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Survey of Parkinsons Disease Using Machine Learning

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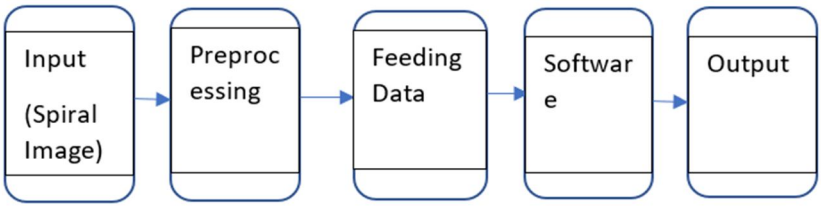
Abstract: ***Many current issues, as well as issues that will arise in the near and distant future, are being resolved in large part thanks to machine learning (ML).***
Problems are being solved by machine learning in every industry. ML is making a significant contribution to real-time applications, robotics, and health care. In this essay, we have chosen to address Parkinson's disease, one of the rare diseases, as one of the key emerging challenges. Parkinson's disease (PD) is a neurological condition that worsens over time and manifests as rigidity, bradykinesia (slowed movements), postural instability, tremor, and freezing of gait, among other symptoms (FOG). We have chosen to deploy a select handful of the ML-related strategies to combat the disease early on in an effort to completely eradicate it.

I. INTRODUCTION

The fundamental component of the neurological system is the NEURON, or nerve cell. There are various varieties of neurons. The motor neuron is one of these types; it receives signals from the brain and spinal cord and uses them to instruct the muscles to contract or relax. Parkinson's is a chronic and developing condition. Approximately 10 million people worldwide suffer from this condition.
Additionally known as the movement disorder. Parkinson's disease is brought on by some crucial neurons in the midbrain region known as the substantia nigra failing.
Dopamine is a substance that is produced by these neurons and is in charge of carrying signals from the substantia nigra to the next section of the brain and then to the rest of the body. The brain also produces the neurotransmitter acetylcholine, which is generated alongside dopamine.
Dopamine and acetylcholine production levels should be balanced for smooth motor performance. The equilibrium between the amounts of dopamine and acetylcholine is upset as the neurons in the midbrain start to age, which results in incorrect muscular contractions and the patient experiencing jerks or occasionally rigidity.

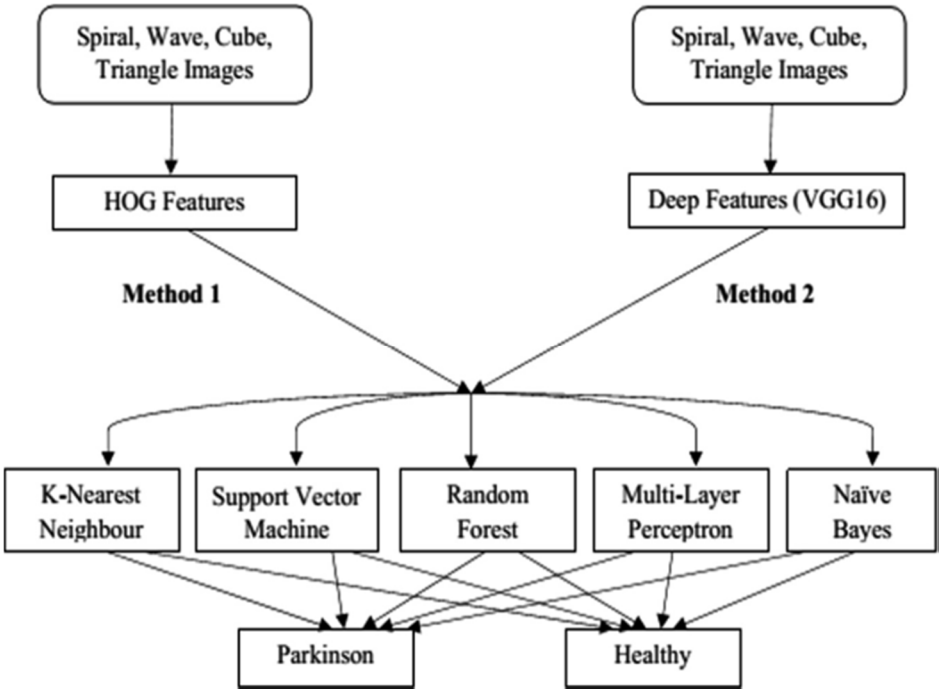
II. DETECTION

The main reason for the eruption of Parkinson’s disease is still unknown due to which there is no specific detection technique. In this paper, study on two datasets is carried out; one of healthy subjects and other is subject suffering from Parkinson’s disease. Here we will be comparing the spiral drawings made by each of the individuals to infer the stage of Parkinson’s disease.
Block diagram of the proposed idea.



According to the block diagram, we are first going to take an input image from the user. Next, we will preprocess the image and feed it to the software. Later we will get a printed output stating which stage the patient is on.

III. FLOWCHART/IMPLEMENTATION



IV. METHODOLOGY

1) Get the Parkinson's disease database that conatins training and testing data.
2) The testing and training data is split.
3) In Training Data the data is preprocessed and the features are selected
4) The training takes place and a predictive model is made.
5) Data preprocessing and feature selection happens for the testing data too.
6) The predictive model that is got from the training data is used in the prediction phase and the prediction is done.

V. DATASET

The dataset that we would be using would be categorised into two parts; healthy people and people affected with Parkinson's disease. The input that we would be using would be spiral and wave images that the PD patients would be drawing with their own hands.

During this process of them drawing we can predict at what stage the PD patients are.

VI. ALGORITHM

The algorithm that we are going to use is Convolutional Neural Networks (CNN). In this we will be using three layers that is input layer, hidden layer and output layer. Using these three layers we can preprocess the images according to the input that is taken by the software.

VII. LITERATURE SURVEY

1) As mentioned, the are many symptoms of Parkinson's disease. Many researchers are doing research on various symptoms and trying to find a treatment for them. Speech disorder occurs in many patients. Some of the factors that are associated with this hypotonia and hypertonia. Hypotonia is the process where the frequency changes, and hypertonia is classified as shaking of the voice. As per our study, one of the ways to over come this is by Cepstral analysis. Cepstral analysis is the process where we use raw signals to get a spectrum. The spectrum here provides the periodic information of the raw signal. We examine the periodicity of the frequency spacings in the spectrum using cepstral analysis. In this type of symptom, the initial symptoms may go unobserved hence it is difficult in most of the cases to predict the disease.

2) In motor skills one of the major symptoms is Bradykinesia. Bradykinesia is the process where by, the body is gradually stopping to respond to the signals sent by the neurons that led to movement. Although Parkinson's disease is not a completely curable disease, it can bemonitored using drugs. Levodopa is the medicine used in the treatment of Parkinson's disease. Levodopa persuades the brain to bring dopamine. Dopamine is a neurotransimitter and hormone the plays an important body functions such as body movements, memory, motivation and many more. Sensors are used in Parkinson's disease. Sensors are directly attached to skin that causes them to capture live biosignals during regular activities. Using this signals we can mointor the patient and his daily improvement. The drawback got from this is that the sensors have to be conductance proof from the skin that is released from the body. Since sweating is a natural process and cannot be reduced, it can be a tough task on attaching th sensor patches to the body with out getting any shock.
3) Impulse Control Disorder(ICDs), a state where the patient is not able to control impulsive thoughts that are generated by the brain and hence causes a strong urge to do an activity that may not necessarilty be required. The common symptoms are stammering, over-eating, etc. Different samples of genes showed different variants and exposure to PD disease. Based on the genetic variants, doctors are able to predict the chances of acquiring parkinson's disease.
4) Different wearable inertial sensors have been used to mease temporary and spatial gait measures. The main reason to use these were their low cost and affordability than the traditional gait measeures. The traditional gait measure were not environment firendly which is why the temporary and spatial gait measures were taken into implementation. By using these 3D sensors, we get the trajectory of the moving feet while any kind of motion either walking or running.The drawback of this is that we have to use many sensors sinc the sensors are small and we need to cover a whole area.
5) When some important neurons that are located in the substania nigra fail to respond, we say that the person is suffering from PD. We can treat the patient based on the patient's health history(using techniques like pin rolling and scientific techniques such as Unified Parkinson's Disease Rating Scale (UPDRS). Sensors are used in this technique to capture the hand movement that are fed into the software in order to predict Parkinson's disease.
6) Research has shown that over 90% of the patients which are suffering from PD have shown the symptom of dysphonia. Dysphonia is a disease that makes a person's voice lower down, shake or not come out at the required time. Study has proved that by the use of different vocal measurements can be taken in order to prevent dysphonia. One of the techniques is Support vector Machine (SVM).
7) Deep learning along with machine learning has been proven to help diagnose in the PD disease. Different techniques in ML such as, Bayes Classification, Decision Trees, Self-Organizing Map along with DL techniques such as Deep Neural Networks, Convolutional Neural Networks, Recurrent Neural Networks are used together to overcome PD.
8) Artificial learning is playing an important role in predicting Parkinson's disease. Non-linear selection algorithm based on the testing and the training of the dataset of brain signals can help to predict Parkinson's disease. The techniques used in this paper provided 97% accuracy and their future implementations are to improve the performance.
9) Electroencephalogram (EEG) are signals that are got from the brain to check the activity of the brain. This study has showed that with deep brain stimulation and implanting an electrode, we can provide electric stimulation as well as understand the collection of iEEG signals. Both the EEG signals and the body movements can help the doctors minimize PD. With more symptoms it would be easier to predict the disease.
10) Hierarchical clustering takes the input in form of hierarchical ways and presents them in the form of dendrogram. Dendrogram is a diagram representing a tree. It is a common technique used in clustering techniques. The implementation of this technique is such that it calculates the distance between the word and similar ways get clustered.
11) Humans' nervous systems are impacted by Parkinson's disease because there will be less neurons there (neurons that are in charge of producing dopamine, a substance that serves as a neurotransmitter). This study offers a technique for detecting eye blinks using MATLAB image processing. This reduction will alter the blink rate in addition to a non-motor symptom. The doctors could utilize this method rather of pricy analysis procedures. Parkinson's disease is recognized by the traits listed below: digital camera (Camera) The Image Processing Toolkit for MATLAB Computer Vision Toolbox 2. 3. The MATLAB Video Processing Toolbox's fourth entry.
12) The focus of this research is on the motor symptoms, especially FOG (freezing of gait). Falls and nursing home admissions could arise, both of which would significantly reduce the patients' quality of life. Technology used Decision Trees (DT) and Support Vector Machines with Polynomial Kernels are used to forecast the event. The method includes the following steps feature selection, feature extraction, and dimensionality reduction.

13) In this study, voice cues are employed to forecast the illness. With an accuracy of 90.76% and an MCC of 0.81 for the training dataset, our method successfully distinguishes between those with Parkinson's disease and healthy patients. This method yields an accuracy rate of 81.55% when tested on a separate dataset of Parkinson's disease patients.
14) A potentially dangerous sign of Parkinson's disease termed freezing of gait is defined by abrupt pausing and an inability to start or even continue walking. Recent studies on brain connectivity have increased our understanding of the pathophysiology of FOG, and electroencephalograms may offer a new method for detecting and predicting FOG. The spatial, spectral, and temporal aspects of the EEG signals were merged by the authors for the Multilayer Perceptron Neural Network and the k-Nearest Neighbor classifier in this study. With 73% sensitivity, this method successfully predicts the change from walking to freezing.
15) Despite the number of symptoms in this study, people who struggle to speak, write, move, or perform other basic tasks are the main focus. When endorphin neurons in particular regions of the brain are harmed or die, this will happen. These symptoms will enhance the disease's severity worse in the sufferers. Therefore, they have provided a technique in this study for employing deep neural networks to predict the severity of PD. They also created a neural network that could predict the severity of the disease and a machine learning model to diagnose the condition. A both random forest classifier and a neural network are used to classify Parkinson's disease.
16) This research suggests stacking generalization and merging complementary neural networks to treat Parkinson's disease. Here, the Parkinson voice dataset from the UCI repository for machine learning is used. The complementary neural networks are made up of the truth and falsity neural networks, which are trained to anticipate the truth output and the falsity output. and a new input feature is created by merging the outputs of each fold.
17) PD In the world today, early diagnosis is crucial. Big data has immensely improved the medical and healthcare sectors. A lot of advances in machine learning algorithms have improved the precision of disease prediction. The data's high dimensionality, however, makes analysis more difficult and complex. The number of characteristics can be lowered by employing a feature selection strategy. On data with fewer features, it is more difficult to achieve the same or greater accuracy. The characteristic should be properly chosen to get better detection. Using principal component analysis (PCA) to determine the most valuable components of the data, we propose a method for forecasting illness in this study.
18) Parkinson's is a neurodegenerative disease that is primarily characterized by both motor and non-motor symptoms. Speech issues are among the earliest motor symptoms, and they are present in almost 90% of PD patients. It is crucial to predict PD based on speech symptoms utilizing machine learning techniques in order to decrease the advancement of PD. The system will employ ensemble classifiers to predict the early prediction of PD using the speech characteristics dataset that was obtained from the UCI repository. And With 252 subjects and three speech feature occurrences per subject, the speech feature dataset offers numerous feature subsets. Without losing any information, the highly connected data are smoothly merged utilizing principal component analysis and linear discriminant analysis.
19) Freezing of the gait is a common issue in people who have severe Parkinson's disease (FOG). To find FOG, many models have been proposed. These models have the ability to learn features, therefore they don't require the use of manually defined features. Yet not all of the particulars of this approach have been studied in depth. Particularly, how the lack of properly tagged pre-FOG data might greatly influence the creation and assessment of models hasn't been fully grasped.
20) For the last 10 years lot of research has been done on automatic detection on wearable sensors. There are sensors which are cheaper and lighter. They present a solution for evaluating them in lab and home. Sensors have measurement units, smartphones, accelerometers , gyroscopes. These are combined with surface electromyography. Inertial sensors were integrated with machine learning for detecting episodes in Parkinson’s disease in this work.
21) Basically, a person with Parkinson’s disease , shins are placed over sensors and TUG test was performed. Comparison was done on ML performance on the detection of pre- Freezing Of Gait periods in patients through dopaminergic therapy. Velocity signal from sensors were used and a step-to-step segmentation process, extracting features from each step. Analysis was done on data with 15 000 patients with age of 50 years. with incident diagnosis of PD and large controls were analyzed.
22) Different clustering techniques were used for Parkinson’s data. Motor-UPDRS and Total-UPDRS was predicted using support vector regression. Comparison was performed between support vector regression techniques and prediction learning approaches. This study is performed on a real-world Parkinson’s disease dataset. Ensembles provided better prediction accuracy with decision trees. Support vector regression, deep belief network, neuro fuzzy combined with other clustering techniques were used in the prediction of Motor predictions.

23) Taken and analyzed 1000 features, including motor, non-motor extracted for each region-of-interest) using our standardized environment for radiomics analysis radiomics software. Segmentation of transposer - single photon emission computed tomography images were performed via (MRI). This study moves beyond cross-sectional PD subtyping to clustering of longitudinal disease trajectories.

24) Pre diagnostic was studied using period study. Prediction model for real world setting was constructed using selected features from the period. This will accelerate the diagnosis in the real-world setting. Two predicting models were constructed. Prediction of PD diagnosis was done using an alternative model and a retrospective approach was taken five years prior to the diagnosis. Surrogate diagnosis for Parkinson's disease was done by retrospective models. Many important features were also captured by retrospective models. Differential diagnostic period suggested a presence of a suspected Parkinson's disease.

25) In recent years, proper classification of normal and Parkinson's patients has become an important problem. A variety of strategies for classifying Parkinson's patients and healthy persons have been proposed throughout the last two decades. A shallow structured network classifier serves as the basis for the majority of them. In this study, a stacked auto-encoder deep neural network framework is used to differentiate audio samples from Parkinson's patients and healthy participants. A stacked auto encoder deep network is fed a spectrogram and scalogram of voice sounds in the current study. The acquired features are assessed using a SoftMax classifier and a support vector classifier (SVM). The SoftMax classifier achieves the highest classification accuracy of up to 87% and 83%, respectively with a spectrogram and a scalogram.

26) Doctors are concerned about the prognosis and progression of Parkinson's disease because of the variance of elements included in the diagnosis technique, which hampers decision-making. Several datasets have been independently reviewed, and machine learning has been used to study the emergence and progression of disease. The current study updates a report on the many types of Supervised Machine Learning algorithms that have risen in popularity over the last five years (2015- 2019). It also emphasizes the superiority of hybrid intelligence models over traditional methods for improving forecast accuracy and sensitivity. Finally, the research emphasizes the importance of developing a multiparametric, big data-driven holistic forecasting system.

27) Using acoustic techniques to evaluate voice difficulties can help with the diagnosis of Parkinson's disease (PD). This study analyzed demographic data and vocal phonation recordings from the open Power database to identify Parkinson's disease patients. In addition to gender and age, a parsimonious model was created that reduced the number of phonation factors from 62 to 5. A model with a high capacity for prediction was created by combining neural networks for logistic regression (LR) with multilayer perceptron (MLP) (area under receiver operating characteristic curve, AUC-ROC, better than 0.82). This study assists in the monitoring of EP patients by taking a few phonation features and recording them on a mobile phone.

28) Parkinson's disease (PD) is a long-term, deteriorating ailment that mostly affects people's neurological and motor systems. Early symptoms include stiffness in the muscles, tremors, loss of balance, and difficulty walking. Blood tests and scans don't provide sufficient details to enable rapid diagnosis. As a result, it might be difficult for clinicians to identify the early stages of Parkinson's disease. Speaking slurring, on the other hand, provides a warning and can be used to accurately forecast Parkinson's disease. Using voice recording samples from people with Parkinson's disease and healthy people, PD was predicted in this study. These predictive models were compared using the UCI dataset, which included biomedical voice recording samples from Parkinson's disease patients and healthy individuals. The effectiveness and accuracy of these predictive models have been developed and evaluated. The best five models for predicting early Parkinson's disease are evaluated in this study based on their performance. Their processing speeds have also been investigated to determine whether these models are appropriate for lightweight mobile apps in the context of ubiquitous computing.

29) Parkinson's disease is a significant global public health issue (PD). According to widely accepted figures, there are five million persons affected by Parkinson's disease globally and over a million people in the United States. In order to plan ahead for therapy, it is crucial to recognize Parkinson's disease in its early stages. The non-motor symptoms of Parkinson's disease that arise before the motor ones are increasingly being studied in an effort to distinguish Parkinson's disease from them. If a precise and timely prognosis is possible, a patient can receive the appropriate care at the appropriate time. Rapid eye movement (REM), sleep behavior disorder (RBD), and olfactory loss are a few of the non-motor symptoms examined. The creation of machine learning algorithms that can aid in disease prediction may be necessary for early disease detection. Key biomarkers are also used in the extensive investigation. Our goal in this study is to create this classifier using novel machine learning approaches. Using Multilayer Perceptron, Bayes Net, Random Forest, and Boosted Logistic Regression, we created automated diagnostic models. It was discovered that Boosted Logistic Regression performs the best, with a great accuracy of 97.159% and a 98.9% area under the ROC curve. These models suggest that Parkinson's disease can be predicted in its early stages.

30) After Alzheimer's disease, Parkinson's disease is the neurological disorder with the highest prevalence. Parkinson's disease is expected to affect more than 10 million individuals. However, Parkinson's symptoms develop gradually and worsen over time. Because of this, early diagnosis and treatment of Parkinson's disease can greatly improve quality of life. Neurodegenerative illnesses are more frequently diagnosed using functional imaging. We chose fMRI data for our analysis since functional magnetic resonance imaging (fMRI) seems to be particularly helpful in the case of brain disorders. The SVM classifier was also used to categorize and forecast Parkinson's illness. On seven individuals, we successfully used our suggested technique to attain 99.76%accuracy, 100% specific, and 99.53% sensitive. Last but not least, this strategy offers a clear paradigm for spotting Parkinson's disease in its early stages. This could aid doctors in spotting ailments earlier so that patients might receive better care.

Sr. no.	Title of the paper	Year Implemented	Technology used
1.	Using EEG Spatial Correlation, Cross Frequency Energy, and Wavelet Coefficients for the prediction of Freezing of Gait in Parkinson's disease patients	2013	EEG signals utilizing wavelet coefficients as input for the Multilayer Perceptron Neural Network and k-Nearest Neighbor classifier
2.	Discriminating between patients with Parkinson's and neurological diseases using Cepstral analysis	2015	Cepstral Analysis
3.	A Novel Approach to Reducing Number of Sensing Units for Wearable Gait Analysis Systems	2015	Implementation using wearable sensors
4.	Prediction of Parkinson's Disease using Speech Signal with Extreme Learning Machine	2016	ELM, Classification Technique
5.	A New Hybrid Intelligent Framework for Predicting Parkinson's Disease	2017	Support vector Machine (SVM)
6.	Facial Features based Prediction of Parkinson's Disease	2018	Image processing in MATLAB
7.	Predicting Freezing of Gait in Parkinson's Disease Patients using Machine Learning	2018	SVM, and Decision Trees
8.	Synchronization Method for EEG Signals of Body Movements in Patients with Parkinson's Disease	2019	EEG signals and Implanting electrode.
9.	Prediction of Parkinson's disease and severity of the disease using Machine Learning and Deep Learning algorithm	2021	Neural network, Random Forest Classifier, XGBoost
10.	Deeply Trained Real-Time Body Sensor Networks for Analyzing the Symptoms of Parkinson's Disease	2022	ML- Bayes Classification (BC), Decision Trees (DTs), Self-Organizing Map (SOM) DL- as Deep Neural Networks (DNNs), Convolutional Neural Networks (CNNs), Recurrent Neural Networks (RNNs)

VIII. CONCLUSION

Amongest the rising technology and the quick adpative world, it is possible to reduce the number of patients that are more exposed to the disease. Be it by means of drugs or technology there is a solution to the symptoms that are shown by patients with Parkinson's disease. Different sensors can be attched to the body to give the live information of the movement of the body. Drugs can be used to reduce the severity of the patient before implemnting and technology. Countries like China have used the technique like implanting the electrodes after complete brain stimulation. Although these techniques are implemented, there are some drawbacks such as missing of symptoms, slow response of software and improvement of algorithm.

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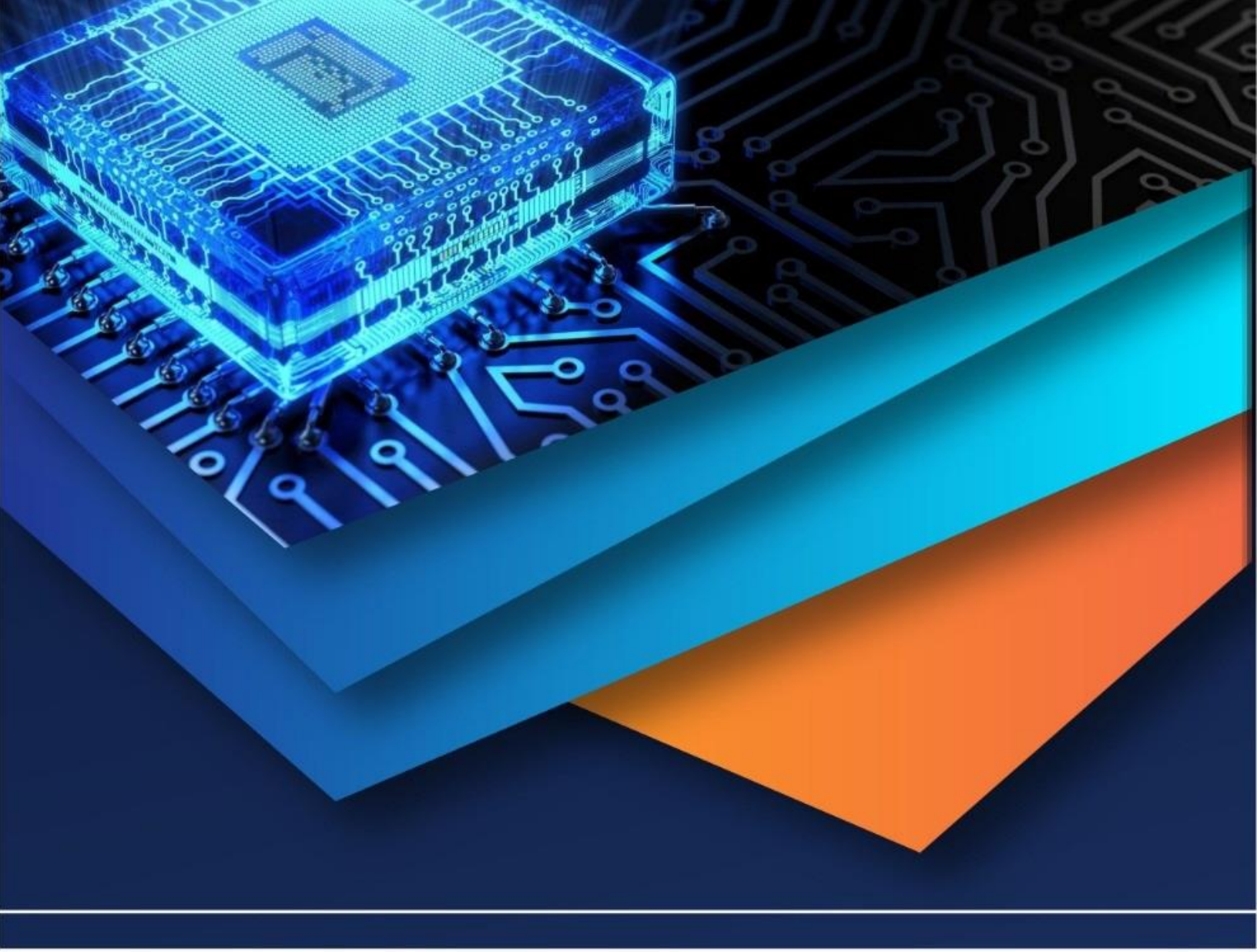

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