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Comparative Analysis of Energy Efficient Hybrid Solar Tracker System using Servomotor

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Abstract: ***The objective of this task was to build up a model of a sunlight based following framework, which can improve the presentation of the photovoltaic modules in a sun powered vitality framework. The working standard of this gadget is to keep the photovoltaic cell board continually lined up with the sunrays, which augments the presentation of sun based board to the Sun's radiation. Accordingly, more yield force can be delivered by the sun oriented board. The framework used an Arduino to control movement of two servomotor, which pivot sun oriented board in two directions. The measure of revolution was dictated by the microcontroller, in light of data sources recovered from four photograph sensors situated close to sun oriented board.***
Keywords: Solar tracker; Efficiency comparison; Servo motor; Arduino

I. INTRODUCTION

In With the unavoidable deficiency of petroleum derivative sources later on, sustainable kinds of vitality have become a subject of enthusiasm for scientists, experts, financial specialists and chiefs from all parts of the country. New kinds of vitality that are getting consideration incorporate hydro-electricity, bio-energy, sun based, wind and geo-thermal vitality, flowing force and wave power. In view of their inexhaustibility, these are recommended as good swaps for petroleum product we have. Among those kinds of vitality, sun based photo-voltaic (PV) vitality is one kind accessible assets.

That innovation has been received applaud generally for private use these days, on account of innovative work exercises to improve sun powered cells' presentation and lower the expense. As per International Energy Agency (IEA), overall PV limit has developed at 48% every year on normal since mid-2000s. Sun based PV vitality is profoundly expected to turn into a significant wellspring of intensity later on.

Nonetheless, in spite of the preferences, sun powered PV vitality is still a long way from supplanting customary sources available. It is as yet a test to amplify power yield of PV frameworks in regions that don't get a lot of sun oriented radiation. We despite everything need further developed innovations from producers to improve the ability of PV components, yet enhancement of framework plan and prototype development is a plausible way to deal with make sun based PV supplied power progressively proficient, along these lines being a dependable decision for clients. Focusing on that reason, this venture had been done to help the improvement of such encouraging innovation.

II. MONO AXIS SUN TRACKER

The mono axis solar tracker is the apparatus in which the sun powered board tracks the sun from east to west utilizing a solitary turn point to pivot. Under this framework there are three sorts: Horizontal single pivot following framework, Vertical single hub following framework and Tilted single hub following framework.

In the Horizontal framework the hub of turn is flat concerning the ground, and the substance of the module is arranged corresponding to the pivot of revolution. In the Vertical framework the hub of turn is vertical regarding the ground and the essence of the module is arranged at a point as for the hub of pivot. In the Tilted following framework the tomahawks of pivot is among flat and vertical tomahawks and this additionally has the essence of the module situated corresponding to the hub of revolution, like the Horizontal following framework.

The single hub following framework comprises of two LDR's set on either side of the board. Contingent upon the force of the sun beams one of the two LDR's will be shadowed and the other will be enlightened. The LDR with the most extreme force of the sun's radiation imparts more grounded sign to the controller which thus imparts sign to the engine to turn the board toward the path in which the sun's power is greatest.

Block Diagram

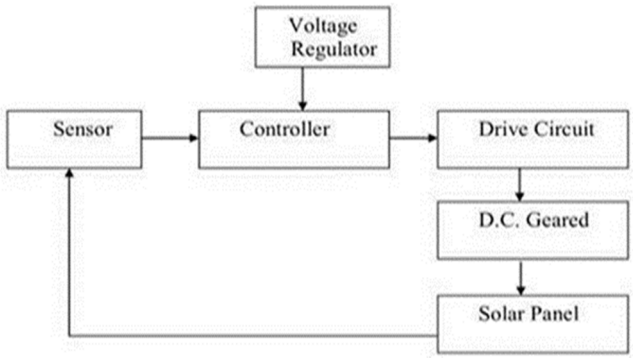

Fig 1. Basic working block diagram

A. Proficiency of Single-Axis Tracking System On top of Static System

To relate the efficiency of Single axis solar tracker and Static solar tracker, the calculations are taken from 9a.m. to 6 p.m. for every one hour in a single day. and the variance of efficiency between static solar panel and single axis solar tracker .

Table.1 Tabulated readings of mono axis sun tracker

Hours	Single axis tracker		solar	Static solar panel		
	Ma	volts	mw	mA	Volts	mw
9 a.m.	2.09	10.1	21.10	2.01	9.6	19.29
10 a.m.	2.32	10.2	23.66	2.37	9.7	22.98
11 a.m.	3.86	10.3	39.75	2.79	9.9	27.62
12 a.m.	3.95	10.6	41.87	3.11	10.4	32.34
01 p.m.	4.56	11.1	50.61	3.64	10.6	38.58
02 p.m.	4.98	11.5	57.27	4.01	10.8	43.30
03 p.m.	5.22	12.2	63.68	3.87	10.2	39.47
04 p.m.	5.02	11.6	58.23	3.42	9.8	33.51
05 p.m.	4.11	11.4	46.85	2.53	9.3	23.52
06 p.m.	3.32	10.2	33.86	1.70	9.1	15.47
Avg			43.68	Avg		29.61

According to the above calculation mono axis sun tracker is 47.51% more efficient than static solar panel. Because of the yearly movement of the earth the sun likewise moves the north and south way relying upon the season and because of this the proficiency of single- pivot is decreased since the single-hub tracker just tracks the development of sun from east to west. During shady days the productivity of the single pivot tracker is practically near the fixed board.

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B. Disadvantage of Single Axis solar Tracker

The principle inconvenience of the mono hub tracker is that this will just follow the day by day direction of the sun and not the annual movement. The effectiveness of the mono pivot following framework is likewise diminished during shady days since it can just track the east-west development of the sun.

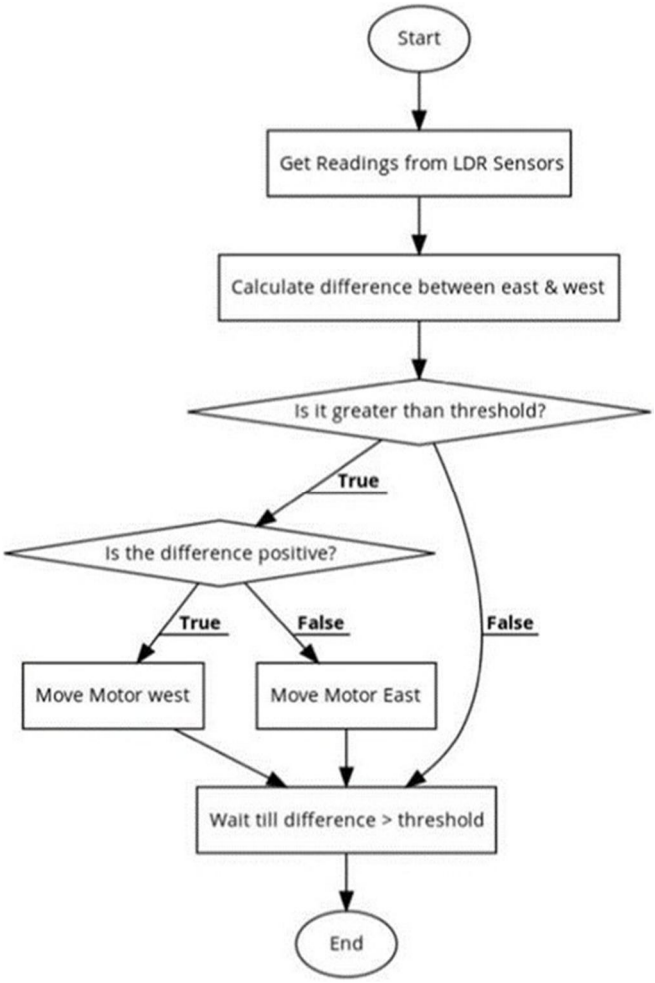

Fig 2. Flowchart of singles axis solar tracker

III.DOUBLE AXIS SOLAR TRACKER

Double axis framework utilizes the sun oriented board to follow the sun from east -west and north-south utilizing two turn focuses to pivot. The double pivot following framework utilizes four LDR's, two engines and a controller. The four LDR are set of four distinct bearings. First lot of sensors and one engine is utilized to bow the tracker in sun's east - west heading and the other arrangement of sensors and the other engine which is fixed at the base of the tracker is utilized to bow the tracker in the sun's north-south bearing. The Arduino distinguishes the sign from the 4 LDR and orders the motor to turn the board separate way.

A. Project Description

The propose framework is the Arduino based variable and compatible framework with a double hub sunlight based following framework. The Arduino gets the information from the LDR sensors to pivot the sun oriented board to the lighting place by utilizing the engine driver and the servo engine. The voltage divider technique is utilized as the voltage sensor. The battery is utilized to store the vitality from the sunlight based board.

Furthermore, applied to the heaps. The sun oriented tracker first check x pivot and adjust to ideal positon then y hub and do likewise. The sun powered tracker will come to end when light force is greatest on the sun based tracker.

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B. Working Principle

1) Working of LDR depends upon source of the light and it shifts as indicated by it. The more is the intensity of light, lower will be the LDR obstruction and because of this the yield voltage brings down and if a light power is low, more will be the LDR opposition and accordingly larger yield voltage is obtained.

2) The LDR faculties the simple contribution to voltages ranging 0-5 V and gives a computerized number at the yield which by and large range between 0-1023.

3) Presently the LDR will offer input to the micro- controller utilizing the Arduino programming.

4) The servomotor position can be constrained by the arduino component which will adjust the sun based board in the ideal bearing

5) The tracker at long last adjusts its position detecting the most extreme force of light falling opposite to tracker and remains stationary until it sees change in light intensity.

6) The affectability of the LDR relies upon point wellspring of light. It scarcely shows any impact on diffuse lighting condition.

C. Circuit Diagram

The standard circuit diagram for dual axis tracker is shown.

The Arduino is powered with 5 volts supply from USB source and it powers the other components of dual axis solar tracker.

1) *Servomotor X:* It rotates the solar panel along east-west direction.

2) *Servomotor Y:* It rotates the solar panel along north- south direction.

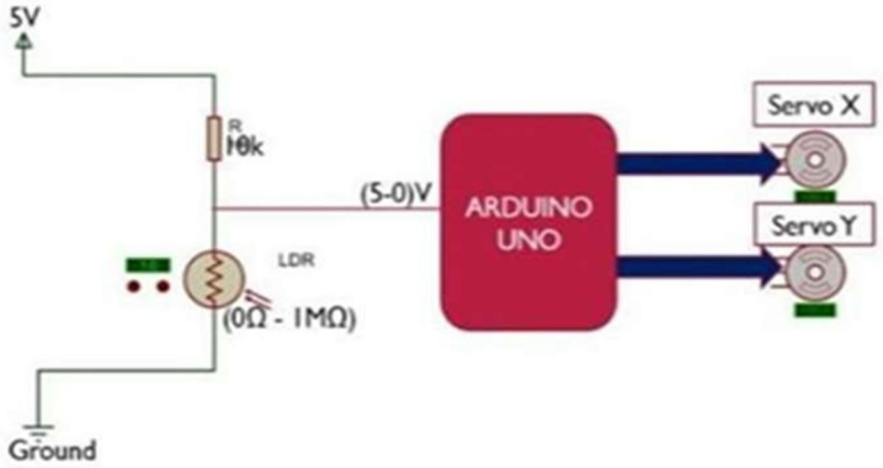

Fig 3. Working diagram of microcontroller

D. Benefits Of Solar Tracker

1) Trackers produce more power than their fixed partners because of expanded direct presentation to sun oriented beams. This expansion can be as much as 10 to 25% contingent upon the geographic area of the following framework.

2) There are a wide range of sorts of sun powered trackers, for example, single-pivot and double hub trackers, which can all be the ideal fit for a one of a kind place of work. Establishment size, nearby climate, level of scope and electrical prerequisites are extremely significant contemplations that can impact the sort of sun powered tracker most appropriate for a particular sunlight based establishment.

3) Sunlight based trackers create greater power in generally a similar measure of room required for fixed-tilt frameworks, making them perfect for upgrading land utilization.

4) In specific expresses, a few utilities offer Time of Use (TOU) rate plans for sun powered force, which implies the utility will buy the force created during the pinnacle time at a higher rate. For this situation, it is useful to produce a more noteworthy measure of power during these pinnacle times. Utilizing a following framework augments the vitality gains during these pinnacle timeframes.

5) Progressions in innovation and unwavering quality in hardware and mechanics have radically decreased long haul support worries for following frameworks.

E. Efficiency Of Dual Axis Solar Tracker

The observation table was drawn by taking readings of stationary and dual axis tracker between 9 a.m. to 6 p.m. and following readings were taken as shown in table.

According to above calculation Dual axis solar tracker is 89.42% more efficient than static solar panel.

Table.2 Tabulated readings of both static as well as dual axis solar tracker

Hours	Dual axis solar tracker			Static solar panel		
	mA	volts	mw	mA	Volts	mw
9 a.m.	3.45	10.6	36.57	2.01	9.6	19.29
10 a.m.	3.98	10.8	42.98	2.37	9.7	22.98
11 a.m.	4.25	10.9	46.32	2.79	9.9	27.62
12 a.m.	4.92	11.1	54.62	3.11	10.4	32.34
01 p.m.	5.54	11.2	62.04	3.64	10.6	38.34
02 p.m.	6.42	11.3	72.54	4.01	10.8	43.30
03 p.m.	6.99	11.4	79.68	3.87	10.2	39.47
04 p.m.	5.91	10.5	62.05	3.42	9.8	33.51
05 p.m.	5.50	10.2	56.10	2.53	9.3	23.52
06 p.m.	4.90	9.8	48.02	1.70	9.1	15.47
Avg.			56.09	Avg		29.61

Flow Chart

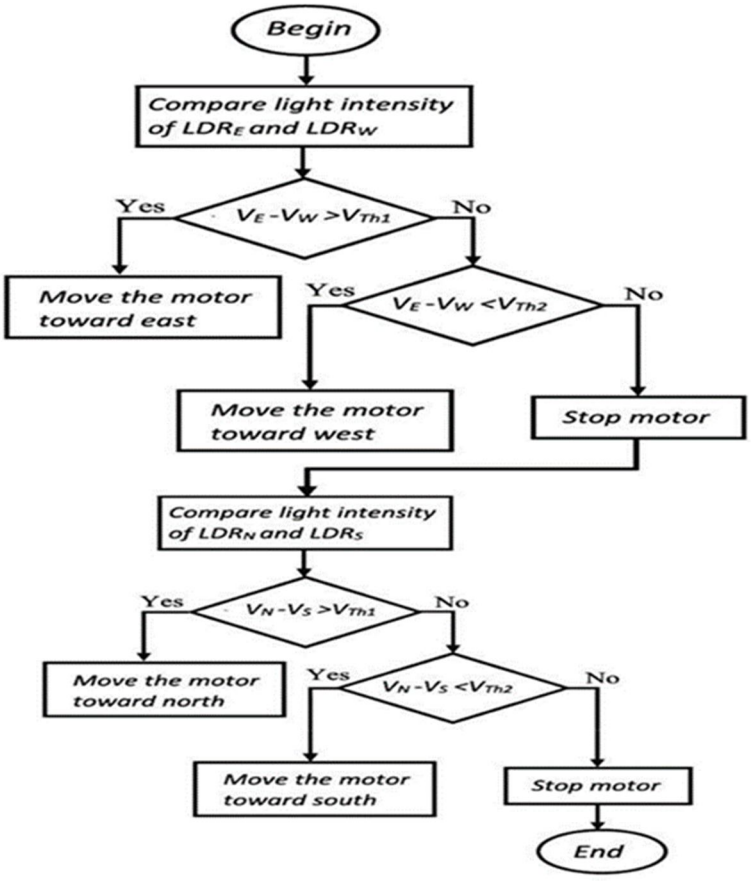

Fig 4. Flowchart of dual axis solar tracker

IV. OBSERVATIONS AND RESULT

In this Duo-Axis Sun Tracker, when sunlight falls on the board, the board alters its situation as per most extreme force of sunlight falling opposite to sun tracker. The target of the undertaking is finished. This was accomplished through utilizing light sensors that can distinguish the measure of daylight that arrives.

At the sun based board. The qualities acquired by LDR are thought about and if there is any huge distinction, there is incitation of the board utilizing a servo engine to where it is practically opposite to the beams of the sun.

This was accomplished utilizing a framework with three phases or subsystems. Each stage has its own job. The stages were:

A. An information stage that was answerable for changing over occurrence light to a voltage.
B. A control stage that was answerable for controlling incitation and dynamic.
C. A driver stage with the servo engine. It was answerable for real development of the board.

The information stage is planned with a voltage divider circuit so it gives wanted scope of enlightenment for brilliant brightening conditions or when there is diminish lighting. The potentiometer was acclimated to provide food for such changes. The LDRs were seen as generally appropriate for this task on the grounds that their obstruction differs with light. They are promptly accessible and are practical. Temperature sensors for example would be expensive.

The control stage has a microcontroller that gets voltages from the LDRs and decides the activity to be performed. The microcontroller is modified to guarantee it imparts a sign to the servo engine that moves as per the produced mistake.

The last stage was the driving hardware that comprised fundamentally of the servo engine. The servo engine had enough torque to drive the board. Servo engines are sans clamor and is reasonable, settling on them the best decision for the venture.

V. CONCLUSION

In this 21st century, as we develop our innovation, populace and development, the vitality utilization per capita increments exponentially, just as our vitality assets (for example fossils fills) decline quickly. In this way, for feasible turn of events, we need to think elective strategies (use of sustainable power sources) so as to satisfy our vitality request.

In this undertaking, Duo-Axis Sun Tracker, we have built up a demo model of sun powered tracker to follow the greatest force purpose of light source so the voltage given by then by the sun powered board is most extreme. After a ton of preliminary and mistakes we've effectively finished our undertaking and we are pleased to contribute some exertion for our general public. Presently, similar to each other investigation, this undertaking has couple of flaws.

1) Our board detects the light in a detecting zone, past which it neglects to react.
2) On the off chance that various wellsprings of light (for example diffused light source) show up on board, it computes the vector total of light sources and moves the board in that point.

This task was actualized with insignificant assets. The hardware was kept straightforward, reasonable and easy to understand.

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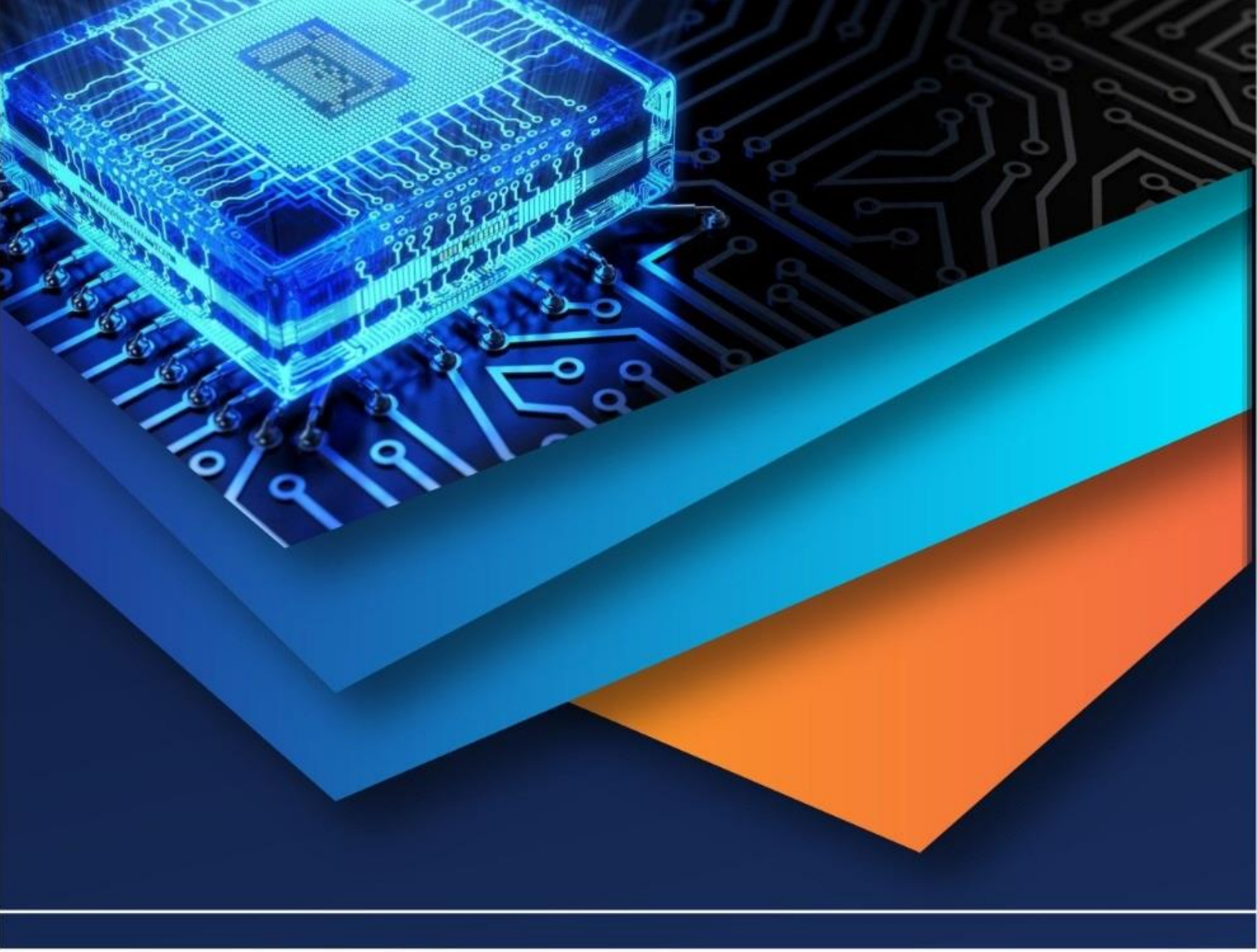

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