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# A Comprehensive Survey on Plant Disesases Detection

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***Abstract: India is an agricultural country. The life and economy of a farmer depends on agriculture. If any disease occurs in his crop, his entire crop goes into loss. Therefore, timely identification and diagnosis of the disease in the crop is very important. With this idea, we have created this product. So that the farmer can know whether the plant is diseased or not by inputting the photo of the leaf in this software. And if so, he can get information about the disease. This whole process he can do from his home just through a Smartphone.***
***Keywords: plant disease, artificial neural network, deep learning, Support Vector Machine***

## I. INTRODUCTION

Having diseases is quite natural in crops due to changing climatic and environmental conditions. Diseases affect the growth and produce of the crops and are often difficult to control. To ensure good quality and high production, it is necessary to have accurate disease diagnosis and control actions to prevent them in time.

In India, Agriculture plays an essential role because of the rapid growth of population and increased demand for food. Therefore, it needs to increase in crop yield. One major effect on low crop yield is disease caused by bacteria, virus and fungus.

Farmers can collect the information and data by use of precision agriculture in in-formation technology to make the best decision on high output from the farm. Precision agriculture is a new technology, which provides advanced techniques to improve farm output. By utilising these advanced technologies, it is possible to achieve economic growth in agriculture. Precision agriculture can be used for many applications like pest detection in plants, weed detection, yield production of crops and plant disease detection etc. A farmer uses pesticides to control pests, prevent diseases and to in-crease crop yield. The diseases in crops are creating problems of low production and economic losses to farmers and agricultural industries. Therefore, identification of disease and its severity has become necessary.

Disease identification in plants is most important in a successful farming system. In general, a farmer recognizes the symptoms of disease in plants by using naked eye observations and this requires continuous monitoring. However, this process is more expensive in large plantations and sometimes this may be less accurate. In some countries like India, farmers may have to show the specimen to experts, this makes time consuming and more expensive.

It can be prevented by using plant diseases detection techniques. Machine learning methods can be used for disease identification because it mainly applies on data themselves and gives priority to outcomes of certain task.

Types of diseases :
Plant Diseases Caused by Fungi
Cankers
Damping off
Downy mildew
Ergot
Powdery mildew
Root rots
Rusts
Scab
Seed decay
Smuts
Soft rots, dry rots
Wilts

 

Plant Diseases Caused by Bacteria
Bacterial wilts
Blights
Cankers
Bacterial speck
Crown gall
Leaf spot
Pith necrosis
Soft rots

Plant Diseases Caused by Viruses
Mosaic leaf
Curly top
Yellowing of leaf
Bud Blight

Plant Diseases Caused by Nematodes
Hairy root
Root-knot
Root lesions
Necrosis and stunting by foliar nematodes

Plant Diseases Caused by Mycoplasmas
Aster yellows
Pear decline
Western X

## II. RELATED WORK

Extensive surveys have been conducted to compare disease detection and classification techniques in Machine learning. We studied Support Vector Machine (SVM) Classification Technique, Artificial Neural Network (ANN) Classification Technique, K-Nearest Neighbor Classification Technique, Fuzzy C-Means Classifier and Convolutional Neural Network Classification methods used in detection of plant diseases and its efficiency,

### *A. SVM Classifier*

SVM Classifier is a supervised learning method in Machine learning were analysed data is used for classification. The following authors used SVM Classifier in disease detection of different crops. [1] Detection of diseases on citrus trees which include grapefruit, lemons, lime and oranges leaf attack by canker and anthracnose diseases. The experimental result obtained 95% of genuine acceptance rate. [2] Grape plant diseases Downy Mildew and Powdery Mildew detected and give 88.89% average accuracy for both the diseases. [3] oil palm leaf diseases Chimaera and Anthracnose detection achieve accuracy of 97% and 95% respectively. [4] Potato plant diseases are Late blight and Early blight detection over 300 publicly available images with accuracy 95%. [5] Grape leaf diseases Black Rot, Esca and Leaf Blight are classified with accuracy using features from both LAB and HSI colour models. [6] Developed a method to identify diseases in Tea plants. Three different types of diseases with less in features are detected using SVM classifiers. The developed method classified the diseases with accuracy of 90%. [7] Used for soybean culture to detect three different diseases Downy Mildew, Frog eye, and Septoria leaf blight. They reported with average classification accuracy approximately 90% using a big dataset.

### *B. ANN Classifier*

Artificial Neural Network is a computational model in machine learning and pattern recognition. Related work on Plant disease detection using ANN classifier as follows. [8] Evaluated a proposed work for recognition of plant diseases using feed forward back propagation algorithm and it performed well with a precision of around 93%.

They tested solutions on early scorch, cottony mould, late scorch, and tiny whiteness diseases which affect plants. [9] Developed a model to increase the accuracy in identification of two types of diseases caused by fungus: Downy Mildew and Powdery Mildew in cucumber plants. [10] Introduced a system to recognize and classify diseases like leaf spot, bacterial blight, fruit spot and fruit rot diseases of pomegranate plant using back-propagation algorithm and the experimental result shows around 90% accuracy. [11] Proposed work on identification of groundnut plant disease is cercospora (leaf spot) using neural network Back propagation method. The experimental results and observation shows out of 100 sample diseased leaf images they classified four types of diseases and secured 97.41% of accuracy. [12] Proposed a method to detect pomegranate plant disease and observed using 40 images with accuracy of 90%.

### *C. KNN Classifier*

K-Nearest Neighbors has been used for pattern recognition, statistical estimation and classification in Machine Learning. We made a survey on plant disease detection using KNN classifier as follows. [13] Proposed an algorithm for identification of disease in sugarcane culture. Image processing algorithms are used for feature extraction. It secured an accuracy of 95% for Leaf scorch disease detection in sugarcane leaf. [14] Developed a method to estimate severity and detection of cotton plant disease Grey Mildew disease achieved with accuracy of 82.5% using 40 images. [15] Proposed an algorithm for plant disease detection using the GLCM feature extraction method and KNN classifier. The KNN classifier is proposed rather than SVM classifier to classify data in multiple classes. The performance is tested in the terms of accuracy is in-creased compared with SVM classifier.

### *D. FUZZY Classifier*

Related work on Fuzzy Classifiers in plant disease detection is an author [16] presenting a method to identify the presence of infection in wheat crop images using Fuzzy Classifier. This algorithm is tested with the dataset of healthy and unhealthy leaves. The classification of healthy and unhealthy leaves found with accuracy of 88% and recognition of disease accuracy is 56%.

### *E. Deep Learning*

Deep learning is a different learning method in ANN and also a part of machine learning methods. [17] Proposed a model to detect healthy leaves and 13 different diseased leaves of peach, cherry, pear, Apple and Grapevine using CNN classification technique. More than 30000 images used in the dataset, achieved accuracy between 91% and 98% for separate class test and average accuracy 96.3%. [18] Developed a method for plant disease detection using public dataset 54306 images of 14 crops and 26 diseases and performed with accuracy 99.35% using 20% of testing data and 98.2% using 80% of testing data

## III. REVIEW OF LITERATURE

The working of different papers is explained individually after that comparative table is created to compare methodology and limitations/future scope.

Eisha Akanksha,Neeraj Sharma and Dr. Kamal Gulati's proposed methodology works as:(1)images are converted into RGB format and the images present in the nodes are removed.(2) the R band is given to the feature extraction stage. (3) the selected attributes are fed to the classifier to classify an image as normal or abnormal. (4)For classification, an optimised probabilistic neural network (OPNN) is utilised. The PNN classifier is improved by using artificial jelly optimization (AJO) algorithm. Finally, the Northern leaf blight disease leaf images are fed to the segmentation stage to separate the affected portion of a leaf.[1]

Ilaria Buja,Erika Sabella,Anna Grazia Monteduro,Maria Serena Chiriacò,Luigi De Bellis,Andrea Luvisi and Giuseppe Maruccio's portable systems and interconnection with Internet of Things (IoT) play a pivotal role. Here we review innovative diagnostic methods based on nanotechnologies and new perspectives concerning information and communication technology (ICT) in agriculture, resulting in an improvement in agricultural and rural development and in the ability to revolutionise the concept of "preventive actions", making the difference in fighting against phytopathogens, all over the world.[2]

Nkolika Nwazor's methods of improving the performance of plant disease detection and prediction using artificial neural network techniques are presented. The hyperspectral fungi dataset of 21 plant species were collected and trained using back propagation algorithms of an artificial neural network to improve the conventional hyperspectral sensor. The system was modelled using self-defining equations and universal modelling diagrams and then implemented in the neural network toolbox in Matlab. The system was tested validated and the result showed a fungi detection accuracy of 96.61% and the percentage increment was 19.53%.[3]

Punam Bedi and Pushkar Gole's paper use a publicly available dataset named PlantVillage to get the leaf images of peach plants. The proposed system achieves 99.35% training accuracy and 98.38% testing accuracy using only 9,914 training parameters.

The proposed hybrid model requires a lesser number of training parameters as compared to other approaches existing in the literature. This, in turn, significantly decreases the time required to train the model for automatic plant disease detection and the time required to identify the disease in plants using the trained model.[4]

Akshai KP and J.Anitha deep learning model is trained to classify the different plant diseases.The convolutional neural network (CNN) model is used due to its massive success in image-based classification. The deep learning model provides faster and more accurate predictions than manual observation of the plant leaf. In this work, the CNN model and pre-trained models such as VGG, ResNet, and DenseNet models are trained using the dataset. Among them, the DenseNet model achieves the highest accuracy.[5]

Xulang Guan's new plant disease detection approach by combining four CNN models. The experiment used an open source database of 36258 images classified in 10 plant species and 61 classes of healthy and diseased plant leaves. 36258 images were divided into two datasets with31718 images for the training set and 4540 images for the validation set. Four CNN models including Inception, Resnet,Inception Resnet, and Densenet were deployed and the results of CNN models were processed by a stacking method. The use of the stacking method achieved an 87% accuracy rate, which is a significant improvement compared to the result of using a single CNN model. The relatively high accuracy rate indicates that using a combination of CNN models by a stacking method could be an appropriate approach that can be extended to practical cultivation conditions as an advanced plant disease warning tool.[6]

Ms. Deepa,Ms. Rashmi N and Ms. Chinmai Shetty have developed a novel approach by using machine learning techniques to predict plant diseases. Experimental results show that the plant diseases can be accurately classified.[7]

Arunabha M. Roy and Jayabrata Bhaduri's deep learning enabled object detection model for multi-class plant disease has been proposed based on a state-of-the-art computer vision algorithm. While most existing models are limited to disease detection on a large scale, the current model addresses the accurate detection of fine-grained, multi-scale early disease detection. The proposed model has been improved to optimise for both detection speed and accuracy and applied to multi-class apple plant disease detection in the real environment. The mean average precision (mAP) and F1-score of the detection model reached up to 91.2% and 95.9%, respectively, at a detection rate of 56.9 FPS. The overall detection result demonstrates that the current algorithm significantly outperforms the state-of-the-art detection model with a 9.05% increase in precision and 7.6% increase in F1-score. The proposed model can be employed as an effective and efficient method to detect different apple plant diseases under complex orchard scenarios.[8]

Kirti and Navin Rajpal have used The PlantVillage Dataset, which contains images of grape plant leaves affected from Block Rot Disease as well as the pictures of healthy leaves. HSV and L*a*b* colour models are used for the segmentation purposes. The healthy part and the diseased part of the leaves are separated using colour based techniques and the features are stored for each leaf. The colour of the diseased part is very much different from the healthy part of the leaves which makes it easier to detect the disease on the basis of color. The machine learning is done using the Support Vector Machine Classifier and the results are analysed on different Kernels of SVM. The highest accuracy achieved is 94.1%.[9]

V V Srinidhi,Apoorva Sahay and K. Deeba's project uses Deep Convolutional Neural Networks models namely EfficientNet and DenseNet to detect Apple plant diseases from Images of apple plant leaves and accurately classify them into 4 classes. The categories include "healthy", "scab", "rust and "multiple diseases". In this project, the apple leaf disease dataset is improved using data augmentation and image annotation techniques, namely Canny Edge Detection, Blurring and Flipping. Based on augmented dataset, models using EfficientNetB7 and DenseNet are proposed providing accuracy of 99.8% and 99.75% respectively and overcoming known shortcomings of convolutional neural networks. [10]

Waleed M.Ead and Mohamed M.Abbassy have developed a proposed system With the objective that information about the malady occasion could be quickly and exactly provided to the farmers, consultants and experts. This accordingly reduces the checking of massive fields by individuals. In sickness affirmation from the picture, the key is to remove the brand name feature of the infected locale. As specified by the infection the features may change. The features that are isolated from the image are shading, shape surface and so on. Now and again for identification of the ailment more features are removed and these isolated features would construct the equipment similarly as programming cost. This further causes an increase in the eccentricism and the calculation time. Subsequently it is essential to reduce the element data.[11]

Pradeep Kumar Mugithe, Rohit Varma Mudunuri, Rajasekar. B and Karthikeyan. S's proposed system aims at developing image processing techniques for disease detection and alerting. Steps involved in this are image acquisition, image processing, image segmentation, feature extraction, classification and disease categorization. After detecting the disease, it sends the alerts through the buzzer.[12]

Rohit Nalawade,Apoorv Nagap,Lakhan Jindam and Prof. Meena Ugale's proposed system provides the leaf disease detection along with complete surveillance of the field with real-time values of field factors like temperature, humidity, moisture, etc. i.e. real-time monitoring. User can automatically control the flow of water if not physically present via app, also the real time values can be tracked.[13]

N Gobalakrishnan, K Pradeep, C J Raman, L Javid Ali and M P Gopinath's study on detection of plant diseases had explored the use of generalised image processing techniques and machine learning algorithms that can be applied at various stages of a plant's life cycle.

Presently there are several techniques based on automation or computer vision perspectives for detecting plant diseases. But still they are incomprehensive and lack precision. Also it is impossible to detect all diseases using any single method. Research can be extended by developing systems that are capable of detecting various pests and leaf diseases also. Infections caused by pests too are increasing day by day resulting in loss of production. Therefore the need of the hour is to develop fast and accurate systems for detecting the pests and leaf diseases.[14]

Rajasekaran.C, Arul.S, Devi.S, Gowtham.G and Jeyaram.S's Artificial Intelligence is an emerging sector in all fields of work for automation and to improve efficiency. It is also included in the agricultural sector to improve crop yield by identifying the disease affection early and classify the type of disease affected for taking precautionary measurements to prevent spreading to other plants in the field.

This becomes possible by image processing on computer vision and train the model by using VGG-16 architecture which is Convolutional Neural Network algorithms.[15]

Sumathi Bhimavarapu and Vinitha Panicker J's Infrastructural defects to determine the illnesses of the crop utilised within the agricultural quarter improvising special standards and solutions. The diagnosis of the different scenario and cause for diseases had been let to indulge in the current mobile technology suitable for the controlling of the disease using wireless scenario or switches. Our paper imparts on the current existing design technique as SVM, providing the mathematical and functional aspects of the design ensuring to improve the locating diseases using test and train scenarios. The setup for the SVM model is also taken into account for considerations of the different data sets of the images related to different crops, nothing to provide the correct information of the problem scenario.

These problems might exist due to natural or man-made for each set of the disease observed and identified. Hence recognition of the diseases would suffice the design criteria ensuring different parametric criteria for each level of training and test set provided. To ensure the novel and more accurate scenario different set of data set have been in consideration for different test and train images providing higher and reliable accuracy for the proposed model as part of CNN applying as Transfer learning. Different scenarios of the plant disease image have been considered as data set of 15617 images under restricted cases improvising a train model on CNN with transfer learning. The accuracy observed from the design model is observed 98.56% on the considered test vectors providing required feasibility. These designs also provide a better and convenient solutions for the people utilising the current technologies.[16]

Fatma MARZOUGUI,Mohamed ELLEUCH and Monji KHERALLAH's System apply a computer methodology on Deep Learning systems based on artificial neural networks, this branch also allows for the early detection of plant diseases, by applying convolutional neural networks (CNNs) familiar with some of the famous architectures, notably the "ResNet" architecture, using an augmented dataset containing images of healthy and diseased leaves (each leaf is manually cut and placed on a uniform background) with acceptable accuracy rates in the research environment.

This Deep Learning technique has shown very good performance for various object detection problems. The model fulfils its role by classifying images into two categories (disease-free) and (diseased). According to the results obtained, the developed system achieves better detection performances than those proposed in the state of the art. Finally, to compare their performances, we use the implementation under Anaconda 2019.10.[17]

Radha N and Swathika R's Automated plant disease detection techniques are useful to detect the symptoms of diseases at an early stage in big farms.

The dataset used for this work contain images of various plants consisting of both diseased and healthy leaves. Convolution Neural Network (CNN) is used to train the model for detecting the plant diseases.The plants considered include Corn, Strawberry, Grape, Tomato and Potato plants. The model predicts the health of most of the plants with optimal accuracy of prediction being 85% and negligible loss of 0.25 was observed in the course of training the data.[18]

## IV. OBSERVATION TABLE

| Sr No. | Paper Name | Publication Yr. | Conference/Journals | Methodology/tool/techniques used | Future scope |
|---|---|---|---|---|---|
| 1 | Optimized Probabilistic Neural Network based Automatic Detection of Maize Plant Disease Detection[1] | 2021 | ieee | Probabilistic neural network, Artificial jelly optimization, Segmentation. | It is possible to identify and solve similar types of diseases in maize plant.Also can work on other crops too. |
| 2 | Advances in Plant Disease Detection and Monitoring:From Traditional Assays to In-Field Diagnostics[2] | 2021 | MDPI | IoT and remote sensing | there are still challenges in making new approaches available on a large scale, if compared to other areas of manufacturing. |
| 3 | Plant Disease Detection and Monitoring Using Artificial Neural Network[3] | 2022 | Research gate | artificial neural network, backpropagation algorithms | It was found that artificial neural networks can be used to improve hyperspectral sensors, a cheap and intelligent fungi sensor was developed. |
| 4 | Plant disease detection using hybrid model based on convolutional autoencoder and convolutional neural network[4] | 2021 | KeAi | Convolutional autoencoder Convolutional neural network Deep learning in agriculture | can be tried to reduce the number of features used for prediction using the CAE network without a significant decrease in the classification accuracy of plant disease detection.Also can be worked on other crops |
| 5 | Plant disease classification using deep learning[5] | 2021 | IEEE | Convolutional neural network | Future work includes expanding the dataset and increasing the number of classes. Another future work is deploying the model into a website/application as it will help farmers/ pathologies to identify different diseases using mobile cameras. |
| 6 | A Novel Method of Plant Leaf Disease Detection Based on Deep Learning and Convolutional Neural Network[6] | 2021 | IEEE | Deep learning in agriculture | The further step is to explore how to estimate the probability a plant would get infected or even predict the disease type the plant might develop. |
| 7 | A Machine Learning Technique for Identification of Plant Diseases in Leaves[7] | 2021 | IEEE | Support vector machine (SVM) | constant monitoring of the farm is necessary. This is a tedious process. This is also very costly, when the size of the farm is huge. Due to this difficulty, even agricultural experts are not able to diagnose the diseases easily and find a solution to the problem. |
| 8 | A Deep Learning Enabled Multi-Class Plant Disease Detection Model Based on Computer Vision[8] | 2021 | MDPI | deep learning; convolution neural net-works; artificial intelligence; computer vision | The current study focuses on plant disease detection in the apple, which has significant commercial value due to its vast dietary and nutritional qualities. We can build a system which can identify similar disease in apple plant as well as other fruit plants |
| 9 | Black Rot Disease Detection in Grape Plant (Vitis vinifera) Using Colour Based Segmentation & Machine Learning[9] | 2021 | IEEE | Pattern Recognition, SVM, HSV, Colour Based Detection,Supervised Learning, Machine Learning. | The diseases in plants can be segmented/separated with the use of color-based image processing techniques. |
| 10 | Plant Pathology Disease Detection in Apple Leaves Using Deep Convolutional Neural Networks[10] | 2021 | IEEE | Machine Learning, Deep Convolutional Neural Networks, Data Augmentation, Canny Edge Detection, | To build models with better training set edge detection, flipping, convolution, blurring, etc can be used. |

| | | | | | |
|---|---|---|---|---|---|
| 11 | IOT Based on Plant Diseases Detection and Classification[11] | 2021 | IEEE | Intelligent Agriculture practices, Picture Processing,IOT | can identify similar disease in other plants too |
| 12 | Image Processing Technique for Automatic Detection of Plant Diseases and Alerting System in Agricultural Farms[12] | 2021 | IEEE | image processing, segmentation, Clustering, | System can also be modified into automatic disease detection, alerting and Pesticides Selection Suggestion through mobile and for more accurate and better detection of diseases, the hyperspectral Imaging systems are to be implemented in the suggested system. |
| 13 | Agriculture Field Monitoring and Plant Leaf Disease Detection[13] | 2020 | IEEE | IoT, API, field monitoring, dataset, neural network, sensor. | Can be modified by adding extra functionalities like location of stores present nearby user, list of pesticides and fertilisers, real-time interaction with agricultural experts via chatting or video call, etc. |
| 14 | A Systematic Review on Image Processing and Machine Learning Techniques for Detecting Plant Diseases[14] | 2020 | IEEE | Image processing, Machine Learning, | we can develop a systems which are capable of detecting various pests and leaf diseases also. Infections caused by pests too are increasing day by day resulting in loss of production so the need of the hour is to develop fast and accurate systems for detecting the pests and leaf diseases. |
| 15 | Turmeric Plant Diseases Detection and Classification using Artificial Intelligence[15] | 2020 | IEEE | Artificial Intelligence, Deep Learning, Convolutional Neural Network, VGG 16, CV2 | We can improve our agricultural yield and protecting our land health from usage of unnecessary fertiliser and pesticides. |
| 16 | Analysis and Characterization of Plant Diseases using Transfer Learning[16] | 2020 | IEEE | Transfer Learning, Convolutional Neural Networks (CNN) | To ensure the scalability of the design and its intensive design approaches for the given leaf or plant disease problems have been undertook different set of the conditions improving the algorithms capabilities as per the user case. |
| 17 | A Deep CNN Approach for Plant Disease Detection[17] | 2020 | IEEE | Deep Learning; CNN; Data Augmentation; ResNet | challenges in making new approaches available on a large scale, if compared to other areas of manufacturing. |
| 18 | A Polyhouse: Plant Monitoring and Diseases Detection using CNN[18] | 2021 | IEEE | Convolutional Neural Network; Plant monitoring; Deep Learning; | The dataset can be refined to produce better plants. The images in the dataset can be augmented and processed to produce better prediction results. Dataset can also be enlarged and refined with better images to increase the accuracy of the model. This system can be experimented with for other sets of plants as future work. |

## V. CONCLUSION

A comparative study is carried out on five types of machine learning classification techniques for recognition of plant disease is done in this review. SVM classifier is used by many authors for classification of diseases when compared with other classifiers. The result shows that CNN classifier detects more number of diseases with high accuracy. In future, other classification techniques in machine learning like decision trees, Naïve Bayes classifier may be used for disease detection in plants and in the sense of helping farmer an automatic detection of all types of diseases in crop to be detected.

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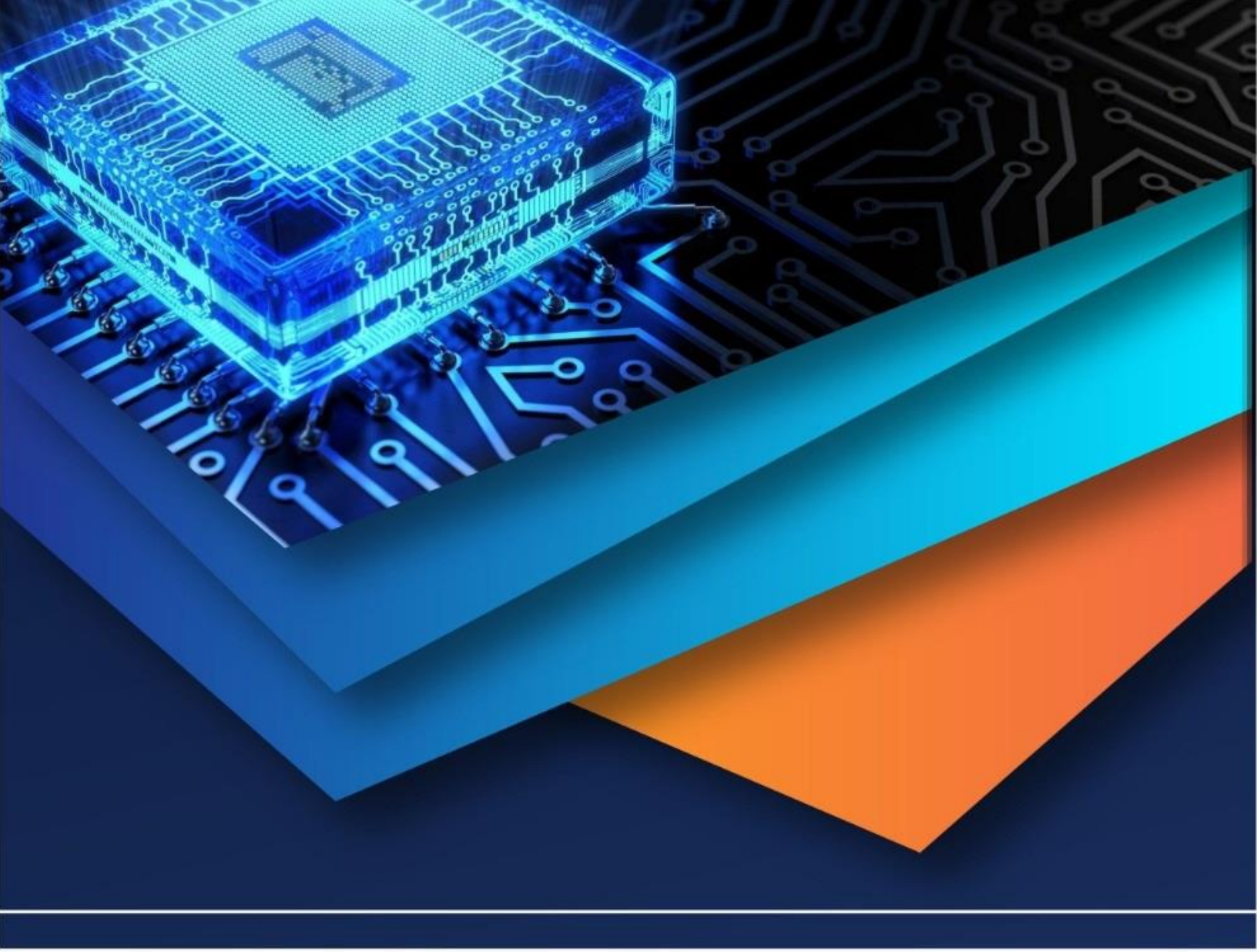

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