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A Novel Approach to Detect and Identify the Abnormal Driving Behavior

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Abstract: Driving behavior analysis is also a popular direction of Smartphone-based vehicular applications. However, existing works on driving behaviors detection using dataset camera videos can only provide a coarse-grained result using thresholds, i.e. distinguishing abnormal driving behaviors from normal ones. Since thresholds may be affected by car type and sensors' sensitivity, they cannot accurately distinguish the differences in various driving behavioral patterns. The fine-grained abnormal driving behaviors monitoring is able to improve drivers' awareness of their driving habits as most of the drivers are over-confident and not aware of their reckless driving habits. There are many problems; the first problem is the new and challenging real-world Problem raised from the auto insurance industry, called driver number estimation and the second problem is the classical driver identification problem, measured by the classification accuracy on unseen trips of seen drivers. These problems are resolved with KNN, Hidden Markov Model and NN for Abnormal Driving Behaviors Detection and Identification.
Keywords: KNN, NN, Driver behavior, Smartphones etc.

I. INTRODUCTION

(WHO), traffic accidents became one in each of the best 10 leading causes of death among the planet. Specifically, traffic accidents claimed nearly 3500 lives on a commonplace in 2014. Studies show that the bulk of traffic accidents area unit caused by human factors, e.g. drivers' abnormal driving behaviors. Therefore, it's a necessity to seek out drivers' abnormal driving behaviors to alert the drivers or report Transportation Bureau to record them. although there have been works [1] on abnormal driving behaviors detection, the most focus is on police investigation driver's standing supported pre-deployed infrastructure, like alcohol device, infrared device, and cameras, that incur high installation worth. Since dataset camera videos have received increasing popularities over the recent years and mixing in our daily lives, plenty of and plenty of data set camera video-based transport applications area unit developed in the intelligent facility. Driving behavior analysis is to boot a popular direction of Smartphone-based transport applications. However, existing works [2] on driving behaviors detection using data set camera videos can exclusively provide a coarse-grained result using thresholds, i.e. characteristic abnormal driving behaviors from ancient ones. Since thresholds are additionally stricken by automotive kind and sensors' sensitivity, they'll not accurately distinguish the variations in varied driving behavioral patterns. Therefore, those solutions cannot offer fine-grained identification, i.e. identifying certain types of driving behaviors. Moving in this direction, we'd wish to ponder a fine grained abnormal driving behaviors observation approach, that uses Smartphone sensors to not exclusively realize abnormal driving behaviors but to boot confirm certain types of the driving behaviors whereas not requiring any further hardware. The fine-grained abnormal driving behaviors observation is in an exceedingly position to spice up drivers' awareness of their driving habits as most of the driver's area unit over-confident and not aware of their reckless driving habits to boot, some abnormal driving behavior area unit improbable and straight forward to be unperceived by drivers. If we are going to confirm drivers' abnormal driving behaviors automatically, the drivers are aware of their unhealthy driving habits, so that they will correct them, serving to forestall potential automotive accidents in line with [3], there area unit six varieties of abnormal driving behaviors printed, which they area unit illustrated in Fig.1. Weaving(Figure one.1(a)) is driving alternately toward one aspect of the lane and then the other, i.e. curving driving or driving in Shape; swerve (Figure one.1(b)) is making degree abrupt redirection once driving on a typically straight course; aspect slipping(Figure one.1(c)) is once driving in associate passing typically line, but deviating from the standard driving direction; fast U-turn(Figure one.1(d)) could also be a fast redeeming U-shape, i.e. turning round(180 degrees) quickly and then drive on the choice direction; Turning with an outsized radius is sound cross degree intersection at such a very high speed that the automotive would drive on a curve with a colossal radius, and conjointly the vehicle usually appears to drift outside of the lane, or into another line; sudden braking is once the driver slams on the brake and conjointly the vehicle's speed falls down sharply in an exceedingly very short quantity of some time. This work uses Smartphone sensing and machine learning techniques. By extracting distinctive choices from the readings of Smartphone sensors, we are going to realize and confirm the six varieties of abnormal driving behaviors on high of. To grasp a fine-grained abnormal driving behaviors detection and identification, we have a tendency to tend to face the following nice challenges. First, patterns of driving behaviors need to be illustrious from readings of Smartphone sensors. Second, the noise of data set camera video sensors' readings has to be compelled to be removed. Finally, the solution has to be compelled to be light-weight and method attainable on data set camera videos. [4]

Additionally, some abnormal driving behaviors are insidious and are ignored by drivers. If we can identify drivers' abnormal driving behaviors automatically, the drivers can be aware of their habits for poor driving, so that they can correct them and prevent them for further accidents. Furthermore, if the results of the monitoring could be passed back to a central server, that will be helpful to the police to detect drunken-driving automatically.

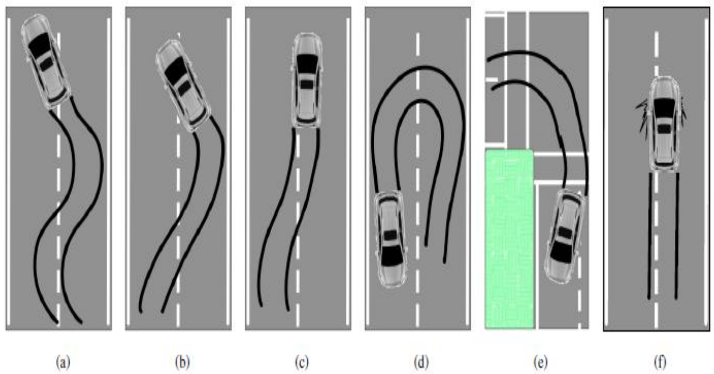

Figure 1: Six types of abnormal driving behaviors: (a) Weaving, (b) Swerving, (c) Side slipping, (d) Fast U-turn, (e) Turning with a wide radius, (f) Sudden braking[1].

II. DETECTION USING SMARTPHONE SENSORS

To eliminate the necessity of pre-deployed infrastructures and further hardware, recent studies have confidence exploitation smartphones to note abnormal driving behaviors. Especially, [4] uses accelerometers, magnetometers and GPS sensors to figure out whether or not or huge motorcycle maneuvers or accidents occur. [5] Uses accelerometers, gyroscopes, and magnetometers to estimate a driver's driving vogue as Safe or Unsafe. [6] Use accelerometers to note drunk driving and sudden driving maneuver, severally. The works area unit similar in this they perform a coarse-grained driving behavior detection that uses some thresholds to hunt out abnormal driving behaviors. All identical, thresholds may be jam-packed with automobile type and sensors' sensitivity so as that they'll not accurately distinguish the variations in varied driving activity patterns. Therefore, none of the existing works can perceive fine-grained identification. Our work uses Smartphone sensing and machine learning techniques to understand a fine-grained abnormal driving behaviors detection and identification. Though' machine learning technique already is utilized to some activity recognition work [5], our work is first to identify driving activities exploitation machine learning technique. In [7], since activities area unit are instant, the pattern of activities is simple. Therefore choices of activities' pattern would be legendary merely. However, in real driving environments, since the period of some driving behavior is long, not instant, like Weaving, the system ought to be compelled to verify the beginning and ending of the driving behavior first. Extracting and selecting effective choices of each type of abnormal driving behavior would be lots of sophisticated.

A. Driving Behavior Characterization

In this, we've got a bent to first describe the data assortment technique for driving behavior samples from real driving environments. Then we've got a bent to research patterns of each type of driving behavior from Smartphone sensors' readings.

B. Collecting data from Smartphone Sensors

We develop degree App to collect readings from the 3-axis measuring device and thus the 3-axis orientation detector. We have got a bent to align the two coordinate systems inside the Smartphone and inside the vehicle by making the accelerometer's axis on the moving direction of the vehicle. Therefore, we've got a bent to may monitor the vehicle's acceleration and orientation by retrieving readings from the Dataset camera video measuring device and orientation detector. [8]

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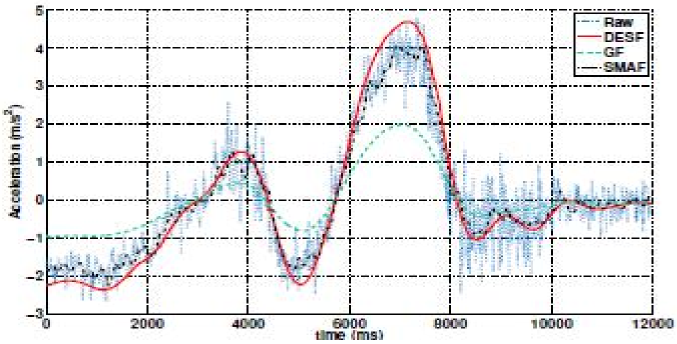

Figure 2: Accelerometer vs. Time Graph

III. RESEARCH GAP

In this research work, the different researchers studied different techniques. Some of them studied Auto encoder Regularized deep neural Network, ITS, and different classifier methods, but they have not got the maximum accuracy of their research work. They have faced the different problems, the first problem was the new and challenging real-world problem raised from the auto insurance industry, called driver number estimation and there were more problems and that problems are discussed in our research problem formulation. It is resolved with the help of KNN, Hidden Markov Model and NN for Abnormal Driving Behaviors Detection and Identification and to get maximum accuracy.

IV.USE OF SMARTPHONES TO DETECT THE DRIVING STYLE

The smartphone could be used to warn for accidently lane-changes as seen in the work of recognize driver aggressiveness. There are smartphone systems which work as black-boxes in case of accidents [5] and inform other traffic participants about the accident so that they could avoid possible traffic jams [4]. Information could be shared among mobile phone owners in order to optimize their speed and avoid stop-and-go situations. Such information is gathered from traffic signals and cameras and distributed to the drivers [5].

Only the accelerometer readings taken from the phone is used to predict and classify the driving behavior. They differentiate between vehicle conditions (speed and shifting), driving patterns (acceleration and deceleration, lane change) and road conditions. The GPS readings could be very efficient and could provides a more reliable speed information compared to the speed computed from the accelerometer readings, and the radius of curvature of the vehicle moving path could be used for recognizing certain types of driving behavior [6]. Nonetheless its localization accuracy represents a problem because of the localization error at the magnitude of several meters which may occur due to GPS. Moreover, the GPS consumes much more energy than the other sensors in the phone and thus leads to higher battery drain [9]. A future area also discussed in the work is that phones equipped with a camera could be very efficient during the drive since they could capture or mark road signs and follow the drivers' sight line. However, their high energy consume, complicated algorithms and "intensive computations for the limited computation capability of mobile phones" lead the authors to a more simple but also effective style for driving detection based on the accelerometer and orientation sensor of the phone. The light sensor in the phone to obtain information about the environment in which the car is moving, because the brightness directly affects the visibility of the driver and this influences his anticipation. Another novel method in the work of Magana is the weather information involved in estimating the driving behavior. This information is obtained from the Internet connection of the smartphone. A smartphone application which uses the information from the embedded sensors and the vehicles state information acquired from the vehicles CAN bus (speed, fuel consumption, GPS, etc.). The gathered data is passed to a fuzzy-based module which analyzes the data and classifies it and then an suggestion is presented to the driver how to optimize the fuel energy consumption/driving behavior. Langari, Murphey and Holmén attempt to classify the driving style by using "the ratio of the standard deviation and the average acceleration extracted from the acceleration profile within a specified window"9 [7]. A fuzzy rule classification was made referring to a conclusion made by the typical average acceleration ranges in a city are different for the various driving styles. The different driving styles according to the measure how fast the driver accelerates and decelerates. The developed algorithm extracts jerk features from the current vehicle speed within a short time-window, and classifies the current driving style into three categories: calm, normal and aggressive, by comparing the extracted jerk feature with the statistics of the driver styles on the current roadway. Few papers use dynamic time warping to detect repeating patterns of driving behavior. It compares the current data read from the sensors with the previously saved template data that is marked as aggressive driving style. If the current data is similar to the template data, then the current driving style is marked as aggressive.

V. METHODOLOGY

We gift the look of our projected system, D3 that detects abnormal driving behaviors from traditional ones and identifies totally different abnormal sorts' victimization Smartphone sensors. D3 doesn't depend upon any pre-deployed infrastructures and extra hardware if needed.

In our system, D3, abnormal driving behaviors may well be detected and identifies by smartphones in keeping with readings from accelerometers and orientation sensors. Fig.4 shows the design of D3. The full system is separated into offline half-Modeling Driving Behaviors and online part watching Driving Behaviors. Within the online half, Modeling Driving Behaviors, D3 trains a classifier model victimization machine learning techniques supported the collected information that may establish specific kinds of driving behaviors. Within the Feature Extracting, effective options are extracted from specific kinds of driving activity patterns on acceleration and orientation. Afterward, the options are trained within the coaching and a classifier model would be generated which may notice fine-grained Identification for varied kinds of driving behaviors. Finally, the classifier model is output and keeps to Model information.

Feature Extraction

When machine learning algorithms are processed, a representative tuple of options instead of information could be a more practical input. Thus, it's necessary to extract effective options from driving activity patterns.

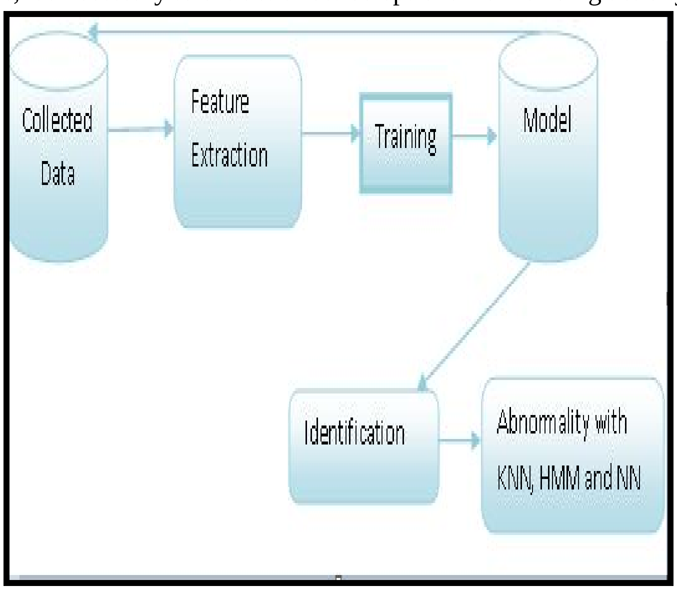

Figure3: System Design

VI. RESULT& DSCUSSION

In this work different snap shorts are taken, which are given below based on Mobile based sensor and MATLAB coding.

In this work different types of operations are performed that are given below:

A. Weaving
B. Swerving
C. Sideslippin
D. Fast U-turn
E. Turning with a wide radius
F. Sudden braking.

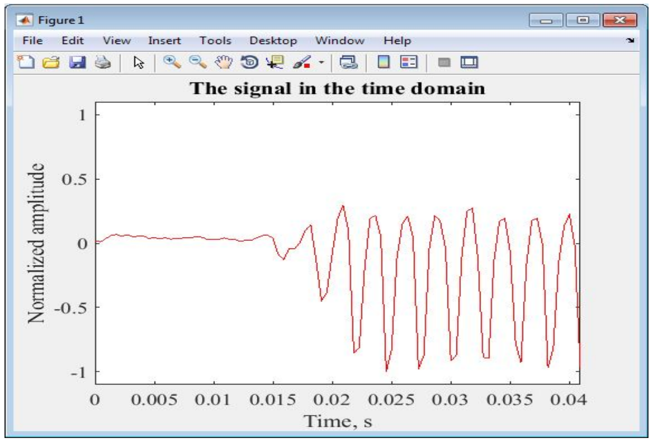

Figure 4: Weaving Normalized amplitude w.r.t Time

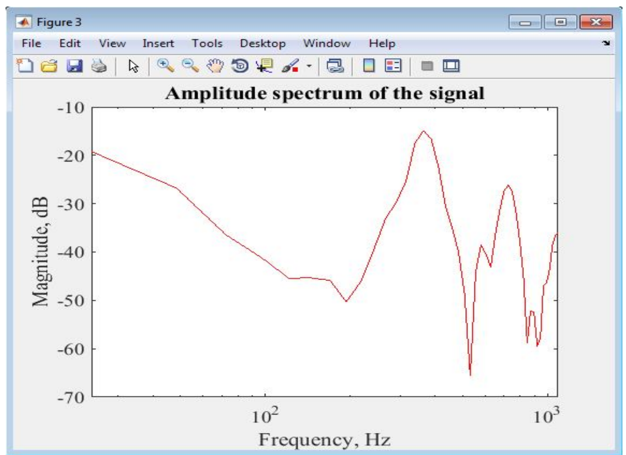

Figure 5: Weaving Magnitude vs. frequency

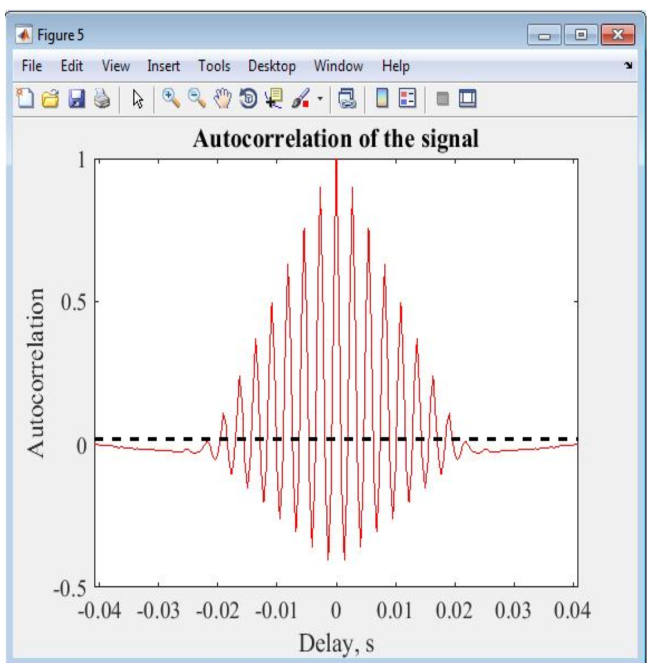

Figure 6: Weaving Autocorrelation vs. Delay

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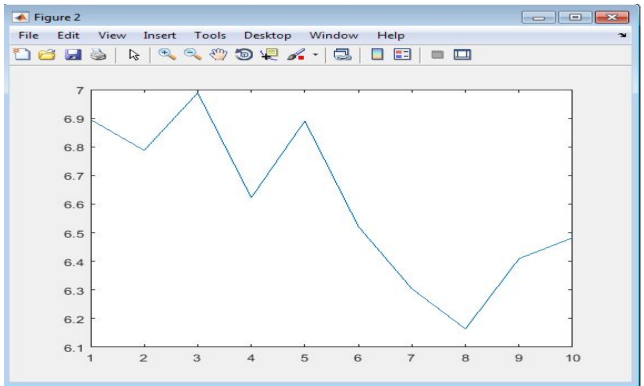

Figure 7: Weaving Signal amplitude vs. Number of samples

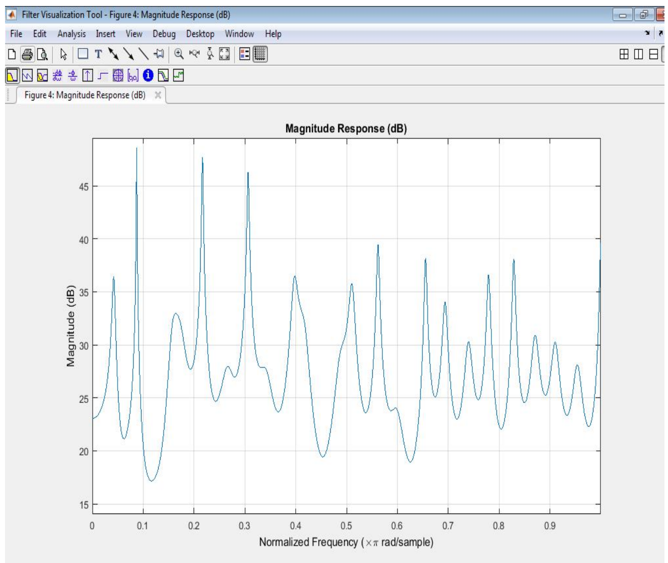

Figure 8: Weaving Magnitude vs. Normalized Frequency

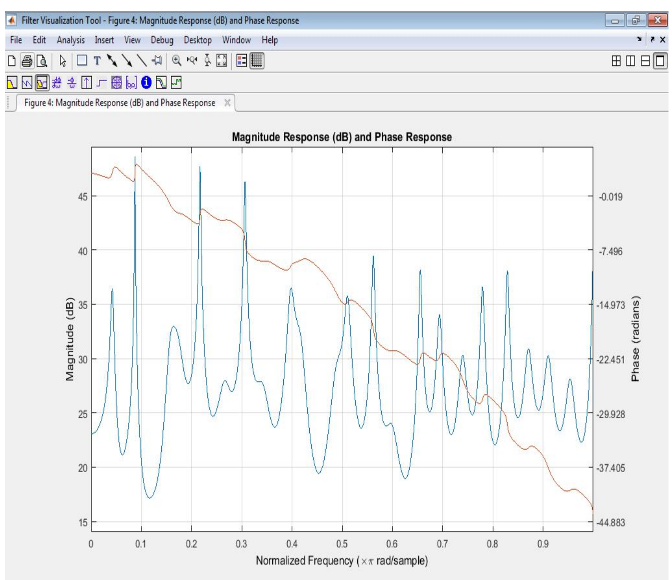

Figure 9: Weaving Magnitude Response and Phase response

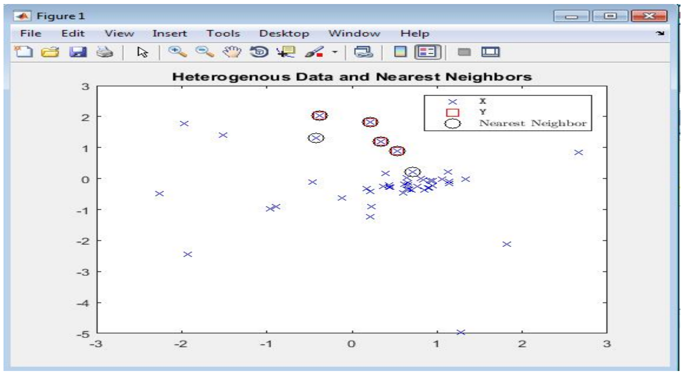

Figure 10: KNN Smart Phone data processing

Type	Sigma	Mu	Peak (crest) factor Q	D	Autocorrelation time
Weaving	0.35611	-0.17454	8.092 dB	42.3767 dB	0.019091 sec
Swerving	0.29122	-0.104	10.2521 dB	58.6266 dB	0.022273 sec
Sideslipping	0.098746	0.066645	18.4812 dB	72.0618 dB	0.73045 sec
Fast U-turn	0.26181	0.15477	10.4078 dB	49.3939 dB	0.015909 sec
Turning with a wide radius	0.34463	0.002353	9.3269 dB	57.399 dB	0.025909 sec
Sudden braking.	0.27887	0.20561	9.2399 dB	26.8328 dB	0.025909 sec

VII. CONCUSION

In this paper, we propose a system, D^3, to detect and identify specific types of abnormal driving behaviors by sensing the vehicle's acceleration and orientation using smartphone sensors. Compared with existing abnormal driving detection systems, D^3 not only implements coarse-grained detections but also conducts fine-grained identifications, i.e. Weaving, Swerving, Side slipping, Fast U-turn, Turning with a wide radius and Sudden braking. To identify specific abnormal driving behaviors, D^3 trains a multi-class classifier model through Support Vector Machine (SVM), KNN and Neuron Networks (NN) based on the acceleration and orientation patterns of specific types of driving behaviors. Here we are getting the better results as compared to existing work.

VIII. FUTURE WORK

As the driving style in this work was based mostly on the lateral and longitudinal forces acting on a car, in a future work the phone camera could be used to detect distance between the vehicles or the car's position in the lane. The speed data acquired from the GPS or computed from the acceleration sensor could be used in combination with the location data from the GPS to detect speeding in various areas.

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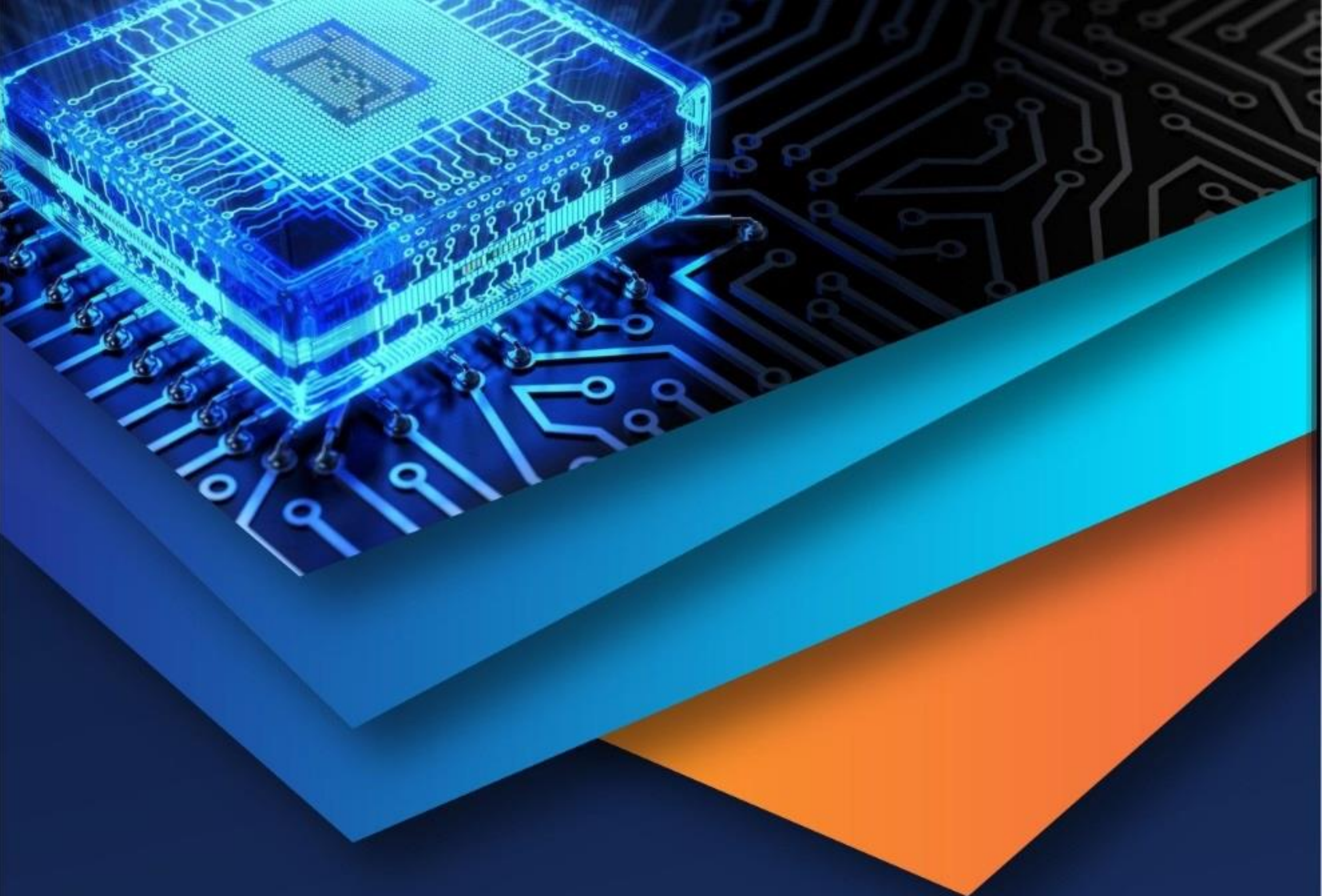

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