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CHAPTER ONE

INTRODUCTION

1 Background Information

The use of computer and computing devices, in the recent decade has seen greater development more than any known time in history. This cuts across all spheres of endeavour. This is seen in the use of different and diverse computer-vision and artificial intelligence based tools in all works of life. According (Ghazal et al., 2024), Vision-based intelligent systems have made way to practically every aspect of modern human life. These systems combine computer vision, artificial intelligence (AI), and machine learning technologies and allow machines to mimic human visual and cognitive abilities to make informed decisions about the task at hand. Computer vision technology is used to process and interpret visual information from the surrounding environment while the artificial intelligence (AI) technologies along with machine learning algorithms are used for recognizing patterns and predicting actions.

Precision agriculture enables the recent technological advancements in farming sector to observe, measure and analyze the requirements of individual fields and crops. The recent development of computer vision and artificial intelligence (AI) techniques find a way for effective (and early) detection of plant diseases, weed, pest, etc. (Fahd et all, 2022). On the other hand, the detection of plant diseases in Ugu using the recent developments of artificial intelligence and computer vision can improve productivity and lower the menace of crop loss and the accompanying economic effects of crop loss.

Traditional disease detection techniques which normally includes laboratory tests and expert consultation can be slow, costly and limited in scope. According to (Lokesh et al.). ML offers a more efficient and accurate solution, enabling early disease detection and timely intervention.

Artificial intelligence algorithms are trained on large datasets of image or other data forms related to the plant diseases. Artificial intelligence algorithms learn to understand and recognize patterns and features associated with the differing diseases, making it possible for the Artificial Intelligence models to predict the presence and severity of disease in new, unseen data.

There are many types of ML algorithms that can be employed for Ugu disease detection. These include image processing technique, deep learning modelss (like

Convolutional Neural Networks - CNNs), and other classifiers. In this, work it is intended to you deep learning and or image processing techniques.

Faster detection: ML algorithms can process images and data rapidly, enabling early disease detection and timely interventions, according to ResearchGate Improved accuracy: ML models can often outperform traditional methods in terms of accuracy, reducing the risk of misdiagnosis and enabling more precise interventions, according to ResearchGate. Increased production: By enabling early and accurate disease detection, ML can help farmers take timely action to prevent crop loses and increase productivity.

Data availability: Training ML models requires large and diverse datasets of plant disease images or data, which may be challenging to obtain. Data quality: The quality of the data used to train ML models can significantly impact their performance, and poor quality data can lead to inaccurate predictions. Generalisation: ML models may struggle to generalise to new or unseen conditions, such as different plant species or environmental factors, according to **Diva Portal**

Early disease detection: ML can be used to identity disease symptoms at their earliest stages, allowing for timely interventions and preventing the spread of diseases. Disease classification: ML models can be trained to classify different types of plant diseases, aiding in accurate diagnosis and targeted treatment. Disease severity assessment: ML can be used to assess the severity of plant diseases, helping farmers determine the approximate treatment strategies. Predicting disease outbreaks: By analysing historical data and environmental factors. ML can be used to predict the likelihood of disease outbreaks, allowing for proactive measures to be taken, according to ResearchGate.

Image-based detection: ML algorithm can analyse images of plant leaves to identify disease symptoms, such as lesions, discolouration and other visual clues.

Ugu is a member of the family of plants / vegetables called Pumpkin. Pumpkin is the name given to a group of plant species in the genus Cucurbita, including Cucurbiat pepo, Cucurbit mixta, Cucurbiat maxima and Cucurbita moschata. It is grown primarily as a vegetable or ornamental plant. Pumpkins have long-running, bristled stems large deeply-lobed leaves often containing white blotches (but not always), and yellow or orange flowers separated into male and female types on the same plant. The fruit is variable in shape and color but is often white, cream or green containing about 70% flesh and several large white [or orange colored] seeds. (Pum)

Ugu leave (botanical name, Telfaira occidentalis) is also known as fluted pumpkin and is a green-leafy vegetable that originated from Nigeria. It is well planted and consumed all over the country especially in the Eastern parts of Nigeria. It is also well consumed in the Western and Northern parts of Nigeria. Ugu is loaded with a lot of vitamins like Vitamin A, B2, C, and E, minerals like Calcium, Iron,

Potassium, Magnessium, Folic acid, Manganese, dietary fibre and other micro nutrients. It is also loaded with other health benefits like hormone balancing, male-female reproductive boosting properties. Dark leafy greens like Ugwu (ugu) are rich in Vitamins A, C and E, as well as essential minerals like iron and magnesium. These nutrients are crucial for maintaining healthy skin and preventing premature ageing (classiscauthor, 2024).

Have you ever heard about the positive impact of Ugu vegetable's leaves on your health? This vegetable has tons of Vitamins and minerals, which help your body to stay healthy and skin to remain smooth, (Adriama, 2017). Hence there exists the potential to harness the rich content of Ugu as a natural source of nutrients and other essential compounds for the production of organic and organic-based beauty products. Also, it could serve as a constituent for the production of supplements by the pharmaceutical firms. (Eseyin et al.)

According to (Kayode and Kayode, 2010) several medicinal uses of the fluted pumpkin (Telfairia occidentalis) in traditional medicine have been documented. Although, many of these claims are yet to be validated by scientific researchers, a review of some investigated therapeutic activities of the plant are highlighted in this article. Experimental works done on Telfaira occidentalis especially in the field of Biochemistry were retrieved via Google search on the internet and studied carefully to identify any therapeutic activity reported on Telfaira occidentalis. It can be inferred that the ability of the plant to combat certain diseases may be due to its antioxidant and antimicrobial properties and its minerals (especially Iron), vitamins (especially vitamin A and C) and high protein contents. We therefore conclude that with further chemical manipulation and clinical investigations numerous drugs designs could emerge from the plant.

According to (Opara and Okoronkwo, 2021) it is also a source of oil used for cooking and making soaps, margarine, paint and varnishes. According to this, vegetable oil is being extracted from this wonderful leaf for cooking and soap making, margarine (a consumable) and paints, but who could have believed this? Varnishes are also produced from Ugu leaf.

The production process of Ugu involves the making of the planting platform (ridge, bed or mounds) planting with the seed and facing the cortex of the seed down. The planting, preferably by the onset of the rainy season (can also be planted all year round with access to water supply) is followed by the first cut "i tu be onu" after about a month of sprouting and or when it must have got about more than four buds. This is to encourage more shooting out from these buds. Then regular or constant weeding as at when needed (weed monitoring and management). Then also regular checks for diseases / inspection and or nutritional issues. (NATURE'S HERITAGE NETWWORKS, 2021)

2 Problem Statement

Develop an ML/AI based system for the early and accurate detection of various Ugu leaf diseases as listed in section **??**, leveraging diverse image datasets, and advanced algorithms to improve farm production efficiency and better crop yield.

3 Objectives

The objectives of the study is primarily to develop an accurate and efficient and robust system for identifying the diseases mentioned in **??** particularly in its early stage. This early detection is very important for prompt management intervention and control and can assist in reduction of crop losses and prevent the spread of the disease(s).

4 Research Questions

- What is the accuracy of using image processing to identify and classify different Ugu leaf diseases?
- How does image processing and classification compare to traditional methods of Ugu leaf disease detection?

5 Justification of the Study

- Existing methods for vegetables, fruits and other plant's leaf diseases identification suffer from low accuracy, posing a huge challenge for precise classification.
- To proffer suitable solutions to identified Ugu (leaf) disease.
- The importance of the study is to find an easier and prompt method of disease detection in the farm. This will reduce loss due to disease in the farm as the cosmetic and pharmaceutical industries have standard qualities they look out for and purchase.

6 Scope of The Study

The scope of the study is to find out how ML/AI (machine learning / artificial intelligence) can be used for only disease detection and classification and treatment suggestion / recommendation in a large scale Ugu farm of the following diseases of fluted pumpkin **Downy mildew, Powdery disease, Mosaic disease and Bacterial leaf spot**

CHAPTER TWO

LITERATURE REVIEW

In the recent time, about a decade or two, there has been this outburst of technological advancement in the fields of Data Analytics, Machine Learning, Data Science and Artificial Intelligence. Along with this outburst of technological advancement is an intersection of these fields of endeavour with our everyday way of lives. This is cutting across how we do business, how we learn, how we access health care, how we farm and now, specifically how to identify plant diseases and take care of them. There is a rich tagestry of methodologies, algorithms and frameworks designed to address the challenges of disease leaf detection when comprehensive exploration on literature is taken. This review of literature brings together findings from different research studies, and offering insights into the evolution of techniques employed and used for plant disease detection and tries to figure out how these can be applied to Ugu leaf disease identification and classification (source ???)

Ugu disease pose a very high severe threat in the planting and production of this highly cherished vegetable. Hence, it very pertinent for the Ugu farmers to effectively deal with Ugu disease and early detection of these diseases is key. This is very easy to handle in very small to medium scale production. But this is a very herculean task as the size of the farm grows into acres of land, most especially for very harmful crop diseases.

Site selection: Squash and pumpkin are best grown on sandly loam or silt loam soils with a pH of 6 to 7. Growth on acidic and or poorly drained soils often results in increased incidence of root, crown and fruit rots. Late plantings should not be situated near earlier plantings where a disease already existed. (source ???)

Sanitation: Old crop debris provides a site were many plant pathogens overwinter and survive between crops. Crop debris shuld be removed or incorporated into the soil to hasten its decomposition as soon as possible after harvest. Care should be taken to avoid contaminating planting areas with soil, diseased culls or diseased plant materials.

Disease resistant varieties: Disease-resistant varieties of squash (virus diseases and powdery mildew) and pumpkin (powdery mildew) are available and should be planted where possible. Resistance is the most effective and economical means of disease control. For diseases such mosaic virus, resistance is the only effective control.

Pathogen-free seed and transplants: Some diseases may be seedborne or introduced into fields on infected transplants. Efforts should be taken to obtain high-quality seed and transplants. Only transplants that appear healthy should be used.

Irrigation: Frequent application of sprinkler irrigation with small amounts of water favour the spread and development of many diseases. Overhead irrigation produces splashing and runoff, which promotes movement of plant pathogens and increases the duration of leaf wetness - a condition that favours infection. Drip irrigation helps reduce diseases by not wetting foliage and by reducing pathogen spread from overhead sprinkler splashing or water run off.

Chemical control: Spray programs with fungicide or bactericide (copper compounds) sprays may be needed for effective management of foliar diseases. Consult the latest edition of the E-832, OSU Extension Agent's Handbook of Insect, Plant Disease adn Weed Control for a list of suggested treatments for specific diseases. Generally, spray programs are most effective when applied on a regular (seven to fourteen days) preventive schedule. Organic growers have fewer spray options than conventional growers, but many copper compounds and sulfur can be used in organic production.

Scouting: Plantings should be scouted regularly - at least once per week - for insect pests and diseases. Scouting allows for early pest detection so timely management practices can be implemented.

Disease identification: Correct disease identification is key to effective management. Incorrect identification can lead to the implementation of an ineffective management practice and crop failure. For example, disease caused by bacteria or viruses are not controlled with most fungicides. Furthermore, some fungicides will control one fungal disease, but not another. Squash and pumpkin growers shuld learn to recognise the more common diseases by their symptoms and have sufficient knowledge of disease development to select appropriate management practices. Some diseases are easy to identify in the field, while others are more difficult. The following descriptions will aid in disease identification and if needed, the OSU Plant Disease and Insect Diagnoses Laboratory offers disease diagnosis as a service to commercial growers and residential gardeners. Samples can be submitted to the laboratory through local county OSU Extension offices.

1 Types of Ugu Leaf Diseases and Causal Agents

Traditionally, there are several types of crop disease: abiotic (also known as non–infectious) and biotic (infectious). Unfavourable environmental conditions often generate non-communicable diseases. Examples are low or high temperature, excess or lack of moisture. Also, diseases are usually caused by harmful impurities in the air. They can accumulate due to the presence of nearby chemical or metallurgical plants. Usually, the unhealthy physicochemical composition of the soil is the disease source. The latter factor is often the result of poor-quality treatment of fields with some herbicides. These examples prove the importance of sustainable agriculture [using AI and other supporting technologies] not only for protecting the environment but also for a profitable [Ugu cultivation and other dependent-to-be industries of the future] businesses. (Vasyl, 2023)0.

According to (John and Lynn, 2019), squash and pumpkin are vegetable crops in the cucurbit family grown both on commercial farms and in residential gardens. This means that both vegetables would be affected by the same diseases mostly.

(John and Lynn, 2019) went further to say the following: Integrated pest man-

agement (IPM) involves the use of several different strategies and the judicious use of pesticides for management of diseases and other cucurbit pests. Both conventional and organic growers should practice IPM. More effective and less costly control is usually achieved when IPM is practised, compared to reliance on a single management practice, such as pesticide application. Management strategies that are components of an effective IPM system include: Crop rotation: Fungi, bacteria and nematodes that cause soil-borne and foliar disease often survive in the soil or on old crop debris and build up to damaging levels with repeated cropping. To reduce pathogen survival and disease carry-over a three-to-four-year rotation with non-cucurbit crops is recommended.

2 Ugu Diseases and Symptoms

According to (Mir, 2024), the following are the common diseases of Ugu leaf with symptoms.

- **Downy Mildew**: Downy mildew only affects leaves of cucurbit plants. Initial symptoms include large, angular or block, yellow areas visible on the upper surface (Figure 2). As lesions mature, they expand rapidly and turn brown. The under surface of infected leaves appears water-soaked. Upon closer inspection, a purple-brown mold (see arrow) becomes apparent (Figure 3). Small spores shaped like footballs can be observed among the mold with 10x hand lens. In disease-favourable conditions (cool nights with long dew periods) downy mildew will spread rapidly, destroying leaf tissue without affecting stems or petioles. (Richard and Karem)

- **Powdery Mildew**: According to (Opara and Okoronkwo, 2024), Powdery mildew is caused by the fungus Fusarium moniliforme. This fungus forms a dry powdery mass of mycelia on the fruits of fluted pumpkin. Symptom is also observed as greyish powdery areas on older leaves; leaf drop may cause sunburn First seen on the lower leaf surface powdery mildew is a white "powdery" covering of spores hat move upper, eventually defoliating the pumpkin plantss.

- **Mosaid Disease**: Many biological constraints, particularly diseases of the virus origin have become potent threats to existence of the plant and thus of utmpst importance is Telfaira mosaic virus (TeMV), genus Poty virus followed by Pepper veinal mottle virus (PVMV), genus Poty virus. Common virus symptoms observed on plants in the filed includes mosaic, mottling and leaf size reduction. Mosaic symptoms on leaves were most common (25%), followed by leaf sizee reduction (17%) and leaf necrosis were least (2%). Telfaira mosaic virus (TeMV), causes mottling of the leaves and low leaf yield; it also causes chlorosis and it therefore transmitted from generation to generation by mere planting (Opara and Okoronkwo, 2024).

- **Bacterial Leaf Spot**: (Opara and Okoronkwo, 2024) said Bacterial leaf spot is caused by Xanthomonas cucurbitae (syn = X, campestris pv. cucurbitae). Lesions appear first on the underside of the leaves as small, water soaked yellow dots on the upper of the leaf. Lesions are especially small in pumpkin, winter

squash and gourd leaves. A s lesions enlarge, they can coalesce and look like Angular

CHAPTER THREE

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CHAPTER FOUR

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CHAPTER FIVE

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Appendix Title

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