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Designing of Energy-efficient Vehicle on Existing Challenges of Electric Vehicle, a Cost Effective and Environment-friendly Approach

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Abstract: An electric vehicle has an electric drive motor which is coupled to drive train for converting the rotational movement of the motor into linear motion of the vehicle and an energy storage device to provide power for the motor uses. Present invention takes advantage of the powerful wind force generated by the vehicle motion. Wind driven turbine of particular design is mounted to rotate the wind energy capturing device upon or in the upper portion of the roof and other is installed under the bonnet area of an electric vehicle to transform wind energy into electrical energy for feeding such energy into the battery pack as the vehicle is being driven forward. At least six wind energy capturing devices are coupled for generating a fast electric potential for recharging the power source. Said wind energy capturing devices would be mounted on particular designed housing and suitable clamps. The motive power of the air rotates the wind-turbines, which are rotatably engaged with an armature shaft to produce electrical energy that is used to continuously recharge the batteries in all phases of road travel, that power the vehicle. Thereby driving range is extended of the vehicle between external charging cycles and reduces time required for that. The design is also prioritized Energy-efficiency and cost-effectiveness of electric vehicles. It also becomes an approach to more environment-friendly rather than the conventional vehicles.

Keywords: Electric vehicle, regenerative, wind turbines, Energy **efficient**, ***cost-effective.***

I. BACKGROUND OF THE INVENTION

A. Field of the Invention

As indicated in the foregoing abstract, the improvement relates to the field of electric powered vehicle. The electric vehicles still suffer from the deficiency that they cultivate to have a limited driving range between external charging that is dictated by the storage capacity of the on-board batteries and the batteries take at least three hours to fully recharge [5] [1].

There are two partial solution to this problem, 1st is to include more on-board storage batteries, however, this increases the mass of the vehicle and hence the drive motor leading to an increased power drain[6]. 2nd is to introduce of battery SWAP technique, however, this created several disadvantages (such as high initial costs for charging station infrastructure, battery degradation, ownership problem) and challenges (such as compact and crusted battery pack designing).

B. Description of the Prior Art

Environmental pollution, noise and inanition of crude oil reserves due to the increasing use of gasoline powered vehicles continue to be of significant concern. Electrically powered vehicles are known to a solution [8], as electricity is now a viable power source for vehicles. For regeneration of on-board power source, electricity can be created in many ways other than using crude oil [5]. It can be generated by capturing wind energy. There have been a number of ideas advanced, as exhibited by the prior art, which seek to achieve the same ultimate objective as here contemplated. Among the prior art which is typically of such arrangements are the following U.S. Pat. Nos: 3,876,925, 3,878,913, 5,986,429, 7,802,641 B2, 7,789,182 B2 and 4,423,368 . However, these exhibit numerous disadvantages, as all are most mechanically complex. These permit a large installation and fabrication cost finally, overcharge to the consumers.

II. SUMMARY OF THE INVENTION

To address the problem of increasing the driving range between external charging cycles and reducing fully recharge time of electric vehicles, as indicated in the foregoing abstract, I have developed an electric powered vehicle that includes six or more modern wind turbine driven wind energy capturing devices which are utilized for continuously recharge the batteries in all phases of road travel [2]. More specifically this is a system, utilizes six or more enclosed multi-bladed small diameter turbines driven generator on a electrical vehicle allowing powerful wind force to energize the wind turbines, take steps next, rotational force to an armature shaft of the wind energy capturing device, which provides electric energy to recharging the on-board power source while the vehicle is being driven forward [4].

It is to be noted that generation of electrical energy occurs not only while the vehicle is in motion but also and, assuming there are prevalent wind flow, when the vehicle is not in motion [10] [7]. Such energy providing a charging mode to increase the driving range of the vehicle between external charging cycles and also reduce time required for external charging - which is accordingly major object of the invention.

Other fundamental objective and advantage of the invention to provide simplicity of the arrangement, without complicated mechanical structure and parts permit minimal installation and fabrication cost finally, reasonable expense to the consumer [10].

III.BRIEF DESCRIPTION OF THE DRAWINGS

For detailed understanding of the present invention, references should be made to the following detailed description of the preferred embodiment, taken in conjunction with the accompanying drawings, in which like elements have been given like numerals and where;

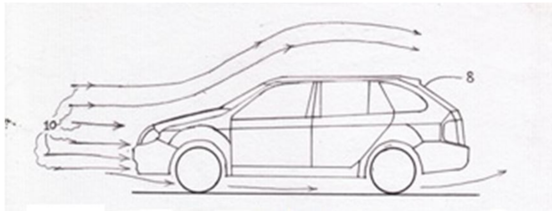

FIG. 1

FIG. 1 is a side view of the airstream generating line during vehicle motion

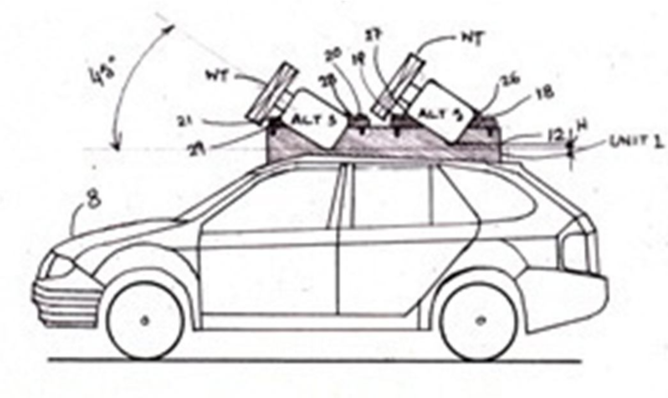

FIG. 2

FIG. 2 is a schematic side plan elevational view of a wind energy capturing device according to the present invention as installed on the roof of an electric vehicle;

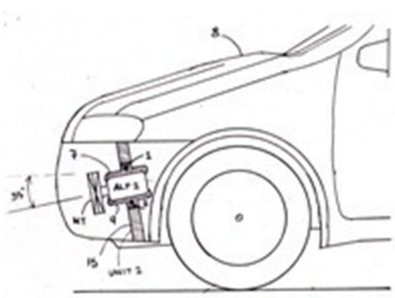

FIG.3

FIG.3 is a schematic side plan view of a wind energy capturing device according to the present invention as installed under the bonnet area of an electric vehicle

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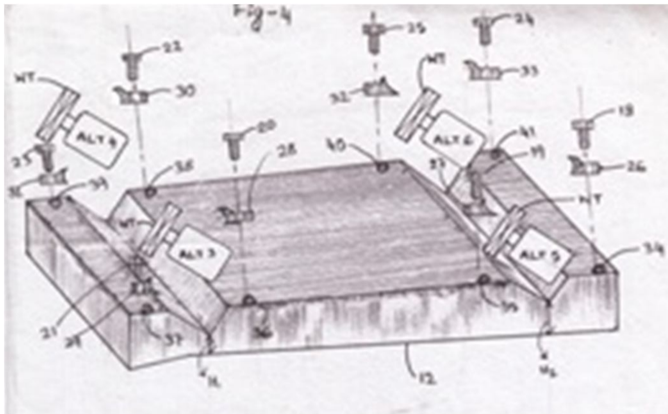

FIG. 4

FIG. 4 is a schematic side plan view of FIG.2, illustrating the major functional components design installed on the roof of an electric vehicle, according to the present invention

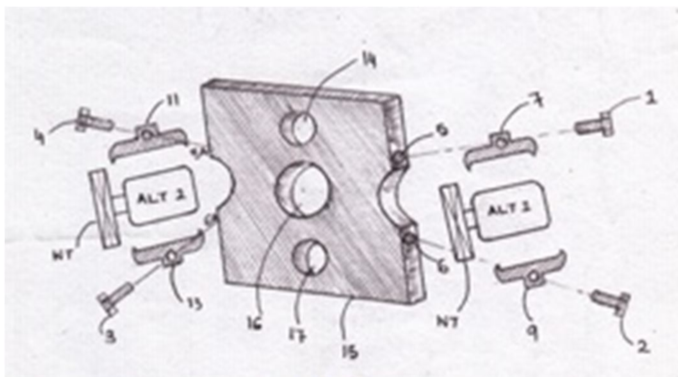

FIG. 5

FIG. 5 is a schematic side plan view of FIG.3, illustrating the major functional components design installed under the bonnet area of an electric vehicle, according to the present invention

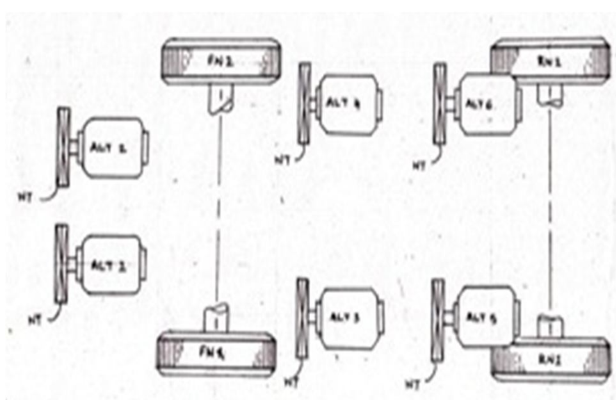

FIG.6

FIG.6 is a schematic top plan view of FIG.2 and FIG.3, illustrating the placement of the wind energy capturing devices

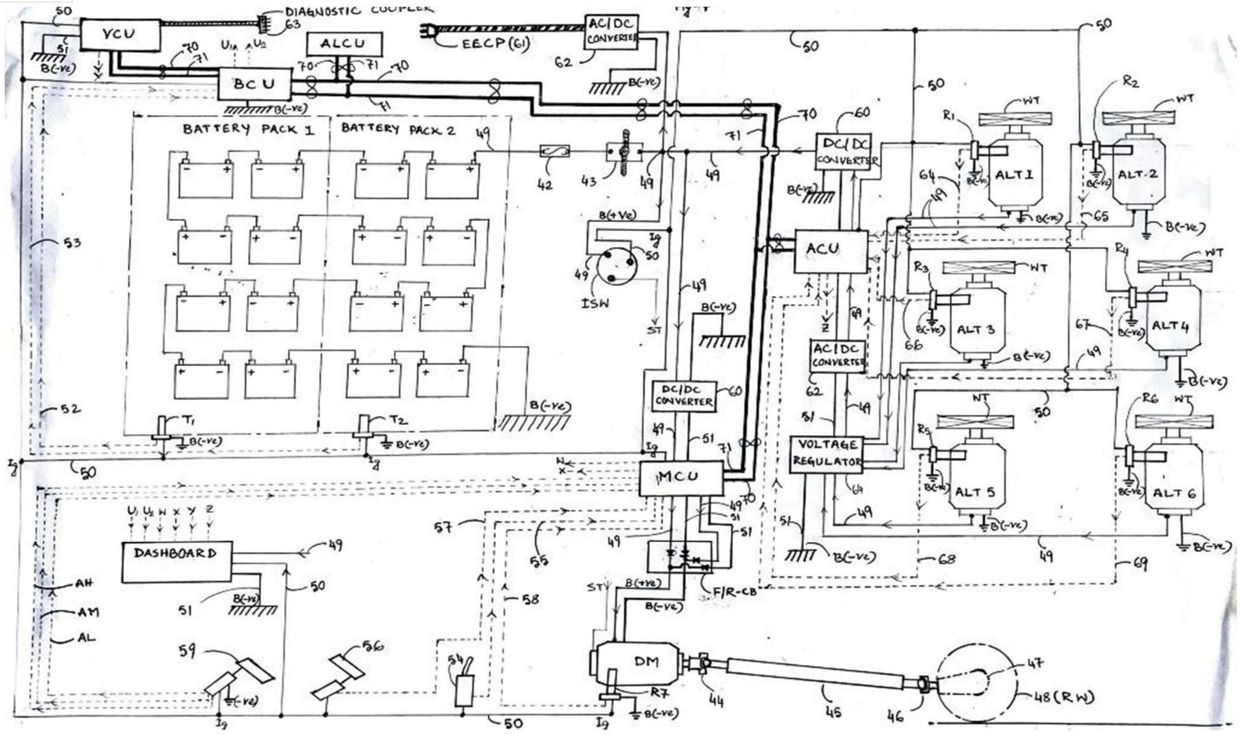

Fig.-7

FIG. 7 is a comprehensive schematic wiring diagram of preferred embodiment showing control parts and electrical connections as a whole.

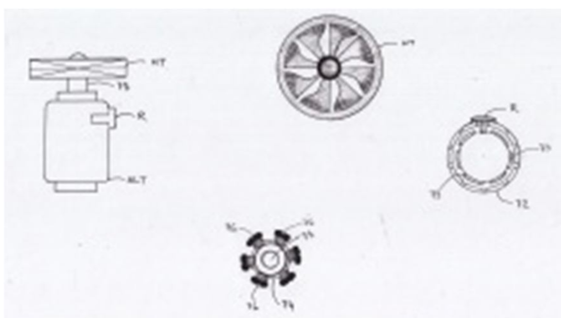

FIG. 8

FIG. 8 schematically shows the break open cross sectional view of a wind energy capturing device, according to preferred embodiment.

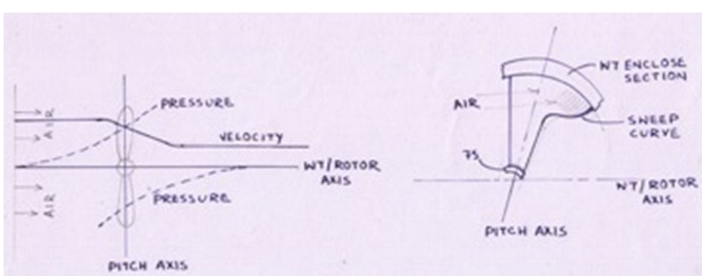

Fig. 9

Fig. 9 is wind turbine aerodynamics.

IV. DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG.1 is intended to show the air stream generating lines *10*, when an electric car *8* is in motion. The present invention takes advantage of the vehicle surrounding prevalent wind-flow.

An electric vehicle body of usual design *8*.attached with two specially designed wind energy capturing unit assembly to fulfill the objectives of present invention. One is installed upon or in the upper portion of the roof [3], *UNIT 1* and other is installed under the bonnet area *UNIT 2* of the given vehicle *8.*

It will be seen, viewing *FIG. 4*, that illustrate the specially designed wind energy capturing unit assembly *UNIT 1*.It contains a specially designed fiber housing *12* with eight threaded holes *34-41*, four wind energy capturing devices *ALT 3 - ALT 6*, eight suitably designed clamps *26-33* and bolt *18-25* to retain the wind energy capturing devices *ALT3-ALT6* safely with the specially designed fiber housing *12* under all road conditions. All the four Wind Energy Capturing Devices *ALT 3 - ALT 6* are assembled on the fiber housing *12* at an angle, i.e. 45°. This design provides the lesser air drag and efficient energy transfer. The seating face *H2* of *ALT 5* and *ALT 6* is slightly higher than the seating face *H1* of *ALT 3* and *ALT 4* , to ensure *ALT5* and *ALT6* gets sufficient air current.

It will be seen, viewing *FIG. 5*, that illustrate the specially designed wind energy capturing unit assembly *UNIT 2*. It contains a specially designed fiber housing *15* with four threaded holes *5-6, 5A-6A* , two wind energy capturing devices *ALT 1-ALT 2*, four suitably designed clamps *7, 9, 11* and *13* and bolt *1-4* to retain the wind energy capturing devices *ALT 1 -ALT 2* safely with the specially designed fiber housing *15* under all road conditions. Both the Wind Energy Capturing Devices *ALT 1-ALT 2* are assembled on the fiber housing *15* at an angle, i.e. 35°. This design provides the lesser air drag and efficient energy transfer. Three passages *14, 16* and *17* are provided at the middle portion of the specially designed fiber housing *15* to minimize the wind resistance while the vehicle is in motion.

Referring to *FIG.6*, there is completely shown about placement of the wind energy capturing devices *ALT 1 - ALT 6* in respect to the front wheels *FW 1 - FW 2* and rear wheels *RW 1 - RW 2.*

FIG.7 is a comprehensive schematic wiring diagram of preferred embodiment showing control parts and electrical connections as a whole. An electric vehicle body of usual design *8* is fitted with two battery pack *BATTERY PACK 1* and *BATTERY PACK 2*. Two battery packs are connected in series, are suitably designed with two temperature sensors *T1, T2*. The Battery Control Unit *BCU* always monitor the two battery packs temperature through the temperature sensors *T1* and *T2* and displayed to dashboard unit through the signal line *U1* and *U2***.**

All the driving conditions and arrangements are monitored and controlled by Motor Control Unit *MCU*. The vehicle *8* gets drive through the Driving Motor *DM*, energized by Motor Control Unit *MCU* through the Forward or Reverse Control Board *F/R-CB* **,** by monitoring input signals from Ignition Switch Starter *ST*, Forward or Reverse Control Switch *54*, Accelerator Pedal *59* and Brake Pedal *56***.** The Motor Control Unit *MCU* gets electrical energy from the Battery Packs through a 'B +Ve' Fuse *42*, 'B +Ve' cut off switch *43*, DC/DC Converter *60*. The Driving Motor *DM* are suitably designed with a RPM sensor *R7*, by which Motor Control Unit *MCU* monitoring the Driving Motor *DM* performance and vehicle speed displayed to the Dashboard Unit by the signal line *X*. Motor Control Unit *MCU* also responsible to display the instant Battery voltage through the signal line *W*.

All the six specially designed wind energy capturing devices *ALT 1 - ALT 6* are connected with Alternator Control Unit *ACU* through a Voltage Regulator *64* and a AC/DC Converter *62***.** All the six wind energy capturing devices *ALT1-ALT6* are specially designed with a RPM sensor *R1 - R6* by which Alternator Control Unit *ACU* monitoring performance of all the six devices *ALT1-ALT6* through the signal lines *64-69* and calculate the 'Regenerating Voltage' as well as displayed to the Dashboard Unit through the signal line *Z*.

In case of any emergency external charging required, there is an Emergency External Charging Point *EECP 61*. Emergency External Charging Point *EECP 61* is connected with battery packs through a AC/DC Converter *62*, a 'B +Ve' cut-off switch *43* and a 'B +Ve' Fuse *42***.**

All the control units *MCU, ACU, BCU* and *ALCU* are connected with *VCU* through 'Can Bus system' *70-71*. If there is any malfunction in any of these Control Unit, the Vehicle Control Unit *VCU* gives signal through signal line *Y* for blinking a red malfunction light on the Dashboard Unit. An External Diagnosis Coupler *63* is connected with Vehicle Control Unit *VCU* to diagnose the root cause of malfunctioning through a external device.

Referring to *FIG. 8* , according to preferred embodiment there is completely shown about the break open cross sectional view of a wind energy capturing device *ALT*. The Wind Energy Capturing Device *ALT* are suitably designed with a RPM sensor *R* to monitoring the device by the Alternator Control Unit *ACU***,** otherwise the working principle is similar as a conventional 'Alternator'. The RPM sensors *R1-R6* convert the motion of pulse generating holes *76* into electrical signals *64-69* without direct contact.

A well designed enclosed multi bladed Small Diameter Wind Turbine *WT* are rotatably engaged with Rotor Shaft *75*. An enclosure will have a positive effort on maintaining the constant speed of Rotor Shaft *75* even the vehicle speed is more or less. A wind turbine *WT* translates wind energy to rotational torque directly related to the total blade area [4] [11]. An Electric Vehicle *EV* will have a size limitation, therefore a small diameter Wind Turbine *WT* is required. For that reason, to increase the rotational torque, multi-bladed Wind Turbine *WT* proves to be more efficient.

While the vehicle *8* is in motion or the vehicle *8* is not in motion but assuming there is prevalent wind flow, such conditions are referred to Wind Drag. Wind Drag to a Electric Vehicle *8* gives power to a Wind Turbine WT**.** The motive power of the air rotates the Wind Turbines *WT*, which are rotatably engaged with a Rotor *74* through the Rotor Shaft *75*. Therefore, the Rotor *74* and Stator *73* arrangement continuously recharge the on-board batteries in all phases of road travel, that power the vehicle.

When constructed in accordance with the teachings of the present invention, the power source regeneration system of the preferred embodiment enable an electrically powered vehicle to travel extending the driving range between external charging cycles and reduce time required for external charging.

V. COMPARISON OF THE INVENTION WITH GASOLINE AND ELECTRIC VEHICLE

Types of Vehicle	Input Energy (%)	Energy Loss Parameters	Energy Loss Percentage	Recovery of Energy (%)	Final Energy for Movement (%)
Gasoline Vehicle	100	Engine Losses	59-65	2-4	18-25
		Drivetrain Losses	5-6		
		Parasitic Losses	3-5		
		Idling	3		
		Braking	5		
		Rolling	4		
		Aerodynamic	3		
Electric Vehicle charged on Grid	100	Electric Drive system	12-15	0	65-70
		Braking	5		
		Rolling	4		
		Aerodynamic	3		
		Auxiliary Electric Losses	2-4		
The Invention (Preferred Embodiments)	100	Electric Drive system	12-15	27-35	82-90
		Braking	5		
		Rolling	4		
		Aerodynamic	18-23		
		Auxiliary Electric Losses	3-6		
		Power Losses due to Extra Mass	3-5		

TABLE I : Energy efficiency comparison among the vehicles.

Types of Vehicle	Rate of petrol/ electric (INR)	On board regenerative sources efficiency	Fuel/ external charging efficiency	Total run in KM (Per month)	Fuel/ electricity required (Per month)	Monthly expenses (INR)	Yearly expenses (INR)
TATA Nexon Gasoline Vehicle (Indian Edition)	97/L	-	15 KMPL (assumed)	1000	66 L	6466	77592
TATA Nexon Electric Vehicle (Indian Edition)	9/kWh	-	10 KMPkWh	1000	100 kWh	900	10800
The Invention (Preferred Embodiments)	9/kWh	(82-90%) Assumed 85%	67 KMPkWh	1000	15 kWh	135	1620

TABLE II: Fuel cost analysis among the vehicles. (Petrol and Electricity rate are considered for June, 2021, in West Bengal, India. Battery Pack size is 30 kWh, Battery Range is 300 KM which are same for both of *TATA Nexon* Electric Vehicle and The Invention. The comparison is proportionate to similar vehicle models.

Fuel Type	CO_2 (lbs)	NO_x (lbs)	PM (lbs)
Gasoline Vehicle [9]	9200	20	1.4
Electric Vehicle charged on Grid [9]	3000	5	1.1
The Invention (Preferred Embodiments)	0	0	0.3

TABLE III: Annual Vehicle Emission (lbs) by Fuel type (12000 Mile).

VI. CONCLUSION

In the developing countries like India, the view of block transfer of fuel-driven vehicles to electric vehicles is very much significant and purposeful. The respective governments also take this as a vital policy of them which can be a regulatory force in upcoming days for economic, social and environmental sectors. But only challenge is facing by the automotive industry is the infrastructure of on-board regenerative power supply i.e. adequate efficient energy and also the extended burden of cost, to be borne by the customers. These can not only make the negative impact on the target customers, also can distract the Governments' regulatory policies as well.

In this present design I have tried to escape from these challenges in possible simple ways, but at the same time keeping in mind the safety and effectiveness of the system. Though, there are possibilities to refine this vehicle system further.

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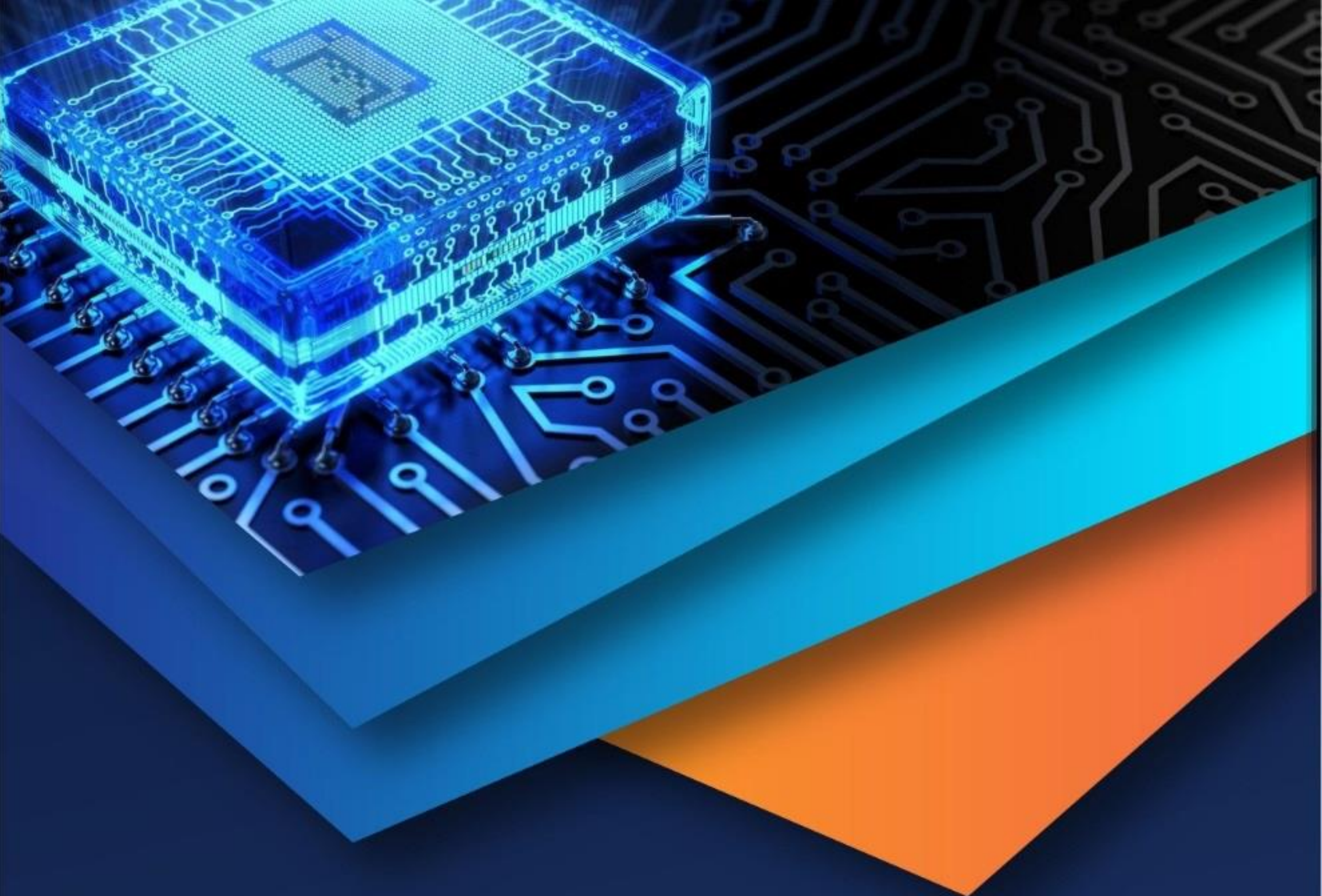

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