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Edge Detection and K-means Clustering Techniques used for Dental X-ray Image Segmentation

Dr. Sunitha M R[1], Asha D[2]
[1]*Professor,* [2]*4th Sem M.Tech, Department of Computer Science and Engineering, Adichunchanagiri Institute of Technology, Chikkamagaluru , Karnataka - 577102*

Abstract: ***Image processing is a strategy of improving the standard of an image after removing irrelevant image information from image in different applications and domain. Dental image contain lot of undesirable data. Image segmentation is one of the most significant processes of dental image analysis. Therefore, to obtain the proper result, it is required to perform the accurate and efficient segmentation approach which provide itself in the aspect of dental image segmentation. In the Digital Image Processing, edge detection playing a vital role. An edge is the boundary between an object and the background, and indicates the boundary between overlapping objects. Image segmentation is the division or separation of an image into regions i.e. set of pixels, pixels in a region are similar according to some criterion such as colour, intensity or texture. This paper compares the color- based segmentation with k-means clustering and Edge detection. The k-means used partition cluster method. Experiment shows that Edge detection gives better result than K-Means clustering.***
Keywords: Image segmentation, k-means clustering, Edge detection;

I. INTRODUCTION

Image segmentation is one of the most important techniques in image processing. It is a pre-processing step in the area of image analysis, computer vision, and pattern recognition. The process of dividing a digital image into multiple regions (sets of pixels) is called image segmentation. Image segmentation is commonly used to determine objects and boundaries (lines, curves, etc.) in images. The result of image segmentation is a set of segments that include the entire image, or a set of contours extracted from the image (edge detection). All pixels in a region is related with respect to some features or computed property, such as color, intensity or texture. Adjacent regions are significantly different with respect to the same characteristics. Some of applications of image segmentation are: digital libraries, image processing, medical imaging, computer vision, face recognition, image and vide retrieval etc. Image segmentation is a low-level image processing task that aims at dividing an image into homogenous regions. Segmentation algorithms are based on one of the two basic properties of intensity, discontinuity and similarity. First category is to partition an image based on small changes in intensity, like edges in an image. Second category is based on partitioning an image into regions that are similar according to some predefined criterion. Threshold approach comes under this category. Image segmentation methods fall into different categories: Region based segmentation, Edge based segmentation, and Clustering based segmentation. Edges contain important information of objects such as shapes and locations, and are often used to distinguish different objects and/or separate them from the background in a scene. It can significantly reduce the amount of data to be processed in the subsequent steps such as feature extraction, image segmentation, registration, and interpretation. Edge detection has found many applications in pattern recognition, image analysis, and computer vision. Edge detection is the process to identify and locate such sharp intensity contrasts in an image and it is well known that slow changes correspond to small values of derivatives while fast changes correspond to large values of derivatives. The result of applying an edge detector to an image may lead to a set of connected curves that indicate the boundaries of objects, the boundaries of surface markings as well curves that correspond to discontinuities in surface orientation. So, it is not always possible to obtain such ideal edges from real life images of moderate complexity. Since image intensity is often proportional to scene radiance, physical edges are represented by changes in the intensity function of an image. Therefore, it should be mandatory to find out the occurrence in perpendicular to an edge.

K means clustering is a method to divide a set of data into a specific number of groups. It's one of the popular method is k-means clustering. In k-means clustering, it partitions a collection of data into a k number group of data. It classifies a given set of data into k number of disjoint cluster. K-means algorithm consists of two separate phases. In the first phase it calculates the k centroid and in the second phase it takes each point to the cluster which has nearest centric from the respective data point.

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II. REVIEW OF LITERATURE

Image segmentation is applied on images so as to isolate a region or object of interest from the entire image. There are number of image segmentation techniques that are classified into region approach, boundary approach and edge approach. We used edge based image segmentation techniques i.e. level set active contour for the segmentation of cavities in the image. Active contour method was an earlier edge based approach used for image segmentation.

Khaled Hammouda[1] has done a survey on different techniques of data clustering in," A comparative study of data clustering technique". It implemented different data clustering technique- k-means clustering, Fuzzy c-means clustering, and Mountain clustering and subtractive clustering.

It analyze these different technique, it is found that k-means and Fuzzy c-means are preferred when the number of cluster is known, and in such cases Mountain clustering is not usually used because of high number of dimension due to its exponential proportionality to the dimension of the problem. But if the number of cluster is not known, Mountain clustering method is used.

Again it is conclude that subtractive clustering is more advantages than Mountain clustering. Lastly it is stated that these different technique can be used in conjunction with other neural or fuzzy system so that it can improve the system performance.

H.D. Cheng, X.H.Jiang, Y.Sun and Jingli Wang [2] did a literature surve on various color image segmentation technique. They discussed about different approaches of segmentation of monochrome images.

They had done comparision on many techniques and point out the advantages and disadvantages of them. They conclude HSI based segmentation as a better method, but still it had disadvantages like unstability of hue at low saturation. Lastly they conclude fuzzy based color image segmentation as promising means for color image segmentation.

Ibrahim A. Almerhag, Idris S Feghi and Ali A Dulla [3] proposed a new method of k-means clustering algorithm in," A modified k-means clustering algorithm for gray image segmentation". It proposed a new modified method of conventional k-means algorithm. In conventional k-means algorithm, usually cluster centers are randomly initialized. But here it intruded a new method to initialized the initial cluster centers.

It uses minimum and maximum data points in the given data set to initialize the cluster centers. Then comparison is done between the standard and proposed k- means algorithm and it is found that the proposed algorithm have effective and more robust than the traditional k-means algorithm.

Nicholas Sia Pik Kong, Haidi Ibrahim and Seng Chun Hoo [4] had a survey on the histogram equalization techniques and implemented the methods like Histogram Equalization, Local Histogram Equalization, Mean Brightness1prevention Histogram Equalization and Modified Histogram Equalization

They conclude that LHE are suitable where it required to reveal small and hidden image content. And MBPHE are useful when it aim to preserv the overall mean brightness of the image.

Active contour model is also called as snake model, first introduced by Kass [5] in 1987. Caselles et al. [6] presented a geodestic active contours scheme for the detection of object boundaries. Chenyang et al. [7] developed a new external force i.e. Gradient Vector Flow for solving the problem of initialization and poor convergence.

Steve et al. [8] proposed a dual active contour method to relieve the problem of initialization of parameters and initial contour. Amelioration over active contour method was level set method, presented by Sathian [9] in 1999, in which geometric shapes are combined with the snake model. Giraldi et al. [10] presented a new approach, a combination of T-Snakes method and multi-resolution method for the segmentation and boundary extraction.

Chan et al. [11] proposed a new method for the detection of objects, based on curve evolution and Mumford Shah function for the level set segmentation.

Derraz et al. [12] presents Application of Active Contour Models in Medical Image Segmentation. Chunming et al. [13] presents a variational formulation for the level set evolution without re-initialization. Qin et al. [14] presented a New Medical Image Sequences Segmentation Based On Level Set Method.

Chiu et al. [15] presents a method for the evaluation of Active contour on medical inhomogeneous image segmentation. Franz et al. [16] presented Fast and Robust Active Contours for Image Segmentation. Huang et al. [17] proposed a level set method for image segmentation in the presence of intensity in homogenieties with application to MRI. Recently, Norouzi et al. [18] proposed a methodology for the segmentation and features extraction in digital dental X-Ray images.

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III. METHODOLOGY

We propose an identification of the defects/cavity present in the Dental X-Ray images and an edge detection based segmentation of the cavity present in the image.

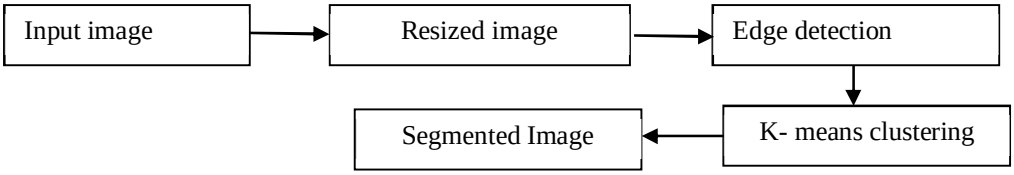


Fig 1: Flowchart of Proposed Method

We are using the techniques to segment the cavities in the X-Ray images. Figure 1 shows flow chart of methodology. Following diagram gives the rough idea of our work:

The proposed segmentation scheme segments the cavities present in the digital dental X-Ray images. The first step is the image enhancement step in which images are resized to 256x256. Further, images are converted from RGB color space to Gray Level color space. Next is the identification step in which the cavities are identified. After the Identification step, the edges are detected using canny edge detection operators. Here we used canny operator for edge detection. The Edge detection results in an image having edges spread over the boundaries of the cavities (REdge). The next1 step is k-means clustering. K- means clustering is also a one type of segmentation. fin1ally segmented image is displayed.

The test images are taken from a dental clinic of size 1024x1024 and following operations are performed:

1) *Step1:* The images are resized so as to get them fit to the screen, using image processing function for resizing the image.
2) *Step2:* The resultant image after step1 is then converted into gray scale image because it becomes easy to analyze the image more easily if it is in gray scale [0 255].
3) *Step3:* In the edge detection process, the defects/cavities present in the image are identified and the cavities are enhanced with covered edges.
4) *Step4:* In the K-means segmentation process, the defects/cavities present in the image are identified and cavity images are divided into separate part.
5) *Step5:* Display segmented image.

IV. EXPERIMENTAL RESULTS AND DISCUSSION

A. Edge detection Segmentation

Edge detection is a process that detects the presence and location of edges constituted by sharp changes in color, intensity of an image. Edge is a part of an image that contains significant variation. The edges provide important visual information since they correspond to major physical, photometrical or geometrical variations in scene object. Physical edges are produced by variation in the reflectance, illumination, orientation, and depth of scene surfaces. Since, it can be proven that the discontinuities in image brightness are likely corresponding to discontinuities in depth, discontinuities in surface orientation, changes in material properties and variations in scene illumination. In this case, the result of applying an edge detector to an image may lead to a set of connected curves that indicate the boundaries of objects, the boundaries of surface markings as well curves that correspond to discontinuities in surface orientation. So, it is not always possible to obtain such ideal edges from real life images of moderate complexity. Since image intensity is often proportional to scene radiance, physical edges are represented by changes in the intensity function of an image[. Therefore, it should be mandatory to find out the occurrence in perpendicular to an edge.

B. K-Means Segmentation

In our work we have used K-mean clustering for performing document image segmentation using Matlab. A good clustering method will produce high quality cluster with high intra-class similarity and low inter class similarity. The quality of clustering result depends in both the similarity measures used by the methods and its implementation. Clustering means classifying and distinguishing things that are provided with similar properties. Clustering technique classifies the pixels with same characteristics into one cluster thus forming different cluster according to coherence between pixels in a cluster. In a method of unsupervised learning and a common technique for statistical data analysis used in many fields such as pattern recognition and document image analysis.

C. Comparison of two Methods

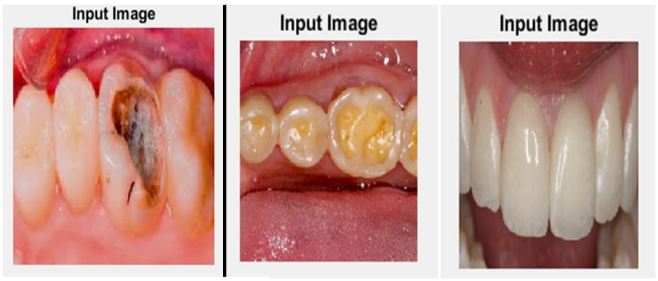


Fig 2: (a) Dental image with Peridontities disease

(b)Dental image with Periopical infection disease

(c)Dental image without disease

Fig 2 shows the sample images. Here in Fig 2(a) dental image with Periodontities disease is taken as a input, In Fig 2(b) dental image with Periopical infection disease is taken as a input, In Fig 2(c) Normal dental image is taken as a input. After we can apply the Edge detection and k-means technique. After obtained image is segmented image.

1) *Edge Detection Method:* Fig 3 shows the edge detection segmented images. Here in Fig 3(a) shows segmented dental image with Periodontities disease, In Fig 3(b) shows segmented dental image with Periapical infection disease, In Fig 3(c)shows segmented Normal dental image. After input images are taken edge detection method can be applied. Here Fig 4 shows the segmented image with disease and also without disease image.

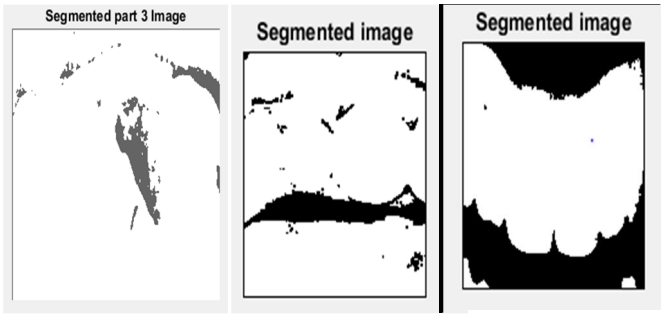


Fig 3: (a) Dental image with Periodontities disease

(b)Dental image with Periapical infection

(c) Dental image without disease

Fig 4: Segmentation Result

2) *K-Means Segmentation*

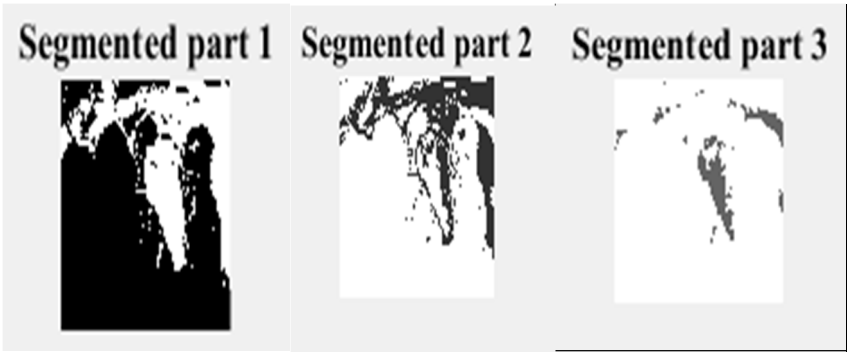
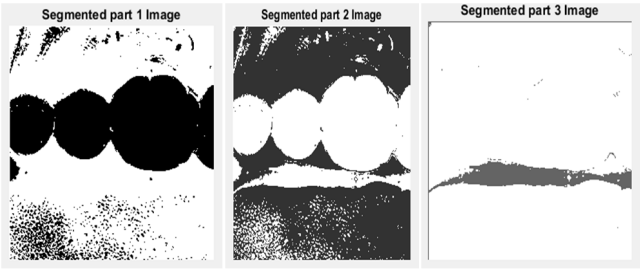
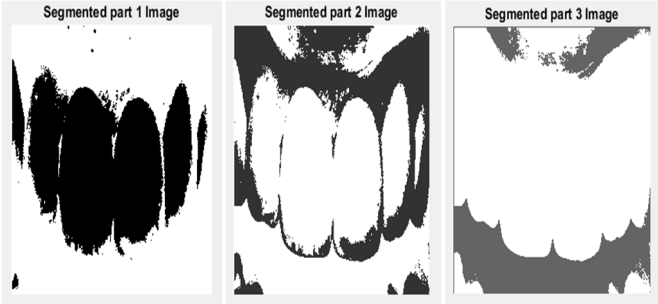


Fig 5: (a) Dental image with Periodontities disease



(b) Dental image with Periapical infection disease



(c) Dental image without disease

Fig 6: Segmentation process results

Fig 5 shows the k- means segmented images. Here in Fig 5(a) shows three part segmented dental image with periodontities disease, In Fig 5(b) shows three part segmented dental image with periapical infection disease, In Fig 5(c) shows Normal dental image. After input images are taken k-means method can be applied. Here Fig 6 shows the k-means segmented image with disease and also without disease images.

D. PSNR Graphs for Dental images with Periodontities Disease

A Compression of Edge detection and K-means graph for Periodontities Disease

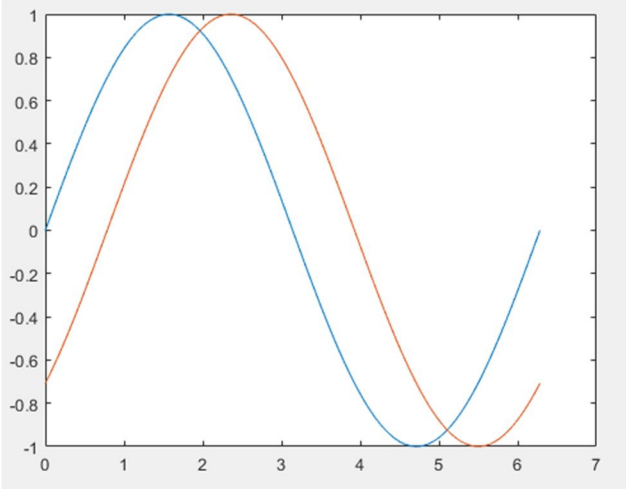


Fig 7: comparison of two graphs

Fig 7 shows the PSNR Graph for Dental image with Periodontities disease and comparison of k-mean and edge detection segmentation graph. Here blue line indicates the edge detection method and red line indicate the K-means method. This paper broke down and looked at two segmentation methods, for example, Edge detection and K-means method. It is observed that among two segmented process, Edge detection method has given better outcome over k-means method dependent on the graph.

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E. PSNR Graphs for Dental image with Periapical Infection Disease

A Comparison of Edge detection and K-Means graph for Periapical infection disease

Fig 8 shows the PSNR Graph for Dental image with periapical infection disease and comparison of k-mean and edge detection segmentation graph. Here blue line indicates the edge detection method and red line indicate the K-means method. This paper broke down and looked at two segmentation methods, for example, Edge detection and K-means method. It is observed that among two segmented process, Edge detection method has given better outcome over k-means method dependent on the graph.

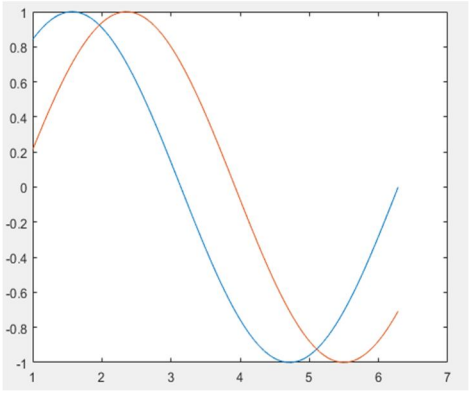

Fig 8: comparison of two graphs

F. PSNR Graphs for Dental image without disease

A comparison of Edge detection and K-Means graph

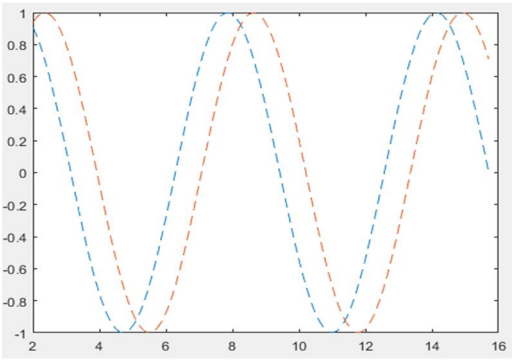

Fig 9: comparison of two graphs

Fig 9 shows the PSNR Graph for Dental image with periapical infection disease and comparison of k-mean and edge detection segmentation graph. Here blue line indicates the edge detection method and red line indicate the K-means method. This paper broke down and looked at two segmentation methods, for example, Edge detection and K-means method. It is observed that among two segmented process, Edge detection method has given better outcome over k-means method dependent on the graph.

Table 1: Table for Segmentation

	Dental image with disease	Dental image without disease
Accuracy	78.6903	60.4774
Sensitivity	75.6279	49.2160
Specificity	82.0741	68.6787

V. CONCLUSION

Find problems in the mouth such as tooth decay, damage to the bones supporting the teeth, and dental injuries. Dental X-rays are often done to find these problems early, before any symptoms are present. Find teeth that are not in the right place or do not break through the gum properly. This work may be extended for plan treatment for large or extensive cavities, root canal surgery, placement of dental implants, and difficult tooth removals. In this paper, we applied to edge detection and K-means segmentation of dental x-ray images and have confirmed its efficiency.

Here, two separating procedure are implemented to various kind of segmentation for dental pictures. This paper investigated and analyzed two segmentation method, for example, Edge detection and K-means. It is observed that among two segmentation process, Edge detection has given preferable result over K-means dependent on the graph. So these techniques can be utilized to segmentation to improve anticipate disease in dental picture dataset.

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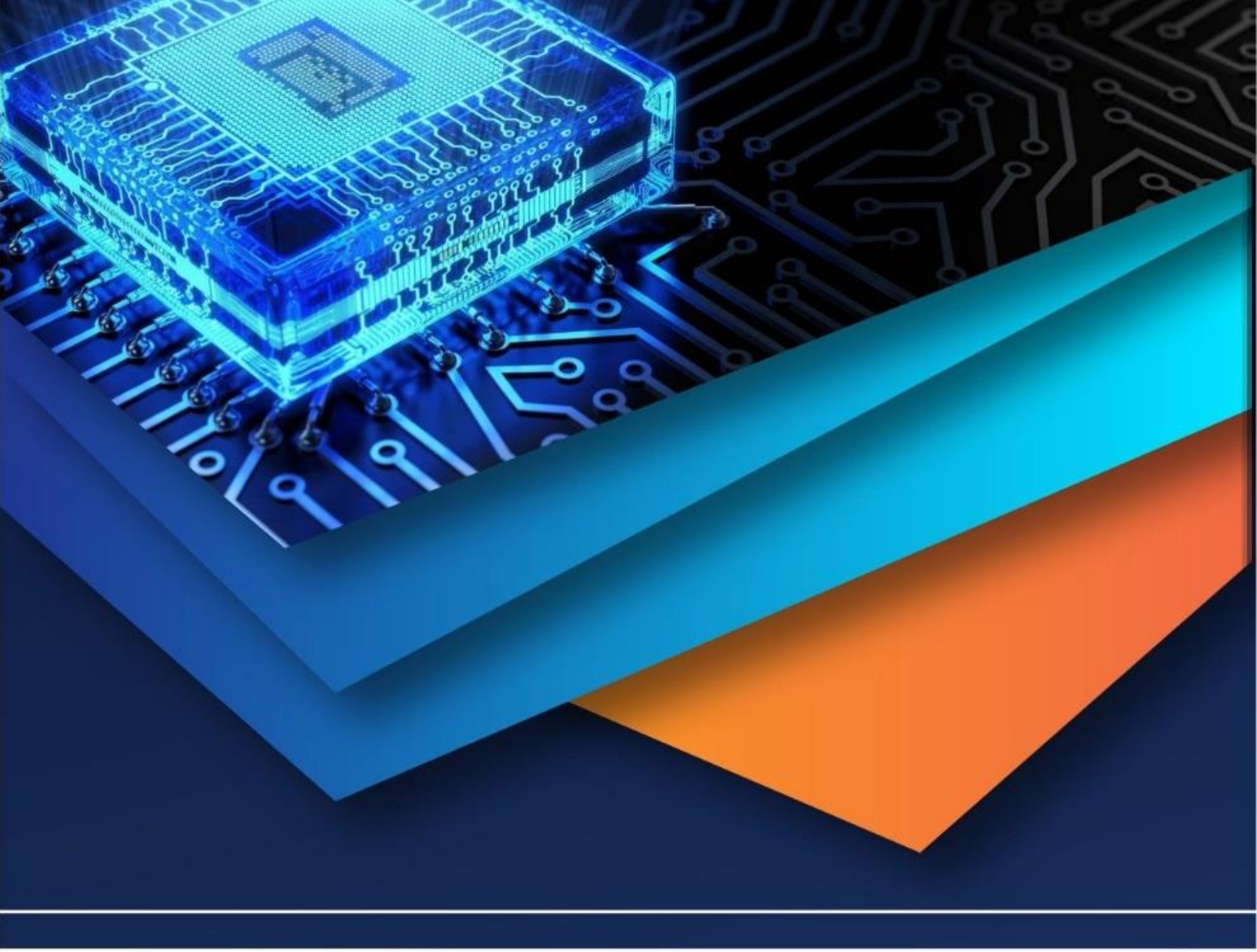

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