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Automatic Stair Climbing Trolley

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Abstract: ***A step climber is fundamentally a streetcar which is being utilized to convey the heap or baggage, so that moving turns out to be a lot more straightforward through steps and labor is decreased successfully. Additionally, it is broadly utilized in ventures and assembling plants where lift or lifts frameworks are not accessible, so that stacking or dumping of material becomes more straightforward and furthermore builds the general consumer loyalty and market prerequisites to which the business is trading or bringing in. Likewise Step climbing streetcar chiefly comprises of 2 kinds either physically worked (Tri-Star Wheel Streetcar) or it tends to be driven consequently utilizing battery and mechanized track framework. For our situation it is completely computerized and just the administrator needs to provide a guidance utilizing the handle and the streetcar will be pushed or pulled up or down strides on a flight of stairs. It depends on rack and pinion component in which the alternating movement of pulley or stuff is sent to a straight responding movement. Additionally, the stuff box mechanized framework is utilized to diminish the stuff proportion and subsequently to build the precise speed of the associated shaft. Alongside that polymer crawler tracks are being utilized which will be at the foundation of the streetcar to give an excellent hold and contact with the surface which is the main piece of the streetcar to choose its movement over the steps***
Keywords: Stair Climber, Tri-Star Wheel, Polymer Crawler Tracks, Rack and pinion Mechanism

I. INTRODUCTION

It requires a lot of exertion, time to lift a significant burden part and to ship them to various areas. This sort of issues brings up in modern area, plant, fabricating units and creation area where weighty mechanical parts are to be shipped starting with one spot then onto the next place and furthermore starting with one story then onto the next floor involving basic system in associated with such activity it turns out to be especially challenging to move weighty parts to various areas. This step climbing streetcar is quite possibly of the most straightforward working vehicle which require less human exertion. This task targets fostering a component for simple transportation of weighty burdens over steps. The requirement for such emerges from one day to another necessity in our general public. Gadgets, for example, hand streetcars are utilized to ease the anxieties of lifting while on level ground. Anyway these gadgets for the most part fizzle with regards to conveying the heap over short armada of steps .Our venture endeavours to plan a step climbing streetcar which can convey weighty items up the steps with less exertion contrasted with conveying them physically .The principal objective of the undertaking is to track down a productive and easy to understand strategy for bringing different articles through steps utilizing least exertion from the client and to likewise give a smooth development while climbing the step. In this paper the efforts are insisted to carry analysis on entire trolley structure is including wheels and fabricated with optimal measurements with suitable materials.

II. MECHANISM

In the venture we are utilizing a rack and pinion system to lift the heap. Likewise, the stuff box mechanized framework is utilized to diminish the stuff proportion and consequently to build the precise speed of the associated shaft. Alongside that polymer crawler tracks are being utilized which will be at the foundation of the streetcar to give a generally excellent hold and contact with the surface which is the main piece of the streetcar to choose its movement over the steps.

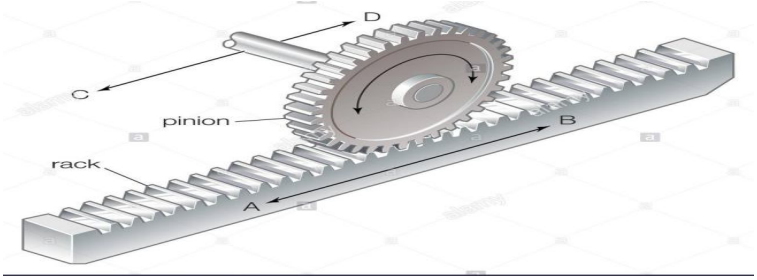


Figure 1: Rack and Pinion mechanism

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A rack and pinion is a sort of direct actuator that includes a round gear (the pinion) connecting with a straight stuff (the rack), which work to make an interpretation of rotational movement into straight movement. Driving the pinion into pivot makes the rack be driven directly. Driving the rack straightly will make the pinion be crashed into a pivot. A rack and pinion drive can utilize both straight and helical cog wheels. Helical cog wheels are liked because of their calmer activity and higher burden bearing limit. The most extreme power that can be sent in a rack and pinion not entirely settled by the tooth pitch and the size of the pinion.

A. Tracked Stair Climber

The followed sort of step climber is normally electrically controlled, and can navigate steps precisely with loads up to 1,000 kg (2,205lbs). Precisely the activity is indistinguishable from Persistent track type vehicles, this strategy for transportation is exceptionally hearty and can arrange steep steps and other abnormal landscape, its disadvantages are size and weight, however like consistent track vehicles with autonomous track control they can pivot on the spot by working the singular tracks in inverse headings. Many models accompany the extra component of a water powered load balance empowering the heap to be kept upstanding while navigating flights of stairs. As an element this empowers the development of items that should be kept upstanding during transportation like cooling units where refrigerant liquid can get away or harm the unit onthe off chance that it isn't fixed



Figure 2: Tracked Stair climbing trolley

III.MATERIAL SELECTION

Material choice is a stage during the time spent planning any actual item. With regards to item plan, the fundamental objective of material determination is to limit cost while meeting item execution objectives. Precise choice of the best material for a given application starts with properties and expenses of competitor materials.

A. Stainless Steel Grade 304

Steel Type 304 is a variety of the fundamental 18-8 grade, Type 302, with a higher chromium and lower carbon content. Lower carbon limits chromium carbide precipitation because of welding and its defenselessness to entomb granular erosion. In many cases, it very well may be utilized in the "as-welded" condition, while Type 302 should be strengthened to hold sufficient consumption opposition. Type 304L is an additional low carbon variety of Type 304 with a 0.03% greatest carbon content that wipes out carbide precipitation because of welding. Therefore, this amalgam can be utilized in the"as-welded"condition, even in serious destructive circumstances. It frequently wipes out the need of toughening weldments with the exception of utilizations determining pressure alleviation. It has marginally lower mechanical properties than Type 304.

1) DC Motor Speed: 30 RPM
2) Mechanism: Rack & Pinion
3) Materials: MS (Mild Steel) and Wood
4) Total mechanism weight: 12 Kg (approx.)

B. Stairs Component

The stairs are mainly composed of stairway and stairs platforms in civil engineering. The stairway components are in Fig.2. In this paper, we only analyze the key stairway parameters which decide the robot climbing mobility, that is, the stairs angle and the stairs dimension.

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1) *Stairs Angle:* The stairs angle is decided by factors such as walking ease, climbing efficiency, and space condition in civil buildings. The line linking the stairs nose is called the nose line. The stairs angle denoting the angle between the nose line and the horizontal ground changes from twenty degrees to forty-five degrees, and has a suitable value as thirty degrees.
2) *Stairs Dimension:* The stairs dimension is decided by the factors such as foot length, step space and building type. The stairs dimension includes the riser height and the tread width. The riser height h, which relates to human step uplift, changes from 120mm to 180mm. The thread width, which is late to human foot length, varies from 200mm to 350mm. If the stairs dimension increases, it will be more difficult for the climbing robot. It is important to design the robot's dimension reasonably as the staircase dimension is fixed in a range. The process of stairs-climbing can be divided into three phases, that is, riser climbing, riser crossing, and nose line climbing. Both riser climbing ability and riser crossing ability also reflect the vertical obstacle climbing ability of the robot.

IV. DESIGN & METHODOLOGY

A. *Methodology*

This is the last step for our task stage 1, in which we need to plan the programmed step climber by considering different boundaries and execution factors. For planning at the underlying stage we utilized AUTO-computer aided design programming, in which independently we planned the parts and afterward at long last we collected it in 3D Demonstrating.

Designed Components

1) Frame (Load carrying part of trolley) –
2) Adjustable Link –
3) Motorized Driving system –

This is the base of our trolley used for the motion of trolleys over the stairs.

B. *Design*

Modelling and designing is done over AUTOCAD as shown, for separate components then finally the assembly is shown.

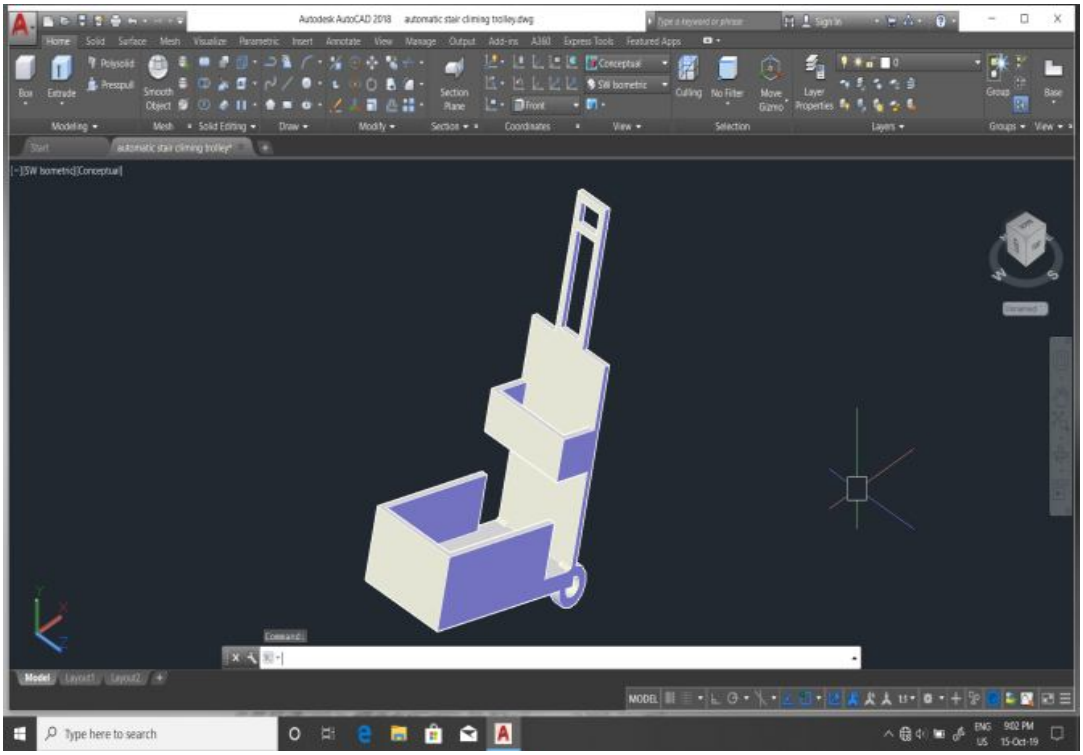


Figure 3:3D Model of Frame

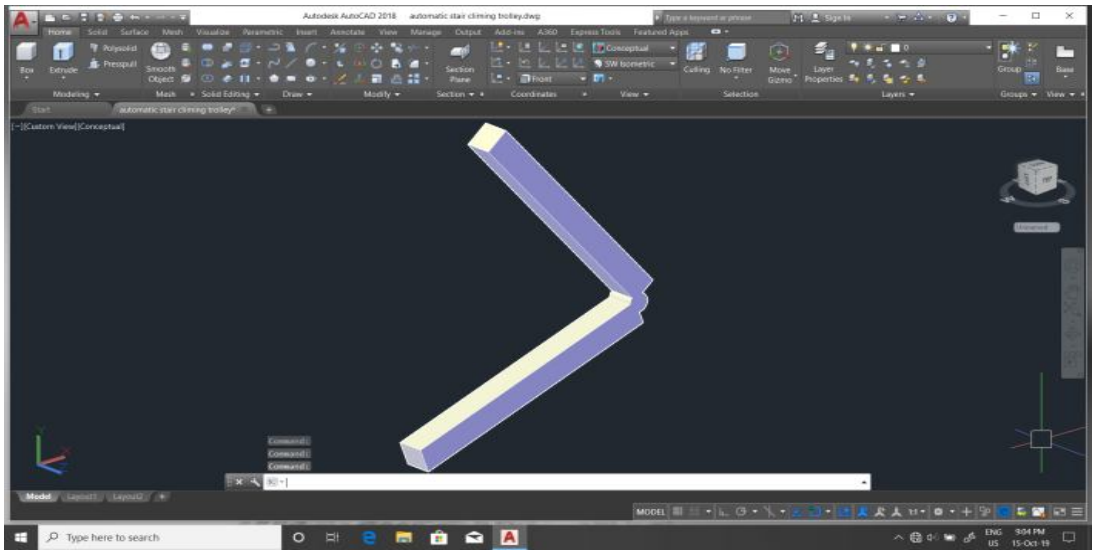


Figure 4: 3D Model of Adjustable Link

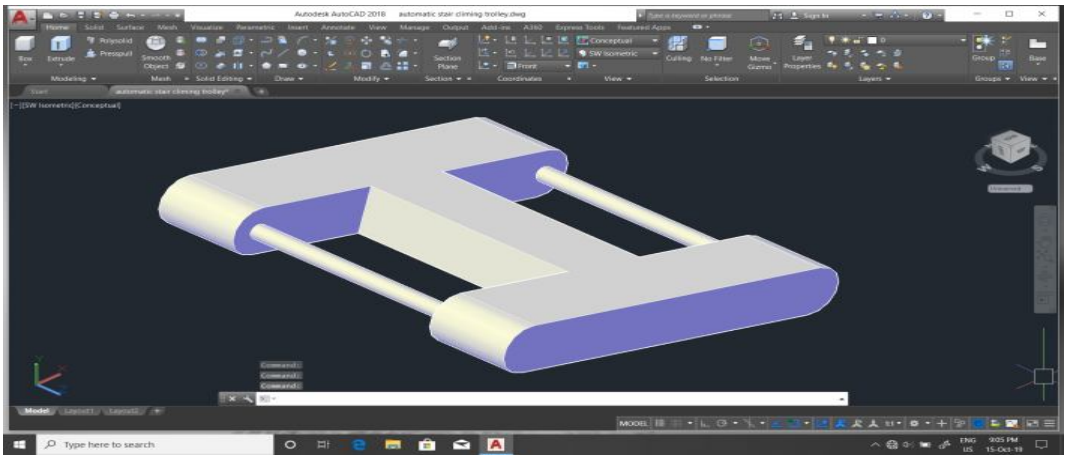


Figure 5: 3D Model of Motorized Driving System

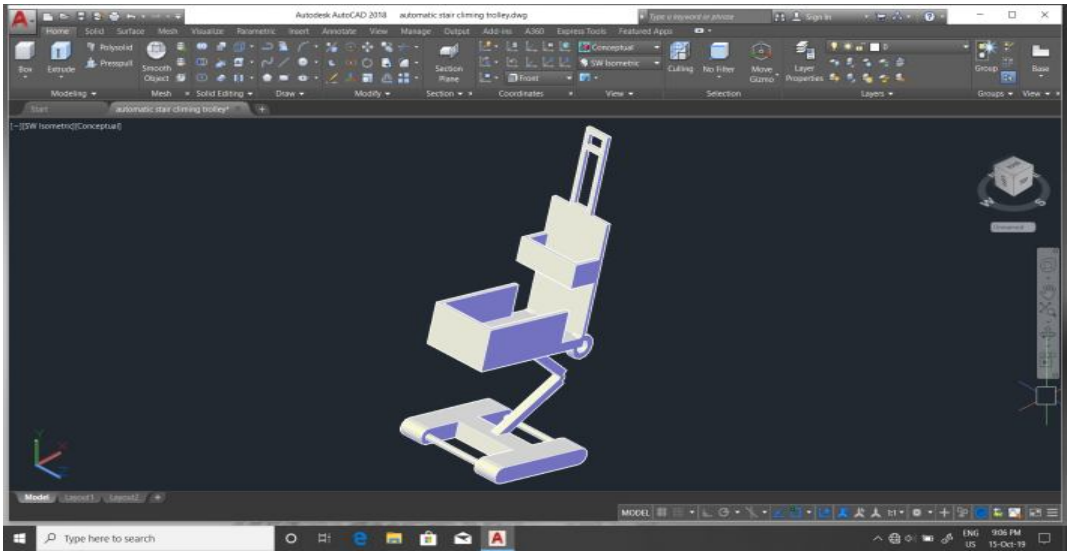


Figure 6: 3D Model of assembled trolley

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V. FABRICATION

This is the final and very crucial step of the project in which the fabrication and assembly of parts is to be done and hence after its completion, we have to do the analysis and testing of the project to overcome the failure. Fabrication of automatic stair climbing trolley is mainly divided into 2 components:

1) Driving System
2) Frame

After the purchasing of materials and required parts from the offline market in which few parts were not available so we looked them up in online stores and ordered them, after that we started the fabrication of trolley.

Steps involved in the fabrication of different components and processes involved are as follows:

A. Driving System

Driving System mainly consists of following parts -

1) Timing Belts
2) Rectangular Base
3) Pulleys
4) Bearings
5) Axles
6) DC Motors (high torque)
7) Battery

Prior to beginning the creation we need to choose the aspects for rectangular base wherein the shafts and pulleys will be joined, however because of the limited length of crankshaft belts that are accessible in the market we picked the belt of greatest length that was accessible and likewise we chose the components of base, shafts and pulleys.



Figure 7: Pulley for front axle

B. Frame

1) It is the second component of the trolley, where the load and weights are kept over it and it is attached to the driving system of the trolley.
2) It is foldable & convertible and can be kept at different angles of inclinations with respect to the driving system of the trolley.
3) Initially we divided the circular pipe into 4 parts of required dimensions and then by using an electric cutting machine we purchased them from the market, after that we joined them together by Electric Arc Welding (EAW) as shown below.
4) After that we prepared another rectangular frame of required dimensions in the similar manner and joined both frames together perpendicular to each other.
5) Then we attached them with the base of the driving system along with two slotted clamps (in which one clamp is on right side and other is on left side) of the driving system so that we can change the inclination of the frame when needed.
6) After that we welded 3 iron sheets on the frame, so that we can support the weights over it and while climbing up & down weights will be in a safe position.

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Table 1. Specification

Part name	Specification	Dimensions
Pulleys	Polyurethane iron core	48mm(Dia.)
Steel sheet	Stainless steel	570mm x 380mm
Shaft	Mild Steel	474mm x 22mm(Dia.)
Battery	Lithium ion ups battery (12V)	-
Battery Charger	Electric charger	-
DC Motor	30 RPM, Rated Torque(19kg-cm)	25.6mm(Shaft length),Gearbox Shape(Rectangle)
Hollow Bars	Iron (Rectangular)	480mm
Hollow Rods	Iron (Circular)	570mm
Belt	Timing belt	520mm x 10mm
Bearing	Iron core ball bearings	22mm (Out. Dia.), 20mm (Inn. Dia.)
Slotted Clamp	Slotted iron strip	130mm x 4mm

VI. CONCLUSION

However, this venture had a few impediments in regards to the strength and worked of the construction, it very well may be viewed as a little step in the right direction, all things considered. During the trial of this venture, it was understood that it wouldn't be an ill-conceived notion to think about this plan for conveying weighty burdens up the steps. This item will be very much acclaimed in the event that fitting the needs can be marketed. However, the underlying expense of the venture appeared to be higher yet more exact assembling would abbreviate this.

Taking everything into account, on the off chance that this item can be completely robotized and delivered at a cheaper the acknowledgment will be incredible. As of now, there are no contenders for such a sort of item in our market.

This venture targets fostering a system for simple transportation of weighty burdens over steps. The requirement for such a framework emerges from everyday necessities in our general public. Gadgets, for example, hand streetcars are utilized to ease the pressure of lifting while on level ground; in any case, these gadgets normally fizzle with regards to conveying the heap over a short armada of steps. In the illumination of this, the venture endeavours to plan a step climbing wheel barrow which can convey weighty items up the steps with less exertion contrasted with conveying them physically. It likewise try's to concentrate on the business reasonability and significance of such an item.

VII. FUTURE SCOPE

A. Use of a lighter metal for assembling of this item should be possible to significantly decrease oneself weight and cost.

B. In future in the event that necessary a similar driving framework can be utilized to change over this streetcar into programmed step climbing wheelchair for debilitated individuals.

C. A sensor and guiding wheel can be carried out to move around the steps. Sensor and engine would be a substitution of a manual power, which runs the casing wheel.

D. With the assistance of clock circuits, the vehicle could run over a foreordained step size flawlessly without utilizing any switch Single engine could be utilized to move over both the level and track of the steps.

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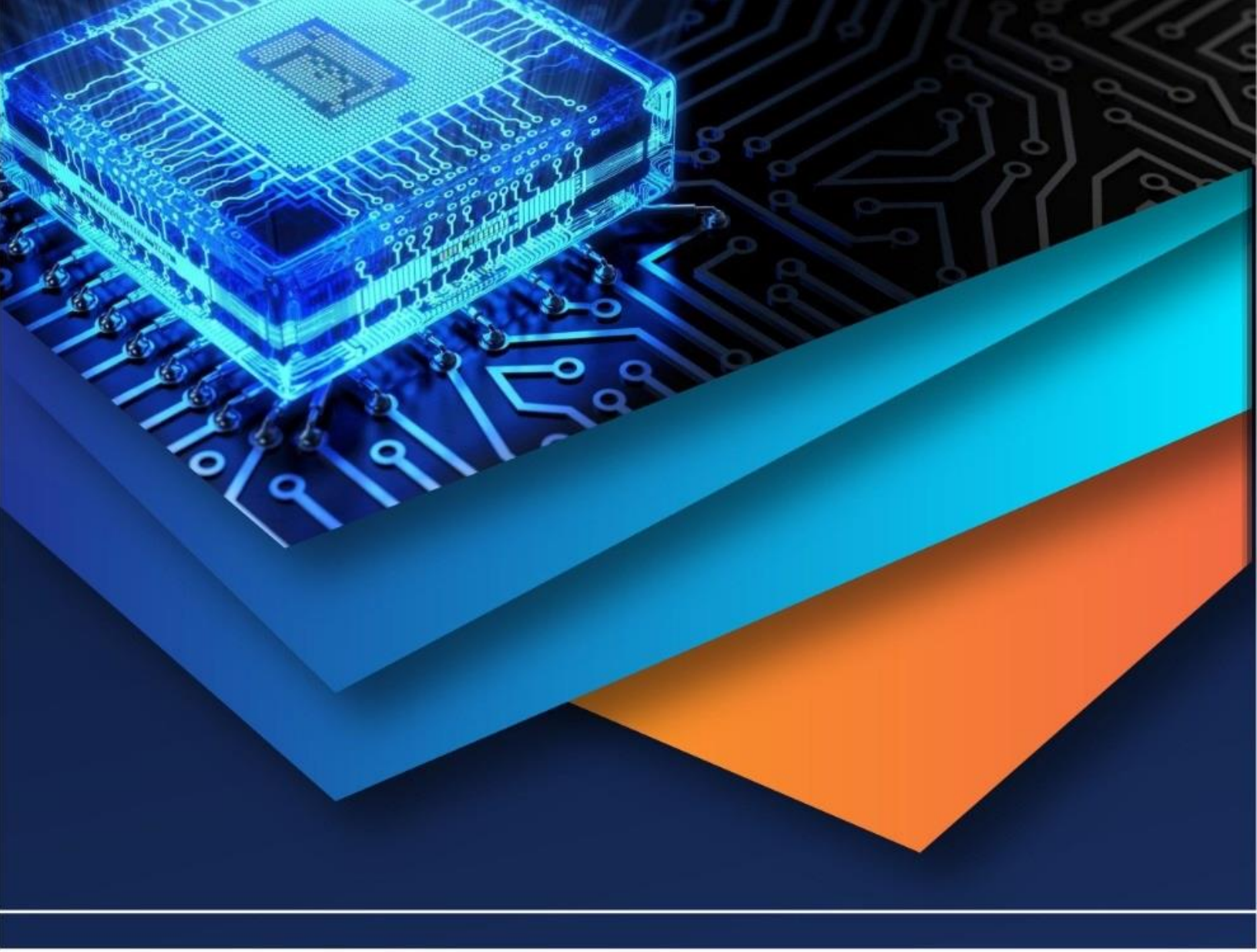
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