Computer Application in Post Processor Development of an Indigenous CAD/CAM Package

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Abstract— **CollabCAD is an indigenous 3D CAD/CAM software system for collaborative design and development of Industrial Designs for strategic use. This work is for CAM module of the indigenous software, in which the development of post-processor is the task that is accomplished. The CAD model is created in CollabCAD and the required tool path was produced in a generic format known as Cutter Location (CL) data. Then it is converted by an application program called "PSG CollabCAD Post processor (PCP)" into the form suitable for the machine tool. CNC machining operations that include drilling, boring and threading operations were considered for post-processing. The CNC program generated by the PCP 2.1 was verified using Fanuc -32i control's tool path simulation and by machining a test piece in a CNC machining centre.**

Keywords-CL data, CollabCAD, PCP 2.1, FANUC – 32i

I. INTRODUCTION

CollabCAD is a 3D CAD/CAM Software system developed based on Free and Open Source Solutions & Libraries for the collaborative design & development of Industrial Designs. Free and Open Source refers to community development and community owned solutions and, therefore, there is no fee or royalty or price for these solutions.

National Informatics centre has taken the challenge and is working on CollabCAD software. CollabCAD facilitates the conventional CAD/CAM capabilities like design, drafting, surface and solid modelling, feature based modelling, basic NC features, data exchange etc. CollabCAD is based on the "Open Cascade" Geometry Kernel which can be downloaded from 'www.collabcad.com' [4]. Modelling technique of CollabCAD is compared with other software's and given in Table 1.

Ref. [1] developed a postprocessor capable of converting cutter location (CL) data to machine control data for five-axis machine tools. A generalised NC postprocessor developer named MultiPOST can produce the specific NC postprocessor that the user demands as in [2]. MultiPOST generated post processor runs only on Windows 98. PCP 2.1 is developed for three- axis machine tools which run on both Windows and Linux Platform.

II. MATERIALS

The CAM Module of CollabCAD can perform the simulation of machining operations like turning, threading, drilling and milling (point-to-point & surface).

TABLE I
MODELLING TECHNIQUE OF COLLABCAD COMPARED WITH OTHER SOFTWARE'S

S. No	CollabCAD	Other Software's
1	While creating a new part, by default the graphics window will be set to front work view and front workspace where user can start creating the part or model. The user has the option of changing the workspace & workview.	While creating a new part, the user will be in part design mode, there is no workview, the user has to choose a workplane to create sketch in 2D sketcher mode.
2	Once the profile (2D or 3D curve) is created in the current workspace the user can create solid model out of it.	The user has to exit the sketch mode to part mode to get 3D.
3	CollabCAD allows multiple profiles in a single workspace.	Only one sketch per feature for a sketch plane.

It can also generate the cutter-location data (CLdata) file. This CLdata can be converted to a specific form of RS-274 NC machine tool commands by using application software known as postprocessor.

A. Objective

The objective is to produce 4no's of 10mm tap in the PCD 106.1 of the component shown in Fig. 1. Here three operations are needed namely center drill, core drill using peck and tap. The component is modelled in CollabCAD 1.9.3.

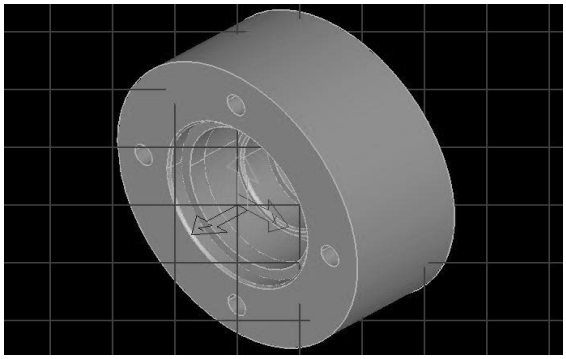

Fig. 1 3D view of the test Piece

B. *Point to Point Milling Parameters*

After creating the model in CollabCAD software, the point to point milling parameters entered are given below.

- Spindle speed = 1200RPM [Center drill]
  800RPM [Peck drill]
  300RPM [Tap]
- Spindle direction = Clockwise
- Feed rate = 140mm/min [Center drill]
  165mm/min [Peck drill]
  450mm/min [Tap]
- Start height = 1mm [constant height]
- Final depth = 5mm [Center drill]
  23mm [Peck drill]
  22mm [Tap]
- Clearance = 0mm
- Retract = 50mm
- Coolant = On

C. *Tool Path Generation*

After entering the point to point milling parameters as mentioned above, the 4 points were selected and tool path is generated as shown in the Fig. 2.

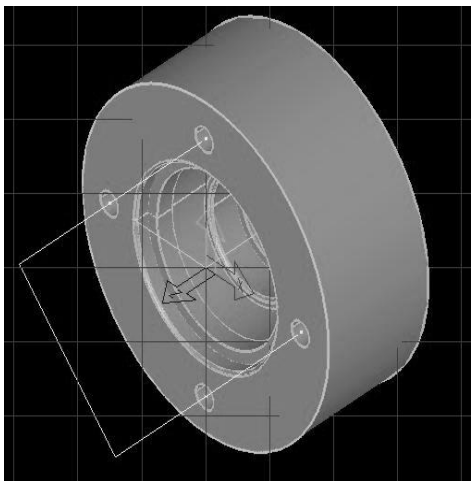

Fig. 2 Tool path generated for the test Piece

D. *CL data Generation*

The Cutter Location data is generated by selecting the already created tool path. The CL data generated for center drill is given below.

```
$$* -- CL FILE -- Generated on: 01.10.2010 at 05:13:46 PM IST
PARTNO/
UNITS / MM
SPINDL / 1200, RPM, CLW
GOTO / 0.0, 53.05, 50.00
RAPID
GOTO / 0.0, 53.05, 01.00
FEDRAT / 140.0, MMPM
GOTO / 0.0, 53.05, -05.00
PULLOUT
GOTO / 0.0, 53.05, 50.00
RAPID
GOTO / -53.05, 0.0, 50.00
RAPID
GOTO / -53.05, 0.0, 01.00
FEDRAT / 140.0, MMPM
GOTO / -53.05, 0.0, -05.00
PULLOUT
GOTO / -53.05, 0.0, 50.00
RAPID
GOTO / 0.0, -53.05, 50.00
RAPID
GOTO / 0.0, -53.05, 01.00
FEDRAT / 140.0, MMPM
GOTO / 0.0, -53.05, -05.00
PULLOUT
GOTO / 0.0, -53.05, 50.00
RAPID
GOTO / 53.05, 0.0, 50.00
RAPID
GOTO / 53.05, 0.0, 01.00
FEDRAT / 140.0, MMPM
GOTO / 53.05, 0.0, -05.00
PULLOUT
GOTO / 53.05, 0.0, 50.00
RAPID
FINI
```

Similarly CL data were generated for peck drilling and tapping in CollabCAD software.

III. METHODS

A Software Requirement Specification (SRS) is a complete description of the behaviour of the system that is developed. It also specifies the functional and non-functional requirements which impose constraints on the design and implementation.

A. *Product Perspective*

PCP version 2.1 is aimed towards a person who has a CL data generated from a Point to Point Milling Module of CollabCAD, and so needs software assistance for developing CNC part programs. It consists of four modules namely ‘Drilling Module’, ‘Peck Drilling Module’, ‘Tapping Module’, and ‘Boring Module’ as shown in Fig. 3.

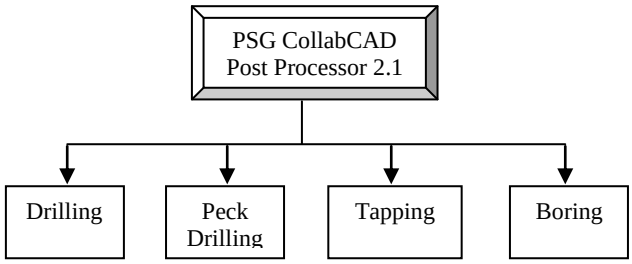

Fig. 3 PCP 2.1 modules

B. Product Inputs

The following are the various cases available in PCP version 2.1.

Drilling module:
- Centre drill
- Core drill
- Centre drill and Core drill

Peck Drilling module:
- Peck drill
- Centre drill and Peck drill

Tapping module:
- Tap
- Centre drill, Core drill and Tap
- Centre drill, Peck drill and Tap

Boring module:
- Boring

The common inputs required for the various cases mentioned above are their respective CL data's and tool number. For peck drill user need to enter the depth of each peck and in case of boring user need to enter the shift amount. For all the cases, program number should be entered.

C. Product Functions

PCP 2.1 supports the following use cases. The use case is a description of a system's behaviour as it responds to a request that originates from outside of that system. In other words, a use case describes "who" can do "what" with the system in question.

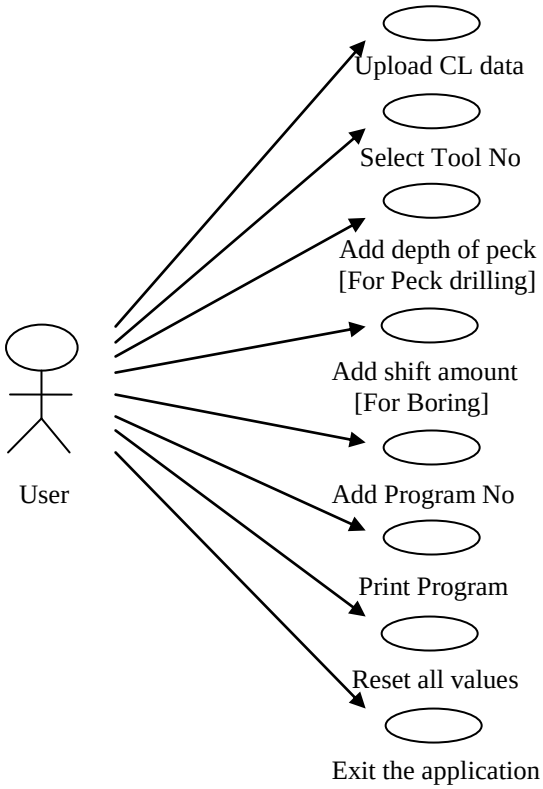

Fig. 4 Use Case diagram

Fig 4 shows the use case diagram for PCP 2.1. User is mapped with various use cases on the right side of the figure.

D. Algorithm

The following algorithm for post processor was developed by considering the CL data obtained from CollabCAD and other input parameters.

i. Start

Start the program

ii. Get the Inputs from the User

Receive the following inputs from the user.
- CL data file
- Tool number
- Depth of peck
- Shift amount
- Program number

iii. Read CL Data File

Read the CL file and do the following.
- Accept the files that are only with '.txt' extension
- Read the file line by line
- Read the lines containing GOTO and copy all the coordinates in an array
- Consider the data's obtained from CL data for further post processing work

iv. Processing the Data

- Take the coordinates of all the points, in which the tool should travel from the CL data
- Using appropriate canned cycles develop the part programme

v. Generate NC Program

Generate the corresponding NC program for the selected case

vi. End

End the program

E. Development of GUI

Various software requirements were considered for the Graphical User Interface (GUI) development. GUI was developed using Net Beans IDE 6.5. Net Beans is open source software that can be downloaded from 'www.netbeans.org' [5].

The GUI consists of one main frame. The main frame consists of 4 panels for drilling, peck drilling, tapping and boring. The panels consist of text fields, labels, drop-down menus and buttons to get data from user and initiate processing. A snapshot of GUI is shown in Fig 5.

F. Development of JAVA Source Code

JAVA source code is a set of instructions in English like language that drives the PCP application upon compilation. PCP 2.1 was developed in various intermediate stages. The algorithms were converted into necessary source code in these stages. At end of the each stage program was compiled and errors were debugged. Finally at end, sample CNC program was generated for various cases. The source code was verified with the algorithm and all logical errors were corrected.

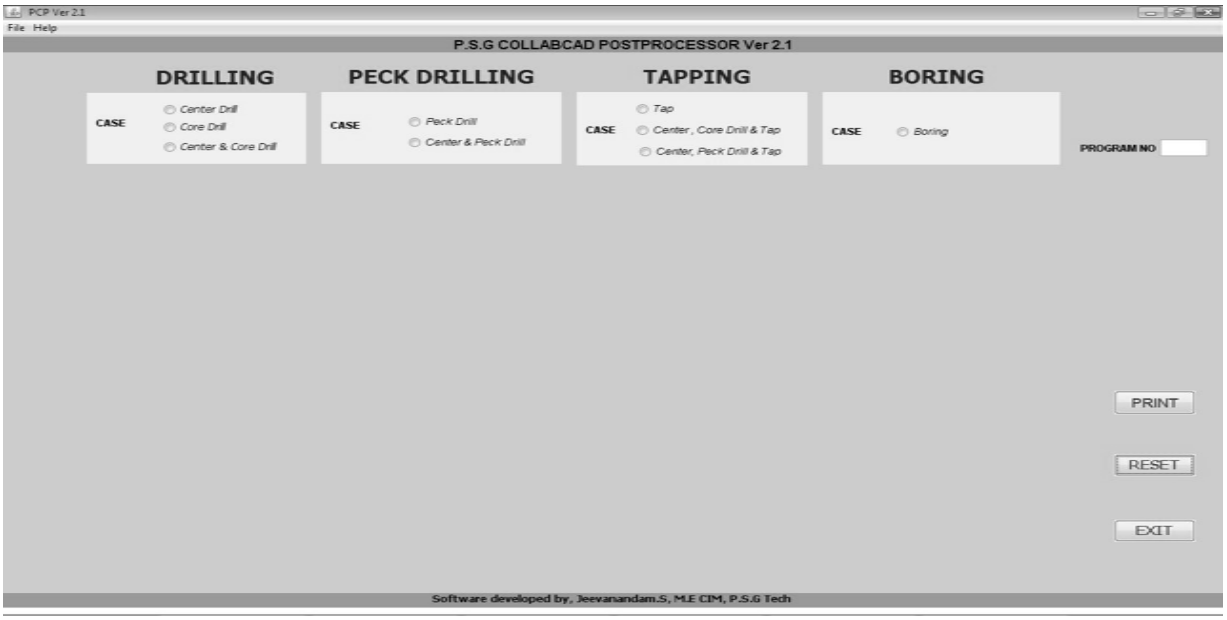

Fig. 5 PCP 2.1 screenshot

IV. EXPERIMENTAL RESULTS

In the experimental phase usability of the PCP 2.1 was tested. The program generated from PCP was fed into CNC vertical machining centre.

A. Part Program from PCP

The case center, peck drill and tap was selected from the tapping module of PCP.

Select the appropriate CL files and tool no from PCP window as shown in Fig. 6.

- Depth of peck value given = 12 mm
- Program No = 1234

After selecting those CL files and entering all the necessary data's print button is pressed and NC program is generated as shown in Fig. 7.

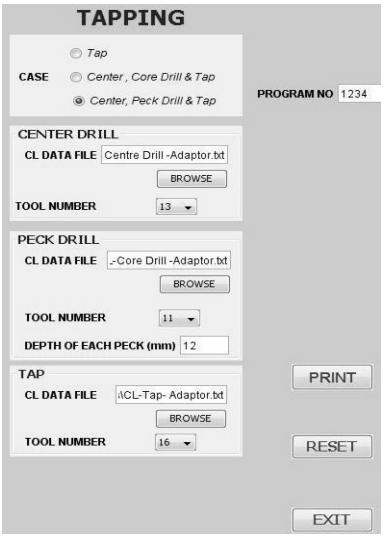

Fig. 6 PCP Window

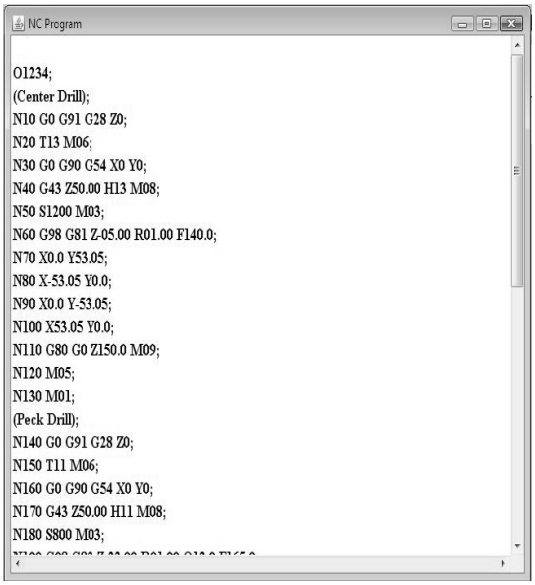

Fig. 7 NC program

B. *Machine tool path simulation*

The NC program obtained from the PCP was then fed into FANUC 32i controller present in CNC Vertical machining centre DMG 835V [Make: Deckel Maco]. The NC program was validated by simulating the tool path in the controller which is shown in Fig. 8.

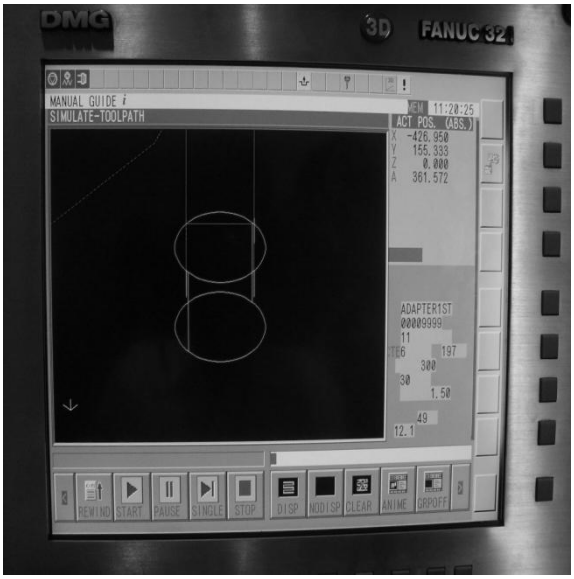

Fig. 8 Machine tool path simulation

Then the test piece is placed in the machining centre and work reference was initialized. NC program was selected and the operations center drill, core drill and tap were completed in sequence. Then the test piece was removed. The test piece after machining is shown in Fig. 9.

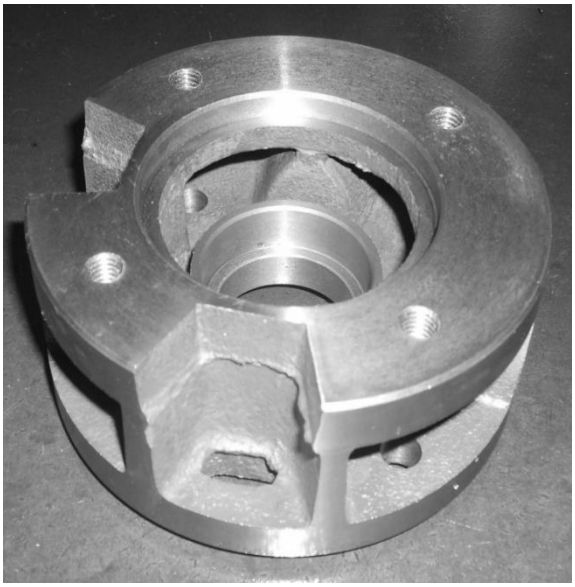

Fig. 9 Test piece production

V. CONCLUSIONS

An Indigenous CNC post processor for Indigenous CAM module was developed using preparatory and miscellaneous functions of FANUC controller and an open source JAVA programming language. PCP generates program with canned cycles which reduces the length of the programming and simplifies programming.

The experimental investigation shows that the PCP was user friendly and could generate accurate CNC programs. The part programs generated by PCP were validated using software simulation and as well as test part production in a CNC machining center. Thus the PCP developed using computer application such as JAVA NetBeans and CollabCAD ensures that the part programs can be directly fed to the control system without manual inspection. It also saves large amount of time spent by CNC programmer by writing the program manually.

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