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Embedding Iris Image Watermark in Hand Vein Image to Improve Biometric Security

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Abstract*: Biometric acknowledgment is a noteworthy technique for acknowledgment of individual as of late. Here, a typical concern is biometric security which is the protection issues gotten from capacity and abuses of the format information. Two noteworthy ways are Encryption and Watermarking by securing biometric pictures and layouts. In this paper, watermarking innovation is utilized to enhance the format security in biometric validation. Here two modalities, for example, iris and hand vein pictures are taken to safeguard the attributes of vivacity and permanency. The proposed method for implanting of iris information to hand vein pictures utilizing watermarking innovation to enhance layout security in biometric acknowledgment is done in view of the accompanying strides, Pre-handling of iris and hand vein pictures, Iris format extraction, Vein extraction, Embedding of iris example to vein pictures in view of district of ntrigue and putting away installed pictures. A ultimate choice of confirmation is done in light of the item lead based score level combination. The usage is done utilizing MATLAB and the execution of the procedure is investigated with FAR, FRR and precision.

Key words: Biometric recognition, Watermarking, Iris template, Hand vein image, Biometric security, FAR, FRR and accuracy.

I. INTRODUCTION

Biometric framework, which is an example acknowledgment framework, misuses a client's matchless physical qualities to distinguish validate him/her. Two noteworthy gatherings of errands that contribute in a biometric framework are distinguishing proof and validation. Biometrics displays as a potential apparatus when joined with customary verification plots that significantly bolster in building up validness. Biometric layout can be made with the guide of highlight extractor or key restricting calculations. Such biometric formats can be remained careful and adequately secured by abusing watermarking systems. Biometric watermarking installs biometric learning into a computerized question and subsequently it associates a human subject with advanced media. Watermarking can be said as a specialty of embeddings pivotal data which can't be perceived by people. It can guarantee multimodal biometric verification if the layout is hidden with other biometric portrayal. Be that as it may, it is relied upon to be powerful against a few assaults against biometric framework. Slightest critical piece (LSB) strategy is recognized as a best prevalent watermarking technique in which the minimum huge bits of pixels are traded for data stowing away. By and by, the expansion in security needs have requires the exploration on creating lasting type of irreproducible biometrics.

One among such biometrics is iris of people. Iris acknowledgment takes a shot at the premise of visual elements, for example, rings, spots, wrinkles and crown. Because of the high level of arbitrariness in such components, iris acknowledgment is observed to be extremely testing. Promote advancements on induced innovation that are seen in the current days, more precision can be proficient by including more human components, particularly like testing veins and hand backs, which are wealthier in veins than fingers. This leads examine ideas close by vein acknowledgment as one of problem area regions in biometric validation. Designs accessible in the hand veins are observed to be unmistakable between the people and stay same for long haul all through the human life. These vascular examples are mind boggling that prompt decide sufficient capabilities to guarantee exact individual recognizable proof.

II. LITERATURE SURVEY

A. Background

Advanced Watermarking depicts techniques and innovations that conceal data, for instance a number or content, in computerized media, for example, pictures, video. The inserting happens by controlling the substance of the advanced information, which implies the data is not installed in the casing around the information. The concealing procedure must be to such an extent that the alterations of the media are vague. For pictures this implies the alterations of the pixel values must be imperceptible. An advanced watermark is a message which is installed into computerized content (video, pictures or content) that can be identified or extricated later. In addition, in picture the genuine bits speaking to the watermark must be scattered all through the document such that they can't be

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distinguished and controlled. Watermarking is the addition of indistinct and indistinguishable data into the host information for information security and uprightness. There are portraying examples, of differing perceivability, added to the introduction media as a certification of realness, quality, possession, and source. The most widely recognized case of watermark is an Indian cash.

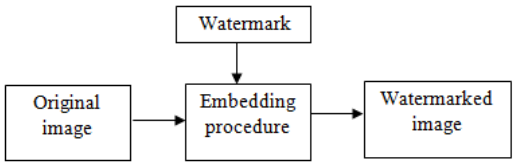

Fig. Block diagram of Watermarking procedure

B. History

More than 700 years back, watermarks were utilized as a part of Italy to show the paper mark and the factory that created it. By the eighteenth century watermarks started to be utilized as Anti-duplicating measures on cash and different archives. The term watermark was presented close to the finish of the eighteenth century. It was presumably given on the grounds that the imprints look like the impacts of water on paper. The main case of an innovation like computerized watermarking is a patent documented in 1954 by Emil Hem Brooke for recognizing music works. In 1988, Komatsu and Tominaga give off an impression of being the first to utilize the expression "advanced watermarking".

Digital watermarks are of four types:

1) Visible
2) Invisible
3) Public, and
4) Fragile

A visible watermark regularly comprises of a prominently noticeable message or an organization logo showing the responsibility for picture. Any evacuation or messing with the logo would break the copyright understanding.

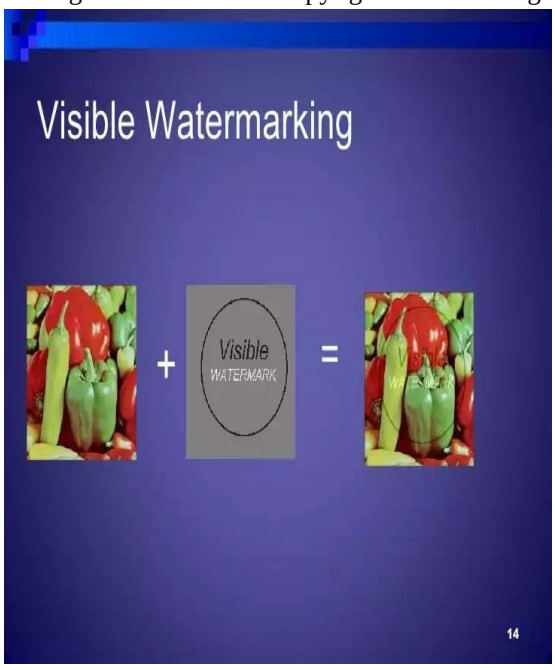

Fig. Visible Watermarking

An invisible watermarked picture seems fundamentally the same as the first. The presence of an undetectable watermark must be resolved utilizing a proper watermark extraction or location calculation. It can be identified by an approved office as it were. Such watermarks are utilized for substance and additionally creator validation and for distinguishing unapproved copier.

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Fig. Invisible Watermaking

C. Iris Recognition

Iris acknowledgment is a robotized strategy for biometric distinguishing proof that utilizations scientific example acknowledgment methods on video pictures of either of the irises of a person's eyes, whose intricate irregular examples are one of a kind, stable, and can be seen from some separation. Retinal filtering is an alternate, visual based biometric innovation that uses the interesting examples on a man's retina veins and is frequently mistaken for iris acknowledgment. Iris acknowledgment utilizes camcorder innovation with inconspicuous close infrared brightening to procure pictures of the detail-rich, unpredictable structures of the iris which are obvious remotely. Computerized layouts encoded from these examples by scientific and factual calculations permit the recognizable proof of an individual or somebody putting on a show to be that person. A key preferred standpoint of iris acknowledgment, other than its speed of coordinating and its outrageous imperviousness to false matches is the soundness of the iris as an inner and ensured, yet remotely obvious organ of the eye.

D. Visible Wavelength(VW) v/s Near Infrared Rays(NIR)

All freely sent iris acknowledgment frameworks obtain pictures of an iris while being enlightened by light in the close infrared wavelength band (NIR: 700–900 nm) of the electromagnetic range. The lion's share of people worldwide have "dim dark colored eyes", the prevailing phenotype of the human populace, uncovering less noticeable surface in the VW band however showing up luxuriously organized, similar to the cratered surface of the moon, in the NIR band. (A few cases are appeared here.) Using the NIR range likewise empowers the obstructing of corneal specular reflections from a brilliant surrounding condition, by permitting just those NIR wavelengths from the limited band illuminator once more into the iris camera.

III.PROPOSED METHODOLOGY

The point of our biometric acknowledgment framework is to enhance the layout insurance by installing the iris information to hand vein pictures in light of watermarking innovation. The proposed strategy of implanting of iris information to hand vein pictures utilizing watermarking innovation comprise of taking after strides, i) preprocessing of iris and hand vein pictures, ii) iris format extraction, iii) Vein extraction, iv) Embedding of iris example to vein pictures in light of area of intrigue, v) Storing installed pictures.

A. Irish Image Pre-processing and key generation

The underlying phase of our proposed strategy is pre-preparing in which the iris pictures are obtained and procedure to remove the iris key. By consequent confinement, the data related with iris part is chosen from the whole picture.

1) *Iris Localization:* All things considered, limitation can be said fruitful, when it is expert with least nonattendances in the quantity of pixels inside the circle limit. The decrease of number of pixels inside the circle limit prompts quick and simple calculation. At that point, the pinnacles of the inclination picture can be limited utilizing non-most extreme concealment. The procedure of non-most extreme concealment on a pixel with its inclination imgrad(x,y) and introduction theta(x,y) can be confined by utilizing an edge converges through two of its eight neighborhood associated pixels. A point at (x,y) can be said as most extreme such that its pixel esteem ought not be littler than the pixel estimations of the two crossing point focuses. In this manner, hysteresis thresholding is performed so that the feeble edges that are beneath sure edge esteem and that are not associated with an edge, which is above high limit, through a chain of pixels, which are over the low edge, can be killed. Limits of the iris and the understudy are resolved to perform edge recognition prepare. The previously mentioned administrator seeks the angle picture alongside limit of circles with high radii and henceforth it acts as a roundabout edge indicator. The circles

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focuses and radii can be computed utilizing the most extreme total, which can be resolved in view of the probability of all circles. Few concerns are related with Hough change. They are, deciding limit values by experimentation premise and escalation in calculation. These issues can be settled by utilizing eight-way symmetric focuses in the hover for each hunt point and range. Thresholding idea can be utilized to isolate eyelashes and these pixels are set apart as uproarious pixels, since they are excluded in the iris key.

B. Image Normalization

The following stage after iris division is standardization to create iris key and their examinations. Standardization process is included two stages that are unwrapping the iris and transformation of it into polar comparable. This should be possible utilizing Daugman's elastic sheet demonstrate. Focus of the pixel is set as the reference point and the focuses are changed over from Cartesian scale to polar scale utilizing a remapping equation. The altered form of the model is given in condition as takes after

$$R' = \sqrt{\alpha\beta} \pm \sqrt{\alpha\beta^2} - \alpha - R_1^2$$

Where, R_1 represents iris radius.

$$\alpha = a_x^2 + b_y^2$$

$$\beta = \cos\left(\pi - \arctan\left(\frac{b_y}{a_x}\right) - \theta\right)$$

Radial determination and precise determination of the picture are set to 100 and 2400, separately. An identical position for every iris pixel is resolved in the polar scale. "interp2" capacity is misused to add the standardized picture to size of the first picture. A standardized esteem can be gotten through the parts in the standardized picture, utilizing the whole of the parts.

C. Encoding

Era of iris key is characterized as the last procedure for which the most remarkable element in the iris example is removed. As the doled out stage edges are autonomous to the picture differentiate, just the stage data from the patter is utilized. Due the reliance of adequacy data with improper variables, it is not utilized. Agreeing Daugman stage data can be separated utilizing 2D Gabor wavelets. It evaluates the quadrant in which the subsequent stage lies. Gabor channel can be easily utilized by isolating a 2D standardized example into various ID wavelets. Log-gabor channels are more appropriate than Gabor channels for speaking to normal, since Gabor channels neglects to beat in definitely speaking to high recurrence parts. LogGabor channel can be spoken to as in condition beneath

$$G(f) = \exp\left(\frac{= (\log(f/f_0))^2}{2(\log(\sigma/f_0))^2}\right)$$

1) *Hand Vein Image Pre-processing and Feature Extraction:*In In this the dorsal hand vein pictures are obtained by a variety of infrared light-emanating diode (LED) and a warm camera. Further to decrease the commotion, the acquired hand vein picture is pre-prepared at first. At that point veil is connected to the pre-handled hand vein picture. The span of the picture gotten in the wake of concealing is same as the information. At that point the qualities more noteworthy than zero qualities are discovered in the gotten veiled picture. After this the veins from the hand vein picture are acquired by utilizing Kirsch's layout extraction strategy. It takes a solitary veiled pixel of a hand vein picture with a size of 3 x 3 and decides it quality of the edges by pivoting it in 45 degree increases through every one of the 8 bearings. At long last the most extreme extent for the chose veil pixel of a picture at all heading is resolved. At that point the following procedure is called nearby thresholding which is connected here to isolate the closer view from the foundation of the hand vein picture. It is unique in relation to ordinary thresholding process which changes the edge progressively over the pictures. Here thresholding is finished by setting all pixels of the hand vein picture whose power qualities are over an edge is closer view esteem and all the rest of the pixels is consider as foundation esteem. The fundamental thought of the strategy is computing the mean m(x,y) and fluctuation v(x,y) of the focuses in r x r neighborhood of each pixel. At that point the division is done in light of the condition given beneath,

$$T(x,y) = m(x,y)+c\times v(x,y)$$

Where, T(x,y) is the threshold and c is the coefficient of correction. The pixel value below the threshold is considered as vein domain.

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The value obtained by Kirsch' method is sorted and calculated its length. It is further multiplied as by the given equation below,

L = 0.97 x Length of the blood vessel obtained

Then, the obtained pixel value is chosen as a threshold. Finally the pixel value below the threshold is selected as the features of the hand vein.

2) *Embedding of iris pattern to band vein image:* The The info is iris key picture l(x,y) and the watermark picture is the hand vein picture H(x,y). The yield is the watermarked picture Hw (x, y).

The different strides in watermark inserting are

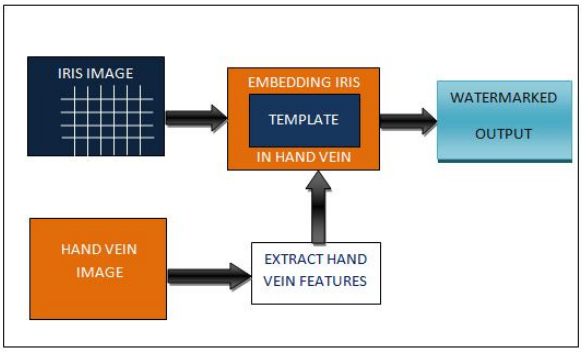
a) The information watermark picture H(x,y)is partitioned into pieces of size B1 ,B2,B3 .....Bn of size MxN. At that point the partitioned square is sorted. From the sorted square of the info picture H(x,y) the principal wavelet coefficient with positive stage and the incentive beneath the edge T(x,y) is picked.

b) Then the second LSB of the chose square of the watermark picture H(x,y)is supplanted by one piece from the iris format J(x,y).

c) If the quantity of bits in the iris format J(x,y) is not as much as the quantity of bloc3s close by vein picture, then all bits of the iris layout J(x,y) can be installed.

d) After installing all the bit of the iris layout J(x,y) close by vein picture an IDWT (Inverse Discrete Wavelet Transform) is connected to the watermarked hand vein coefficient to produce the last secure watermarked hand vein picture.

The watermark installing procedure is appeared in the figure beneath,



e) Recognition Phase using Score level fusion

The acknowledgment stage is isolated in two noteworthy strides.

3) *Step (I) Watermark extraction:* In this acknowledgment stage the watermarked picture is given as information and the iris key and hand vein components are removed. The watermark extraction stage comprises of different strides.

The information is watermarked picture Hw(x,y) and the span of watermarked picture Hs(x,y) and the yield is recuperated watermark picture Rw (x, y).

a) The watermarked picture is partitioned into the detail sub band of watermarked picture into pieces. The each piece of the watermarked picture is of size 2M - 1 x 2N - 1.

b) Identify the incentive beneath the limit T(x,y) in each piece which has the principal coefficient with positive stage.

c) The pixel esteem 1 from the watermarked picture is extricated if the inserted pixel esteem is more noteworthy than the mean pixel esteem generally pixel esteem "0" is separated. This procedure is rehashed until every one of the pixels from the watermarked picture are y given in condition beneath

d) A matrix equal to the size of watermark image $H_w(x,y)$ and the extracted pixels are placed in it to obtain the watermark image $H_s|(x,y)$.

In acknowledgment stage the both iris and vein picture of an individual is taken. At that point both the got iris picture and the hand vein picture are pre-handled independently as by the above strategies. After this pre-handling stage the iris key from the iris picture and the vein highlights from the vein picture are gotten. Assist keeping in mind the end goal to discover whether the info client is honest to goodness or sham we need to contrast the got include and the element put away in the database. Be that as it may, in the database the iris key is implanted in the hand vein picture to enhance the layout insurance. So here we need to extricate the iris key and vein picture independently.

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4) Step (II) Matching: Presently the separation between iris key created from the info question picture and iris key extricated from the implanted picture put away in database is resolved. The coordinating separation for the info iris key and the extricated iris key from implanted picture is meant as Diris. In like manner the pre-prepared vein picture of a similar individual is coordinated with the vein picture highlight removed from the installed picture put away in database. At last a coordinating separation Dvein for the vein picture is resolved. Promote the two standardized comparability separate Diris and Dvein are intertwined straightly utilizing aggregate lead as given in condition beneath,

$$MS = \alpha * D_{Iris} + \beta * D_{Vein}$$

where α and β are two weight values that can be resolved utilizing some capacity. In this paper a mix of straight and exponential capacity is utilized. The estimation of weight is relegated directly if the benefit of coordinating score is not as much as the edge; generally exponential weightage is given to the score. The estimation of MS is utilized as the coordinating score. So if coordinating score is more noteworthy than edge esteem then individual is permitted to enter the framework generally dismisses.

IV. RESULTS

A. Experimental Setup and Evaluation metrics

Implementation of the proposed method is done using MATLAB in a system having 6 GB RAM and 2.6 GHz Intel i-7 processor. Also, the evaluation metrics used here is the accuracy. The accuracy in multimodal biometric is computed
based on FAR (False Acceptance Rate) and FRR (False Rejection Rate). Here, FAR is rate for which the system identifies the non-authorized person. It occurs due to the wrong matching of template with the input. False Rejection Rate is the rate of authorized person incorrectly rejected by the system. Here FAR is represented as,

$$FAR(t) = \frac{GMS}{NGRA}$$

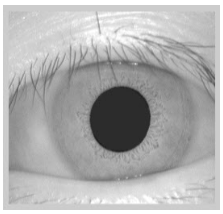
Where, GMS means Genuine Matching Score and NGRA means Number of Genuine Recognition Attempts.
Also the FRR is calculated by

$$FRR(t) = \frac{IMS}{NIRA}$$

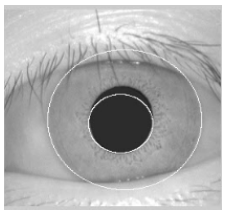
Where IMS is Imposter Matching Score and NIRA is Number of Impostor Recognition Attempts.

B. Experimental Result

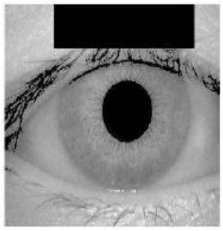
The result obtained at various stage of the method is shown below.



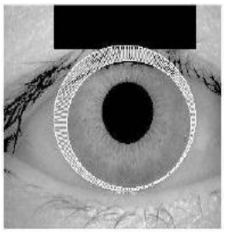
Fig(a) Original Iris Image



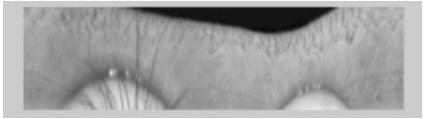
Fig(b) Iris Image with Boundaries



Fig(c) Segmented Iris Image



Fig(d) Segmented Iris Image with boundaries



Fig(e) Polar array obtained after Normalization

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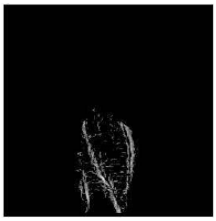
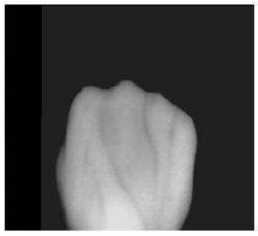
Initially the original iris image obtained is shown in the fig(a). Advance the got unique iris picture is procedure to get the limits of the picture utilizing watchful edge indicator which is appeared in the fig(b). Subsequent to acquiring the limits the iris picture is sectioned this is appeared in the above fig(c). At that point the limits from the portioned picture are gotten that contain data which is appeared in the fig(d). The fig(e) speaks to the polar cluster gotten after iris picture standardization handle. At last the iris key component is removed from the limits. The following phase of the proposed technique is vein picture extraction. Here the first hand vein picture is appeared in the fig(f). After this the acquired unique hand vein picture is preprocessed at different stages to get the vein highlight which is appeared in the fig(g).

Fig(f) Original hand vein Image



Fig(g) Vein Image after Preprocessing



Fig(h) Watermarked hand vein Image

After this the iris key extracted in the first stage is embedded in to the pre-processed vein image. Finally the watermarked vein image obtained is shown in the
fig(h).

V. CONCLUSION

An efficient biometric recognition system for template protection has been presented. A watermarking technology is used to improve the template protection based on the two modalities; the iris and the hand vein. The iris template is extracted from the pre-processed iris image. Then the features of the hand vein are extracted. After this the extracted iris template is embedded in to the hand vein and stored in the database. Subsequently in recognition phase the iris template and hand vein features are extracted from the watermarked image. Finally the extracted features are matched with input query image. The final decision of authentication is done based on the product rule-based score level fusion. The results obtained from the experimentation shows that the proposed watermarking techniques provide better results with higher accuracy. The accuracy of proposed method can be further improved by improving the embedding strength and embedding location by various search algorithms.

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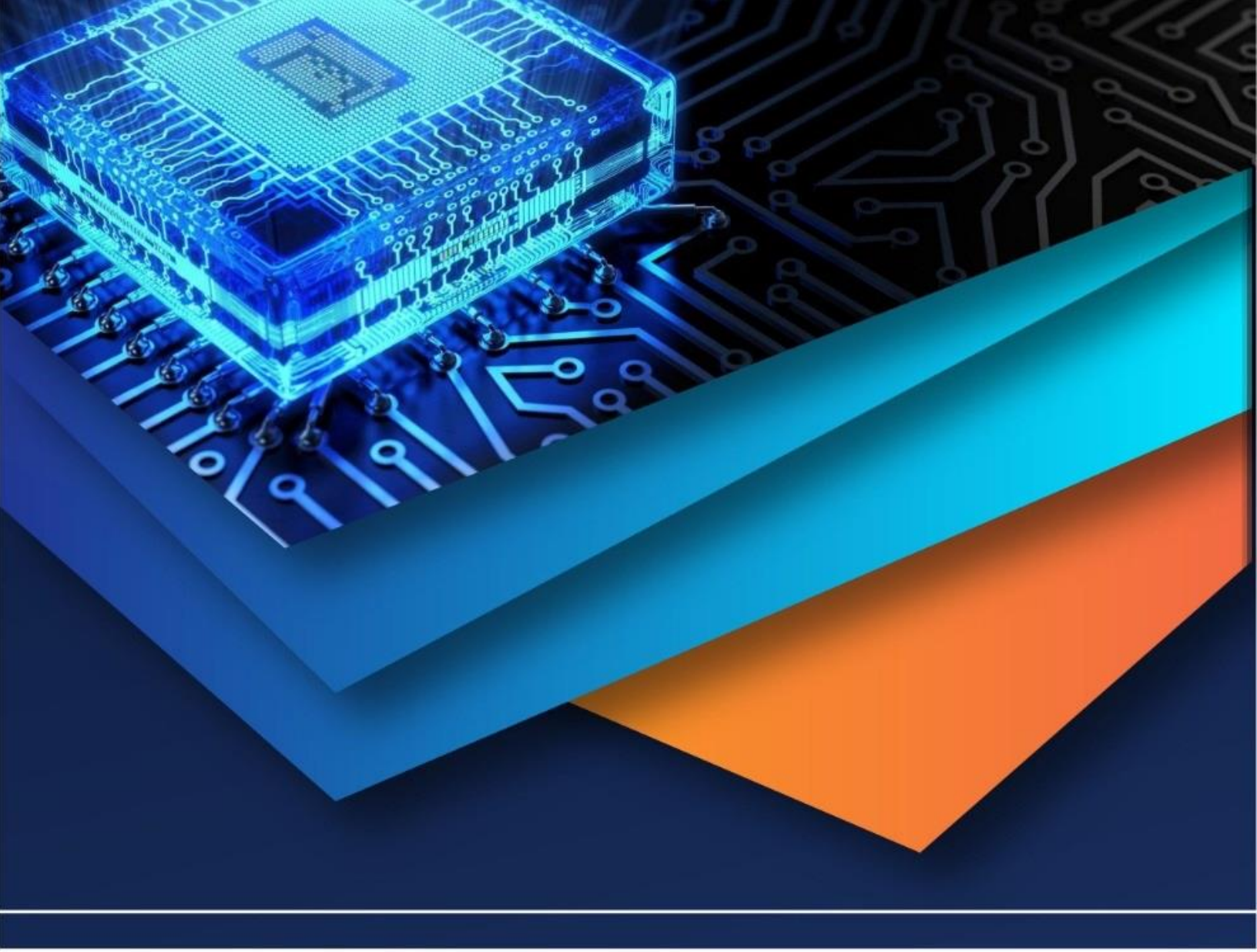

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