Ain Shams University
Faculty of Engineering

Simulator for CNC Machining Centre

M.Sc. Thesis

Eng. Omar Monir Mohamed Farid Koura
B.Sc. Production Engineering

Submitted in Partial fulfilment of the requirements
For the M.Sc. Degree in Production Engineering

SUPERVISED
By
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June 2006

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ABSTRACT

CNC machine tools are becoming more and more the most important machine tools in industry. To manufacture complicated components in the range of the nano technology for complicated components, CNC machines have become a must. Handling these machines properly and programming them are a difficult task.

The part program is developed by two main programming methods:-

- Manual programming Method
- CAD/CAM programming method

Even with the second method the programmer must be capable of reading the instructions given in the block format and capable to modify the part program or add new blocks or delete others …. etc .

Hence, knowing manual programming is a must for all who work with CNC machine tools. On line training and programming are costly and unsafe to trainees.

For this reason the present work aims to develope a software package through which it is possible to learn and to have:-

- off-line programming and editing unit,
- possibility to set machines,
- checking the part programs for error free,
- simulating all manual operations,
- automatic execution of the CNC programs
- getting familiar with the CNC error messages.

The thesis consists, mainly of six chapters. Chapter # 1 provides a historical review of the main aspects related to the subject. Forty one references are included covering the start of the CNC, the scientific papers

relating to the machine components and their accuracies and the different methods used in computer aided programming.

In chapter # 2, full specifications of the CNC machining centre that will be simulated is given. The specification put down are so general to the extent that it covers a very wide range of CNC machining centres. It can be used for laying down the specifications needed for procuring of CNC machining centres.

In Chapter # 3, a survey of the Logics involved in operating the CNC machining centres are included. This is followed by the programming flow charts. The program used in writing the source code is visual basic # 6.

Chapter # 4 includes the operating manual of the proposed software. Through the use of this simulator the following activities can be done:-

- Editing of part programmes,
- Importing files from the CAD packages,
- Build tool library for CAM purposes,
- Simulating all manual operations and moving of all drives ,
- Plotting of programmed parts,
- Simulating the execution of the part program,
- Introducing the various parameters to the machine.

To prove the validity of the proposed software, six cases are studied and are given in Chapter 5. One of the cases is used to explore the method of extracting the geometrical coordinates from DXF AutoCAD file (Appendix A). The cases cover:-

- positioning cuts,
- linear cuts,
- circular cuts,
- fixed cycles:-
    - drilling cycle

- tapping cycle
- slotting cycle
- circular pocket cycle
- rectangular pocket cycle

The conclusion is presented in Chapter # 6. The work proved that it has fulfilled all the points aimed to be achieved. The simulating software is found to be a powerful tool to know how to program CNC machine tool, to get familiar with the logics involved in the design of CNC machine tool, to learn how to execute the manual operations in the machine, to test the part program offline and to deal with the error messages.

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APPENDIX A

EXTRACTED DXF FILE

To test the importing of the dimensional coordinates of the part, the part shown in fig. A.1 was drawn using ACAD 2000. It was saved as DXF file Version R12. This part is the same part of case study #3.

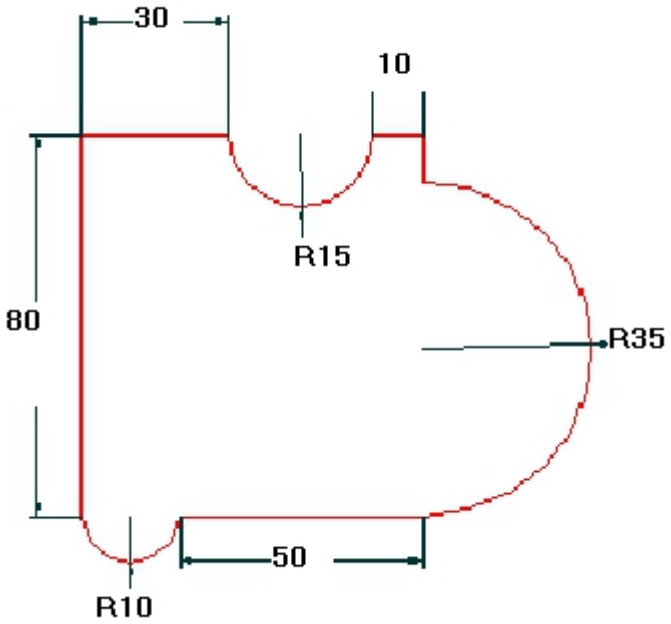

Fig A.1 Drawing of Case 3

The DXF file was processed by the proposed simulation software. The section that includes the "ENTITIES" was extracted. The listing of this section is given below, in table A.1 .

Table A.1: Listing of the Entities Section

SECTION
2
ENTITIES
0
ARC
5
3A
8
0
62
1
10
240.0
20
105.0
30
0.0
40
35.0
50
270.0
51
90.0
0
LINE
5
3C
8
0
62

1

10

240.0

20

140.0

30

0.0

11

240.0

21

150.0

31

0.0

0

LINE

5

3D

8

0

62

1

10

240.0

20

150.0

30

0.0

11

230.0

21

150.0

31

0.0

0

ARC

5

3E

8

0

62

1

10

215.0

20

150.0

30

0.0

40

15.0

50

180.0

51

0.0

0

LINE

5

3F

8

0

62

1

10

200.0

20

150.0

30

0.0

11

170.0

21

150.0

31

0.0

0

LINE

5

40

8

0

62

1

10

170.0

20

150.0

30

0.0

11

170.0

21

70.0

31

0.0

0

LINE

5

46

8

0

62

1

10

240.0

20

70.0

30

0.0

11

190.0

21

70.0

31

0.0

0

ARC

5

47

8

0

62

1

10

180.0

20

70.0

30

0.0

40