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ARTIFICIAL INTELLIGENCE DRIVEN DRONE OBSERVATION AND PEST CONTROL IN BANANA CROP: A SYSTEMATIC REVIEW

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Article Info

Abstract
Bananas are the most commonly eaten and significant fruit in global trade. Bananas are produced using a variety of methods and environments. In addition to regularly updating farmers on problems in banana plant leaves, this system aims to discover, diagnose, and treat banana leaf diseases. Customers' wants and lifestyles have changed significantly during the past few decades. These modifications provide additional difficulties for farmers whose output must satisfy consumer needs. Both the farmer and the consumer will benefit from the capacity to categorize agricultural products according to size and quality. In this case, the system gets its input in the form of standard photos of banana leaves taken using various image capture devices. It will then process those photos to identify any diseases and alert the farmer. Additionally, the system will advise the farmer on what to do next, including which fertilizers, herbicides, and agricultural practices to employ in order to prevent illnesses from harming neighboring crops. In this systematic review, useful and efficient methods for identification are presented in works that fall under the categories of image classification, AI/ML, deep learning, and mobile applications.

Keywords: *Banana, Control, Pest, and Image Classification.*

Introduction

Bananas are the second-highest fruit production in the globe and one of the most marketed and eaten fruits, according to the World Food and Agriculture Ministry. Tropical and subtropical nations cultivate them extensively. In addition to being a fruit that can be eaten, bananas provide therapeutic benefits since their natural active ingredients contain antibacterial qualities. Because of their high planting density and insufficient ventilation during farming, bananas are prone to illnesses. On the leaves, these illnesses show themselves as Sigatoka, Cordana, and Pestalotiopsis. The viruses can quickly spread across banana populations if the banana leaf disease is not identified in time, leading to extensive banana mortality and a decline in output [1].

The name "banana" in scientific language describes a big, perennial, evergreen monocot plant that is a member of the genus Musa and family Musaceae. Over a thousand varieties of bananas are grown and manufactured worldwide. Among these species, Musa cavendishi, Musa paradisiaca, and Musa sapientum are the three that are most frequently grown. The Food and Agriculture Organization's (FAO) updated statistics. Because of their high fiber consumption level and important vitamin and mineral content, bananas are regarded as a useful nutritional component. Of every one of banana's leftovers, including pseudo-stems, leaves, and blooms, banana peel accounts for around half of the fruit's bulk (35%–50%). The banana pseudo-stem, or BPS, is 6–7.6 m tall and produces fruits, leaves, and flowers. it comprises the bulk of plant biomass, which is usually burnt and thrown away. Due to its high availability of many nutrients, including protein, carbohydrates, and dietary fiber, which boost its nutritional advantages, BPS has seen an increase in popularity in the last decade [2].

Human survival depends on food, and agriculture is one of the main economic forces in every given country. Agriculture is widely recognized as the main source of income for the majority of developing countries. Banana farming and the banana industry are important parts of the global agribusiness since bananas are a great source of nutrients including calcium, manganese, potassium, magnesium, and iron. People consume this particular crop because it has a lot of vitamins and is thought to provide instant energy. About 15% of the world's banana crop is exported for consumption in western countries, according to Wikipedia. India produces around 25.7% of the world's bananas, according to data on exports and production. Due to disease and other weather-related issues that impact banana trees, banana production and exports may possibly entirely collapse. The biggest blooming herbaceous plant is the banana. Usually tall and quite strong, they are sometimes confused for trees. But what seems like a trunk is actually a pseudostem made up of closely spaced leaf sheaths. Every portion that is above ground originates from a soil corm. Immediately following the final leaf, the bloom appears from the middle of the pseudo-stem. After the banana is picked, the mother plant will wither, but the suckers or branches will mature and bear fruit the next year. To provide the remaining nutrients for the pseudo-stem nourishing the suckers, the mother plant's canopy will be cut off [3].
Bananas are currently the fourth most valuable food crop in the entire globe in terms of money and are cultivated in at least 107 nations. Bananas are high in fiber and potassium. They could aid in the prevention of digestive issues, high blood pressure, diabetes, cancer, asthma, and cardiovascular disease. Additionally to being grown commercially for food, bananas are a common component in conservatories and gardens in warm climates, where they provide eye-catching landscape elements. Bananas are not very difficult to cultivate when planted in locations with lots of sunlight, but issues with banana plants will always arise. Which diseases and pests affect banana plants? To learn how to fix issues with banana plants, continue reading. For good reason, bananas are among the most popular fruits consumed worldwide. By taking these, you can lower your blood pressure and lessen your chance of developing asthma and cancer [4].

Figure 1: Banana Pets

The destruction of crops is greatly impacted by bugs. Crop yields are already dropping as a result of insect infestations, which affects production rates. The notion of discovering the plant disease in an adverse setting is now abandoned. The primary challenge is reducing the usage of pesticides in agricultural areas while increasing assembly rates and quality. An image segmentation technique might be used to automatically classify banana leaf illnesses. Banana crop diseases are categorized and identified using images. This has made it possible for farmers to assess the plant's condition both inexpensively and efficiently. Segmentation is required in order to examine and extract information from the images. A more thorough investigation may be carried out thanks to this image processing module, which separates the object of interest from its surroundings.

In the field of agricultural food safety, efficient pest management and control are essential elements. As a result, throughout the agricultural planting process, precise crop pest identification and automated monitoring are quite useful.

Only a very small percentage of the raw resources used to create paper and paperboard worldwide are non-wood fibers. However, in many countries, they remain widely used and have significant value both in terms of overall volume and as a percentage of the total paper supply. Moderate density, appropriate biomechanical and elasticity properties, high renewable status, and recycling are all significant advantages of plant-based fibers. They may also be washed and thrown away. Numerous studies have been conducted on the usage of natural fibers as substitutes. Since that is also the name of the plant's fruit, herbaceous plants of the genus Musa and family Musaceae are frequently referred to as bananas. As deep learning/ Machine Learning-based algorithms have evolved over time, results for pest identification and detection have greatly improved. These techniques are encouraging, but they still lack the accuracy and effectiveness needed to identify agricultural pests in trace amounts. These findings could be used as a guide for next studies on banana field pest detection. This information might be used by governmental and non-governmental entities to develop plans for quickly identifying pests in banana fields.

Figure 2: The Banana

Features of the illness

- Yellowing of the lowest leaves, extending from the leaf border to the midrib.
- Eventually, the heart leaf alone stays green for a while and is also impacted as the yellowing spreads higher.
- The leaves hang down around the pseudostem after breaking close to the base.
- The pseudostem splits longitudinally. Vascular artery discoloration shown as brown or red striations.
- Young leaves, usually the third or fourth leaf from the top, exhibit the first signs.
- On foliage, there are tiny spindle-shaped dots that run parallel to veins and have a grayish core with a yellowish halo.
- Individual bananas seem tiny, their flesh becomes a buff pinkish hue, and they store badly if the fruit is almost mature when there is a strong infection. The flesh ripens uniformly.

Sustainability

- The bacteria thrives in soil, riot hosts, vegetable propagative systems, and diseased plant detritus.

Materials and Methods

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) standards were followed in conducting this systematic review. This study's primary goal is to use image processing to recognize, distinguish, and analyze the various approaches used in banana field pest management. The method used to find, choose, and acquire the information needed for this systematic literature review is explained in this section. Differentiating, evaluating, and examining earlier relevant research that is significant to the goals of the current study is the aim of doing a systematic literature review.

Search Strartergy

Using keywords specific to the study's scope, an electronic search was conducted on publicly accessible resources such IEEE Xplore, PubMed, Science Direct, and Google Scholar. We chose and vetted peer-reviewed conference and journal articles that used several machine learning techniques for banana field pest identification. The following keywords were used in the search: "Banana Pest," "Image processing," and "Pest Control System." The databases were searched using the Boolean operator "AND."

Inclusion/exclusion criteria

After the studies were retrieved, the following inclusion and exclusion criteria were established in order to gather pertinent data.

Inclusion Criteria:

- Initial, reviewed by experts research papers that have been published in journals and conferences.
- the original, expert-reviewed research articles that have been presented in seminars and publications.
- Studies that use machine learning metrics like accuracy and classifier.
- Studies conducted between 2000 and 2022.
- English-language research publications.

Exclusion criteria:

- Studies that use machine learning metrics like accuracy and classifier.
- Studies conducted between 2000 and 2022.
- English-language research publications.
- Patents, letters, editorials, unpublished studies, case reports, tiny case series, and cross-sectional studies are examples of research articles published in languages other than English.
- Studies released prior to the year 2000.
- Research articles that do not include a machine language strategy for pest identification.
- Research papers that contain any other plant or leaf outside banana fields.

The importance of research:

- Increased agricultural productivity: Farmers may take preventative action to avoid crop damage and increase crop yield by monitoring the environment and identifying pests early on.
- Savings on investments: Using drones with AI and image processing capabilities can save labor costs as well as associated expenditures for supplies, equipment, and materials needed for environmental monitoring and pest management.
- Environmental protection: Using drones to manage pests lessens the need for dangerous chemicals, which may be bad for the environment and people's health.
- Enhanced efficiency: The accuracy and efficiency of pesticide detection and environmental monitoring may be greatly increased by combining drone technology with artificial intelligence and image processing technologies.

Figure 3: Shows diseased Banana

Banana bunchy top disease (BBTD), which is brought on by the banana bunchy top virus (BBTV) and spread by the banana aphid (Pentalonia nigronervosa), Fusarium wilt or Panama disease (a wilt disease brought on by the fungus Fusarium oxysporum f. sp. cubense), black sigatoka or black leaf streak (BLS), which is a foliar disease caused by the fungus Pseudocercospora fijiensis, formerly: Mycosphaerella fijiensis, and Banana streak virus (BSV). The majority of diseases and pests can and are easily spread by other factors. For example, Fusarium wilt spores can travel in surface water from an infected area to new areas along drainage ditches, or black leaf streak/black sigatoka ascospores can be blown from plant to plant in a field by the wind. The equipment or boots of workers leaving polluted fields, as well as contaminated planting material or plant parts (such as banana leaves used to wrap food), can transport infections, their spores, or pests either directly or through soil that adheres to them.

These diseases and pests pose considerable risks to the production of bananas and have the capacity to destroy whole plantations, which would severely impair dependable livelihoods and have a negative impact on household incomes and food security. If the significance of the various methods of dissemination is understood, it will be possible to prevent losses brought on by diseases and pests.

Table : 1 Research papers for systematic Review

Year	Authors	Method Used	Effectiveness	Future work
2017	Jihen et al. [5]	Deep Learning-based Approach (LeNet architecture as a convolutional neural network)	From iteration 25, the model began to settle, and by the last iteration, it had high accuracy.	Test more banana and plants diseases with the model
2019	Selvaraj et al. [6]	AI-powered detection (ResNet50, InceptionV2 and MobileNetV1)	Significant high success rate makes the model a useful early disease and pest detection tool	Create a completely automated smartphone application to assist millions of banana growers in underdeveloped nations.

2020	Mary et al. [7]	Create a completely automated smartphone application to assist millions of banana growers in underdeveloped nations.	99.35% categorization accuracy is the highest for actual data sets.	Verifying the categorization of different plant diseases in images
2022	Narayanan et al. [8]	Hybrid Convolutional Neural Network	The accuracy of the suggested method is 99% when compared to equivalent deep learning approaches.	For farmers to quickly diagnose the illness, a mobile application might be developed.
2016	Tigadi & Sharma [9]	Image Processing	Accurate images acquisition, pre-processing, feature extraction, and feature file creation	Take the place of the manual illness identification approach.
2018	Kumar et al. [10]	Image processing and Artificial neural network	100% accurate MATLAB results	The manual approach to illness recognition can be replaced with a system for identification.
2020	Selvaraj et al. [11]	Aerial images and machine learning modelling method	Random forest based ML model classifies banana with more than 90% accuracy	Complete AI-Powered Health Monitoring System
2021	Aeberli et al. [12]	AI-Powered System for Monitoring Illnesses	The best results for plant detection accuracy are obtained via Convolutional Neural Networks (CNN).	Applications of precision agriculture for health monitoring
2020	Bhamare & Kulkarni [13]	Image Processing Techniques (ANN	Using image analysis to calculate the percentage of	Concepts on the life stages and growth of pests

		and RBG imaging)	infected area accurately	
2021	Anasta et al. [14]	Image processing based thermal camera (PCA statistical analysis)	Recall of 85.4%, precision of 89.35%, F measure of 87.33%, and accuracy of 92.8% are examples of parameter values exceeding 80%.	Calculate how quickly the illness is spreading.
2014	Jose et al. [15]	High Spatial Resolution Orthophotos	User's mapping accuracy of 88% (n = 146) was achieved	Rate of Banana Bunchy Top Virus Inspection
2021	Salokhe & Takmare [16]	Wireless Sensor Network and Machine Learning	Accuracy of 58% for disease prediction	Raising the system's illness prediction accuracy to 67%
2020	Ye et al. [17]	UAV Remote Sensing	The models' total fitting accuracy was more than 80%.	Advice on identifying the illness and modifying crop planting
2021	Chaudhari & Patil [18]	Deep Learning Technique	90.3% overall accuracy	Detection of disease in plants
2014	Prabha & Kumar [19]	Image Processing Methods	The image processing-based algorithms used to identify diseases were extremely precise.	Pattern classification for better disease classification
2020	Almeyda et al. [20]	Modeling for Machine Learning (Logistic Regression)	The model developed can predict pest incidence at 79% accuracy	Improving the pest management of crops
2017	Lakshmi & Gayathri [21]	IoT with Image processing (MATLAB)	Highly scalable image processing	Pattern recognition of leaf
2020	Deenan et al. [22]	Image Segmentation Algorithms	greater Server-Side Image Map (SSIM) value (0.196) and peak signal-to-noise	Segmentation of banana leaf disease images

			ratio (PSNR) value (6608) than any other technique.	
2022	Jayanthi et al. [23]	Deep Neural Networks	When it comes to pest detection, YOLOv3 outperforms Convolutional Neural Networks (CNN) by 92.11%.	Region suggestion network for insect pest detection
2022	Krishnan et al. [24]	Segmentation and classification model	Fast segmentation and classification	Better disease prediction
2022	Nandhini et al. [25]	Deep Learning model of sequential image classifier	Convolutional Neural Networks (CNNs) swiftly identify possible characteristics in the sequences of pictures.	Early detection of banana tree disease

Results: Articles were found using the electronic search. There were still study papers once the duplicates were eliminated, however this one was removed following the abstract and title needed searches because it didn't cover the topic of finding insects in banana crops. The remaining publications were then subjected to thorough assessments, wherein the various components of each research piece were closely examined. It was then chosen whether to include relevant research papers in the systematic review. A overview of the chosen studies' publication years, methodology, and level of pest detection in banana fields is given in Table 1.

Characteristics of Research

The effectiveness of the suggested approach has been verified by a number of experiments, namely Jihen et al. [5], Chaudhari & Patil [18], Jayanthi et al. [23]. Eight studies focus on image classification namely Tigadi & Sharma [9], Kumar et al. [10], Selvaraj et al. [11], Bhamare & Kulkarni [13], Anasta et al. [14], Prabha & Kumar [19], Lakshmi & Gayathri [21], and Deenan et al. [22]. Two papers focus on machine learning namely Salokhe & Takmare [16] and Almeyda et al. [20]. The two remaining papers concentrate on independently strategies or reviews of existing publications. The bar graph that shows the percentages from the utilized data set is shown in the image following. It shows that the greatest and equal proportion of articles are from sorting images and review approaches, which are governed by deep learning techniques and machine learning.

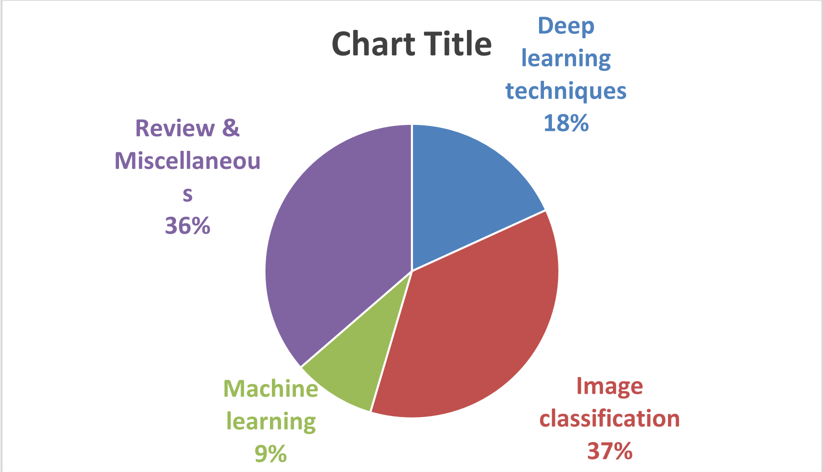

Figure 4: Pie chart of the used data set.

Analysis of Comparative Results: Using a real dataset of banana disease data gathered from the Plant Village project, Several tests have been carried out to confirm the efficacy of the recommended strategy. Numerous pictures of both healthy and damaged agricultural plants may be found online as part of the third plant village initiative. Three distinct categories—black speckle, black sigatoka, and healthy—are annotated on the photos in our dataset. A variety of backdrops, lighting conditions, locations, scales, and orientations were used to take these pictures.

In Southern India and Africa there were a huge number of collection of images of Banana illness and pest which received effective pre screening was collected. developed a detection method and retrained three different deep neural network architectures using a transfer learning technique. A total of 18 diverse categories were used to generate six different models using photographs taken at different points throughout the banana plant. ResNet50 and InceptionV2 models outperformed MobileNetV1 models in their analysis. The bulk of the models under examination have an efficiency of above 90% and incorporate the latest research on pest and disease detection in bananas. The outcomes of these experiments are comparable to those of other state-of-the-art models that have been covered in Literature Review. In order to use these detecting capabilities on a electronic gadget in coming time, they evaluated the SSD MobileNetV1's effectiveness. Efficiency and verification methods were also devised in order to evaluate the effectiveness of various models in automated illness detection systems.

During fragmentation, the Y component of the supplied picture YCbCr is taken into account. It is the result of unevenly combining the RGB and B components of a gamma-compressed color picture. It denotes brightness in a color image. The Y color element for banana leaf diseases produces good results when compared to an RGB image. These results show that a simpler and more efficient classification method is used in the proposed framework. When compared to other existing classification frameworks, this simpler framework yields better results when used to classify images of banana leaf disease. The identification and classification of banana tree diseases were assessed. Five distinct types of obtained images were utilized in earlier study to demonstrate the recommended method of picture classification. The proposed model gathers the image data and extracts the image properties using the proposed CNN, whose architecture is based on LeNet-5. Using the characteristics found by the fusion-based SVM testing method, the first-level P1 binary SVM then classifies the image as either a healthy leaf or an infected leaf. The process is finished when a new image is provided as a search query and the classifier determines independently in phase P1 whether the provided test image is a real image. Prior to feeding the neural network with data, it is essential to select the type of networking, the training approach, the quantity of hidden neurons, and other optimal characteristics. Employ a back propagation algorithm that is feedforward. Grades are used to indicate the severity of the issue based on the affected pixel area. The data set file, which includes a range of images required for testing, is created before selecting the query image for testing.

The collection of features effectively conveys the key components of an image that are necessary for categorizing illness, which is a form of responsibility reduction. Following statistical considerations, the characteristics in this case were chosen. One of the easiest methods for representing texture is to use the gray level histogram's statistical events of the picture. This characteristic is based on the grey degree histogram, the grey layer pairing the matrix, and the variability of run dimensions and border incidence. We concentrated solely on orders of statistics, or traits depending on what is present and grayscale.

According to the earlier results, 74% of the test set can be accurately identified by the model. They used IoU to extract the reliability and recall data in order to differentiate the distinction between false positives (FPs) and true positives (TPs). When the sickness classifier takes expectations into account, this work is crucial. Given how hard it is to label each individual banana in the orthomosaics, the computer could have also identified the unlabeled predictions like databases and eventually achieved strong FPs. This explains why FPs are observed more than the TPs in both training and testing.

It shows that when there was a large amount of crown overlap brought on by various orientations or circumstances, the form of nearby crowns affected CNN identification. Rather than that other procedures the CNN is having a CNN's median crown misinformation positive is smaller than the other techniques', however it was demonstrated that false negative detection techniques frequently arise in regions with thick vegetation. Because neighboring plants may have had huge crowns that encroached on the excluded plant or cases of double crown plants growing from the same corm, the amount of crown overlap is not necessarily indicated by the distribution of the plants' crowns [27]. The removal of background is a photographic classification method used to separate fixed items from changing or shifting things in a picture. The most difficult processes are handled by statistical methods, whereas the simplest ones are handled via frame differentiating. For example, Because it is always present and almost ever shifts a leaf from an evolving tree may seem in the front owing to a simple frame difference, but an effective. A technique based on statistics would cause the branch to show up in the image's backdrop [12].

Each picture tile required 15 to 20 minutes for handling following the division of the 1 km ortho picture tiles into four categories for the cognitively client programs sequential processing. Banana plant bunches were frequently identified and accurately characterized using the created rule set, however individual banana plants were occasionally overlooked. Those with more contrast or those that clearly cast shadows on the ground in the shape of leaves were frequently disregarded in contrast to those that were immediately recognizable. The region where banana cultivation is popular in some places, will host the study. Because the illness is prone to travel to the banana production during the rainy season, this time of year was chosen especially. Throughout this season, rainfall, abrupt variations in temperatures, and high humidity levels are the main causes of illness and bug invasion. Before alerting the farmer, the disease alarm system periodically verifies that the minimal requirements have been met. Our method yields more precise findings than farmers' traditional open-eye inspection in the field. The cumulative count barrier is being breached faster than with the traditional method.This is understandable given that the technology is in operation in the field seven times an entire week, so it's challenging for farmers to observe it up close [28].

The Fusarium wilt detection method was validated with OAs above 70% and Kappa values above 0.4, CIRE and CIgreen shown remarkable performance in detecting Fusarium wilt, according to the validation data at two locations. This illustrates the variety of environmental situations under which the Fusarium wilt detection method may be applied. This implies that a certain level of reliability may be lost if the

Fusarium wilt detection approach were applied in other contexts. These factors can be the cause of this situation. One of the most important elements influencing the results of the verification may be the different species found at the two testing sites. Williams B6 and Baxijiao were the kinds used for VD1 and VD2, respectively. The biological and biophysical characteristics of the two types differed. Depending on how these variety properties change, the spectral information could change. Second, The two test locations employed different planting strategies, which resulted in significant variations in the emergence phases at each site. Every of both trials used in the present research was at a distinct developmental stage at the time of the images. Currently, the method accepts an image of a banana leaf as input. grows it during preprocessing, and then uses outline filtering and thresholding technique to collect data. The attributes of the picture are then obtained using CNN. This helps to identify the characteristics of the image being supplied, which are then utilized to classify the image. One of the finest supervised learning methods for mechanized disease identification is support vector machines. because of their superior ability to identify illnesses like Ye. [29].

Selecting a nonlinear function is the initial step in transforming the returning sickness image into a space with greater dimensions. The development of a hyperplane or collection of hyper-planes that in the mapping and classification process facilitates The distance between the nearest data point and the hyperplane is known as the functional margin. When illnesses are electronically recognized, their larger value leads to a smaller categorization error. The parameters of the ML models were fitted in each iteration. sought out the best classifiers for each model. They knew they had to select models with performance metrics of about 0.7. In the training and testing sets, the SVM model's accuracy was discovered to be 78 and 79 percent, respectively. Conversely, the LR model achieved 79 and 64% in the same way. When it comes to forecasting when pests would appear in banana plantations, the SVM model excels. Its methodology yields better outcomes than other machine learning techniques [20].

The accurate taxonomy with the computerized tracking of crop development. Businesses, food engineers, medical professionals, and forensic botanists might all benefit from this information. combines Internet of things-based image manipulation to keep an eye on the plant and collect ecological *data,* such as temperature and humidity. Photographs can be used to control the use of pesticides because of a technique for identifying plants that uses photos of their leaves produced by image processing. Before a pattern matches, the system preprocesses and extracts properties from the picture. Then, it contrasts the information from this image using the database to look for appropriate matches. A number of leaf characteristics, such as color, texture, and form, are retrieved and contrasted [21].

The effectiveness of several segmentation methods is evaluated by comparing them using different images of leaves. The results show that the geodesic strategy, with a significantly lower MSE and superior PSNR and SSIM, is the most successful method for precisely dividing the area affected by the illness. The next best technique is multiple threshold. Due to its higher SSIM, PSNR, and MSE values, which show less volatility, the geodesic technique fared better than previous strategies. The geodesic technique of segmentation may therefore be viewed as a preprocessing step in the development of an automated system that will extract the required region of interest from the image [22].

Provided a method for automatically identifying illnesses that damage banana leaves using picture segmentation. Infected banana crops are categorized and identified using images. This has made it possible for farmers to assess the plant's condition both inexpensively and efficiently. Segmentation is required in order to assess and extract information from the images. By separating the object of interest from the backdrop, this image processing module enables a more thorough investigation. Consequently, the success of advanced image processing modules is significantly influenced by the efficiency of picture segmentation modules. To segment and classify, a hybrid fuzzy C-means technique is employed. In order to identify illnesses in banana plants, the characteristics of color, shape, and texture were also carefully examined [30].

Recently, advancements in the categorization and detection of agricultural diseases have been made possible by the Convolutional neural networks (CNN) and the Recurrent neural networks (RNN), both of which have demonstrated efficacy in a variety of fields. uses a Model for early prediction and illness classification in an effort to help plantain producers. A new sequential image classification model known as the Gated-Recurrent Convolutional Neural Network (G-RecConNN) is created to detect diseases by fusing RNN with CNN. The model receives data from the plant image sequences.Tamil Nadu, a region in southern India, provided the study's most recent data. Numerous advantages are sought by this method, including reductions in the amount of actual specific information, easy effectiveness on the internet evaluation, minimal preparation of the data, etc. The GRecConNN model was applied as a result of the experimental results in farmer support systems that examine continuous images of banana crops in their entirety or partially because of the beginning detection of the banana branch diseases [31].

Outcomes for the recognition and detection of pests have risen substantially over time due to the development of deep learning-based strategies. Despite their potential, these methods are not yet precise enough or efficient enough to detect agricultural pests in trace levels. Building a algorithm to distinguish and categorize little pests that surrounds or comparable products is difficult since current deep learning-based algorithms might not be able to extract enough distinct visual information for small things in a shot. On the other hand, to address the issue of identifying and detecting microscopic insects. More research at various sizes for prompt micropest detection. The visual attention network affected the Residual network, which they first introduce focus mechanisms into to provide a richer representation of pest traits, particularly the delicate components of tiny item pests. In order to enhance the RPN's capacity to detect pests and provide more superior item recommendations, it is thus advised to employ sampling-balanced area proposal generation. A unique adaptive region of interest (RoI) selection technique they developed has allowed users to learn pictures from various feature pyramid levels.

In experiments conducted on the anticipated With a mean recall of 89.0 percent and a mean accuracy of 78.7 percent, the approach surpasses state-of-the-art techniques such as SSD on the AgriPest21 dataset. The trend of publications since 2014 is seen in the figure below. Given that the banana infestation peaked in 2020, the majority of the papers selected for evaluation were from that year. No publications older than 2014 were selected in order to validate the review findings.

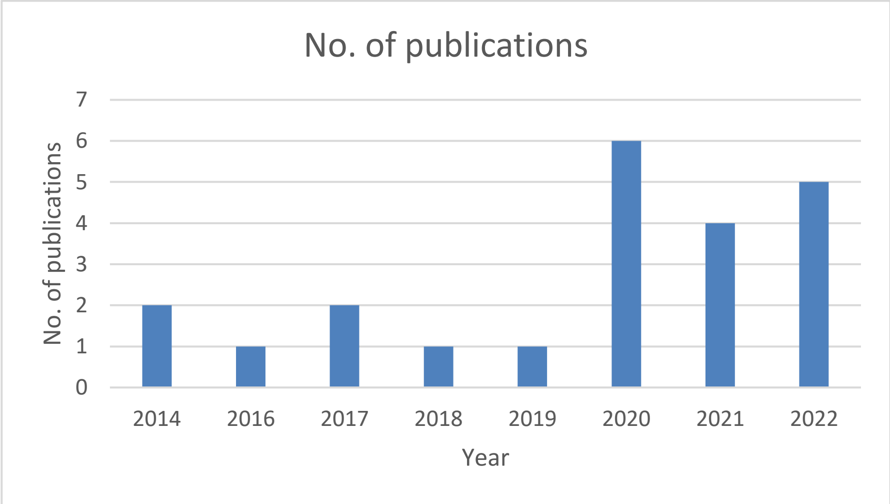

Figure 5: The Publication Trend 2014

Discussion

Plant infections lower crop quality and productivity, making them a significant issue in agriculture. Lack of diagnostic tools has a major negative impact on the development and level of living in developing nations. It is essential to create affordable, easily navigable tools for early plant disease diagnosis. suggested a method for identifying and categorizing banana infections that is based on convolution neural networks. The proposed model might serve as a decision support system to help farmers identify the disease in the banana plant. The algorithm will then be able to identify the illness if the farmer takes a picture of a leaf showing symptoms.Their primary involvement is the use of deep learning models to alter image size, quality, attitude, and direction as well as distinguish among the two common banana diseases, banana specks and banana sigatoka, under difficult illumination and actual situations. After extensive testing, this algorithm produced accurate categorization results. It has been demonstrated that applying the suggested method might greatly and effectively aid in the precise identification of leaf illnesses [32].

Despite the numerous computer-envisioned techniques for digitalized plants disease detection and classification that have been developed, a comprehensive investigation. There is currently no actual time disease or insect screening system. An innovative use of the deep transfer learning technique was used to quickly detect indications of banana diseases and pests on different sections of the banana trees with field images taken in real time. A key difference between this method and other approaches to classifying plant diseases is that it provides a practical and realistic solution for determining the kind and progression of diseases in banana plants. The proposed model was able to differentiate among healthy and diseased plants sections for a range of banana ailments.The dependable performance from this research will facilitate the creation of an assistive navigation system with the early identification and management of diseases and pests [6].

When diseases affect banana leaves, the crop's quality and yield suffer. The absence of diagnostic resources also has a major effect on their development and quality of life. Therefore, it's important to identify diseases in banana leaves as soon as possible. A revolutionary deep learning technique called heap auto encoders (HAEs) has been put out. The suggested approach allows for the effective extraction of crucial characteristics while lowering the requirement for distinctive quality. HAE additionally employs the dropout technique and the Rectified Linear Units (ReLU) activation function. The training method's overfilling issues are lessened, and the tiny training set's efficacy is increased.It is recommended that farmers utilize this method as a decision-support tool to help them recognize whether a banana leaf is diseased. Thus, the algorithm would determine the type of sickness based on a snapshot taken by the farmer of a banana leaf exhibiting the symptoms. The suggested approach is noteworthy because of its remarkable practicality, efficacy, and durability. The suggested method performs better than other tried-and-true methods, according to the results. At 99.35 percent, this framework provides the best classification accuracy for actual data sets [33].

Agriculture has a major impact on both the nation's economic growth and the production of food for human use. Consequently, proper handling of agricultural goods is crucial. Since bananas are a crop that is farmed worldwide and are of the utmost importance, it is imperative that they be kept free of dangerous diseases. A comprehensive deep learning-based method for detecting and diagnosing banana illness is achieved by analyzing not using CNN and an FSVM, not just the banana leaves but also other crop sections, which combines binary and classification SVM.The recommended method is the most efficient for diagnosing unhealthy banana trees due to its high precision, F1-score, and rapid progress with a total precision of 99.99 percent. The computerized approach to banana plant disease detection might eventually replace the traditional approach. Botanists or cultivators will discover it very useful to identify the disease and potential treatments because it is more accurate than the human way. Crop output will rise as a result of this strategy. [34].

A new method is discovered for detecting the illness in tallest Banana trees that is Matlab Compute. The system's development included capturing images, preliminary processing, segmenting them, extracting features, and producing data files . During the feature extraction stage, a number of situation are chosen, calculated, and used for ANN-based illness classification. The human approach of tall banana crop illness identification that will be changed by new technologies. Agricultural or plant pathologists will find it very helpful in identifying the disease and its treatments because it is more accurate than the manual way. This strategy will boost the integrity of food and agricultural productivity [19].

In mixed complex African environments (PCA) they showed a viable method for joining bananas banana categorization using paired pixels and a randomized forest (RF) model that incorporates integrated characteristics like the headteacher component and vegetal indices (VIs) According to this study, medium-quality satellite pictures (S2) cannot match the precision of high-quality sensors while mapping bananas. Despite advancements it is still difficult to efficiently map bananas using open-source resolution satellite in mixed complex systems when combining data from several sensor inputs. It will be identify bananas and their primary ailments more precisely and with fewer mistakes by using RGB vision technology based on UAVs. Other agro-diseases could be able to be classified using the useful, reasonably priced UAV-RGB based mixedmodel sickness detection pipeline used in this study.Future research will focus CNN model using a larger information that encompasses a variety of plants and illnesses in order to further enhance the mixed-model pipeline-based methodology established by this study. To enhance the current datasets and evaluate the created machine learning algorithms, they want to gather fresh real-world data from our international banana partners in Asia, Africa, and Central America. To improve the worldwide digital illness surveillance system, the findings of the CGIAR Research Group on Seeds, Root Vegetables, and Bananas is incorporating this work into other platforms related to communicable diseases in bananas. Because banana plants develop differently and have unique physical and developmental traits, mapping individual banana plants is essential to obtaining accurate ratios and significant details on the wellness, state, and evolution of plants. The application of multi-temporal picture captures significantly advances our understanding of agricultural dynamics, including phenology, yield forecasting, and maintenance operation planning. Multispectral UAV imagery was collected over many days to test the effectiveness of three different approaches for locating banana crowns in a GEOBIA scenario.Compared to TM and LMF, CNN was given the software most accurate for recognizing banana agriculture. The CNN models produced excellent results when applied to data from various dates, but they might be improved by accurately recognizing objects utilizing contextual and crown elevation data (CHM) (CHM). It could be possible to pinpoint traits of those plants that the three classification techniques overlooked by contrasting observations of the structure of plants obtained from UAVs with measurements made in the field. These results show that, given the constraints of the study, the CNN technique was successfully used to achieve the stated aims.Additionally, the CNN technique offers important information that will be useful for developing practical procedures, expanding the scope of viable applications, and researching agricultural techniques [11].

Using image analysis, the percentage of the polluted area may be ascertained. The outcome is shown using pixels. One of the problems faced by agricultural experts worldwide in their battle against aggressor is banana tree diseases. Image processing technology plays a significant role in it. Our first objective is to find black sigatoka on banana plants and plant diseases in order to get ready for future research. Objects for identification or the implementation of novel image-categorization methods to evoke the required information. They provide a brand-new method for quickly identifying the illness of banana plant. To differentiate organic objects on a complex background, we employed scanning picture collection, sample optimization, and state-of-the-art cognitive vision. It is an illustration of how several techniques and fields might be integrated to produce a reliable, automated system. Black sigatoka may be quickly identified using the prototype approach. It is rather simple to use and works on par with a conventional manual approach. To determine the appropriate course of action, they instead aim to more accurately pinpoint and measure the origins of bio agressor attacks. [13].

A technique for identifying sick leaf regions on banana plants using a thermal camera. The recommended technique is effective in identifying disease-related patches on banana leaves. This may be attributed to the following: 92.8% accuracy, 85.4% recall, 89.35% precision, and 87.33% FMeasure rates. To assess the disease's progression and create preventative measures, more observations will be needed in the futur to increase the inspection rate for Banana Bunchy Top Virus and facilitate the location of banana plants on Queensland, Australia's Sunshine Coast. An innovative approach to object-based image analysis was developed to automatically identify and categorize potential banana plants, followed by a last visual inspection to verify or disprove the theories. For both producers and users, the accuracy rates were 79 and 88 percent, respectively. The step takes an average of photo tile to differentiate between potential and actual banana plants. Our method significantly decreases the average human picture interpretation time of 73 minutes per image tile.Even when just a piece of a property may be mapped, the established rule set offers a novel way to automatically create barriers surrounding possible characteristics for usage in various apps. The manufacturers' accuracy rate was 79 percent, while the users' was 88 percent. It took 13 minutes on average for each photo tile to be visually interpreted in order to differentiate between actual and potential banana plants. The average human visual analysis time is 73 minutes per image tile, which is significantly reduced by our method.Even if a characteristic is only partially mapped, the established rule set offers a novel way to automatically create buffers around features that could be used in different apps [14].

A method of banana detecting VIs produced from UAV-based multidimensional data in conjunction with BLR were used to detect Fusarium wilt. The findings showed that this method may be used to identify Fusarium wilt in bananas. The OA was greater than 80% for each fits. For both verification datasets 1 and 2, the CIRE fared better than the other VIs that were taken into account. The rededge band VIs performed better than the ones without one when comparing VIs of the same type. The simulation of imaging at various spatial resolutions showed that when the resolution was greater than 2 m, Fusarium wilt will be distinguished with efficiency . As quality dropped, so did the characterization accuracy of Fusarium wilt. The results of the study indicate that new remote sensing imaging is a useful method for detecting the banana-damaging this wilt disease and might be applied to direct changes in crop cultivation and disease control [17].

Using image processing techniques improves the accuracy of automated disease identification and classification in banana leaves. The requirement to find subject-matter experts who are adept at detecting illnesses has been removed by these technologies. This saves both money and time. Here is a summary of the symptoms of several illnesses that impact the leaves of banana plants. Algorithms for using image processing to diagnose illnesses are also being researched. This paper also discusses the need for pattern classification for more precise illness diagnosis [19].

The "Trips de la mancha roja" bug is anticipated to be found in organic banana fields in Piura. They offer a prediction model in this study that allows them to group pest data into low and medium incidence categories. The model's inputs and outputs were information on the weather and pest frequency, respectively. The top six characteristics were selected using the PCA method. The two machine learning models developed were logistic regression and support vector machines. For this experimental project, the SVM model's successful generation of a classification accuracy of 79% is considered an acceptable level. LR models are easier to construct and need less processing resources to train than other ML approaches, among other benefits [20].

This research article has demonstrated that however, with the SVM model, has a strong mathematical basis and is capable of reliably and precisely classifying objects. Through early detection of the insect's presence and timely pest control actions, this approach would assist Piuran farmers in making more informed choices about their organic banana crops. By using the recommended practices going forward, farmers might be able to increase productivity, enhance banana quality, more effectively supervise their crops, and utilize the resources available to them. The chart below illustrates the percentage accuracy of findings for ten publications. MATLAB demonstrated 100% accuracy, making it the most efficient method for detecting pests [19].

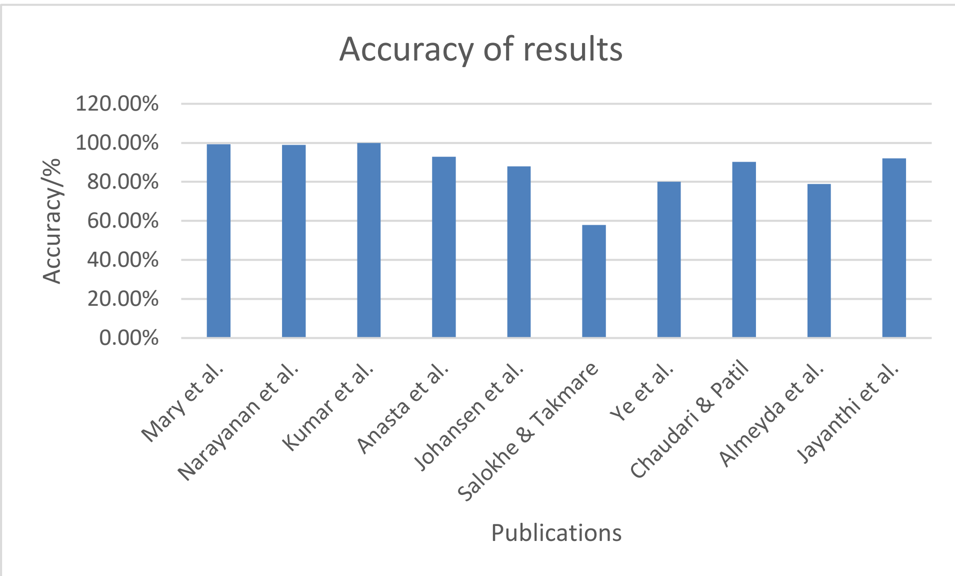

Figure 6: Accuracy Percentage of Ten Publications

Conclusion

Pest identification in banana fields is crucial since bananas are a staple meal. This systematic review includes multiple publications that offer practical and effective detection methods that fall into the following categories: deep learning, mobile apps, artificial intelligence and machine learning, and picture categorization. These techniques can all help identify pests in banana fields. These proposed models might be utilized as a decision support tool to help farmers identify the disease in the banana plant. The technology can then identify the illness if the farmer takes a picture of a leaf exhibiting characteristics. The technology can then identify the illness if the farmer takes a picture of a leaf exhibiting symptoms. The main goal of all these papers is to adjust image size, quality, posture, and orientation while identifying the two common banana diseases like banana black spot and banana speckle that were found under the tough real world and mild case with the help of deep learning, Machine learning algorithms, image categorization and Neural networks. These studies have the primary benefit of using deep neural networks, image classification, and machine learning to identify the two well-known banana diseases, banana speckle and banana sigatoka, in challenging real-world conditions and lighting conditions.

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