Grenze International Journal of Engineering and Technology, Jan Issue

Image Processing based System for Leaves Disease Diagnosis

K.Balamurugan[1], S.Dinesh[2], G.Guhan[3] and S.Hareesh[4]
[1]Assistant Professor KPR Institute of Engineering and Technology/EEE, Arasur, Coimbatore, India
Email: balamurugan.k@kpriet.ac.in
[2-4]UG Scholar KPR Institute of Engineering and Technology/EEE, Arasur, Coimbatore, India
Email: guhan.gp13@gmail.com

***Abstract*—India is a land of agriculture, with agriculture supporting three-quarters of the population. Farmers can plant a variety of crops in their fields depending on the environment and other resources available. However, some technical skills as well as technological support are needed to achieve a high yield and good quality. This is one of the reasons why disease detection in plants is critical in the agricultural sector, as disease in plants is a normal occurrence. If careful care is not taken in this environment, it can have serious consequences for plants, affecting product quality, quantity, and productivity. It is advantageous to detect plant disease using an automated technique, It eliminates a lot of monitoring work in large farms of crops, and it identifies plant diseases early on and sprays the appropriate fertilizer on the leaves.**

***Index Terms*— Agriculture, Image processing, Plant disease detection, Conventional neural network, Diagnosis, Motor driver module.**

I. Introduction

Agriculture is a major source of revenue. Farmer's revenue source. Plants can be grown in a number of ways by farmers, but plant development is hampered by diseases. One of the most important factors is Infection is the primary cause of plant illness. Plant productivity could be reduced by 10% to 95% as a result of the attack. Agriculture is the most important and well-known economic activity on the planet. Until the industrial revolution, agriculture was the sole source of income for the vast majority of the world's population. However India's agriculture is undergoing a structural change that is causing a crisis. Pest attacks on crops are one of the most important problems that have arisen in the agricultural sector. For increased production, proper crop disease evaluation and diagnosis in the field is important. Currently, there are many methods for eradicating plant diseases, including manual removal of infected seeds, mechanical planting, and the use of various pesticides. Using a microscope to identify diseases in plants is a simple procedure. However, this form of manually detecting takes a long time and a lot of effort to cure diseases. Recognition of Plants and Infected Plants through Digital Image Processing and Machine Learning Approaches to Monitor Disease Development on Plants. Using Pesticides in the Appropriate Amount to Avoid Overuse of Pesticide An automated pesticide sprayer is used in this project to apply the pesticide to a particular region of the affected crops. Even if the fluid properties and conditions change, this will provide accurate and consistent fluid flow. The style is suitable for use with a pesticide sprayer. Image analysis can be used to diagnose insect diseases effectively. In addition, different leaf classification and segmentation methods have been continuously monitored.

Grenze ID: 01.GIJET.7.1.626_1

II. Literature Survey

[1] F Ahmed in 2012, stated that one of the serious challenges in most agricultural practices is reducing the occurrence of Unwanted Crops. In most cases, removing unwanted plants from agricultural fields includes the use of chemical herbicides, which may result in high productivity but have negative implications for the environment and human health. The ability to locate and identify plants or unnecessary crops in digital images may contribute to the creation of self-driving vision-guided agricultural machinery that can apply herbicides to specific sites.

[2] S Arivazhagan et al., established a texture-based algorithm for detecting abnormal plant leaf regions and recognising disease. There are three steps to the algorithm. The picture, which is initially in the RGB colour space format, is first given a colour transformation structure. After that, the pixel values within the design are masked, and form and texture features have been extracted. Finally, the infection is identified using a SVM Classifier model with the Distance Measure Criterion.

[3] V. A. Gulhane et al., to extract colour and spot feature from its leaf images, he used a self-organizing feature map in conjunction with BP-NN. Cotton leaves were examined using this technique to detect and diagnose diseases.

[4] Gavhale and Gawanade, paper reviews and summarises image processing methods for identifying plant diseases in a number of plant species. Back propagation neural networks (BPNNs), Support Vector Machines (SVMs), K-nearest neighbour (KNNs), and Spatial Gray-level Dependence Matrices (SGDM) are the most common techniques for detecting plant diseases. These methods are used to evaluate the leaves of both normal and infected plants.

[5] P. Revathi et al., to detect cotton leaf spot disease, researchers devised a complicated algorithm. The algorithms use two feature selection methods the Particle Swarm Optimization (PSO) method, which uses skew divergence for edge extraction, and the Genetic Algorithm (GA) method, which is based on colour and texture variances. Within the Cyan-Magenta-Yellow Black (CMYK) colour space, both approaches are used. The extracted features are then used to identify the data using an SVM BP-NN.

III. Methodology

A. Block Diagram

A Raspberry Pi microcontroller is used here. This can be operated by a USB cable and also an external 9-volt battery, with variation exists from 7 to 20 volts. The microcontroller will be attached to a camera. The picture will be shot using a camera at first. The picture would then be sent to the microcontroller.

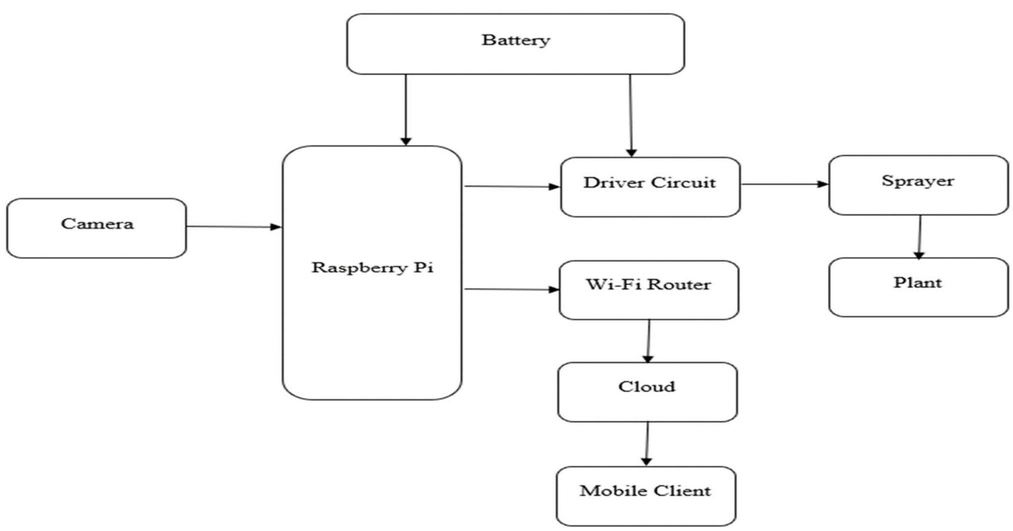


Figure 1. Proposed Model Block Diagram

The Data set is where we presented Reference Images of Stable, Unhealthy, and Partially Affected Plants. Power will be supplied from battery to Raspberry Pi and to Driver Circuit. The image that was captured would be compared to a reference image. If the processed and reference photos are the same, the plant is called

“HEALTHY,” and it will send information to the control person's mobile device app. In that app it will indicates whether the plant is healthy or unhealthy. The Raspberry Pi will have an integrated Wi-Fi router and will be cloud-connected. In the Mobile app, we can get more information from there. Monitor would be more useful for tracking plants in the agricultural sector. If there are any differences between the captured image and the reference image centered on leaves, the sprayer's motor driver circuits are enabled, and the sprayer begins to spray. In the mobile app it will show as “UNHEALTHY”.

B. Working

The picture will be shot using a camera at first. For the purpose of image capture, we are using a 720P camera. Following that, the image captured by the camera will be sent to the microcontroller. The Data set is where we presented Reference Images of Healthy, Unhealthy, and Partially Affected Plants. The image that was captured will be compared to reference images. If the processed and reference photos are identical, the plant will appear as “HEALTHY” in the mobile app, and the sprayer will be turned off. The Raspberry Pi 3 will come with an inbuilt Wi-Fi router that will connect to mobile Wi-Fi. The details about the plant will be saved in a cloud-based system. We can retrieve information about the plant, such as whether it is healthy or unhealthy, sprayer motions, and captured photos, from there. Power will be supplied from battery to Raspberry Pi and to Driver Circuit.

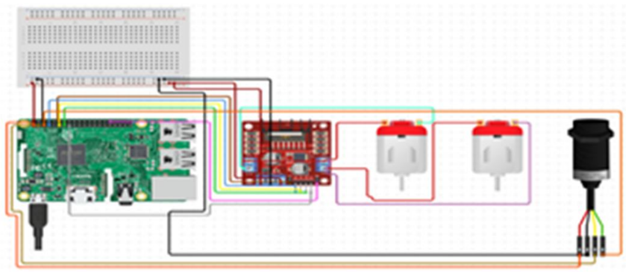


Figure 2. Circuit Diagram of Proposed System

These data are presented in a mobile app that we can easily track. It will make our job easier. If there is any differences between the captured image and the reference image based on leaves, the plant will be marked as “UNHEALTHY” in the mobile app, and the sprayer will be enabled. We will have the specifics of the plant in the mobile app, whether it is healthy or unhealthy, on the basis of cloud-based technology. The sprayer will activate based on the percentage of leaves that are affected. If the sprayer captures 30 percent of the slightly affected plant leaf, the motor driver circuit will turn on for twice times and sprayer can spray twice times. If the captured image of the plant leaf is affected by 50%, the motor driver module will turn on for thrice times and the sprayer will spray three times.

Figure 3. Healthy Plant

Figure 4. Partially Affected Plant

Figure 5. Unhealthy plant

C. *Camera*

A camera is a system used to capture images (photographs). A camera is an optical system that takes images. It produces an image of something using film or electronics. It's a photography tool. The Pi camera module is a lightweight, light camera that works with the Raspberry Pi. The MIPI camera serial interface protocol is used to communicate with the Pi. It's typically used in image processing, machine learning, or surveillance projects, and it can capture both high-definition video and still images. Various mechanisms exist in cameras to monitor how light falls onto the light-sensitive surface. It has video modes of 1080p30, 720p60, and VGA90, as well as still capture. It connects to the Raspberry Pi's CSI connector via a 15cm ribbon cable.

D. Raspberry pi

RASPBERRY PI 3 is a PI series development kit. It can be known as a single-board machine that runs on the LINUX operating system. The board not only has a lot of features, but it also has a fast processor, making it ideal for advanced applications. The Raspberry Pi 3 has GPIO (General Purpose Input Output) pins, which are required for connecting to other electronic equipment. These inputs and outputs pins receive commands and operate according to the device 3s programming. The Raspberry Pi 3s hard drive is an SD card inserted into a slot on the board. The video output can be connected to a traditional RCA TV display, a more modern monitor, or even a TV via the HDMI port, and it is powered by USB. These inputs and outputs pins receive commands and operate according to the device programming. The Raspberry Pi 3s hard drive is an SD card inserted into a slot on the board. The video output can be connected to a traditional RCA TV display, a more modern monitor, or even a TV via the HDMI port, and it is powered by USB.

E. Motor Driver Module

L-298 is an Integrated Circuit (IC) available in two form of packages now a days which will be provided later. The L-298 is a dual complete bridge driver that can handle both high voltage and high current. It accepts simple TTL (Transistor Transistor Logic) logic levels and can control a variety of loads including DC motors, stepper motors, and relays. The L-298 has two enable inputs that can be used to enable or disable any computer. The L-298 IC is widely used in motor drivers and controllers. Any microcontroller, such as an Arduino, PIC, or Raspberry Pi, can power these motor controllers. They take input from microcontrollers and use it to regulate the load connected to their output terminals.

F. *Battery*

Primary carbon-zinc and alkaline chemistry, primary lithium iron disulphide, and rechargeable nickel-cadmium, nickel-metal hydride, and lithium-ion batteries both are common nine-volt battery varieties. On one end of the battery, all connectors are connected by a snap connector. The positive contact is the smaller circular (male) terminal, and the negative contact is the larger hexagonal or octagonal (female) terminal. The battery's connectors are similar to those on the load device; the smaller one connects to the larger one, and vice versa. Other battery types in the Power Pack (P) are using the same snap-style connector. Although mechanical connection is usually only possible in one configuration, battery polarized is usually obvious. One problems with this kind of connector is that it is very easy to short circuit two batteries, which instantly discharges all batteries, triggering heat and potentially a fire. Nine-volt batteries should be kept in their original packaging once they're no longer a hazard.

IV. HARDWARE RESULT

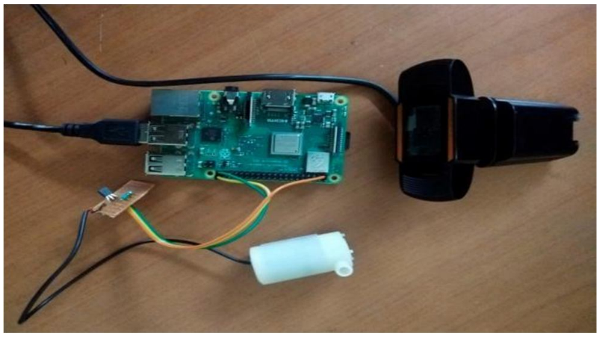
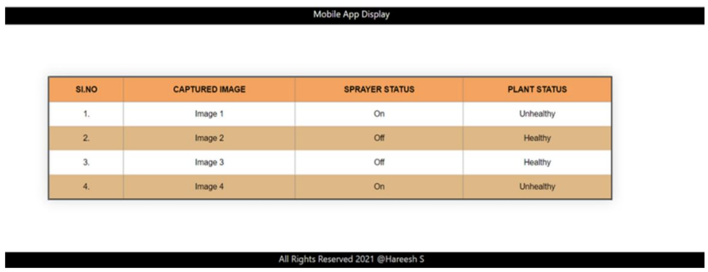


Figure 6. Hardware of Proposed System

The Figure 6 shows the hardware of proposed system. In this we used Raspberry Pi as a microcontroller which is interfaced with camera, controls motor driver circuit. Through motor driver circuit we could control the flow of sprayer.

V. Simulation Result

Proteus software is used to design the device. A camera will be connected to Raspberry pi. There the captured image will be compared with reference images. If there is any difference between captured images and reference images so that raspberry will identify the plant as unhealthy plant. The Raspberry pi will send a high signal to motor driver module such that driver circuit gets turned on then sprayer will start sprays. If the captured images and reference images are same then the Raspberry pi will identify the plant is healthy. These values will be monitored by a Mobile app.



SI.NO	CAPTURED IMAGE	SPRAYER STATUS	PLANT STATUS
1.	Image 1	On	Unhealthy
2.	Image 2	Off	Healthy
3.	Image 3	Off	Healthy
4.	Image 4	On	Unhealthy

Figure 7. Mobile App

From these app we can monitor the plants whether it is either Healthy or Unhealthy which leads to increase agricultural productivity. Here we will store the details of images of plant, sprayer movements, plant status in the cloud. From there we can retrieve the details of it. In the mobile app we can display these details in prescribed manner such that we can monitor easily. It will be very useful for the monitor to monitor. This system that can reduce efforts and use of pesticides. We will connect the mobile's Wi-Fi through raspberry pi inbuild Wi-Fi router so that we could store the details of plants. From these app we can identify the disease of plant.

TABLE I: LEAVES DISEASE MONITORING

S.No	Captured Image	Plant Status
1.	Image 1	Healthy (3)
2.	Image 2	Unhealthy (1)
3.	Image 3	Partially Affected (2)
4.	Image 4	Healthy (3)

Figure 8 shows that graphical representation of leaves disease monitoring system. Here the table shows that plant statuses in healthy means its value will be 3. If unhealthy means its value will be 1. In case plant status is partially affected means its value will be 2.

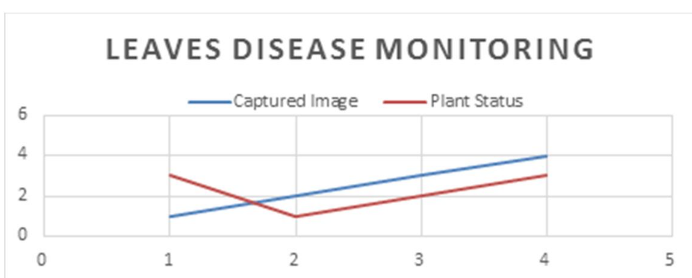


Figure8. Leaves Disease Monitoring

VI. Abbreviation

RGB – Red Green Blue
SVM – Support Vector Machine

USB – Universal Serial Bus
Wi-Fi – Wireless Fidelity
HDMI – High-Definition Multimedia Interface
MIPI – Mobile Industry Processor Interface
TTL – Transistor Transistor Logic
IC – Integrated Circuit
PIC – Peripheral Interface Controller
App – Application
CNN – Conventional Neural Network
BPNN – Back Propagation Neural Network
KNN – K-Nearest Neighbours
SGDM – Spatial Gray-level Dependence Matrices
PSO – Particle Swarm Optimization
GA – Genetic Algorithm
CMYK – Cyan Magenta Yellow Black
GPIO – General Purpose Input Output
RCA – Root Cause Analysis
TV – Television
DC – Direct Current
SD – Secure Digital card
PI – Python Interpreter

VII. Conclusion

We were able to diagnose disease-affected leaves by spraying pesticides in this paper using image processing method and a conventional neural network (CNN). The controller is quicker and smarter at detecting diseased leaves in this work. This prevents both the plants quality and quantity from increasing. This work also ensures the development of a mobile app that can be used by the monitor by using cloud-based technology. This work could be modified to include a stepper motor for shifting purposes to speed up the process. If one plant's leaf is not affected, it can use robotic methods to switch to another plant. As a result, machine performance will prove. We used an image recording or processing device to track the plants by matching the captured images with the photographs of the corresponding leaves, such as partially affected plants, healthy plants, unhealthy plants, and so on. This helps to keep the plants under control.

Reference

[1] Mohanty, Sharada P., David P. Hughes, and Marcel Salathé. "Using deep learning for image-based plant disease detection." *Frontiers in plant science* 7 (2016): 1419.
[2] Arivazhagan, Sai, R. Newlin Shebiah, S. Ananthi, and S. Vishnu Varthini. "Detection of unhealthy region of plant leaves and classification of plant leaf diseases using texture features." *Agricultural Engineering International: CIGR Journal* 15, no. 1 (2013): 211-217.
[3] Gulhane, Viraj A., and Ajay A. Gurjar. "Detection of diseases on cotton leaves and its possible diagnosis." *International Journal of Image Processing (IJIP)* 5, no. 5 (2011): 590-598.
[4] Gavhale, Kiran R., and Ujwalla Gawande. "An overview of the research on plant leaves disease detection using image processing techniques." *IOSR Journal of Computer Engineering (IOSR-JCE)* 16, no. 1 (2014): 10-16.
[5] Revathi, P., R. Revathi, and M. Hemalatha. "Comparative study of knowledge in Crop diseases using Machine Learning Techniques." *Inter-national Journal of Computer Science and Information Technologies (IJCSIT)* 2, no. 5 (2011): 2180-2182.
[6] Al Bashish, Dheeb, Malik Braik, and Sulieman Bani-Ahmad. "A framework for detection and classification of plant leaf and stem diseases." In *2010 international conference on signal and image processing*, pp. 113-118. IEEE, 2010.
[7] Dhakate, Mrunmayee, and A. B. Ingole. "Diagnosis of pomegranate plant diseases using neural network." In *2015 fifth national conference on computer vision, pattern recognition, image processing and graphics (NCVPRIPG)*, pp. 1-4. IEEE, 2015.
[8] Anthonys, G., and N. Wickramarachchi. "An image recognition system for crop disease identification of paddy fields in Sri Lanka." In *2009 International Conference on Industrial and Information Systems (ICIIS)*, pp. 403-407. IEEE, 2009.
[9] Deepak, K., and A. N. Vinoth. "Leaf detection application for android operating system." In *2014 International Conference on Computation of Power, Energy, Information and Communication (ICCPEIC)*, pp. 511-517. IEEE, 2014.

[10] Abdullah, Noor Ezan, Athirah A. Rahim, Hadzli Hashim, and Mahanijah Md Kamal. "Classification of rubber tree leaf diseases using multilayer perceptron neural network." In *2007 5th student conference on research and development*, pp. 1-6. IEEE, 2007.

[11] Xia, Yongquan, Yaobin Li, and Chen Li. "Intelligent diagnose system of wheat diseases based on android phone." *JOURNAL OF INFORMATION &COMPUTATIONAL SCIENCE* 12, no. 18 (2015): 6845-6852.

[12] Kavya, R. M., A. Gowda, P. T. Bharathi, and H. K. Virupakshaiah. "Image processing techniques based plant disease detection." *Int J Adv Found Res Computer: Pragmatic Rev* 3, no. 8 (2016): 1-8.

[13] Husin, Zulkifli Bin, Ali Yeon Bin Md Shakaff, Abdul Hallis Bin Abdul Aziz, and Rohani Binti S. Mohamed Farook. "Feasibility study on plant chili disease detection using image processing techniques." In *2012 Third International Conference on Intelligent Systems Modelling and Simulation*, pp. 291-296. IEEE, 2012.

[14] Petrellis, Nikos. "Plant lesion characterization for disease recognition A Windows Phone application." In *2016 2nd International Conference on Frontiers of Signal Processing (ICFSP)*, pp. 10-14. IEEE, 2016.

[15] Georgakopoulou, Konstantina, Christos Spathis, Nikos Petrellis, and Alexios Birbas. "A capacitive-to-digital converter with automatic range adaptation for readout instrumentation." *IEEE Transactions on Instrumentation and Measurement* 65, no. 2 (2015): 336-345.

[16] Khirade, Sachin D., and A. B. Patil. "Plant disease detection using image processing." In *2015 International conference on computing communication control and automation*, pp. 768-771. IEEE, 2015.

[17] Yuan, Youli, Min Zhang, Pengfei Luo, Zabih Ghassemlooy, Lei Lang, Danshi Wang, Bo Zhang, and Dahai Han. "SVM-based detection in visible light communications." *Optik* 151 (2017): 55-64.

[18] Kumari, Ch Usha, S. Jeevan Prasad, and G. Mounika. "Leaf disease detection: Feature extraction with k-means clustering and classification with ann." In *2019 3rd International Conference on Computing Methodologies and Communication (ICCMC)*, pp. 1095-1098. IEEE, 2019.

[19] Patil, Jayamala K., and Raj Kumar. "Advances in image processing for detection of plant diseases." *Journal of Advanced Bioinformatics Applications and Research* 2, no. 2 (2011): 135-141.

[20] Ekka, Bijay Kumar, and Bibhu Santosh Behera. "Disease Detection in Plant Leaf Using Image Processing Technique." *International Journal of Progressive Research in Science and Engineering* 1, no. 4 (2020): 151-155.