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Design and Manufacturing Semi-Automatic Machine for Battery Tray Riveting Operation

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Abstract: The successful implementation of any manufacturing sector is largely depending upon the quality and its productivity. In traditional machining process for performing the one side riveting, machine's required which becomes a time consuming also the inaccuracy in productivity due to involvement of human error which affects to productivity cannot be get improved at a faster rate. The main purpose of this project to design and manufacture semi-automatic machine for battery tray riveting. Which leads to improve the quality and productivity by minimising the time period in all Mahindra and Mahindra's vehicles battery is fitted with the help of battery tray. While placing the battery tray two side rivets are required in current situation while fitted tray only one side riveting operation is performed. We are designing a semi-automatic machine which will perform riveting operation to both sides at once which will improve the productivity.
Keywords: Riveting, Semi-Automatic, Machine, Pneumatic system, Battery tray, Automation

I. INTRODUCTION

The latest trend in the automobile industry is to common the production line for different parts. Because now a single vehicle has different variants available in the market for each variant has different components according to their functionality, therefore in the automotive industry it is difficult to maintain multimodal production lines for most of the different parts with the same functionality but a different design for different variations. These processes are very much time consuming and due to which the production losses are observed which leads to delay in vehicle launch, so for this we have fabricated the semi-automatic machine for battery tray riveting. The objective is to design and fabrication of the riveting machine which reduces the operation as well as transportation time required for completing the job. Riveting operation is till now performed manually, but by using semi-automatic Riveting Machine it can be performed automatically. The purpose of this machine is to replace manual hammering into automation, to increase productivity in operation also to reduce cost and time required. It is more beneficial to use in workshops, industries where riveting operations can perform simultaneously on both sides.

II. PROBLEM STATEMENT

In bolero pickup the battery is fitted with the help of battery tray. While placing the battery tray two side rivets are required in current situation while fitted tray only one side riveting operation is performed. We are designing a semi-automatic machine which will perform riveting operation to both sides at once which will improve the productivity.

III. OBJECTIVE

1) To DESIGN the semi automation machine for battery tray riveting both sidessimultaneously.
2) To MANUFACTURE the machine which can rivet both sides of the battery traysimultaneously.
3) To ANALYZE the time reduction in process by this automation.

IV. METHODOLOGY

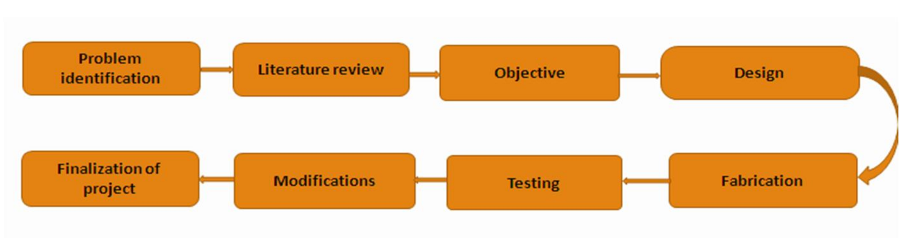

Fig.1. Methodology

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Volume 11 Issue I Jan 2023- Available at www.ijraset.com

V. DESIGN AND ANALYSIS

A. *Material Selection*

Mild steel is a type of low carbon steel. Carbon steels are metals that contain a small percentage of carbon (max 2.1%) which enhances the properties of pure iron. The carbon content varies depending on the requirements for the steel. Low carbon steels contain carbon in the range of 0.05 to 0.25 percent.

Due to the following physical properties of Mild steel's material used for the fabrication of machine:-

1) High tensile strength.
2) High impact strength.
3) Good ductility and weld ability.
4) A magnetic metal due to its ferrite content.
5) Good malleability with cold-forming possibilities.
6) Not suitable for heat treatment to improve properties.

Table no.1: Properties of Material

Material	Density (Kg/m^3)	Melting point (°C)	Modulus of Elasticity (Gpa)	Thermal Conductivity (Mpa)	Yield Strength (Mpa)	Tensile Strength (Mpa)	Elongat-ion (%)
Mild Steel	7860	1370	120	42.7	345	485	20
Aluminum	2710	660.2	70	88-251	240	90	12.25
Gray Cast Iron	7150	1204	105	48	-	250	-
Stainless-Steel	7982	1375	193	16.3 at 100°C	170	485	40

B. *Specification*

Table 2. Part specification

Sr. No.	Part name	Specification/Dimension
1.	Rivet head	Dia. = 155mm
2.	Rivet	Dia. = 7mm
3.	Motor	1 HP
4.	FRL unit	Size – ¼ " TO 2"
5.	Valve	
	5/2 *1/4 solenoid single valve	Port Size – G ¼" Air flow – 1250 L/M
	5/2 *1/8" solenoid single valve	Port Size – G1/8" Air flow – 1250 L/M
6.	PLC controller	
	SMPS	I/P = 230VAC, 1.0A O/P = 24VDC, 2.5A
	PLC	AC 100-240V
	MCB	3 Phase
	Contactor	-
	Relay	-
7.	Tube connector	1/8* M6
		1/8* M8

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Table 2. Part List with material

Sr. no.	Part name	Material	Function
1.	Head	MS EN31	To guide the shaft
2.	Stud with Jacking plate	MS EN31	To lifting the head
3.	Dial Holder	MS EN31	To hold the reading holder
4.	End cap	MS EN31	To held the shaft
5.	Anti-rotation Holding part	MS EN31	To hold the anti-rotation part
6.	Motor Housing	MS EN31	To hold the motor assembly
7.	Motor	-	To rotate the spindle shaft
8.	Pneumatic system	-	To operate the whole system
9.	PLC control panel	-	To control the whole system automatically
10.	Frame	MS EN31	To mount the assembly of machine parts

VI. ANALYSIS

In this model usually performed a static structural analysis on a geometric model. The performed analysis is same for three different various material. The main focus during entire simulation had observed is that, on how various material changes a value of desired parameter such as total deformation and maximum principle stress. A tested model is on the Ansys Workbench. The Ansys analysis performed on the materials are aluminium, gray cast iron and mild steel from that analysis mild steel is selected for the model development.

A. Head

1) Total Deformation of Head

It is found that total deformation alone x-axis1.316* 10^{-6} Maximum. Total deformation generated on mild steel while 1.4622*10^{-7} Minimum

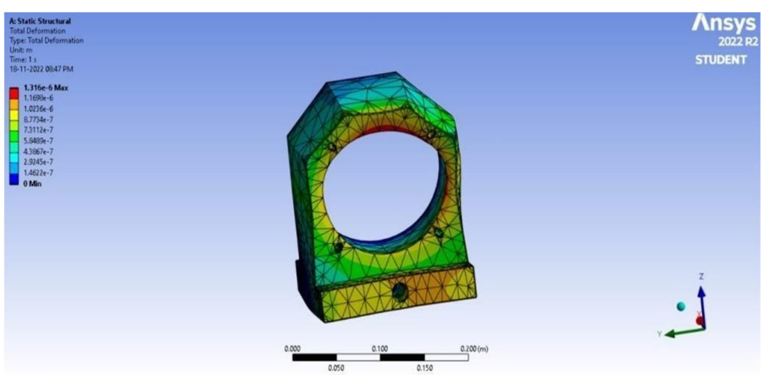

Fig.2. Total deformation of Head

2) Maximum Principle Stress of Head

It is found that Maximum Principle Stress alone x-axis 2.2435*10^{6} Maximum amount of stress generated on mild steel while -3.0162*10^{6} Minimum.

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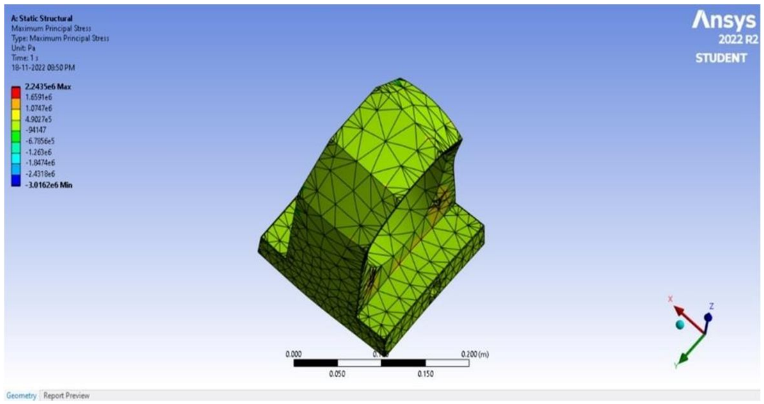

Fig. 3.Maximum Principle Stress of Head

B. End Cap

1) *Total deformation of End Cap:* It is found that total deformation alone x axis1.052* 10^{-7} Maximum. Total deformation generated on mild steel while 1.1694*10^{-8} Minimum.

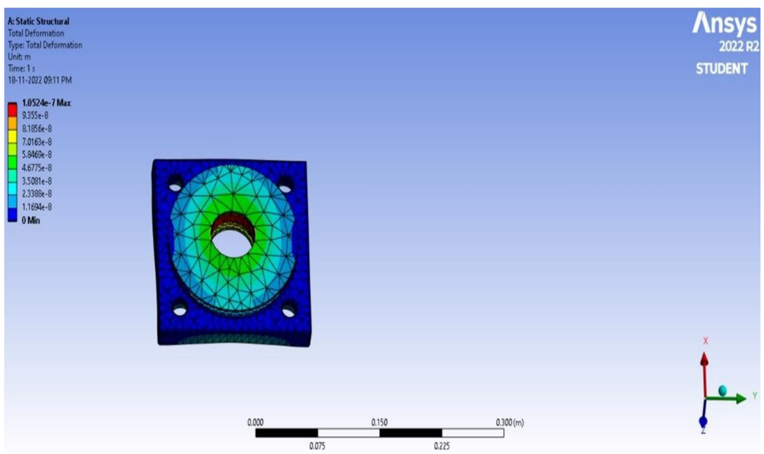

Fig. 4. Total deformation of End Cap

2) *Maximum Principle Stress of End Cap:* It is found that Maximum Principle Stress alone x-axis 8.371*10^{5} Maximum amount ofstress generate on mild steel while -2.1957*10^{5} Minimum.

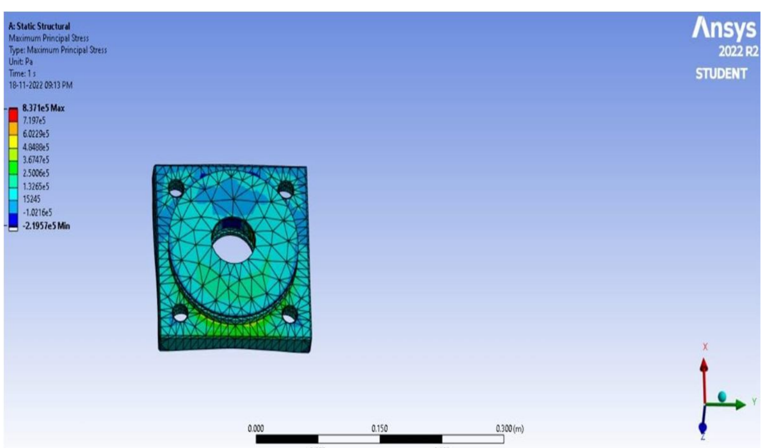

Fig.5. Maximum Principle Stress of End Cap

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Volume 11 Issue I Jan 2023- Available at www.ijraset.com

C. *Bush*

1) *Total deformation of Bush:* It is found that total deformation alone x-axis1.1074* 10^{-6} Maximum. Total deformationgenerated on mild steel while 1.2305*10^{-7} Minimum.

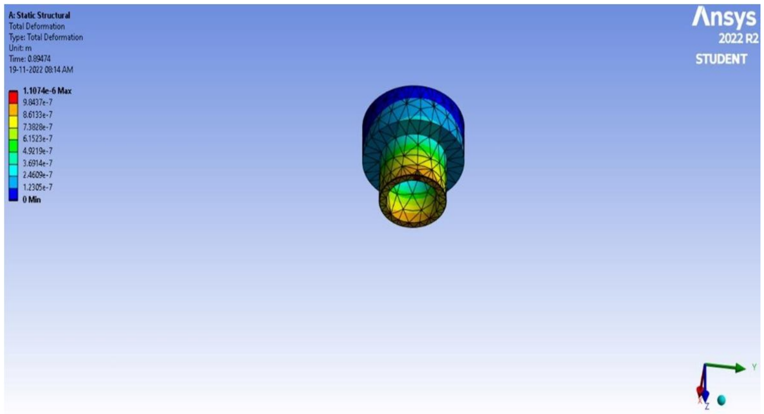

Fig.6.Total deformation of Bush

2) *Maximum Principle Stress of Bush:* It is found that Maximum Principle Stress alone x-axis 1.1122*10^{7} Maximum amount of ss generated on mild steel while -2.5922*10^{6} Minimum.

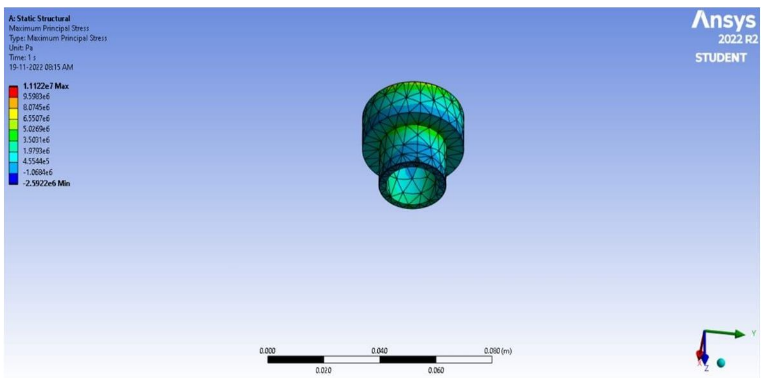

Fig. 7.Maximum Principle Stress of Bush

D. *Anti Rotating Plate*

1) *Total deformation of Anti- rotating Plate:* It is found that total deformation alone x-axis 6.1183*10^{-8} Maximum. Total deformationgenerated on mild steel while 1.3596*10^{-8} Minimum.

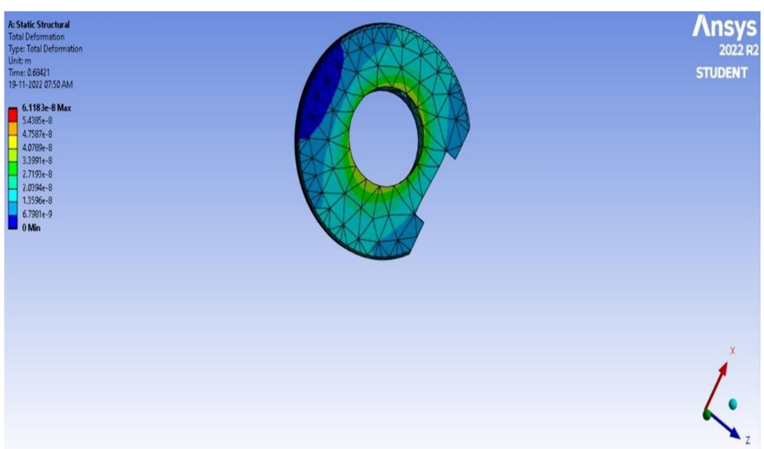

Fig.8. Total deformation of Anti- rotating Plat

2) *Maximum Principle Stress of Anti- rotating Plate:* It is found that Maximum Principle Stress alone x-axis $1.1637*10^6$ Maximum amount ofstress generated on mild steel while $-1.1816*10^5$ Minimum.

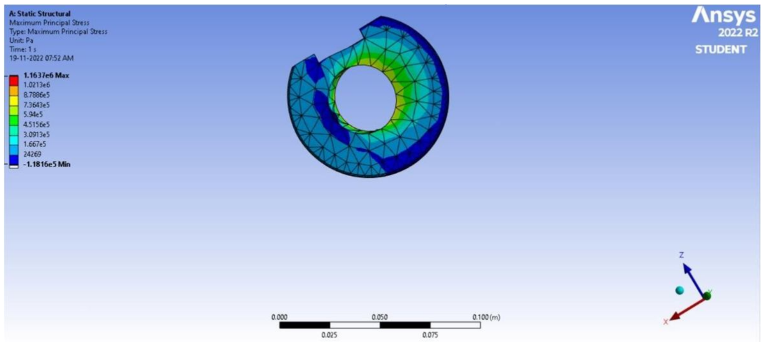

Fig.9. Maximum Principle Stress of Anti- rotating Plate

C. Fabrication

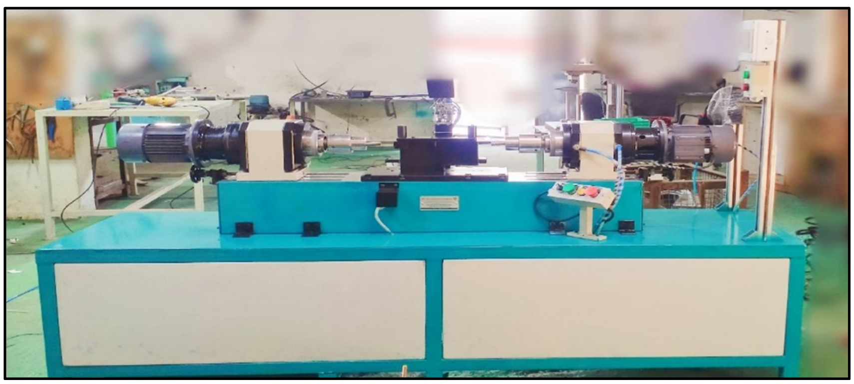

Fig. 10.Actual machine setup

VII. RESULT

Table 3. Part List with material

Part name / Material	Safe or unsafe			
	Cast iron	MS EN31	Aluminum	Gray cast iron
Head	Unsafe	Safe	unsafe	unsafe
Stud with Jacking plate	Unsafe	Safe	unsafe	unsafe
Dial Holder	unsafe	Safe	unsafe	unsafe
End cap	unsafe	Safe	unsafe	unsafe
Anti-rotation Holding part	unsafe	Safe	unsafe	unsafe
Motor Housing	unsafe	Safe	unsafe	unsafe
Motor	-	-	-	-
Pneumatic system	-	-	-	-
PLC control panel	-	-	-	-
Frame	unsafe	Safe	unsafe	unsafe

VIII. CONCLUSION

The main purpose of this project to developed semi-automatic machine for battery tyriveting which leads to improve the quality and productivity by minimizing the production cycle time. This machine increases the efficiency and accuracy of object. The machine atomized by using pneumatic system. This machine is to replace manual hammering into automation to increase the productivity in operation to reduce cost and time required. It is more beneficial to use in workshop industry which operation can be perform both sides simultaneously.

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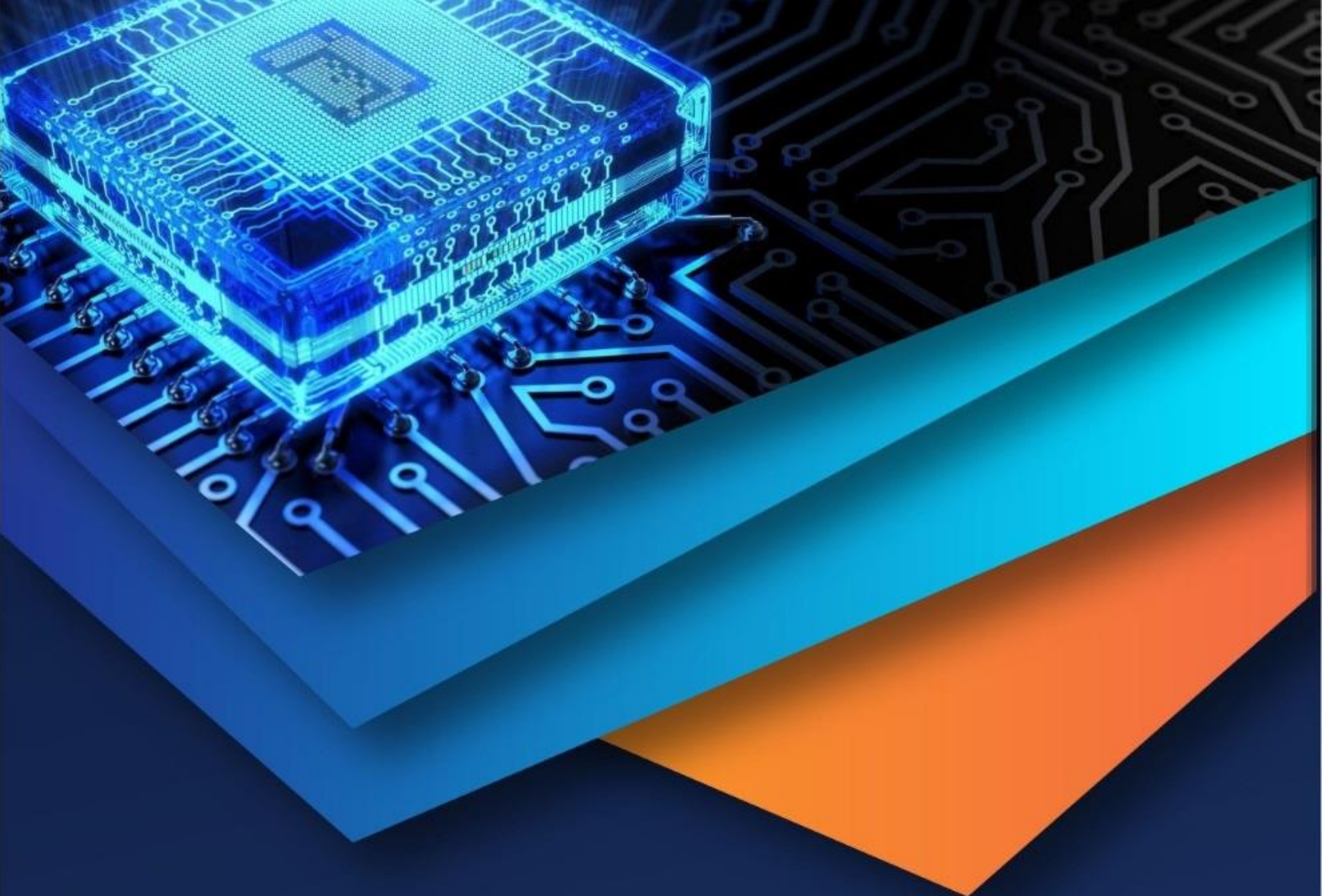

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