Section A-Research paper

DESIGN AN IOT SYSTEM FOR DISEASE DETECTION OF A TOMATO PLANT USING MACHINE LEARNING

Mr. G Balram[1]
[1]Assistant Professor
Department of Computer Science and Engineering
Anurag University
Venkatapur, Ghatkesar, Medchal District
Hyderabad 500088
balaramcse@anurag.edu.in

Mr. Bursu Manikanta[2]
[2]M.Tech Student
Department of CSE,
Anurag University
Venkatapur, Ghatkesar, Medchal District
Hyderabad 500088
bursumanikanta123@gmail.com

ABSTRACT: More often than not, farmers experience difficulty with illnesses and irritations that assault various types. After some time, the harm has deteriorated, which has made the yield fall flat. Present day examination devices can be utilized to attempt to make a cunning framework that can assist with foreseeing issues and do whatever it takes to fix them in a quick way. Considering these things, a technique has been set up to track down the illness in plants. This is a novel approach to the problem that alters the operation of conventional farming systems by utilizing picture processing, machine learning, and weather monitors. The framework utilizes an organization of sensors, like temperature, stickiness, and light sensors, to watch out for the normal circumstances that are significant for spotting plant sicknesses. Machine learning algorithms analyze the data collected by these devices in real time to enhance a plant's ability to recognize diseases in its surroundings. To make control simple and compelling, a portable UI is made, which allows ranches to watch and deal with the framework from a good way. The UI converses with the focal control unit, for example, a Raspberry Pi Arduino board, through a Bluetooth module. The focal control unit is responsible for organizing the sensors, picture handling, and engine control.

Keywords – CNN algorithm, VNC viewer, Arduino board , raspberry pi board, motor shields , arduino-bluethooth controller ,thing speak cloud-based dashboard.

1. INTRODUCTION

The main thing that farmers and agriculture specialists need to do is track down sicknesses on plants. With the assistance of IoT (Internet of Things), the primary objective of the recommended framework is to track down plant sicknesses. IoT, is when contraptions, vehicles, structures, and different things are associated through sensors, network associations, programming, and regulators with the goal that they can gather and share information. In this, we train pictures on a Raspberry Pi to differentiate among solid and undesirable leaves. We have discovered in our project that the environment, humidity, light, and water are some of the most crucial factors for plant growth. We have additionally utilized ML and image processing to find and dispose of weed plants, which can prevent different plants from developing. We can save a significant amount of money on manual labor and upkeep by streamlining this procedure. This makes our methodology exceptionally modest and viable. The way traditional farming is done and the amount of food that can be grown could be drastically altered by our project. Most of individuals in India live off of cultivating. There are numerous ways for ranchers to develop food in the field. In any case, these harvests are filled in a specialized method for getting the best yields and greatest items. In this way, innovation can be utilized to expand the result and work on the quality. At the point when a plant is debilitated, the leaves are generally the most effective way to tell. More often than not, ailment causes the leaves to have spots on them. Be that as it may, assuming there

is a great deal of illness on the plant, the infection spots will cover the entire leaf. Utilizing picture handling techniques, the sickness will track down these spots and show the illness by contrasting it with the learned datasets. It will likewise show the upsides of temperature, dampness, soil, and light, so we know the full condition of the plant.

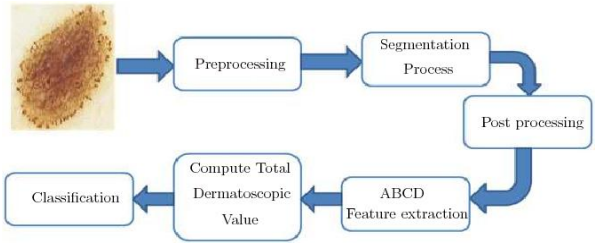


Fig.1: Example figure

The farming industry is very important to the majority of people in India. Tomatoes are the most common food in India. Vitamin E, vitamin C, and beta-carotene are the three most important antioxidants found in tomatoes. They likewise have a great deal of potassium, which is an exceptionally solid supplement. India develops tomatoes on an area of around 3,500,000 hectares, and the nation makes around 53,000,000 tons of tomatoes every year. This makes India the third greatest tomato maker on the planet. Diseases are prevalent in tomato fields at all stages of growth due to the sensitivity of the plants and the conditions in which they grow. Diseased plants are responsible for 10–30% of the total crop loss. It is vital to sort out what sort of infections a plant has with the goal that you don't lose a great deal of harvest result or cultivating item. Due to their complexity, manual monitoring of plant diseases is difficult and time-consuming. Thus, it's critical to diminish how much actual work that goes into this assignment while as yet making right forecasts and ensuring the ranchers' lives are simple. Designs that should be visible are difficult to sort out from the start, which leads numerous ranchers to make wrong suspicions about the illness. In this way, the manners in which the ranchers attempt to stop the bugs may not work and may try and be harming.

2.RELATED WORK

Gittaly Dhingra1, Fix Dutt Joshi1, and Vinay Kumar1 [1] In this, we discussed a total report on perceiving illnesses and putting plant leaves into various gatherings by utilizing picture handling procedures. The standard natural eye quality check strategy can't be depicted in an organized manner since it doesn't work the same way like clockwork. This framework is comprised of various sensors, for example, ones that action soil wetness, temperature, stickiness, and deterrents. A PC is utilized to make a robot that watches over the farm.[3] In a review, the creator proposed the CNN model as an approach to naturally perceive and characterize dietary shortages and harm on apple trees. The creator additionally utilized basic ways of collection things. The creator involved the Multi-facet Perceptron for essential strategies and the Alex Net for CNN. They made a correlation between the frail ways and CNN. [4] This study tells the best way to utilize picture division to track down leaf illnesses. Additionally, it groups the leaf diseases. Picture division is one of the means in this technique. Then, utilizing master techniques, sort the diseases into groups.[5] This paper depicts the strategy, which incorporates looking at an image of a debilitated leaf that was transferred and pictures from an information base. On the off chance that a similar element picture is found, find the picture's connected subtleties and sort out what's going on with a plant leaf.[6] Mohammed Brahimi Kamel Boukhalfa and Abdelouahab Moussaoui (2017). Deep Learning for Tomato Sicknesses: Arrangement and Side effects. A study of the effects of tomato disease visualization on the Algerian economy was published in Applied Artificial Intelligence, 31:4,299315.[7] When extracting a feature from a leaf image, it is essential to understand how to divide the image into its components. For the purpose of analyzing sick leave, Mrunalini R. Badnakhe and Prashant R. Deshmukh compare the Otsu threshold and the k-means grouping method.

3. METHODOLOGY

Throughout the course of recent many years, individuals have gained some significant experience about agro-based mechanization and created numerous ways of making sense of how robotization functions. All things being equal, the greater part of the work is as yet finished manually. Recognizing illnesses is likewise finished the hard way, which takes a great deal of time. The farmer may have lost a lot of money by the time they find out about the

disease because it may have spread to the entire field. With a lot of people, this has been going on for a long time. The ongoing undertaking has been advanced to dispose of this strategy.

A CNN or convnet is a kind of ML. A kind of counterfeit brain organization can be utilized for various errands and sorts of information. A CNN is a sort of organization plan for profound learning calculations. It is utilized for occupations like perceiving pictures and taking care of pixel information. There are different sorts of brain networks in deep learning, yet CNNs are the best ones for finding and perceiving things. This makes them incredible for computer vision (CV) positions and applications where object acknowledgment is significant, similar to self-driving vehicles and face acknowledgment. The CNN design known as VGGNet was developed by Karen Simonyan, Andrew Zisserman, and others at Oxford University. VGGNet is a 16-layer CNN with up to 95 million boundaries that was prepared on more than a billion pictures (1000 classes). It has 4096 convolutional features that can handle large images with a resolution of 224 by 224 pixels. CNNs with such huge channels are costly to prepare and require a great deal of information. This is the significant motivation behind why CNN plans like GoogLeNet (AlexNet engineering) work better compared to VGGNet for most picture grouping position where the information pictures are between 100 x 100 pixels and 350 x 350 pixels. The ILSVRC 2014 characterization work, which Google Net CNN design likewise won, is a certifiable illustration of how VGGNet CNN engineering can be utilized. The VGG CNN model is not difficult to fabricate and is a decent beginning stage for some PC vision applications since it very well may be utilized for some errands, like recognizing objects. Its profound models of highlights are utilized by Consequences be damned, SSD, and other brain network plans.

The standard is displayed in the picture underneath. A CNN can have more than one layer, and each layer can figure out how to track down various things in an image. Each image is given a channel or portion to make an outcome that improves and more point by point as additional layers are added. The channels can begin as straightforward elements in the lower layers. At each stage, the channels get more convoluted so they can check and find qualities that are special to the info thing. Therefore, the input for the subsequent layer is the result of each convolved picture, which is the portion of the image that can be recognized after each layer. The CNN recognizes the image or object it represents in the final layer, an FC layer. With convolution, the image you give it goes through a bunch of these channels. As each channel turns on pieces of the image, it goes about its business and sends the outcomes to the following channel in the stack. Each layer figures out how to perceive various attributes, and similar cycles are finished again and again for handfuls, hundreds, or even a great many layers. Lastly, CNN is able to determine the entirety of the situation thanks to the picture data that moves through its various layers.

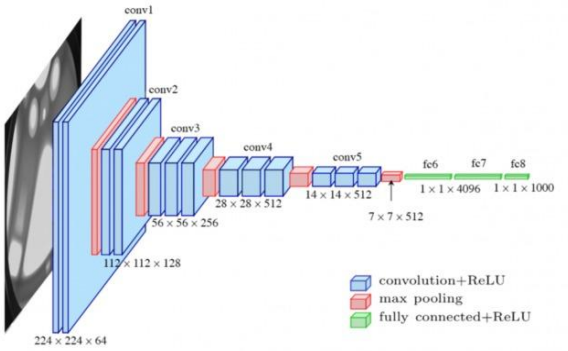


Fig. 2 VGG-16 Architecture

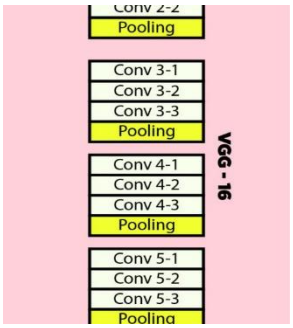


Fig.3 VGG-16 Architecture Map

The code predicts leaf illnesses by utilizing deep learning models that have previously been instructed.

A previously trained model known as "tomato_disease.h5" is used to predict tomato leaf diseases.

A model called "potatoes.h5" is utilized to recognize leaf illnesses in potatoes. This model has previously been prepared.
To predict corn leaf diseases, the code makes use of a mix of classes and models that have already been created.
The means of this program are as per the following:

Step 1:To begin with, pick the kind of picture.

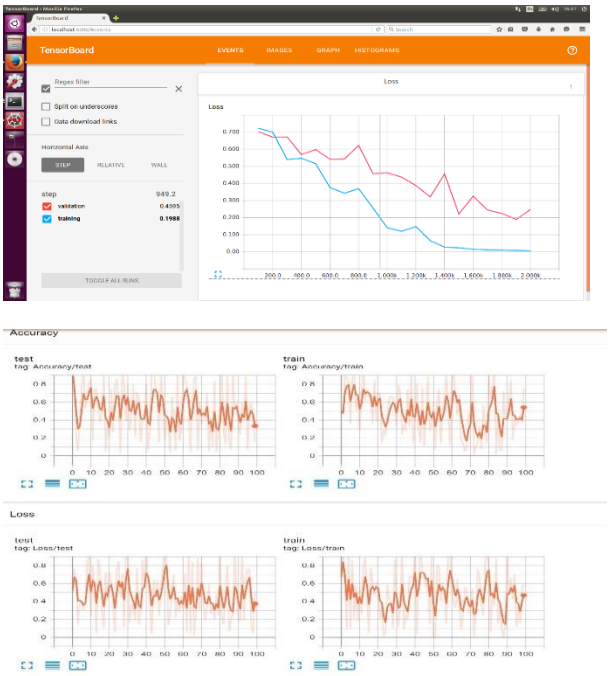
Step 2: Picture from camera or from a source

Stage 3: Select a potato or tomato plant starting from the drop box.

Step 4: Select the type of illness from the drop-down menu.

Step 5:The outcome will be displayed in the accompanying screen captures subsequent to handling.

GRAPHS:



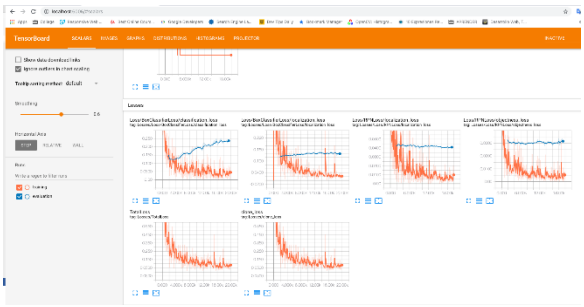


Image processing and ML are utilized rather than individuals to characterize pictures in the frameworks that have been proposed. The proposed structure utilizes a Bluetooth module, Arduino board, Raspberry Pi, mugginess sensor, LDR, soil dampness detecting sensor, and temperature sensor. It has to do with identifying the sick leaves in a crop. It does this by utilizing progressed ML calculations like the CNN calculation to investigate the leaves that are wiped out. Using the VNC viewer on the Raspberry Pi, the data are screened. With this product, we can undoubtedly see the result on the screen. This hardware is set up on a track and moves along the X-Y axis with the assistance of engine safeguards. So, ranchers can develop more yields thus we can watch out for the temperature, pace of water in the dirt, moistness, and light with screens. Utilizing a cloud device like ThingSpeak's cloud stage, this information is transferred at ordinary spans. This undertaking will assist the ranchers with watching out for their harvests and sort out what illnesses have harmed them.

BENEFITS:

Try not to lose data or commit different errors.

It is inexpensive.

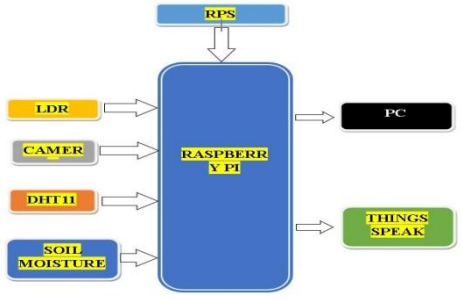


Fig.4: Block diagram

4. IMPLEMENTATION

1. BLUETOOTH:

An instinctive Bluetooth SPP (Serial Port Protocol) piece created to enact an open wireless serial link is the HC-05 piece. The HC-05 Bluetooth Module maybe start as either an Expert or a Slave. This creates it a marvelous order for transporting by chance. This Bluetooth piece has a subsequent traffic and everything accompanying Bluetooth V2.0+EDR (Upgraded Information Rate) 3Mbps Regulation. It has a complete 2.4GHz wireless transmitter and baseband. It takes advantage of a CSR Blue center 04-Outer alone-chip Bluetooth device accompanying CMOS change and AFH (Adaptive Frequency Hopping Feature).

2. L283D MOTOR:

It depends on the likelihood of a H-bridge. The strength can arrest individual habit or the added through a H-bridge, that is a in a way boundary. You are knowledgeable that orderly for the engine to alternate circling or anticlockwise, the route of the generated power needs to shift. To this end H-bridge ICs are ultimate ideal habit to drive a DC motor.

3. LDR:

A photo resistor, also known as a light-dependent resistor, is a tool that alters allure opposition in reaction to electromagnetic strength. Therefore, they are designs that can discover light. They are furthermore named photocells, photoconductors, and photoconductive containers. They are making sense of extreme-antagonism photoelectric matters. There are many habits of appearance that entity is an LDR. The drawing that attends describes individual of ultimate prevailing orders.

4. CAMERA:

In April 2016, the basic Camera Module was replaced steadily Camera Module. The Sony IMX219 8-megapixel sensor in the v2 Camera Module is outside limits the 5-megapixel Omni Vision OV5647 sensor in the basic camcorder. The Camera Module 2 may be applied to take both still photographs and superior value records. It's plain for neophytes to employ, nevertheless has a heap to present more knowing customers the one need to learn more. Individuals have appropriated it to rush-pass, slow-activity, and different cool records that you can view as on computer network. You can similarly form impacts accompanying the apparatuses we present you accompanying the camcorder.

5. DHT11: (TEMPERATURE AND HUMIDITY)

Humidity Sensor is possibly of the main apparatus used to gauge and path very damp weather in display, new, therapeutic, environmental, and various domains. The amount of water present on the way about you is popular as humidness. This measure of water at hand is essential to human well-being. For instance, even though the hotness is 0°C and the humidity is low—indicating that the air is dry—we will still feel fine.

6. SOIL MOISTURE:

The Moisture sensor is applied to resolve how much water is in the soil. At the point when the ground needs more water, the piece's result is extreme. In any case, the result is depressed. This maneuver lets the customer experience when to water their plants and checks how wet the soil is. It has existed appropriated widely for farming, irrigation, and plant growth.

5. EXPERIMENTAL RESULTS

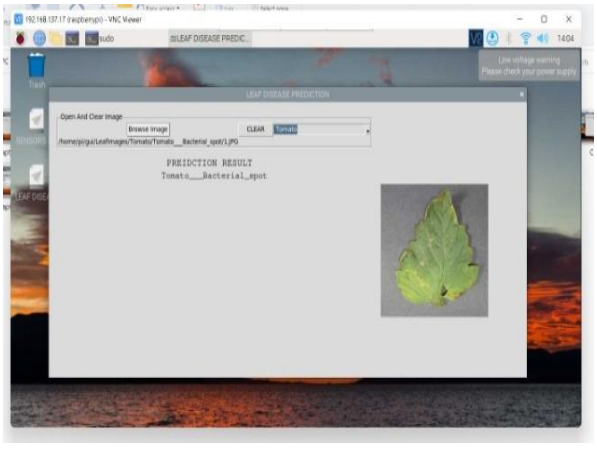


Fig.5: Output screen

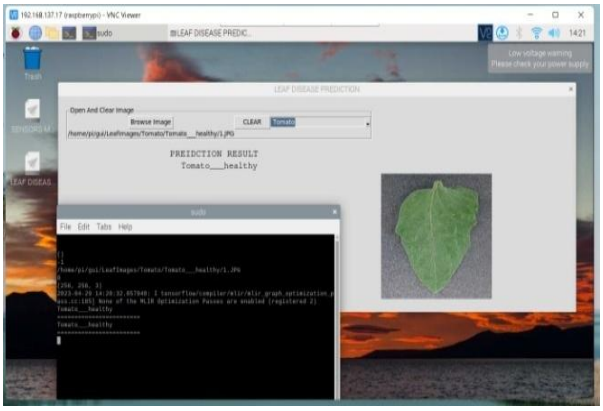


Fig.5.1: Output screen

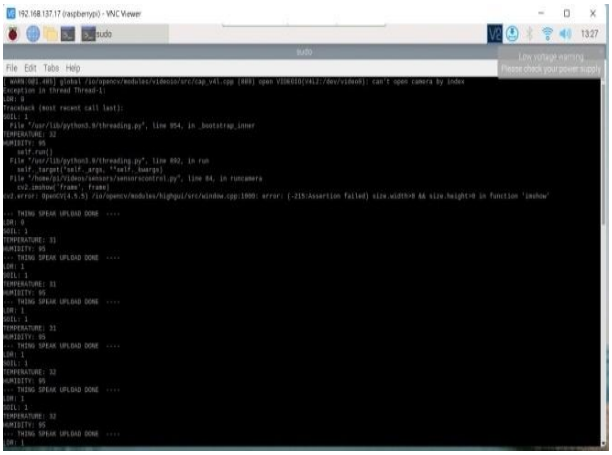


Fig. 5.2: Output screen

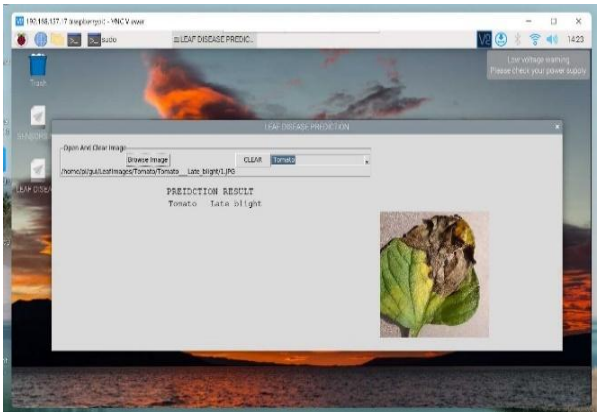


Fig 5.3: Output screen

6. CONCLUSION

Utilizing progressed ML calculations like the CNN calculation, The's task will probably track down the sick leaves in a harvest. This will assist ranchers with expanding crop creation. We are also monitoring the temperature, soil moisture content, humidity, and light with sensors. This information is transferred at ordinary stretches. This venture will assist farmers with watching out for their harvests and sort out what the weather conditions meant for them.

7. FUTURE SCOPE

As a future improvement to the venture, we intend to make it with the goal that it tends to be joined to some other undertaking connected with the harvest infection discovery framework. For instance, in the event that a robot or Rorer plant illness identification framework will be worked as a model, we can straightforwardly join our raspberry pi board to the robot and give it power so it can take care of its business.

7. REFERENCES

[1] Dhingra, Gittaly, Vinay Kumar, and Hem Dutt Joshi. "Study of digital image processing techniques for leaf disease detection and classification." *Multimedia Tools and Applications* 77 (2018): 19951-20000.

[2] Suma, N., Sandra Rhea Samson, S. Saranya, G. Shanmugapriya, and R. Subhashri. "IOT based smart agriculture monitoring system." *International Journal on Recent and Innovation Trends in computing and communication* 5, no. 2 (2017): 177-181.

[3] Nacht gall, Lucas G., Ricardo M. Araujo, and Gilmer R. Nacht gall. "Classification of apple tree disorders using convolutional neural networks." In *2016 IEEE 28th International Conference on Tools with Artificial Intelligence (ICTAI)*, pp. 472-476. IEEE, 2016.

[4] Marwaha, Sudeep, Subhash Chand, and Arijit Saha. "Disease diagnosis in crops using content-based image retrieval." In *2012 12th International Conference on Intelligent Systems Design and Applications (ISDA)*, pp. 729-733. IEEE, 2012.

[5] Sahitya. Roy, Dr Rajarshi. Ray, Aishwarya Roy, Subhajit Sinha, Gourab Mukherjee, Supratik Pyne, Sayantan Mitra, SounakBasu, Subhadip Hazra, "IoT, Big Data Science & Analytics, Cloud Computing and Mobile App based Hybrid System for Smart Agriculture", *Industrial Automation and*

Electromechanical Engineering Conference (IEMECON), 2017 8th Annual, IEEE, Bangkok, Thailand.

[6] Brahimi, Mohammed, Kamel Boukhalfa, and Abdelouahab Moussaoui. "Deep learning for tomato diseases: classification and symptoms visualization." *Applied Artificial Intelligence* 31, no. 4 (2017): 299-315

[7] Badnakhe, Mrunalini R., and Prashant R. Deshmukh. "Infected leaf analysis and comparison by Otsu threshold and k-means clustering." *International Journal of Advanced Research in Computer Science and Software Engineering* 2, no. 3 (2012): 449-452

[8], Abirami, Karunya Rathan, SarvepalliJaahnavi, and K. Indira. "Identification of plant disease using image processing technique." In 2019 International *Conference on Communication and Signal Processing (ICCSP),* pp. 0749-0753. IEEE, 2019.

[9] Kaur, Rajneet, and Manjeet Kaur. "A brief review on plant disease detection using in image processing.". *International journal of computer science and mobile computing 6*, no. 2 (2017): 101-106.

[10] 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.

[11] Singh, Vijai, and Ak K. Misra. "Detection of plant leaf diseases using image segmentation and soft computing techniques." *Information processing in Agriculture 4*, no. 1 (2017): 41-49.

[12] Sladojevic, Srdjan, Marko Arsenovic, Andras Anderla, DubravkoCulibrk, and Darko Stefanovic. "Deepneural networks-based recognition of plant diseases by leaf image classification." *Computational intelligence and neuroscience* 2016 (2016).

[13] Thorat, Apeksha, Sangeeta Kumari, and Nandakishor D. Valakunde. "An IoT based smart solution for leaf disease detection." In 2017 *international conference on big data, IoT and data science* (BID), pp. 193-198. IEEE,2017.

[14] Ead, Waleed M., and Mohamed M. Abbassy. "IOT based on plant diseases detection and classification.". In 2021 7th *International Conference on Advanced Computing and Communication Systems (ICACCS),* vol. 1, pp. 2030-2033. IEEE, 2021.

[15] Rumy, SM Shahidur Harun, Md Ishan Arefin Hossain, Forji Jahan, and TanjinaTanvin. "An IoT based.system with edge intelligence for rice leaf disease detection using machine learning." In 2021 *IEEE International.IOT, Electronics and Mechatronics Conference (IEMTRONICS),* pp. 1-6. IEEE, 2021.

[16] Madhulatha, G., and O. Ramadevi. "Recognition of plant diseases using convolutional neural network.". In 2020 *fourth international conference on I-SMAC* (IoT in social, mobile, analytics and cloud) (I-SMAC), pp.738-743. IEEE, 2020.

[17] Panchal, Poojan, Vignesh Charan Raman, and Shamla Mantri. "Plant diseases detection and classification using machine learning models." In 2019 4th *International Conference on Computational Systems and Information Technology for Sustainable Solution (CSITSS),* vol. 4, pp. 1-6. IEEE, 2019.

[18] Gowtham, R., and R. Jebakumar. "AN IOT BASED PLANT LEAF DISEASE DETECTION USINGMACHINE LEARNING AND AUTO SPRAYING MECHANISM." *Journal of Positive School Psychology* (2022): 283-297.