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Process Optimization of Electronic Component by Using NX-Cam Software

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Abstract: Mill turning is a process applied in the milling of a curved surface while the work piece rotates around its centre. Depending on the eccentricity of the tool, when a flat-end mill tool performs a curved trajectory perpendicular to the rotation axis of the tool, its bottom part is engaged in removing material. This paper presents the techniques of the tool path, planning for the simultaneous turn-mill machining. The new turn-mill machine tools allow the parallel processing of both multi-axis milling and turning operations concurrently. Turn-mill machine tools have identified to be able to reduce the total setup time and manufacturing cost by milling and to turn the difficult parts with a single setup. In this paper, computational geometric analysis of complex electronic components is presented for turn-mill machine tool operations. The electronic component presented in this paper is a type of low resistance resistor that acts as a sacrificial device to provide over current protection, of either the source or load circuit. Its essential component is a metal strip or wire that melts only when too many current flows, which interrupts the circuit to which it is connected. This component is complex because it has the huge number of operations and is very difficult to manufacture in 3 & 4axis milling machines because it requires 46 tools to load at the time of manufacturing. Dimensions are also tremendously critical and complex. In this paper optimized process plan has been developed for the turn-mill process of the electronic component which gives high surface finish and less machining time.cad/cam systems have been implemented to develop the optimum turn-mill process plan.
Keywords: UNI-Graphics, turn-mill, Electronic Component

I. INTRODUCTION

A. About The Component

In electronics and electrical engineering, a fuse body is a type of low resistance resistor that acts as a self-sacrificial device to provide over current security, of either the load or origin circuit. Their essential parts are a metal wire or strip that liquid solution when too many currents flow, which mainly interrupts the circuit to which it is connected. Overloading, mismatched loads, Short circuit, or device failure are the prime reasons for excessive current. A fuse interrupts excessive current (flows) so that further damage by overheating or fire is prevented. Wiring regulations often define a maximum fuse current rating for particular circuits. Over current protection devices are essential in electrical systems to limit threats to human life and property damage. Fuses are selected to allow passage of normal current plus a marginal percentage and to allow excessive current only for short periods. Slow blow fuses are designed to allow harmless short-term higher currents but still clear on a sustained overload. Fuses are manufactured in a wide range of current and voltage ratings and are widely used to protect wiring systems and electrical equipment. Self-resetting fuses automatically restore the circuit after the overload has cleared; these are useful, for example, in aerospace or nuclear applications where fuse replacement is impossible.

B. Uni-Graphics Introduction

Nx is a premier 3d computer-aided design suite. It allows you to model solid components and assemblies, to perform engineering analyses like mechanism simulation and stress analysis, to create tool paths for computer-based manufacturing processes and to perform numerous other engineering design activities in a single software environment. Software suites like NX are referred to as Product Lifecycle Management (PLM).

II. LITERATURE SURVEY

Sofia poulikidou-The main objective of this report is to provide an overview of the existing methods and tools that aim to improve the environmental performance of products and to perform this task as early as possible at the product design and development processes. There are many methods and tools available that can provide guidance and relevant information to designers on aspects that should be considered already during the product design and development, and that would minimize the environmental impact of goods over their lifecycle. Many options of analytical tools are also available that identify specific areas and properties of the product that needs to be improved although they can be considered as more demanding in regards to the environmental knowledge required or the amount of data required to provide reliable results.

Anil Gupta, TK Kundra-As an ideology, leanness is not a new concept but still; researchers strive for developing new methods to reduce almost all kinds of identified wastages at virtually every stage and in every activity right from design till delivery of final product to the end-customer. Newly developed manufacturing ideologies, paradigms and systems are always critically examined for leanness. In other words, leanness is becoming an important evaluation tool to compare the recently developed/pioneered approaches. There has been a gradual evolution of the leanness over the years from the shop floor level of manufacturing automobiles organization to almost every operational and management aspect now. The leanness has undergone and still is going through a process of continuous and never-ending evolution due to its inherently built dynamic concept of continuous improvement. Although in the literature a lot of work has been reported to the application of lean tools, principles, theories and methodologies to production systems, but a very few are evident in the area of the lean design process of a product and machine tool. For this reason, the attempt is made here to focus a significant proportion of this paper on an evolutionary aspect of leanness from manufacturing to design stage. Also, this paper reviews the concepts and practices being followed till date by the industrialists, researchers and academicians in applying lean tools and techniques in the design of product and machine tools along with the methods to measure the lean improvements in the systems.

III. COMPUTER AIDED DESIGN

A. Development Of 2d Drawing

1) *Fuse body 2d drawing:* A 2D drawing is used to design a 3D model for our component using Uni-graphics NX 7.5 CAD software. Below shows the 2D drawings of the fuse body with all the required dimensions and GD&T representations the suits the best for manufacturing the component without any errors.

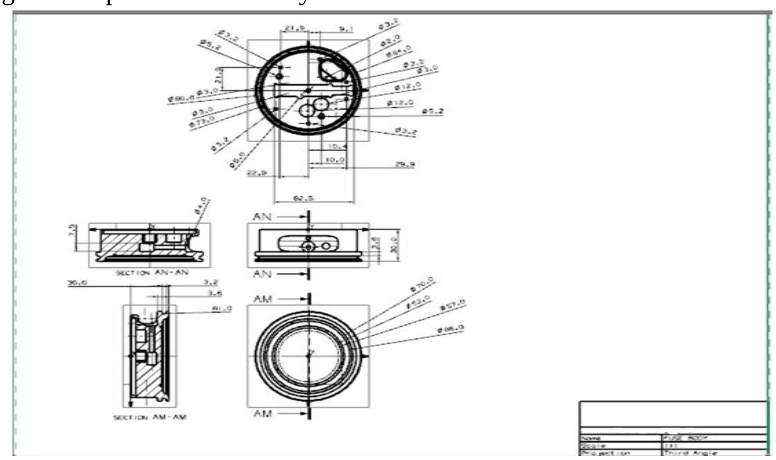


Fig: 2d input of fuse body

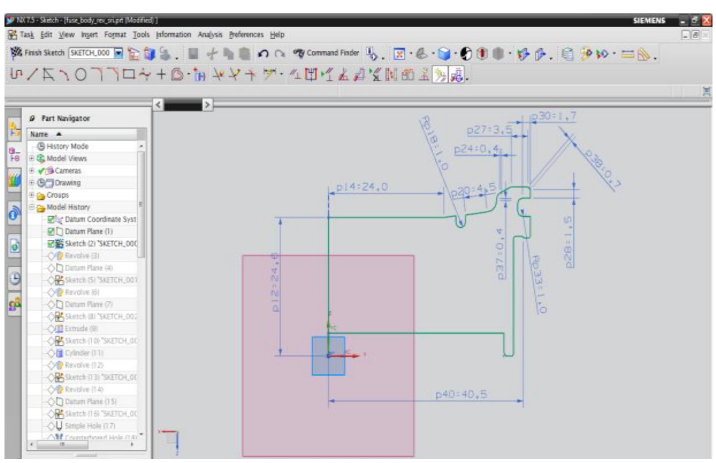


Fig: sketch of fuse body

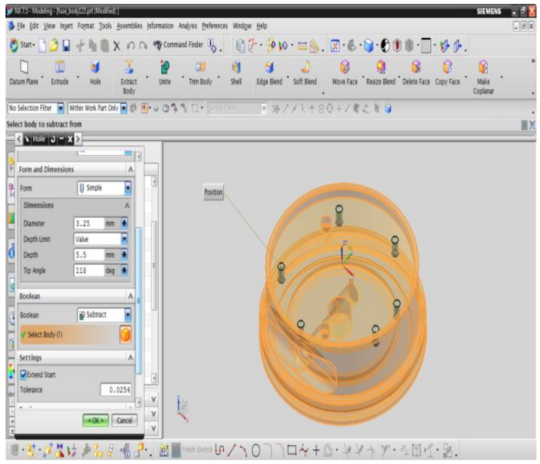


Fig: Hole option

2) *Below image shows 3d model of fuse body*

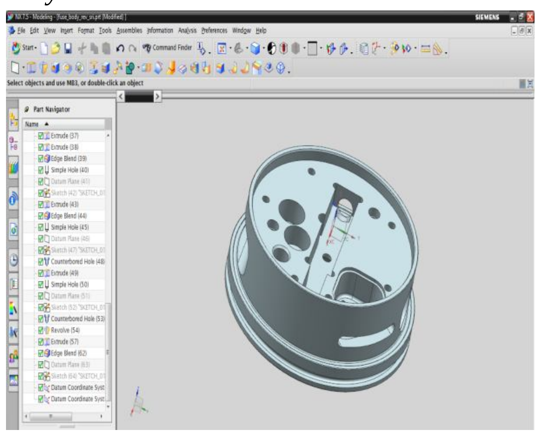


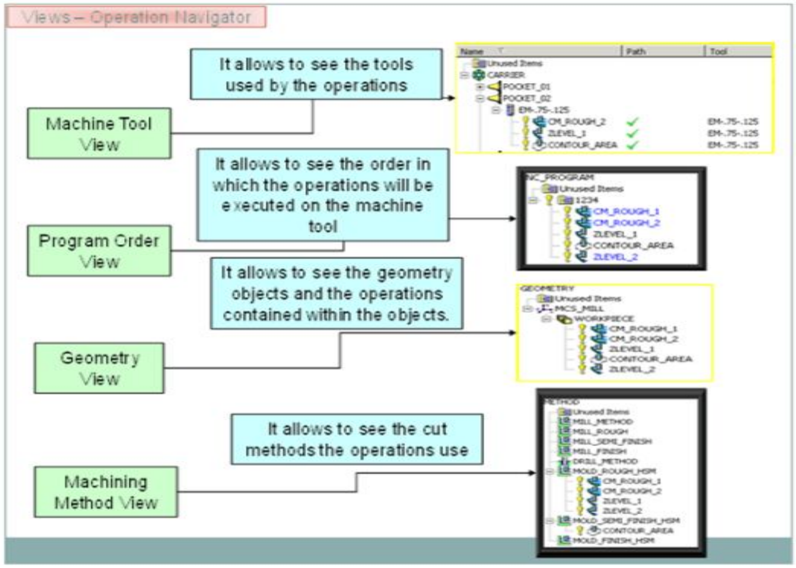
Fig: Final 3d model

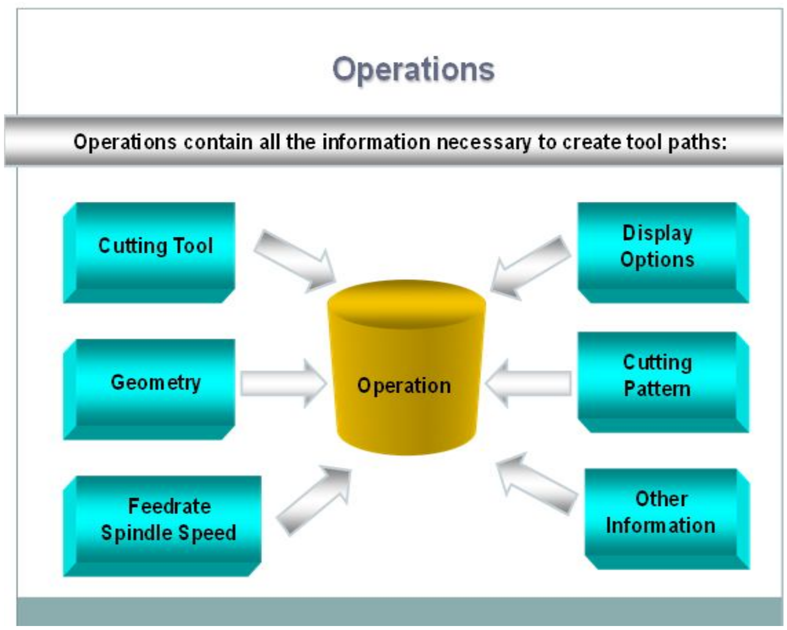
IV. COMPUTER AIDED MANUFACTURING (CAM)

After modeling fuse body, NX program is generated using cam software by generating tool path on the model using NX CAM software. The generated NC program is given to CNC machine through DNC. The main objective of the project is to obtain high surface finish and less machining time.

Fig: DMG 5-axis milling machine

A. Below image shows operation navigator in cam





Operations come in many "types"

1) Fixed contour
2) Mill control
3) Drilling
4) Planar Mill
5) Cavity mill
6) Face Mill

a) *Convert to NC code:* Using the post processor, we have to convert cl file data into machine specified NC part programmed. In the project manager, select the first operation on the operations page, then hold down the shift key and select the last operation. All the cutting operations are selected. Press the right mouse button and select NC code from the menu. Select a machine format file from the pull-down list (3-axis/5-axis).

b) *Generating NC program:* Below image shows blank component

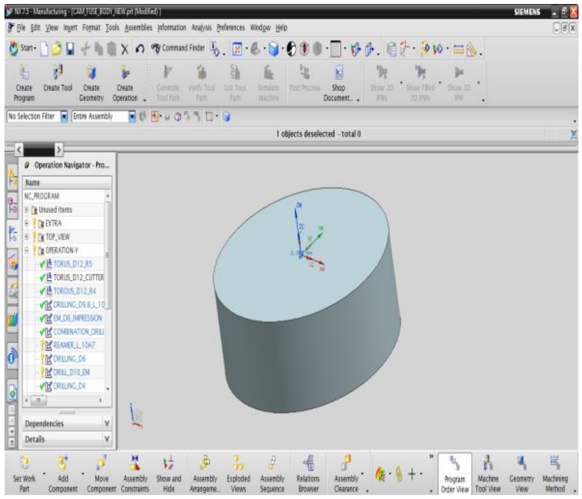


Fig: blank component

B. Below image shows part of fuse body

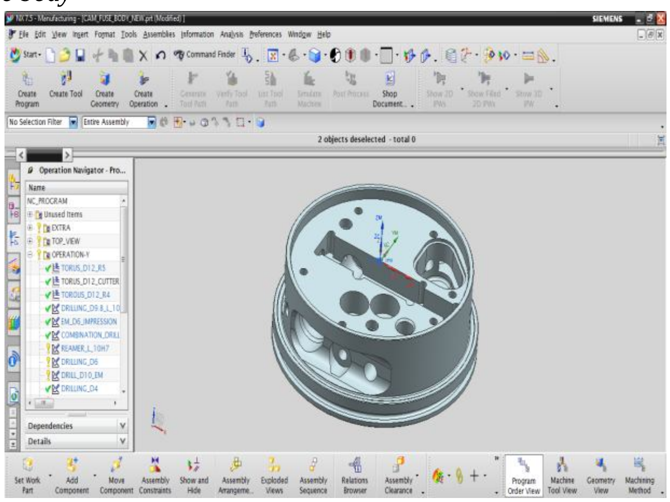


Fig: Part of fuse body

C. Turing operations on fuse body

Below image shows facing operation of fuse body with 1300rpm speed and o.24mmpr feed

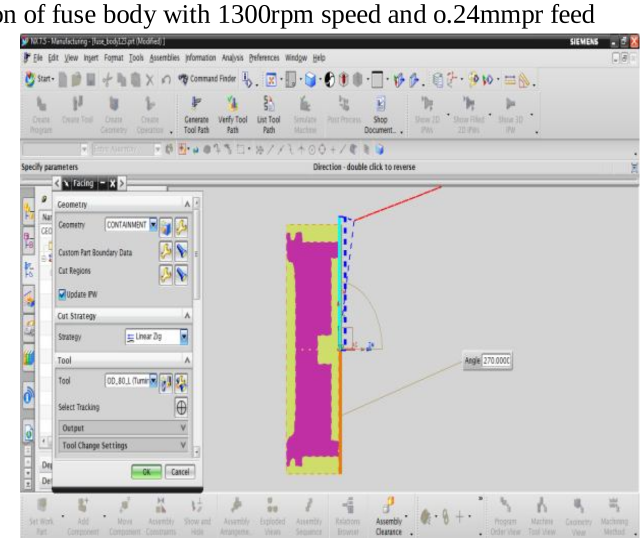


Fig: Facing operations of fuse body

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D. Below image shows verification of facing operation

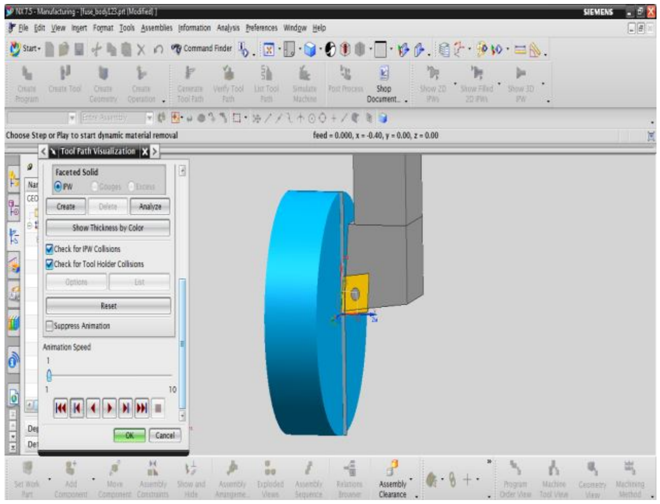

Fig: Verification of facing operation

E. Below image shows verification of rough turn_od operation

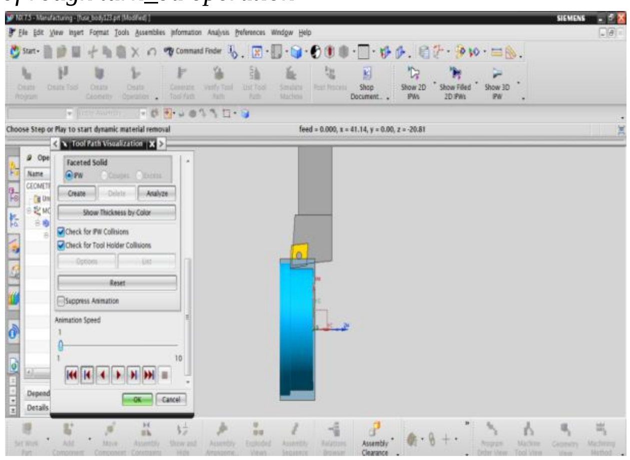

Fig: Verification of rough turn_odoperation

F. Below image shows verification of rough bore_id operation

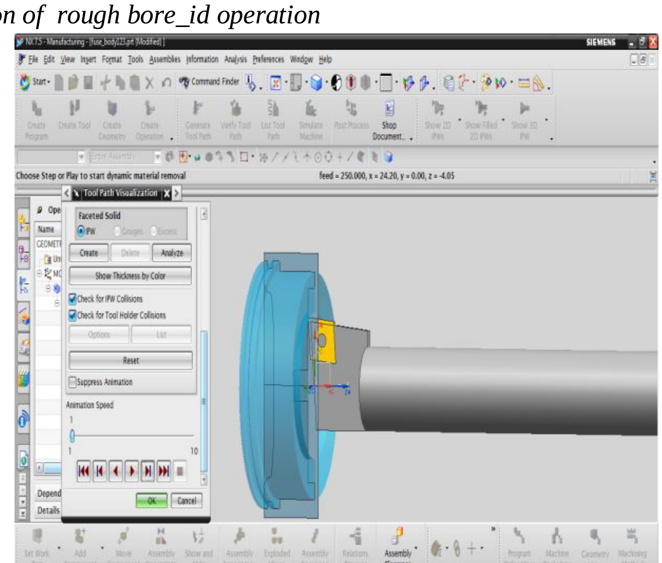

Fig: Verification of rough bore_idoperation

G. Milling operations on fuse body

Below image shows planar mill operation of fuse body with 1400rpm speed and 230mmpm feed

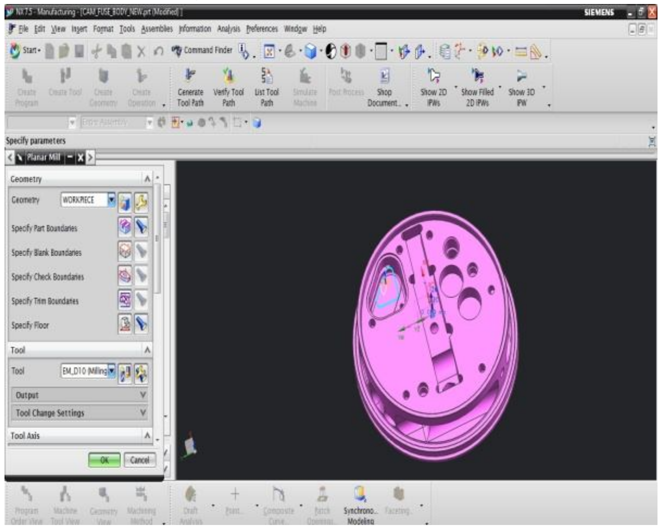

Fig: Planar mill operation

H. Below image shows verification of planar mill operation

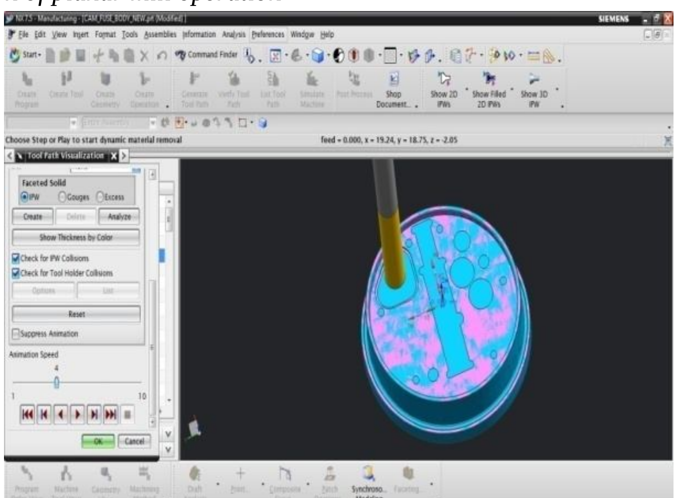

Fig: Verification of planar mill operation

I. Below image shows verification of planar mill operation

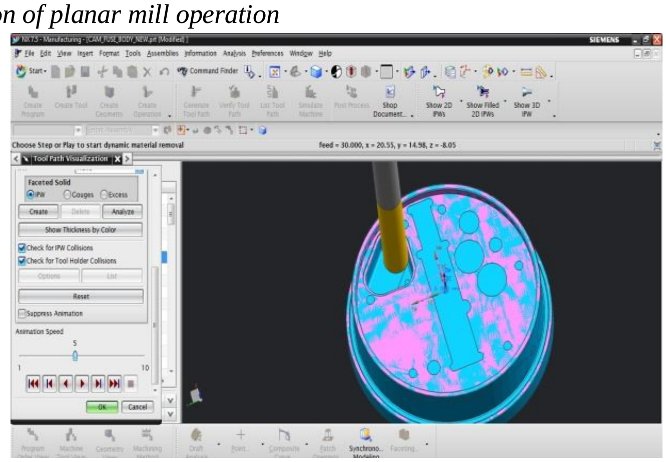

Fig: Verification of planar mill operation

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J. *Below image shows planar mill operation of fuse body with 1400rpm speed and 230mmpm feed*

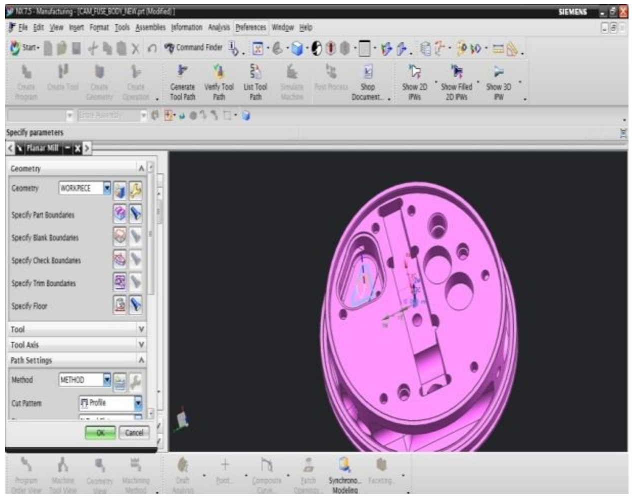

Fig: Planar mill operation

K. *Below image shows drilling operation of fuse body with 1250rpm speed and 230mmpm feed*

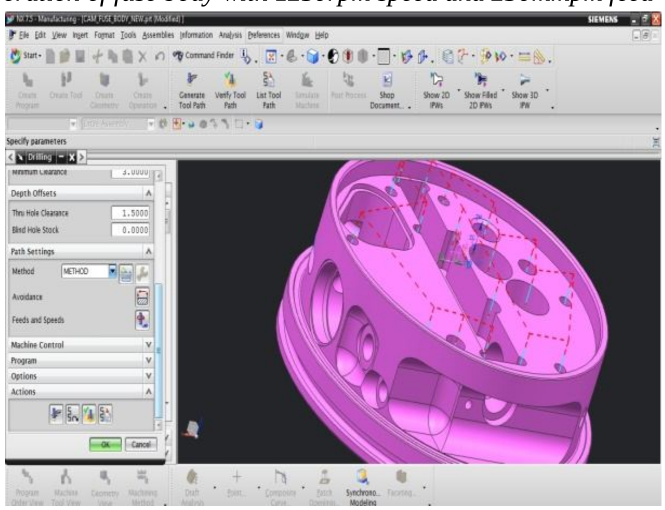

Fig: drilling operation

L. *Below image shows drilling operation of fuse body with 1250rpm speed and 230mmpm feed*

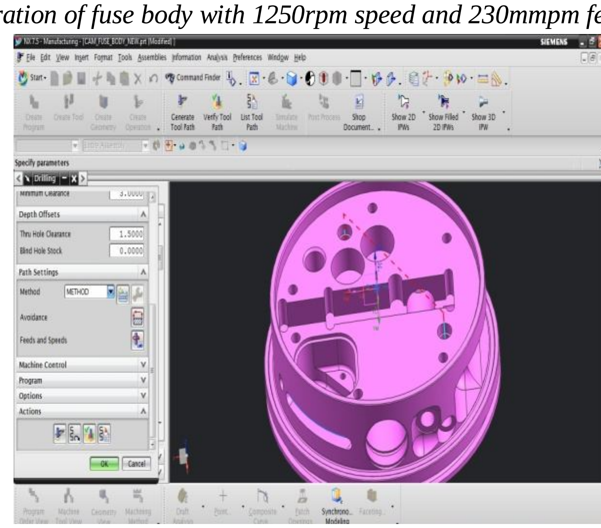

Fig: drilling operation

M. Below image shows drilling operation of fuse body with 1250rpm speed and 230mmpm feed

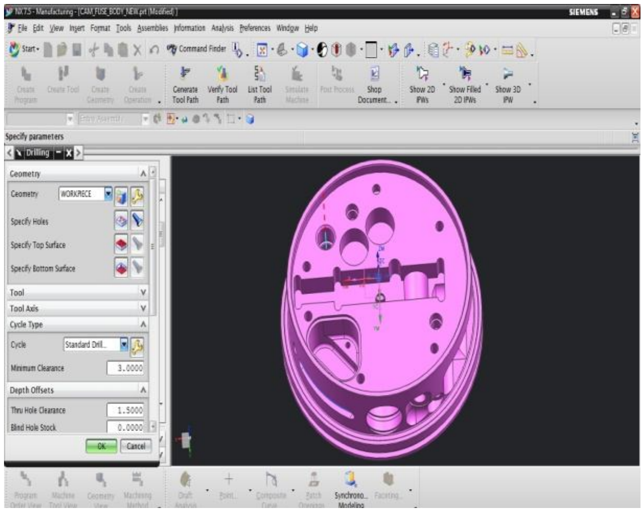

Fig: Drilling operation

N. Below image shows verification of planar mill operation

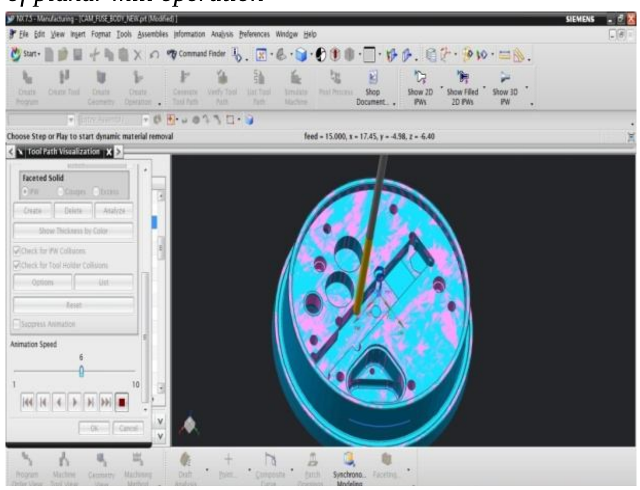

Fig: Verification of planar mill operation

O. Below image shows planar mill operation of fuse body with 1400rpm speed and 230mmpm feed

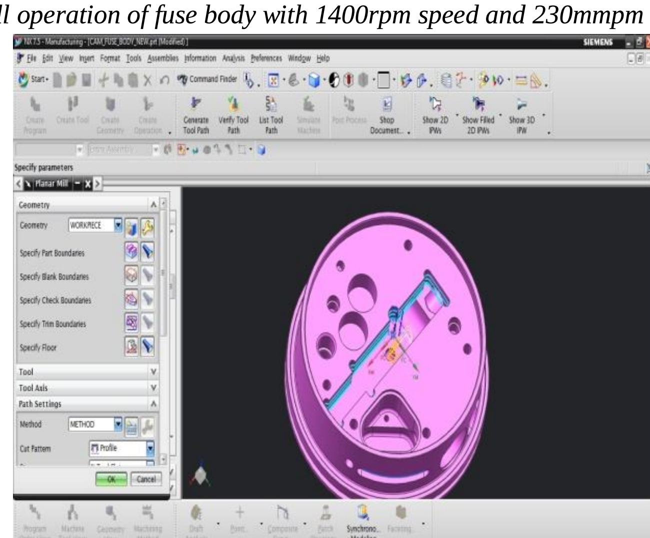

Fig: planar mill operation

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The manufacturing process of fuse body on cnc machine.

Raw material is placed on the machine, and degree of freedom is arrested using fixtures. 3-jaw chuck is used for arresting degree of freedom of the fuse body.

First step: facing operation is done on the raw material

Second step: planar mill operation will be done on sides of the fuse body

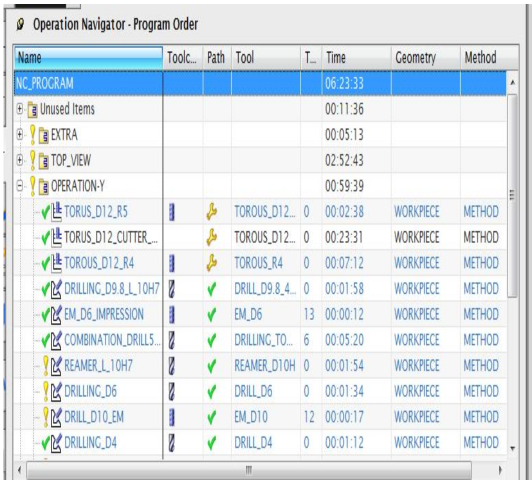
Third step: angular planar mill operation will be done on fuse body

Fourth step: drilling operation will be done to create holes

Fifth step: after completing setup_1 operation component is removed from fixture and it is reversely placed in fixture for setup_2 operations.

Sixth step: again facing, planar milling & drilling operations will be done on the component. Finally finish operation will be done.

P. Below image shows time taken for manufacturing fuse body.


Operation Navigator - Program Order

Name	Toolc...	Path	Tool	T...	Time	Geometry	Method
NC_PROGRAM					06:23:33		
Unused Items					00:11:36		
EXTRA					00:05:13		
TOP_VIEW					02:52:43		
OPERATION-Y					00:59:39		
TORUS_D12_R5			TOROUS_D12...	0	00:02:38	WORKPIECE	METHOD
TORUS_D12_CUTTER_...			TOROUS_D12...	0	00:23:31	WORKPIECE	METHOD
TOROUS_D12_R4			TOROUS_R4	0	00:07:12	WORKPIECE	METHOD
DRILLING_D9.8_L_10H7			DRILL_D9.8_4...	0	00:01:58	WORKPIECE	METHOD
EM_D6_IMPRESSION			EM_D6	13	00:00:12	WORKPIECE	METHOD
COMBINATION_DRILLS...			DRILLING_TO...	6	00:05:20	WORKPIECE	METHOD
REAMER_L_10H7			REAMER_D10H	0	00:01:54	WORKPIECE	METHOD
DRILLING_D6			DRILL_D6	0	00:01:34	WORKPIECE	METHOD
DRILL_D10_EM			EM_D10	12	00:00:17	WORKPIECE	METHOD
DRILLING_D4			DRILL_D4	0	00:01:12	WORKPIECE	METHOD

Fig: Time taken for manufacturing fuse body.

V. DESIGN OF TOOLS

Tools are designed for typical operations to reduce manufacturing time and cost and to get high surface finish. These tools reduce number of operations. Each designed tool can do nearly four operations at a time and reduce machining time, tool change and tool setup time as well as part cost. Tools are designed as per the dimensions required for machining such operations. Using designed tools we can go for high cutting speed and feeds. The machining time will be reduced at high speed cutting as well as component cost is reduced.

A. Tool 1

1) Below image shows sketch of designed tool

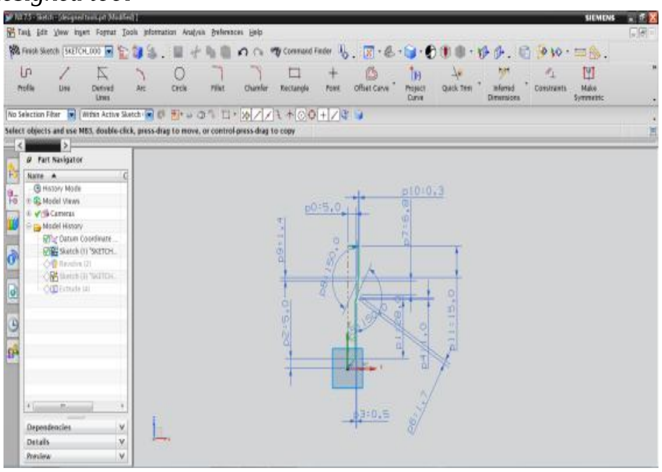


Fig: sketch option of tool-1

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2) *Below image shows final part of designed tool*

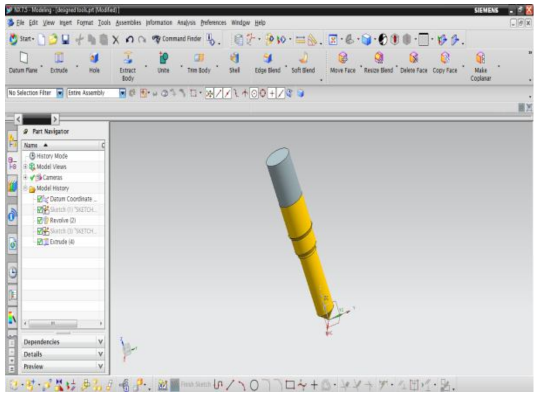

Fig: Final part of designed tool-1

B. Tool 2

1) *Below image shows sketch of designed tool*

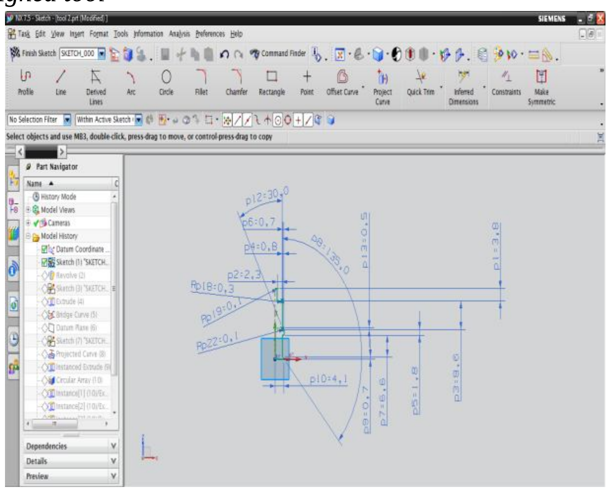

Fig: Sketch option of tool-2

2) *Below image shows final part of designed tool*

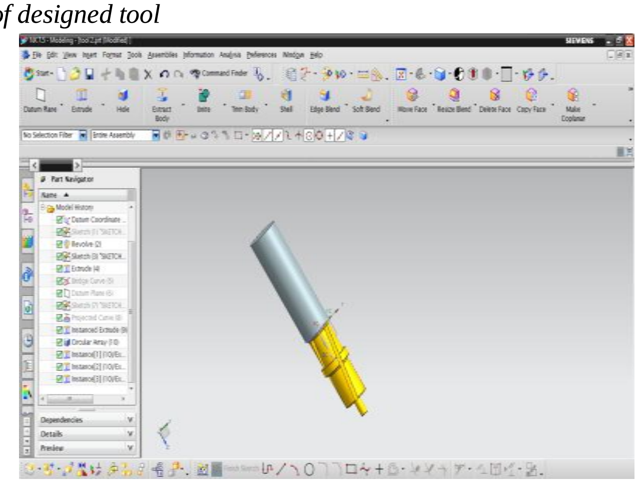

Fig: Final part of designed tool-2

The manufacturing process of fuse body on CNC machine with designed tools.

The production process will be same for machining fuse body, but designed tools were used to reduce machining time and cost of the part. The time taken for manufacturing fuse body is shown below

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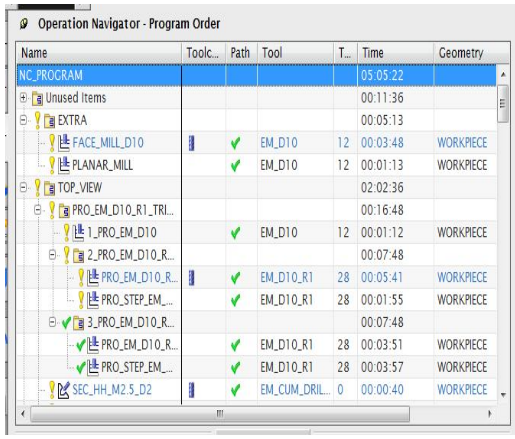

Operation Navigator - Program Order

Name	Toolc...	Path	Tool	T...	Time	Geometry
NC_PROGRAM					05:05:22	
Unused Items					00:11:36	
EXTRA					00:05:13	
FACE_MILL_D10		✓	EM_D10	12	00:03:48	WORKPIECE
PLANAR_MILL		✓	EM_D10	12	00:01:13	WORKPIECE
TOP_VIEW					02:02:36	
PRO_EM_D10_R1_TRI...					00:16:48	
1_PRO_EM_D10		✓	EM_D10	12	00:01:12	WORKPIECE
2_PRO_EM_D10_R...					00:07:48	
PRO_EM_D10_R...		✓	EM_D10_R1	28	00:05:41	WORKPIECE
PRO_STEP_EM_...		✓	EM_D10_R1	28	00:01:55	WORKPIECE
3_PRO_EM_D10_R...					00:07:48	
PRO_EM_D10_R...		✓	EM_D10_R1	28	00:03:51	WORKPIECE
PRO_STEP_EM_...		✓	EM_D10_R1	28	00:03:57	WORKPIECE
SEC_HH_M2.5_D2		✓	EM_CUM_DRIL...	0	00:00:40	WORKPIECE

Fig: Time is taken for manufacturing fuse body using designed tools.

3) *Below image shows final component after manufacturing*

VI. RESULTS & DISCUSSIONS

Product cost reduction, reduction machining time, manufacturing component on CNC machine using default tools, manufacturing component with regular tools consumes more time and increases production cost. Time and cost calculation for manufacturing fuse body as shown below,

Production time is taken by single component= 6hrs 24mins

Machining cost per hour for milling operations =. 1200rs

Machining cost per hour for drilling operations =. 800rs

Machining cost per piece for turn-mill operations (machining cost per min x machining time in min) = 1200/60*198min= 3960rs

Machining cost per piece for the drilling operations (machining cost per min x machining time in min) = 800/60*186min= 2480rs

Total machining cost per piece= turn-mill+drilling= 3960+2480 = 6440rs

Table1: table of machining time& cost using default tools for manufacturing

Set up Operations	Time required in mins.	Machining cost Per hour	Machining cost/piece
Turn- mill	198	Rs.1200/hr	Rs.3960
Drilling	186	Rs.800/hr	Rs.2480
Total	384		Rs.6440

A. *Manufacturing component on CNC machines using designed tools*

Using designed tools number of operations can be reduced and manufacturing time, and the part cost will be reduced.

Manufacturing time is taken by single component= 5hrs 6min
Machining cost per hour for turn-mill operations =. 1200rs
Machining cost per hour for drilling operations =. 800rs
Machining cost per piece for turn-mill operations (machining cost per min x machining time in min) = 1200/60*198min= 3960rs
Machining cost per piece for drilling operations (machining cost per min x machining time in min) = 800/60*108min= 1440rs
Total machining cost per piece= turn-mill+drilling= 3960+1440 = 5400rs
Table2: table of machining time& cost using designed tools for manufacturing

Set up Operations	Time required in mins.	Machining cost	Machining cost/piece
Turn-mill	198	Rs.1200/hr	Rs.3960
Drilling	108	Rs.800/hr	Rs.1440
Total	306		Rs. 5400

B. Graph

Graphical representation of manufacturing time and cost of the component

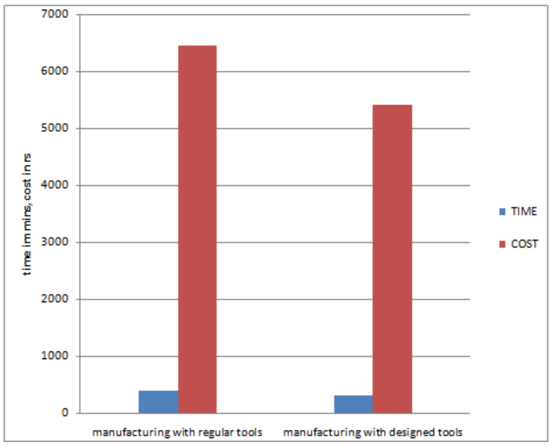

Fig: graph of machining time & cost

VII. CONCLUSION

Modeling of fuse body is done using Uni-graphics software. Proper tools are specified which will support for machining typical components like fuse body. Manufacturing process sequence of fuse body is shown in the document. Manufacturing time is noted when the part is manufactured with regular tools, to reduce time and cost tools are designed as per the operations. New tools are designed to do four operations at a time and reduce manufacturing cost and time Graphical representation of product cost reduction, reduction of manufacturing times are shown in results. Graphical representation of product cost reduction rate of fuse body shows a reduction of time as well as the cost of the component when manufactured by using design tools which will reduce manufacturing time and cost of the component. Manufacturing process is optimized by using designed tools to reduce manufacturing cost and time

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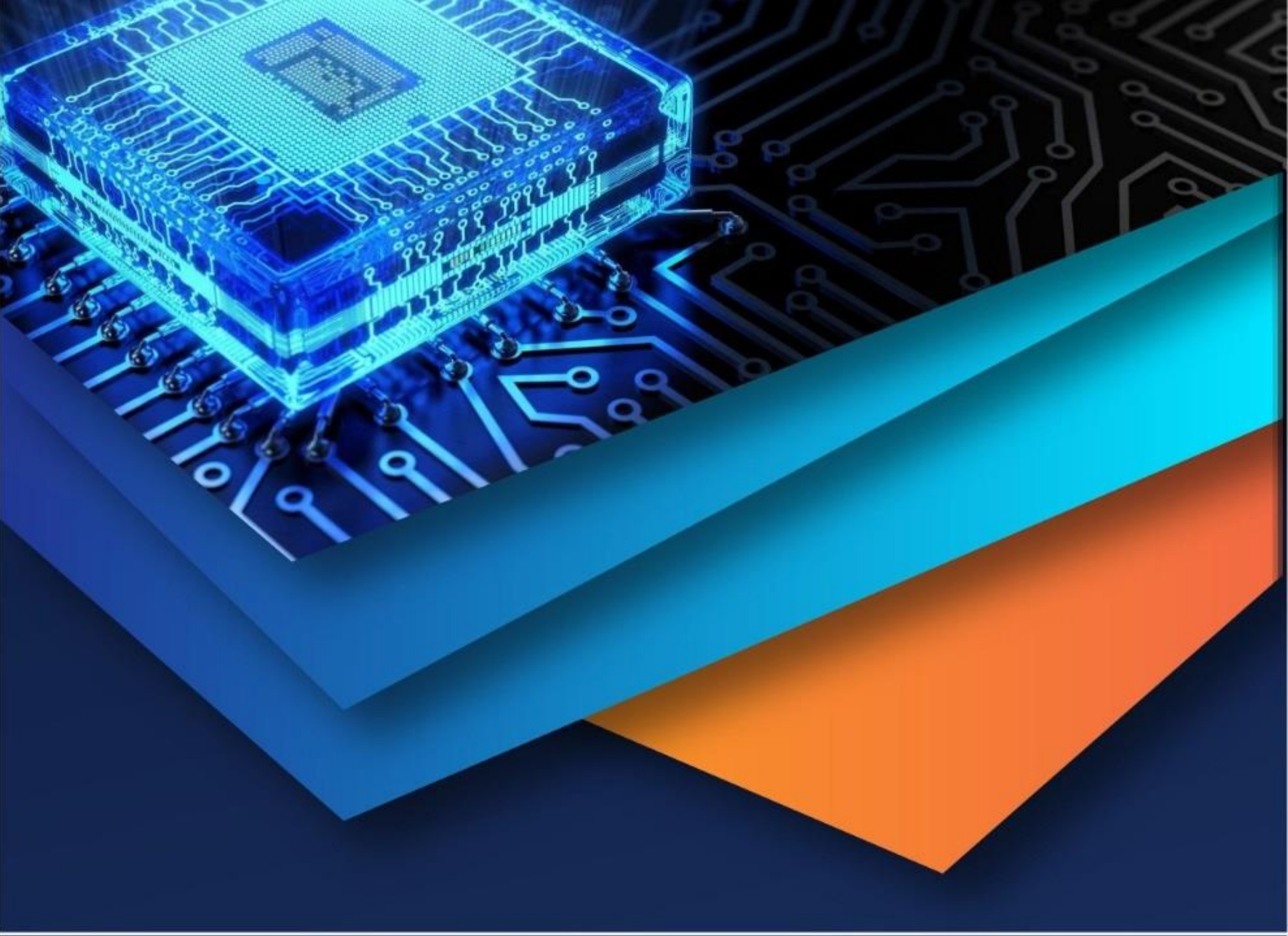

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