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Positive Drive Tricycle for Physically Challenged People

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Abstract: Harnessing green energy is a vital resource on today's fuel driven age. The advantage of this project depicts how a tricycle will run by using simple revolute pairs replacing the conventional wrapping pair of tricycle. The tricycle that we design moves on the four bar crank rocker mechanism which allows moving and simultaneously changing the direction of the tricycle using the steering provided. The tricycle is extremely useful for physically handicapped persons. The main advantage of the tricycle is it allows them to rotate the tricycle at a point in its reverse direction. The tricycle is so designed by providing appropriate links that it can take a complete revolution at a particular point. As we see the tricycle will find its application in various fields as to increase the efficiency by providing a small effort. Here the rocker arm is used for propulsion, using the advantage of leverage. Here balance and distribution of mass and balance and center of gravity and the steering column which is pivoted and affecting the link mechanism to crank the wheel shaft for propelling.
Keywords: Harnessing, wrapping , rocker arm, propulsion, leverage.

I. INTRODUCTION

A tricycle often abbreviated to trike is a human-powered three-wheeled vehicle. Some tricycles such as cycle rickshaws (for passenger transport) and freight trikes are used for commercial purposes especially in the developing world. There is lot of technological advancement in wheel chair propulsion other than manual wheel turning. A normal wheel chair used for handicap and the tricycle users for normal people use hand drive or propulsion or foot pedal propulsion.

The manual propulsion has become increasingly important because the population of propulsion of individuals using wheelchairs is growing and requires efficient mobility to maintain a quality of life equivalent to the general population. Several attempts have been made at improving manual wheel chair propulsion, such as changes in the wheels and tires, adding gears and designing alternative propulsion systems. Still, experts and consumers generally agree that innovation in propulsion is still needed. Improved propulsion technologies will reduce physical fatigue and effort maneuverability. Pain and upper extremity injury is common among manual wheel chair users. Shoulders related injuries have been shown to be present in up to 51% of manual wheel chair users. In addition, the prevalence of elbow, wrist and hand pain has been reported to be 16%. During wheel chair propulsion, users must exert large forces in order to propel the chair forward. In addition, the component of force that is directed in towards the hub does not contribute to forward motion but is necessary in order to provide friction between the hand and the push rim.

There are two popular types of propulsion assist devices on the market today. One is a manual assist that uses gear rations to reduce the effort required to propel the vehicle and the other is a power assist that uses a battery powered motor to reduce the effort.

Mechanical advantage is a measure of the force amplification achieved by using a tool, mechanical device or machine system. Ideally the device preserves the input power and simply trades off forces against movement to obtain a desired amplification in the output force. An ideal mechanism transmits power without adding to or subtracting from it. This means that ideal mechanism does not include a power source, and is frictionless and constructed from rigid bodies that do not deflect or wear.

II. WORKING PRINCIPLE

This is a single seater three wheeled vehicle with front wheels being steered by the handle column. The cranking mechanism is on one of the rear wheel axle. The rear wheels are held on two different axles. The bearing housing of the rear axles are welded to the frame. The entire frame is made of mild steel circular tube of 25mm diameter. The rocker arm when pulled or pushed the rocker arm pivoted at the base from a distance. This is termed as a rocker arm that pivots on a bearing attached to the fixed frame. The rocker arm operates by applying force at the rocker arm, at distance from the bearing or pivot. As the rocker arm pivots on the bearing, points further from this pivot move faster than points closer to the pivot. The power into and out of the rocker arm must be the same, so forces applied to points farther from the pivot must be less than when applied to points closer in.

A four bar mechanism consists of 4 rigid links connected end to end creating a closed loop. Further, one of the links, called the ground link, is in a fixed stationary position. Four bar mechanisms can produce a large variety of paths of motion depending on the lengths and orientation of its links. It is for this reason that four bar mechanisms are used for a large number of applications, particularly in manufacturing. You may remember from ME---358 (Machine Dynamics and Mechanisms) that the type of motion produced from a 4 bar mechanism is determined by the Grashof conditions. Grashof conditions will determine the type of motion based on the position and length of links in the mechanism. Determining the Grashof condition begins with the calculation of link lengths:

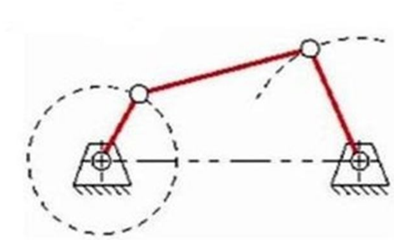

Figure 1: Crank-rocker mechanism

For a crank---rocker mechanism, the above equation can be simplified to: Where:
S = length of shortest link L = length of longest link
P = length of one remaining link Q = length of other remaining link

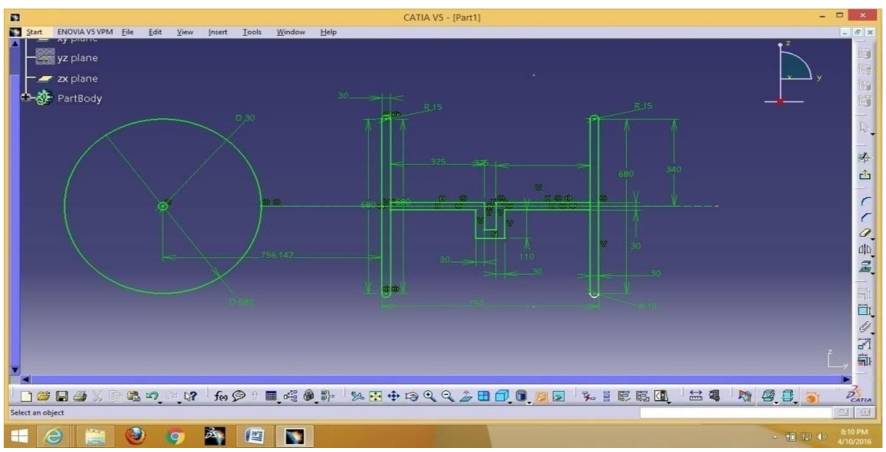

Figure 2: Design of rear axle and rear wheels

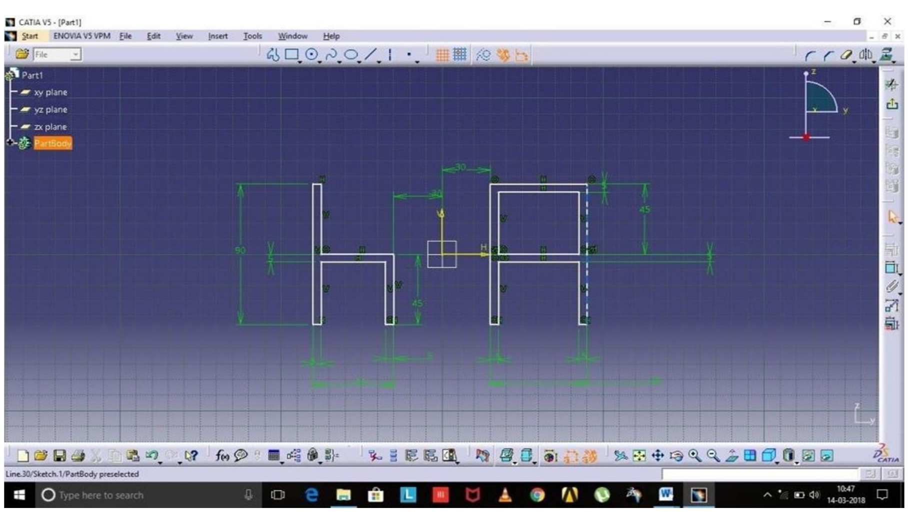

Figure 3: Design of chair

III.CALCULATIONS OF VARIOUS FORCES ACTING ON TRICYCLE

A. Calculation of effort of person on rocker arm.

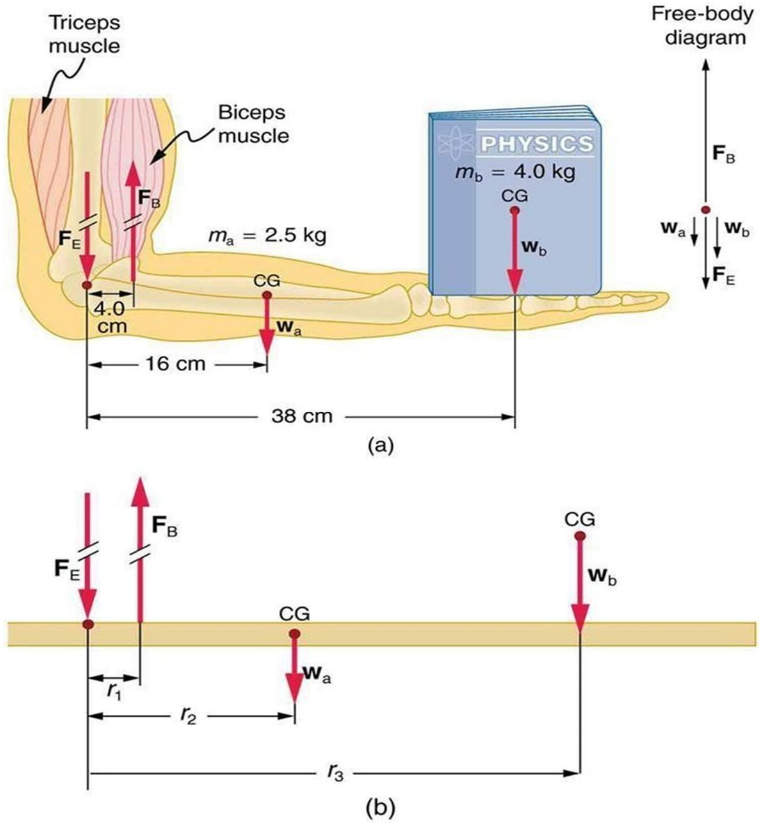

Figure 4: Calculations of forces excreted by hand muscles

There are four forces acting on the forearm and its load (the system of interest). The magnitude of the force of the biceps is *F*B; that of the elbow joint is *F*E; that of the weights of the forearm is *w*a, and its load is *w*b. Two of these are unknown (*F*B and *F*E), so that the first condition for equilibrium cannot by itself yield *F*B. But if we use the second condition and choose the pivot to be at the elbow, then the torque due to *F*E is zero, and the only unknown becomes *F*B.

The torques created by the weights is clockwise relative to the pivot, while the torque created by the biceps is counterclockwise; thus, the second condition for equilibrium

(Net τ=0) becomes

$r_2wa+r_3wb=r_1FB$

Note that sinθ=1 for all forces, since θ=90º for all forces. This equation can easily be solved for *F*B in terms of known quantities, yielding

$$FB=r_2wa+r_3wb/r_1$$

Entering the known values gives

$$FB= (0.160m)(2.5kg)(9.8m/s^2)+(0.38m)(4kg)(9.8m/s^2)/0.04m$$

$$FB=470N$$

Now, the combined weight of the arm and its load is (6.50 kg)(9.80m/s2)=63.7N, so that the ratio of the force exerted by the biceps to the total weight is

$$FB/wa+wb=470/63.7=7.38$$

This means that the biceps muscle is exerting a force 7.38 times the weight supported

Thus so this tri-vehicle weights 95KG including man weight of 60 KG. So applied force is 7.01kN, for both pulling and pushing of steering column.

By applied force the point of fulcrum placed in entire cycle is equal to700mm from top of the steering column.

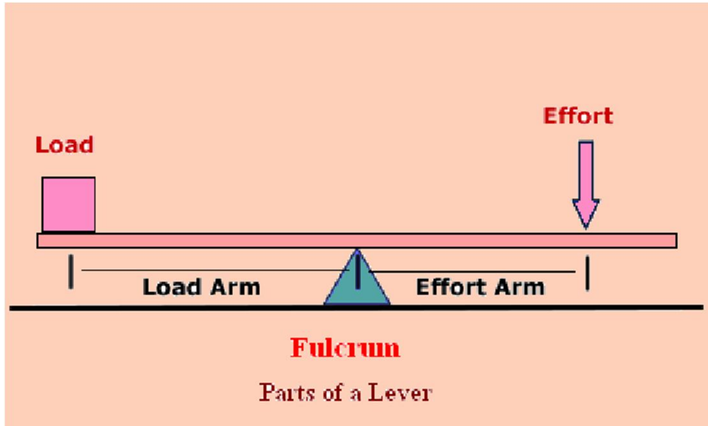

Figure5: Calculation Of Amount Of Force Acting On Rear Wheel And Amount Of Safe Weight Can P.D.T Withstand.

Forces ancting on Rear axle calculated from R.P.M of wheels.

$$F = m v^2 / r$$

$$= m (n\, 2\, \pi\, r /60)^2/r$$

$$= 0.01097\, m\, r\, n^2 = 0.01097(95/9.81)(2.5)(20*20)$$

$$F = 100N.$$

Where

n=No.of rotations per minute. r=Distances travelled in 'm'. m=mass of the vehicle.

So From above forces the maximum weight this vehicle can withstand 100kg terms of weight in Kg.So we are allowing a SAFE weight of 60kgs to drive this vehicle

B. Calculations of Angle of Swing of Rocker Arm

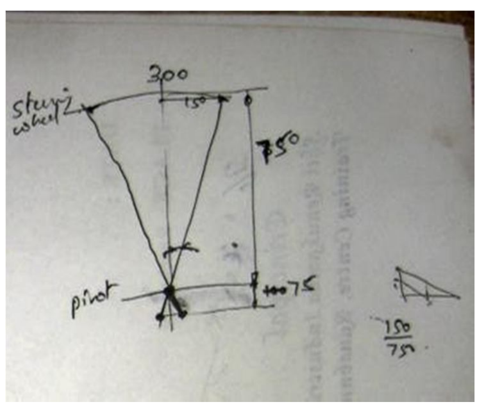

Figure 8: Angle of swing

From above figure which representing rough diagram of rocker arm at two ends of to and fro motion. From Triangle ADC, taking Angle ɵ at pivot, we get

Opposite side DC=150mm. Adjacent side AD=750mm.

Applying Tan ɵ, we get,

$$\tan \alpha/2 = 150/750 \quad \alpha/2 = 11.2^{\circ}$$

. . The angel of swing is $\alpha = 22.4^{\circ}$.

C. Graphical Analysis

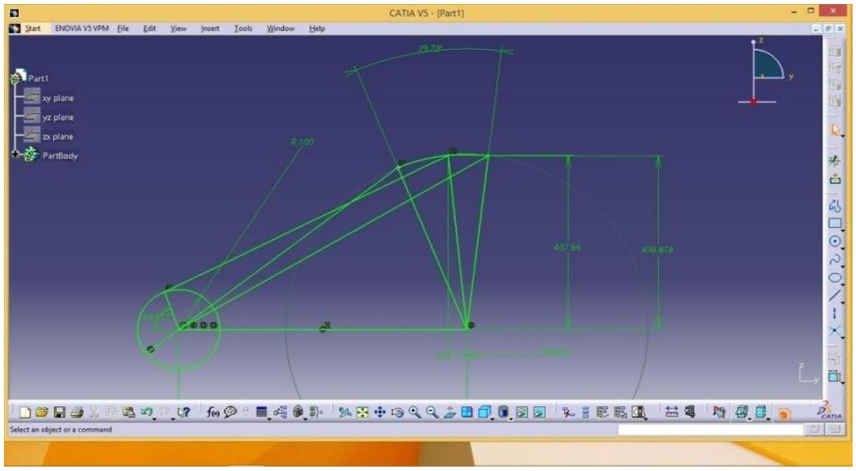

Figure 9: Design in Catia

SCALE
Crank = 100mm
Coupler = 770mm
Rocker =440mm
I-Fixed link = 700mm

Crank + Fixed link < Coupler + Rocker (Grashof's linkage) Where

OD^I = Position of crank where rocker is extremely forward OD^{II} = Position of crank where rocker is extremely back BC^I = extreme forward position of rocker

BC^{II} = extreme backward position of rocker

θf= Angle of rotation of crank for forward stroke of rocker = 190°

θb= Angle of rotation of crank for backward stroke of rocker = 170° α = Angle of oscillation of rocker = 30°

For one oscillation of rocker, distance covered by rocker= BC $*\alpha*(\pi/180)$= 8.46 $*(\pi/6)$= 4.42 cm

For one forward oscillation of rocker distance covered by crank = OD * θf *(/180)

= 6.63 cm

For one backward oscillation of rocker distance covered by crank= OD* θb *(/180)

= 5.93 cm

D. Load Calculation

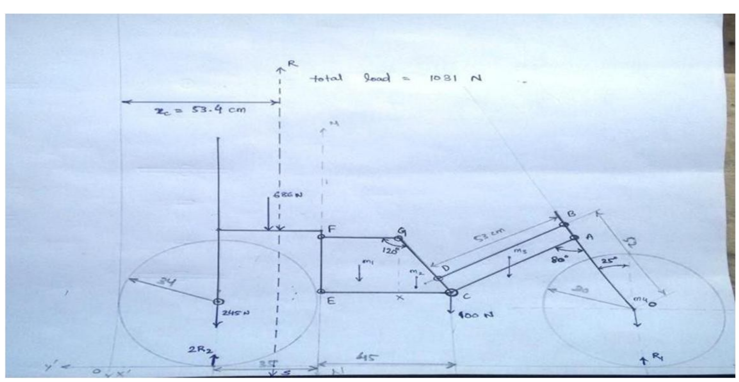

Figure 10 : Load calculation

TR(time ratio) = time taken by forward stroke/time taken by backward stroke = θ_f/θ_b

= 190/170

=1.11

Center of gravity of axel is at center =245N , Xc_1=34cm Center of gravity of axel at rider =686N , Xc_2=51.5cm

Center of gravity of right side of section MN W_3=100N, Xc_3=114cm

CG of total vehicle and under Xc = (245*X1+686*Xc_2+100*114)/(245+686+100)

=(245 * 34+686 * 51.5+100 * 114)/(1031)

=53.4CM

Reaction rare wheel =2R_2 Reaction on front wheel =R_1

From static equilibrium analysis $\sum Fy = 0$

W = 2R_2+R_1 1031=2R_2+R_1

Moment about rear wheel $\sum m = 0$

1031*Xc = R_1*141.67

R_1 = (1031*53.4) /(141.67) =388.80N 2R_2 = 1031-388.8

2R_2 = 641.2N

R_2= 320.6N on each rear wheel

From the graphical method of analysis, we found the center of gravity of whole tricycle at a distance of 53 cm from the rear wheel end.

Also we calculated the reactions at the three wheels by static analysis.

Reaction on rear wheel = 2R2 = 641.2 N Reaction on front wheel = R1 = 388.8 N

From analysis we come to know that 37% of the total load is acting on the front wheel and rest 63% is acting on the rear wheels

E. Fabrication of Positive Drive Tricycle

Figure 11 : Total assembly

IV. CONCLUSIONS

This rocker arm Tri-wheel vehicle is Cheapest and weight-less. Easy to move with effort of both hands and single hand for handicaps. New up gradation of previous tri- wheel vehicle. Runs entirely on Mechanical linkages. No Out-source is required to drive the vehicle. Reverse direction also possible with low effort . Easy to repair which may get solved by Welding and Hammering.

REFERENCES

[1] Kinematic Design and Fabrication of Four Bar Mechanism to Steer a Human Powered Vehicle,(volume-3, issue-4, pid-ijrest-34201668.)
[2] Tong Yuxuan, four-bar linkage synthesis for a combination of motion and path-point generation,
[3] benthamopen.com/contents/pdf/TOMEJ/TOMEJ-4-16
[4] journals.elsevier.com/mechanism-and-machine-theory
[5] A text book of Strength of Materials by R.K.RAJPUT.
[6] A Text book of strength of materials by R.S KHURMI

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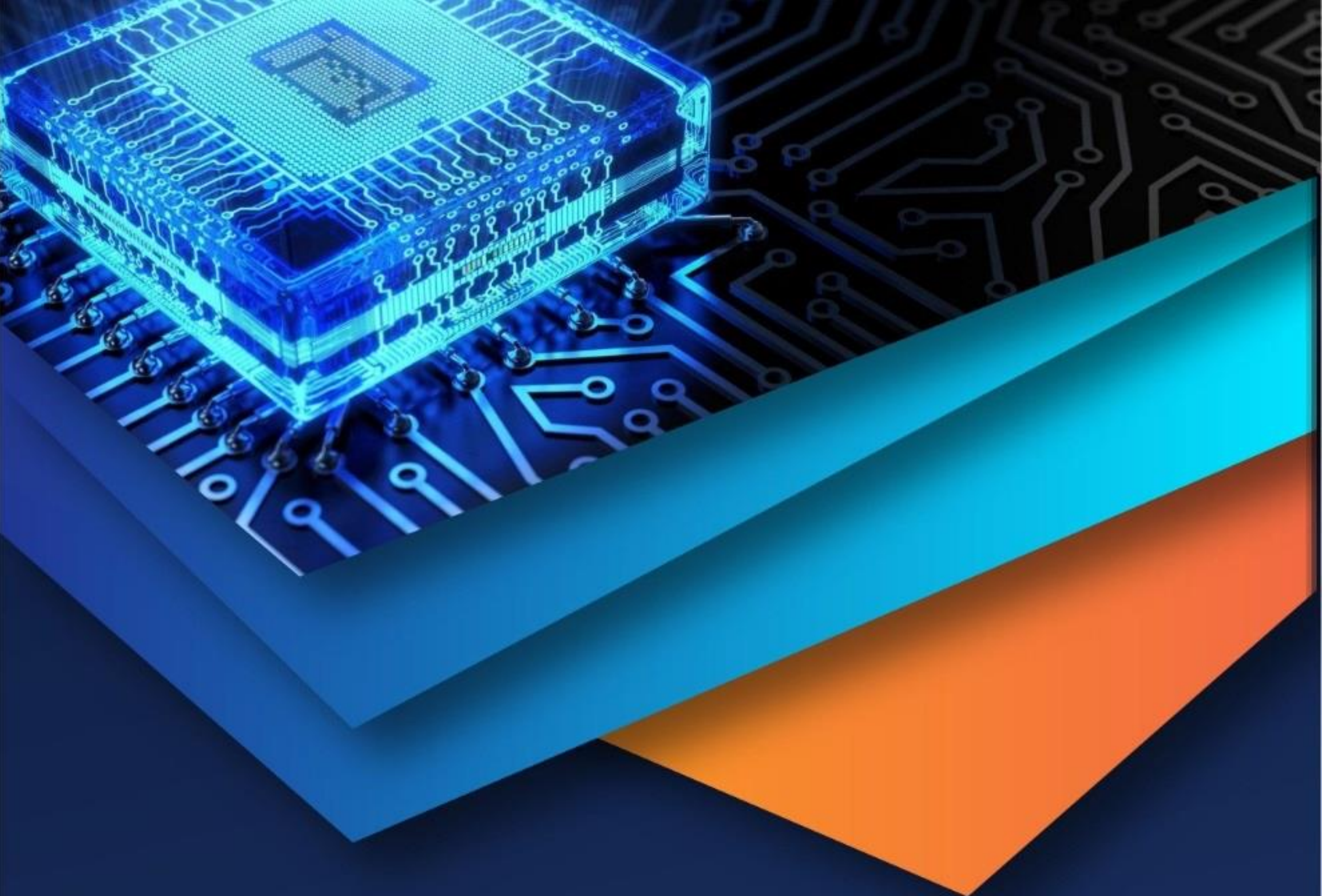

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