iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 7 **Issue:** VII **Month of publication:** July 2019

DOI: http://doi.org/10.22214/ijraset.2019.7209

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.177
Volume 7 Issue VII, July 2019- Available at www.ijraset.com

An Approach for the Reusability by Component based Unified Modelling Language (CB-UML) in Power Distribution System

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Abstract: ***The reusability principles are effectively carried out by the component based unified modelling language (CB-UML) method. To specify the reusability, the power distribution system is used as a component for the estimation of power. The design of component based method (CBM) is focused by the UML. The UML is a standard tool used for CBM to produce an efficient solution. The main idea is to reuse already completed components instead of developing everything from the very beginning each time. Use of CB-UML brings many advantages: faster development, lower costs of the development, better usability, etc. The CB-UML allows us to develop and integrate various components which facilitate reusability, high quality etc. The power that is distributed from the generating station to the consumers is shown by the sequence diagram and component diagram. Finally the total amount of power received and consumed for twenty four hours is evaluated by the power estimator algorithm and the result is shown by the mat lab software.***

Keywords: Components, CB-UML, Power Distribution System, CBM, UML

I. INTRODUCTION

The stipulate for constructing more composite and higher eminence of software systems is growing. It leads to the development of new methods, languages and tools. CBM is a most promising contract with the demand [1]. The CBM provide various methods and frameworks for the development of software systems. It highlights the system into smaller independent and reusable modules called the components. The combination of various components can be gathered together to produce a system. Each of the components can be varied with different functionalities. The combination of CB-UML is considered as an efficient approach to estimate the power in power distribution system.

The broadly accepted UML provides a strong support for the CBM [2]. To enumerate, various observations for the models, UML uses thirteen types of diagrams. These diagrams are splitted into three groups: correspond to static, behavior and interaction. This work concentrated on class diagram, sequence diagram and component diagram. The CBM and UML require strong interactions and interfaces between the components. The UML represents a powerful support for the CBM. The benefit of using CBM with UML produces a system with combined, consistent and to make use of UML tools for maintaining development time and effort.

Chouambe et al [3] focuses on component based systems for reverse engineering software models. The authors' dispute that component based technologies are used for the large number of software systems. Some of the component based technologies are common object request broker architecture (CORBA), component object model (COM) and enterprise java beans (EJB). Though there is a need of service and proficient tools for the reverse process techniques. To build a system using components can be developed by the component based software development (CBD) method [4, 5].

Crnkovic et al [6] concentrates on a different component based software models and are developed by various objectives, technologies and principles. The principles used for the above models are different but it produces similar outputs. Some of the models do not give clear procedures in the early stage but produce very simple, easy and understandable form of component based models.

Breivold and Larsson [7] describe about the component based software engineering and service oriented software engineering. According to them the above paradigms are the important and efficient for the development of software. The benefits of the approaches are used as a simple procedure and can improve the quality of attributes [8].

Koziolek [9] highlights the performance of evaluation measurement and prediction approaches to evaluate the system component specification designed by component developers. For the reusability artifact, Adnan has proposed a framework. This framework is divided into two phases. In the initial phase, it can store the newly developed components into a storage area for the latter use. The latter phase deals with searching and analyzing the stored components for reuse [10]. The connections and components in the

software system represent a higher level of abstraction in the software architecture. The component and their architecture focus on the individual component and their interfaces [11].

The reusability approaches raises the development of software by the previously developed components, thus the time taken and cost needed for the software development reduces [10]. The well accepted definition for reusability focus that each reusable binary piece of code is a component [12].

In this paper, we estimate the reusability by the CB- UML method for the power distribution system. It is expressed by the combination of procedure oriented methods and object oriented methods. Also shown the comparison for procedure oriented method, object oriented method and component based method. For the procedure oriented method, resilient back propagation (RB) algorithm based approach can be used for the Modeling of the reusable component based on metrics [13]. And for the object oriented method, levenberg – marguardt algorithm is used for the reusability principles. The quasi-newton BFGS Algorithm also produces a better solution for the modeling of reusability data [9]. To integrate with CBM, power distribution system is used with the help of UML. This method is used to estimate the amount of power received and consumed by the consumers for twenty four hours interval. The power estimator algorithm gives a good solution for the reusability of the components expressed for the power distribution system. The interface used between the components substation and consumers shows the integration of components.

II. COMPONENT BASED METHOD (CBM) USING UML

The CBM allows to construct a large system by assembling reusable components. It is a good solution to optimize the time and cost of software design while still guaranteeing the quality of the software [14]. The UML is the best choice and is used to signify and develop the architecture of software system by its different model diagrams [15]. To overcome the complex situations in software or application programs the UML models are used [16].

The UML is a standard tool to represent the software system's design and structure by various diagrams. Each diagram concentrates its own principles to show the design, development and implementation of software systems [17]. The UML diagrams are helpful to generate the source code for any object related languages and to produce reports.

The UML can also be used for business modelling, enterprise architecture and object oriented analysis and design. The UML is considered as the standard modelling language in the industrial area. This modelling language consists of high level graphical notations and various set of diagrams [18]. Sanjukuta proposed a new prioritization technique for retesting the component based software [19]. The CB-UML is focussed for reusability of the various components integrates with one another. The power distribution system is taken as a best choice to show the reusability principle by the component based UML method. Swati expressed her objective to bring together the constructive information on software component reusability and the aspects on which reusability of the component is greatly dependent [20].

III. REUSABILITY IN PROCEDURE ORIENTED AND OBJECT ORIENTED METHODS

A. Procedure Oriented Reusability

Various Neural Network Algorithms for Identification of Reusable Modules are used by Sonia [21]. Eleven neural networks algorithm has been implemented to get the solution for reusability by the procedure oriented method. Procedural metrics have been applied for the measurement of software complexity and size of structured systems [23].

Reuse frequency is calculated by comparing number of static calls addressed to a component with number of calls addressed to the component whose reusability is to be measured [24]. kNN based approach is evaluated for Reusability Prediction of function based Software systems. The time taken to complete the process will be more and the number of lines of code will be more.

B. Object Oriented Reusability

The metric based approach is used successfully in designing the framework for evaluation of reusability of object oriented systems and Levenberg – Marguardt algorithm is proved to be the best as compared to the other algorithms considered in this work [13]. Weighted complex networks are used to measure the maintainability and reliability [25]. Encapsulation, inheritance, coupling and cohesion properties are used for the design and reusability of the software [26]. Object oriented metrics are used to measure properties of object oriented designs [23]. The reusability of a software component is related to the number of used classes among all ones composing the software component. Thus, we calculate the reusability of the component based on the ratio between the numbers of used classes composing the component to the total number of classes composing the component [22].

The reusability principles can be evaluated by the use of inheritance method for object oriented method. The time taken to complete the process will be less than the procedure oriented method but more than the component based method.

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.177
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IV. POWER DISTRIBUTION SYSTEM –INTERFACE AND COMPONENTS

The power distribution system involves large amount of data. This data is carried out for the use of component based method. The UML is a natural choice for the component and can be used for both component and system modeling [27]. Literature concentrates various applications of CBM using UML for power distribution systems. The power distribution system distributes the power to the first component (substation). From the substation it is divided into two methods: primary distribution and secondary distribution. The power can either distribute in any one of the method to the next component (consumer). It is based upon the request from the consumer. The two individual components substation and consumers are connected by the interface (power) as shown in Figure 1. The interface can act as either primary distribution or secondary distribution.

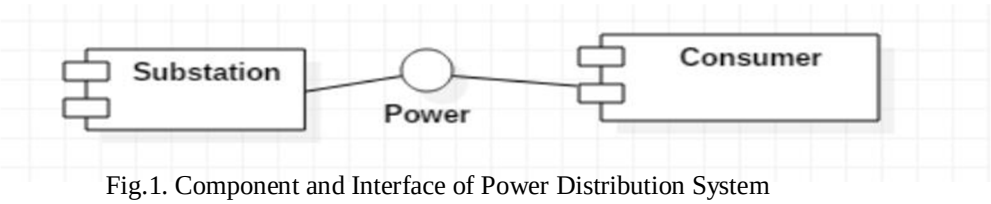

Fig.1. Component and Interface of Power Distribution System

A component is an object, used to interact with other components, encapsulating certain functionality or a set of functionalities. A component has a clearly defined interface and conforms to a prescribed behavior common to all components within an architecture.

A. Construction Of Uml Diagrams

Software systems evolve into complex systems every day. Component-based software model is a new trend in software development. The main idea is to reuse already completed components instead of developing everything from the very beginning each time. Use of component-based software development brings many advantages: faster development, lower costs of the development, better usability, etc. The testing technique works by to doing all existing test cases, but technique however require a lot of time and efforts, depending on the size and complexity of the component based system under test [28].

The UML is used to represent the data by various modelling diagrams. UML offers a broad notation for the entire lifecycle of object oriented development process. It is a successful proven language for modelling huge and complex systems. The UML provides set of rules and notations for the designing purpose.

The UML diagrams hold the properties of structural and behavioural features of architecture [6]. The UML represents how to identify and describe the class, object, use cases, sequence association, interface etc [27]. It produces a pattern to visualize the architectural form by different elements such as actors, activities, processes, components, databases, interfaces and reusable software components [28].

The power distribution system is effectively shown by the UML diagrams such as sequence diagram and component diagram. The sequence diagram explains the brief content of power distribution system for the various timing sequence it acquired. With the help of component diagram, a number of modeling constructs, such as connector, port and required or provided interface are used. UML provides a semi-formal means for specifying components, their composition and deployment [1].

B. Sequence Diagram

The sequence diagram obtains the entire activities into a single form. The sequence diagram is used to perform different activities of object into single use case. This diagram focuses on the interaction between the objects and messages that are connected by the use cases.

The Generating Station, Receiving Station, Substation and Consumers are the list of use cases shown in Figure 2. The lines connecting each use cases represent the lifeline that holds the use cases. The Primary Transmission object can distribute 220/132V power from Generating Station to Receiving Station. The Primary Transmission object lifeline will be activated only within this region. When the object transmitted to the Secondary Transmission the Primary Transmission object will be disabled. The Secondary Transmission object distributes 132/11kV of power to the Substation object. The power can be distributed to the Consumers by either Primary Distribution (11kV/400V) or Secondary Distribution (400 & 230 V*)* methods. In this stage, the amount of power distributed for each time intervals will be evaluated.

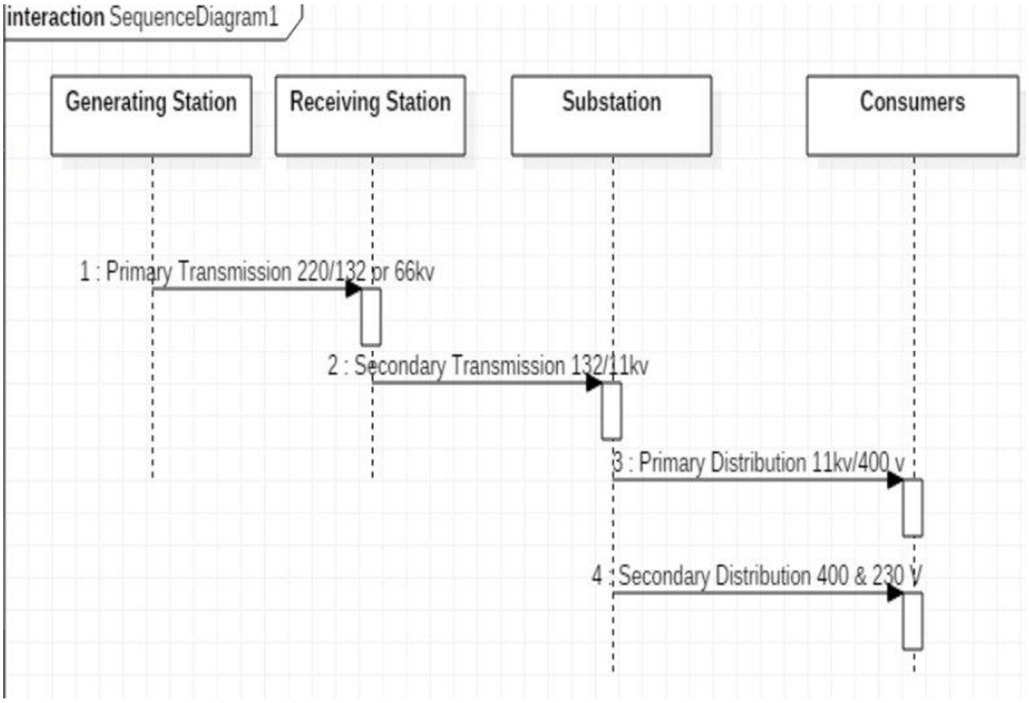

Fig. 2. Sequence diagram shows the timing order of power distribution system

C. Component Diagram

The component diagram is partitioned into three divisions. The first part denotes the class name, the second part lists the attributes, and final part represents the operations. Figure 3 explains the entire concepts of power distribution system by showing that, each class as a separate component diagram. Each component can be integrated into one component showing the Generating Station, Receiving Station, Substation, and Consumers. The Volt and Power are the attributes of Generating Station and voltage, power, current are the attributes of Receiving Station. Transmit (), Accept () and Distribute () are the operations of Generating and Distributing Stations. Table 2 shows the comparison result of CB-UML for the power distribution system with object oriented concepts and procedure oriented concepts. From the table it is clearly stated that the component based methods produce an accurate result with a very short span of time than the other two methods.

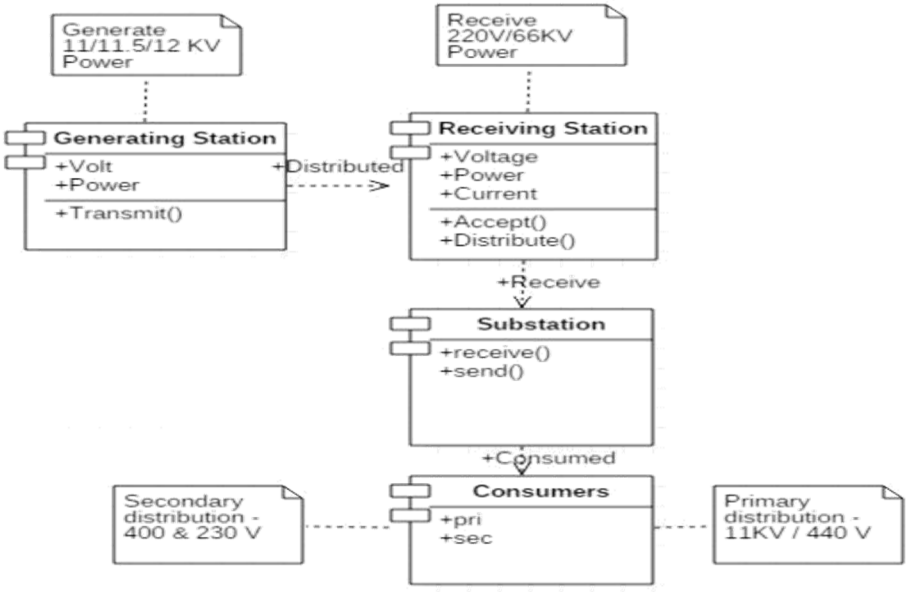

Fig.3. Component diagram shows the receiving and consuming of power

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.177
Volume 7 Issue VII, July 2019- Available at www.ijraset.com

V. COMPONENT BASED METHODS FOR REUSABILITY

McCarey et al. describe collaborative filtering strategy that allows developer using reusable components to achieved main objective of the on-demand learning; thus, improve quality of developer productivity at low cost and reduced development time [9,29]. The majority of component-based model utilize high level programming development. In such cases, some component-based models execute a specific language for implementation that requires some specific predefined rules [30]. Enterprise Java Beans component-based model uses Java with some additional requirements for implementation and some component-based model use translator for their specific language or multiple languages such as Corba component model [10].

The reusability principles can be estimated by the use of component based method without the use of inheritance [31]. The components itself will be used as a reusability agent and produce the result in a very short span of time. The time taken to complete the process will be less than the procedure oriented method and object oriented method. The number of lines of code used here is very minimal than the other two methods. It can support reusability principles for various applications also.

VI. ESTIMATION OF POWER RECEIVING AND CONSUMING FOR TWENTY FOUR HOURS INTERVALS.

The total power received from the receiving station and consumed by the consumer component is estimated for twenty four intervals. The timing slots starts from the range of 0-25. It is splitted into seven sub slots. The various range of power received and consumed by in each slots can be shown in Table 1.

Table 1. Total power received and consumed for 24 hours in voltage level

Sl. No	Hours	Total Power Received in 24 hrs (Volts)	Total Power Consumed in 24 hrs (Volts)
1	0	235	212
2	5	250	220
3	10	300	255
4	15	325	210
5	20	358	325
6	25	390	315

A. Algorithm Used For Estimation Of Power In 24 Hours Interval

The power estimator algorithm is used as the proposed algorithm for the estimation of power in twenty hours interval. When compared to the other algorithms, the power estimator algorithm very much support for the reusability method which is applied for the CBM.

B. Algorithm Power Estimator

1) Let v, p and c are the voltage, power and current
2) R is the receiving station
3) G is the Generating station
4) ∑r=r1.r2.....rn [r can be any receiving station]
5) S is the substation
6) ∑G->R, R->S
7) X is the consumers
8) ∑X=c1,c2.....cn [c can be any nature of consumers]
9) S->∑X at time t0
10) ∑R is the amount of power received
11) ∑C is the amount of power consumed
12) Estimate Time T=∑X+24 for 11KV or 400 V
13) ∑T=(∑R+24)-(∑C+24)
14) ∑T shows the amount of power received and consumed for 24 hour intervals.

The Figure 4 shows the final estimation of power received and consumed for twenty hours intervals. These shows the power estimator algorithm can be reused for various time intervals within different slots. The results are compared with procedure oriented and object oriented with CB-UML are shown Table 2.

Table 2. Comparison of CBUML with procedure oriented and object oriented methods

Principles	Procedure Oriented	Object oriented	CB-UML
Reusability	Use procedures	Use inheritance	Without inheritance
Complexity	More	Less	Very Less
Flexibility	Difficult	Simple	Flexible
Abstraction	NA	Classes, interfaces	Component interfaces, encapsulation

C. Comparison Of Cb-Uml With Procedure Oriented And Object Oriented And Methods

The components are treated as a coarse grained software entities and object oriented classes are treated as fine grained nature. The components can define and use their needed interfaces among them [13]. Reusability, Complexity, Flexibility and Abstraction are the standard principles used for the comparison. Each methods are explained by their principles individually.

VII. CONCLUSIONS

The CB-UML method is used effectively to show the reusability principles. For this, the power distribution system is used as a major component. The components of substation and consumer are connected by an interface. The total power received and consumed for twenty four hours interval is evaluated. This result shows that the CB-UML produces a very good result within the stipulated time. The sequence diagram is used to show the timing sequence of power from the generating station to the consumer end. Also the component diagram represents the flow of power from the generating station to the consumer with the amount power flows in each region. The CBM is compared with procedure oriented and object oriented method. The power estimator algorithm is used to show that the CB- UML method produces a less time to estimate the power that is received and consumed for twenty four hours interval. This can be reused for various time intervals and also with different components integrated together.

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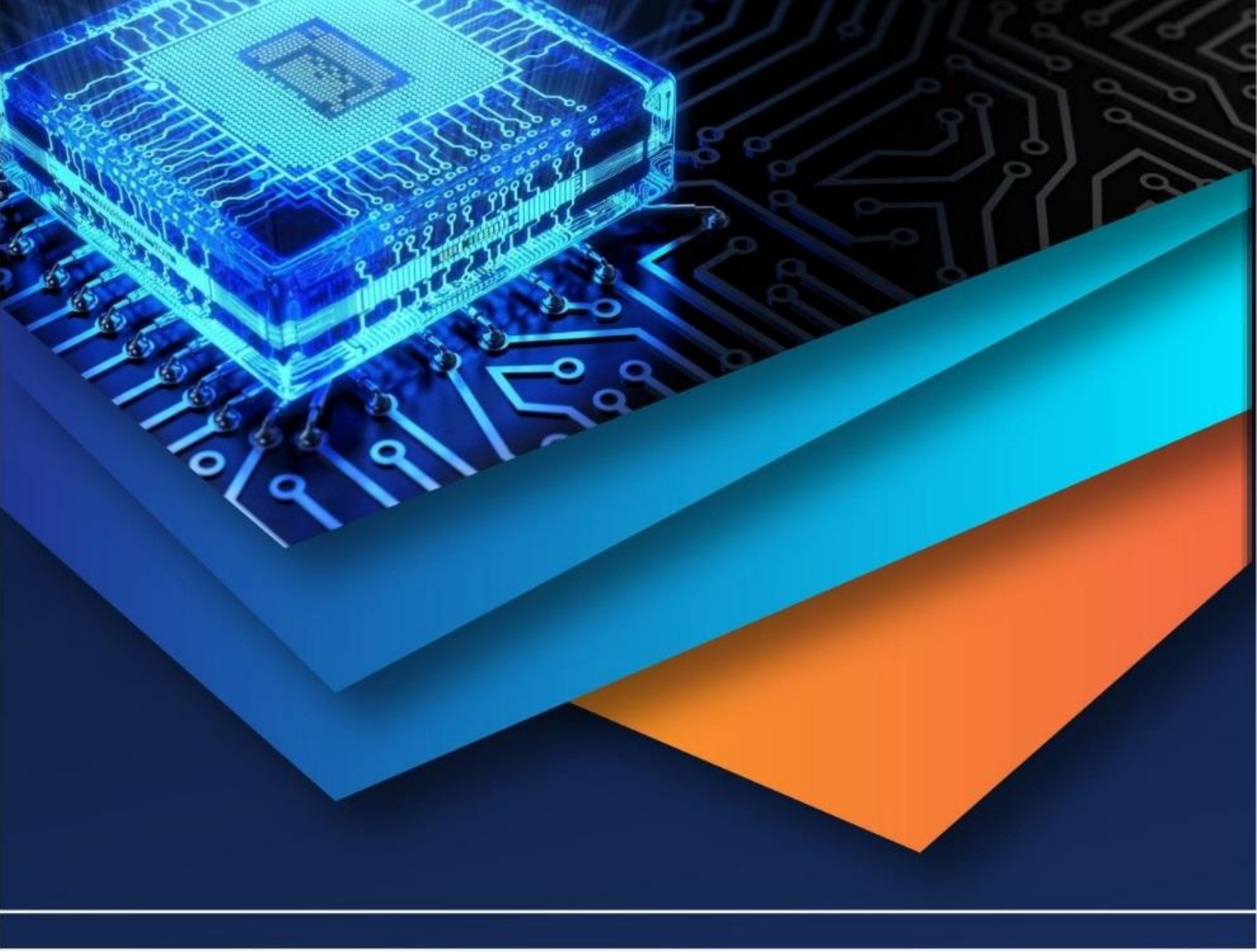

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