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CONVERSION OF 2D DRAWINGS TO 3D PARTS

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Abstract. The paper deals with investigation of automated design systems, its adaptation to user's requirements and development of subsystem for conversion of 2D drawings to 3D parts. The methodology of solid part development and algorithm of this solution are presented. Using AutoLISP programming language the required programs are created . By employing this methodic for 2D detail drawings conversion to 3D parts it is possible to design any complicated solid part. The methodology is attached to Mechanical Desktop system.

Key Words: AutoCAD, AutoLISP, automated, design, 3D modeling, 3D parametrical model, 3D object creation process.

1. Introduction

Today's economics requires a high quality product, which would be created decreasing the production time and material resources. The rise of the quality, while reducing the product price, the time assigned for the design and manufacturing process, is possible only through the employment of the front edge CAD/CAM/CAE (automated design, manufacturing and engineering) systems [1, 2]

At the present time, in the automated design systems that maintain the entire process of product development "design – manufacturing", the traditional parametrical modeling process is widely applied . This method allows to change the parameters of modeled objects at any stage of design process, to generate the different variations of product, modifying parameters of the model and to choose the best one. Applying the "object oriented" automated design systems it is possible to reduce the costs of experimental prototypes. It is executed by evaluating the quality of virtual models and eliminating inaccuracies before making first samples. This method ensures quality of the new product and fast presentation in the market.

Nowadays, many companies and organizations have big database of 2D drawings with xxx.dwg extension. These drawings are generally prepared using AutoCAD system. The demand appears to transform these drawings into 3D parametrical objects, adjusting "old" detail drawings to the state "object oriented" automated design systems and employing graphical databases for CAD/CAM/CAE systems. This job is labour-intensive and requires special skills. The creation of subsystem for conversion of 2D detail drawings to 3D objects and its integration in to Mechanical Desktop (MD) system makes the execution of this type of jobs faster, rises up the level of the product.

2. Conversion of 2D detail drawings to parametrical objects in Mechanical desktop system

In this paper interactive modeling method allows to create 3D parametrical objects in MD system, using 2D parts detail drawings files with extension xxx.dwg are presented . An appropriate methodic, algorithm for realization of this task, special users fragment menu ant toolbar „From 2D to 3D" were created. Those items contain macros and special commands created by employing AutoLISP programming language [3, 4].

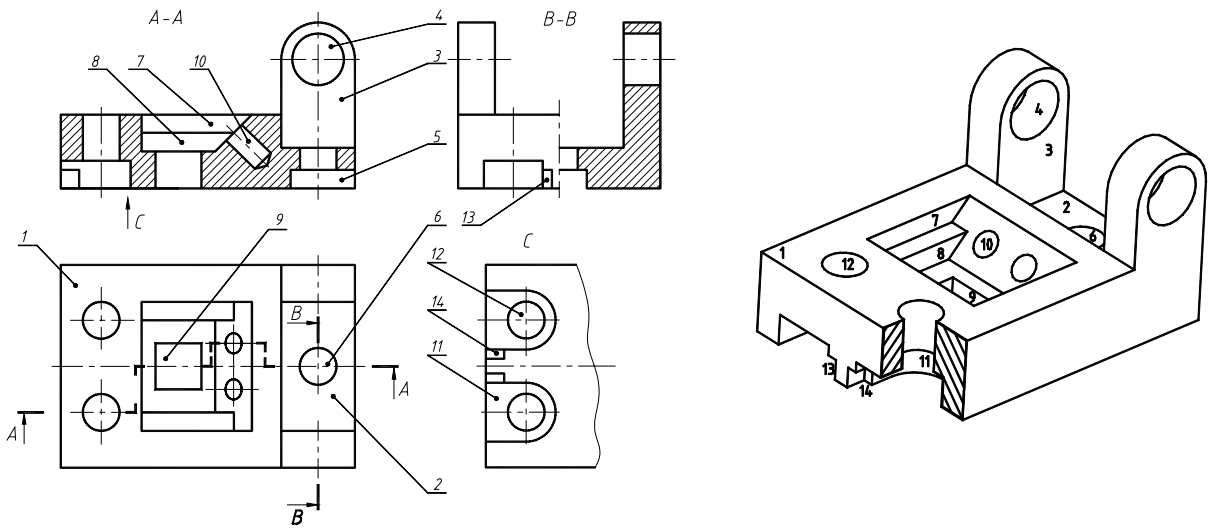


Figure 1: Detail drawing and it parametrical model created by subsystem

Design process for all "object oriented" systems is similar: closed profile must be created; parametrical dimensions are indicated (it can be corrected at any stage of design process if needed); 3D objects can be created from the drawn profile using extrusion, rotation, lofting, sweeping and other operations (created object can be added, subtracted form each other etc.). The final object is the complex of all 3D objects combined with operations attached to it.

The main labour expenditures of 3D parametrical modeling depend on profiles creation and its orientation in the space. Many additional operations (users' coordinate change, new working and sketch planes creation etc.) must be executed for realization of these steps.

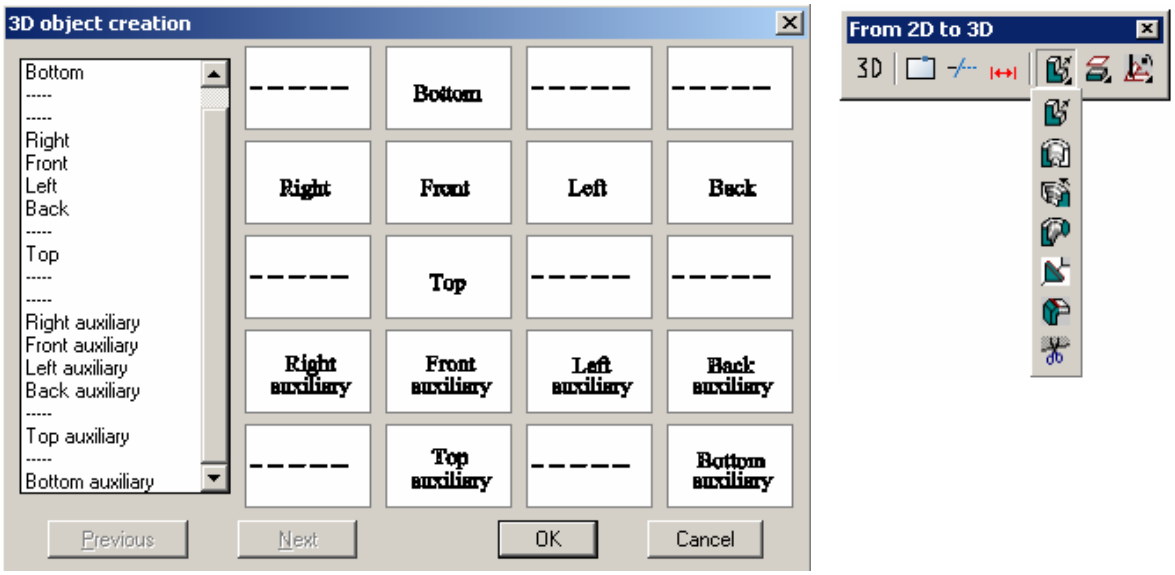
The operating methodics of the created subsystem is based on:

- Information, concerning 2D profile, extraction from within detail drawing;
- profiles orientation in the space with the respect to the elements of new-formed model;
- automated creation of sketch planes and profiles inside of it;
- creation of 3D parts using interactive way.

In 3D modeling process, the required information about profile is obtained from any of the six principle (Front, Top, Bottom, Left, Right, Back) views and auxiliary views respectively to the principle ones, and at the same time estimating the sectional views inside of it (Fig. 1). The information from any views is renewable in the space using the rule of projections relationships. In our program the base deducting view is the top view. The profiles, from which 3D objects are created, are formed using AutoLISP programming language. It could be activated from "3D object creation" dialogue window (Fig. 2). It can be activated from fragment menu „From 2D to 3D" (which is integrated in the main menu of MD system, or from the original toolbar „From 2D to 3D". Inside of the toolbar additional operations break at point, trim, ampardim, attached to sketched features and etc. are present. Over AutoLISP programs creation process, DXF code analysis was made in order to extract the information concerning graphical objects, for the creation of new data lists with the required information.

Detail drawing of the part and its 3D parametrical model are presented in the Fig. 1. The numbers presented on the drawing indicates an appropriate profiles and surfaces created from it. The created parametrical object can be optimized in the next stage.

The auxiliary tools of subsystem are presented in the Fig. 2. The 3D icon presented in the toolbar activates the „3D object creation" dialogue window. All original commands are created using Autodesk corporation methodology.



a) „3D object creation“ dialogue window b) toolbar

Figure 2: Auxiliary tools for subsystem operating

Algorithm of 2D drawings transformation to the 3D parametrical objects is presented in the Fig. 3. The format of additional information depends on the stage of algorithm execution and is related with sectional view estimation, definition of extrusion distances etc. It should be mentioned, that the presented methodic also has the limitations: the 3D parametrical model is built in the same file as the part drawing; the qualified engineering skills are required for the parametrical 3D model creation; the user will premeditate the operations sequence; there are a lot of information which must be executed interactively (for example profile correction when projectional errors are present on detail drawing etc.). These problems are important and will be studded in the future.

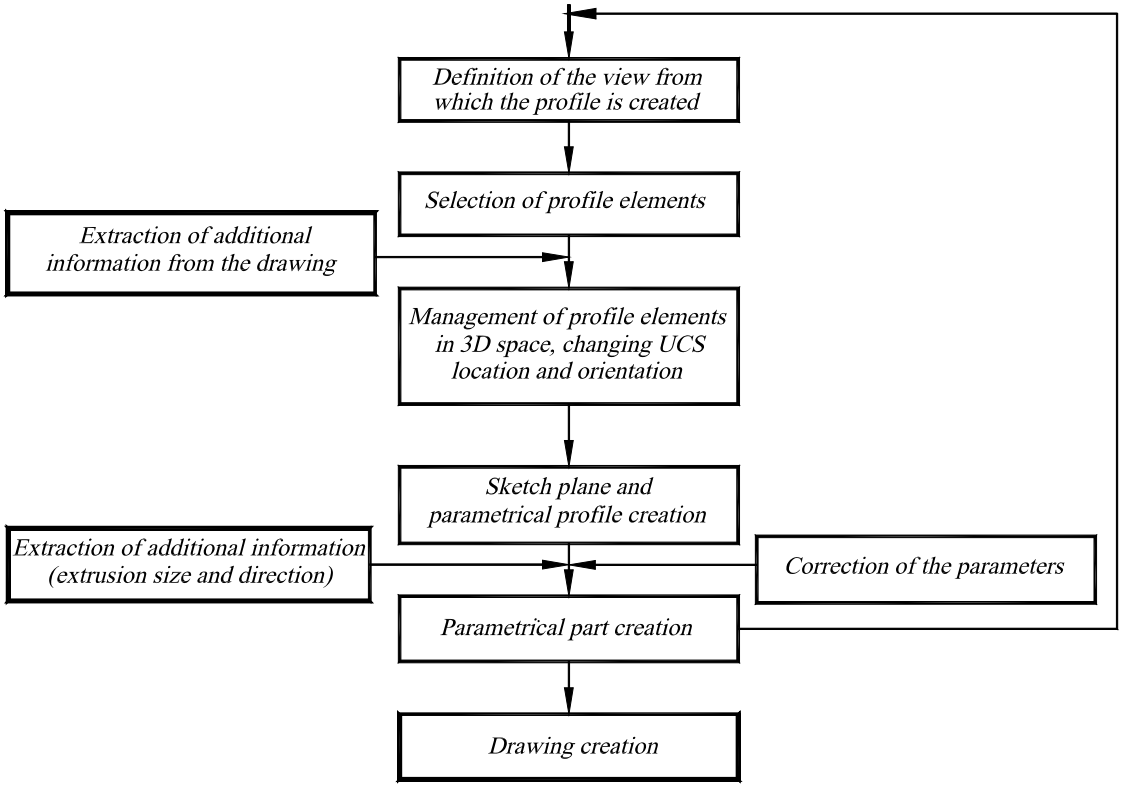


Figure 3: The algorithm of subsystem for conversion 2D detail drawings to 3D objects

3. Conclusions

1. Using the proposed methodic of 2D drawings conversion to the parametrical 3D objects it is possible to model the solid of any configuration. The detail drawing can be composed from complex sectional and auxiliary views.
2. The developed Mechanical Desktop users menu „From 2D to 3D“ and adequate toolbar facilitates the 3D modeling work.
3. After the automatization of 3D modeling process, there was considerably reduced the time, which was required for the adjusting of created database to the CAM/CAE systems.

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KONWERSJA RYSUNKÓW 2D DO WIRTUALNYCH OBIEKTÓW 3D

Praca zawiera badania nad automatycznie projektującymi systemami, ich adaptacją do potrzeb użytkownika i podsystemami tworzenia obiektów trójwymiarowych na podstawie rysunków dwuwymiarowych. W pracy zaprezentowano metodę konstrukcji obiektu dwuwymiarowego i algorytmu rozwiązującego ten problem. Implementacji, na przykładzie programu wspomagającego projektowanie elementów w mechanice, dokonano w języku AutoLISP.

Reviewer: Prof . Bogusław JANUSZEWSKI, DSc

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