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A RESEARCH VISION

Identification of diseases and/or pests in fruit trees through image processing techniques and artificial intelligence

Identificación de enfermedades y/o plagas en frutales mediante las técnicas de procesamiento de imágenes e inteligencia artificial

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ABSTRACT

This article presents an analysis of the most relevant articles in the sector, in which image processing, segmentation, feature extraction and machine learning techniques were used for the detection and identification of diseases and/or pests in fruit trees. In this way, a route is established for the techniques that researchers have recently been working on in the discipline of computer vision, oriented towards agriculture, addressing the need to recognize early the presence of diseases in crops, and to thus prevent them, which results in increasing agricultural productivity.

RESUMEN

En este artículo se presenta un análisis de los artículos más relevantes del sector en los cuales se usaron técnicas de procesamiento de imágenes, segmentación, extracción de características y aprendizaje de máquinas para la detección e identificación de enfermedades y/o plagas en los frutales. De esta manera, se establece una ruta de las técnicas que recientemente se vienen trabajando por los investigadores en la disciplina de visión por computadora orientada a la agricultura, atendiendo la necesidad de reconocer de forma temprana la presencia de enfermedades en los cultivos, y de esta forma prevenirlas, lo cual redunda en aumentar la productividad agraria.

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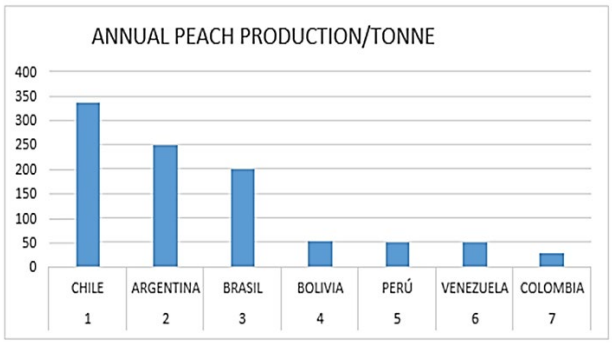
1. Introduction

For agriculture, the use of techniques of intelligence artificial, whose aim is detect the diseases further common in the fruits, to through of algorithms of learning and optimization, achieving increase the performance of productivity of various fruits in several countries.

To level world produce 25,003,345 tons of peach by year [12]. The peach production has increased in relation to other fruit trees and the main producers are China, Italy, Spain and state Joined; while that, in Latin America, Chili situates in the first position, with a production approximate of 337,402t annual, following of Mexico, Brazil ; TO level south american Colombia occupies the seventh place, with a production of 31,340 annual tons of peaches, production per person of 0.628 kilograms and a to surface of production of 2,130 Hectares. [12], [13]. As visualize in the Figure 1.

Figure 1. Production of peach annual in South America.



Source: Own.

The main problems that have been detected in peach fruits are maturation heterogeneous and inadequate, and to this you add the damage caused by cold, as fleshiness, internal browning, this occurs during storage, refrigeration, marketing and transportation; The different investigations have been aimed at developing models that allow supporting the task of detecting diseases in fruit plants. A revision exhaustive and systematic of the literature, presents a analysis of the articles further relevant, in which image processing and machine learning techniques are used to detect diseases through images of different fruit trees crops, it which entails a analysis of prosecution of images, segmentation, extraction of features and learning of processes of each model, [1].

The vision by computer is one of the subfields further important of the intelligence artificial [14], which allows implementing different methods to process, analyze and extract information from the images and in this way be able to generate software algorithms that help to interpret the results obtained [14],[15]. Inside of the Applications further highlights of this discipline we find: The recognition of objects, the restoration of images, construction of Models 3D, between others.

The context of the problem can be addressed from the discipline of vision by computer and artificial intelligence, through various data processing tools images and video for the extraction of information that provide solutions for identification of diseases pests in the fruit trees.

This article presents an analysis of the most relevant techniques in the identification of diseases I pests in the fruit trees.

1.1. Diseases further common

1.1.1. Rot

This disease is caused by a fungus called Monilinia Fructicola. For the regularly, the disease occurs during flowering times, infecting flowers and peach buds. After infecting the flowers, small cankers appear gummy that form the infection that will end up rotting the fruit. A way of to know if a peach tree is sick is by observing the flowers, if the flowers start to wither or turn brown early, we may have this fungus. In many occasions this mushroom is difficult to detect already that, although

is infected the fruit they continue seeing healthy, is until after, when the fruit starts to mature that can perceive the disease

1.1.2. Cladosporium carpophilum

Cladosporium carpophilum is the fungus that causes freckles on peaches. This fungus usually only damages smaller fruits and does not cause damage. severe on the plant. The fruits begin to fill with small spots of light brown in color and after approximately 30 to 70 days they become dark although the outside of the fruit is full of these freckles, inside it is clean and alone one has to peel it for power it consume.

1.1.3. Deforming Taphrina

Another fungus that commonly attacks the peach tree is the Taphrina Deformans. This Fungus damages leaves, flowers and fruits. Some of the symptoms are thick leaves, puckered, fat and red. After some time the leaves begin to turn yellowish and begin to fall. This fungus, in addition to reducing the quality of the fruit, can weaken the tree.

1.1.4. Gummosis

One of the causes of the death of peach branches or trees is gummosis, this disease is caused by a fungus called Botryosphaeria Dothidea. The main symptoms appear first in the bark, between the lenticels, as small blisters when the trees are still young. Although usually the infection begin to produce to the final of the season, no is but until the autumn either the following spring when the first signs are seen. Many times A rubbery resin appears in the infected areas, on the trunks and branches of the more trees big of age appear chancres.

1.2. Main diseases in postharvest

During the post-harvest, fruits and vegetables are susceptible to being affected by different microorganisms as fungus and bacteria that get worse his performance and quality. Each of these pathogenic organisms has an effect different in the fruits, but the most common consequences derived from these postharvest diseases are rot, degradation, loss of flavor and the bad smells. How much elderly time are the fruits stored, elderly will be the possibility of contracting any of these diseases, since the synthesis capacity of natural substances that protect them against these diseases decreases. Some of the diseases in postharvest further common are the following:

- Penicillium Digitatum (mold green) and Penicillium Italicum (mold blue).
- Alternaria Citri.
- Botrytis Cinerea.
- Geotrichum Candidum.
- Phytophthora Citrophthora.
- Phomopsis.
- Diplody.
- Rhizopus Nigricans.

1.3. Damage physiological in postharvest

The damage physiological: Due to factors external and natural as, by example, the exposure to extreme temperatures or nutritional imbalances, fruits and Vegetables can present physiological damage that affects their quality. These are some of the more common:

1.3.1. Damage by cold

Although low temperatures help keep fruits and vegetables in better condition, vegetables, there must always be control. Exposure to frost or temperatures Constantly below zero can develop negative symptoms on the fruits as flavors bitter, smells powerful, deterioration of the fabrics, between others.

1.3.2. Damage by high temperatures

To the equal that the cold excessive, the temperatures too much elevated also influence in the quality of the fruits. High temperatures modify the effect of ethylene accelerating the aging process. They also promote the germination of fungal spores, which

helps the development of pathogens. The temperatures High temperatures cause the fruits to experience an accelerated loss of water that can finish in the loss of the harvest.

1.3.3. Damage by low levels of oxygen

Low levels of O_2 in the environment can induce fermentation processes in the fruit causing the production of bad smells and flavors, so as the deterioration of the product. This is common when the ventilation of the environment in which it is find fruits or vegetables deficient and may be favored by high temperatures.

1.3.4. Damage by tall levels of CO_2

The accumulation of dioxide of carbon can delay the process normal of softening and loss of greenness in some fruits. In other cases, the Symptoms that are observed are discoloration, as well as internal deterioration due to accumulation of this gas. Excess CO_2 can also produce in some bad fruits flavor and brands on the fur.

1.3.5. Damage physical

They can be injuries caused by hits, falls any guy of rip of the fruit skin. As a consequence of this, a series of reactions occur physical that they can appear in shape of tissue damaged, blackening of the fur, bad smells, between others.

The objective of this Research is to understand how technology helps people on a daily basis. day of the peach fruit planting process, in this investigation, it is evident how the Technology has meant that crops are not lost and that, with a little investment, there is the top results to the hour of process a crop, because can identify early pests and diseases that affect the fruits or the tree, in order to prevent future illnesses.

Through different methods, it is observed how the way of cultivating and cultivating has advanced. implement improvements to the hour of sow and collect the fruit. The technology has made that the crops be further productive, that I don't know have the same percentage of loss when attack a plague either a disease, already that, applying the different methods either resources technological, to these crops, attack and eradicate these diseases and/or pests.

The development of are tools as are algorithms, instruments technological, images either videos in time real, implement an improvement to the moment of want identify it that it affects the crops, being So all these resources of great aid to the moment of to mitigate the damage caused to crops, and by implementing all these resources, we make sure we are up to date on all known diseases and even those that are not known. we know in the moment of carry a process of crop of this fruit.

This article emphasizes how artificial intelligence, through images achieve help in the moment of identify the different pests that they can be attacking the crops of peaches, already be with diseases I pests known, either in the investigation of new diseases that may occur in this fruit and that we have not identified. We can see how by uniting different resources and methods, such as algorithms and technological resources and knowledge of the diseases that affect the crop, lead to develop a tool that will help thousands of people who love and work with these fruits, and so they can mitigate or minimize expenses and losses.

When implementing these resources, think about the cost that this may generate. additional to the moment of cultivate this fruit, but also can see that when We identify these pests and/or diseases before they begin to consume the fruit or the tree, we save money on solving an already advanced disease or pest uncontrollable.

2. Method

The data collection process for this review consisted of a thorough search for reliable sources in different search engines for articles and magazines where they developed different techniques and research corresponding to the theme mentioned in the title and following the guide for structured literature review (SLR) of Massaro [2]. proposes a protocol that describe to continuation:

- Definition of the questions, the which give answer to the problematic raised.
- Parameters of search of literature related.
- Classification and depuration of the literature.
- Comparison, analysis and effectiveness of results obtained.

Continuing with it raised previously; identify different techniques of prosecution of image consulted, that allow carry out a better harvest of information for interpret the images, isolating the symptoms of the pests and so have data clear for the ID in leaves, stems or fruits.

The steps taken into account for the selection of information; mainly consists in detecting articles where they seek to compare the efficiency of different techniques of image processing and which are the most efficient to isolate and segment the Symptoms of diseases caused by viruses, fungi either pests.

On the other hand, identification methods and their efficiency are an important factor; given that allow quality to be compared depending on how the data are obtained and how their arrays of training they can identify with elderly precision the diseases and differentiate your origin.

3. Analysis

Next, different relevant aspects of the articles consulted are reviewed, results of the research analysis, and that provides a vision of the items to be taken into account. account in the process of ID of diseases in the peaches through the techniques of vision by computer.

3.1. Preparation of data

3.1.1. Acquisition of images

In the process of ID of diseases in the peaches distinguish various shapes of acquisition of the images.

Table 1. Shapes of acquisition of the images

References	Object of interest of the trees fruit trees	Sources of acquisition	Number of images
[3]	leaves	drones	600
[4][5][6] [7] [8]	leaves	DATABASE WEB	50000 27113 87848 54303
[5] [9]	leaves	smartphones	2939 3226
[6]	Fruits and leaves	Camera of high resolution	4000

Source: Own.

3.1.2. Prosecution

Digital image processing is defined as the set of techniques that are apply to the images digital with the aim of improve the quality either ease the search of information within them. “Before extracting information directly from the image, It is customary to do a prior processing of it to obtain another one that we “allows us to make the data extraction process simpler and more efficient.” The process may include functions to modify brightness and contrast, to rescale the image, color levels, curves, binarization, blur, among others. The images digital, has three properties basic: resolution, definition and number of blueprints.

For the stage of preprocessing finds changes in the spaces of color that They allow affected regions to be highlighted based on elements such as: color detection, threshold, Gaussian filter, rotation, among others, which allows a considerable improvement in the image, for the subsequent segmentation and ID of the areas sick.

Table 2. Digital image processing techniques.

References	Techniques	Accuracy
[3]	color detection (detection of color)	
[3]	Threshold (threshold)	
[3]	Gaussian filter	
[4] [9]	rotation	
[4]	mirroring	
[4]	addition of Gaussian noise	
[4]	brightness adjustment	
[4]	contrast adjustment	
[9]	resized	
[6]	ΔE color differences algorithm	99
[7]	Reduction of size	

Source: Own.

3.1.3. Segmentation

The segmentation of images (Table 3) is a of the stages further critics of the process of recognition of patterns, now that it affects to the results of the classification.[10]

Table 3. Digital image segmentation techniques

References	Technique of segmentation	Performance
[3]	Threshold method	
[3]	Clustering method	
[3]	edge detection method	
[3]	Regional method	
[4]	Original	76
[4]	Background removed	79
[4]	Subdivided (full)	87
[4]	Subdivided (full)	81
[5]	Mechanism of attention SENet (Squee zeNet and excitement Network)	

Source: Own.

3.1.4. Extraction of characteristics

With the regions established, it is necessary to extract a series of characteristics that the represent. This makes by half of the extraction of traits that represent a characteristic quantitative. These traits they can qualify in geometric either topological. A feature geometric It allows describe a property geometric of the object; the area and the perimeter of an object are two features of this type. A typological feature allows you to describe a property which has to do with the structure of the object; the number of holes, Fourier descriptors, the number of Euler are examples of these traits.

Table 4. Image feature extraction techniques.

References	Techniques of extraction of characteristics	Performance
[4][5][6] [7] [8]	Pixel and superpixel	
[eleven]	Color	88.77
[eleven]	Shape	79.92
[eleven]	Texture	89.25

Source: Own.

Table 5. Deep learning techniques

Reference	Technique	Ranges
[3]	Machine learning Random forest SGD SVM	- 0.78 - 0.87 - 0.87
[3]	deep learning(CNN) VGG-19 VGG- 16 Inceptio -V3	 - 0.88 - 0.89 - 0.89
[4]	CNN architecture LeNet AlexNet GoogLeNet LeNet modified VGG	- 92 At 99 - 99 - 99 - 96
[9]	CNN MobileNet SelfStructured (SSCNN)	 - 98 - 98
[5]	DTL-SE-ResNet50 EfficientNet AlexNet	- 94.85 - 91.68 - 80.84

	Start V3 VGG19	- 89.98 - 87.79
[6]	DANet ResNet-50	- 96.75 - 96.56
[7]	CNN AlexNet AlexNetOWTBn GoogLeNet Overfeat VGG	- 99.06 - 99.44 - 97.27 - 98.96 - 99.48
[8]	Siamese learning architectures	90.06
[11]	Algorithms learning automatic supervised. algorithm Naïve Bayes (NB) analysis discriminating K-Nearest neighbor Machines of vectors of medium	-91.39 - 96.7 - 99 - 97.2
[11]	Algorithms learning automatic No supervised -Group of K- Means Group diffuse -Models of mix gaussian	-97 - 97.32 - 96

Source: Own.

3.1.5. Learning of machine

For the classification of objects they can be framed in learning methods deep either deep Learning, these they have produced a revolution in the field of the vision by computer, for pattern recognition, techniques have demonstrated robustness in the tasks of classification, being able of cope with different ranges of transformations either distortions as noise, scale, rotation, displacement, variation of illuminance.

4. Conclusions

The bases of data as plants Village and ImagiNET, are free and they use to consult and get the pictures of the plants of peach.

The major method for identify the diseases I pests are the networks neural and the most used are: EfficientNet, AlexNet.

The segmentation is a stage important in the process of ID, due to that it affects the patterns of classification.

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