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Automatic Personality Analysis through Signatures

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Abstract*: Handwriting analysis or Graphology is the most widely used tool for personality analysis. Writing is a process in which the brain and muscles are involved. Each time a person writes a particular thing specific neuro-motor control is triggered and almost same pattern is generated. These neuro-motor controls are highly affected by age, behavior, drug addiction etc. That is why Signatures or handwriting are treated as behavioral biometric. Specific behavioral traits are associated with a specific signature pattern. These patterns can easily be decoded by skilled graphologists. This paper proposes an automated technique to identify some basic traits of the person on the basis of his/her signature. The proposed system uses basic signature traits like proportion, size, baseline, slanting and space to identify behavioral traits of the signer. Personality types are divided into four pairs of dominant traits. Each pair consist of two extremes. The signer is characterized on the basis of these dominant classes.
Keywords: Graphology, neuro-motor control, Handwriting Analysis, behavioral biometric.

I. INTRODUCTION

Signatures are considered to be behavioral biometric[1]. They are widely used as verification and recognition of an individual because hardly two people have the same signature. Signatures can be some legible or illegible pattern. Such patterns are the result of neuro-motor control.

The brain sends specific signals to the muscles to create a special pattern. Each time something is written same neuro-muscular response is generated due to which almost the same pattern is generated. These patterns are the result of various behavioral patterns and personality traits of a person. Science of reading personality traits on the basis of signatures and handwriting is known as graphology[2].

Graphology is considered as one of an important tool in personality assessment while recruitment of while choosing a career across many countries. Signatures are the embodiment of significant personas like optimism, honesty, fear, emotional balance, creativity, self-analysis etc.

Signatures are a brief representation of one's mental state. There are several features which are a mark of specific personality traits. . Professional graphologists take into account these features while interpreting the personality of an individual. Five core features are caliber, proportion, space, baseline and slant angle. Each of which is evidence in some crucial behavioral pattern.

Since graphology is a science that can predict attitude, attributes, perspective and skills of a person by his signature, it is often used by recruiters, counselors, forensic investigators etc.

Professional graphologists draw a character sketch by analyzing signature patterns on the basis of these elements, individually and with respect to others as well. Such behavioral prediction by a human being can be error-prone due to fatigue, lack of expertise, age or illness factors. In this paper an automated system for personality analysis is presented.

This system identifies slant of the signature, baseline of signature, height and width of the signature in addition to loops and edge points to predict personality types.

MATLAB is used for the implementation of the Automatic Personality Analysis System(APAS). The APAS focuses on minimizing the pre-processing work overhead and identifying features of acquired signatures by using an artificial neural network. Such automated systems can significantly minimize the human error rate by eliminating human intervention in the system.

II. LITERATURE REVIEW

Handwriting analysis is widely used across the globe for behavior prediction by various people. Use of signatures for behavior prediction is a concise methodology used for instant personality traits identification. Various works have been done in the area of handwriting analysis. A few techniques are discussed in this section.

1) *Using Support Vector Machine*- Usually this system uses slant, baseline, pen pressure, the spacing between words and letters. These machines are tuned by radial basis kernel functions. In [3] SVM classifier with polynomial kernel and the Gaussian radial basis function kernel is used. A tenfold cross-validation method is also used. This system reported 93% accuracy as compared to manual systems. On the other hand in [4] a similar approach is presented by using SVM. In this paper authors have used segmentation techniques for preprocessing and extracted various features like baseline, slant, spacing and pressure etc. this system reported 94% accuracy.

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2) *Using Artificial Neural Network*- Neural networks are widely used as classifiers and predictors. In [5] authors have presented an approach for personality analysis using ANN. The features extracted are pen pressure, baseline and the t-bar placement. The baseline is calculated by using polygonalization method, pen pressure by threshold values and height of t-bar is calculated by template matching. The performance of the system varies with variation in a number of hidden nodes and the number of epochs. In [6] four categories of personalities were identified with two extremes in each and each type is identified by a separate handwriting trait. The edge detection algorithm is used to identify features for prediction. This approach is unable to identify spaces between the words. Accuracy of the system depends on the training samples and the number of epochs.
3) *Using Hidden Markov Model*- this method creates a dictionary of patterns with specific traits. In [7] authors proposed a technique which identifies edges and arcs. Each edge is transformed into a ten-dimensional feature vector. Training of the HMMs is done by the Baum-Welch algorithm, whereas the Viterbi algorithm is used for recognition. A recognition rate of 98% was achieved by this system.

III. GRAPHOLOGY

Graphology is a behavioral science used to create a character sketch of a person using his/her handwriting or signature. Various application areas of graphology are in education, psychology, medicine, forensic investigation, matchmaking, career guidance and recruitment. Graphology is a strong tool for personality analysis. Some basic graphology features[8] are –

1) *Size:* Signature can be categorized as large medium or small.
2) *Proportion:* It is the height and width ratio of the signature. It also gives the description of the signature as in which zone it is more dominant. It may be upper, lower or middle. If it is equally spread over all the regions it is known as the proportionate signature.
3) *Space:* Spacing between the letters or if multiple words are there then the spacing between the words can also be taken into account.
4) *Baseline:* It describes the angle of signature to the standard horizontal baseline.
5) *Slanting:* It can be forward slant or backward slant.

These are some features read in graphology. Apart from these many traits are taken into account while getting the character sketch of the signer.

IV. PERSONALITY TYPES

There are various personality types dependent on certain dominant personality traits. In this paper four pairs of extremes are taken into account. To generate a character sketch one property from each pair is selected which suggests a basic personality type of a person. Following are the four pairs of extreme personality traits-

A. Introvert/ Extrovert
B. Intuitive/sensing
C. Thinking/ Feeling
D. Judging/ Perceiving

Certain aspects of the signatures are able to display personality traits like -if the signature of a person is making a positive angle with baseline he is an optimist person and if it is negative he might be clouded with more of negative thoughts. Positive angles are also the sign of creativity and high ambition whereas negative angles show a person is skeptical. If the signature is straight it shows a balanced thought process.

Another Important trait is the size of the signature. Larger the size of the signature more will be the confidence. Smaller signatures are often sign shown by persons who have a difficult time to claim their space. Signature is usually divided into three zones upper, middle and lower[9].

Each zone has its possible interpretations. To interpret this property most dominant zone is observed. If all three zones are weighted equally, the signer is supposed to be a highly stable and balanced person. Following table gives the basic idea of personality traits for signature analysis.

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TABLE I
PERSONALITY TRAITS AND THEIR INTERPRETATION

Sno	Trait	Explanation	
1	Size	Small	Good concentration, minute details are important for them
		Medium	Traditional & Realistic
		Large	Ambitious & Rebellious
		Variable	Highly indecisive and moody
2	Baseline	Positive angle	Optimism & creativity
		Straight	Logical, balanced and reason-oriented
		Negative angle	Pessimism and skeptical
3	Proportion	Upper zone	Philosophical, Spiritual and imaginative
		Middle Zone	Egocentric, Common sense, Realistic and logical
		Lower Zone	Short term planner, work on immediate needs
		Equilibrium	Highly stable mind
4	Space	Very Wide	Lost in the virtual world
		Wide	Quick action taker, extravagant
		Narrow	Thrifty
		Even	Consistent, Even Planning
5	Slant	Right	Future-oriented
		Left	Introverted, lives in past
		Vertical	Balanced and thoughtful
		Varying	Unpredictability

V. METHODOLOGY OF APAS

Flowchart of APAS is given in Fig. 1. Personality analysis task is divided into four stages- Data acquisition, Image preprocessing, Feature Extraction and Behaviour prediction. In Data acquisition phase an offline image of the signature is acquired[10]. This image is then converted into a standard size of 250X250 pixels. In the preprocessing phase, image is subjected to thresholding, skeletonization and binary image conversion. In third phase feature extraction is done. To identify personality traits some features of the signature must be extracted. In this system five features are extracted- size, baseline, proportion, space and slant are extracted. On the basis of these features an already trained ANN classifier is fed with the newly extracted features and the classification is done. This task is done in the last phase i.e. behavior prediction phase. The extent of behavior is obtained by the values provided by the classifier ANN and the final result is displayed.

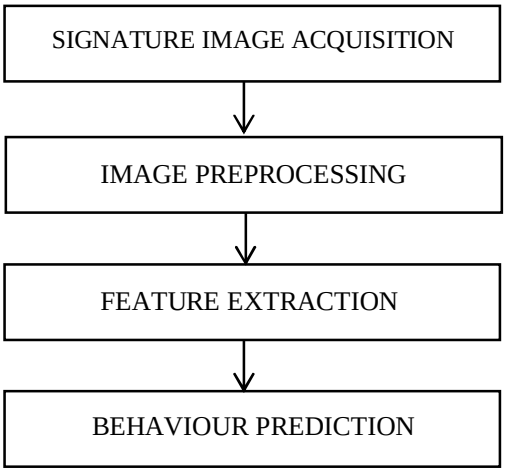

Fig. 1 Flowchart of APAS

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VI. FEATURE EXTRACTION FOR APAS

After the acquisition of the offline signature of the user it is preprocessed. Preprocessing operations consist of conversion into a binary image, thresholding and skeletonization. and the preprocessed image is used to extract features. Five features of each specimen are extracted and fed into the ANN. Extracted features lie in the standardized range of 0 to 1. For a certain value of each feature personality analysis is done by the classifier network. All five features and their extraction methods are discussed below in brief.

1) *Size*- it is determined by the distance between first and last black pixel per scanline horizontally and vertically. Maximum of all 250 values gives the height and width of the signature.
2) *Baseline*- it is measured as an angle made by the signature skeleton with the imaginary horizontal line. One arm of the angle is the imaginary line and the second arm is made by joining the starting and ending lowest pixel of the signature.
3) *Proportion*- the signature is divided into three zones upper, middle and lower. Pixel density in each zone is calculated separately to identify the most dominant region.
4) *Space*- It is identified by the strings of white pixels between the two consecutive alphabets. If no black pixel is present in one vertical line it is counted as a single space.
5) *Slant*- it is calculated for those alphabets which starts from the lower zone and spread over the upper zone. The highest and lowest points of such alphabets are joined and the angular measurement of the inclination is recorded.

According to the extracted features a feature vector is created which acts as input to the classifier. The classifier than analyses the feature vector and gives the personality analysis on the basis of the same. Description of the above-mentioned features are given below in Fig. 2

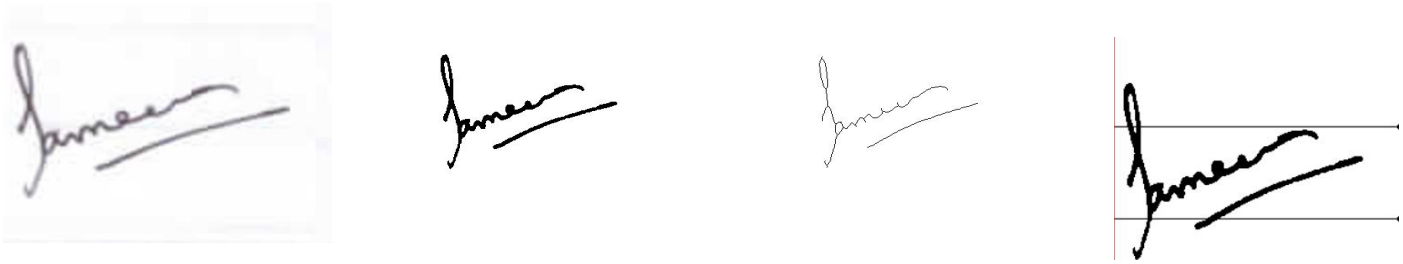

Fig. 2 Preprocessing Stages (a) Original Image (b) Thresholded Image (c) Skeletonised Image (d) Zonewise division

VII. RESULTS

The Automated Personality Analysis System is implemented using MATLAB. The feature set of five features namely- Size, Baseline, proportion, space and slant are extracted. An ANN classifier is used to extract the features. On the basis of these features personality analysis is done by the automated system. This system reduces inconsistencies in the manual system which occurs due to human intervention. Manual personality analyses are subjected to the physical conditions of the graphologists like fatigue, illness or mental biases whereas APAS doesn't have any such disadvantages. One major disadvantage of APAS is that if the acquired data is distorted or rotated, it might not give accurate analyses. To strengthen the results of APAS various other features can also be added. More robust the feature set is the more appropriate result will be obtained.

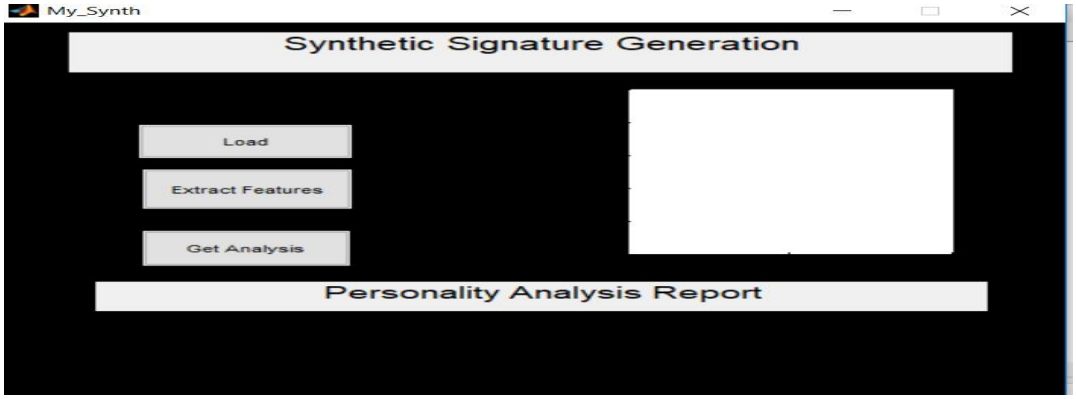

Fig. 2 APAS GUI

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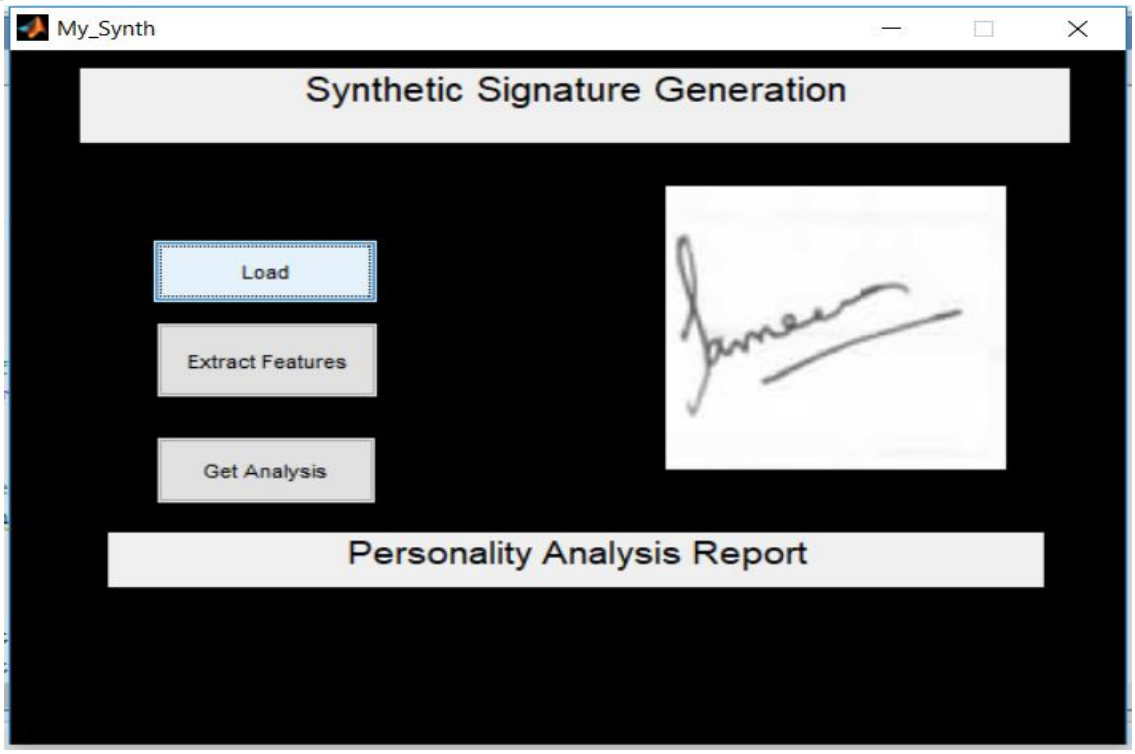

Fig. 3- Specimen Signature loaded

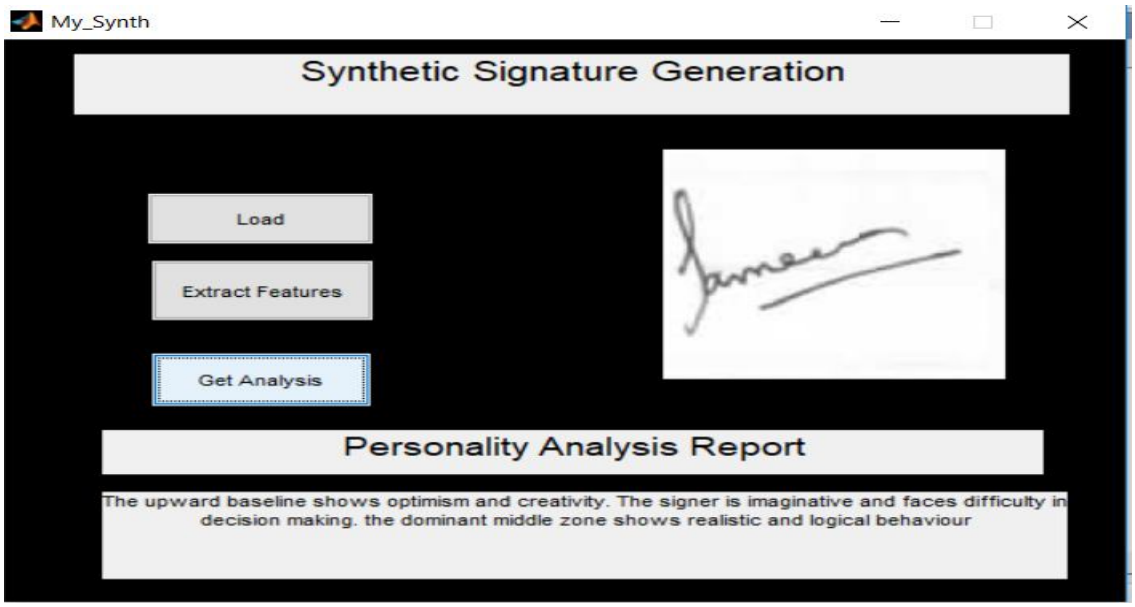

Fig. 3- Personality Analysis Report by APAS

VIII. CONCLUSIONS

An automated system is implemented for personality analysis which is like manual graphology methods but reduces the disadvantages of manual methods. In approx. 78% of cases APAS gives the same result as the graphologists. To toughen the system many other features can also be added in the feature set. This system uses a concise feature set of five features. Furthermore rotation invariant features can also be incorporated for better results. Applications of such systems can be in the area of career guidance, forensic investigations, matchmaking etc. If signatures specimens are taken in regular interval and are analyzed properly, it can give early signals of various neurodegenerative diseases.

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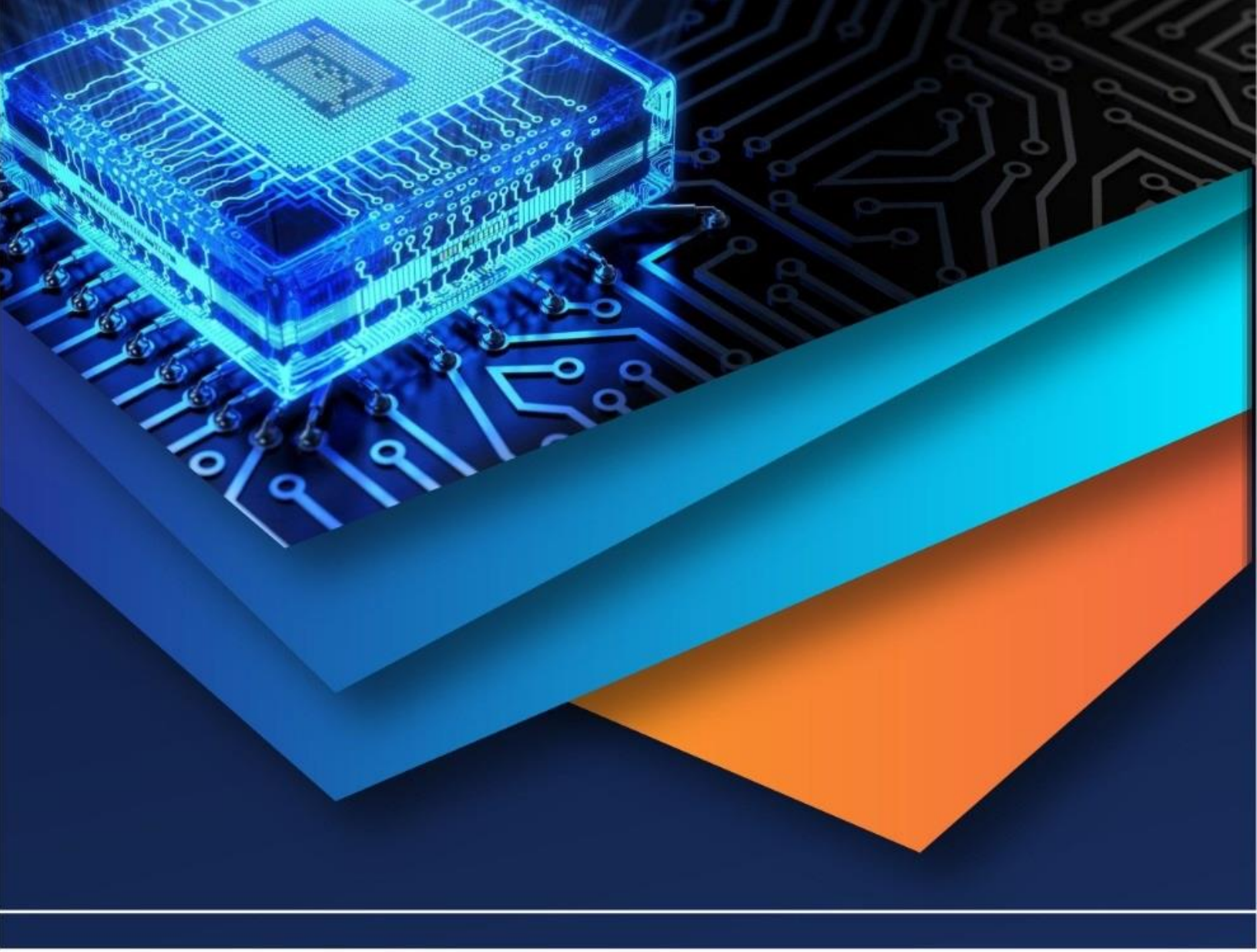

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