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Disease Detection in Apple Using Machine Learning

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Abstract: ***Crop production is a key component in the agricultural industry. The crop's quality directly affects the rate of output. The crop infection factor emerges as a crucial component of quality. Most of the time, diseases during cultivation are found using conventional methods such as Naked Eye Surveys, Surveys through Experts, etc. The processing time and cost of this process are enormous. High-quality output requires automatic severity detection. The project's goal is to provide a real-time, affordable method of identifying fruit (Apple) disease. Here, disease identification is accomplished via a machine learning-based method. The illness in an Apple is identified by image processing. The 'You Only Look Once'(YOLO) CNN-based algorithm is used to do feature extraction and classification. Based on the nature and degree of the sickness that is detected by this system, a comprehensive report is provided.***

Keywords: Convolutional Neural Network (CNN), YOLO, Deep learning, Sooty blotch, Apple Rot.

I. INTRODUCTION

The arising of new advancements, for example, computerized picture handling and picture examination innovation has numerous applications in the natural field. In India, around 78% of the ranchers are minor and thus they are poor in assets. Consequently, they are not in that frame of mind to involve the accessible assets for expanding efficiency. An easy-to-understand programming will help the rancher somewhat to recognize regardless of whether the organic product is infected. The picture is handled utilizing the Picture Handling strategies and the infection is recognized. The sickness is distinguished by our picture handling programming that assists the ranchers with avoiding potential risk. This demonstrates benefits in checking enormous plantations of natural products, and consequently naturally identifies the sicknesses when they show up on natural products. The biggest area in the Indian economy is horticulture and it is likewise the biggest boss. In this way, the horticultural business puts a critical job in expanding the Indian economy. Day to day items in India are less expensive when contrasted with different regions of the planet for instance 1] In Western Europe 1kg of apple costs € 2.5 (as in Jan. 2021), around 220 rupees, while a similar amount of apple costs 100rs in India. Thus, this is the typical cost variety between Milk, fruits, Vegetables and numerous other horticultural items like Rice, Wheat contrasted with different nations. Subsequently there is a great deal of extension for send out, which is another way for the rancher to bring in more cash which in term will build the rural pay which thusly increment the Indian economy. This is conceivable provided that we produce more fruits. Thus, this paper centers around illness recognition in fruit which helps in expanding the production of natural fruits. The conventional approach to disease and pest identification entirely depends on the producer's observation or consulting experts. This approach is slow, ineffective, expensive, very subjective, inaccurate, and not very timely.

Farmers are still currently responsible for diagnosing the majority of plant illnesses. On the other hand, the artificial analysis results may provide a significant variation as the imaging capacities of certain diseases are similar and there is no clear distinction between exceptional grades of the same disease. This presents an opportunity to control chaos. Furthermore, certain illnesses cannot be diagnosed promptly due to their random incidence. This will harm the development of the agricultural sector by affecting the yield and satisfaction of the outcome. Consequently, the application of predictive deep learning techniques is becoming more widespread to provide automated and accurate disorder analysis.

Apple Scab Bitter Rot Sooty Blotch

Fig 1. Example of Diseased Apple Fruit

Fig1 are the different types of diseases that may affect apple. The apple in the above figure is affected by 3 types of diseases they are, 1) Apple Scab, 2) Bitter Rot, 3) Sooty blotch.

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II. CONVOLUTION NEURAL NETWORK

A convolutional neural network (CNN) is a class of AI model, specifically a sort of profound learning calculation appropriate to examining visual information. CNNs - - here and there alluded to as convnets - - use standards from straight polynomial math, especially convolution activities, to remove includes and recognize designs inside pictures. In spite of the fact that CNNs are transcendently used to handle pictures, they can likewise be adjusted to work with sound and different information.

CNN engineering is roused by the network examples of the human cerebrum - - specifically, the visual cortex, which assumes a fundamental part in seeing and handling visual upgrades. The fake neurons in a CNN are organized to decipher visual data, empowering these models to effectively handle whole pictures. Since CNNs are so successful at recognizing objects, they are oftentimes utilized for PC vision undertakings like picture acknowledgment and item location, with normal use cases including self-driving vehicles, facial acknowledgment and clinical picture examination.

III. YOLO

You Only Look Once (YOLO) is an item location calculation that edges object identification as a relapse issue to isolated jumping boxes and related class probabilities. Forecast of jumping boxes and class probabilities from pictures in a single assessment is finished with a solitary neural network.

IV. YOLO v4

Typically, a cutting-edge locator has two-section, a spine and a head. Spine is pretrained on ImageNet, set out toward expectation classes and bouncing boxes. A few spines for GPU stages incorporate VGG, ResNet, and DenseNet, and for computer chip stages incorporate SqueezeNet, MobileNet, and ShuffleNet. The item locator is classified into two sorts in view of the head, a one-stage object finder, and a two-stage object identifier. R-CNN series, quicker R-CNN, R-FCN, Libra R-CNN are instances of two-stage object finder models, and Consequences be damned, SSD, RetinaNet are instances of one-stage object identifier models.

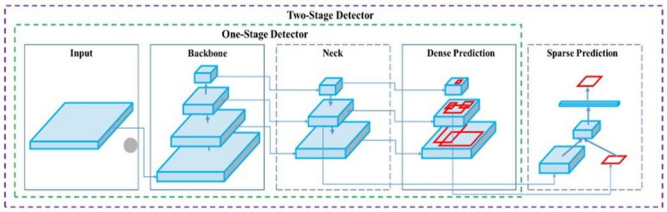


Fig 2. YOLO v4 architecture

V. CONVOLUTION

Convolution is a strategy that will be performed on the picture pixels to trim the external layer of the info picture with a special worth by utilizing a bit. On account of convolution, it essentially plays out the 'speck item' between the first picture and portion. The portion, perhaps 3*3 or 5*5 picture/templet, it resembles a channel/examining channel. The fundamental thought here is to partition the first picture into different pixels and the piece is put on top of the first picture pixels then it will register the speck item. Also, the bit is moved to the better places and it will figure all dab items then at last, we will get one of a kind picture from this dab item called Result picture. On account of portion development, we can play out a shift over by one segment or shift over by two sections.

VI. METHODOLOGY

1) *Data Collection:* Gather a dataset of images of healthy and diseased apples. Ensure the images are labeled correctly.
2) *Data Preprocessing:* Resize images to a consistent size, convert them to a suitable format (e.g., RGB), and normalize pixel values.
3) *Feature Extraction:* Use a pre-trained convolutional neural network (CNN) like ResNet, VGG, or Inception to extract features from the images. Alternatively, you can fine-tune a CNN on your dataset.
4) *Model Selection:* Choose a machine learning model such as Support Vector Machines (SVM), Random Forests, or Neural Networks for classification.
5) *Training:* Split the dataset into training and validation sets. Train the selected model on the training set and tune hyperparameters using the validation set.

6) *Evaluation:* Evaluate the model on a separate test set to assess its performance using metrics like accuracy, precision, recall, and F1-score.
7) *Deployment:* Once the model performs satisfactorily, deploy it to detect diseases in new images of apples.
8) *Continuous Improvement:* Monitor the model's performance and retrain it periodically with new data to improve its accuracy and reliability.

VII. WORKFLOW OF THE MODEL

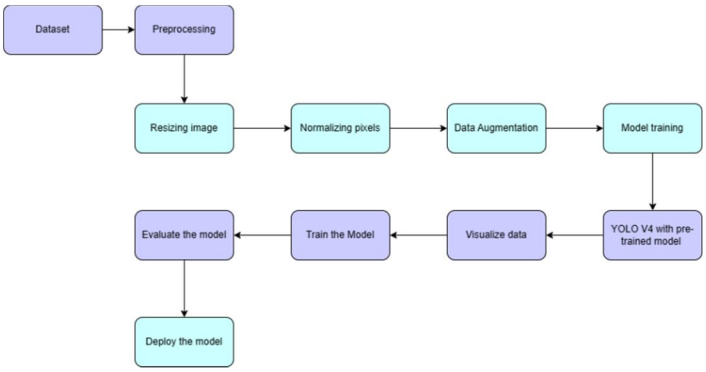


Fig 3. Workflow of the Model

VIII. PROPOSED SYSTEM ARCHITECTURE

The client, which requires web browser access, is part of the system architecture. The user must supply input data, which can be either a static or live image or video, to diagnose the illness and receive a full report. The CNN-based YOLO algorithm receives the input data and uses it to identify the illness. The user is given the choice to download the disease report or not, depending on the type of condition that has been identified. Based on the parameters, a comprehensive report is produced and utilized to treat the illness appropriately.

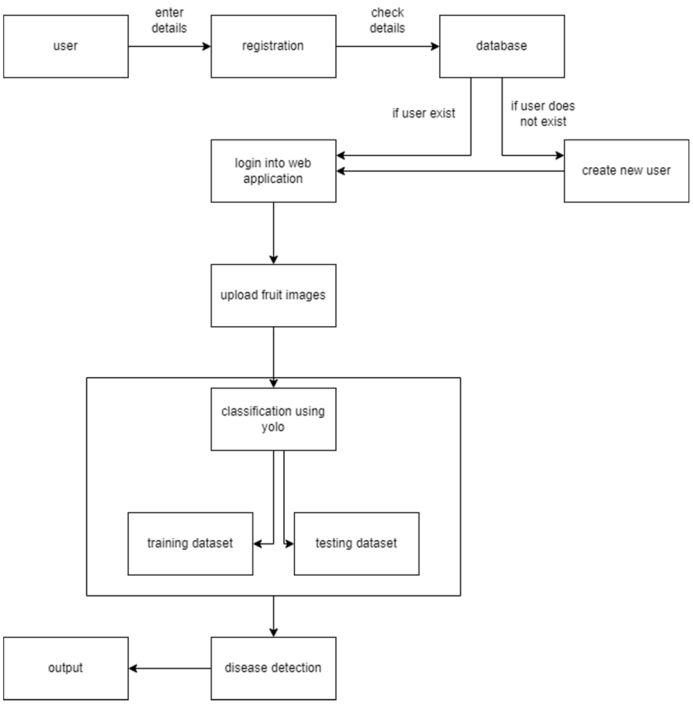


Fig 3. System architecture

A variant of single-stage object detection called YOLOV4 adds multiple bags of suggestions and modules to enhance its predecessor, YOLOv3. A machine learning model is used to find the form and position of an object. YOLOv4, a device research model that can be utilized with the Ailia SDK, is being introduced here. This is more effective and simpler to utilize. The YOLO network consists of 24 convolutional layers that gather features from images as seen by two completely linked layers to predict class rankings and bounding field coordinates. For each region where an object is recognized, a single convolutional neural network predicts several bounding boxes at the same time to calculate the class probabilities. Because Yolo has a complex CNN architecture, training takes longer, but prediction accuracy is good. The training data with manual annotations will improve the prediction accuracy of the YOLO model.

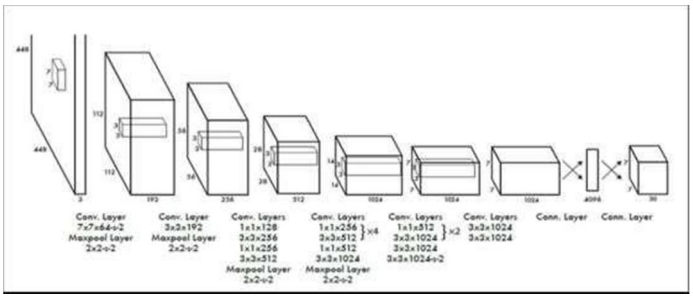


Fig. 4. YOLO Architecture

IX. UML DIAGRAMS

Fig. 6. Flowchart diagram

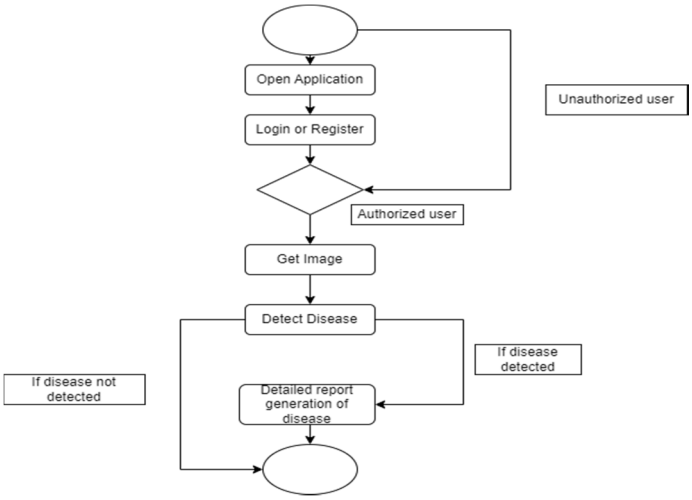


Fig. 7. Activity diagram

As the activity diagram mentioned above states the activity perform in the application and the flow of the web application it has traveled:

i. Open application
ii. Login or Register
iii. Upload Image
iv. Detect Disease
v. If disease detected
vi. Detailed report generation of the disease
vii. If disease not detected end the process
viii. End

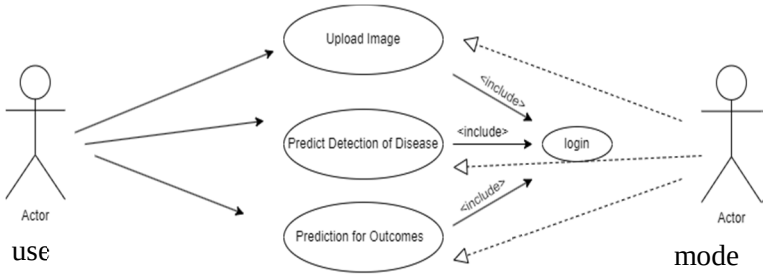
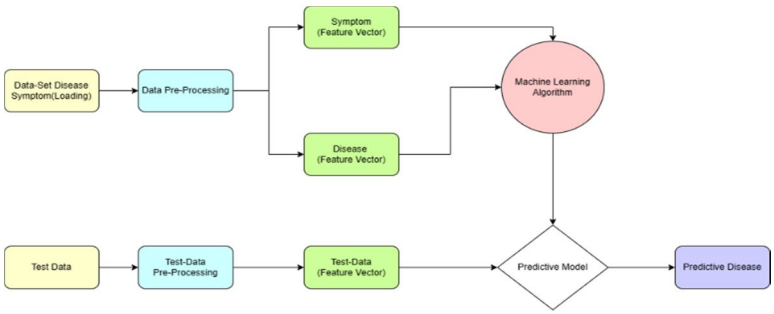
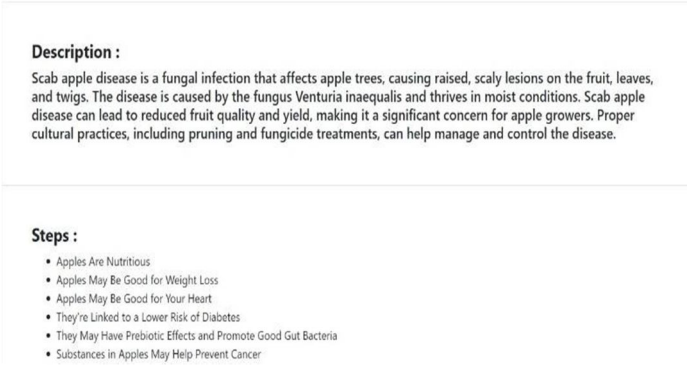


Fig. 5. Use case





X. RESULTS & DISCUSSION

The results of the project are given below:

Fig.8(a) Upload image of apple

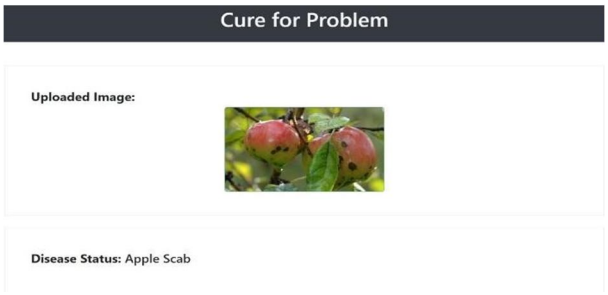


Fig.8(b) Disease Detection of apple

XI. APPLICATIONS

1) Early disease detection will reduce the overall yield loss.
2) Disease can be cured within initial days.
3) A detailed report of the disease would be helpful for further cultivation purposes.
4) Quality Analysis can be done in future.

XII. FUTURE SCOPE

1) Exploration of other cumulative methods to improve the accuracy.
2) Fusion of some other advance features will improve the output.
3) Three-Dimensional Approach can be developed.
4) To make our model more optimized.
5) Needs exploration on video model. Improvement for faster results on low end devices.

XIII. CONCLUSION

In conclusion, the use of AI in sickness identification inside the apple business holds critical commitment for further developing yield the board rehearses and guaranteeing food security. Through the usage of cuttingedge calculations and methods, scientists and professionals can precisely distinguish and analyze illnesses in apple at beginning phases, empowering opportune mediation and relief methodologies.

The discoveries of this examination paper highlight the viability of AI models in recognizing sound and sick apple in view of different boundaries, for example, apple

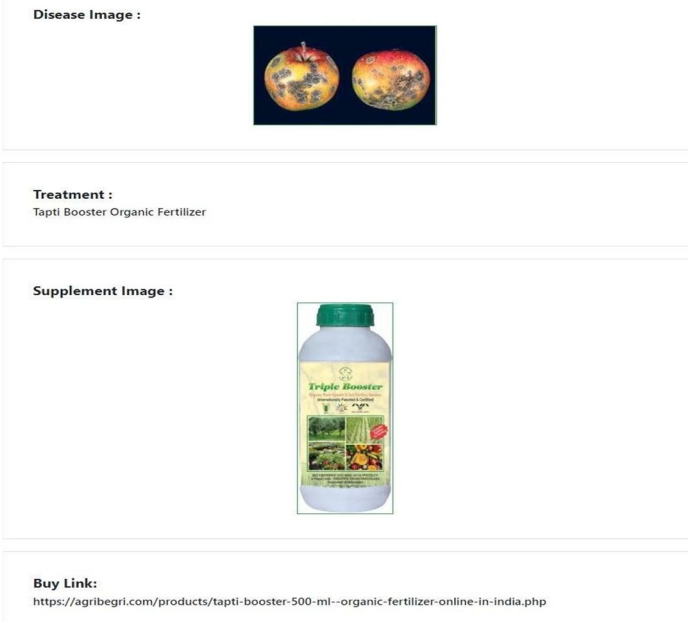


Fig.9(a)Description of disease
Fig.9(b)Treatment, Supplement image and Buy link

XIV. ADVANTAGES

1) The quality of fruits directly determines the economic development of the apple plantation industry. [3]
2) It reduces the tedious work of monitoring large farms.
3) Fetches Dynamic input.
4) Creation of Detailed Report.
5) Suggestion of Related Remedies.

XV. LIMITATION

1) Time consuming process if input isn't of good quality.
2) Requires high-end computational resources.
3) Requires an abundant amount of data for more accurate results.
4) Requires human interference pictures. By outfitting the force of AI, farmers and agrarian specialists can settle on informed choices with respect to illness the executives, asset portion, and harvest insurance measure.

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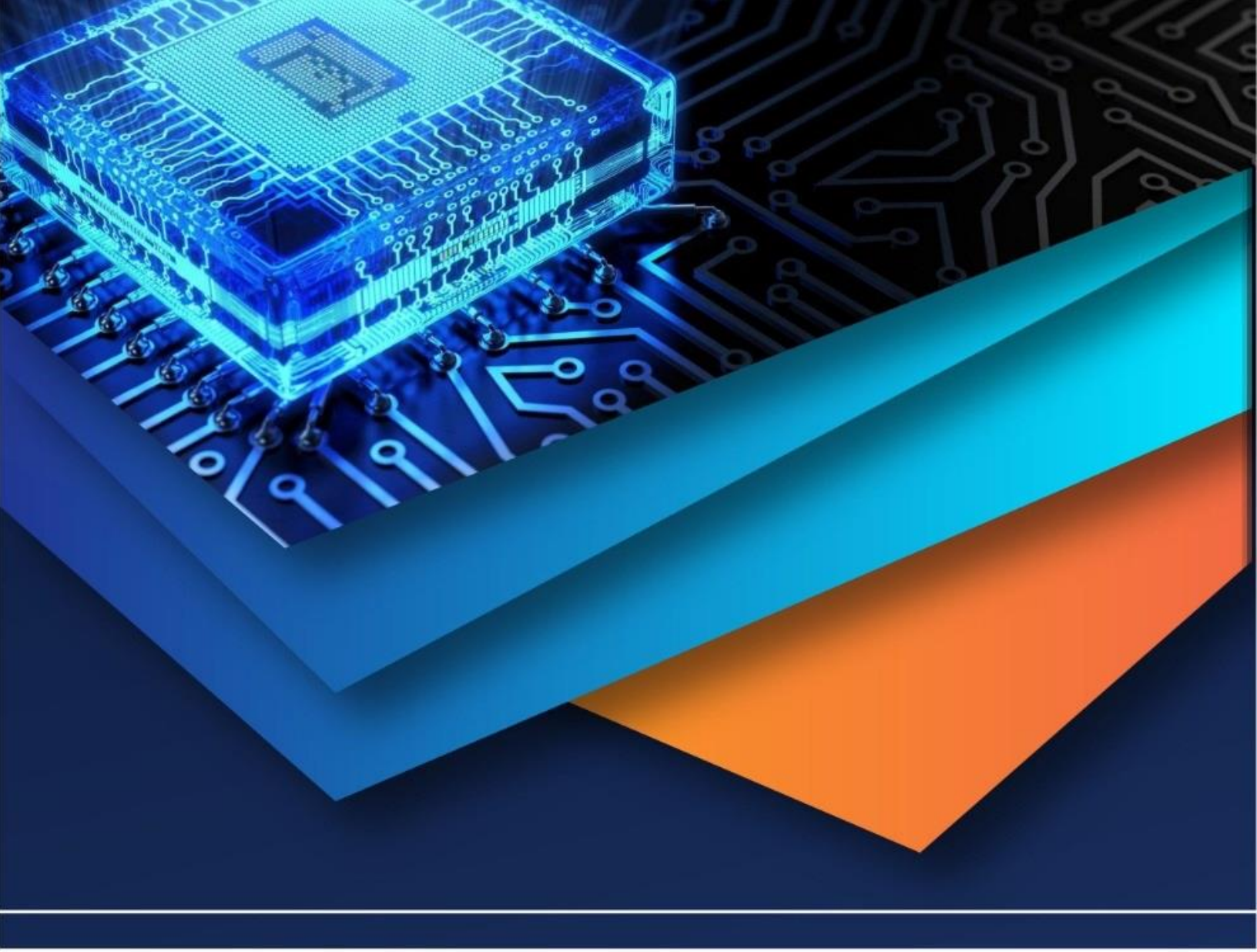

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