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Pest Detection System

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***Abstract*—** Pests are organisms that spread diseases as well as causes destruction to the crops. Detection of pests is a must-do in the field of agriculture as growing plants to their fullest requires making the plant free from diseases. Although there are pesticides and insecticides available in the market, proper use of them and selection of them is a must to avoid excessive use or improper use of pesticide and insecticide. In this proposed system, pests are first attracted to a chemical named 1-Octen-3-ol above which flypaper is placed which will trap the small insects after which those insect gets detected using a USB digital microscope endoscope magnifier video camera and YOLO real-time object detection algorithm. The experiment has shown accurate results and might be a useful solution for preventing pests from destroying crops.

***Keywords*—** Pests, Agriculture, Microscope, Endoscope, Insecticide, Pesticide, YOLO, Deep learning, Image Processing.

I. INTRODUCTION

Crops are generally attacked by pests among which the important being insects, mites, nematodes, and gastropod mollusks. The damage they are doing results in both the direct damage they cause to the crops as well as indirect fungal, bacterial, or viral infections. Plants have their defense mechanism against these attacks but these could get overwhelmed, especially in habitats where the plants are already stressed, or where the pests are accidentally introduced. Humans have traditionally performed pest control in agriculture and forestry with the use of pesticides and insecticides however, excessive use of them can result in other detrimental effects. In the modern era, new methods exist such as mechanical control, and recently developed biological controls which are considered safe as well as give desired results.

II. NEED

The primary motive of this system is to develop a self-reliant system that will identify the pests. The system exercises efficient techniques for the detection of pests which are better than the traditional approaches. All the variables are automated, to make the system natural and more handily discernible by novice users.

III. RELATED WORK

This paper introduces an automatic system for early pest detection. Various Computer Vision techniques were used. Support Vector Machine (SVM) is employed for image classification.[1] This paper aims to develop an AI-based banana disease and pest detection system using Deep Convolution Neural Network (DCNN).[2] Analyzed various neural network models and selected the optimal models and characteristics for every insect. Within the paper, the principle of operation of the developed laser device is described thoroughly. They also created a program for detecting a pest within the video stream calculation of their coordinates and transmission data with coordinates to the device with the laser.[3] In this system, SVM is employed in Machine Learning for image classification and Color histogram and Contour Detection for feature extraction, K-fold, and Bootstrapping algorithm for validation. Also developed a mobile app for giving farmers reports of harm.[4]

The bio-inspired method is proposed to detect and recognize insect pests. The system has achieved a recognition rate of 85.5% and will effectively recognize insect pests under complex environments.[5] In this proposed system the detection is established by extracting the variant distinctive attributes between the pest and its habitat (leaf, stem) and using the correspondence filter to spot the plant pests to get correlation peak values for various datasets.[6] In this system, the diseases and pest recognition support deep learning where the original image is directly given as input. rather than the tedious steps like image pre-processing, feature extraction and have classification within the traditional method, the end-to-end structure is adopted to simplify the popularity process.[7] In this system, Image pre-processing methods like noise removal and contrast enhancement followed by color space transformation and k-means clustering is used to segment affected parts of leaves, after that both texture and color features are extracted from segmented leaves and based on extracted features support vector machine classification method is used to classify the pests.[8] In this system, agricultural robots inspect the field using artificial intelligence for detection, diagnosis, and classification of crop disease.[9]

IV. PEST DETECTION SYSTEM

The automatic Pest Detection System is a self-reliant system that is used to detect pests present inside a field.

A. Research Methodologies

In the development of this method, related theory and also the principles of system design were involved to fulfil the wants of users. The objective of this innovation is to monitor the number of pests visiting or are present inside the field. Based on the readings obtained a report is provided to the farmer which can be used to take further necessary actions.

B. Hardware

The following are the components that are used in the proposed in this automated hydroponic system:

1. USB Digital Microscope Endoscope Magnifier Video Camera

It provides 50x-1000x Magnification with 8-LED's present on its top for better lighting and capturing of images. The microscope is made up of high-quality IC and electronic components, with clear image quality, low power consumption, and high resolution. Its resolution is 5.0 Mega Pixels and has a 40mm focus range.

Figure 1. USB Digital Microscope Endoscope

C. Software

1. Open CV

OpenCV (Open-Source Computer Vision Library) is an open-source computer vision and machine learning software library which was fabricated to supply a standard framework for computer vision uses and to make use of machine perception incorporate products.

2. YOLO

YOLO is an algorithm that uses neural networks to provide real-time object detection. It is a very popular algorithm because of its speed and accuracy.

3. NumPy

NumPy is the essential package for computation in Python. It's a Python library that provides a multidimensional array object, multihued deduced objects (masked arrays and matrices), and a variety of routines for fast operations on arrays, including mathematical, logical, shape manipulation, sorting, opting, I/ O, discrete Fourier transforms, basic linear algebra, basic statistical operations, random simulation and much more.

4. Imutils

Imutils are a series of convenience functions to make basic image processing functions such as translation, rotation, resizing, skeletonization, and displaying Matplotlib images easier with OpenCV and both Python 2.7 and Python 3.

5. Spyder

Spyder is an open-source scientific environment written in python which is used as a workbench for scientific computing in python.

V. RESULTS AND DISCUSSION

In the block diagram of this proposed system, the working of the whole source code in the background is mentioned. YOLO real-time object detection algorithm identifies pests in live feeds. YOLO uses features learned by a deep convolutional neural network to discover an object. YOLOv3 algorithm first separates an image into a grid wherein each grid cell predicts some number of boundary boxes around pests that score largely with the forenamed insect class. Each boundary box has a separate confidence score of how accurate it assumes that prognosis should be and detects only one insect per bounding box. The boundary boxes are generated by clustering the confines of the ground verity boxes from the original dataset to find the most common shapes and sizes. Other similar algorithms that can carry out the same pretension are R-CNN and Fast R-CNN, and Mask R-CNN. However, unlike systems like R-CNN and Fast R-CNN, YOLO is trained to do division and bounding box regression at the same time.

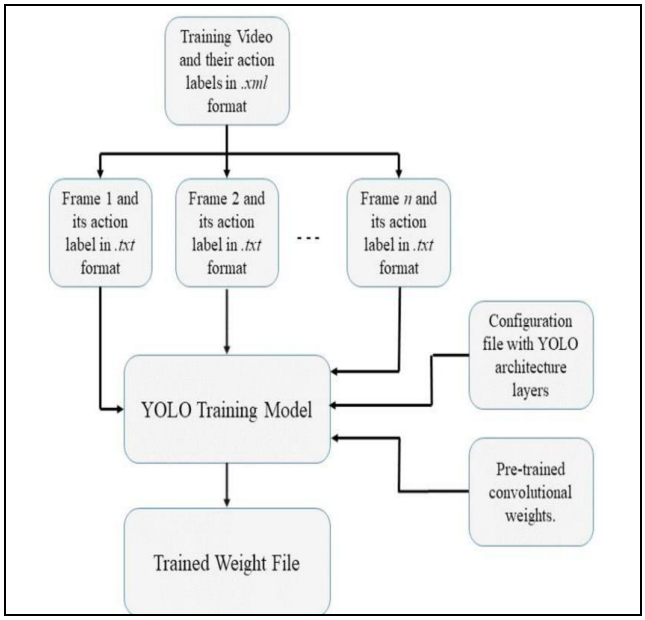

Figure 2. Flow Chart of YOLO

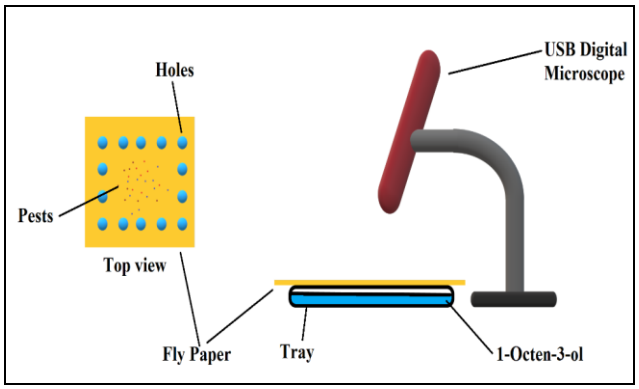

Figure 3. Automatic Pest Detection System

The proposed system consists of various steps: First of all, A tray is placed on a rigid surface under which 1-Octen-3- of chemical is poured which is an insect attractant. Above the tray, flypaper is placed to trap the insects in place and some holes are made in the flypaper to make it possible for the fumes of the chemical to penetrate. After sometimes insects got trapped on the flypaper because of its sticky nature and those trapped insects are then observed with a USB Digital Microscope Endoscope Video Camera. The camera is organized in such a way that the main focus of the camera is on the central area of the flypaper where the majority of the pests get accumulated. Pests are detected in real-time by using the YOLO object detection algorithm with the help of a trained dataset of a variety of pest data present inside it. After the pests get detected, a report is created of detected pests which are provided to the farmers or the end-user who can take necessary steps to protect their field from pests.

VI. CONCLUSION AND FUTURE SCOPE

As detection of pests is important mostly in every branch of agriculture, this system will be useful for the detection of pests in real-time which would be quite convenient and economical for farmers as well as for users who like to do home gardening. Real-time reports are also obtained by which users can take necessary actions for controlling pests in their fields. The system could be improved by creating an application that could be used on Android and IOS for getting regular updates as well as receiving reports on the phone itself. The system should be improved by recommending pesticides and insecticides based on the pest detected in the field. Proper dosage of insecticide and pesticides could be provided as per the field size and number of pests encountered.

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