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Thermal Management in a Processor: CPU Throttling

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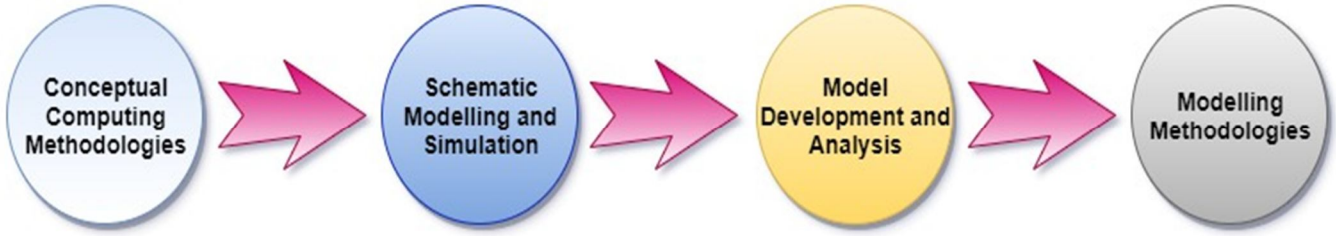
Abstract: ***Modern computers rely upon technology quite ever especially with the software programs getting bigger and bigger which implies making of computer system faster in terms of processor. High performance computing devices tend to generate significant amounts of heat during operations. Heat is an inevitable byproduct of work. Heat is also prevalent in electronics where it can be more difficult to manage and may be detrimental to their continued operations. In some cases, excessive heat temperatures can damage the electronic parts or may result in resource exhaustion. If the temperature is greater than a threshold temperature, the throttling factor is to reduce the performance of the electronic component. By this we can conclude that the user experience can be degraded so, we understand that there is a strong need for power consumption and thermal analysis. In a typical thermal arrangement, CPU's are throttled to avoid excessive temperatures by altering its clock speed.***
Keywords: Throttling, Frequency, Dynamic Thermal Management (DTM), Modeling, CPU, Heat, Processor

I. INTRODUCTION

As the complexity grows, the continued success of Moore's law has enabled integration of various latest technologies but has gradually dominated the system performance due to the lack of coordination between CPU and GPU which induces recurrent frequency throttling to maintain on chip temperature below the permissible limit. This leads to significantly degraded application performance and large variation in temperature over time. To avoid it, CPU throttling has been proposed as a novel, practical solution. CPU throttling or thermal throttling is a power saving technique in computer architecture whereby the clock/operating frequency of a microprocessor is automatically reckoned on the particular needs. It is a well-known technique to reduce the activity in the pipeline. To prevent the increasing heat from damage of processor or accidental shutdown while at high workload, this technique regulates the thermal environment by alternating between running the processor at full speed and placing the processor in a sleep state whenever the upper limits of the thermal envelope are reached. This will force the processor to enter partially idle mode in line with preset processor operating temperature. When the system senses the processor operating temperature reaching the preset value, the processor reduces the voltage that a component draws and operating bandwidth will be decreased to the preset idle percentage to chill down the processor. Therefore it reduces the amount of heat generated by the chip and guarantees data reliability. It is useful as a security measure for overheated systems (e.g. after poor overclocking). Hence it allows the possible elimination of cooling solutions, reduces system weight and time-to-market as there is no need for explicit microprocessors thermal management. The renowned concept of throttling is utilized in all ranges of computing systems, ranging from mobile systems to data center to reduce the power at the times of high workload. Thus processor can deliver fast reaction time and high throughput to both the CPU and GPU to work in tandem in order to provide a maximized user experience alloying dynamic thermal management
Design Methodologies for "Performance Optimal Processor Throttling under Thermal Constraints"

Activity Diagram

Activity Diagram showing the flow of CPU Thermal Management



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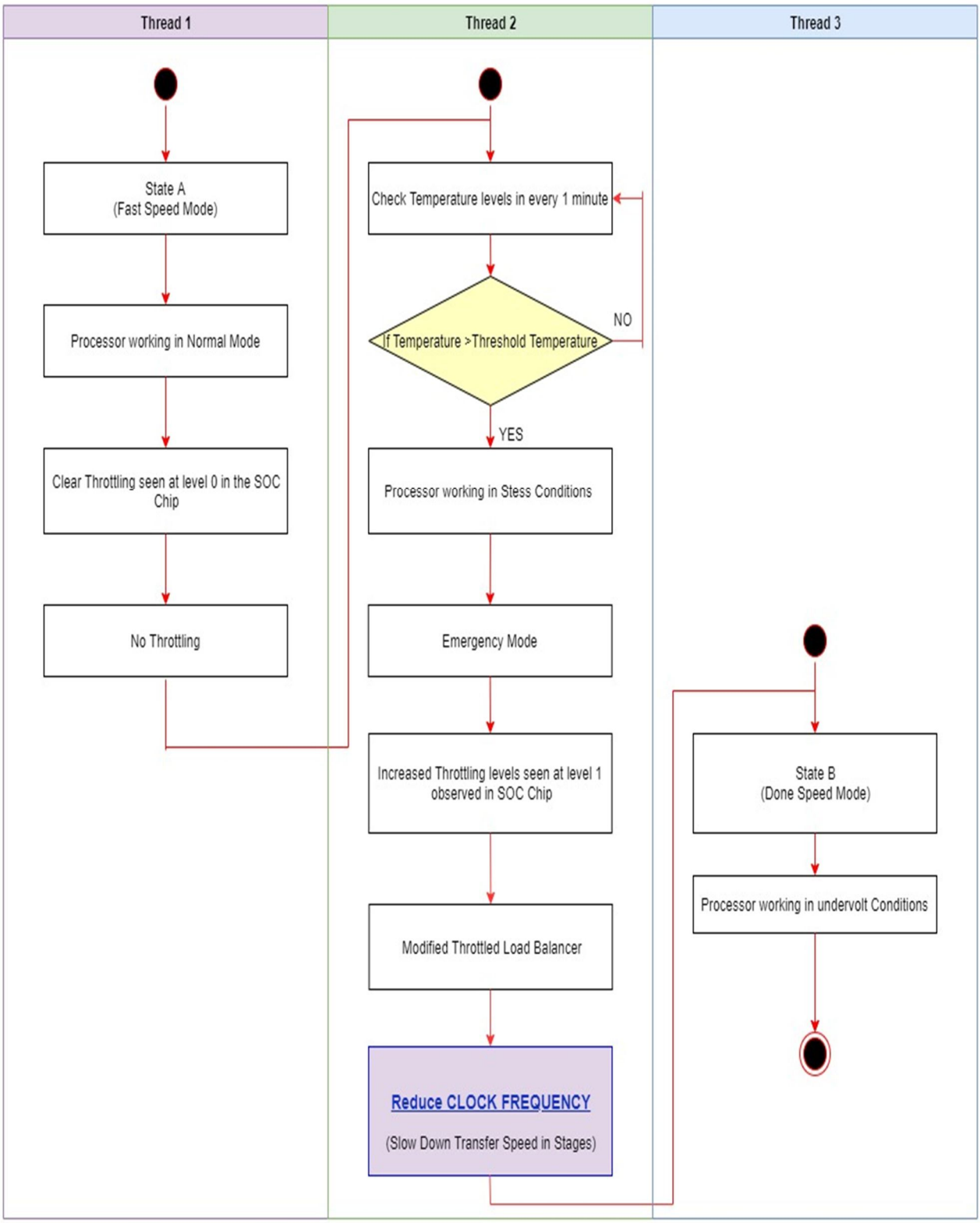
Sequence Diagram

Sequence Diagram depicting the working of Thermal Management in the order of which they occur



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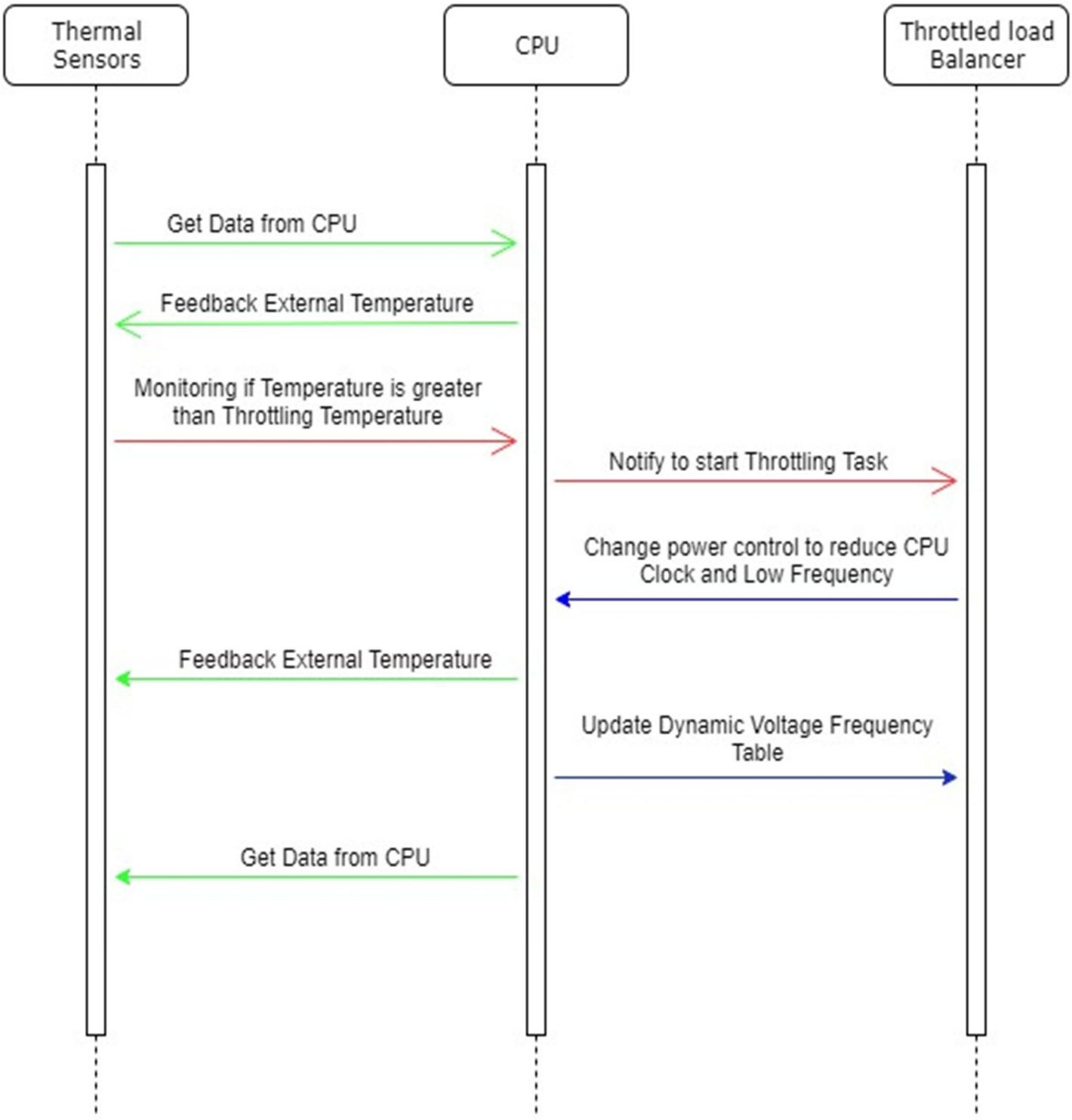

Thermal aware design concept strategy for a MPSoC (Multi-processor System on Chip)

A. Thermal aware design strategy for a MPSoC plays an integral part in architectural practices.
B. It is dedicated design strategy based on Dynamic Thermal Management
C. It identifies basic roles in performance simulation

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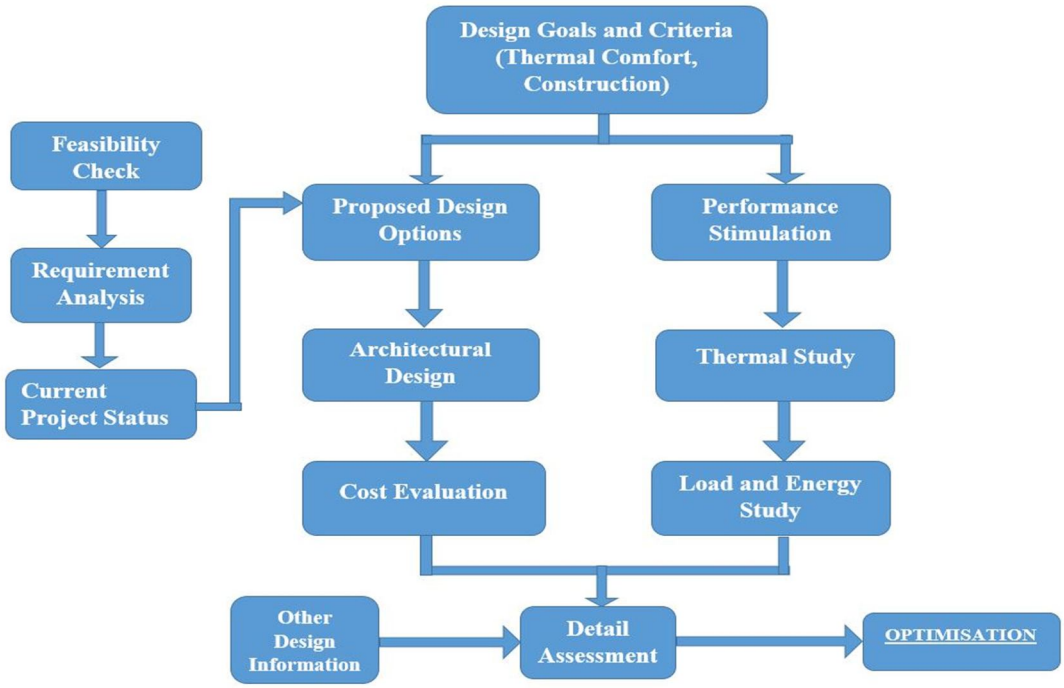
II. CONCLUSION

Thermal behavior is one of the biggest bottlenecks for high performance chip designers. Therefore, it is possible to integrate and use of thoughts of this technique with exiting processor to study system level power and thermal issues for various high performance accurately. In this paper, we performed a detail characterization of the thermal behavior of the CPU and hence must be managed cooperatively to achieve high performance with robust thermal management. The goal is to reduce power consumption so as to kill thermal problem caused during processing by mean of thermal management. It is a holistic energy optimization. The work finds application in fair processor performance, Power management, Dynamic voltage scaling. The proposed technique served as a useful framework for future work on thermal scheduling yet the Thermal throttling has proven to be challenging due to heat effect of cores and subsequent trade-off that occurs between performance requirements and overheating.



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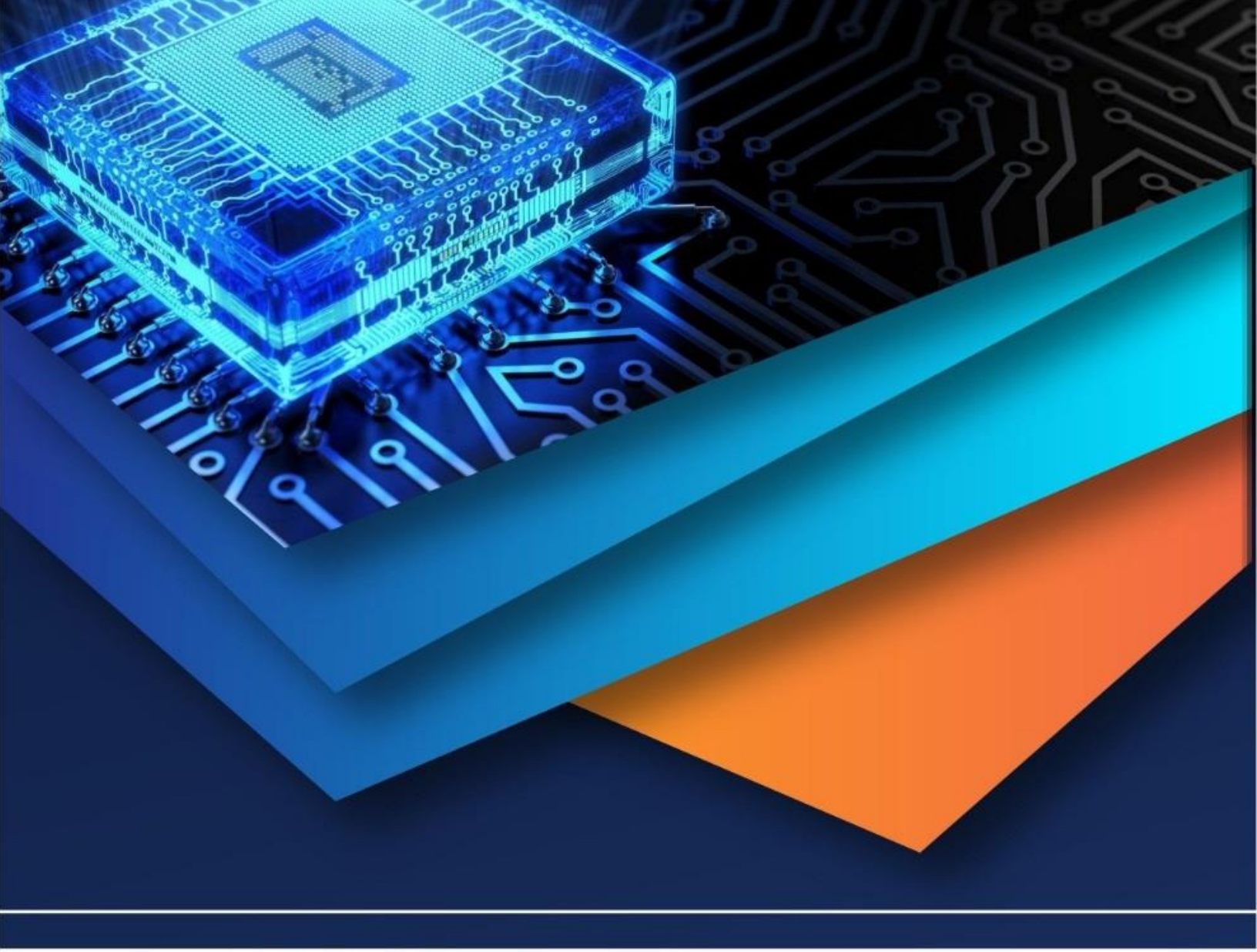

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