Chapter - 1

INTRODUCTION

CHAPTER - I

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Now-a-days methods of designing and manufacturing are replaced by Computer Aided Design (CAD) and Computer Aided Manufacturing (CAM). Widespread CAD/CAM systems reduce human interaction and the result would be increased productivity, reduced costs and best quality of product. Today, almost all manufacturing industries invariably have more than one CNC machines due to business development, technology and market requirement. CNC machines utilize a variety of cutting technologies such as multi turrets and multi spindles in complex axial configurations increasing the level of flexibility compared to the machines of the previous decade.

Generally a design engineer would design the component according to the customer requirement and then sends to the manufacturing department. If the manufacturing department finds any manufacturing related problems, then that design is sent back to design department. To nullify this time consuming process, a number of software tools have been developed allowing design engineers to analyze manufacturability during the design stage itself. Computer Integrated Manufacturing (CIM) systems have emerged as a means of upgrading productivity and the quality of manufactured products. In such systems, various computers are utilized to assist design and manufacturing engineers to enhance the overall manufacturing productivity and quality of the product in less time and with less cost.

1.1 INTEGRATION OF DESIGN AND MANUFACTURING

Today the scarcity of skilled workers in manufacturing industry is a common problem. Moreover, fully integrated automation systems cannot be achieved until human intervention is avoided. A direct link is established between product design and manufacturing in an integrated

CAD/CAM system. It includes all the information on the product generated during design such as geometry data, material specifications, bill of materials, tool selection, tolerance, assemble sequence etc., as well as additional data required for manufacturing. The ability to automatically recognize turned features from Neutral file is very important aspect for CAD/CAM integration. Because of its importance in CAD/CAM integration, the extraction of geometric features in design information has received considerable attention since the mid 1970s.

The first two generations of automates manufacturing continue to evolve in today's modern industry. The first generations of mechanizations evolved from simple mechanism to complex mechanical machine systems and are still being developed today. The second generation of relays and switching logic, which brought automation to a variety of medium to high volume production systems, also continues to evolve. Today's flexible automation is driven by increased international competition from countries like Japan and Germany. The foundation of third generation manufacturing is numerical control.

Over the decade, the CAD/CAM research community has developed the concept of machining features to assist in the conversion of design information into machining information. The concept of features has been a major work towards automation of machining and remains as vital research work. Machining features have proved to be convenient because they characterize the capabilities of machining operations. Automatic feature recognition has been an active research area in solid modeling for many years, and is considered a critical task for CAD/CAM integration. A general methodology is presented for automatic feature recognition from a neutral file.

1.2 FEATURE BASED APPROACH FOR CAD/CAM INTEGRATION

Over the last 20 years there has been a great deal of interest in the development of computer tools that can identify features with real world meaning from 2D images or 3D design models. The term feature recognition refers to techniques that are able to automatically identify features from product geometry for some manufacturing or other purpose. The features may be form features, assembly features and material features. The form features identify the combination of geometric and topological entities. Assembly features give location of parts for assembly and material features specify material of the product.

Automatic feature recognition reduces the manual intervention and manipulates part geometry to prepare it for machining. Automatic feature recognition is done for the integration between CAD and CAM, which means that geometrical data involved in solid model can easily transferred from CAD system to CAM system. Automated feature recognition can best be facilitated by CAD systems capable of generating the product geometry based on features there by making it possible to extract data about tolerance, surface finish and so on. However, such CAD systems are not mature yet and their wide usage in different application domains remains to be seen. The design and development of CAM tools have not been fully consistent with the growth in CAD techniques. Hence there is an enormous scope for research to fill this gap. Automatic feature recognition is the first stage in such an effort.

In solid modeling there are two main representation schemes, one is Boundary representation (B-Rep) and the other is Constructive Solid Geometry (CSG). In the present work B-Rep scheme is considered. Features can be divided as design features and manufacturing features. Design features are specific geometric portions that have certain functions from a usage viewpoint, whereas manufacturing features are the removal volumes from the initial stock to generate the part model.

In present automation scenario many CAD/CAM systems are using various neutral formats such as Stereo Lithography (STL), Drawing Exchange Format (DXF), Initial Graphics Exchange specification (IGES), STandard for Exchange of Product (STEP), etc. IGES and STEP are most popular neutral formats. STEP is intended for product data exchange and IGES for geometry data exchange. STEP has fewer storage requirements than IGES.

Features can be viewed upon as information sets that refer to form or other attributes of a part, in such a way that these sets can be used in reasoning about design, performance and manufacture of the product or the assemblies. In the present work STEP format of the parts modeled in CATIA are used for feature recognition and the technique used for recognition is named as "STEP to Feature" feature recognition technique.

1.3 HARDWARE AND SOFTWARE REQUIREMENT

Table 1.1 gives the requirement of hardware and software needed to run/execute developed software.

Table 1.1: Hardware and Software Requirement

Hardware	Software
Intel Core duo 1.66 GHz PC or above processor	JAVA2
512 MB RAM or above	CATIA V5R 20
Hard disk space 80GB or above	

1.4 AN OVERVIEW OF THE DEVELOPED SYSTEM

The aim of the present work is to develop software for the automatic feature recognition of rotational components. The software is developed using 'JAVA' language. The software contains five modules namely i) geometric data extraction module ii) cylindrical feature module iii) curvature feature module iv) cross hole feature module and v) special feature module. Figure 1.1 shows the architecture of the software developed.

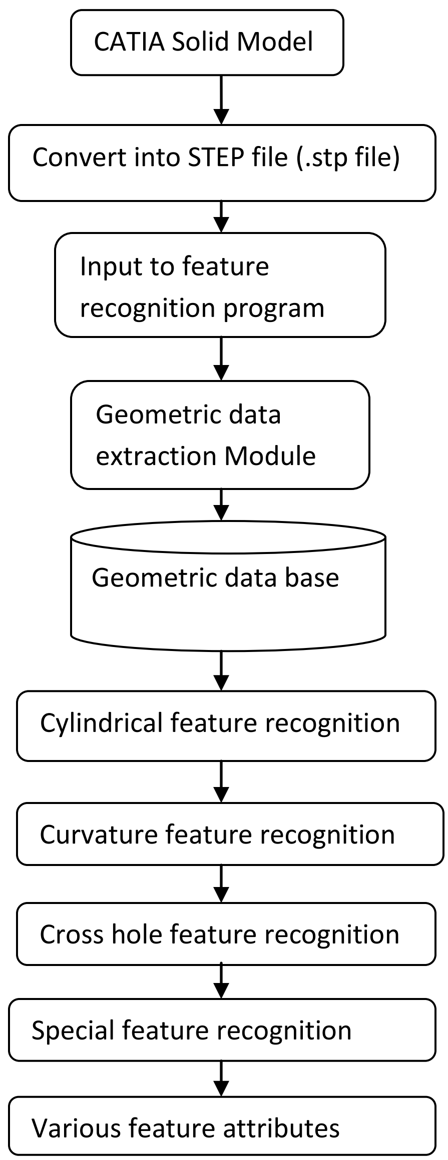

Fig. 1.1: The overall structure of feature recognition system

1.5 ORGANIZATION OF THE THESIS

The present thesis comprises of seven chapters. The introductory chapter starts with a discussion on the general introduction of CAD/CAM, the integration of design and manufacturing. Hardware and software requirements and also the overview of the developed system are presented.

Chapter 2 Presents a literature review of the published articles related to feature recognition. Critical observations are stated based on literature review objective and scope of the work.

Chapter 3 Presents Geometrical data Extraction (GDE) procedure to extract geometrical data from STEP file.

Chapter 4 Presents extraction procedure for cylindrical, curved, cross hole features. **Chapter 5** Presents extraction procedure for special features like slot, keyway, elliptical and knuckle thread features.

Chapter 6 Presents application of developed techniques to test components and results.

Chapter 7 Presents conclusions and future scope of work.

A list of references and appendices are included at the end.