# Chapter 9
# Plant Disease Detection Using Generative AI and Deep Learning Models

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## ABSTRACT

*Cassava Plant scientifically Manihot esculenta which is also known as the tapioca plant, is a shrub that is majorly cultivated in many countries. The major cassava plant diseases are Cassava Bacterial Blight (CBB), Cassava Brown Streak Disease (CBSD), Cassava Green Mottle (CGM) and Cassava Mosaic Disease (CMD). The objective of this work is to make the Cassava Plant Disease Prediction from the given input image and tell whether the provided sample is infected with the above mentioned disease or not. To meet the main objective, we build the Model with the Convolution Neural Network, Visual Geometry Group 16, ResNet50, EfficientNetB0, Visual Transformer, and Variational Auto-encoder. Variational Auto-encoder model with various latent dimension size and optimizers are tested. Usage of generative variational autoencoder provides the highest accuracy of 95% while the other tested models are providing accuracy less than 90%.*

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## 1. INTRODUCTION

Cassava which is termed Manihot esculenta scientifically, is declared a drought plant due to its tolerance to climatic conditions. This plant will be cultivated mainly in subtropical areas of the world. This cassava plant's born place is South America and is currently cultivated mainly in Brazil and many developing countries. The cassava plant witnesses diseases by both components namely the Biotic factor and Abiotic factor. The biotic organisms are the major reason for the disease of the plant and the agents are viruses, nematodes, bacteria, and fungi. The Abiotic factors which can be a threat to the cassava plant are environment-oriented factor stresses, deficiency in nutrients and not containing the required resources for cultivation (McCallum & et. al., 2017).

Cassava plants witness many diseases including Cassava Bacterial Blight (CBB) which can occur because of the Bacteria Xanthomonas axonopodis pv manihotis, which is shortly called Xam. The bacteria found in the plant can cause the loss of a major part in leaves called necrosis which leads to poor quality in production and root damage which will affect the plant growth. This bacteria also affects the stem with a disease called lesions which always poses a high level of risk for plants since it affects the leaf parts with major spots in the leaf. If this disease occurs in the cassava plant, it leads to the death of the cassava plant. This disease is mainly witnessed in a major part of Africa including central and part of West Africa.

The next important disease which is caused by viruses is Cassava Mosaic Disease (CMD) by the viruses with the scientific name Begomo viruses, Potyviruses **(**McCallum & et. al., 2017**).** It can be seen in many African and east African countries. This disease makes plant production and affects the major parts of the leaves by making distortion and it reduces plant growth. Transportation of the viruses is mainly possible through the vectors of the leaves which is called as whiteflies and similar insects. Another major reason for the loss of plant growth is environmental impacts such as less fertility due to less nutrients in the soil, poor management of crop rotation, and variation in climate.

Infection of the Casava plant by another virus which is similar to potyviruses is also more prevalent. This virus variant is known as Cassava Brown Streak Virus and it is responsible for the reason of the syndrome called Cassava Brown Streak Disease (CBSD) (Legg et. al., 2015). The following viruses are primarily found in Uganda and are classified as Ugandan Cassava Brown Streak Viruses. This disease mainly affects the roots of the cassava plant. Similarly, another virus, known as Cassava Green Mottle Virus (CGM), is found in many parts of Africa and typically affects the leaves, causing them to change color. In some cases, protozoa, which are rarely involved, can also contribute to the disease. Additionally, insects such as grasshoppers and leafhoppers are major vectors of cassava motile disease, exacerbating its spread. Environmental factors, such as stress, also play a significant role in the disease's development. Ultimately, healthy plants can thrive with proper cultivation practices, ensuring the best quality crops.

The Cassava plant is an important crop that will be in growing in many tropical similar countries and it is main food for people who rely on carbohydrates. This plant has special growth in bad or limited soil conditions. The cassava plant can be cultivated in low photosynthesis and it can produce greater results to the farmers. This plant as many significant adaptations called resistance in drought by making its parts to adapt to the environment. They make this by reducing the transpiring level and make the roots adjustable automatically to find the water in low ground level. This enables the plant to withstand more humid climate changes with the help of changing the regulation of the leaf. This behavior allows the plant to survive in high humid climate changes. Cassava is an important crop in developing countries, where it serves as a key food source. The plant's edible parts are used in various food preparations, with