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Speed Control of DC Motor using Artificial Intelligence

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***Abstract:** The structure of intelligent control frameworks has been a zone of extreme research intrigue. A promising course in Smart Systems Design includes the utilization of fuzzy logic Controller to find the capacities of keen working frameworks in the utilization of experience through rule-based knowledge. The most generally utilized controller in the business is Proportional in addition to integral plus derivative to subsidiary PID controller. PID Controller requires a numerical model of the framework The Fuzzy Logic Controller (FLC) offers an option in contrast to PID Controller, particularly if information isn't or just incompletely accessible for the framework. In examination, three controllers have PI, PID and FLC is structured and actualized in MATLAB/Simulink Model to explore the presentation of the DC engine with various Control. The outcomes demonstrate that the FLC responds better contrasted with the PI and PID controllers.*

I. INTRODUCTION

Dc motor speed can be balanced inside the wide limits with the goal that gives good performance and simple controlling. DC motor have various applications cars, trains, mills, busses etc. which required a control speed. There are many traditional methods are used like PID controller. PID is the most widely recognized and most prominent input controller utilized in Industrial Process today. A PID controller ascertains a "blunder" esteem as the contrast between a measured process variable and an ideal 'set-point'. Open circle tuning techniques are the place the input controller is detached, and the experiments energize the plant and measures the reaction. The key point here is that since the controller is currently detached the plant is unmistakably now no longer carefully levelled out. If the loop is basic, at that point this test could be perilous. In fact, if the procedure is open-circle unstable, then we will be in a bad position before we start. Despite for some procedure control applications, open circle type investigations rush to perform, and deliver informative outcomes. In spite the fact that the modern control procedure has taken impressive consideration amid the most recent quite a long while, PID controllers are as yet a standout amongst the best realized controllers utilized in numerous mechanical procedures. Their significant and great properties, for example, quick and proficient control activity, straightforward however useful structure, simplicity of utilization and hearty execution are among the purposes behind their inclinations. Further fuzzy logic controller is used to get a stable output using Fuzzification Defuzzification. Inputs are converted to fuzzy values and then outputs are calculated and converted to known languages

II. DC DRIVES

A regular traditional electric drive framework for variable speed application utilizing multimachine framework is appeared in Fig. 1. The system is clearly massive, costly, rigid and requires ordinary upkeep. Previously, acceptance and synchronous machines were utilized for consistent speed applications – this was for the most part a direct result of the inaccessibility of variable recurrence supply.

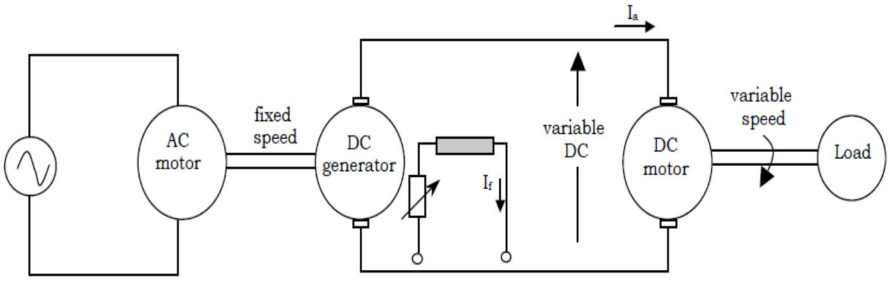

Fig. 1 Conventional variable speed control of electrical drive system

To get to the issue detailing the mathematic condition of independently energized dc motor should be get it. The independently energized dc motor model elements are depicted by a lot of electrical and mechanical differential and mechanical condition in continuous time space.

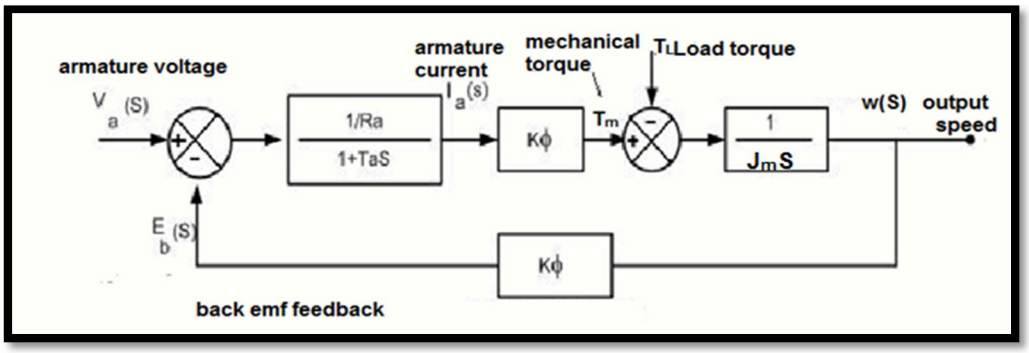

Fig. 2 Mathematical model of DC Drive

III. PROPORTIONAL INTEGRAL DERIVATIVE CONTROLLER

The proportional integral derivative of the control panel contains Proportional (P), Integral (I) and Derivative (D). An uncontrolled proportional integral derivative computes an effect correction queue that corrects the file from the point of view of the transmission, i.e. the process and the case of the speed, according to the process. Either the control output or the variable is manipulated.

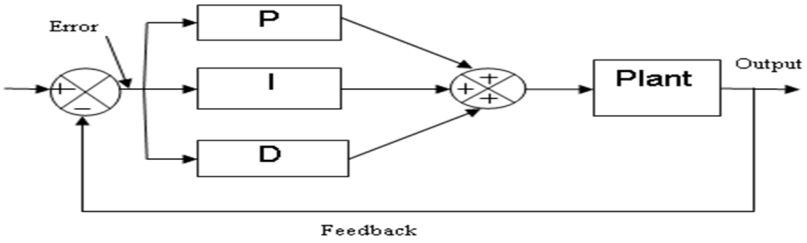

Fig. 3 Schematic Diagram of PID Controller

The integral action expels the balance presented by the corresponding control yet bring a phase lag into the framework. The derivative controller yield is relative to the rate of progress of blunder. Derivative control is utilized to diminish the size of overshot created by the vital part the joined controller-process dependability. In PID controller, control commands combine with each other which the overall form is as follows

$$U(t) = K_p + K_i\int e(t)dt + K_d\frac{d\,e(t)}{dt} \quad (1)$$

IV. FUZZY LOGIC CONTROLLER

Fuzzy logic is called “mathematical words instead of numbers” or “sentence controlled” instead of numbers .it is same as the fuzzy theory that focuses on object with boundaries and membership function. It is different from conventional multi- value logic system in concept and content.

In the controller inputs are changed from crisp to fuzzy and then rule is applied to get the output and then the output values are changed from fuzzy to crisp. It is better than other traditional controllers as it is cost effective and easy to use.

A. Fuzzification

Conversion of crisp set into fuzzy set is known as Fuzzification. First step of the FLC controller is Fuzzification where all the inputs are converted to membership grades with their membership function. Commonly its inputs include status error, derived status error, status error latches and so forth

B. Defuzzification

Conversion of fuzzy logic values into numeric or crisp values are known as Defuzzification. Defuzzification is the last step of fuzzy logic controller. It decreases the non-linearity of the output and define the membership function by generating the desired output.

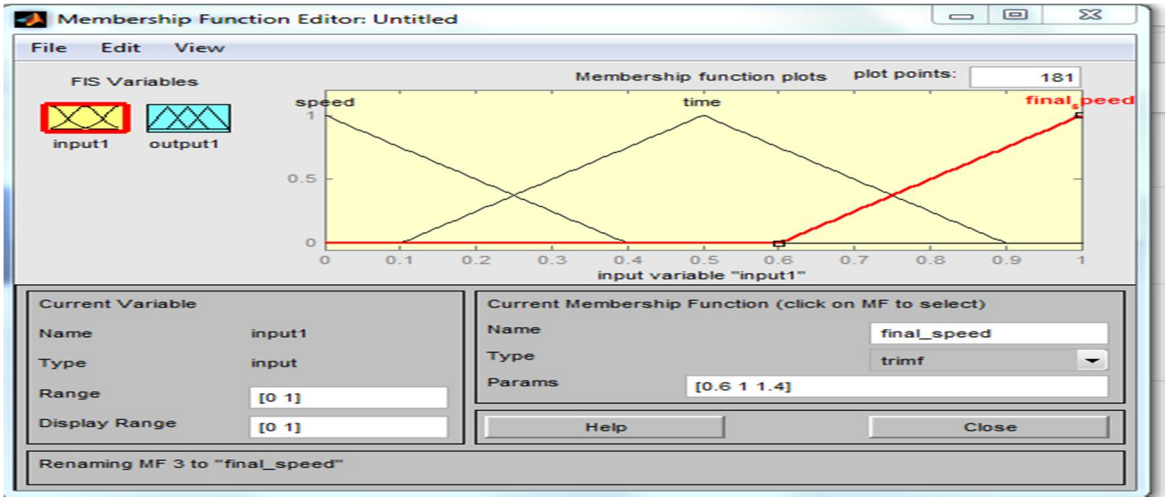

Fig. 4: Membership Function Editor Block

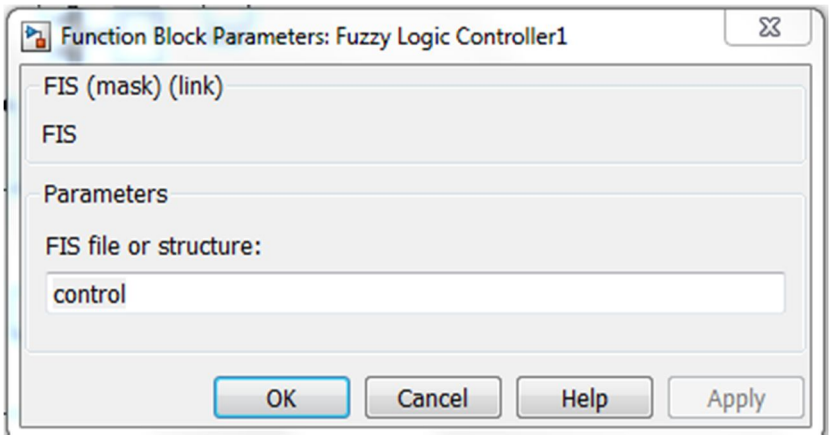

Fig. 5: Fuzzy Logic Controller Block

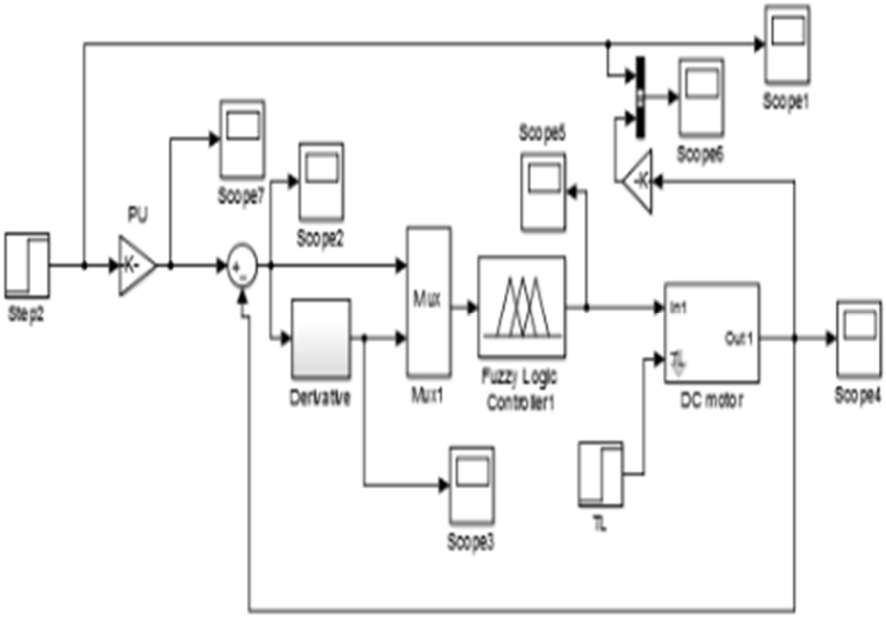

Fig. 6 FLC controller Simulink

V. RESULTS AND DISCUSSION

The FLC is added to the traditional PID controller to alter the parameters of the PID controller on-line as per the difference in the sign blunder and change of the mistake. The controller proposed likewise contain a scaling increases inputs (Ke, KΔe) as appeared in Fig. 7, to fulfil the operational extents (the universe of talk) making them increasingly broad.

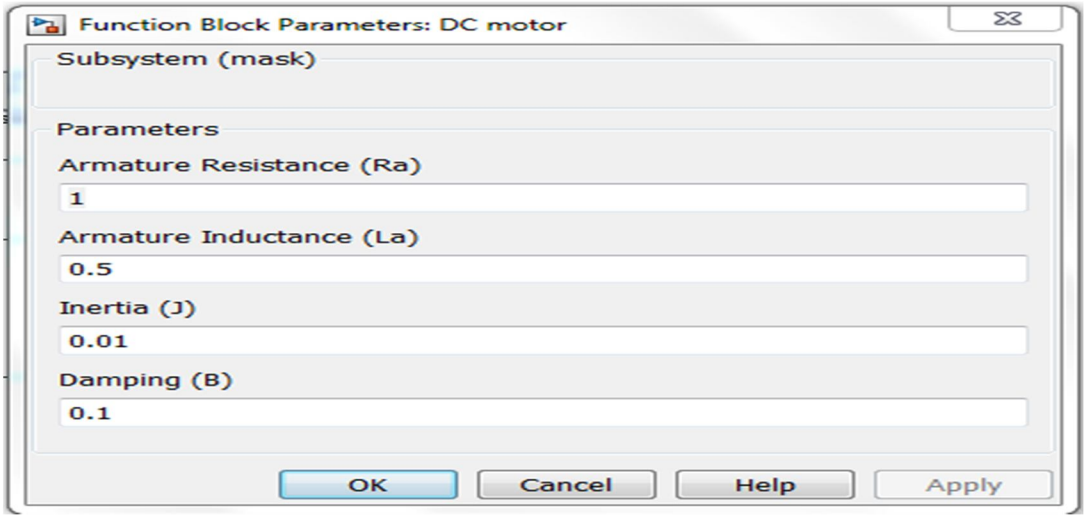

Fig. 7 Function Block for DC motor

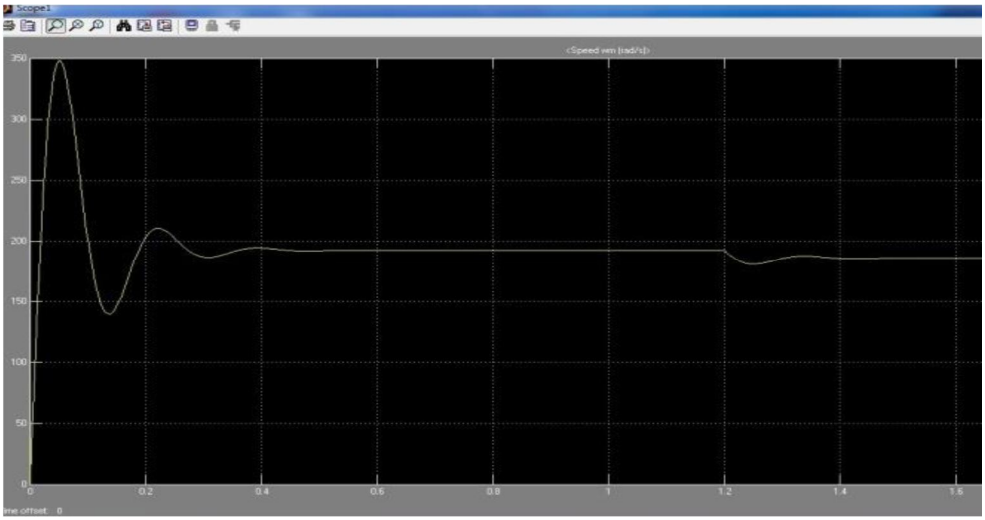

Fig. 8 Speed Response of DC Motor without any controller

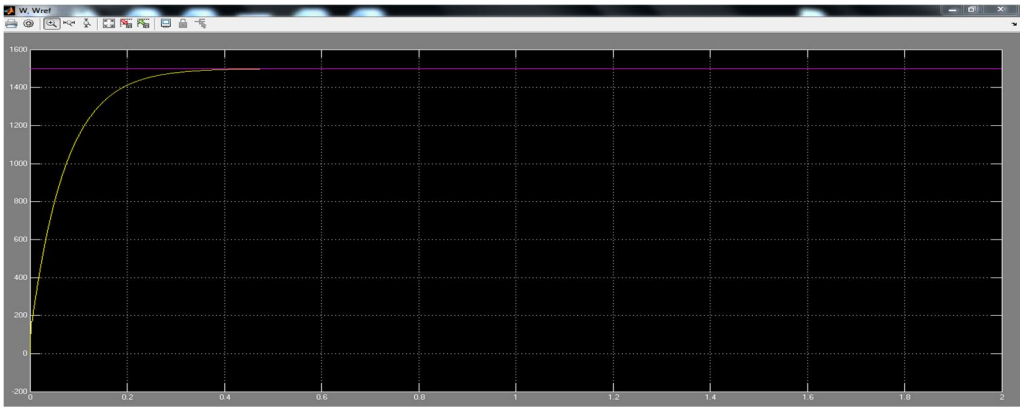

Fig. 9 Result of proportional integral controller

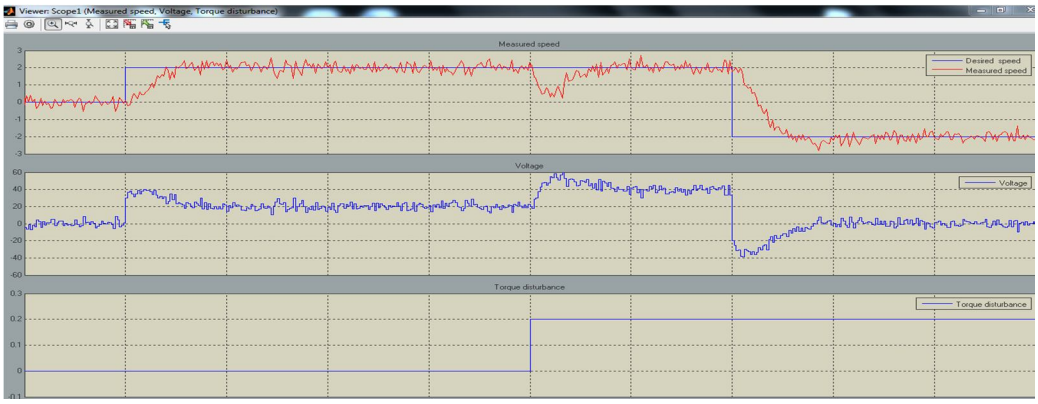

Fig. 10 Result of proportional integral derivative controller

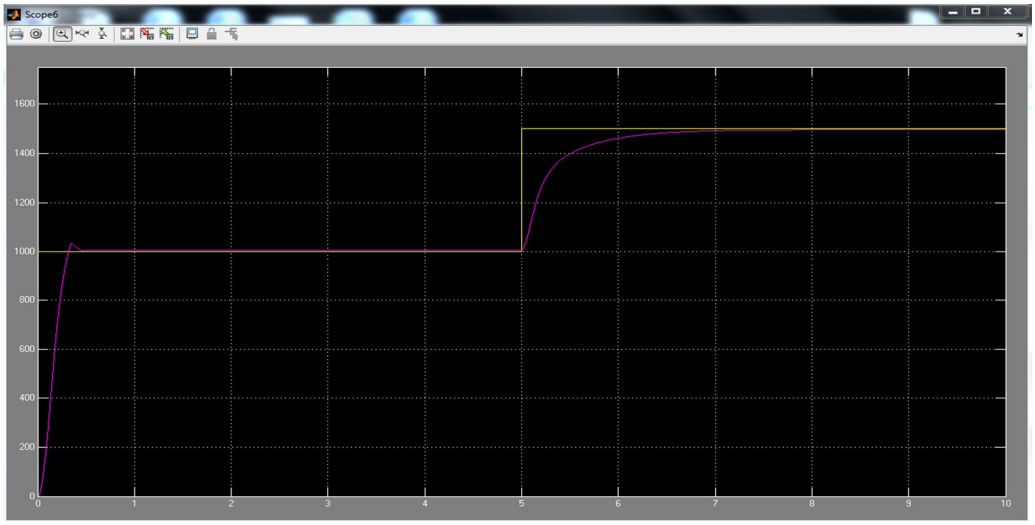

Fig. 11 Result of fuzzy logic controller

VI. CONCLUSION

In the paper, Fuzzy rationale controller brings down the estimations of rise time, most extreme overshoot and execution time and gives an increasingly responsive reaction to stack unsettling influences in the customary controller. Also, the fuzzy logic controller is better than a traditional proportional integral and proportional integral derivative controller.

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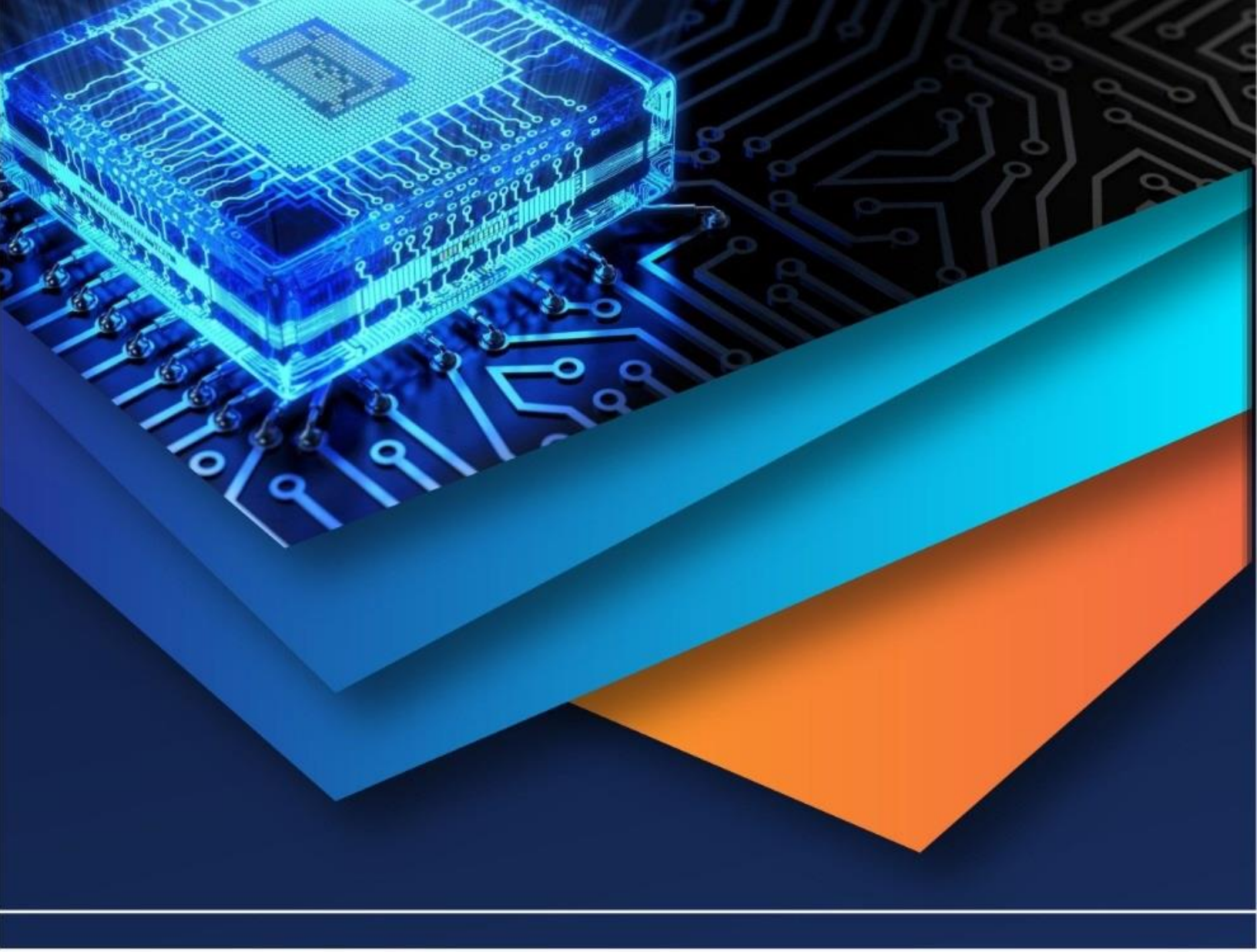

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