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# 3D Modelling and Drafting of mechanical Component using AutoCAD

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**Abstract:** *Most of the manufacturing industries produce similar components where the designer has to model similar products again and again which is not only time consuming but also introduces operator fatigue and reduction in the productivity of the designer. Different activities of the CAD division can be automated in order to free the operator/designer from the repetitive tasks and perform other important functions such as analysis which cannot be automated. In the present work it has been successfully demonstrated, how the geometric CAD modeling can completely be automated reducing the chances of error and increasing the overall efficiency of the design process.*

**Keywords:** GUI, Application Programming Interface (API), Geometric CAD modelling

## I. INTRODUCTION

For many decades, one of the main disciplines of the system of training the highest technical qualifications (engineers of mechanics, engineers of builders and other specialists) is descriptive geometry. It was created more than two hundred years ago [1, 2] by the French scientist Gaspar Monge, "descriptive geometry was cultivated in the technical school as a science, without which it is inconceivable the formation of an engineer" [1]. As a rule, the "birth" of any product, practically regardless of the field of application, is associated with three stages: design and conceptualization of the idea in the engineer's mind, creation and processing of documentation, production of the product itself on the basis of this documentation. Obviously, these stages are not only closely interrelated, but they do not exhaust all the nuances of preparing and ensuring the production of the finished product. If the product is a construction, in reality a three-dimensional, then the second stage necessarily includes the presentation of information about this design in the form convenient for processing it. Currently, this is a three-dimensional computer model [3, 4, 5], the necessary calculations [6 – 12] and drawing. Drawing, according to Monge, is the language of technology, and the grammar of this language is descriptive geometry [1]. The technology of creating 3D models of three-dimensional objects and the development of design documentation on their basis became available to students and teachers of universities in the early years of the 21st century. Currently, the design process carried out by the vast majority of enterprises is based on the following scheme: the creation of a 3D model of the product, the execution on its basis of calculations (kinematic, dynamic, strength and others), the development of the designed product on their basis and, in a semi-automatic mode, the development drawings and other documentation necessary for the subsequent organization of his (product) production. At first glance, with such an approach, the knowledge of many disciplines studied in higher education institutions is not necessary. The authors may exaggerate, but among such disciplines, mathematics – numbers can be multiplied on a calculator, and, for example, solving an equation in Maple, MatLAB or MathCAD, mechanics – problems in the theory of mechanisms and machines, machine parts, material resistance are easily solved in within the framework of many 3D modeling systems: Autodesk Inventor Professional, Autodesk Simulation, SolidWorks, descriptive geometry – for example, the line of intersection of geometric objects can be constructed without difficulty in any of the three-dimensional modeling systems. However, the essence of higher education, according to the authors, is not the acquisition of a set of skills and the ability to use them mechanically, but the formation of an engineer's special structure of thinking and knowledge base in a whole range of sciences that allowhim to creatively approach the task assigned to him, just copy, but get the best possible solution.

## II. OVERVIEW OF SYSTEM

During the last few decades CAD software are extensively used to increase the productivity of the designer, improve the quality of design and communication through documentation and to create database for manufacturing. This is due to their benefits such as lesser design lead times i.e. lesser time to market, easy modifications, improved quality and productivity, less number of design iterations, etc. A variety of CAD software are available in the market made more and more generalised so as to fit the purpose of wide range of industries. But it is difficult to find CAD software which will meet all the requirements of particular industry. Hence there must be some facility in the CAD software so as to model them to satisfy the specific need of the industry. This can be done by customizing the CAD software according to the application programming interface (API) in which various objects of the CAD software can be used in the program and application which is termed as 'Automation'.

### A. Limitations of CAD geometric modelling

CAD software's have made their place in the industry due to many advantages they have. However, they suffer from following limitations.

- Skilled manpower required
- Time consuming modelling processes
- Higher cost of software as well as higher wages of the operator

Chances of human errors and drafting errors are not eliminated.

### B. Alternative Methods

In the present scenario the above problems are tackled by one of the alternative solutions as stated below [1].

- By storing the master file for each type of component and then modifying it as per requirement
- By using the 'Variable table' provided by the CAD software
- By using the part family option if provided by the CAD software

### C. Limitations of existing methods

All the methods discussed above, suffer few of the drawbacks as discussed below.

- A graphical master file is required to be stored: The biggest limitation of all above mentioned methods is that, all of them require at least one model file to be stored. The graphical nature of these model files requires more of the memory space to store. This problem more prominent when number of variations in the part goes on increasing goes on increasing.

- Shape changes cannot be accommodated: Though above methods are effective in case of dimensional changes, they are not at all useful to accommodate the shape variation in the components. Some of the features can definitely be suppressed or unsuppressed and few shape changes can be achieved but upto a certain extent. These methods are not available for assembly and drafting. By none of the above methods, repetitive drafting can be eliminated.

- Skill required cannot be completely eliminated: All the above-mentioned methods still require good knowledge of the CAD software rather greater knowledge and understanding of the CAD software that

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required for straight forward modelling. None of these methods can reduce the skill requirement. The wages are directly linked with the skill requirement and hence cannot prove useful for considerable reduction in cost.

- Error may creep in due to mistakes in inputting data from catalogues: The changes in the dimensions are to be achieved by changing the values manually wherein thee new values for the required model are generally available from the different catalogues (manufacturing catalogues) available in the design department. Errors may creep is due to

- mistakes in inputting data from catalogues. There is no any foolproof system to avoid any such mistakes and such errors may not be identified and thus the model created may be a faulty model.

- Accidental changes in master files are possible: This is one of the risky limitations of all the three methods. As the master files are in soft form only and are directly available for the user. There are also some changes of accidental changes in the master file. If such changes are saved this may cause major problem, as the data related to master file itself is lost forever. The change may or may not be repairable.
- Being soft in nature may get corrupt or accidentally be deleted: The model files stored are also softcopies only so they may be any time get damaged. The files may accidentally delete. Thus, the master file is required to be created again and reducing the reliability of the method.

**D. Part Libraries and e-drawings**

Every design calls for standard part such as bolts, screws, nuts, or linear actuators. Modelling these components repetitively takes a lot of time. There are various part libraries according to the different standards. Once installed, these part libraries can be viewed with the Library Browser so that parts can be inserted into your drawings [2].

On insertion, each part is converted into a block which can be re-inserted many times. Block, a group of entities can be inserted into the same drawing more than once with different attributes locations, scales and rotation angle. Such an instance of a block is usually called an "insert". Inserts have attributes just like entities and layers. An entity that is part of an insert can have its own attributes or share the attributes of the insert. The power of inserts is that you can modify the block once and all inserts will be updated accordingly. Blocks can contain useful text, dimensions and reference notes [3].

Many software provide most commonly required models on the internet in the form of e-drawings for almost all CAD software. e-drawings are the premier 2D and 3D design communication tool for internal and external design teams which deliver a rich collaborate tool set and enable to speed up the design process. [4].

The electronic data format of e-drawings files is highly compressed to enable easy transmission via email. edrawings files are created through the use of the e-drawings publisher add-in, which works as a plug-in to many popular CAD products. Once created, an e-drawings file may be sent to anyone via email and support file formats such as CATIA V5 (.CATPart), SOLIDWORKS native files and templates (.sldprt, .slddrw, .sldasm, .prtdot, .drwdot and .asmdot), DXF/DWG files (.dxf, .dwg), ProEngineer files (.prt, .prt, .xpr, .asm, .xas), edrawings native files (.edrw, .eprt, .easm, .edrwx, .eprtx, .easmx). Even the above alternatives have drawbacks of size i.e. require high memory due to graphical nature of the files. The size of a typical e-drawings software is in the range of 10 to 12 GB and that of an e-drawing file is around 15 to 20 MB. It takes much time to download the files from the internet which may be comparatively costlier affair. The market price of an e-drawing software is about 1000$ which is very costly [5].

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## III. PROBLEM DEFINITION

As the CAD modelling techniques become more and more advanced, there is a need to complete the product modelling and design changes faster than ever. Updating the assemblies having hundreds of sub-assemblies and parts manually in 3D modelling software is very complicated & time consuming. The CAD models that have large number of parameters and high memory required more graphics and time to process the data. To reduce the development time, minimizing the errors and introduce technologies faster to the market, many companies have been turning more and more to automation process [6]. Automation is a set of technologies that results in operation of systems and machines without significant human intervention by saving the time and also achieving performance superior to manual operation. By using automation it is possible to achieve increase in productivity, quality and robustness along with reduction in time, labour costs and other expenses. The concept of automating the different activities of the design department can better be demonstrated by taking some product [7]. The present study is to automate the different activities of the design department for the basic mechanical components.

## IV. METHODOLOGY

A novel approach of Application Programming Interface (API) is used in the present study to achieve the above stated objective. API serves as an interface between different software programs and facilitates their interaction, similar to the way the user interface facilitates interaction between humans and computers [7]. An API expresses a software component in terms of its operations, inputs, outputs, and underlying types, defining functionalities that are independent of their respective implementations, which allows definitions and implementations to vary without compromising the interface. A good API makes it easier to develop a program by providing all the building blocks, which are then put together by the programmer [8]. An API may be for a web based system, operating system, or database system, and it provides facilities to develop applications for that system using a given programming language. APIs often come in the form of a library that includes specifications for routines, data structures, object classes and variables. The API for CATIA is called Component Application Architecture (CAA) and it is written in C, C++, Java and Visual Basic [9]. Originally the API available for CAD software was developed with computer programming languages such as FORTRAN, ALGOL, AutoLISP for AutoCAD, GRIP for UniGraphics, ProProgramming for Pro-E and advanced languages such as C, C++, Visual Basic 6.0, Visual C++, etc. for UniGraphics, CATIA, SolidEdge, SolidWorks, etc.) In the present work, the API for CAD modelling software (CATIA V5) used is Visual Basic 6.0. It is interlinked within the CATIA tools option through VB Editor or it can be in the form of external software. The 'macro' used for automated modelling is coded in VB Script [10]. To simplify the inputs from the user and to minimize the skill requirement from the operator, a simple VB form is designed which takes input from the user in simple text format like the overall size, capacity etc. The sample form for user input is shown in fig. 1 below.

The system has the intelligence developed inside for calculating the dimensions based on the empirical relations and the design formulae used for commonly required components. Further it also checks the dimensions for the stress levels developed within the components using the various design formulae and the weakest sections within the components so as to ensure the design to be safe. In case the design is found unsafe, it will modify the design in an appropriate way so that it becomes safe. The design calculations are presented to the user for approval. Also this can be saved and printed as the design report. Once the design is approved or modified for some reason, the modelling task is started at the background. One of the most important features of the present study is that it follows the same flow of steps like a human operator. Now each component is modelled separately as a separate part file and they are assembled together as a subassembly. This is the most natural way of modelling the components. If required all the drafting files can also be automatically generated. Few of the sample models generated using the proposed system are as shown in fig. 2.

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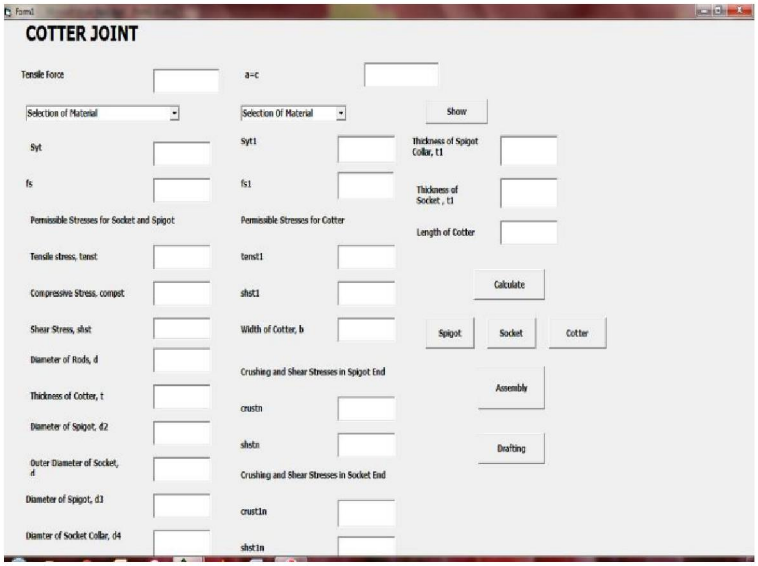


Fig1: User Interface

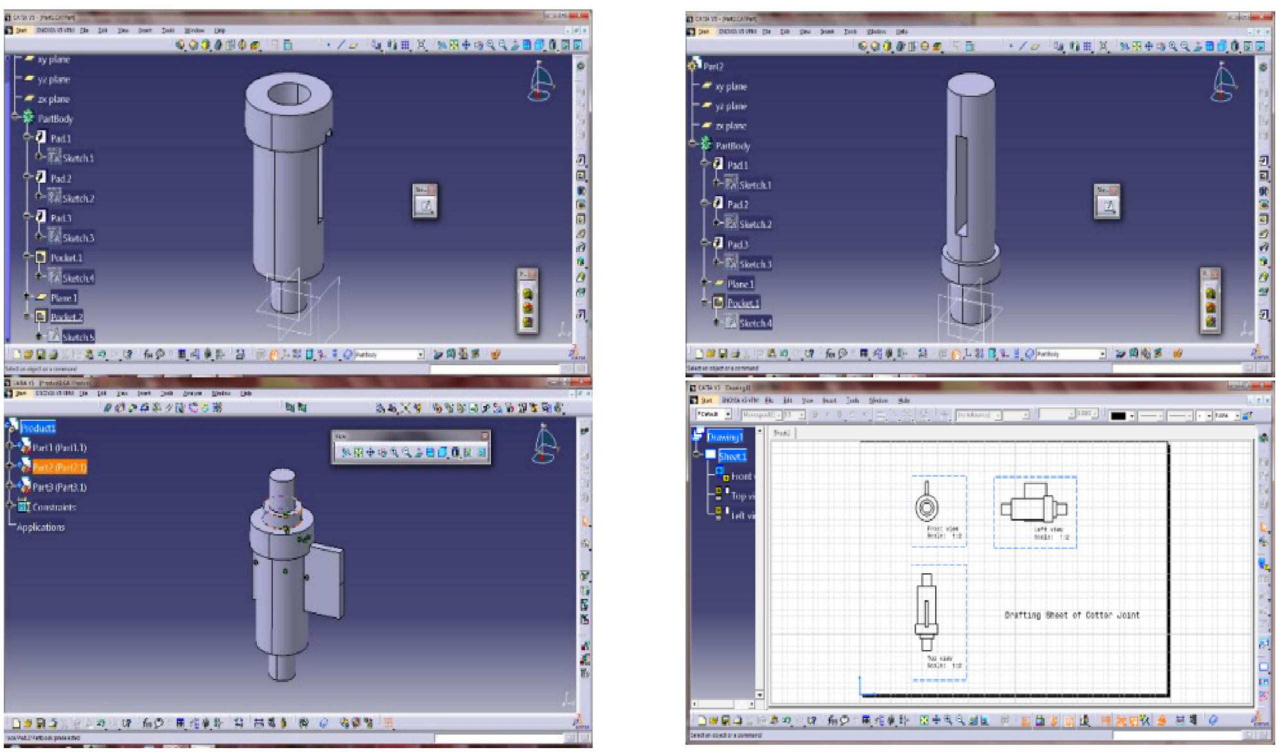


Fig1: Sample Output

**A. Commonly used mechanical components**

It can be easily observed that for any of the mechanical systems more than 60% components are either the standard components such as bearings, screws, nuts, bolts, etc. or commonly required mechanical components such as shafts, keys, couplings, etc. Few of them are listed below:

Table1: List of Components

**Transmission elements**

- Shafts
- Couplings
- Keys, Splines and pins
- Belt, Chain, Cable drives
- Brakes and Clutches
- Gear trains
- Cam and follower systems
- Linkage

**Joints**

- Cotter Joint
  Knuckle joint

**Gears**

- Spur gear
- Helical gear
- Worm gear
- Herringbone gear
- Sprocket

**Bearing**

- Roller bearing
- Plain bearing
- Thrust bearing
- Ball bearing

**Fasteners**

- Screw
- Screw thread
- Power screw
- Nut and bolt
- Split pin
- Cotter pin
- Tapered pin
- Linchpin
- Rivet
- Seals

In the present study following frequently required mechanical components are used for the case study.

(A) Helical spring (B) Cotter joint (C) Nut and bolt

## V. CONCLUSION

The present studypropose a method of using an automated process for modelling commonly required mechanical components and subassembly. Following advantages can be observed with the proposed method.

- Skill required for the CAD modelling is greatly reduced. The user is never required to use a CAD software. The user has only the interface in the form of a VB form.
- Cost of design process is greatly reduced as the skilled operator is not required.
- As the complete modelling process is automatic it takes place in very little time. Ideally it takes about 2-3 minutes for modelling of a small subassembly like knuckle joint with all its components and subassembly.
- The modes are backed with the design calculations so that the final design is ensured that it is safe.
- Graphical memory is not used. Thus saving cost on memory requirement.
- As the model is generated where and when required, the transportation of the files becomes very easy. A very complicated model, which otherwise may require fe MBs of space, can also be saved through a text file with almost few kilo bites.
- Modelling errors are 100% eliminated.
- e-models and e-drawings can very easily be saved and transferred with very few KB files even on mail.
- Overall, it can be said that, in coming future this method may prove to be the best method of modelling commonly required components. .

## REFERENCES

[1] Siddesh S.,B.S.Suresh, Automation of Generating CAD Models, Journal of Mechanical Engineering and Automation 2015
[2]. https://msdn.microsoft.com/en-us/library/aa733592(v=vs.60).aspx/
[3]. http://geomagic-design.nl/3d-cad-software-professioneel/part-libraries/
[4]. http://www.edrawingsviewer.com/ed/products.html

ISSN: 2581-9429 Volume 6, Issue 7, May 2026 Impact Factor: 8.2

[5]. David J. Kasik The Boeing Company, William Buxton Design David R. Ferguson DRF Associates, IEEE Computer Graphics and Applications, March/April 2005.

[6]. Varun Tiwari, Prashant K. Jain, and Puneet Tandon, Member, IAENG, Design Process Automation Proceedings of the World Congress on Engineering 2013 Vol. II, WCE 2013, July 3-5, 2013, London, U.K.

[7]. Mehdi Tarkian, Design Reuse and Automation (On High Level CAD Modelling for Multidisciplinary Design and Optimization), Printed in Sweden by LiU-Tryck Linkoping, 2009

[8]. http://www.qcad.org/doc/qcad/2.2/reference/en/chapter30.html

[9]. Tomas Fors, Development of a Modular API for the CAD-System CATIA V5, Master's Degree Project Stockholm, Sweden 2004

[10]. Rahul Kumbhar, Dattatray Jadhav, Sanjay Pawar and Narendra Dhanrale, "Customization of CATIA V5 for Creating Different Types of Holes on Disc Wheel," International Journal of Engineering Research & Technology, vol. 3, no. 5, pp. 506-509, May-2014.


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