

Study on the possibilities of dedicated CAD applications development for the furniture industry

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Abstract

This paper presents the results of a research for finding the best solutions to design and develop the CAD applications for the furniture industry. The solutions considered exclude the use of complementary software such as AutoCAD, Inventor or SolidWorks, the main target being stand-alone, cheap and easy to use solutions. The paper presents concepts of components typing in the furniture industry and the possibilities to construct complex combinations of furniture using these typed components. A dedicated application for designing certain types of bookshelves is also presented. The application is stand-alone and it was written in the object oriented programming language VB.NET. The study has been carried out with partners from the furniture industry, whose opinions and views on this matter were of great help.

1. Introduction

The computer aided design field (CAD) cannot be conceived without the existence of geometric modeling software. Nowadays, there are available very powerful such applications that contain almost all a CAD designer needs for the development of his projects. Examples of this kind of software are AutoCAD, Inventor, SolidWorks, CATIA, etc. These applications offer unlimited possibilities of constructive design and parameterized modeling of basically any type of geometric configuration. Moreover, these software products usually offer technological modules for the computer numerical controlled machines and output for the most common CAM applications. The applicability domain for these products is very wide, ranging from the auto or aeronautic industry to machine building or fast moving consumer goods.

In the fast moving consumer goods industry, the furniture industry occupies a special place. Here, the use of powerful software like the ones mentioned above

is not justified, because the design necessities are much lower than what these products offer, given the relatively simple geometric shape of the furniture. The investment in both the qualification of the personnel to use complex software products that don't match their exact needs and in the software itself (usually priced at several thousands or tens of thousands of dollars) is economically inefficient. The furniture companies are typically small or medium ones, with a limited financial power. They are specialized on a certain kind of furniture, usually typed, that doesn't require too much design effort. Thus, many Romanian furniture manufacturers use particleboard as their main material, producing almost any type of furniture out of it, like desk tables, drawers, bookshelves, kitchen blocks, etc. The number of input parameters for this kind of products is small, usually the exterior dimensions, the number and position of shelves, drawers, doors, etc.

Considering that every piece of furniture is unique, its design, even if pretty simple, requires some time. The classical approach, the manual design, is no longer an alternative, leading sometimes to the paradoxical situation where the design takes longer than the actual fabrication of the furniture, considering the modern fabrication lines. The design tools must keep up with the modern fabrication possibilities, thus, the manufacturers look for accessible CAD solutions, both in terms of cost and ease of use. The present paper details the problem of dedicated CAD applications for a certain segment of products in the furniture industry.

2. Typing in furniture manufacturing

The typing of the parts composing the furniture is every manufacturer's preoccupation. After these components are identified, one can establish their precise technology of execution. Based on this observation, the specialists of the Swedish company IKEA conceived pieces of furniture composed entirely of typed parts. In addition, they innovated furniture

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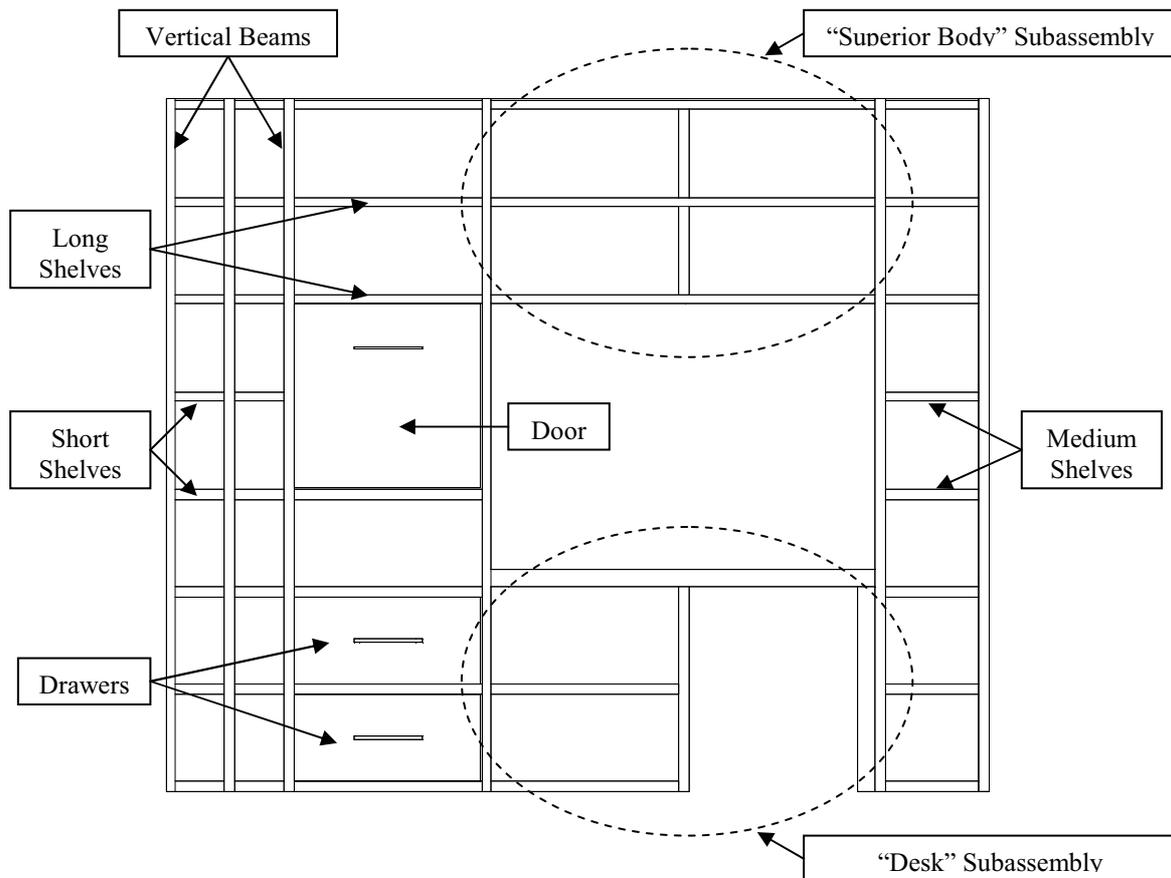


Figure 1. Example of a bookshelf with a desk

delivery by supplying only the disassembled parts and special mechanical joints that the customer can easily assemble based on a mounting scheme. This concept spread very fast, mainly because it's offering a very convenient alternative to the classical troublesome delivery of whole pieces of furniture from the shop to the client.

The advantages of typing in furniture manufacturing are:

- Relatively easy design that can be accomplished by less qualified personnel;
- Easy furniture transportation;
- The possibility to identify optimal component dimensions to be used as a base for complex combinations;
- The possibility to centralize components from different orders and conceive technological lines dedicated to these components;
- Significant labor productivity increase.

Based on these observations and following discussions with different furniture manufacturers we reached several conclusions that will be summarized as

follows. As mentioned before, using a small number of typed components one can achieve complex designs of furniture. In figure 1 a bookshelf built from few typed parts is presented. It contains vertical beams, shelves, drawers, doors and typed subassemblies.

It can be observed that the whole furniture is formed of 8 types of components and subassemblies. Their assemblage is done using very ingenious joint elements that are easy to work with and assure an acceptable rigidity for the whole structure, but this aspect is beyond the scope of this paper.

Using the same 8 primitives we can conceive numerous other configurations of furniture, rearranging the components and using different positions for the vertical beams, shelves or doors. Thus, if a company wishes to type some of the components it uses, the engineers should look for the most commonly used dimensions for them or at least dimensions very close to these. By optimizing the components dimensions, one can afterwards impose an internal standard for their typing.

3. Example of a dedicated CAD application

In the chosen example the design of a bookshelf consists in the arrangement of certain components to form an assembly that satisfies the customer's functional and aesthetic exigencies. These primitive components are typed vertical beams, shelves, drawers,

.NET Framework, these offering very powerful tools and instruments that greatly simplify complex programming tasks.

In principle, the application has several modules, as presented in figure 2.

The central panel – represents the starting interface of the application and offers access to the other

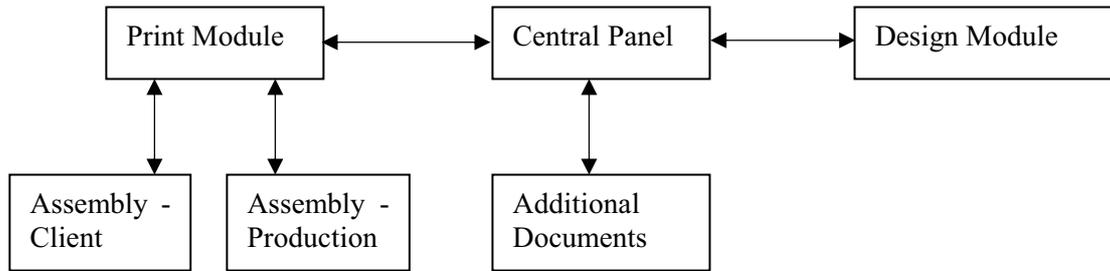


Figure 2. The structure of the application

doors and the subassemblies „Superior Body”, „Desk” and „TV Table”. After the bookshelf design is finished, the designer needs to extract all the components, group them, send an order to the manufacturing department and then ship the finished furniture components to the client. These operations consume a lot of time and are human error prone. It is why the proposed dedicated CAD application must offer support not only for the design phase but also for the subsequent ones. Considering it all together, the application should:

- offer tools to visually create the typed components of a bookshelf (vertical beams, shelves, subassemblies);
- offer tools for the manipulation of these graphical elements – copying, moving, deleting;
- ensure the constituent elements can only be inserted, moved, copied or resized to valid positions and dimensions, to form a consistent furniture assembly;
- be able to generate the mounting scheme of the assembly, together with the functional dimensions and allow the user to print this scheme;
- be able to generate the mounting scheme of the assembly, together with the mounting dimensions and allow the user to print this scheme;
- offer the possibility to generate a table with the component elements of the furniture, including the number of pieces of each type needed, the partial and total price of acquisition for the client.

The application is intended as a stand-alone software, not requiring other support applications, such as AutoCAD or Excel. It developed by the authors using the VB.NET programming language and the

modules.

The design module – represents the main module which is responsible for the actual design of the furniture. It contains commands for inserting and modifying the graphical elements. These elements are predefined and are manipulated using the „drag and drop” technique. Figure 3 presents this user interface.

The printing module – prepares the document for printing and offers the options for printing the assembly scheme in two variants:

- the scheme for the client – containing the dimensions required by the client;
- the scheme for the assembly – containing the dimensions needed for mounting the elements.

The additional documents module – responsible for printing some documents required by the client or by the production workshop, like the table of components with each individual price listed, the necessary of materials and accessories, etc.

In principle, in order to design a bookshelf with this application, one needs to follow these steps:

- receive a basic scheme or a list of specifications from the client;
- fit the dimensions required by the client in the manufacturer's standards;
- design the bookshelf complying with the client's specifications (this step only takes a few minutes, thanks to the powerful and easy to use dedicated design module);
- check and adjust the final aspect of the bookshelf together with the client;
- print all the documents, including the total price of the bookshelf;

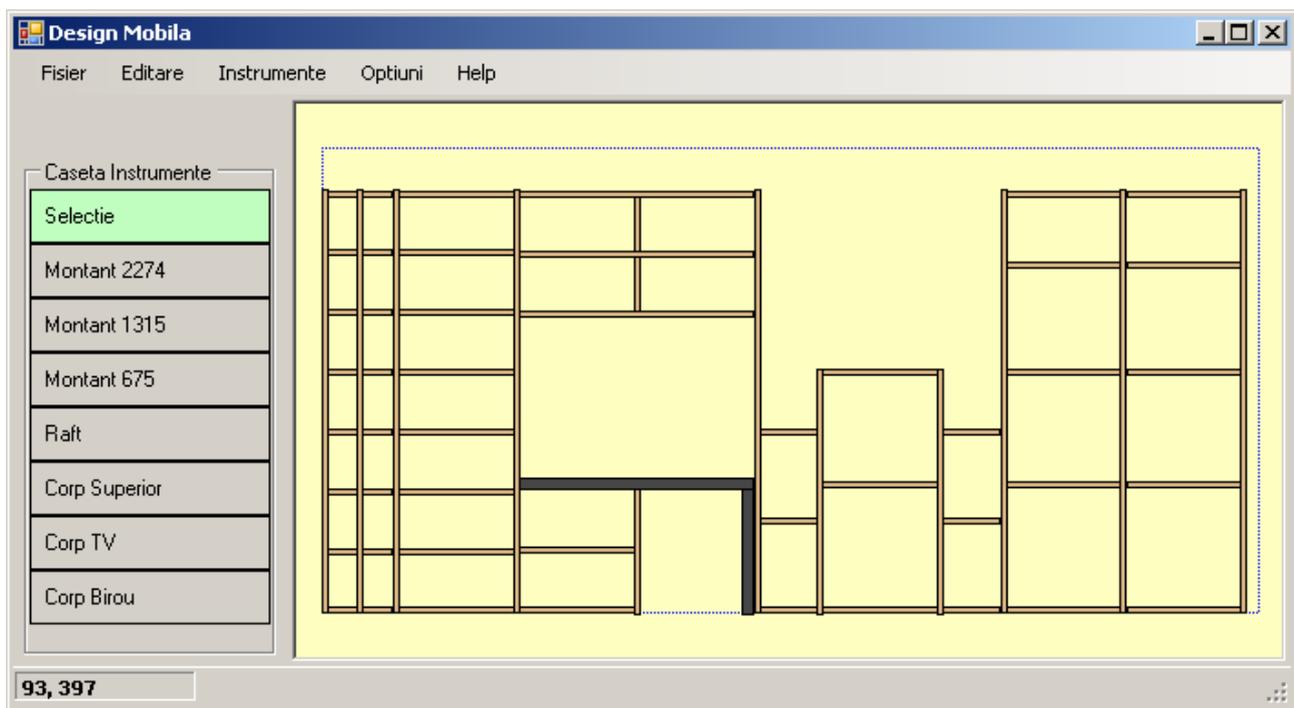


Figure 3. The user interface of the design

- save the design and send the necessary documents to the production line.

4. Conclusions

This paper presented the results of a study on the possibilities of development of dedicated CAD applications for a certain product in the furniture industry. It presented ways to approach such an application, starting from typing of components and building of elements libraries, to the possibilities of furniture assembly out of these predefined primitives and writing of code in VB.NET. One presented the case of a bookshelf with vertical beams, shelves, doors and subassemblies, like drawers, a desk and a superior body above the desk. Practically, using the 8 basic elements, out of which 3 are subassemblies, one can design unlimited bookshelf configurations to fit in the space available for the bookshelf. The time needed to design such a bookshelf with this application is very short, within several tens of minutes, and the process, being automated, is error free.

Using this model, one can conceive applications dedicated to other products, like kitchen or office furniture. Because it's a narrow targeted software, the application does not contain any unneeded functions or any other such ballast, as it's specific to general

purpose software. This makes it very easy to use without any prior training, any person who might want to design their own furniture being able to do so with the dedicated application. In fact, big furniture companies offer their possible customers this kind of software for free, so they can design their own furniture with the manufacturer's standard components. The process usually takes place online. The customer downloads the application, designs their own furniture and if they decide to buy it, they send the order via the internet back to the company.

The VB.NET programming language together with the .NET Framework offer powerful tools to elegantly, quickly and easily develop complex software that satisfy the needs of furniture dedicated CAD applications, both in terms of performance and user interface. The perspectives of this language are unlimited.

5. References

- [1] ***, VB.NET product documentation.
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