Crop Disease Identification using convolutional neural network

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Abstract

Troublesome crop pests cause a significant loss of revenue for the agricultural sector of the economy. It is crucial for efficient pest control to have a prompt and precise identification of both the pests themselves as well as the harm that they cause. This essay will not only explain why it is so crucial to identify agricultural pests correctly, but it will also discuss the steps to attain that exact goal. When weeds and other agricultural pests are accurately recognized, it is much simpler to eradicate them using a management strategy that follows a systematic approach. It is essential for accurate pest identification, predicting how the pest will behave, and eradicating the pest. These data are essential for making sound decisions on IPM practices and applying pesticides effectively.

Keywords : Agriculture, Pests, Images, Convolutional neural networks, Preprocessing, Pest Management.

I. Introduction

Pests of crops are a significant problem, and each year they cause the agricultural industry to lose a significant amount of money. For effective pest treatment, it is necessary to accurately and promptly identify not only the pests but also the damage that they do [1]. This essay will provide an overview of the methods and processes that are used to identify crop pests, as well as an explanation of the importance of doing so.

If they are properly identified, weeds and other field pests can be managed more effectively by systematic control. It is vital for effectively recognizing pests, making accurate predictions about them, and eradicating them. This knowledge is essential for correct decision-making regarding integrated pest control as well as the application of pesticides in the appropriate manner. A number of methods, including visual examination, monitoring, and laboratory analysis, can be utilized in order to ascertain the presence of pests in crops. Visual inspection involves looking for signs of insect damage on the plants, such as holes, chewed leaves, and changes in coloration. This method is uncomplicated and beneficial for locating pests, but it does not identify the species [2].

II. System Flow

The process of identifying crop diseases and insect pests based on convolutional neural networks mainly includes the collection and preprocessing of image data sets, the construction and training of convolutional neural networks, and the verification of the accuracy of neural network. The system flow is shown in Figure 1.

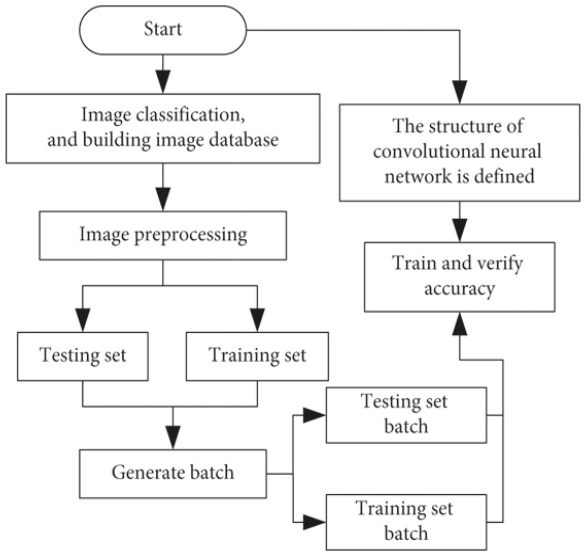

Figure 1. Architecture of crop disease identification n CNN

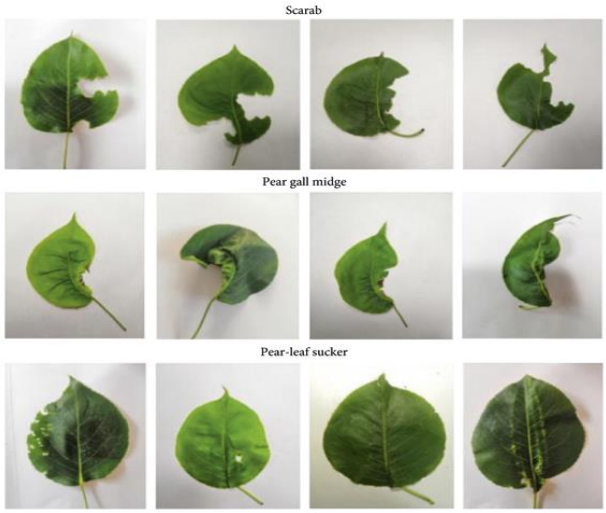

Figure 2
Image of pear leaf diseases and insect pests.

III. Methods to identify pests in crops

Visual Inspection

Visual inspection is one of the most prevalent methods utilized in the process of identifying pests in crops. In order to accomplish this, you will need to walk through the fields looking for signs of insect damage, such as holes in the leaves, changes in color, and components of the plant that have been chewed up. Shaking the plants and checking to see if any insects fall off is yet another method that can be utilized to identify pests. Aphids, mites, and whiteflies are examples of pests that benefit greatly from this strategy since they are difficult to identify. Sticky traps are an extra way that may be utilized in the process of identifying the species of pest that are currently in the area. Flying insects such as moths and flies can be captured using these yellow or white self-adhesive cards, which can be placed in fields [3]. This method is an excellent option to consider if you are interested in keeping track of insect populations and determining whether or not they are growing in number.

Pheromone traps

Pheromone traps are yet another method that can be utilized in the process of determining the various kinds of pests that inhabit the area. In order to lure in the undesirable insects, pheromones, which are actually chemical compounds, are used. Pheromones are used to lure in the unwanted pests, which are then caught in the trap and may be recognized with relative ease once they have been apprehended. This is an effective strategy for getting rid of creepy crawlies that are hiding, such as beetles and moths. DNA barcoding and polymerase chain reaction are two examples of molecular biology techniques that can be used to identify pests in a more complex manner [4]. One more example of a technique that can be used to detect pests is gene sequencing. When using these techniques, the invasive species can be located rapidly and without much difficulty, even if it is just in the egg or larval stage at the moment. This is especially helpful for getting rid of pests like thrips and spider mites, which are difficult to see with the naked eye but may do significant damage to plants [5].

Before effective steps for eradication and crop protection can be done, the pests in question must first be appropriately recognized. If a farmer does not know which insects are responsible for the damage, there is a chance that they will eliminate the wrong insects. This could be a wasteful investment of resources as well as a source of wasted energy. Incorrect identification can also contribute to environmental destruction since it may result in the use of poisons that are harmful to insects and other species that are beneficial to the ecosystem[6].

IV. Integrated Pest Management

IPM, which stands for "integrated pest management," is a strategy for controlling pests that takes into account all of the program's components. It does this by implementing a wide range of control techniques, which in turn helps to safeguard the environment by lowering the number of insect populations. IPM, or integrated pest management, employs a broad variety of methods to identify the kinds of pests that are present. These methods include visual inspection, sticky traps, pheromone traps, and DNA analysis. Farmers can use this method to track the presence of pests and establish the most effective control methods, thereby minimizing the cost of crop damage and boosting agricultural output. Additionally, farmers can use this method to find the most effective control measures [7].

V. Crop diseases and parasites

Crop diseases and parasites are two other possible avenues of investigation. In order to identify and keep track of pests, it is required to construct traps and to install monitoring equipment. Some traps, such as pheromone traps and sticky traps, are designed to attract and catch particular kinds of pests, while others, such as pheromone traps and

sticky traps, are meant to catch particular types of insects while they are in flight. With the use of monitoring equipment, one is able to collect information regarding the population size, incidence rates, and life cycle of a pest [8]. Laboratory examination is the method that provides the most accurate identification of insect pests that attack crops. Sending samples of both the pest and the damage it has caused to a laboratory is the only method to get an accurate assessment of the level of destruction caused by a particular insect. In order to discover and identify the pest, the laboratory intends to make use of a wide variety of techniques, including microscopy, molecular biology, and biochemical analysis [9]. This method generates trustworthy data about the insect, including information about its feeding, lifespan, and destructive capacity. It is imperative that you are aware of this knowledge in order to eradicate the unwanted creature successfully.

The identification of crop pests is of the utmost importance and cannot be emphasized enough. Accurate identification is necessary for effective pest management and reducing the amount of crop that is lost. It is difficult to determine which method of pest control, such as the use of pesticides, biological control agents, or cultural practices, will be most effective in the absence of proper identification. Farmers are able to monitor pest populations and respond quickly to outbreaks as a result of their familiarity with the pests. For instance, the early detection of a newly introduced pest can assist farmers in eradicating the problem before it causes widespread destruction [10]. If a pest is detected in its early stages, farmers have a better chance of avoiding pest management techniques that may be harmful or ineffective, such as the application of insecticides, which, in the event that they are unsuccessful in eradicating the pest, may cause harm to beneficial insects and other non-target species.

VI. Literature Review

In recent years, there has been a growing amount of interest among specialists and researchers in the creation of an automated pest identification system that is based on digital image processing. The majority of the applications that are currently being used for traditional machine learning technology include image preprocessing, feature extraction, and pest detection. Analysis using Support Vector Machines (SVM), with region index and intensify as the color index, was suggested as a method for finding thrips as a potential solution. The standard deviation of the percentage of errors committed during classification was lower than 2.25 percent. The automatic identification of rice pests was made possible by an insect imaging system that utilized rice light traps. The findings of the experiment showed that a rate of accuracy of 97.5% was attainable when classifying the four different species of Lepidoptera that are known to be rice pests. A method that can automatically classify common orchard insects based on the constant regional traits they have across their range [11].

VII. Discussion

The performance of classic machine learning approaches in the recognition of pests still depends on the effects of feature extraction and the efficiency of the classifier that is chosen. The end result is an identification model that is both less trustworthy and more difficult to generalize than the original. Pests in agricultural crops behave like moving visual targets due to their microscopic size and continually fluctuating positions. It is challenging to get a handle on its method of person recognition, which is an additional obstacle. Because the majority of field pests have a color that allows them to blend in with their environment, accurately recognizing them requires a deep learning identification model that has a high capacity for generalization. In this method, different types of layers, including convolutional layers, activation layers, normalization layers, and pooling layers, are layered on top of one another continually [15]. By utilizing a layer that is completely interconnected, the features of the pest may be automatically retrieved and recognized by the system. In order to identify rice plant hoppers, researchers created a feature-optimized classification strategy, and using it, they were able to obtain 96.19 percent accuracy. The researchers observed that the Faster R-CNN (Convolutional Neural Networks) model may be improved by exchanging the VGG16 (Visual Geometry Group) for the depth residual network when it came to the detection of aphids and leaf miners on sticky cards. The results demonstrated that there was room for improvement in the accuracy of the Faster R-CNN model, which was already quite high at 90.7%. In the context of recognizing specific flying insects, Patel D. J. and Bhatt N. [20] investigated three popular deep learning meta-architectures for object recognition: Faster R-CNN, SSD (Single Shot MultiBox Detector) Inception, and SSD Mobilenet. With an accuracy of 95.33 percent, the Faster R-CNN meta-architecture was able to achieve the best performance of all the possible architectures. American in addition to Thenmozhi K. The insect classifier had an accuracy of between 86% and 92% across the board for all categories of insects. Although they may be helpful, the following techniques for identifying pests are only applicable in instances in which the insect is stuck to a sticky card or in which there is a significant contrast between the bug and the background in which it is located. Surprisingly little research has been done in this area, which involves the use of color for the purpose of identifying pests in the field [12].

Near-infrared imaging, in particular the traditional imaging in the first near-infrared (NIR-I) window (700 to 900 nm), has the potential to differentiate target items from background objects that appear to be similar. This is accomplished by increasing the capabilities of computer vision. In spite of the dearth of knowledge that surrounds the technique, it is commonly used in the identification of insect species as well as the monitoring of plant diseases. Because of this, near-infrared imaging technology and YOLOv5 have been utilized in order to locate bugs that use coloration as a kind of camouflage or self-defense. The use of hyper spectral imaging allowed for the discovery that the average spectral characteristic curves of cabbage and Pieris rapae are comparable to one another. The purpose of this exercise is to discover at what wavelength the spectral reflectance difference is at its greatest by comparing and contrasting the

two graphs. The choice of infrared filter, ring light source, and other image capture instruments that are part of the imaging acquisition platform is determined by the wavelength. You'll have an insect image data set when you've accumulated a significant amount of bug photos, had it edited and enhanced, and then added to it. In the end, the most effective deep learning model, known as YOLOv5, is chosen to identify field pests based on the protective color patterns they use [13].

Accurate identification of crop pests is required in order to monitor the efficacy of pest management strategies and determine whether or not they are effective. Farmers, as a consequence of their greater understanding of pests, will be better able to evaluate the performance of current pest control measures and make required improvements. This will allow farmers to better protect their crops from pests. This guarantees that any and all efforts to rid the area of pests will be successful.

VIII. Conclusion

To summarize, it is vital for the proper management of crop pests to first identify the pests that are already present in the area. This is the first step in the management process. It is absolutely necessary, in order to establish efficient methods for pest control, to make use of visual inspection, surveillance, and laboratory analysis in order to obtain correct information regarding pests and the harm they do. Because the crop damage that can be caused by pests can be significant, farmers require a dependable method that can swiftly find the pests. In order to reduce the amount of damage done to crops and ensure that agriculture will continue to thrive in the future, an effective pest management approach should include identification, monitoring, and control of pests .

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