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Career Prediction Website using Machine Learning

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Abstract: ***A significant proportion of high school students often grapple with a perpetual sense of uncertainty when it comes to making career choices upon their graduation. This is a natural consequence of their age and the developmental stage they find themselves in. The decision of what to pursue professionally can be quite daunting, especially for individuals who are merely eighteen years old. At this stage, many students may not possess the maturity and life experience required to confidently select a career path that resonates with their true aspirations and capabilities. The process of choosing a field of study after high school is often riddled with complexity. Students encounter a myriad of challenges and uncertainties, making it a particularly convoluted decision-making process. Key concerns include whether they possess the necessary skills, what careers align with their interests, and how they can navigate this critical juncture in their educational journey. In the light of these challenges, the central focus of our work is the development of a career prediction system. This system leverages essential web development techniques and machine learning methodologies to address this complex issue. It does so through the utilization of a comprehensive questionnaire and machine learning algorithms, including decision trees, KNN algorithms, and classification models. In the realm of technology, the Python programming language plays a pivotal role. It serves as the foundation for creating the machine learning algorithms and classifiers that underpin our career prediction system. These algorithms are designed to analyze the data collected from the questionnaire, identifying patterns, interests, and aptitudes, ultimately assisting students in making informed career decisions.***

In essence, our work aims to empower high school students with the tools and insights needed to make well-informed career choices. By incorporating advanced techniques and technologies, we offer a system that not only helps students understand their potential career paths but also ensures that their choices are based on a more comprehensive understanding of their interests, skills, and aspirations. This endeavor represents a significant step toward providing valuable career guidance and reducing the uncertainty that often plagues students during this critical phase of their educational journey.

Keywords: Career Counseling, Decision Tree, KNN, Python,Django, ML(Machine Learning)

I. INTRODUCTION

When deciding a career path, it becomes necessary to not only contemplate upon the choice of academic pursuit but also to study the post-graduation profession in alignment with personal passionrent. Career counsel plays a pivotal role in facilitating individuals in discerning their unique skill sets and proficiencies. Machine learning, an adaptable technological paradigm, finds widespread utility across diverse domains and industries, encompassing clinical diagnostics, image processing, classification, and regression. Its inherent automation capabilities render it an efficacious instrument in the pursuit of advanced solutions. Machine learning delineates into three primary categories: unsupervised, supervised, and reinforcement learning algorithms. In essence, machine learning constitutes the science of endowing systems with the capacity to acquire and replicate human-like decision-making processes.

The accurate evaluation of a student's aptitudes assumes paramount significance, serving as a guiding determinant in their career selection and concomitant educational pursuits. This evaluation encompasses the choice of career trajectory, suitable training programs, prospective employment opportunities, potential career transitions, and the requisites for further formal and informal instruction. The ongoing Information Technology (IT) revolution exerts profound influence on individuals' career decisions, manifesting in two distinct manners. Firstly, there exists a burgeoning demand for proficient professionals, spanning the domains of engineering, mathematics, science, and technical expertise. However, this revolution concurrently engenders the specter of job displacement, propelled by the escalating prevalence of robotics and automation. Second, easy access to a wide range of analytical and evaluative tools is made possible by the widespread use of information and communication technologies. This is true for both online self-help resources and individualized career counseling.

Therefore, career advisors must maintain a perpetual commitment to enhancing their knowledge base and competencies to harness emerging fountains of information regarding contemporary career assessments and the dynamic terrains of the labor market. This proactive approach empowers them to offer the most informed guidance to individuals seeking optimal career trajectories and opportunities within an ever-evolving employment landscape.

II. LITERATURE REVIEW

Insufficient counseling and guidance sessions in universities can lead to students feeling confused and disconnected from their desired course of study, as discussed in [2]. Consequently, they may find themselves pursuing courses that fail to ignite their interest, resulting in disengagement and a sense of purposelessness, as highlighted in [3]. Addressing this issue and gaining insight into how students make career choices is crucial, as emphasized in [4]. The role of the guardians in shaping their offspring's career aspirations is very significant, as explained in [5]. However, [6] argues that parents may not fully realize the substantial impact they have on their children's career decisions, while [7] suggests that their influence might be limited to encouraging adherence to the school curriculum.

Nonetheless, collaboration among educational mentors, guardians, and students can significantly impact students' academic motivation and prospects positively, as stated in [8]. Seeking professional educational counselors for guidance is particularly impactful for confused students, as previous research [10] has found. It is essential to consider key factors such as students' interests, capabilities, abilities, and character when advising them [10]. Unfortunately, at times, parents may overlook their children's passions, leading to ignorance about their true potential.

Other factors influencing career choices include the influence of peers, the reputation and status of courses and institutions, and potential employment opportunities [13]. As suggested in [14], employment prospects in a specific field also play a crucial role, while [15] highlights the influence of job prestige on students' career decisions. In the study on guidance and regulation systems [17], it was discovered that course details, self-exploration, are the factors that affect choices of students. Additionally, [18] revealed that students are influenced by previous information, relations with people in their areas of interest. In Nigeria, factors like the Senior School Certificate Examination results, Joint Admission Matriculation Board benchmarks for Unified Tertiary Matriculation Examination, and Post-UTME results also impact students' choices [19].

Furthermore, [20] noted that some students are compelled to choose courses based on their parents' decisions, while [21] suggests that knowledgeable teachers in a subject can influence students' course of study. Moreover, [22] and [23] highlight how the pros and cons of a course can shape students' perceptions, and [24] emphasizes how the morals associated with a profession can impact career choices. Additionally, [25] thinks that exposure to media can manipulate students career choices.

While existing literature has addressed the determinants in career choices among pupils, there has been limited exploration of leveraging computer advancements to collect information about less popular courses. Some studies have implemented expert systems to advise students based on their characteristics, but they often neglect less popular fields like the construction profession, which hinders career planning in these fields [26], [27], [28].

III. METHODOLOGY

A. *Technologies Utilized*

Sklearn is the premier Python machine learning library, providing a comprehensive toolkit for machine learning and data modeling. This toolbox includes classification, regression, clustering, and dimensionality reduction capabilities. Scikit-learn, an open-source data analysis library, is widely used for Machine Learning (ML) in the Python ecosystem. It also provides algorithms for decision-making activities including data classification. NumPy, complete toolkit for mathematical computations, works well with arrays and matrices in Python, providing high-level mathematical functions as well as strong data structures for numerical operations. Matplotlib is a cross-platform data visualization and charting program that acts as an open-source counterpart to MATLAB, allowing plots to be integrated into graphical user interface (GUI) applications. Pandas, a Python data analysis library conceived by Wes McKinney in 2008, emerged to fulfill the demand for a potent tool in quantitative research and has since burgeoned into one of the most esteemed Python libraries, bolstered by an active contributor community.

This study's approach consists of four critical stages:

1) *Data Acquisition:* Methodically collecting and scrutinizing data from diverse sources to gain a thorough understanding of a specific subject.
2) *Data Preparation:* Executing a sequence of operations on unprocessed data to ready it for subsequent analysis. This phase is of paramount importance in data mining, as it converts data into a format conducive to efficient handling.
3) *Machine Learning (ML) Model Initiation:* Run the Machine Learning model on the preprocessed dataset to make predictions or obtain insights.
4) *Results Formatting and Presentation:* Systematically arranging the ML model's output and communicating it in a transparent and understandable manner.

B. Rationale for Employing Django

A "web framework" comprises an assemblage of technologies aimed at streamlining and reducing the inherent repetition and effort involved in web development. Many websites share common foundational features, such as database connectivity, configuration of URL routing, content presentation, privacy and security management, among others. Over the years, web frameworks have emerged across various programming languages, notable examples being Django in Python, Laravel in PHP, and Rails in Ruby. These frameworks eliminate the need for developers to recreate the basic infrastructure for each new project. Django, founded on Python's self-sufficiency philosophy, offers comprehensive support for routine web development tasks. This support encompasses user authentication, testing, form handling, URL routing, database model creation, template usage, and an administrative interface. Rather than perpetually reinventing core components, this approach enables web developers to concentrate on the unique aspects that distinguish a particular website. In contrast, some frameworks, like Flask, adopt a microframework approach, providing only essential components for rudimentary web pages. Although Flask offers more flexibility and a lighter footprint compared to Django, developers often need to incorporate ten or more third-party packages, some of which might be outdated. Consequently, Flask projects may exhibit divergent organizational structures, hindering smooth transitions between projects and adherence to established community best practices. Django remains a dynamic and evolving framework, with major releases occurring approximately every eight months, accompanied by regular updates addressing security and bug fixes. Adopting Django confers multiple advantages, including the utilization of a robust codebase, thus negating the need to readdress previously resolved issues. Moreover, the Django community continually introduces new features and bolsters security measures. Its reliance on the legible and robust Python programming language further enhances its appeal, solidifying Django as a formidable choice for developing websites from the ground up.

C. Selection of PostgreSQL

Choosing the accurate software for a future assessment is a critical choice that requires careful evaluation of the pros, disadvantages, and suitability of each option. For many years, PostgreSQL has been a mainstay in the database business. This object-relational database system uses SQL as its query language and is based on open-source principles. It is highly user-friendly.

1) *Robust Feature Set and Extensions:* PostgreSQL enables extensions such as OpenFTS for full-text search, HypoPG for hypothetical indexes used in indexing, and pg_qualstats for PostgreSQL extension-restricted search results.
2) *Adoption by Prominent Companies:* PostgreSQL is used by prestigious firms such as Microsoft, Autodesk, MasterCard, Atlassian, and many more. It is especially popular among small and medium-sized businesses, as well as firms in the Internet, Software, and Communications Equipment industries.

Overall, PostgreSQL's appeal stems from its open-source nature, speed, extensive feature set, regular releases, and the availability of cloud PostgreSQL databases from various providers.

D. Implemented Dataset Metadata

The dataset used in this project consists of responses to a standardized questionnaire that was painstakingly created to examine a variety of technical and psychological elements. The questionnaire is designed to provide a thorough study of the respondents, revealing information on their prejudices and present opinions.

The essential characteristics and details pertaining to the dataset are as follows:

1) Description: "Questions Related to Student Career Prediction" .
2) January 12, 2022 is the date
3) Description: This dataset consists of multiple-choice answers obtained from a variety of people on their interests. These group answers provide insightful information on popular viewpoints.
4) Keywords: Prominent keywords include Public Service, Arts, Education, Technology, Healthcare, Finance, and Business, which represent the main areas of interest that the dataset covers.
5) The file format CSV.

IV. MODULES

The framework comprises three interlinked modules, each assigned to a distinct facet of the process. The initial module, known as the Skill Assessment Module, administers an assessment that encompasses questions related to both psychological attributes and core skills. Upon successful completion, students receive comprehensive feedback regarding their performance in various skill areas.

Subsequently, the Prediction Module employs a machine learning algorithm, leveraging the performance data acquired from the initial module, to predict the most suitable department placement for the candidate.

The final component of the framework is the Outcome Analysis Module, which offers the applicant an in-depth understanding of their performance through a variety of analytical approaches.

A. Skill Assessment Module

This module's implementation and design easily combine Django, HTML 5, CSS 3, and other web technologies. Although CSS optimizes how these pages are presented, HTML provides the basic structure for creating frontend pages that are displayed on websites. HTML web pages become dynamic and interactive when client-side scripting languages like JavaScript are used to provide responsiveness. Regarding development of the basic front end, technologies like HTML 5 and CSS 3 are indispensable components, while Django assumes a pivotal role in backend development. Within the module, users are presented with multiple-choice responses for each question. Django takes charge of the validation process and assigns weights to answer choices based on their appropriateness. Notably, the validation process is skill-centric, ensuring that responses align with specific skill-based criteria.

B. Prediction Module

The Prediction Module, considered the cornerstone of the framework, leverages an array of cutting-edge technologies, including training datasets, APIs, and machine learning algorithms. This module is underpinned by Python, a potent and versatile programming language renowned for its capabilities. In the realm of model generation, the module harnesses decision tree modeling, a widely adopted predictive technique within the domains of data mining and machine learning. Furthermore, the K-Nearest Neighbors (KNN) method is employed for classification tasks, relying on proximity-based data grouping principles to generate classification hypotheses. Moreover, the module introduces a novel global k-means clustering algorithm, designed for efficient clustering. Importantly, this algorithm facilitates progressive problem-solving without the need for predefined initial conditions or empirically adjustable parameters. This approach ensures the provision of deterministic and efficient solutions to clustering challenges. The speed of execution can be enhanced by implementing various strategies derived from the core principles of the k-means algorithm. These strategies aim to lessen the computational load while preserving response quality. In the upcoming sections, we introduce two modifications, each targeting a distinct aspect of the procedure.

The second enhancement involves a fast global update. Instead of performing localized searches, the k-means method calculates a swift estimate of the clustering error. The second alteration entails dividing the data region using a k-d tree structure.

Algorithm of the Prediction Module

To apply the Machine Learning Model to the provided data, the following steps are taken:

1) Import the necessary libraries, including seaborn, matplotlib, pandas, numpy, django.shortcuts, DecisionTreeClassifier, and warnings.
2) Interpret the data from the CSV file "ml_model/EDI1.csv."
3) Create a process that will remove all null values from the data and add float values in their stead.
4) Purify the data by using the specified function.
5) Create the two datasets, X (features) and Y (target), from the data. Utilizing the X and Y datasets, create training and testing sets.
6) Make a DecisionTreeClassifier model with a maximum depth of three tiers and the 'gini' criterion.
7) Use training set to train the model
8) Predict the target values using available data
9) Determine the precision score using test data
10) Make a DecisionTreeClassifier model with a depth of three at most and criterion "entropy."
11) Create the 'test' view function, which accepts a request object as an input.
12) Take the input values out of the request object and convert them to integers in the view function "test."
13) In its fields, enter the extracted input values after creating an instance of the replies model.
14) Return a redirect response.
15) Confusion Matrix

To assess the performance of a model or a system, one powerful tool at our disposal is the confusion matrix. It's a fundamental concept used in various fields, such as machine learning, medical diagnostics, and quality assurance. The confusion matrix is essentially a structured table that provides valuable insights into how well a model's predictions align with actual ground truth.

This table is comprised of four distinct components, each serving a specific purpose:

a) **True Positives (TP)**: These are instances where the model correctly identifies a positive condition. In the medical field, for example, this could represent cases where a diagnostic test correctly identifies individuals with a certain disease.

b) **False Positives (FP)**: This category includes instances where the model incorrectly identifies a positive condition when it shouldn't. For instance, it might indicate cases where a test incorrectly labels a healthy individual as having a particular medical condition.

c) **True Negatives (TN)**: True negatives are instances where the model accurately identifies a negative condition. In medical diagnostics, this might be where a test correctly identifies individuals who do not have a disease as disease-free.

d) **False Negatives (FN)**: These are cases where the model incorrectly identifies a negative condition when it's not. In the medical context, it could represent instances where a test incorrectly labels individuals with a disease as disease-free.

The beauty of the confusion matrix lies in its versatility. It can be applied to various datasets, where the ground truth values are known or established. In the context of machine learning, this means comparing model predictions to actual outcomes. By populating the matrix with counts in each of these four categories, we gain a clear understanding of how well our model is performing, including where it excels and where it might need improvement.

In essence, the confusion matrix is a powerful tool for quantifying a model's accuracy, precision, recall, and other performance metrics. It serves as a foundation for assessing and refining models, making it an indispensable component of data analysis, classification, and evaluation processes.

Values that more clearly identify the cases as positive are known as true positives (TP).

False positive (FP) values occur when a result is evaluated as positive even when the examples are negative.

The value in which samples are more accurately classified as negatives is known as the true negative (TN).

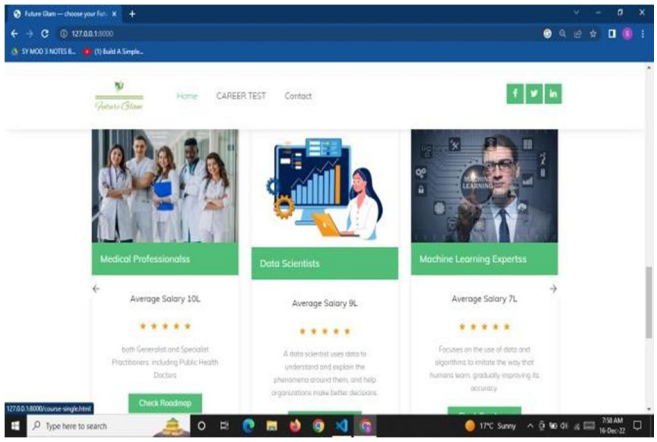
False negative (FN) values are those in which positive examples are given but the actual outcome is found to be negative.

```
Confusion Matrix:  [[25  0  0  0  0  0  0  0  8  0  5  0  0  0  0]
 [ 0 17  0  0  0  0  0  0  7  0  0  0  0  0  0]
 [ 7  0 31  0  0  0  0  0  6  0  0  0  0  0  6]
 [ 8  0  2 19  0  0  0 10  0  0  8  0  0  0  5]
 [ 0  0  0  0 13  0  0  0  0  0  0  0  0  0 10]
 [ 0  0  0  6  0 31  0  0  0  0  0  0  0  0  0]
 [ 0  8  0  0  0  6  0  0  0  0  0  0  0  0  5]
 [ 0  0  0  0  0  0  0 26  0  0  0  0  7  0  0]
 [ 0  0  0  0  0  0  0  0 18  0  0  0  0  0  0]
 [ 0  0  7  0  8  0  0  9  0 15  0  0  0  0  0]
 [ 0  0  0  0  0  0  0  0  0  0 22  0  0  0  0]
 [ 0  0  0  0  4  6  0  0  7  0  8 18  0  0  0]
 [ 0  0  0  0  0  0  0  0  0  8  0  4 15  0  8]
 [ 0  0  0  0 11  0  0  8  0  3  6  4  0  1  0]
 [ 0  5  0  0  0  0  0  0  0  0  0  0  0  0 12]]
```

Fig. 3. Confusion Matrix of the applied -Model

C. Result Analysis Module

The third module is made up of HTML and CSS visualizing components that display the processed data from the prediction model as informative visuals and customized career recommendations from earlier modules. The analysis and findings are displayed as personalized road maps and career information articles that outline the critical actions needed to move toward the intended goals.



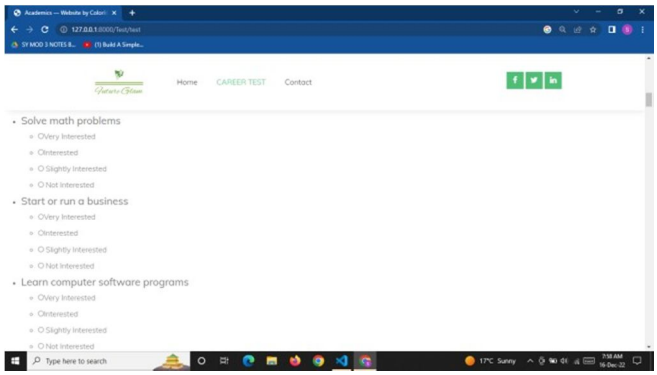


Fig. 5. MCQ Form Template of the Website

In addition to delivering results, the system also serves as a valuable resource by presenting detailed academic articles focusing on recommended career paths. These articles offer in-depth insights into various professional trajectories, encompassing essential components such as the requisite skills, prevailing market trends, and potential future prospects. This wealth of information empowers users to proactively plan their career journeys and make well-informed decisions regarding their professional pursuits.

Furthermore, the system's visualization module complements this comprehensive approach by providing detailed roadmaps that visually outline the critical steps necessary to progress along the suggested career pathways. The primary objective of these roadmaps is to offer users a clear understanding of the pivotal actions required to achieve their professional aspirations. They serve as guiding tools, elucidating the path to acquiring the requisite education, training, and hands-on experience essential for advancing within the recommended career domains. These roadmaps are designed to be practical aids in charting a course toward fulfilling and successful careers.

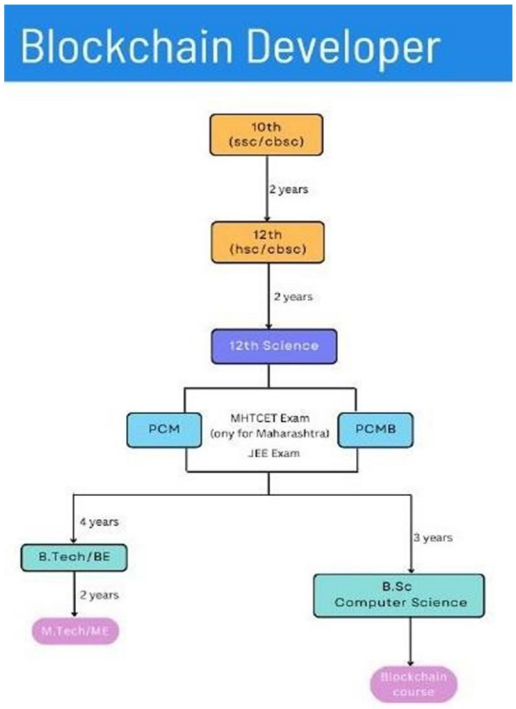


Fig. 6. Roadmap for Blockchain Developer displayed on website

V. RESULTS

The suggested solution successfully uses machine learning models based on user input from questionnaire responses to display pertinent career recommendations. Along with basic first roadmaps that show the initial steps to pursue the jobs, the results also contain further details about the suggested careers. Our project is a superb example of combining machine learning and web development.

VI. LIMITATIONS

Limitations of planned and present industry systems:

1) It cannot forecast for every field (Domain Specific).
2) It is possible to improve the prediction model's accuracy.
3) To improve the dynamism and user-friendliness of our website, we might also incorporate React and Bootstrap.
4) Database technologies such as MongoDB and others can be used to store additional Education fields that can later be trained into our prediction model.

VII. FUTURE SCOPE

The utility of this website extends its advantages to both students and parents alike. It provides a platform that caters to the educational needs and aspirations of the younger generation. In our ongoing efforts to enhance user experience, we can explore the application of technologies like React and the Bootstrap Framework. These technological enhancements are aimed at creating a user-friendly interface that is both intuitive and engaging.

Furthermore, we recognize the importance of refining the prediction model. One key avenue for improvement is to augment the questionnaire with additional questions. By doing so, we aim to achieve a higher degree of accuracy in predicting the most suitable career paths. In this endeavor, we also plan to introduce a broader range of aptitude questions that are designed to not only gauge academic strengths but also delve into the user's genuine interests and passions.

Expanding the questionnaire and collecting a more extensive set of responses will contribute to the enrichment of our dataset. A more substantial dataset is invaluable in generating more refined and precise forecasts. It enables the prediction model to capture a wider spectrum of user profiles and preferences, resulting in optimal career recommendations that align closely with individual aspirations and capabilities.

In summary, this website serves as a versatile and beneficial resource for students and parents alike. Through the integration of advanced technologies and the expansion of our questionnaire, we are committed to providing an increasingly user-friendly and insightful platform. The ultimate goal is to offer accurate and tailored career guidance that empowers individuals to make informed decisions about their educational and professional futures.

VIII. CONCLUSION

The primary objective of this study was to conceive and develop a website designed to predict career possibilities, offering candidates valuable guidance in selecting a suitable career path. This approach aspires to provide more accurate and valid predictions than the traditional career counseling methods currently prevalent in the field. To achieve this, we adopted a multifaceted strategy that involved several key steps. First, we collected responses from students pertaining to their skill sets. These responses were meticulously analyzed and categorized into clusters using the sophisticated K-Means Clustering algorithm. This approach allowed us to group students with similar skill sets into distinct clusters. The resulting clusters served as a basis for predicting suitable career disciplines based on the candidates' responses to a series of multiple-choice questions (MCQs).

In the pursuit of precise career predictions, we assessed the success rates within each cluster. We expected to find higher success rates and lower failure rates within specific clusters, indicating the appropriateness of certain career paths for individuals with particular skill sets. Throughout the course of this project, we conducted an extensive exploration of various career prediction methodologies. The aim was to create a web-based application that not only met but exceeded our desired outcomes. This involved the incorporation of additional attributes and the removal of outliers from the dataset, ensuring that the predictions were as reliable as possible. However, to comprehensively gauge the accuracy of the framework, further research and analysis are warranted. Continuous refinement and validation of the methodology will help us better understand its effectiveness and ensure that it remains a valuable tool for candidates seeking career guidance. In doing so, we aim to set a new standard in career prediction that assists individuals in making well-informed decisions about their future professional paths.

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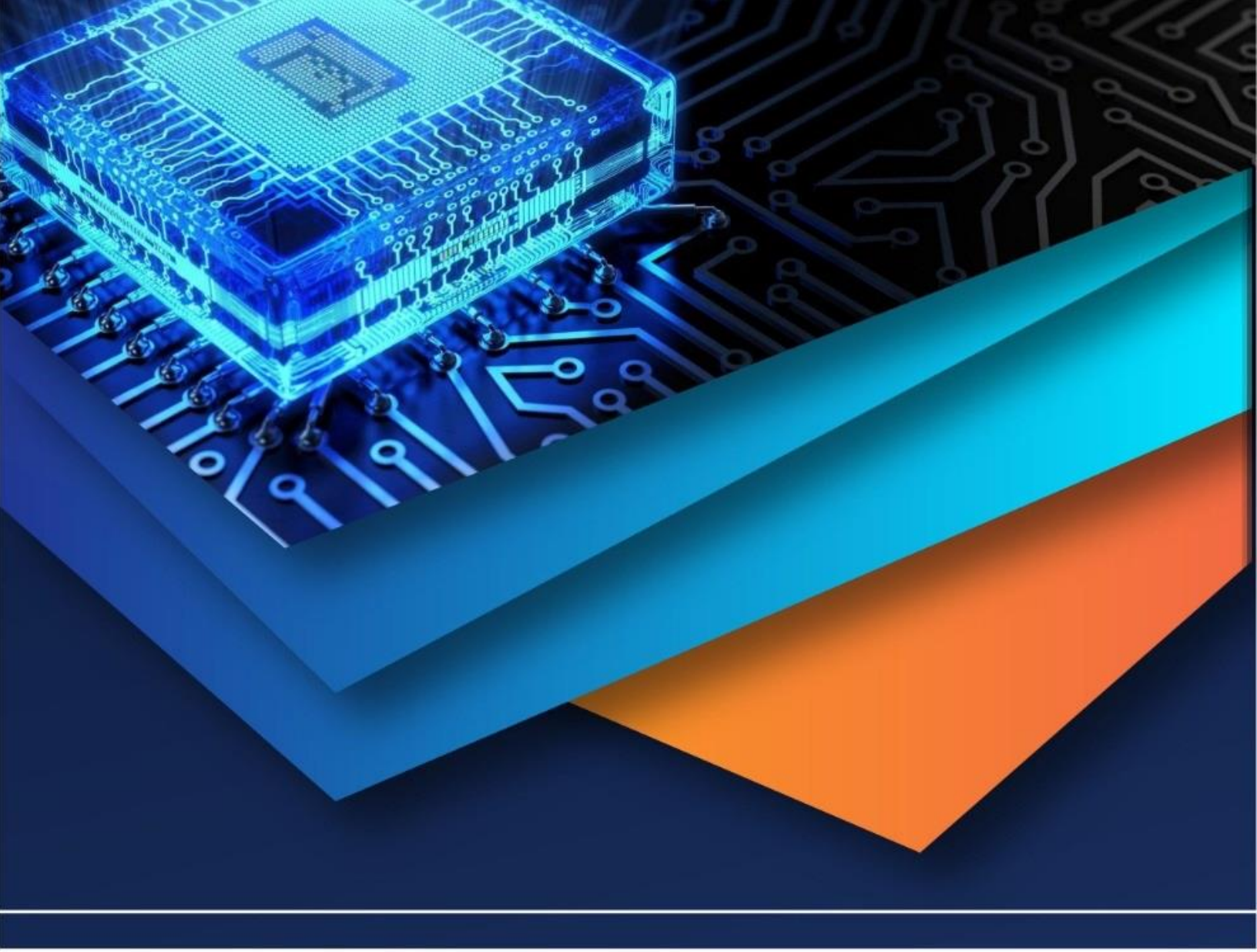

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