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Nutritional Values of Fruit through Image Processing

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Abstract: Health is the most important aspect of any human being. With the increasing pace of life, the focus on health was decreasing. This has created a wide number of problems like obesity, diabetes, hypertension, etc. Fruits contain a major source of energy, vitamin, nutrients which should be the vital part of diet. This paper presents a nutrition measurement system which calculates the precise quantity of moisture, protein, fiber, carbohydrates and fats present in the fruit. The system works without any complex hardware and weighing scale. It calculates the precise mass of fruit using two images digital images of the same fruit.

Keywords: Health, Nutrients, Obesity, Diabetes, Machine learning, YOLO.

I. INTRODUCTION

To avoid obesity people started eating healthy food and they became interested in watching their weight, a system that can measure calories and nutrition in every day meals could be very useful. In this paper, they proposed a idea that helped the patients and dieticians to measure daily food intake. In this they used nutritional value tables. As trend of smartphones and mobiles were increasing and people carried it everywhere, so system used a photo or video from phone and calculated the calorie content of food. Nutrition values are calculated in two phases, namely fruit detection and dimension calculation. The system takes two images of the same fruit as input and gives the accurate weight of that fruit along with its nutritional values.

For object detection, YOLOv3 (You Only Live Once version 3) is used. The R-CNN family of techniques primarily use regions to localize the objects within the image. The network does not look at the entire image, only at the parts of the images which have a higher chance of containing an object. The YOLO framework on the other hand, deals with object detection in a different way. It takes the entire image in a single instance and predicts the bounding box coordinates and class probabilities for these boxes [yolo paper]. The biggest advantage of using YOLO is its superb speed. It is incredibly fast and can process 45 frames per second. YOLO also understands generalized object representation. Once the fruit is detected, its dimensions are to be calculated. The fruit image must consist of a fixed sized reference box which is used to calculate pixel density. This pixel density is then used to calculate the dimensions of the fruit. This way, we can prevent errors in measurement due to difference in depth. This is helpful as the distance of fruit from the camera need not be fixed, since the values of pixel density would adjust accordingly. Using these dimensions, the volume and subsequently the mass of the fruit is detected. This is done by using a multivariate linear regression model. The proposed model is user friendly in the only requirement is a basic digital image capturing tool, for example mobile phone or digital camera.

II. LITERATURE REVIEW

In this system [1] it consists of a camera and a light emitting diode which was used for measuring food portion size. The LED is located alongside the camera at a fixed distance and its optical axis is parallel to the camera's optical axis. The distance to object and oblique angle of the object plane are calculated according to the deformation of the projected spotlight pattern. To determine the effectiveness of their measurement method, they carried out experiments. The first experiment was supposed to be Estimate the distance when keeping the plane of the object perpendicular to the optical axis of the sensor. For the tilted plane, the second experiment was to estimate both the oblique angle and distance. Prior to the tests, the camera's intrinsic parameters were calibrated. The center position and dissimilarity of the spotlight pattern were extracted in each image, By a threshold after binarization [1].

Food Image Recognition with Convolutional Neural Network As proposed by authors in [2], mainly this model consists of five layers in which four are convolution-pooling layer and the fifth one is a fully connected layer, the input is passed into the first layer which takes 128 x128 x3 size image and after filtering the image is passed on to the second convolution network and like that the process continues until the fourth convolution layer and the output of this layer is passed on to the fully connected layer which consists of 1000 neurons. Here they have used two sets of datasets UECFOOD100 dataset and another dataset for fruit images which they have created and they used techniques called flipping and blurring on images to enlarge the dataset to reduce overfitting problem.

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Food Calorie Measurement Using Deep Learning Neural Network Here authors [3] have proposed the Deep Learning Neural Network method handles the training and testing requests at the top layers, without affecting the central layers. Firstly, the segmentation is performed using the deep learning approach followed by Graph Cut segmentation. Here the user's thumb is used for size calibration. In this method, the first step is to generate a pre-trained model file and then the system is trained with a positive set of images. In the second step, they re-train the system with the set of negative images. In this system, once the model file is generated from the training, they load it into the application and test it against the images captured and submitted by the user.

This was the first study of a food image classification, segmentation, recognition, and calorie measurement method that not only used 3000 images, but also under various conditions, such as using various cameras, lighting, and angles, to keep the accuracy in mind. In this design a method to apply Gabor filter for texture segmentation of food images. To do this, a bank of Gabor filters with different desired orientations and wavelengths are applied to an image and for data classification, they have used the SVM technique. Five textures, five colors, three shapes, and five scale characteristics are included in the SVM function vectors. The feature vectors of each food item, extracted during the segmentation phase, would be used as the training vectors of SVM [4].

Detection of objects has become one of the most important topics that many computer vision researchers are trying to solve. There are quite a number of deep learning techniques, such as YOLO, like Quick RCNN, which already produces state-of-the-art detections. Detecting small objects, however, that occupy less than 1% of the picture room is still an unfinished issue to address. There are three key explanations why small objects are observed. In computer vision research, this will be viewed as a difficult problem to solve. Most of the photos have, first of all, restricted resolution of inputs. If there are the pictures themselves in a Low resolution, then it is possible to represent only small objects By a couple of pixels. Even humans will not do well enough with such little knowledge from the images. Furthermore, most of the architectures of computer vision scale the Input size, which is usually very small, to a fixed size. This, Image size can further decrease.

In this method It trains end-to-end CNNs in order to classify the regions proposed into object groups or backgrounds. R-CNN functions primarily acts as a classifier and does not predict object boundaries (except for refining by bounding box regression). Its precision depends on the efficiency of the proposal module area. Several papers have suggested methods of using deep networks to predict bounding boxes for objects [8]. A fully-connected layer is trained in the Over Feat method to predict the box coordinates for the localization role that a single entity assumes. To detect multiple class-specific artefacts, the fully-connected layer is then converted into a convolutional layer. The Multi Box methods generate region proposals from a network that simultaneously predicts multiple class-agnostic boxes from its last completely connected layer, generalizing Over Feat's "single box" fashion. For R-CNN, these class-agnostic boxes are used as proposals.

SSD is designed for real-time object detection. Faster R-CNN uses a region proposal network to create boundary boxes which are utilized to classify objects. The whole process runs at 7 frames per second which is too low compared to real-time processing needs. The process in SSD by eliminating the need for the region proposal network. To deal with the drop in accuracy, improvements including multi-scale features and default boxes are applied. These improvements make SSD match the Faster R-CNN's accuracy using lower resolution images that further pushes the speed higher. YOLO (you look only once) real-time object detection algorithm[10]. With the ground-breaking 2015 paper by Joseph Redmon et al, YOLO came to the computer vision scene. "You Only Look Once: Unified, Real-Time Object Detection,". Furthermore, classification does not operate on images that contain more than one object. A totally different strategy is used by YOLO. For doing object detection in real-time, YOLO is a clever convolutional neural network (CNN). The algorithm applies the whole image to a single neural network, then divides the image into regions and for each region forecasts bounding boxes and probabilities. These bounding boxes are weighted by predicted probabilities [9]. YOLO is common as it achieves high precision while being able to run in real-time as well. In the sense that it needs only one forward propagation pass through the neural network to make predictions, the algorithm 'only looks once at the picture. After non-max deletion (which means that each object is only detected once by the object detection algorithm), it then outputs known objects together with bounding boxes. With YOLO, for such boxes, a single CNN simultaneously forecasts several bounding boxes and class probabilities. YOLO trains on full images and specifically optimizes detection efficiency. This model has a range of advantages over other methods of detecting objects YOLO is extremely fast

During training and test time, YOLO sees the whole picture so that it indirectly encodes contextual details about classes as well as their presence. YOLO learns generalizable object representations, such that the algorithm outperforms other top detection methods when educated on natural images and evaluated on a network.

An electronic device for measuring the volume measurement of banana fruit has been developed to predict the volume of banana fruit [5].

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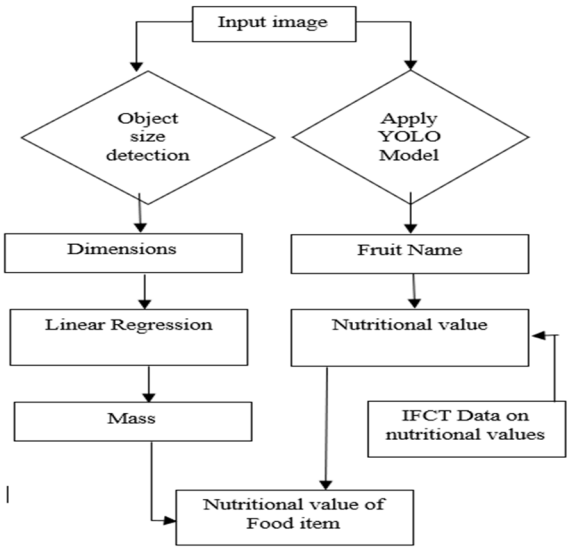
To predict the volume of the banana fruit, an electronic device based on a capacitive sensor was developed. The rectangular parallel plate capacitor, electronic circuitry, microcontroller, and display unit[5] are four components of this device used for volume calculation. The capacitive sensor method is accurate for measuring banana volume and needs to be calibrated for other fruit volume measurements.

Develop equipment to calculate the mango base volume on the basis of Technique of Acoustic Resonance [6]. This tool generates Frequency used in the mango extract form. This method has an instrument, A cylinder-shaped polyvinyl chloride (PVC) pipe. There is a single plastic plate at the bottom of the instrument and the speaker is Installing the tools at the end. The microphone was placed at a height of 15 cm from the base to the cylinder wall. The personal computer's sound card and the speaker were connected to the sound card's audio output. The microphone detects the response signals and enters the sound card of the personal computer. The MATLAB program converts the received signal into frequency using a fast Fourier transform (FFT). The mango put on a resonator then the frequency is measured. Mangos are put on this resonator with different positions and sizes.

III. FLOW DIGRAM



IV. METHODOLOGY

A. Object Detection

The dataset for required fruits is collected [11]. The dataset is processed in order to implement YOLO algorithm. We need to pass the labeled data to the model in order to train it. The images are labeled using Labellmg. Labellmg is a graphical image annotation tool and label object bounding boxes in images. The image is divided into grids. It then identifies the object in each grid and compares the matching probabilities to a threshold. The box with the highest probability is selected as the output prediction.

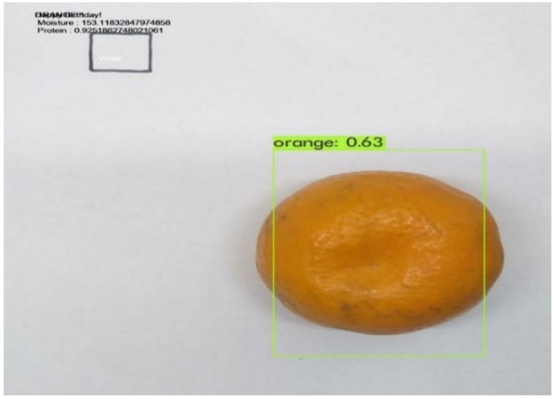


Figure 1 – Detection of object

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B. Dimension Calculation

The program intends to calculate of volume of fruits without the use of any measuring hardware. We are calculating the volume of the minimum possible bounding box on the particular fruit. For this, we require all the three dimensions. These dimensions are obtained by the means of image processing on two different images of the same fruit in different angles (adjacent). The image of the fruit must consist a reference box of a fixed size.

A digital image is made up of pixels. The code will calculate the number of pixels for the reference box. The pixels per centimeter are obtained by dividing the distance from one corner of bounding box to the adjacent corner of the bounding box by the fixed distance in centimeter.

Now a bounding box is formed on the given fruit. And the pixel position for the top right, top left, bottom right and bottom left is stored. Then, in order to calculate the width, we find the Euclidian distance from top-right to top-left point and divide it by pixels per centimeter. This gives us the width of the bounding box in centimeters. Similarly, we find the height by using the bottom-right pixel instead of top-left pixel.

The same procedure is applied on second image of the same fruit but with adjacent angle. This gives us 4 possible dimensions of the fruit, 2 of whom are same. The dimensions that are same in length would be considered as one. This will give us the three required dimensions. With these dimensions, we can calculate the volume by multiplying them together.

A bounding box is formed on the reference object. The corner points of the bounding boxes are stored as top-left, top-right, bottom-right and bottom left (tr, tl, bl, br). To calculate pixels per unit length, we need the distance between tl and tr.

Length of bounding box = $\sqrt{(tl_i - tr_i)^2 + (tl_j - tr_j)^2}$ (1)

Since this is of fixed length, we can calculate the pixels per unit length.

Pixel per cm = distance in pixel / distance in cm - (2)

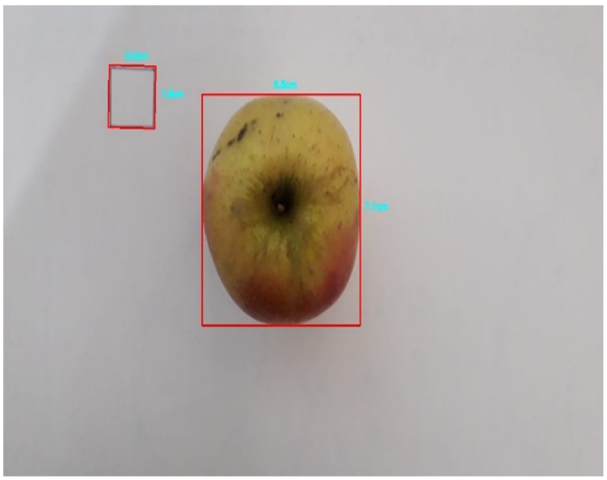

Figure 2 – Dimensions of object (Top View)

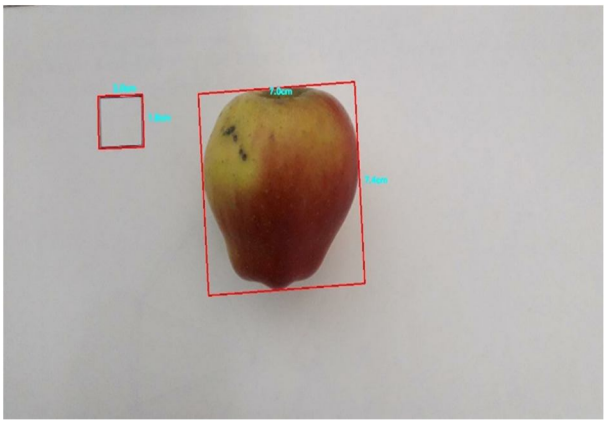

Figure 3 – Dimension of object (Side view)

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C. Mass Prediction using Linear Regression

Now a Dataset is created having actual mass of the fruit and 3 dimensions i.e., length, breath and width. Using linear regression, we predict the weight of required fruit with help Data set. Data set is dived in two-part X and Y Where X is input with 3 dimensions and Y is actual mass of fruit which is output.

D. Nutritional Value Calculation

After obtaining the predicted mass of the fruit and collecting the nutritional value of the fruit per 100 gm from the IFCT dataset, buy the use of unitary method applied on data obtained the nutritional value of fruit is determined

Fruits	Moisture	Protein	Total Fat	Fiber	Carbohydrate	Energy
Apple	0.83	0.0029	0.0064	0.0259	0.1311	2.61
Orange	0.89	0.007	0.0013	0.0129	0.0729	1.56
Banana	0.71	0.0149	0.0035	0.0233	0.2341	2.5
Pineapple	0.8606	0.0052	0.0016	0.0346	0.0942	1.8
Papaya	0.9147	0.0042	0.0018	0.0283	0.0468	1

Table No 1- Nutritional Values of Fruits

E. Glycemic Load

Glycemic Load is the best way to compare blood glucose values of different types and amounts of foods. Glycemic Load is calculated by the carbohydrate content of food.GL value is calculated by the Eq. (3).

GL = (GI x the amount of carbohydrate) divided by 100 (3)

Sr.no	GL Value	Risk Factor
1	0-10	Low
2	10-20	Medium
3	More than 20	High

Table no 2- Range of GL value for Risk Factor.

```
Weight: 180.25635195161422 g
ORANGE 1
Moisture : 160.42815323693665
Protein : 1.2617944636612994
Total Fat : 0.23433325753709847
Fiber : 2.3253069401758233
Carbohydrate : 13.140688057272678
Should be avoided by patient
```

Figure 4 – Output

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V. EXPERIMENTATION

A. Dimension Measurement

While capturing Image From a particular Base distance will not be a constrain for Calculating the Dimension of object. Reason being the program will first detect the Reference Box of 2X2 cm Which is Drawn on top Left corner. Now this gives the benefit of capturing the image of fruit from different heights and still gives exact same dimension.

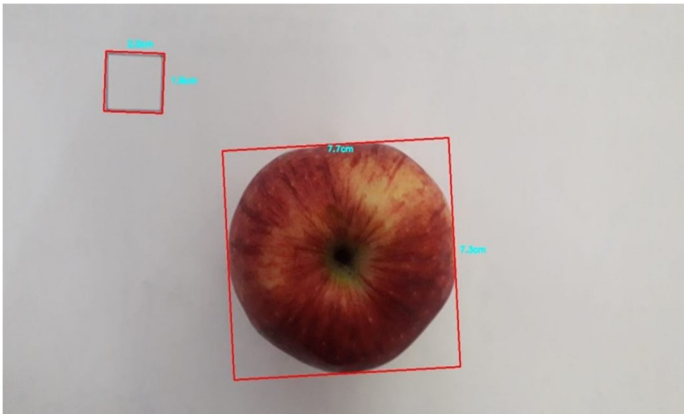

Figure 5 - Apple captured from height of 20cm

Figure 6 – Apple captured from height of 15cm

B. Accuracy

The weight of various oranges was measured on a weighing scale and was compared with the output obtained through images. The following table shows the calculated result in tabular form.

L	B	W	ACTUAL	MODEL	DIF	%
8	8.6	8.3	183	179	0.98	98
7	8.2	8	206	199	0.97	97
8	8.3	7.2	184	186	0.99	99
8	7.5	7.2	183	180	1.02	98
8	7.8	7.3	203	200	0.99	99
8	7.6	7.5	178	181	0.98	98
8	7.6	6.7	179	182	0.98	98
8	7.8	6.8	180	178	0.99	99
8	7.8	6.8	182	184	0.99	99

Table 3 – Accuracy Table

Hence the average accuracy of weight value is 97.77%.

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VI. CONCLUSION

The nutrition value calculation with accuracy over 95% is achieved by this model. This model is more usable than several others that use expensive hardware or take longer time. The nutritional values available on any sources gives the value for a fixed amount of food portion but this will enable the users to get the exact amount of nutritional values that he/she consumes. This model gives an average accuracy of 97 percent while calculating weight.

REFERENCES

[1] A food portion size measurement system for image based dietary assessment, in Proc. IEEE 35th Bioeng (Apr.2009)

[2] Zhang, Weishan, et al. "Food image recognition with convolutional neural networks." 2015 IEEE 12th Intl Conf on Ubiquitous Intelligence and Computing and 2015 IEEE 12th Intl Conf on Autonomic and Trusted Computing and 2015 IEEE 15th Intl Conf on Scalable Computing and Communications and Its
Associated Workshops (UIC-ATC-ScalCom). IEEE, 2015.

[3] Pouladzadeh, Parisa, Pallavi Kuhad, Sri Vijay Bharat Peddi, Abdulsalam Yassine, and Shervin Shirmohammadi. "Food Calorie Measurement Using Deep Learning Neural Network." 2016 IEEE International Instrumentation and Measurement Technology Conference Proceedings, 2016, DOI:10.1109/i2mtc.2016.7520547, pp 1-6.

[4] Measuring Calorie and Nutrition From Food Image
Parisa Pouladzadeh, Shervin Shirmohammadi, Senior Member, IEEE, and Rana Al-Maghrabi. IEEE, 2014.

[5] Javad Taghinezhad, Reza Alimardani and Mahmoud Soltani, "Prediction of banana volume using capacitive sensing method", Javad Taghinezhad et al./ Elixir Agriculture 46 (2012) 8418-842.

[6] Nikita Sharma, Mahendra Mishra, Manish Shrivastava, "Colour Image Segmentation Techniques and Issues: An Approach", International Journal of Scientific & Technology Research Volume 1, Issue 4, May 2012.

[7] JokoSiswantoro, Anton SatriaPrabuwono, Azizi Abdullah, and Bahari Idrus1, "Monte Carlo Method with Heuristic Adjustment for Irregularly Shaped Food Product Volume Measurement", Hindawi Publishing CorporationThe Scientific World Journal Volume 2014, Article ID 683048.

[8] Shaoqing Ren, Kaiming He, Ross Girshick, and Jian Sun," Faster R-CNN: Towards Real-Time Object Detection with Region Proposal Networks"
[9] J. Redmon, S. Divvala, R. Girshick and A. Farhadi, "You Only Look Once: Unified, Real-Time Object Detection," 2016 IEEE Conference on Computer Vision and Pattern Recognition (CVPR), Las Vegas, NV, 2016, pp. 779-788, doi: 10.1109/CVPR.2016.91.

[10] SSD: Single Shot MultiBox Detector Wei Liu1 , Dragomir Anguelov2 , Dumitru Erhan3 , Christian Szegedy3 , Scott Reed4 , Cheng-Yang Fu1 , Alexander C. Berg1 1UNC Chapel Hill 2Zoox Inc. 3Google Inc. 4University of Michigan, Ann-Arbor,29 Dec 2016.

[11]. https://www.kaggle.com/mbkinaci/fruit-images-for-object-detection

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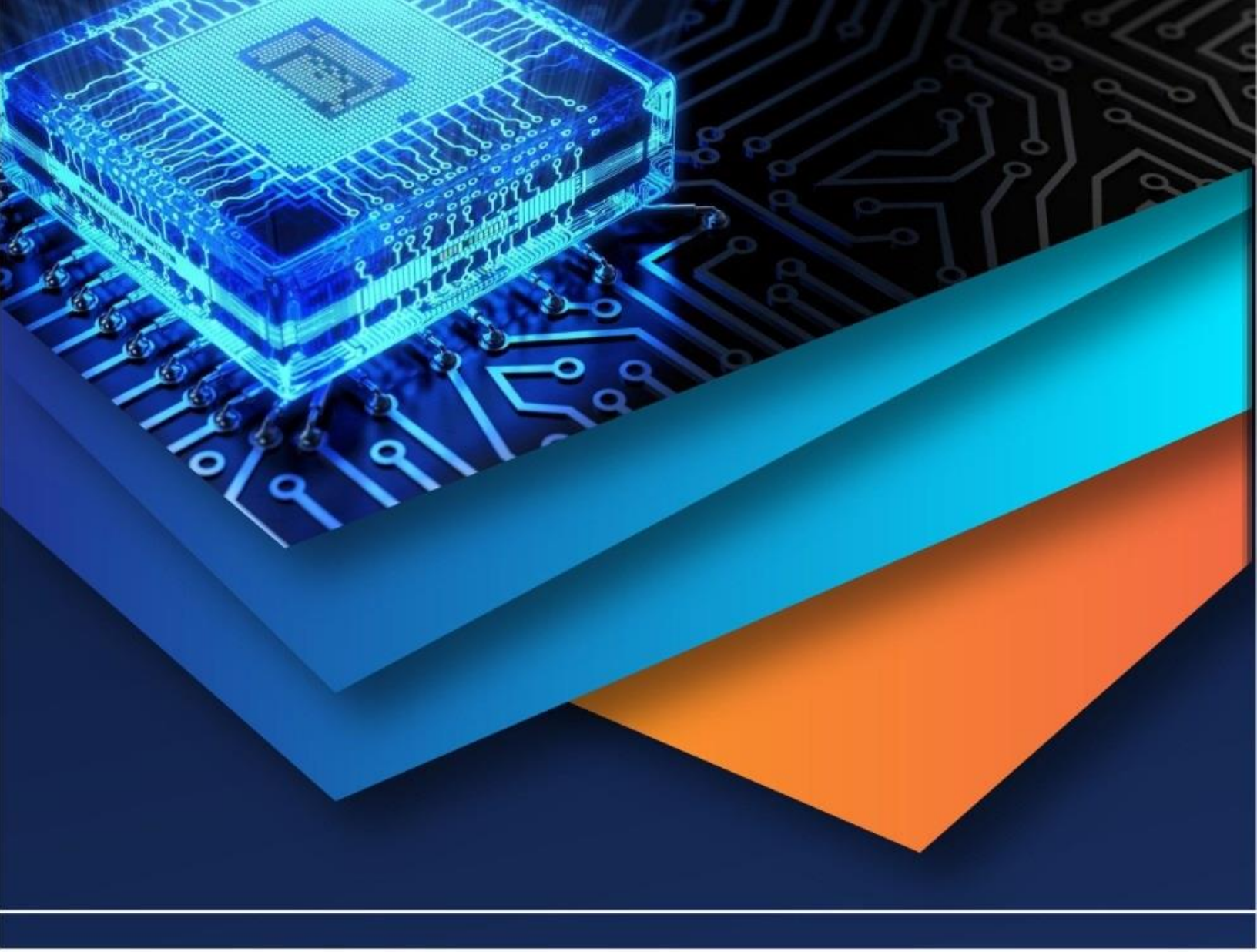

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