Smart Pest Identification and Control Mobile App for Gherkins Cultivation

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Declaration

I declare that this is my own work, and this proposal does not incorporate without acknowledgment any material previously submitted for a degree or diploma in any other university or Institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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The above candidates are carrying out research for the undergraduate Dissertation under my supervision.

Dr. Dharshana Kasthurirathna 2/29/2024

Signature of the supervisor Date

Abstract

This paper is dedicated to the problem of Gherkin growing linked with precise pest diagnosis and the way to present the solution which can be useful for farmers through a mobile application. In Sri Lanka, the agriculture sector is occupying a most important position, as it is employing 27.1% of the population and is contributing 7.4% to the nation's GDP. Gherkins, a crop that have a well-recognized brand with world market, over 10-20% of the harvest per annum being damaged by thrips attacking. Modern pest control methods are inefficient. They highlight that we do have to develop new methods of handling with that. Inno Agri mobile application that operates on artificial intelligence, image processing, and augmented reality opens a broad spectrum of options in pests control of cultivating cucumbers. The objective of this app is to help overcome language hindrance while unravelling logic in training settings and complexity of pests and disasters. The export of garcinia has increased dramatically, particularly to Europe, and has reached 6984 tons in 1991 as compared to 320 tons in 1988 which indicate the demand. Crop reduction is a long-term research issue due to pests which delays preventive measures hence loses occur economically. The proposed app is well equipped with machine learning models likeYOLOv3 and Inception v3 that are known to be highly accurate. In addition, it applies mixed reality to demonstrate farmers the full dimension of the pests and helps them to better comprehend the topic. It will also offer selections in Sinhala to ensure maximum usability to the farmers in Sri Lanka and mapping with the Gemini model to examine the environment and propose solutions including artificial intelligent. Ino Agri app innovative, modern, and farmer friendly results in productivity, efficiency and sustainability, making gherkin production to grow. Our proposed budget is also aligned with the process through which the system will perform the functions of steering the Sri Lanka agricultural establishment.

Keywords – Image Processing, Machine Learning, Convolutional Neural Network, Augmented Reality, Pest Identification and Control, YOLOv3, Inception

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List of Abbreviations

Abbreviation	Description
GDP	Gross domestic product
SVM	support vector machines
ANN	Artificial Neural Network
AR	Augmented Reality
KNN	K-Nearest Neighbor
CNN	Convolutional Neural Network

Introduction

Background and Literature Survey

The main activity in Sri Lanka is agriculture. 27.1 percent of the population will be involved in agriculture field in 2020 which surpasses 7.4 percent of the national GDP [1]. Different vegetable and fruit crop grown in Sri Lanka. Gherkins holds significant importance in Sri Lanka’s agriculture and has high demand worldwide. Gherkins are a versatile crop, widely used in pickles, salads, and various culinary dishes. But the "gherkin disease" which is actually the tendency of the gherkin plant to attract pests is one of the severest challenges of the current season. Sri Lanka exported a mere 320 metric tons of gherkins in 1988. This rose to 6984 tons in 1991 with the total earnings of Rs. 189 million. This indicates that the gherkin production has been popularized in Sri Lanka in a very short period [2]. Gherkins are accounted in Sri Lanka for the export market and grown in a wide range of solid and climate conditions.

Sri Lanka lost 10% to 20% of its harvest each year because of pest infections [3]. In India, the outbreaks of pests are abrupt and have caused approximate 18% losses, or up to 90,000 million rupees lost annually [4]. Therefore, Pest control is quite important to improve agriculture production and food quality. Fresh farmers rarely receive formal training in pest detection or pest control techniques. It relies heavily on agricultural experts because of the large number of subtle differences among pest species. Gherkins pest disasters are very complex and large, Plant pests are uneven, diverse, widely distributed, increase suddenness and randomness, reproduce quickly and in large numbers, and can also cause an increase in resistance. Traditional methods and theories are different to deal with pests and are no longer suitable for solving pest disasters. Therefore, our smartphone mobile app for pests detection and provision of good control recommendations to help farmers in their crop production is a good step to control this problem.

In countries under development, farming is the foundation of employment, national revenues, and raw material input for the industry [5]. Then the image recognition technology of artificial intelligence has achieved great success in many computer vision-tasks. This report is about the automatic detection method of any pest that would need the use of several algorithms but the main three are, identify the lifecycle of stage of that pest, capture the stage of damage in the plant and only then would a biological preventive method be provided. However, most farmers do not have good knowledge of English. They could not understand the recommendations. Then, that app provides translated recommendations to avoid pests. Therefore, farmers can simply understand all details about pests and recommendations. The automated monitoring system provided detailed information about the application of chemicals, including quantity, usage guidelines, and application methods. The app outcome will be shown as augmented reality, and then it is described as simultaneous integration of digital information with the farmer's environment. Provide translated solutions and augmented reality 3D based animation to increase farmers' interest in new technologies.

A novel technique of pest categorization is putting the natural environment at risk among the agricultural activities and changes in farmers' lifestyle on the top of the list. Implementation of automated surveillance system with camera devices that are meant to ward off and control insect infestation should not be overlooked [6]. The results we attained were quite high. The system, incorporating machine learning for pest identification and providing farmer-friendly solutions, improves the efficiency, productivity, and sustainability of gherkin cultivation in Sri Lanka. Traditionally, pest identification based on visual observation and experiential knowledge passed down through generations. This process has a lot of limitations. Fresh farmers faced difficulties identifying pests before the disaster. The lack of comprehensive understanding and technical knowledge about different pests causes delayed identification of infestations, reduced harvests, and economic losses for farmers.

In agriculture domain, Machine learning, deep learning, and Computer Vision methods are utilized in a precisely to perceive pests and also various types of pest testing and detection researches have also been done on the same subjects [7]. Digital image processing tools aided on photos of crop insects by performing the pre-processing, segmentation, and feature extraction steps, to evaluate the insect shape. In the early stage of pest recognition, handcraft-feature methods were the primary solutions. Mayo et al. proposed an automatic identification method using support vector machines (SVM). It has a novel approach for the early detection of whiteflies, aphids, and thrips on greenhouse crops [8].

Figure 1 Sample Pest Images

Thenmozhi Kasnathan et al. [9] Wang and Xie dataset were experimented for the identify of 9 and 24 insect classes, respectively using algorithms such as Support Vector Machines (SVM), Artificial Neural Network (ANN), K-Nearest Neighbor (KNN). The results shows that the Convolutional Neural Network (CNN) model, using datasets from Wang and Xie. It provides pest classification accuracy of 91.5 percent and 90 percent for 9 and 24 classes of insects.

Yufeng Shen et al. [10] presented implementing a system for detecting and identifying stored-gran insects by applying a deep neural network. They used Faster R-CNN for disclosing the corresponding genus of these insects. Hence, the developed innovative procedure can identify the kind of poisonous insects under grain storage. These conventional methods have some disadvantages in terms of practicality, contributing to delayed pest identification, recognized accurate pest, provided farmer friendly solutions

Research Gap

To identify and control pests in gherkins industry, the following key points are considered.

- Identify accurate pest.
- A study of pest distribution, growth, and harm.
- A study of avoid techniques for pest.
- A study of applying chemicals to the farm.
- Provide farmer friendly smart solution system.

1.1 Comparisons between former research and the systems

Research	Pest identification	Pest re-identification and detection	Provide solutions to pests	Augmented reality pest visualization	Translate the solutions
Smart Pest Management: An Augmented Reality Based Approach for an Organic Cultivation	✓	✖	✖	✓	✖
Pest Identification and Control using Deep Learning and	✓	✓	✖	✖	✖

Augmented Reality					
Insect Pest Detection and Identification Method Based on Deep Learning for Realizing a Pest Control System	✓	✖	✓ (only chemical name)	✓	✖
Pest Identification and Control using Deep Learning and Augmented Reality	✓	✖	✓	✖	✖
The Study of Traditional Pest Image Recognition and Deep Learning Pest Image Recognition	✓	✖	✖	✖	✖
A Research Review of Pest Identification	✓	✖	✖	✖	✖

and Detection Based on Deep Learning					
Faster-PestNet: A Lightweight Deep Learning Framework for Crop Pest Detection and Classification	✓	✖	✓	✖	✖
Proposed System	✓	✓	✓	✓	✓

Research Problem

The main challenge in the gherkin industry is identifying and controlling pest infestations while lacking experiential knowledge. Fresh farmers often struggle to recognize pests in their early stages, leading to delayed interventions and substantial losses in harvest yields. Additionally, there is a lack of knowledge of various pests and the corresponding chemical solutions. The critical aspect of this research problem revolves around the fact that fresh farmers having limited or no past experiences to identify pests and provide solutions. Unlike experienced farmers who can rely on years of observation and accumulated knowledge. Furthermore, farmers waste a lot of time and money to avoid pest infections because they lack good knowledge of English. Considering Image [Figure 1.1] provided survey details about farmers interest and experience of information technology usage. It shows that 57% of farmers do not have a good knowledge of information technology. Then the past pest identification app did not work in an effective and efficient way. The main reason for this is farmers having a lack of experience, and the system is not farmer friendly.

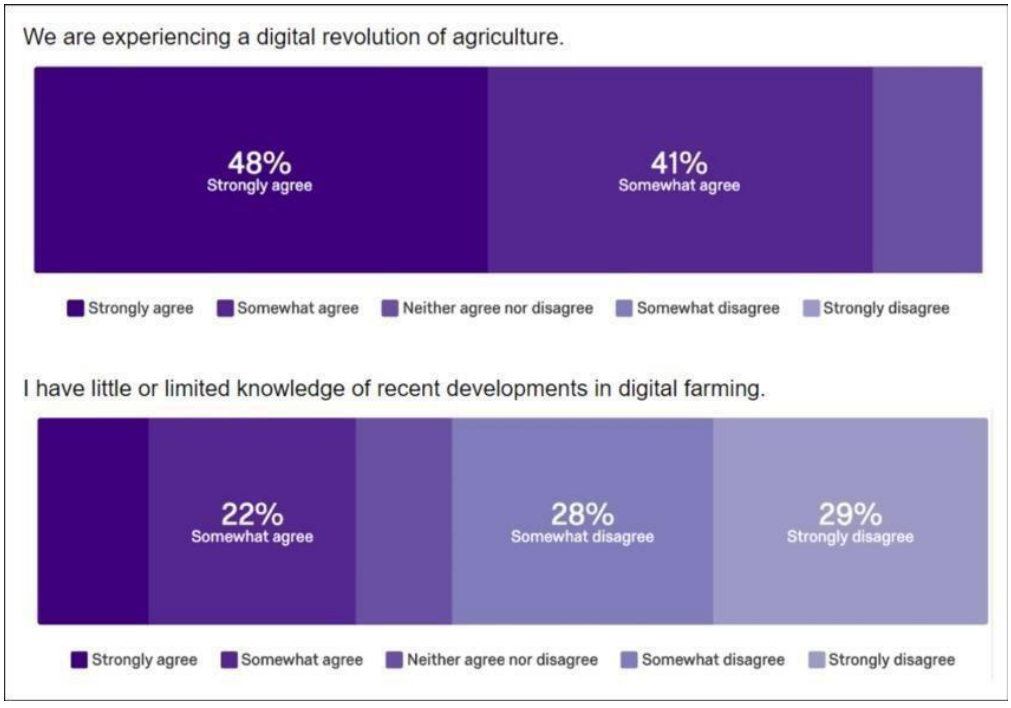

Figure 2 Farmer knowledge of the digital agricultural revolution

Moreover, identifying highly accurate pests is another critical research problem. Using machine learning, Algorithm provides real-time pest identification with an accurate rate of 90% [10]. However, achieving high accuracy required careful consideration in the pest identification step. In this step, the system identifies the wrong pest, and the process goes the wrong way. It is very harmful to the overall industry. Farmers are applying according to the identification and recommendation in this application. Therefore, it reduces the quality and quantity of the gherkins harvest. Pest recognition with 95% accuracy using machine learning models will increase the harvest and time in the agriculture industry.

The research problem of accurate pest identification and design for a farmer-friendly system includes the challenges of experiential knowledge, time-intensive learning processes, and language barriers. Providing machine learning for accurate pest identification and developing farmer friendly systems are crucial avenues for research. By solving these challenges, researchers can contribute to the implementation of sustainable and accessible solutions that empower new farmers and increase overall agricultural resilience and productivity.

Objectives

Main Objectives

The primary objective of this system is to develop a mobile application to identify accurate pests in gherkin cultivation and provide effective solutions to address pest-related challenges. The mobile app is implemented to be innovative, smart, and farmer-friendly with considering the latest information technology features. The term "innovative" describes the application's use of cutting-edge information technology (IT) features and discovering new technologies. And the "Smart" refers to intelligent, unique, and flexible functionalities tailored to the specific requirements of farmers. Finally, the main objective is to produce an efficient mobile app for the Gherkins industry to increase global market value.

Sub Objectives

- Identification of Gherkins Pests

  Build robust systems to identify accurate pests affecting grain crops. This involves advanced machine learning models and algorithms to ensure precision in pest identification.

- Pest Re-Identification and Detection

  Implement a system to identify pests by using two machine learning algorithms and continuous detection of pests. This ensures that farmers can monitor and address pest-related issues throughout the gherkin's cultivation.

- Augmented Reality (AR) Based Pest Visualization

  Implement augmented reality (AR) technology into the mobile app to provide farmers with a three-dimensional visual representation of pests. This specific feature improves

farmer's understanding of pest characteristics and behaviors, contributing to more informed pest management.

- Translation of Pest Solutions to Sinhala

  Identify the language barrier by translating pest solutions and information into Sinhala, the native language of Sri Lanka. This ensures that the mobile app is accessible and comprehensible to a wider audience, particularly farmers who may not be proficient in English.

Methodology

System Architecture Diagram

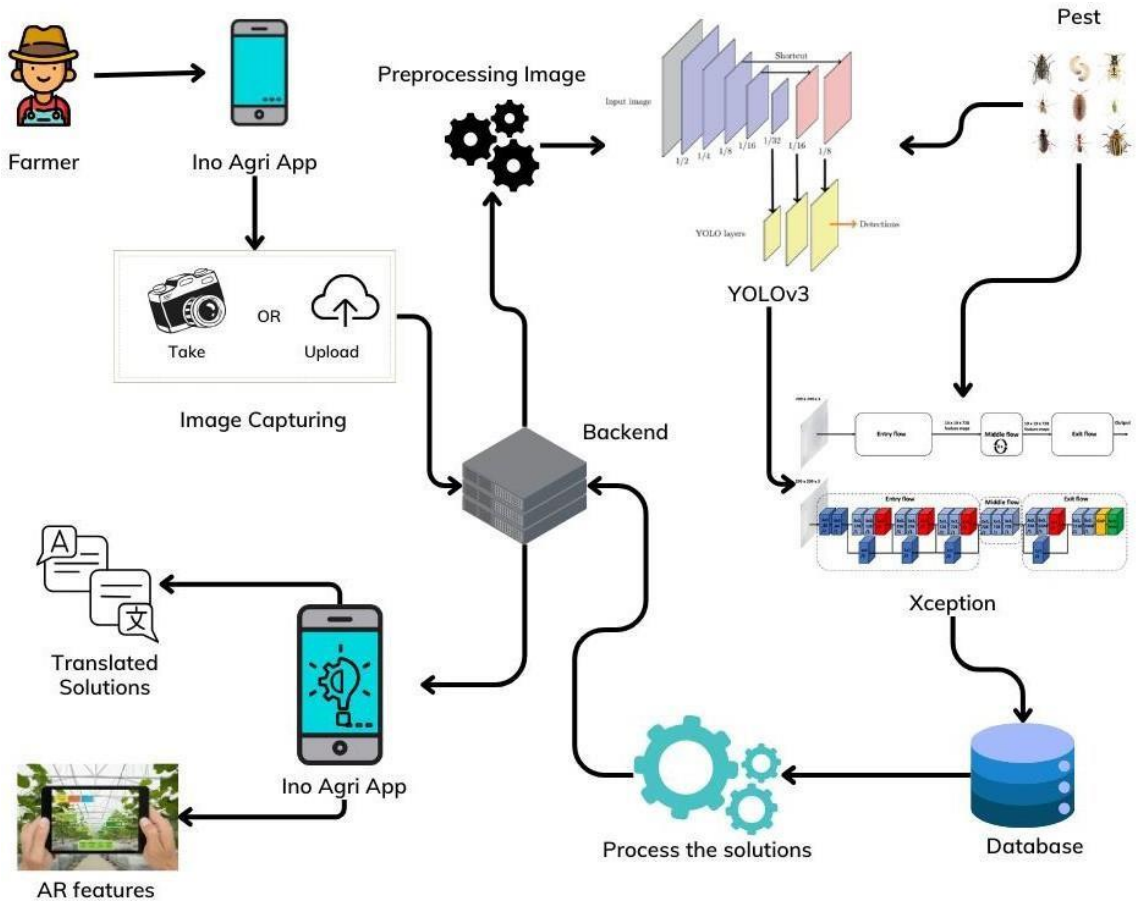

Figure 3 System architectural diagram

Problem Statement

The primary objective of this system is to develop a mobile application to identify accurate pests in gherkin cultivation and provide effective solutions to address pest-related challenges. The mobile app is implemented to be innovative, smart, and farmer-friendly with considering the latest information technology features. The term "innovative" describes the application's use of cutting-edge information technology (IT) features and discovering new technologies. And the "Smart" refers to intelligent, unique, and flexible functionalities tailored to the specific requirements of farmers. Finally, the main objectiveis to produce an efficient mobile app for the Gherkins industry to increase global market value. Agriculture, more so horticulture in the geographical areas that rely heavily on the production of Gherkin is a challenge due to pests that threatens the yield and quality. Old approaches to pest control are

mostly conservative, and do not have the level of specificity which is necessary to achieve appropriate pest control. There is also the problem of time and accuracy in the identification of pests especially in view of the right insect control measures to be applied.

In Sri Lanka, where a rather large segment of farmers might be illiterate in English and not quite knowledgeable of Information Technologies, it takes on a different level of difficulty. There are always language barriers when it comes to farmers when it comes to comprehending and applying instructions offered by the modern farming equipment.

The Ino Agri App solve these problems by providing a solution that not only provides an accurate and fast pest identification but also give the farmer meaningful, understandable solution in the farmers' own language. This approach is meant to improve the practice of pest management to boost the health and yield of Gherkin production.

Main Components

App has two main parts.

1. Accurate pest identification
2. Provide user-friendly recommendations.

Accurate Pest Identification:

To identify pests from the images which the user uploads, the app taps YOLOv8 and Inception v3 algorithm, both of which are intricate Convolutional Neural Network (CNN) models. YOLOv8 is used first to identify the objects in real-time, but with lower precision, and the Inception algorithm is used to refine the first identification. This symbiotic two-model strategy enhances the ability of correctly identifying a pest to high levels of accuracy and precision.

User-Friendly Recommendations:

After identification the app offers subsequent recommendations concerning the pest control. These recommendation they are provided in a manner that is understandable even for the novice computer user so that they can be implemented as desired. In order to make the recommendations easily understandable for the local farmer community, the app also uses the Expo Speech Library to provide these recommendations in Sinhala voice messages. Its design is fairly distributed and simple as well as made to fit the demanding positions of real time pest identification and use of both frontend and backend interfaces effectively.

Data Collecting Techniques

Through several ways, data will be collected. These various ways are mentioned below.

- Engagement with Gherkin Export Companies - Collaborate with HJS Gherkin export companies for industry insights and Conduct field visits to test the application in real world scenarios.
- Review of research papers - Analyze local and international research papers on gherkin cultivation and pest management.
- Consultation of Recognized Books - Study recognized books on gherkin cultivation and pest identification.
- Engagement with university resource person - Meet with university lectures, supervisors, and co-supervisors.
- Field Visits - Meeting home garden farmers.

Figure 5 Meeting with the Company

Figure 4 Nikawaratiya Field Visit

Data acquisition and processing

The Ino Agri App utilizes a large and varied database of pest images to train its machine learning algorithms. The data set is obtained from hjs gherkin company and field surveys so that a broad cross section of pests in diversified environments are captured.

Data Collection:

Samples are collected from various habitats, and at various times of the year, daylight conditions and development phases of pests. Despite consisting of over 1,700 pictures, each image is pre-tagged with pest type and environment and therefore fills datasets with all the

details necessary for pest identification.

Preprocessing:
The images containing the pests collected, from field, before being input into the models are prepared by resizing, normalizing and denoising. This also helps in standardizing the data and keeping it in the right format with respect to model training.

Data Augmentation:
The methods like rotation, flip, and color change are used to the dataset in order to generate the extra training set and the model's stability. This assists the models to perform well at other real situations since the models combine the given inputs in such a way that makes it easier for them to perform and generalize at other scenarios.

Model Training:
The processed data is used in training of YOLOv8 and Inception models. Libraries in Python including TensorFlow as well as Keras offer the layout for this process. The models are trained in progressive cycles reducing errors to detect pests with indicators as accurate sur ratings and F1-score.

Pest Recognition with YOLAV8

YOLOv8 is the main model utilized on the identification of pests in real-time using the Ino Agri App. Taking as a network (CNN) machine learning algorithms to accurately identify pests. Once an image is submitted basis the YOLO (You Only Look Once) architecture, YOLOv8 has implemented more significant advancements in terms of performance and less accuracy compared to the previous versions. The app will use two convolutional neural, initial identification is done by a convolutional neural network (CNN) algorithm called YOLOv3 (You Only Look Once). Given that training has been completed, the machine learning (ML) model s will give the binary outputs. To develop that model We will use python with the following libraries: NumPy for the processing of the array data of the images, OpenCV for image classification, TensorFlow, and Keras to deal with the ML framework. The model ensures accurate pest identification with real time object detection capabilities. Output the accurate pest identification, the backend use dataset of previously identified pests.

Training Process:

YOLOv8 model is fine-tuned from a dataset of pest image set to detect and accurately identify pests. The training includes changing of the values that are characteristic of the model in order to minimize the error of the prediction with using the checking data for the assessment of the accuracy.

Real-Time Detection:

Upon training, YOLOv8 is integrated into the app for real-time pest identification and detection. This is basic, it provides the foundation from which the subsequent recommendations should begin the farmers can submit images, and the model immediately determines the pest in question.

Final phase of the model that operates in parallel is the detection phase, where bounding box and class label are predicted for the whole image within one go in the case of YOLOv8 with the use of fully convolutional network. It has parts like the backbone, the neck as well as the head which are designed to extract features, to bootstrap features to build a representation or to make a prediction, respectively.

Pest Re-identification Using Inception v3 Algorithm

The Ino Agri App employs the sophisticated Inception algorithm for a secondary analysis or re- identification of the image. That extra layer of scrutiny and an optimized pest identification process will improve the overall efficacy and accuracy of the answers given to farmers. As a result of this process, we collected and documented accurate information, such as pests and their characteristics. This data is stored in a dedicated database to be retrieved for future analysis. To make the amount of pests identified more accurate, the Inception algorithm is used for the secondary analysis. A more powerful feature extractor, ‘Inception’ adds yet another layer of accuracy as it identifies the visibility and intricacies of pest images for their better identification.

Model Overview:

The Inception model works by processing the image in a more detailed and a more intricate manner than the YOLOv8. Its architecture has parallel convolutional layers of various scales, which enables the identification of different levels of the picture, which is very useful when it comes to re-identifying pests that are difficult to categorize.

Re-identification Process:

Following the identification made by the YOLOv8, the Inception algorithm goes over the image again to make further identification. These measures can reduce errors associated with misidentification therefore assuring the farmer more accurate results.

Data Storage:

The output from both YOLOv8 and Inception is saved in a database that contains extensive information about the pests in question. Aside from serving for the continued learning and for constructing a database for the future analysis towards improving the app's accuracy and performance, this database is useful for the program.

An ensemble machine learning model was implemented by integrating the YOLOv8 model with the Inception V3 model. Initially, pest detection is performed using the YOLOv8 model, and the results are then passed to the Inception V3 algorithm for further analysis.

Offering Sinhala Voice Translated Solutions Employing Expo Speech Library

To serve those users who are not conversant in the English language, especially in the context of likely user base of the app in Sri Lanka, the Ino Agri mobile app steps forward. It makes use of Google Translate API which translates the results in Sinhala, the native language of the region. This makes it possible for the recommendations and insights developed by the app to go beyond the realm of those who fully understand the technical details of the software. In the case of pest management, the Ino Agri App is designed to offer recommendations in Sinhala with the help of the Expo Speech Library. This feature is especially significant for farmers of Sri Lanka since they may better understand the voice, demonstrated in their first language.

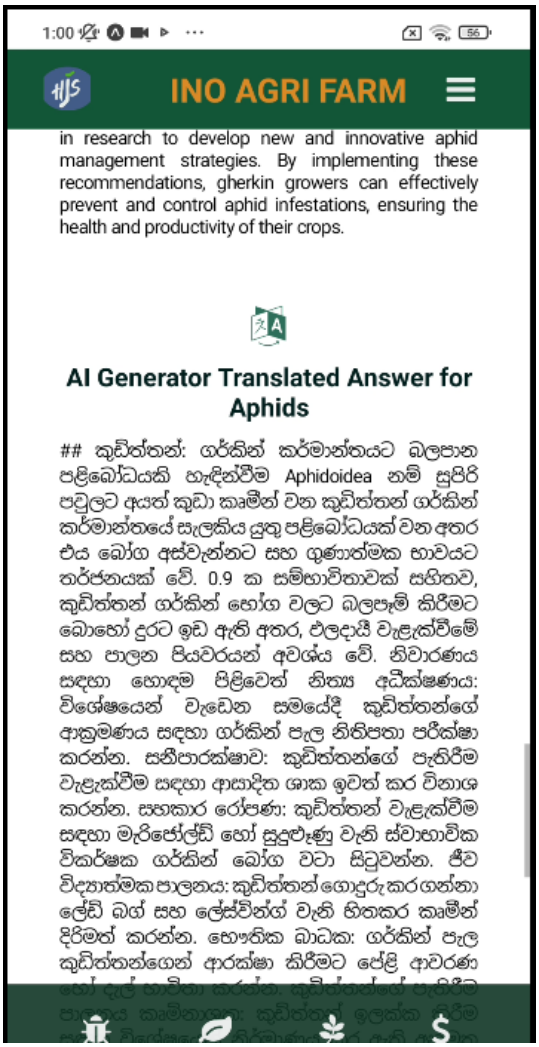

Figure 6 Translated Answer

Voice Translation:

To avoid the use of text instruction, the app developed is designed to provide voice instruction through an application known as Expo Speech Library in Sinhala language. This will make the sense when giving any recommendations on the app, to be both in writing and being able to verbally explain, for the benefit of those who cannot read or prefer being told rather than being read to.

Implementation:

On this basis, the recommendation results are transformed into voice utterances by utilizing the Expo Speech Library of text-to-speech. The voice output should therefore be clear and unambiguous, so that the farmers will be able to follow them without much problem.

User Experience:

This feature supports the use of the app where different farming situations are concerned and, therefore it is very useful. Hailed as a farmer's companion, whether doing it in the field or inside their homes, the app will provide voice prompts on how to manage pests and control measures that can be done immediately.

The app takes the user experience to a new level by infusing it with innovation with the use of augmented reality (AR) to display the pest insects visually. This capability provides farmers with a 3D view of the pests and thus helps them to develop a deeper perception and clearer picture of the characteristics and behaviors of the pests.

Figure 7 AR Pest View

Finally, the Ino Agri mobile app is a multipurpose solution as it is a combination of different technologies to diagnose pests in a more precise manner in Gherkins cultivation. The user-friendly interface, language accessibility, and augmented reality features put altogether make it inseparable to the farmers who need efficient and optimal pest management.

This Gemini model was trained using environmental data of pest images.In doing so, there was a multi-modal approach where the image and environmental data were combined to predict the main cause of the pest, its frequency and to offer solutions on how to eliminate the instances of data. The model was developed to provide pest classification as well as advice on preventing pest risk factors. A custom recommendation system was built using Gemini to deliver implementable measures to farmers.

Tools and Technologies

- Mobile App Development
  - React Native
  - Node JS
  - MongoDB
  - Python Flask

- Machine learning & deep learning libraries
  - OpenCV (Open-Source Computer Vision Library) - Enables versatile use of machine learning and computer vision.
  - YOLOv3 (You Only Look Once) - Real-time object detection algorithm vital for prompt pest identification.
  - Inception - Specialized algorithm for re-identifying pests, optimizing the identification process.
  - TensorFlow - End-to-end open-source platform supporting comprehensive machine learning.
  - CNN (Convolution Neural Network) - Neural network class specializing in grid-based data processing.

- Augmented reality for pest visualization - Display a 3D view of pests to increase farmers understanding of the pests.
- Expo Speech for Sinhala translations - Using Google Translate API convertsolution to Sinhala language.
- Tools
  - VS Code – for developers Visual Studio code - code editor.
  - PyCharm - Python IDE for professional developers.
  - Git and GitHub - Version control system (Git), code management and collaboration.
  - Jupiter Notebooks - An interactive notebook for data science and machine learning tasks, fostering experimentation and visualization.
  - Docker - Containerization tool for creating and managing lightweight, portable environments, ensuring consistency across different systems.

- Postman - API development and testing tool, facilitating the testing of API endpoints and requests.
- Tensor Board - Visualization tool for TensorFlow, aiding in understanding, debugging, and optimizing machine learning models.

Testing & Implementation

Implementation

Ino Agri is a novel mobile application created to help farmers in Gherkin farming and differentiating pests and moreover, attending to their challenges. Depending on artificial intelligent, the app has high stated value and has simple interfaces that are tailored to meet the requirements of farmers operating in Sri Lanka. The Ino Agri App is a cross-platform mobile application meaning it is developed to run on both android and IOS operating systems The application was developed using react native for easy integration of both platforms. The farmers have an ability to take pictures of pests and receive identification results as well as voice translated suggestions in the Sinhala language through the app. The options in React Native also make it possible to have a single UI for the devices which enhances the use of the app by different people.

Backend Development

The back end of the managed Ino Agri App is based on using Node.js and Python Flask servers, providing a robust and flexible environment for handling various node.js and Python Flask servers, providing a robust and flexible environment for handling various tasks:

Node. js Server:

The Node. js server processes the API call and its associated data as well as handles the user login process and other data processing and interaction with entities, such as the Expo Speech Library for vocal translation. It also handles the conversation between the MongoDB database and Google Cloud Storage to improve its functionality in managing and getting data.

Python Flask Server:

For tasks related to machine learning, including processing images uploaded by users and operating the YOLOv8 (Figure 3) and Inception (Figure 4) models for pest identification and re-identification, there is a separate Python Flask server. This server is designed to meet the computational requirements of such tasks, the results will be swift and precise.

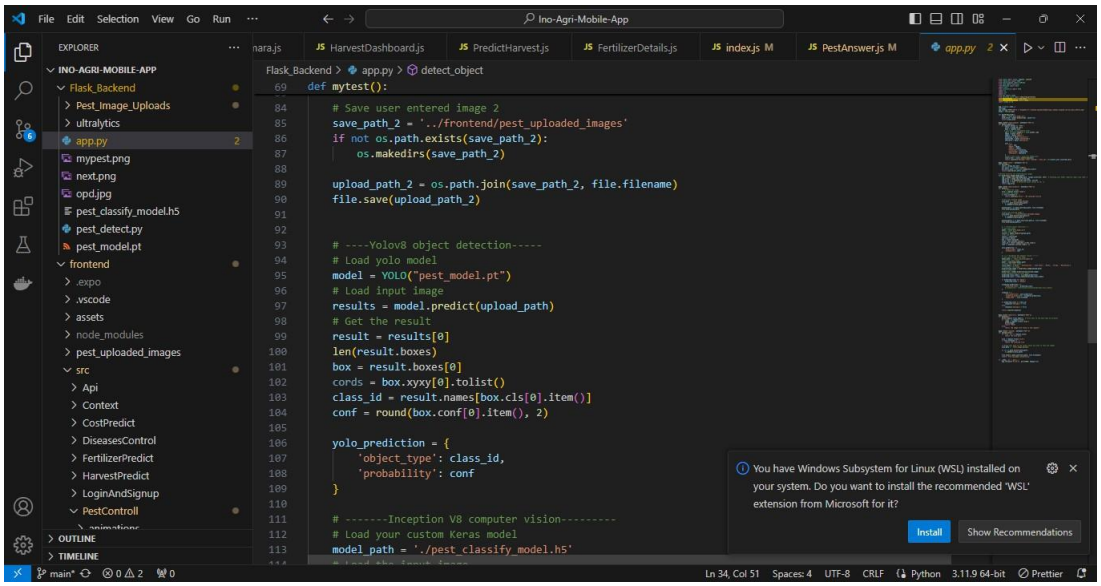

Figure 8 Flask server for yolo v8

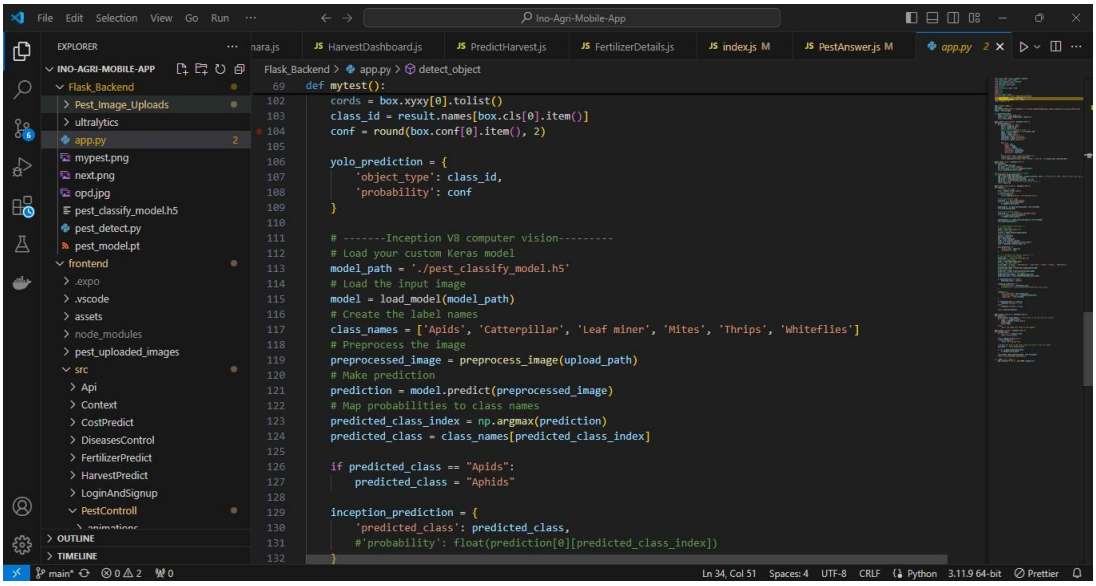

Figure 9 Inception v3 Model

Database and Storage:

The Ino Agri App uses a MongoDB cluster that is used to store user information pest identification data, and other records. This is a NoSQL database that is suitable for handling of unstructured data hence meeting the requirements of this app.

Machine Learning Model Training

The Ino Agri App relies on two key machine learning models for pest identification:The Ino Agri App relies on two key machine learning models for pest identification.

YOLOv8 Model:

YOLOv8 (You Only Look Once) is a variety of the neural network architecture engineered by utilizing Python and other related packages including Tensorflow and Keras, OpenCV, and NumPy. This model is involved in the first stage of pest detection in as much as it is done in real time from the images produced by user's or clients. The model was trained on a large dataset of pest images allowed by Google Colab where high GPU memory and RAM are provided. To do this process in a efficient and fast manner the Pro version of Google Colab was employed.

Inception Model:

The Inception algorithm – a Python-based tool – is a more refined analysis of the images and is used in parallel to improve the pest identification. Like all the models used in this project, including the YOLOv8 model, the Inception model used in this project was trained on Google Colab.

Deployment:

Both the Node. js and Python Flask servers, as well as all the machine learning models, are hosted on Google Cloud Platform (GCP). This deployment strategy makes it possible to implement the app reliably, maintaining high availability and dealing with a high load of both requests from users and processes that will be required to support the application.

Voice Translation and User Interaction:

For the use in Sri Lanka with its farmer community, the Ino Agri App implements the Expo Speech Library for the Sinhala voice translated recommendation on pest control. This feature improves on the interface, and it guarantees that regardless of the level of literacy or preferred mode of learning, a farmer can go through the app.

Requirements

Functional Requirements

- Pest Identification

  The mobile app should develop machine learning algorithms (such as YOLOv3 and Xception) to accurately identify pests affecting gherkin crops.

- Translated language Support.

  Utilize Google Translate API to translate pest identification answers and recommendations into Sinhala for accessibility farmers.

- User friendly interface

  Implement an attractive and user-friendly interface for easy navigation, catering to users with varying technical expertise.

- Real time Image Processing

  Enable users to upload or capture real-time images of gherkins crops.

- Reporting and Analytics

  Generate reports on pest identification and effectiveness of recommended solutions.

- Database Management

  Maintain a comprehensive database of pests, and recommended solutions, ensuring accuracy and relevance.

Non-Functional Requirements

- Performance: The system should deliver quick and reliable pest identification results within seconds to support real-time decision-making.
- Scalability: Design the system to scale seamlessly as the database grows, accommodating the increasing volume of gherkin cultivation data.
- Security: Implement robust security measures to protect user data, ensuring confidentiality and integrity.
- Reliability: The system should be reliable, minimizing downtime and ensuring consistent availability for users at HJS Condiments.
- Usability: Conduct user testing to ensure the system is user-friendly and meets the needs of both experienced and novice cultivators.

System requirements

- The app is designed to needs of HJS Condiments Limited, focusing on gherkin cultivation in Sri Lanka.
- The mobile app is compatible with both Android and iOS operating systems.
- Consideration for Sinhala language support to enhance accessibility for local users.

Description of Personal and Facilities

Mr. Gayan Fernando

Mr. Gayan Fernando working at Hayleys PLC as a Manager IT Infrastructure, Group IT, will be guiding us throughout the project as our external supervisor

Raw Data

HJS Condiments Limited will provide the collection of pest infection and recommendation data.

Budget and Budget Justification

Ino Agri mobile app, pest identification system for Gherkin cultivation presents a valuable solution for HJS Condiments limited. This can be utilized to ensure the success of Sri Lanka's ongoing crop cultivation project. Depending on what the system requires, more components can be added. The proposed pest identification system is mainly designed to meet the requirements of Gherkin farmers. By providing features like real-time object identification, augmented reality visualization, and Sinhala translations, the system becomes efficient for gherkin cultivation. However, there may be a fee for services.

10.1 Budget allocation table

Item	Budget (USD)	Budget (LKR)
Sample Cultivation	10.00	3110.00
field visits	16.08	5000.00
Server Cost	25.73	8000.00
Total	51.81	16110.00

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