

Lemon Leaf Fungal Disease Grading Using Image Segmentation Based On Pixel Intensity Transformation In Android Smartphone Platform: A Novelty And Review

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Abstract: Leaf diseases are a major threat to food security, which will lead to productivity loss, economic loss, quality loss, quantity loss, crops loss and famine. Prediction of Leaf disease stage is difficult in many parts of the world due to the lack of technology. There are very minimal number of technologies developed which will aid farmers across the world. Especially lemon plants are mostly effected by fungal diseases Human received basket of benefits from Lemon because it is used as medicine for variety of illness. So increasing lemon harvesting will be more useful for the healthy society. Therefore, this paper demonstrates a new method which will identify the stages of lemon leaf diseases using image processing segmentation techniques. Due to the wide usage of smart phones and its popularity, research work was implemented in android technology. And the paper elaborately explains about related works, penetration of android technology in the agriculture, comparison between the existing system and developed system, Finally result were compared with the developed system and found the developed system was successful.

Index Terms: Image Processing, Leaf disease, Smart phone, Android

1 Introduction

ALL over the era humans are living by the food that is harvested by the farmers. "Without farmers, there is no food and no livings things". Image processing with android technology will bring a new phenomenon and turning point in the research field because both techniques are vigorously growing in the research world. Research based on these techniques will be a boon for the farmers who are the backbone of the human society. During the last decade, mobile application development has gone through a massive growth. According to the statistics in 2015, there are 1.4 billion active android devices across the world. Mobile phones are even used by many farmers widely for communication purpose. Hence this paper focuses on grading of the leaf disease using smart phones which will be helpful for the farmers. This could advice farmers to spray limited pesticides and thereby reducing the crop loss. This is implemented by using the following two techniques such as 1. Image processing –which is the analysis and manipulation of a digitized image, especially in order to improve its quality. [Rafael C Gonzalez, 2009]. 2. Android technology - which is the set of processes and procedures involved in writing software for small, wireless computing devices such as smart phones or tablets [Moumtzoglou, Anastasius, 2014]. This paper is organized into seven sections. Section II discusses the related work carried out in the android platform. Section III explains about the usage of android smart phones in the agriculture area. Section IV describes the necessity of the leaf disease grading. Section V compares the existing mobile applications available for leaf disease grading with the proposed technique.

Section VII illustrates the proposed method for development and the final section summarizes the overall contribution for this paper.

2 RELATED WORKS

Gaurav Thakre et al, have proposed colors transform and Non-Contextual Thresholding to detect the leaf disease in android mobiles. Sachin D.Khirade et al (2015), used image processing techniques such as neural network, back propagation and support vector machine to detect the diseases in plant leaves. This tends to be more attentive in disease detection process because most of the disease symptoms can be observed in the leaves of an agricultural crop. Kurniawati et al. (2009), proposed a technique for paddy plants which will classify the different types of diseases using threshold and segmentation for segmenting the healthy and diseased area. The authors used two types of threshold techniques which are Otsu's and local entropy. Manisha Bhangea et.al, have proposed k-means algorithm to categorize the healthy fruit and the bacterial blight disease on pomegranate fruit in android platform. Megha.S et al, have proposed FCM-Clustering Technique for detecting and classifying the diseases in plant leaves but not in mobile platform. Rastogi et al suggested using artificial neural network for agricultural plant leaf disease recognition and classification. Vijay Singh et al (2015), proposed a method using genetic algorithm in image processing to detect the unhealthy area of plant leaves. Vijay Singh et al proofed that segmentation using genetic algorithm requires very less effort to detect the diseased part in leaves and this approach provides benefits to raise the accuracy of recognition rate in classification process after performing all the experiments in MATLAB. In 2009, Samantha Patricia Bail has proposed the issues of recognizing an emergency exit signs with a mobile device by using Image processing techniques such as edge detection, rectangular detection, and line detection. It was developed by IDE Carbide c++ for Symbian mobiles and it can run on Mac OX [Samantha Patricia Bail,2009]. Henryk identified an effective method for extending monochrome barcodes to color by using Color interference cancellation

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Image Processing algorithm for mobile device. [Henryk Blasinski, 2013] Himanshu Borse et al., found a robotic application that tracks the moving object by using a mobile robot with sensors and image processing. The robotic platform uses a visual camera to sense the movement of the desired object and a range sensor which helps the robot to detect and then to avoid the obstacles in real time while continuing to detect and follow the desired object [Himanshu Borse, Amol Dumbare, Rohit Gaikwad & Nikhil Lende, 2012] Anand Joshiy et al., implemented two applications called PocketPal and PocketReader for Optical character recognition based on OCRdroid on HTC Android G1 mobile phone [Anand Joshiy, Mi Zhangx, Ritesh Kadmawalay, Karthik Dantuy, Sameera Poduriy, Gaurav S. Sukhatme]. Yu-Doo Kim et al., finds an optimum threshold value for image detection in mobile applications using the ORB algorithm [Yu-Doo Kim et al., 2014]. The existing mobile applications with the image processing techniques are useful to the users so it can be concluded that the integration of image processing and mobile application will provide an immense uses to the researchers. Also, the proposed research of leaf disease grading will be more useful to the farmers with the integration of image processing and android mobile application development.

3 PENETRATION OF SMARTPHONES IN AGRICULTURE

This section explains the popularity of smartphones in worldwide and also helps to choose the popular operating system for leaf disease grading. Figure 1, shows the approximate number of smartphone users worldwide from 2014 to 2020. The number of smartphone consumers is estimated to reach 2.6 billion by 2019. And is also predicted that this will be further increased to around 2.8 billion in 2020, which clearly depicts the smartphone penetration growing rate. In the total world population, 36% of people are projected to use smartphone in the year of 2018 which was 11% in 2011. The statistics also reveals that if the research development uses smart phones which are widely used by the people in developing new technologies, then promisingly it will bring a transformation in agriculture field too. Statistics in Fig. 2, shows the global mobile operating system market share, in terms of sales to an end users, from 2009 to 2017. In the first quarter of 2017, 86.1% of the smartphones sold to the end users were using the android operating system. While comparing to iOS, android has the greatest position among the users; 72.4% of extra users are available for Android when compared to iOS. This section explains the various number of reasons to choose the android platform for developing the proposed system.

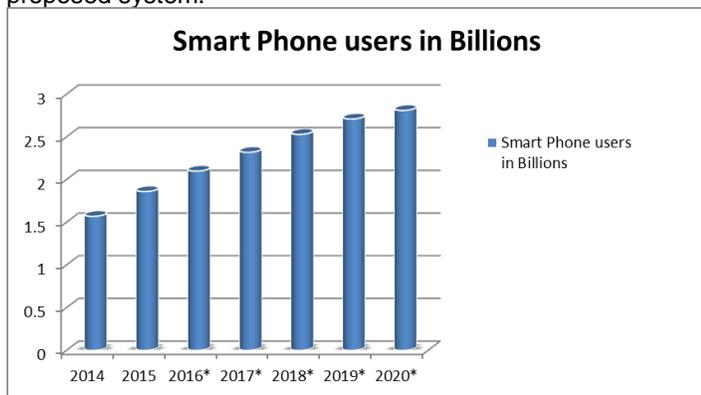


Figure 1. Worldwide smartphone users [http://www.statista.com/, 01/2018]

Android operating system is one of the most widely used operating system based on the Linux kernel and is developed by Google in 2005. The user acceptance of Android was very low, when it was launched in 2007. But android technology has risen enormously due to Google's effort and involvement. Android OS was developed for numerous purposes such as for smart phones, tablets, computer, android TV, android auto for cars, android wrist watches etc. Android is an open source mobile operating system which includes immense users and mobile application developers. The android OS is a good platform to grade the leaf disease due to its plenty of modern real world application to use it conveniently. Therefore this paper is focuses on smart phone application development for grading the leaf diseases. Below section reveals the step by step penetration of smart phones user in the field of agriculture.

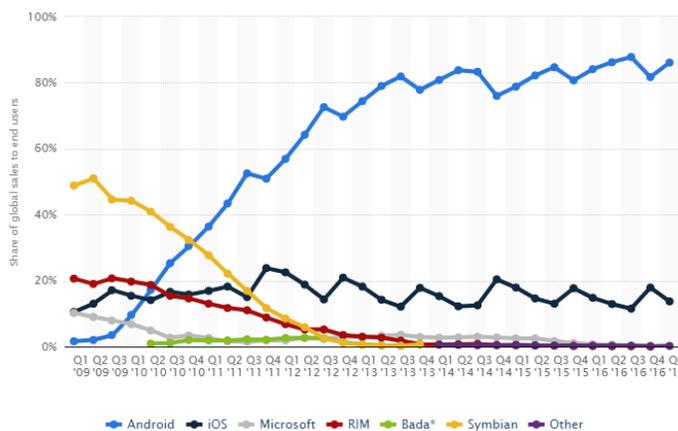


Figure 2. Worldwide various operating system users (http://www.statista.com/, 07/2017)

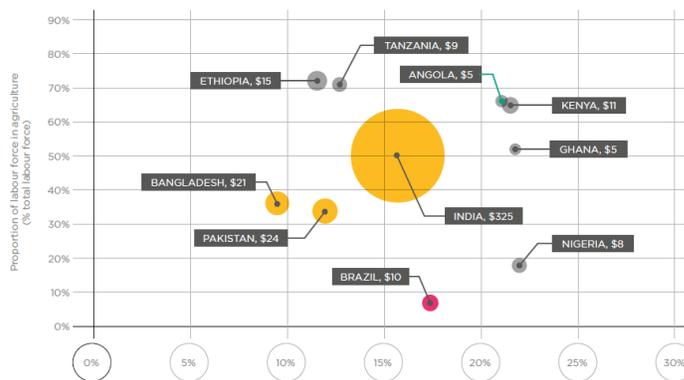


Figure 3. Worldwide mobile usage for agriculture [gsma.com, visited 08/2017]

Fig. 3, statistics demonstrates that android technology is having bright future and also confirms that the challenges in android development are not shrinking the android development and its usage. Android mobile users are increasing day by day which is indicating that android applications are more convenient and flexible for the users. Based on the statistics and analysis, this section reveals that the android is a good platform for the proposed system development which will be liked by the farmers and it also highlighted the percentage of world wide mobile application users in agriculture field.

4 NECESSITY OF THE LEAF DISEASE GRADING

India is an agricultural country and 70% of its population depends on the agriculture. If the farmers are able to find the disease and the solution at an earlier stage, this could avoid many economic losses. Leaf diseases will bring Productivity loss, Economic loss, Quality loss, Quantity loss, Crops loss and Sickness. Therefore, a new technology is needed for the leaf disease grading to reduce the disease, spraying limited

pesticides and also to increase the crops and production.

5 EXISTING SYSTEM FOR LEMON LEAF DISEASE

Leaf disease will affect the crops and it will also bring loss of production, quality, quantity and economy. opinion to overcome the threats of leaf disease in an easy way.

TABLE 1
COMPARISON OF LEAF DISEASE GRADING MOBILE APPLICATIONS

Tools	Plantix	Agrio	Leaf Doctor	Pestoz	CropAI
Developed by	RobertStrey, Progressive Environmental and Agriculture Technologies, Germany	Saillog Limited, Isreal	Adelante Consulting, Hawai	Agro connect India, Hyderabad	Spacenus GmbH
Released on	June 2015	June 2017	December 2017	May 2017	June 2017
Language	English, German, French, Hindi, Portugues, Hindi, Arabia, Malayalam	English, Tamil, Spanish, French, Hindi, Portugues, Russian, Chinese, Arabia, Greek, Vietnamese	English	English, Tamil, Malayalam, Hindi,	English
Uses	Diagnose plant disease, pests and nutrient deficiencies affecting the crops	Identify the leaf disease and pests	To measure the percentage of tissue are diseased	Identify the plant disease	Leaf Disease identification and leaf diseases detection. Corn, Wheat, Tomato, Soy Beans, Rice
Used Technology	Artificial Intelligence	Computer Vision with AI	Color image processing and AI	Computer Vision Techniques	Artificial Intelligence
Features	Instant feedback from experts, Temperature monitor and regional weather.	Image will store in cloud for expert verification	Detection by using thresholding	Number of plants can be used.	Used for only real time images
Requires internet connections?	Yes	Yes	No	Yes	Yes
Requires upload multiple images?	No	Yes	No	Yes	No
Experts Needed	Yes	Yes	No	Yes	No
Limitations	High Speed Internet requires	It can classify only clear images	Black background is required	Result assumption is	User contribution required

Table. 1 explains some of the existing methods which was initiated and instituted for leaf disease grading by using different environment and different mobile platform. And the table concludes that most of the existing applications require internet connection and experts opinion. It is not an automatic disease grading application since it needs advices from experts. So there is need of an automatic mobile application without a need of expert's suggestion and opinion to overcome the threats of leaf disease in an easy way.

6 METHODOLOGY

The developed system will be developed in an Android studio. The correct API level must be set before starting the development of the mobile application or else the application may not support for all android smart phones. The virtualization technology is required to run the android application in the computer and the virtual device creation should be done in android studio.

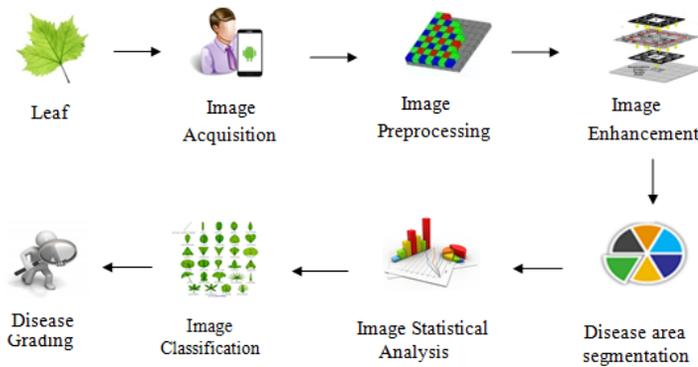


Figure 4. Architecture of Developed System

And also, essential software development kit should be installed in the android studio. Figure 4 illustrates the framework of the proposed system to segment leaf disease and to grade the disease leaf disease which is acquired by smart phones. The developed algorithm is shown in table 2. The developed system were done the pixel intensity transformation and image segmentation done based on the pixel intensity transformation. The developed system has four sections: 1. Lemon leaf upload 2. Disease area detection 3. Disease stage detection and 4. Exit . The designing of the developed system is very friendly to the user so farmers can easily use the system and it will serve for the farmer's life and it will be a countless benefit to the farmers for making their life easy by detecting the Lemon leaf disease stage. Spraying unlimited pesticides leads to crop loss and it is not good for human health. So the developed system used to spray limited pesticides to increase the crops. Figure 5 shows the result of the developed system which indicates the diseased area and the stages of the disease.

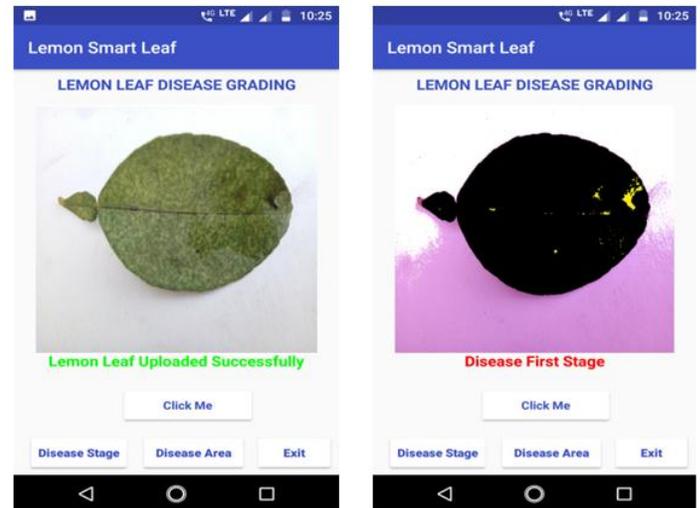


Figure 5. Sample result of disease grading system

7 RESULT COMPARISON WITH EXISTING SYSTEM

Totally 170 lemon leaf were used to test the developed system. Table 3 shows the comparison result of the existing system versus existing systems. Fig. 6 shows the graphical representation of the developed system versus existing system.

TABLE 2
DEVELOPED ALGORITHM

Step 1: Image Acquisition is a process to acquire the digital image by the android mobile phone. Diseased leaf image have to be captured by the mobile phones. The following android code is used to capture the image and to display it on the mobile screen. `Bitmap bitmap = MediaStore.Images.Media.getBitmap (getContentResolver (), uri);`

Step 2: The pre-processing technique removes the incomplete, noisy and an inconsistent pixel from the diseased image. Images sharpen can also be done in this step to improve the image quality for the next step.

Step 3: Image Enhancement - To improve the pre-processed visual appearance of the leaf image, enhancement techniques will be used such as Blur mask filter, Shading filter, Saturation filter, Hue filter, Gaussian filter in the android platform. The android code for the filter is `Bitmap bitmap = ImageFilter.applyFilter(f, Image Filter. Filter. Filter Name);`

Step 4: After the Image enhancement process, Image Segmentation will be done for the disease area identification.

Step 5: In next step, standard deviation will be calculated to identify the diseased stage from the segmented image.

Step 6: Image classification will be done based on the values of the Standard deviation to identify the stage of the disease.

TABLE 3
RESULT OF EXISTING SYSTEM VERSUS DEVELOPED SYSTEM

Tools	Non-Diseased of Lemon Leaf Images	Correct Result	Incorrect Result	Correct result percentage	Incorrect result percentage
Agrio	170	133	37	78.24 %	21.76%
Leaf Doctor	170	22	148	73.57 %	73.57 %
Plantix	170	116	54	68.24 %	31.26 %
LLDGS	170	157	13	92.35%	7.65%

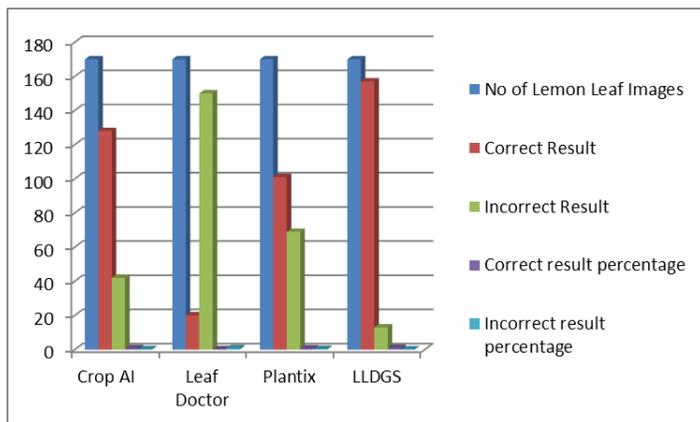


Figure 6. Leaf Doctor, Plantix, Agrio and Developed System Result Comparison

8 CONCLUSION

This paper reveals that the leaf disease grading in smart phone is useful for the farmers to overcome the economic failures and it also reduces the task and error. The below discussions, reviews and comparison of the existing methods, denotes the requirement of the newer technologies for leaf disease grading. The developed system will be a user friendly and an automated system for the farmers who are the backbone of our society. Finally this paper explains that the existing methods are not flexible to help the farmers and so there is a need of a new system. Since the new research work was done and compared with the existing system. The developed system found successful and provide better result than the existing system to grade the lemon leaf fungal disease to increase harvesting.

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