* 1. fcdrgaszBACKGROUND OF THE STUDY

Agriculture continues to be the backbone of many economics worldwide, particularly in developing countries in developing countries where it serves as the primary source of food and income for millions of households. Among the wide range of crops cultivated, potato(Solanum tuberosum) and maize (corn, Zea mays) stand out as two of the most important staple crops globally.

* Maize is one of the world’s most cultivated cereals and a primary food source for both humans and livestock. In sud-Saharan Africa, maize provides more than 30% of caloric intake for millions of people, making it vital for food security.
* Potato is the fourth most consumed food crops globally after rice, wheat, and maize. It provides essential nutrients such as carbohydrates, vitamins, and mineral and serves as both a subsistence and cash crop for farmers.

Despite their importance, both maize and potato production are heavily threatened by plant diseases. For instance:

* Potato is prone to diseases such as late blight (Phytophthora infestans), early blight (Alternaria solani), and bacterial wilt.
* Maize is affected by northern leaf blight (Exserohilum turcicum), maize streak virus, and gray ledaf spot(Cercospora zeae-maydis).

These diseases can cause 30-70% yield diseases, depending on the severity of the outbreak, environmental conditions, and farmers access to early intervention strategies, in worst case scenarios, epidemics like the Irish Potato Famine in the 19th century demonstrate the devastating socio-economic consequences of unchecked plant diseases.

Traditionally, farmers rely on visual inspectations or advice from agricultural extension officers to diagnose crop diseases. However, these methods are time-consuming, subjective, and often inaccessible to smallholder farmers living in remote areas. Laboratory-based diagnostics, while accurate, are expensive and not practical for on-field decision making.

Wit the advancement of Artificial Intelligence(AI), Computer Vision, and Mobile Technologies, there is now an opportunity to democratize plant disease diagnosis. AI-powered mobile applications can enable farmers to simply capture an image of a diseased crop leaf with their smartphone, process the image using Convolutional Neural Networks(CNNs), and receive instant feedback about the disease type and possible control measures.

This project proposes Cropcare AI, an AI-powered mobile application designed specifically for real-time disease detection in potato and maize crops. By providing early, accurate, and accessible disease identification, Cropcare AI aims to improve crop productivity, reduce yield losses, and enchance food security.

* 1. STATEMENT OF THE PROBLEM

Crop diseases remain a major obstacle to sustainable agricultural production. For smallholder farmers who form the majority of potato and maize producers in developing countries, several challenges persist

* Limited Access to Expert Knowledge: Many farmers cannot access extension officers or plant pathologist who can diagnose diseases acuurately.
* Late Diagnosis: By the time symptoms become visible, diseases may have spread extensively, making treatment ineffective.
* Misdiagnosis: Farmers moften mistake nutrient deficiencies or environmental stress for diseases, leading to inappropriate treatments.
* Post-harvest Losses: Potato, in particular, suffers from storage diseases that continue to cause losses even after harvest.
* Digital Divide: Most existing agricultural apps focus on global crops like wheat or rice, while regionally significant crops such as maize and potato in Africa receive less attention

These challenges highlight the need for a smart, accessible, and low-cost disease detection system that empowers farmers to identify diseases accurately and take timely preventive or corrective measures.

* 1. AIM AND OBJECTIVES

Aim:

The aim is to design and develop a mobile-based application (Cropcare AI) for real-time detection of diseases in potato and maize crops.

The application is an intuitive mobile interface that allows farmers to capture and upload crop leaf images.

To train and integrate a Convolutional Neural Network (CNN) capable of identifying common potato and maize leaf diseases.

The application provides a real-time diagnostics feedback and basic treatment recommendations.

It also has a backend database for strong disease reports, enabling monitoring of disease prevalence trends over time.

* 1. SCOPE OF THE STUDY

The scope of this project will cover the development of a mobile app (Android-based initially) for potato and maize disease detection. The focus on leaf based diseases due to their visibility and diagnosability through image processing, using machine learning (CNN models) for classification. It provides actionable feedback in user-friendly formats (e.g., text and icons).

However, there are some limitations affecting the development of the app like the fact that only leaf diseases are considered (root and stalk diseases excluded). the availability may limit the number of disxeases covered and suggested treatments will be informational, not prescriptive or region-specific.

* 1. PROJECT RISKS

|  |  |  |  |
| --- | --- | --- | --- |
| Risk | Description | Impact | Mitigation Strategy |
| Poor image quality | Blurry or poorly lit photos may reduce | Incorrect diagnosis | Provide image-taking guidelines in app |
| Dataset limitations | Lack of region-specific images of potato/maize diseases | Limited disease coverage | Partner with research institutes for dataset expansion |
| Model bias | CNN may classify some diseases more | Misdiagnosis risk | Regular retraining with diverse datasets |
| Adoption barriers | Farmers may be reluctant to trust AI | Low usuage | Provide simple UI and farmer training workshop |

* 1. SWOT ANALYSIS

|  |  |  |  |
| --- | --- | --- | --- |
| Strengths | Weaknesses | Opportunities | Threats |
| Real-time diagnosis with AI | Dependent on quality of images | Expansion to other crops beyond maize/potato | Competition from global agricultural app |
| User-friendly mobile app | Limited disease scope initially | Partnerships with agricultural bodies | Cybersecurity/data privacy risks |
| Supports smallholder farmers | No control over treatment implementation | Contribution to digital agriculture policies | Farmers mistrust of digital tools |

* 1. SIGNIFICANCE OF THE STUDY

The development of CropCare is significant in several ways like, the mobile application provides an immediate, expert-level disease diagnosis without requiring expensive consultations for farmers, for researchers, it contributes datasets and diagnostic tools for under-researched crops (potato and maize in Africa). It also aligns with digital agriculture goals enhancing good security and poverty reduction efforts. It also reduces crop losses, increases yield, and ensures better nutrition for communities reliant on potatoes and maizes.

* 1. ORGANIZATION OF THE PROJECT
* Chapter One: Introduction (background, problem statement, aims, objectives, scope, SWOT, and significance).
* Chapter Two: Literature Review (plant disease detection, AI in agriculture, mobile apps, image processing, research gaps).
* Chapter Three: System Design and Architecture (model design, dataset, system workflow, and app structure).
* Chapter Four: Implementation and testing (development, model integration, results, evaluation).
* Chapter Five: Summary, Conclusion, and Recommendations.

1. LITERATURE REVIEW
   1. INTRODUCTION

The agricultural sector remains the backbone of human civilization,serving as the primary source of food, income, and employment for millions of people around the globe. Among staple crops, maize (Zea mays) and potato (Solanum tubersum) are of particular importance due to their significant contribution to global food security, nutritional intake, and economic value. Maize is one of most cultivated cereal crops in the world and is used not only as a direct human food source but also as livestock feed and raw material for various industrial products such as starch, ethanol, and biofuel. Similarly, potato is the world’s fourth most important food crop after rice, wheat, and minerals, and its versatility in local and industrial food systems.

This chapter reviews the literature on potato and maize diseases, traditional diagnostic approaches, AI in agriculture, mobile-based disease detection systems, and the gaps that still exist. The review will demonstrate how AgriScan, an AI-powered mobile application designed for real-time detection of potato and maize diseases, seeks to fill these gaps and provide a reliable tool for farmers.

* 1. IMPORTANCE OF POTATO AND MAIZE IN GLOBAL AGRICULTURE
     1. Global Importance of Maize

The most extensively grown cereal crop worldwide, maize is grown in more than 160 countries. Global maize production exceeded 1.1 billion metric tons in 2021 making it the most abundant cereal crop in terms of production volume, according to the Food and Agriculture Organization (FAO,2022). More than 300 million people in Africa rely on maize as their main source of calories and as a staple food. For example, in Nigeria, maize accounts for roughly half of all cereal production, and it is consumed in almost every household in a variety of forms, such as pap, maize meal, roasted corn, boiled corn and maize flour.

About 60% of the maize produced worldwide is used in animal husbandry, making it an essential commodity for livestock feed. Additionally maize is a crop of both subsistence and commercial value because of its industrial applications, which include the production of ethanol, cooking oil, and pharmaceuticals.

Therefore, maize-related diseases disrupt regional and global supply chains in addition to endangering household food security.

* + 1. Global Importance of Potato

Grown in more than 150 countries, potatoes are an important food crop. It is particularly important in nations like China, India, Russia, and Peru, but it is also becoming more and more significant in Africa. For instance, Nigeria is one of sub-Saharan Africa’s leading producers of potatoes. In addition to their high starch content (roughly 17%), potatoes are prized for their high vitamin c, potassium, and dietary fiber contennt. Potato cultivation benefits both smallholder farmers and large-scale agricultural enterprises because of its short maturity period and enivronmental adaptability.

Globally, potatoes are used for a variety of purposes, including starch production, chip, fries, flour, and fresh consumption. The crop’s perishable nature makes it particularly vulnerable to storage diseases, which add to the already significant burden of field diseases. Any outbreak in potato diseases has the potential to cause both economic and nutritional crises, particularly in regions where it constitutes a dietary staple.

* + 1. Regional Importance in Africa

In sub-Saharan Africa, maize and potato are essential for subsistence farming and household food security. For instance, maize accounts for over 30% of caloric intake in East and southern Africa. Potato, while less consumed than maize, is increasingly important in regions like the Jos Plateau of Nigeria, where it supports local economies. Therefore, disease out breaks in either crop significantly undermine livelihoods, income stability, and food supply. The importance of maize and potato underscores the need for sustainable disease detection and management practices.

* 1. OVERVIEW OF DISEASES IN POTATO AND MAIZE
     1. Major Potato Diseases

1. Early Blight (Alternaria solan)

* Symptoms: Small, dark brown concentric rings on lower leaves, progressing upward. Leads to defoliation and reduced tuber size.
* Widely prevalent in warmer climates; causes up to 20-30% yield reduction if uncontrolled.
  + 1. Major Maize Diseases

1. Common Rust (Puccinia Sorghi)

* Produces Reddish-brown pustules on both leaf surfaces.
* Severe infections weaken plants and reduce grain yield.
  1. ARTIFICIAL INTELLIGENCE IN AGRICULTURE
     1. Role of AI in Agriculture

AI is transforming agriculture through some ways like, disease detection, yield prediction, precision farming (fertilizer/pesticide optimization) and early warnings for pest outbreaks. All these ways have making farming so much easier and sustainable, making work 10x faster for workers.

* + 1. Machine Learning Approaches

Early approaches used Support Vector 9svm0, Random Forest (RF), and K-Nearest Neighbor (KNN). These methods relied on manual features Extraction (color, shape, texture), making less scalable.

* + 1. Deep Learning and CNNs

CNNs are the most advanced approach for image-based classification: they achieve a high accuracy with large datasets and automatically extract relevant features.

**Case Studies:**

* Mohanty et al.(2016): Achieved 99% accuracy using cCNNs on PlantVillage dataset.
* Ferentinos (2018): Trained deep CNNs for 58 plant diseases with >95% accuracy.

However, potatol and maize remain underrepresented in datasets, creating a research gap.

* 1. RESEARCH GAPS AND AGRISCAN CONTRIBUTION

|  |  |
| --- | --- |
| Gap | AgriScan Contribution |
| Lack of potato/maize datasets | Develops CNN models trained on these crops |
| Complex Interfaces | Simple farmer-friendly design |
| Generic treatment advice | Provides localized recommendations |

* 1. SUMMARY

The literature confirms that while AI and mobile apps are revolutionizing agriculture, most existing solutions neglect potato and maize. AgriScan bridges this gap with a farmer-centered, AI-powered app tailored to these critical crops.