EVERANT PUBLISHER PVT. LTD. Available Online at www.mejournal.in

Management and Economics Journal

Research

ISSN: 2456-2661 Volume:2_Issue: 08 August 2018

Artificial Vision in Mexican Agriculture, a New Techlogy for Increase Food Security

Author: Jaime Cuauhtemoc Negrete*

Independent Researcher and Technical writer graduated in Agrarian Autonomous Antonio Narro University

Corresponding Author:

Jaime Cuauhtemoc Negrete*

Independent Researcher and Technical writer graduated in Agrarian Autonomous Antonio Narro University

CrossMark

Abstract:

At present there are around 7,000 million human beings in the world and the World Bank estimate is that we will reach some 9,000 million people by 2050. The FAO assures that the arable lands will not increase and that, due to the shortage of water and desertification will even decrease. Mexico is not exempt from the previous situation because it is estimated that the population of our country for 2010 will be 150, 837, 517.CONAPO.(2017). World food security is determined by the production methods of poor farmers and by the purchasing power of low-income consumers. Sufficient reasons above to explore any new technology such as Agricultural Mechatronics, Precision Agriculture, Precision Beekeeping, Precision Livestock, Automatization of agriculture with Arduino and Artificial Neural Network, in which artificial vision plays an important role for its application in the Mexican agriculture, increasing its productivity and to feed the population thus increasing the food security of our country. In México, the application of the artificial vision to agriculture is low.It does not have the dynamism that it is taking in other countries, it is necessary to promote it to increase the food security in the country.

Keyword: Agriculture, México, Artificial Vision, Food Security, Agricultural Technology. JEL.Q01, N56, L63, Q16

1. Introduction:

Introduction of Author Article At present there are around 7,000 million human beings in the world and the World Bank estimate is that we will reach some 9,000 million people by 2050. The FAO assures that the arable lands will not increase and that, due to the shortage of water and desertification will even decrease. Therefore, the two main challenges facing agriculture are: a) feed this growing population with less arable land and b) achieve this production with fewer resources. Serrano (2016). Mexico is not exempt from the previous situation because it is estimated that the population of our country for 2010 will be 150, 837, 517.CONAPO. (2017). World food security is determined by the production methods of poor farmers and by the purchasing power of low-income consumers.

Therefore, the problem of world food security is not a technical, environmental or demographic problem in the short term, but first and foremost a problem of lack of means of production by the poorest peasants of the world, who cannot meet their food needs. It is also, therefore, the lack of purchasing power of other poor consumers in rural and urban poor areas, while the poverty of non-farmers is also a consequence of rural poverty and emigration from agricultural areas.

Sufficient reasons above to explore any new technology such as those proposed by Negrete (2015; 2016; 2017a; 2017b; 2018; 2018a; 2018b) such as Agricultural Mechatronics, Precision Agriculture, Precision Beekeeping, Precision Livestock, Automatization of agriculture with Arduino and Artificial Neural Network, in which artificial vision plays an important role for its application in the Mexican agriculture, increasing its productivity and to feed the population thus increasing the food security of our country.

Materials and Methods. - A revision was made on the topics of artificial vision in agriculture on the Internet, in databases of libraries, magazines, etc.

Artificial vision definition

Artificial intelligence opens a wide range of objects of study, one of them is artificial vision: You can define the "Artificial Vision" as a field of "Artificial Intelligence" that, through the use of appropriate techniques, allows obtaining , processing and analysis of any type of special information obtained through digital images. Artificial vision is made up of a set of processes used to perform image analysis. These processes are: capturing images, memorizing information, processing and interpreting the results. As you can see, the artificial vision seeks to imitate one of the 5 senses of man, a physiological sensor that we have capable of converting photons that travel in the space in the form of electromagnetic spectrum that lie between 400nm-700nm, range where we can witness the rainbow of colors that our eyes can see, this electromagnetic spectrum at the moment that affects our eyes, are automatically converted into electrical signals that they are interpreted by our brain to offer us the images with which we see the world. Artificial vision seeks to interpret the images of the world through sensors that capture electromagnetic spectra, obtain images, and that systems are able to process, recognize and catalog the images they are witnessing, artificially giving them the quality of being able to see the world, as our eyes and brains witness our reality. Villareal, (2015).

Artificial vision (also known as computer vision or computer vision) is an optical, clean, safe and very versatile acquisition technique. The analysis of the obtained images allows detecting in object physical characteristics invisible to the human eye or establishing or checking some predetermined property or measurement. Anonymous (2010).

Artificial vision in the agriculture of the world

Machine vision in agrobotic systems (henceforth, agrovision) is yet to reach its full potential, many applications have been developed for various tasks in the fields, orchards, and greenhouses. Among these are autonomous navigation and obstacles avoidance, precision and selective spraying; weeds detection, yield estimation, seedling planting and ripeness and quality evaluation. However, perhaps the most prevalent application has been fruit detection, where the goal is; to detect the presence of individual fruits; to discriminate them from the rest of the scene (leaves, branches, sky, etc.); to localise them in space.All these detected targets are then used in order to facilitate the interaction of the fruit with robotic manipulators and end effectors for further handling and physical processing, and in particular for harvesting operations. Interestingly, although much attention was given to these three visual processing problems during the last 30 years, no selective harvesting robot has ever reached commercial maturity. Kapach. (2012).

For Graziano applications of artificial visionin Agriculture is in;Classification and selection of seeds; Classification and selection of fruits; Analysis of plants and level of foliar damage caused by pests and diseases; Control of autonomous vehicles; Identification of invasive plants in the culture medium to control them. but for Pinto it is in

1. - selection and classification of agricultural products mainly fruits 2.-Animal behavior 3.-Robotization of the harvest 4.-Positioning of agricultural implements 5.-Automatic management 6.-Identification of diseases, pests, invasive plants (Remote sensory)

Table.1: ***Literarature Review about Artificial Vision in World Agriculture***

Author and year	**Description**	**Country**
Anisha Syal (2013).	Review previous studies and systems to count the number of fruits on trees and their yield estimation is performed	India
Wang(2008)	Proposed a new design of Intelligent Cotton Picking Robot (ICPR) based on machine vision including the motion control subsystem and machine vision subsystem	China
Beltran	Proposes the automation of quality control in seed germination using artificial vision.	Colombia
Aydin (2017)	Reviews recent developments in image analysis systems for the plant growth and health evaluation	
Oppenheim (2017)	Presents an image analysis algorithm to detect and count yellow tomato flowers in a greenhouse with uneven illumination conditions, complex growth conditions and different flower sizes	
Huang(2016)	Develop and evaluate new methods for estimation of cotton yield for precision cotton farming.. Two methods were employed to estimate cotton yield using very high-resolution digital images	US.A
Jahari(2015)	Developed a machine vision system to evaluate harvested paddy grain quality during harvesting using double lighting	
Guerrero(2014)	Realized the design of an expert system based on computer vision for real-time crop rows and weeds identification in maize fields	Spain
Bossu(2009)	Proposed testing and validating the accuracy of four image processing algorithms (wavelet transforms and Gabor filtering) for crop/weed discrimination in synthetic and real images.	
Morten(2016)	Studied a High-resolution images from digital cameras support of plant characteristics.	
Burgos (2011)	Present a system consists of two independent subsystems, a fast image processing delivering results in real-time (Fast Image Processing, FIP), and a slower and more accurate processing (Robust Crop Row Detection, RCRD) that is used to correct the first subsystem's mistakes	Spain
Burgos (2009)	Developed several computer-vision-based methods for the estimation of percentages of weed, crop and soil present in an image showing a region of interest of the crop field.	Spain
Li.(2015)	Used a method to provide real-time positional information of crop plants for a mechanical intra-row weeding robot.	China
Shi (2015)	Pproposed an automatic crop disease recognition method , which combined the statistical features of leaf images and meteorological data	China

Abergos.(2012)	Developed An Android application which automates the LCC using Image processing techniques such as color histogram analysis and pixel bitwise operations.	Philippines
Camargo(2009)	Present a machine vision system for the identification of the visual symptoms of plant diseases, from coloured images.	UK
Camargo(2008)	Present image-processing based method that identifies the visual symptoms of plant diseases, from an analysis of coloured images.	UK
Berenstein(2010)	Present an Autonomous spraying in vineyards and four machine vision algorithms that facilitate selective spraying.	Israel
Sahurkar(2017)	Developing an easy and proficient automatic method for finding nitrogen and chlorophyll content in a plant based on leaf color and image processing	India
Li (2009)	Present conceptual framework of an agricultural vehicle autonomous guidance system,navigation sensors, computational methods, navigation planners and steering controllers. (GPS), machine vision, dead-reckoning sensors, laser-based sensors, inertial sensors and geomagnetic direction sensors.	Japan
Asif(2019)	Design avision guidance system for automated weed detection robot	Pakistan
Bravo(2004)	detect and recognize the plant stress caused by disease in the field conditions by combining hyperspectral reflection information between 450 and 900nm and fluorescence imaging.	Belgium
Bucksch(2014)	Proposed an Image-Based High-Throughput Field Phenotyping of Crop Roots	USA
Arivazhagan(2013)	Detection of unhealthy region of plant leaves and classification of plant leaf diseases using texture features	India
Santos (2009)	Development of a pattern recognition system that recognizes weeds and gives the occupation porcentage of wide and narrow leaves in an agricultural production system,with digital image processing techniques.	Brazil
Upadhyay(2014)	Presens a system based on a distributed imaging device that is able to automatically acquire and transmit images of the trapping area to a remote host station	India
Behfar1(2014)	methods of vision-based row detection for lentil field	Iran
Jiang(2009)	Present novel two-step 3D data analysis strategy to differentiate apple stem-ends/calyxes from true defects according to their different 3D shape information	USA
Barbedo(2013)	Surveing methods that use digital image processing	

	techniques to detect, quantify and classify plant diseases from digital images in the visible spectrum.	
Bhange(2016)	Realice an application of machine vision system and Image Processing methods to identify nodes from sugarcane and to plant it as a seed by planting machines	India
Tellaeche(2008)	Developed automatic computer vision method for detecting Avena sterilis, a noxious weed growing in cereal crops, and differential spraying to control the weed	Spain
Junior(2008)	Evaluate the discrimination among three nutritional levels in wheat crop using digital images and a portable chlorophyll meter.	Brazil
Sahurkar (2017)	Reviewed an automatic method for finding nitrogen and chlorophyll content in a plant based on leaf colour and image processing	India
Momin(2017)	Developed an image acquisition and processing system to extract projected area, perimeter, and roundness features. To automate the grading of mangos (geometry and shape)	Bangladesh
Cruvinel(2010)	Present a method based in computer vision for the construction of maps of application of variable rate herbicide dedicated to broad-leaved and narrow-leaf invasive plants of maize.	Brazil
Qureshi(2017)	Proposes two new methods for automated counting of fruit in images of mango tree canopies, one using texture-based dense segmentation and one using shape-based fruit detection, and compares the use of these methods relative to existing techniques	Pakistan
Bossu(2008)	developed a machine vision system for a real time precision sprayer. From a monochrome CCD camera located in front of the tractor, the discrimination between crop and weeds is obtained with image processing based on spatial information using a Gabor filter.	France
Bossu(2009)	Develop a machine vision system for a real-time precisión sprayer	France
Sathesh(2015)	Develop image processing based coconut harvesting system	India
Åstrand(2002)	Develop autonomous agricultural mobile robot for mechanical weed control in outdoor environments.	Sweden
Martinez(2016)	Used an unmanned aerial vehicle USENSE X8 for determination of plant cover and salun in sugarcane, through the capture of RGB images and their processing	Cuba41
Liu(2015)	Developed a moldy tobacco online detection system based on machine vision to realize automatic screening of mildew tobacco leaves .	China
Gonzalez(2016)	Compares three different color segmentation	Spain

	techniques that have been applied to estimate the percentage of green cover of a lettuce crop of variety Little Gem	
Wan(2008)	Design and development of a camera-vision guided unmanned mover sprayer for the purpose of automatic weed control.	Malasya
Silva(2015)	Proposes an aerial images processing solution to be capable of identify exposed soil areas in large areas of plantations and can be embedded in a small computer and low power	Brazil
Gao(2015)	Proposed a research method of garlic clove direction identification based on machine vision	China
Li(2017)	Developed an automatic counting system for urediospores of wheat stripe rust pathogen based on image processing using MATLAB GUIDE platform in combination with Local C Compiler (LCC).	China
Bennedsen(2005)	Used An experimental machine vision system to identify surface defects on apples, including bruises	USA
Liu	Proposes an efficient image processing algorithm to detect the parameters of an ear of corn based on a machine vision. An experimental device was designed to detect the parameters	China
Guerrero(2015)	Design of an expert system based on computer vision for real-time crop rows and weeds identification in maize fields. Furthermore, the proposed system controls the guidance of the tractor and the overlapping of the areas of treatment in order to apply a site-specific treatment	Spain
Gonzales(2015)	Developed a novelty system for obtaining the crop cover with easy, unattended and automated procedures from a digital photography ,the crop water needs are calculated from this photography combined with a mathematical algorithm.	Spain
Santiago (2014)	Propose a new approach for automatic classification of weeds and crop digital images.	Brazil
Nakarmi(2013)	Developed an inter-plant spacing sensing system using a TOF (time of flight) of light based 3D sensor. The 3D sensor was capable of capturing distance information, intensity and amplitude data in a single shot.	USA
Amatya(2017)	Developed a method of locating shaking positions for automated cherry harvesting based on branch and cherry pixel locations determined using RGB images and 3D camera images.	USA
55 Asaei(2016)	Designed a sprayed to detect between the trees in orchrads using a machine vision system to stop the	Iran

	spraying on places where no tree exists.	
Tao (2017)	Presented a machine vision-guided systems for food processing automations. A showcase of an automated vision-guided intelligent strawberry de-calyxing machine and an automated 3-D imaging system for seafood sorting lines	USA
Sahu (2016)	Develop an automated tool, which can be capable of identifying and classifying mango fruits based on shape, size and color features by digital image analysis	India
Moriya(2015)	Develop a methodology to perform processing and analyzing hyperspectral images obtained by airborne sensor, so that the products assist in characterizing the spectral response of the sugarcane aiming discrimination and recognition stands with disease in sugarcane.	Brazil
Santiago(2015)	Develop and evaluate the performance of an image processing system to identify weeds in sugarcane and estimate their level of infestation, since the existence of a computer tool to recognize plants species should give a great support to decision-making about the management of weed communities.	Brazil
Tamboli(2017)	Suggest the application of machine vision system and Image Processing methods to identify nodes from sugarcane and to plant it as a seed by planting machines	India
Amatya(2015)	A machinevisionsystem was developed to segment and detect cherry tree branches with full foliage, when only intermittent segments of branches were visible	USA
Sivakumar(2015)	Used image-processing techniques, to identify ripe tomatoes, and once identified; an automatic robotic vehicle harvests the ripe tomatoes	India
Sourabha (2016)	Proposed a method to detect and count the number of white-flies using image processing on Simulink and Matlab software.	India
Chaudhari(2016)	Discussed existing segmentation method along with classifiers for detection of plant leaves. A Survey On Detection Of Unhealthy Region Of Plant Leaves By Using Image Processing	India
Silwal(2016)	Present a machine vision in a robotic Apple harvesting system consists of a camera attached to the manipulator or end-effector	USA
Lottes(2016)	Propose a system that performs vegetation detection, local as well as object-based feature extraction, random forest classification, and smoothing through a Markov random field to obtain	Germany

	an accurate estimate of the crops and weeds.	
Lottes(2017)	Propose a system that performs vegetation detection, plant-tailored feature extraction, and classification to obtain an estimate of the distribution of crops and weeds in the field. We implemented and evaluated our system using UAVs	Germany
Junior(2002)	Develop and evaluate an algorithm for identifying damaged corn plants by the fall armyworm (Spodoptera frugiperda)using digital color images	Brazil
Stein(2016)	Presents a novel multi-sensor framework to efficiently identify, track, Fruit are detected in images using a state-of-the-art faster R-CNN detector, and pair-wise correspondences are established between images using trajectory data provided by a navigation systemlocalise and map every piece of fruit in a commercial mango orchard.	Sweden
Diago(2012)	Implement a methodology through the generation of a supervised classifier based on the Mahalanobis distance to characterize the grapevine canopy and assess leaf area and yield using RGB images.	Spain
Sritarapipat(2014)	Developed an automatic image processing technique to detect rice crop height based on images taken by a digital camera attached to a field server.	Thailand
Casanova(2014)	Presents a technique using computer vision to detect disease stress in wheat.	USA
Aguilera(2015)	Provide an automatic inspection system, based on computer vision, and to classify automatically different batches of olives entering the milling process	Spain
Yamamoto(2016)	Develop a method for internode length estimation using image processing technology.	Japan
Orlando(2003)	Develop and evaluate a weeds and corn identification system,using color and monochomatics digital images	Brazil
Komi(2008)	Design and evaluate a novel dual camera sensor for use in an accurate single leaf level plant detection and classification system for weed control purposes.	UK
Çakir (2016)	Determine the seed distribution uniformity of seeding machines using a low sensitivity (maximum 300 frames per second (fps)) high-speed camera and image processing method for corn, cotton, and wheat seeds under laboratory conditions.	Turkey
Han(2015)	Developed a novel computer vision-based approach for automatically identifying crop diseases based on marker-controlled watershed segmentation, superpixel based feature analysis and classification	China

L. De Wet(2003)	Detecting daily body weight changes of broiler chickens with computer-assisted image analysis.	
S.Amraei (2017)	Used a machine vision and artificial neural network (ANN) procedures to estimate live body weight of broiler chickens in 30 1-d-old broiler chickens reared for 42 d	India
Wang(2013)	Used a digital camera to take pictures of the canopies of 3 rice (Oryza sativa L.) cultivars with 6 different nitrogen (N) application rates.	China
Latha(2014)	Implemented image processing using MATLAB to detect the weed areas in an image we took from the fields.	India
Junior (2007)	Evaluate the discrimination among levels of nitrogen in wheat plants grown in pots, submitted to five doses of nitrogen, using data extracted from digital images.	Brazil
Montalvo(2012)	Proposes a new method, oriented to crop row detection in images from maize fields with high weed pressure. The vision system is designed to be installed onboard a mobile agricultural vehicle	Spain
Pajares(2016)	Provides guidelines for selecting machine-vision systems for optimum performance, considering the adverse conditions on these,outdoor environments with high variability on the illumination, irregular terrain conditions or different plant growth states for agricultural vehicles	Spain
Halimatu(2017)	Developed a database from images of remote sensing, the images are analyzed and a model is developed to determine the right treatment plans for different crop types and different regions	UK
Cruvinel(2004) ,	Presents a low-cost computer vision system with the use of stereoscopic imaging and computational model dedicated to the recognition of small their variability, with particular application to those that present geometric primitives based on circular patterns.	Brazil
Bressan(2006)	Proposed a fuzzy classification system using the attributes described to infer about the infestation risks of crop regions by weed plants. Simulation results of the proposed risk classification system are presented to illustrate its use in the site-specific herbicide application.	Brazil
Downey(2004)	Proposed method for locating and identifying weeds, using cotton as the example crop. The system used a digital video camera for capturing images along the crop seedline while simultaneously capturing data from a global positioning system (GPS) receiver	USA

Salamanca(2016)	Present a module of artificial vision for an application of precision agriculture, which is applied as an automation solution precision farming consisting of a controlled through Plexil robot, which runs on a SoC card (System on a chip) Intel Galileo.	Colombia
Yano(2017)	Proposes a system for weed identification based on pattern recognition in imagery taken from a Remotely Piloted Aircraft (RPA).	Brazil

Artificial vision in Mexican agriculture

Salazar (2016). Proposes the use of an artificial vision system to identify the fusarium fungus on corn crops by integrating the technology in a smartphone and an implementation of javaCV to identify color patterns in the corn and be able to identify any anomaly. Artificial vision systems aim at mathematically modeling the visual perception systems of living beings and create programs that will allow the simulation of such capabilities by means of a computer system. The current frameworks that run on mobile devices allow both monochromatic and color image processing. The structure and properties of the 3D world that they try to describe aim at not just geometrical properties but also at properties such as material, light intensity/absorption on surfaces in an automated way. In Mexico, the implementation of such technologies in corn crops is almost nonexistent. However, by developing solutions the beneficial impact would boost the creation of technologies that may be able to detect plagues or diseases in crops.

Contreras (2012) Reports an FPGA-based Smart sensor able to perform non-destructive, real-time and in-situ analysis of leaf images to quantify multiple symptoms presented by diseased and malnourished plants; this system can serve as indicator of the health and nutrition in plants. The effectiveness of the proposed smart-sensor was successfully tested by analyzing diseased and malnourished plants.

Martinez.(2017). Develop an information system that works as a database tool for nutritional (nitrogen, phosphorous, potassium) deficiency and water stress characterizations of alfalfa crops, integrating all parameters mentioned before. The database utilizes images captured by a CCD camera, and results of extraction techniques and recognition of configured patterns in a machine vision system previously developed. Integration of the artificial vision module and human expert knowledge module are presented in a single information base, programmed in Visual Basic language.

Hernández (2016) .Described and compared three computer vision techniques to detect and count fruits, vegetables, and plants in agricultural crops are. The three proposed methods are based on: average total volume, connected components, and a mixed method that combines the previous two. In all cases the first step consists of color segmentation in order to detect the objects of interest. The three methodologies require images of the crops, which can be taken with mobile devices or with camera of average resolution. Tests have been performed both with images taken in situ on the crop, and recorded video from an unmanned drone. A stitching algorithm is applied to these videos to generate an orthophoto, which is then used for counting trees or plants. All techniques work well when counting objects are separated. When there is overlap, the mixed method is the one that gets the best results.

Villareal (2015). Present technical conceptualization and engineering, for the design of a DRON crop pollinator. The construction of a DRON pollinator is not a simple task and involves multiple branches of engineering, because the article focuses on the discussion of the artificial vision aspect for the detection of flowers, explaining in detail the methodology and procedures carried out by a cable To obtain a cascade file classifier by the Viola-Jones algorithm, better known as haartraining. Topics such as the OpenCV library, the process for creating a classifier for objectrecognition, evaluation tests for object recognition and the results obtained have been discussed.

González (2013). Proposes a method for knowing and preventing the disease in chili peppers plant through a color image processing, using online system developed in Java applets. This system gets results in real time and remotely (Internet). The images are converted to perceptual spaces [hue, saturation and lightness (HSL), hue, saturation, and intensity (HSI) and hue saturation and value (HSV)]. Sequence was applied to the proposed method. HSI color space was the best detected disease. The percentage of disease in the leaf is of 12.42%. HSL and HSV do not expose the exact area of the disease compared to the HSI color space. Finally, images were analyzed and the disease is known by the expert in plant pathology to take preventive or corrective actions.

Martinez (2018). Give an overview on recent development of image processing applied to color analysis from horticultural products, more specifically the practical usage of color image analysis in agriculture. As an example, quantitative values of color are extracted from Habanero Chili Peppers using image processing; the images from the samples were obtained using a desktop configuration of machine vision system.

Lopez (2017) Studied the application of image processing through computer vision, obtained from digital cameras; these images were taken during the entire corn crop cycle, coupled with the recording of field variables, such as plant height and leaf length and width. In order to perform these measurements,was used a tripod adapted with Bluetooth sticks where a cell phone camera was connected to take pictures of a delimited area by a 1.1 x 1.1 m frame and thus have control of the plants and monitored ground. The dataset was processed, highlighted by the use of VisualStudio with Open CV software as the basis for the plant cover calculation extracted from photos, the Penman-Montieth equation for ETo and Kc coefficients, and the determination of LAI (Leaf Area Index) from destructive and non-destructive sampling methods; these values were analyzed according to parameters mentioned in FAO Bulletin 56 to define growth stages. Was searched for relationships between the generated data, finding models that allow calculating zone Kc coefficients from plant height, results that reflect local weather conditions; this, in turn, allows generating irrigation calendars, which will help provide a better application of water and obtain greater yields in areas with similar weather characteristics, by using a very precise and cheaper technique compared to other technologies.

Saldaña(2016) Develop an algorithm to identify the garlic apex through artificial vision. For this purpose, a video camera and illumination lamps were used, with which digital images of the cloves of garlic were obtained. The images were processed to identify the apex in four steps: 1) capturing the image; 2) detecting the perimeter edge of the garlic cloves; 3) calculating the angles on the inside edge of the cloves and localizing the apex under the hypothesis that it coincides with the smallest angle on the inside edge; 4) identifying the need of reorienting the apex. The impact of the location and size in the correct identification of the apex was evaluated statistically and the border detection methods Canny, Roberts and Sobel were compared. The results did not show significant statistical differences between the different sizes and positions of the garlic when localizing the apex, which is convenient. However, there were significant statistical differences between the border detection methods, because Canny's had a better performance in the localization of the apex. The algorithm developed in this research could be used to design a mechanical system to reorient the apex through artificial vision in garlic sowing.

Chavez (2016) proposed a new method for tomato stem recognition. Consequently, an algorithm was developed to segment the crop into the image, using its color distribution model in the CIE L*a*b* space. Two Logitech model c920 webcams were mounted in a stereo vision configuration with a baseline of 50 mm. The recognition algorithm is based on the use of 3D information for segmenting objects to a specific distance. It also includes novel components such as the crop segmentation from images, use of support wire as a visual cue, the implementation of interpolation using cubic splines and the use of principal components to determine segment orientation. Experiment shows that the performance of the proposed method was 95.0%, with a standard deviation of 9.9%. In addition the segmentation quality of the proposed method was 93.6%, with a standard deviation of 2.4%. Overall, the proposed stem recognition algorithm in conjunction with the crop segmentation can be used as a first step for the recognition of axillary buds and leaves in crops that grow along a support wire.

Hahn (2006) developed a methodology to detect Escherichia coli, using thermal imaging. Escherichia. Coli grown on classical LEVINE agar were imaged using a thermal IR camera. A prototype was developed to avoid temperatura changes on the surface due to air movement. The prototype which injected heat from the bottom was analyzed thermally to detect relative humidity and temperature changes. The images had to be taken 15 s after taking the Petri dish from the incubator. The thermal images were processed by counting the pixels per color. A RGB processing algorithm worked better than the grey scale algorithm as yellow and rose could not be discriminated properly. The value was introduced in three equations and a detection success rate of 100% was achieved.

Velasquez (2011) developed a detection system of powdery mildew (Sphaerotheca pannosa) on rose with Open CV. Open CV is an open source computer vision library, which is written in C and C++ language. The detection was made according to the HSV space color. The source image was converted from the RGB to the HSV space color and the disease and the plant parts were extracted according to the H, S and V information. After that the noise (white objects) was removed. Finally the accuracy of the detection was evaluated. The developed disease detection system is able to detect the powdery mildew disease through the HSV space color with Open CV. Better results were obtained when using close pictures (10 cm). The miss-matched rate caused mostly by halation when using distant pictures could be successfully avoided using active sensing which allows for disease detection even when using distant pictures.

Espitia&Gonzales(2017)design and construction of three different systems of detection and classification of fruits (round tomato) based in the average equatorial diameter; with the intention of comparing and determining which of these is maintained to greater efficiency, in terms of hits. Finally, the goal of developing an efficient system is that a post-harvest activity can be applied for production and sales purposes. In order to develop the 3 systems, firstly the algorithms of machine vision and artificial neural network were designed, taking into consider the norm NMX-FF-031-1997, which presents the classification for globe tomatoes (small, medium, large and extra large). The first one (Matlab) was focused mainly on the image analysis, so the algorithm was based on some basic operations such as: color separation, binarization, filtering, filling and contour detection. Also, the algorithm contains a basic classification method, which used a separation by means of conditions. The second system (Matlab) just like the previous one, contains the code for image processing, in addition to incorporating the single-layer perceptron neural networks (2 neurons) to complete its goal. Finally, the algorithm developed in Python language (third system), focuses essentially on machine vision techniques, and the main variations being the processing card in which it was implemented and the library used (OpenCV). Once the codes were obtained we proceeded to acquire results and finally compare them. Also a prototype of conveyor belt was fabricated to visualize and to analyze the classes of obtained tomatoes.In conclusion, the use of a single-layer perceptron network allowed to obtain a better classification, obtaining a significant mean squared error of 6.3% (variation of diameters of ± 0.6 mm), in addition to an efficiency of 73%, compared to the analyzed data (diameters).

Ramirez (2013) design, build and test a robotic system capable of climbing palm trees for detection of coconuts by means of an artificial vision system. The prototype has the ability to be incorporated sensors to determine pests as well as harvest automatically coconuts, thereby reducing costs generated and increases safety during harvest. Concluding the crank-crank mechanism, despite being very rustic, it was effective for the robot's ascent on the palm tree. It also helps to reduce the presence of engines on the robot, considerably reducing the amount of electronic devices necessary for its control ,must change the used motor to increase the torque and so do not have problems regarding the weight supported by the robot when climbing on the palm tree.

Soliz (2009) describes a machine vision system able to detect whiteflies (Bemisia tabaci Genn.) in a greenhouse by sensing their presence using hunting traps. The extracted features corresponding to the eccentricity and area of the whiteflies projections allow establishing differences among pests and other insects on both the trap surfaces and dust generated artefacts. Because of whiteflies geometrical characteristics, it was possible to design an efficient (related to manual counting) machine vision algorithm to scout and count units of this pest within a greenhouse environment. These algorithm results show high correlation indexes for both, sticky screens (R2 = 0.97) and plant leaf situations (R2 = 1.0). The machine visión algorithm reduces the scouting time and the associated human error for IPM-related activities.

Conclusion:

From the literature review, the results are dominated predominantly by Asian authors (India and China) in Europe Spain predominates and in Latin America Brazil has promoted it in research centers.In México, the application of the artificial vision to agriculture is low.It does not have the dynamism that it is taking in other countries, it is necessary to promote it to increase the food security in the country.

References:

Asaei, H.; Jafari, J.; Loghavi, M. ;(2016).Developments and evaluation of a targeted orchard sprayed using machine vision technology. Journal of agricultural machinery.Vol 6, No.2 pag.362-375.

Amatya S. (2017) Automated Detection of Branch Shaking Locations for Robotic Cherry Harvesting Using Machine Vision. Robotics 2017, 6, 31; doi: 10.3390/robotics6040031

Amatya, S., et al., (2015), Detection of cherry tree branches with full foliage in planar architecture for automated sweet-cherry harvesting, Biosystems engineering http://dx.doi.org/10.1016/j.biosystemseng.2015.10.003

Muhammad Asif, Samreen Amir, Amber Israr and Muhammad Faraz (2010) A Vision System for Autonomous WeedDetection Robot.International Journal of Computer and Electrical Engineering, Vol. 2, No. 3,

Arivazhagan S., R. Newlin Shebiah*, S. Ananthi, S. Vishnu Varthini (2013) .Detection of unhealthy region of plant leaves and classification of plant leaf diseases using texture features. Agric Eng Int: CIGR Journal Open access at http://www.cigrjournal.org Vol. 15, No.1 211

Abergos,J. L.V., ,Philip Zesar Boreta ,Ricardo John B. Comprado ,Stephen R. Soltes Andy V. Tatel (2012)Android-Based Image Processing Application for Rice Nitrogen Management,B.Sc.Thedsis.Ateneo de Naga University .Philippines.

Åstrand B., Baerveldt A.J.(2012).An Agricultural Mobile Robot with Vision- Based Perception for Mechanical Weed Control.Autonomous Robots. Volume 13, Issue 1, pp 21–35

Anónimo ./(2010).Sistemas de Visión Artificial .Introducción al Diseño de Micro Robots Móviles2009/10. [Retrieved from]. file:///C:/Users/UsuarioHP/Downloads/IDMRM0910_Trabajo_VisionArtificial_v2%20(1).pdf

Anisha Syal; Divya Garg; Shanu Sharma ;(2013) A Survey of Computer Vision Methods for Counting Fruits and Yield Prediction International Journal of Computer Science Engineering, Vol. 2 No.06

Aguilera P.D., Martínez G.D.M., Gámez G.J. Gómez O.J.(2015) Sorting Olive Batches for the Milling Process Using Image Processing. Sensors 15, 15738-15754; doi: 10.3390/s150715738

Aydin A.; Çay A.; Polat, B.;(2017).Image Analysis Applications in Plant Growth and Health Assessment. Journal of Agricultural Faculty of Mustafa Kemal University. 22(1):112-126

Barbedo (2013) Digital image processing techniques for detecting, quantifying and classifying plant diseases. SpringerPlus 2:660. Doi: 10.1186/2193-1801-2-660

Behfar H., Hamid Reza Ghasemzadeh, Ali Rostami, MirHadi Seyedarabi Mohammad Moghaddam (2014) Vision-Based Row Detection Algorithms Evaluation for Weeding Cultivator Guidance in Lentil. Modern Applied Science; Vol. 8, No. 5; 2014 ISSN 1913-1844 E-ISSN 1913-1852

Bargoti S., Underwood P.J,;(2006).Image Segmentation for Fruit Detection and Yield Estimation in Apple Orchards, [Retrieved from]. https://arxiv.org/pdf/1610.08120.pdf

Bennedsen B.S. , Peterson D.L., Amy Tabb(2005)Identifying defects in images of rotating apples Computers and Electronics in Agriculture 48 92–102

Beltran .Automatización en la Agricultura: UN caso de aplicación de la visión artificial control de calidad en semilleros, Universidad de Colombia.

Berenstein R., ShaharB.O. , Amir Shapiro A., Edan, Y.; (2010) Grape clusters and foliage detection algorithms for autonomous selective vineyard sprayer.Intel Serv Robotics 3:233–243 DOI 10.1007/s11370-010-0078-z

Bossu,J.;Gée Ch.;Jones,G.;Truchetet,F.(2009). Development of a machine vision system for a real time precisión sprayerComputers and electronics in agriculture.volume 65, issue 1.

Bossu J., Gee Ch., Truchetet F.,(2008).Development of a machine vision system for a real time precisión sprayer.Electronic Letters on Computer Vision and Image Analysis. 7(3):54-66,

Bossu J., Gee Ch., Truchetet F.,(2009). Wavelet transform to discriminate between crop and weed in perspective agronomic images. Computers and Electronics in Agriculture 6 5. 133–143

BurgosA. X.P., Ribeiro A. , Tellaeche A., , Gonzalo Pajares G. , Fernández-Quintanilla C.,(2010).Analysis of natural images processing for the extraction of agricultural elements .Image and Vision Computing 28 (2010) 138–149

Burgos A. P.X., Ribeiro A., Guijarro M., Pajares G.(2011).Real-time image processing for crop/weed discrimination in maize fields. Computers and Electronics in Agriculture 75 . 337–346

Bravo C., D. Moshou, R. Oberti, J. West, A. McCartney, L. Bodria, and H. Ramon.(2004). Foliar Disease Detection in the Field Using Optical Sensor Fusion. Agricultural Engineering International: the CIGR Journal of Scientific Research and Development. Manuscript FP 04 008. Vol. VI.

Bucksch A., James Burridge, Larry M. York, Abhiram Das, Eric Nord, Joshua S. Weitz, and Jonathan P. Lynch(2014). Image-Based High-Throughput Field Phenotyping of Crop Roots. Plant Physiology, October 2014, Vol. 166, pp. 470–486,

Bhange K.,Bhong A.Chattar A.(2016).Automated sugar cane node cutting machine via image processing.International Journal of advance Reserach in Science and Engineering.Vol No.5 Issue No.12.

Bressan, G.M., Koenigkan, L.V., Oliveira, V.A., Cruvinel, P.E., & Karam, D... (2006). Sistema de classificação fuzzy para o risco de infestação por plantas daninhas considerando a sua variabilidade espacial. Planta Daninha, 24(2), 359-364. https://dx.doi.org/10.1590/S0100-83582006000200004

Çakir E., et.al. (2016). Determination of in-row seed distribution uniformity using image processing. Turkish Journal of Agriculture and Forestry. 40: 874-881. Doi: 10.3906/tar-1604-110

Camargo,A., J.S. Smith(2009)Image pattern classification for the identification of disease causing agents in plants.Computers and Electronics in Agriculture.66 (2009) 121–125.

Camargo,A., J.S. Smith(2008)An image-processing based algorithm to automatically identify plant disease visual symptoms: B i o s y s t e m s engi n e e r i n g

Cruvinel, P. E.; Karam, D. (2010)Construção de mapas de aplicação em taxa variável de herbicida para cultura do milho (Zea mays L.) com base em visão computacional e ocupação de plantas invasoras de folhas largas. In: Congresso Brasileiro de Agricultura de Precisão.

Cruvinel, P. E. et al. (2004)Sistema computacional de baixo custo para reconhecimento da variabilidade de plantas daninhas baseado em imageamento estereoscópico. In: CONGRESSO BRASILEIRO DE AGRICULTURA DE PRECISÃO CONBAP, Piracicaba. Anais… Piracicaba: 2004. p. 1-14.

Casanova J.J.et.al(2014) Development of a Wireless Computer Vision Instrument to Detect Biotic Stress in Wheat. Sensors 14, 17753-17769; doi:10.3390/s140917753

Contreras M.L.M et.al(2012)Smart Sensor for Real-Time Quantification of Common Symptoms Present in Unhealthy Plants. Sensors 12, 784-805; doi: 10.3390/s120100784

CONAPO (2017) [Retrieved from]. http://www.conapo.gob.mx/es/CONAPO/Proyecciones_Datos

Chavez S.A.O.(2016)Reconocimiento Automático del tallo en cultivo de tomate en invernadero mediante visión por computadora.M.Sc Thesis .UACH.Texcoco.México.

Chaudhari S. I.; Pathare M.S., Hara S., Mule Y., Katti N. (2016) A Survey on Detection of Unhealthy Region of Plant Leaves by Using Image Processing .International Research Journal of Engineering and Technology (IRJET) Volume: 03 Issue: 09

Diago M.P.et.al.(2012) Grapevine Yield and Leaf Area Estimation Using Supervised Classification Methodology on RGB Images Taken under Field Conditions. Sensors 12, 16988-17006; doi: 10.3390/s121216988

Downey D, Giles D, Slaughter D. (2004). Weeds accurately mapped using DGPS and ground-based vision identification. Calif Agr 58(4):218-221. [Retrieved from]. https://doi.org/10.3733/ca.v058n04p218.

Espitia P.O., Gonzalez L.I.(2017)Clasificador de jitomate redondo aplicando técnicas de visión artificial y redes neuronales artificiales con mathlab y python.B.Sc.Thesis.UACH Texoco.México.

Gao Chi, GAO Hui (2013) Direction Identification System of Garlic Clove Based on Machine Vision.TELKOMNIKA, Vol. 11, No. 5, May 2013, pp. 2323 ~ 2329.

González D.J.K. (2005).Alternativa de visión artificial para aplicaciones en agricultura de precisión".Trabajo de Diploma. Universidad Central "Marta Abreu" de las Villas.Cuba.

González P. J. L. ; et.añ.(2013) Color image segmentation using perceptual spaces through applets for determining and preventing diseases in chili peppers.African Journal of Biotechnology Vol. 12(7), pp. 679-688, DOI: 10.5897/AJB12.1198

González E. J.M.et.al.(2016)Estudio y comparación de técnicas de segmentación por color para la estimación de la fracción de cobertura vegetal II simposio Nacional de Ingeniería Hortícola.Automatización y TICs En Agricultura.Alemería,España.

Gonzales e.J.M.et.al.(2015).Procesamiento automático de fotografías digitales para la obtención de las necesidades de riego de un cultivo hortícola.Anuario de jovenes Investigadores.Volumen 8.Spain

Gudiño, J. Gudiño-Bazaldúa, J. L. Rojas-Rentería, V. Rodríguez-Hernández and V.M. Castaño, "Color image segmentation using perceptual spaces through applets for determining and preventing diseases in chili peppers", African Journal of Biotechnology Vol. 12,no.7, pp. 679- 688, 2013.

Guerrero H.J.M.(2015). Sistema de visión para agricultura de precisión: identificación en tiempo real de líneas de cultivo y malas hierbas en campos de maíz .Ph.D. Thesis .Unversidad Complutense de Madrin.Spain

Graciano A.(2012) Utizacao na Agricultura da visao artificial online in https://es.slideshare.net/aandrade1234/aplicaes-de-viso-computacional-em-agricultura-de-preciso-grupo-2

Han L. ; Muhammad Salman Haleem ; Taylor M (2015)A novel computer vision-based approach to automatic detection and severity assessment of crop diseases. Science and Information Conference (SAI). DOI: 10.1109/SAI.2015.7237209

Halimatu S. A., Oba M. Z. (2017) Advances of image processing in Precision Agriculture: Using deep learning convolution neural network for soil nutrient classification. Journal of Multidisciplinary Engineering Science and Technology (JMEST) Vol. 4 Issue 8.

Hernández H. J.L.et al. (2016) Comparación de metodologías para el conteo de frutas, verduras y plantas en un cultivo agrícola usando visión artificial II Simposio Nacional de Ingeniería Hortícola. Automatización y TICs en agriculture. Almeria .España.

Huang Y. , H. J. Brand, R. Sui, S. J. Thomson, T. Furukawa, M. W. Ebelhar; 2016. Cotton Yield Estomation Using Very High-Resolution Digital Images Acquired With a Low-Cost Small Unmanded aerial vehicle. Vol. 59(6): 1563-1574 2016 American Society of Agricultural and Biological Engineers ISSN 2151-0032 DOI 10.13031/trans.59.11831

Hahn, F., Hernández, E., Echeverría, E. and Romanchick, E. 2006. Escherichia coli detection using thermal images. Canadian Biosystems Engineering/Le génie des biosystèmes au Canada 48: 4.7 - 4.13.

Jahari M.; , Yamamoto K. ;Miyamoto ,M; Kondo N.; Ogawa Y.; , Suzuki T.; , Habaragamuwa H.; Ahmad U.;2015.Double Lighting Machine Vision System to Monitor HarvestedPaddy Grain Quality during Head-Feeding Combine Harvester Operation. Machines 2015, 3, 352-363

Jiang L., B. Zhu, X. Cheng, Y. Luo, Y. Tao (2009)3D Surface Reconstruction and Analysis in Automated Apple Stem-End/Calyx Identification. Transactions of the ASABE Vol. 52(5): 1775-1784

Junior D.G.de S. et.al.(2007)Influência do solo na identificação de doses de nitrogênio em trigo utilizando classificadores multivariados com base em imagens digitais. Anais XIII Simpósio Brasileiro de Sensoriamento Remoto, Florianópolis, Brasil, INPE, p. 385-39

Júnior D.G.S., et.al.(2009) Discriminacao Entre Estágios Nutricionais na Cultura do Trigo com Técnicas de Visao Artificial e Medidor Portatil de Clorofila.Eng. Agríc. Jaboticabal, v.28, n.1, p.187-195.

Júnior, D. G. deS.,(2002) Sistema de visao artificial para identificacao deplantas de milho atacadas pela lagarta do cartucho (Spodoptera frugiperda) M.S.Thesis, Universidade Federal de Viçosa

Kapach K.:, Barnea E.; Mairon R;,. Edan Y. (2012) . Computer vision for fruit harvesting robots – state ofthe art and challenges ahead .Int. J. Computational Vision and Robotics, Vol. 3, Nos. ½

Komi J.P.(2008) Plant classification combining colour and spectral cameras for weed control purposes Ph.D.Thesis Loughborough University.Unit Kingdom.

Latha et.al.(2014) Image Processing in Agriculture. International Journal of Innovative Research in Electrical, Electronics,Instrumentation and Control Engineering .Vol. 2, Issue 6,

L. De Wet, E. Vranken, A. Chedad, J.M. Aerts, J. Ceunen & D. Berckmans (2003) Computer-assisted image analysis to quantify daily growth rates of broiler chickens, British Poultry Science, 44:4, 524-532, DOI: 10.1080/00071660310001616192

Li Xiaolong et.al.(2017)Development of automatic counting system for urediospores of wheat stripe rust based on image processing.September, 2017 Int J Agric & Biol Eng

Li N, Zhang C L, Chen Z W, Ma Z H, Sun Z, Yuan T, et al.(2015) Crop positioning for robotic intra-row weeding based on machine vision. Int J Agric & Biol Eng; 8(6): 20－29.

Li M., Imou K., Wakabayashi K., Yokoyama S.,(2009) Review of research on agricultural vehicle autonomous guidance Int J Agric & Biol Eng Open Access at http://www.ijabe.org Vol. 2 No.3 1

Liu Bin, Zhu Wenkui, Zhou Yaning, et al. (2015)Study on on-line detection of mildewed tobacco leaves based on machine vision and MSD descriptors [J]. Acta Tabacaria Sinica, 21 (2)

Liu Changqing, Chen Bingqi (2014) Method of image detection for ear of corn based on computer vision.Transactions of the Chinese Society of Agricultural Engineering Vol.30 No.6

Lopez R.J.I.(2017)Procesamiento digital de imagenes para la estimación de coeficiente KC y etapas fenológicas en Maíz.M,Sc.Thesis UACH.Edo De México.

Lottes P., M. Hoferlin, S. Sander, and C. Stachniss. Effective vision- ¨ based classification for separating sugar beets and weeds for precisión farming. Journal of Field Robotics, 2016.

Lottes, P., Khanna, R., Pfeifer, J., Siegwart, R. and Stachniss, C., 2017. Uav-based crop and weed classification for smart farming. In: Proc. of the IEEE Int. Conf. on Robotics & Automation (ICRA).

Martinez R.A.(2016).Sistema de procesamiento de imágenes RGB aéreas para agricultura de precisión B.Sc.Thesis.Universidad Central "Marta Abreu" de Las Villas.Cuba.

Martínez S. J.R.; Martínez R.M.E.; Ernesto Martínez S.E.; Miranda V.M.M.; Cervantes De Á.H. (2018). Color Analysis and Image Processing Applied in Agriculture, Colorimetry and Image Processing, Dr. Carlos Travieso-Gonzalez (Ed.), InTech, DOI: 10.5772/intechopen.71539.

Martínez C. E., Martínez R., Flores G.F., Castellanos G.C., Juárez A.R., López M.J.D. (2009) .FYTON ISSN 0031 9457, 78: 43-47 .Database development for alfalfa (Medicago sativa L.) characterization in an artificial vision system

Morten Stigaard L.M., Nyholm J.R., Skov M.H, Jensen K., Christiansen P.M., Mosgaard G.T., Krogh M.A., Kryger J.P.2016.Dicotyledon Weed Quantification Algorithm for Selective Herbicide Application in Maize Crops. Sensors. 16(11), 1848; doi: 10.3390/s16111848

Momin M.A., M.T. Rahman , M.S. Sultana , C. Igathinathane , A.T.M. Ziauddin , T.E. Grift (2017)Geometry-based mass grading of mango fruits using image processing . Information Processing in Agriculture 4 (2017) 150–160

Montalvo M.et.al.(2012) Automatic detection of crop rows in maize fields with high weeds pressure. Expert Systems with Applications, Volume 39, Issue 15, Pages 11889-11897

Moriya, E.A.S.(2015) Identificação de bandas espectrais para detecção de cultura de cana-de-açúcar sadia e doente utilizando câmara hiperespectral embarcada em VANT.Ph.D.Thesis.UNESP.Brazil.

Nakarmi A.D.(2013)Automated inter-plant spacing sensing of corn plant seedlings and quantification of laying hen behaviors using 3D computer vision.Ph.D.Thesis.Iowa State University.

Negrete J.C., (2015) Mechatronics in Mexican Agriculture Current Status and Perspectives .SSRG International Journal of Agriculture & Environmental Science (SSRG-IJAES) –volume 2 Issue 3

Negrete J.C., (2016) Automation of greenhouses in Mexico, current status and perspectives. Advance Research in Agriculture and Veterinary Science Volume 3(2)

Negrete J.C., (2017a), Precision Apiculture in Mexico, Current Status and Perspectives, International Journal of Recent Development in Engineering and Technology. Volume 6, Issue 1

Negrete J.C., (2017b), Mechatronics and Precision Livestock Farming in Mexican Animal Production, Animal Review Vol. 4, No. 1, pp. 1-7https://doi.org/10.18488/journal.ar.2017.41.1.7

Negrete J.C., (2017c), Precision agriculture in Mexico, current status, obstacles and strategies. International Journal of Horticulture, Vol.7, No.10, 75-81

Negrete J.C., Romantchik E.K., Lopez G.D.J.C., Zuñiga C.I.A., and Lopez G.H., (2018a)Arduino board in the automation of agriculture in Mexico, a review, International Journal of Horticulture, 8(6): 52-68 (doi: 10.5376/ijh.2018.08.0006

Negrete J.C., (2018b), Artificial Neural Networks in Mexican Agriculture,A Overview. International Journal of Research in Agriculture and ForestryVolume 5, Issue 7, 2018, PP 1-4

Orlando R.C.(2003)Sistemas de visao artificial para discriminacao entre plantas daninhas e milho.Ph.D.Thesis.Universidad Federal de Vicosa.Brazil.

Oppenheim,D.; Edan,Y.; Shani, G.;(2017).Detecting Tomato Flowers in Greenhouses Using Computer Vision. World Academy of Science, Engineering and Technology, Vol:11, No:1.

Pajares G.et.al.(2016) Machine-Vision Systems Selection for Agricultural Vehicles: A Guide. Journal Imaging , 2, 34;doi:10.3390/jimaging2040034

Pinto F.A.C.Sistemas de Visão Artificial [Retrieved from].

ftp://ftp.ufv.br/dea/Disciplinas/Extensao/Espanha_J_Moure/SVA_Frutas_facpinto.ppt.

Qureshi, W.S., Payne, A., Walsh, K.B. et al. Precision Agric (2017) 18: 224. DOI https://doi.org/10.1007/s1111

Rodrigues, V.C.(2006).Distrubucao espaciale bem-estar de aves podeiras em comdicoes de estrese e comforto térmico utilizando Visao Computacional e inteligencia Artifical.These M.Sc.ESALQ.Brazil.

Ramírez R., R., & Hahn-Schlam, F. F. (2013). Coconut palm climbing robot and associated system for coconut fruit detection (Cocos nucifera L.). , 5(1), 3 - 10. http://dx.doi.org/10.5154/r.inagbi.2013.04.001

S. Amraei, S. Abdanan Mehdizadeh & S. Salari (2017) Broiler weight estimation based on machine vision and artificial neural network, British Poultry Science, 58:2, 200-205, DOI: 10.1080/00071668.2016.1259530

Sahu D., Dewangan Ch.(2016).Identification and Classification of Mango Fruits Using Image Processing.International Journal of Scientific Research in Computer Science, Engineering and Information Technology

Salamanca G.A.(2016)Módulo de visión artificial para una aplicación de agricultura de precisión.B.Sc.Thesis.Escuela Colombiana De Ingeniería Julio Garavito.Colombia.

Santiago W.S.(2015) Identificacao de plantas Daninhas em Cana-deacucar por meio Processamento de imágenes.Ph.d.Thesis.Universidade Estadual de Campinas.Brazil

Santiago W.S.(2014) Digital image analysis to detect weeds in crops of sugarcane aiming at a localized treatment.American Society of Agricultural and Biological Engineers, St. Joseph.Paper number 141899586

Santos, A.P.O. (2009).Desenvolvimento de Descritores de Imagens para Recohecimento de Padroes de plantas invasoras (fohas largas e Folhas estreitas).M.Sc.Thesis UFSCar.Brazil.

Sahurkar s.,Chilke B. J. ,Bhirange P. D. (2017)A Review of Approaches for Estimation Chlorophyll and Nitrogen Contents Of Leaves Using Image Processing Technique.International Conference on Recent Trends in Engineering Science and Technology (ICRTEST 2017) ISSN: 2321-8169 .Volume: 5 Issue: 1(Special Issue 21-22 January 2017)

Salazar P., Ortiz,S., Hernández,T;, Velasco,N.;2016.Artificial Vision System Using Mobile Devices for Detection of Fusarium Fungus in Corn . Research in Computing Science 121.

Saldaña R.N.et.al (2016) Localization of garlic ápex by digital image analysis techniques Agrociencia, Volumen 50, Número 2.

Sahurkar S.,Chilke B.J. (2017)Estimation of Nitrogen and Chlorophyll Contents of Leaves Using SVM Chilke International Journal of Innovative Research in Computer and Communication Engineering.Vol. 5, Issue 7, July 2017 DOI: 10.15680/IJIRCCE.2017. 0507013 12978

Sathesh S.; S.Maheswaran(2015).Agricultural Harvest with Incarcerate Image Using Single Board Computer.International Journal of Advanced Research Trends in Engineering and Technology (IJARTET) Vol. II, Special Issue VIII.

Serrano, L. T..;, Bazán, J. V.C.; y López C.H.;(2015).Dron polinizador de cultivos. Detección de flores con algoritmos de visión artificial. Revista Mexicana de Ciencias Agrícolas, vol. 1, 2015, pp. 67-71

Serrano C.L. 2016 Retos y oportunidades de la agricultura en México: innovar o morir. [Retrieved from]. https://www.launion.com.mx/opinion/sin-embargo-se-mueve/noticias/87125-retos-y-oportunidades-de-la-agricultura-en-mexico-innovar-o-morir.html

Silva J. F. da, Moura H. N. de, Lima J. A. G. de, Brito A. V.,(2015)Identification of malformation in plantations through aerial images processing obtained by UAV. X Congreso Brasileiro de Agroinformática.Brazil.

Sivakumar N., Pushkarini Kulkarni, M. D. Nandeesh (2015) Automatic Recognition and Harvesting of Ripe Tomatoes under Greenhouse Conditions- A Survey. International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering Vol. 3, Issue 12.

Silwal, A., Davidson, J., Karkee, M., Mo, C., Zhang, Q., (2016). Design, Integration and Field Evaluation of a Robotic Apple Harvester. Journal of Field Robotics; Special issue on Agricultural Robotics

Sourabha P.S., K.Parvathi (2016) Simulink model for automaticdetection and counting of the number of White-flies onplants using image procesing.IJRET: International Journal of Research in Engineering and Technology.Volume: 05 Issue: 01

Solis S. L. O..et al.(2009) Machine vision algorithm for whiteflies (Bemisia tabaci Genn.) scouting under greenhouse environment Journal. Appl. Entomol. 133. 546–552

Shi Y, Wang X F, Zhang S W, Zhang C L. (2015) PNN based crop disease recognition with leaf image features and meteorological data. Int J Agric & Biol Eng; 8(4): 60－68.

Sritarapipat T., Rakwatin P., Kasetkasem T.,(2014)Automatic Rice Crop Height Measurement Using a Field Server and Digital Image Processing. Sensors 2014, 14, 900-926; doi: 10.3390/s140100900

Stein M.; Bargoti S.; Underwood J. (2016) Image Based Mango Fruit Detection, Localisation and Yield Estimation Using Multiple View Geometry. Sensors 16, 1915; doi: 10.3390/s16111915

Tellaeche A., Burgos A.X.P., Pajares G., Ribeiro A., Fernandez Q.C.,(2008.)A new vision-based approach to differential spraying in precision agriculture.Computers and Electronics in Agriculture 6 0 . 144–155

Tao Y., Lin J., Vinson R., Holmes M., Seibel G.(2017)Machine Vision-Guided Food Processing Automation.Chemical Engineering Transactions Vol. 57

Tamboli A.A.et.al.(2017)Design and Fabrication of Automated Sugarcane Node Cutting.International Engineering Research Journal (IERJ), Volume 2 Issue 9 Page 3802-3805

Upadhyay A. J., P. V. Ingole(2014) Automatic Monitoring of Pest Insects Traps Using Image Processing .TELKOMNIKA Indonesian Journal of Electrical Engineering Vol. 12, No. 8, August 2014, pp. 5779 ~ 5783 DOI: 10.11591/telkomnika.v12i8.6272

Velasquez N.L.et.al.(2011) Detection of Powdery Mildew Disease on Rose Using Image Processing with Oen CV.Revista Chapingo Serie Horticultura 17(2):151-160.

Villareal H., Ch.; López Ch.H.; Castellanos S.L.T.; López F.E. ;.(2015) "Dron polinizador de cultivos. Tecnologías aplicadas para alternativas sustentables". Revista Mexicana de Ciencias Agrícolas, vol. 1, pp. 67-71.

Wang M., Wei J., Yuan J., Xu, K.2008.A Research for Intelligent Cotton Picking Robot Based on Machine Vision. Proceedings of the 2008 IEEE International Conference on Information and Automation June 20 -23, Zhangjiajie, China

Wan Ishak, W.I., Hazlina H. and Awal M.A.(2008) Development of a Camera-Vision Guided Automatic Sprayer Pertanika J. Sci. & Technol. 16 (2): 97 – 105

Wang Qi (2009) Autonomous Machine Vision for Off-Road Vehicles in Unstructured Fields .Ph.D.Dissertation.University of Illinois at Urbana-Champaign.USA.

Wang et.al (2013) Estimating nitrogen status of rice using the image segmentation of G-R thresholding method. Field Crops Research 149. 33–39

Yamamoto K., Guo W., Ninomiya S. (2016) Node Detection and Internode Length Estimation of Tomato Seedlings Based on Image Analysis and Machine Learning. Sensors 16, 1044; doi: 10.3390/s16071044

Yano H.I.; Oliveros Mesa O.N.F.; Santiago W.E. ; Aguiar R.H.; Teruel R.(2017)Weed Identification in Sugarcane Plantation Through Images Taken from Remotely Piloted Aircraft (RPA) and kNN Classifier. Journal of Food and Nutrition Sciences. Vol. 5, No. 6, pp. 211-216. Doi: 10.11648/j.jfns.20170506.11