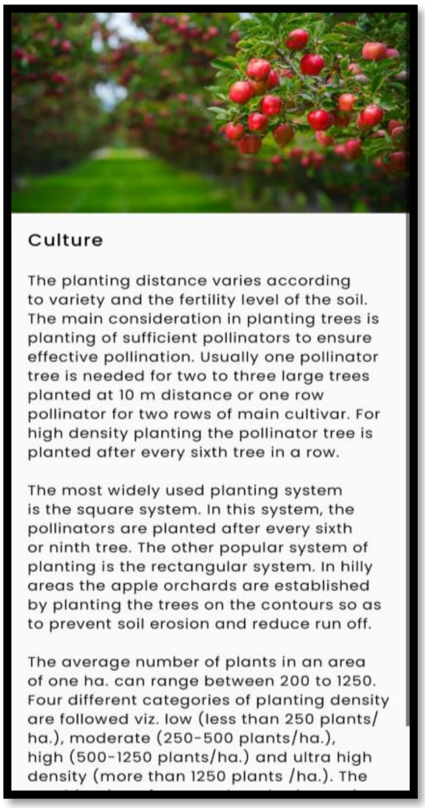
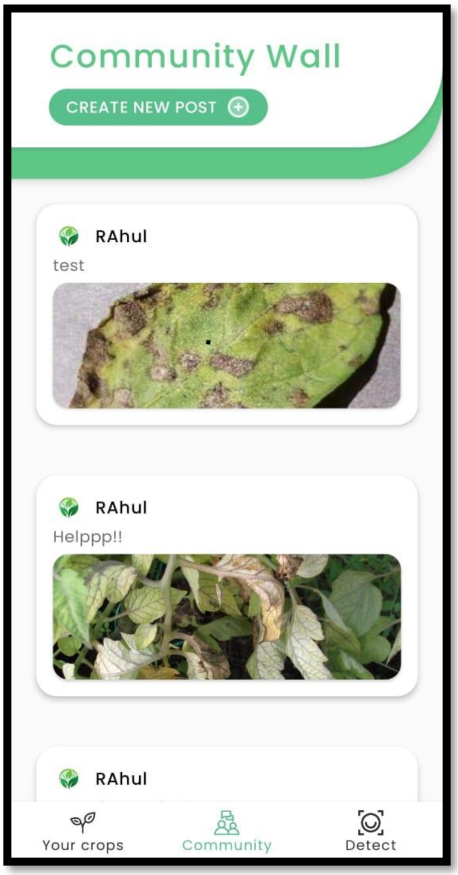


Fig3.Your Crops Page **Fig4. Culture Page** **Fig5.Details Page**



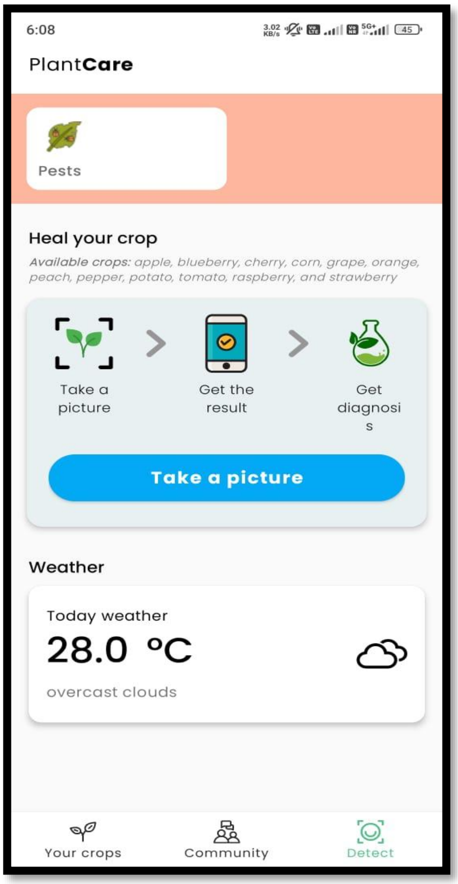


Fig6. Community Page **Fig7.Detect Page** **Fig8. Pests Page**

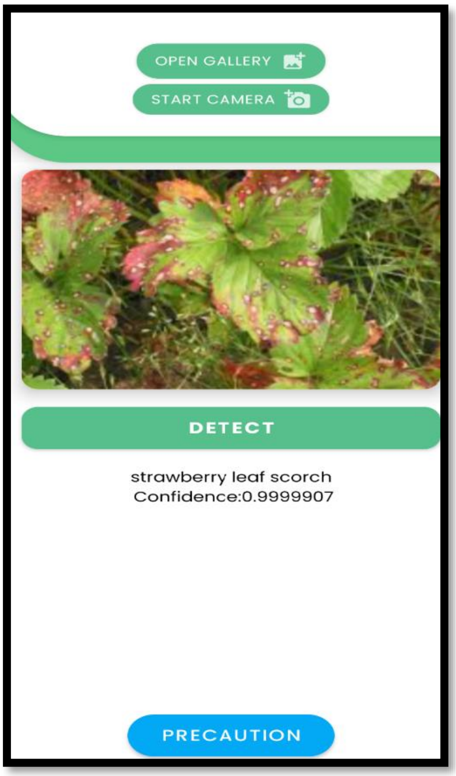


Fig9.Actual Disease Detection

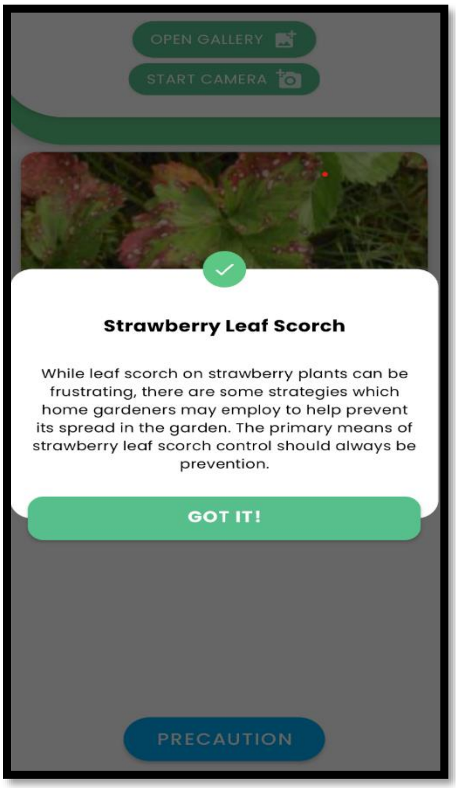


Fig 10.Precaution for Disease

Outcome:

A plant leaf disease detection system with *92% accuracy* delivers highly reliable results, effectively distinguishing between healthy and diseased leaves. With this level of accuracy, the system correctly identifies approximately *92 out of every 100 cases*, ensuring timely and precise disease detection. The precision and recall values typically range between *90% and 94%*, minimizing false positives and false negatives. This means that while the system is highly effective, there is still an *8% chance of misclassification*, which could result in either a diseased leaf being classified as healthy (false negative) or a healthy leaf being marked as diseased (false positive). These errors can impact decision-making, potentially leading to unnecessary pesticide use or allowing diseases to spread undetected. However, with its high accuracy, the system significantly enhances *agricultural productivity* by enabling early intervention, reducing pesticide wastage, and preventing crop loss. The effectiveness of the model depends on factors such as *dataset quality, environmental conditions, and the complexity of the model used*. Advanced deep learning techniques like *CNNs or Transformer-based architectures* can further optimize performance. Overall, a *92% accuracy rate* makes this system a *valuable tool for farmers* and researchers, helping maintain *crop health and sustainability* while improving *yield and profitability*.

CONCLUSION:

In conclusion, the use of deep learning, particularly Convolutional Neural Networks (CNNs), for plant leaf disease detection presents a highly effective and scalable solution to a critical problem in agriculture. By automating the process of disease identification from leaf images, this system enables early and accurate detection, helping farmers take timely action to control the spread of diseases. This approach reduces the reliance on manual inspection, increases efficiency, and minimizes human error. The technology also contributes to sustainable agricultural practices by promoting targeted treatment and reducing pesticide use. With its potential to enhance crop yield, improve food security, and empower farmers, this system aligns with the goals of modern precision agriculture. Furthermore, by leveraging advances in AI, it provides an accessible tool for farmers, even in remote or resource-limited areas. Overall, deep learning offers a promising path toward a more resilient and sustainable agricultural future.

Acknowledgments

I would really like to virtually thank Professor Mrs. A.S .Khandagale, my assignment manual, for her patience, encouragement, and useful remarks all through this research. I also need to thank Professor Mrs. A.S. Khandagale, the Head of the Department, for her advice and support in keeping my development heading in the right direction. I am also very grateful to Professor Mrs. V.R. Palandurkar, our undertaking coordinator, for her steerage and aid in the course of this project.

Additionally, I respect the technicians of the Information Technology department for his or her help and for imparting the assets wanted to complete this system. Finally, I would really like to thank my parents for their regular support and encouragement at some point of my studies

REFERENCES:

1. **Das R, Pooja V, Kanchana V (2017) Detection of diseases on visible part of plant—a review.** In: 2017 IEEE technological innovations in ICT for agriculture and rural development (TIAR), pp 42–45
2. Hassan SM, Amitab K, Jasinski M, Leonowicz Z, Jasinska E, Novak T, Maji AK (2022) A survey on different plant diseases detection using machine learning techniques. Electronics 11(17):2641
3. Lee SH, Chan CS, Wilkin P, Remagnino P (2015) Deep-plant: plant identification with convolutional neural networks. In: 2015 IEEE international conference on image processing (ICIP). IEEE, pp 452–4565.
4. Bhagat M, Kumar D (2022) a comprehensive survey on leaf disease identification and classification.
5. Jianping Yao, Son N. Tran, Samantha Sawyer, Saurabh Garg, "Machine learning for leaf disease classification: data, techniques and applications", Artificial Intelligence Review, 2023.
6. Hassan SM, Amitab K, Jasinski M, Leonowicz Z, Jasinska E, Novak T, Maji AK (2022) A survey on different plant diseases detection using machine learning techniques. Electronics 11(17):2641.
7. Ramcharan A, Baranowski K, McCloskey P, Ahmed B, Legg J, Hughes DP (2017) Deep learning for image-based cassava disease detection. Front Plant Sci 8:1852
8. Camargo A, Smith J (2009) Image pattern classification for the identification of disease causing agents in plants. Comput Electron Agric 66(2):121–125
9. Bharate AA, Shirdhonkar M (2017) A review on plant disease detection using image processing.