Using computer graphics in design

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Abstract. In the modern world, with the development of technology, it becomes possible to create design art objects from the developed sketch to the implementation of the project in material using computer graphics. Thanks to vector graphics programs and the emergence of laser and milling equipment with numerical software (CNC), designers were able to transfer the drawing to the material using material cutting technology. The object of the study is vector graphics programs, laser and milling cutting technology. As a result of the study, the authors conclude that thanks to software products and the development of technologies and equipment, designers were able to simplify the process of making decorative products.

1. Introduction
The ability to transfer the pattern along specified lines and dimensions using laser and milling equipment with CNC and vector graphics programs allowed designers to create unique decorative products, minimizing the subsequent process of processing edges and surfaces of blanks, due to the high quality of the cut.

The purpose of the study is to analyze the technology of making a plywood product by transferring a vector pattern and performing laser and milling cutting using the example of a decorative panel "Cranes".

2. Materials and Methods
Designers use different methods when creating products. With the advent of computer graphics and specialized equipment, the technology of making art objects has been significantly simplified. Thanks to computerization, designers were able to create a product flow using the same drawing. This became possible with the advent of vector graphics of specialized software products. CorelDraw is usually used as programs. Separately, it is worth highlighting the technology of laser and milling cutting of various materials. Materials that designers choose for future products may be glass, plastic, plywood and metal.

3. Steps of making a decorative product from a sketch to an embodiment in a material
Let us consider the technology of making a designer product using laser and milling equipment using the example of a decorative panel "Cranes". In most cases, plywood is the most common among the materials used to make decorative panels. The reasons for its wide distribution are not only the trends in fashion and the popularity of styles such as minimalism, loft and modern, but also in its environmental friendliness, strength, wear resistance, easy workability. Plywood is also easily cut, engraved, glued and decorated.
The production of an art object begins with the idea of the designer. After viewing similar options, obtaining various kinds of information, a sketch is created (Fig. 1). A sketch is an example sketch of an idea. For the best result, you usually make several sketches of a product that differ from each other in style, design, and creative solution. After the best option is chosen, it is finalized; all the smallest details are carefully drawn. Further, since the panel consists of several layers, you must draw each one separately. For these purposes, tracing paper is used. It is applied to the sketch and the outlines of each layer on a separate sheet are drawn, and new parts are added as needed.

![Figure 1. Sketch of a panel](image1)

At the second stage, the layers drawn on the tracing paper should be photographed and transferred to the program. To create a picture in the CorelDraw program, it is convenient to use a tool such as the "Bezier Curve", using it to indicate the main lines that can be edited later [1]. If necessary, you can delete or draw lines again to simplify the sketching process and optimize time. A program can also be used to draw a future product AutoCad.

It is at this stage that the overall dimensions of the product are finally established. Each panel layer is drawn separately (Fig. 2).

![Figure 2. Example of a drawing for laser cutting](image2)

At the third stage, the layers drawn in the program are cut from plywood using a milling cutter. Feathers and other small parts for panels are cut with the help of laser equipment (Fig. 3). The design is assembled. Fasteners are installed on the background layer from the back.

After the article is cut out, the plywood panel must be refined and prepared for subsequent application of paint and varnish.
A sandwich web is used for this purpose. Despite the fact that laser cutting is characterized by accuracy and high cutting quality, it is still necessary to grind the plywood product (Fig. 4). The cut quality after the cutter is much worse, so it is necessary to clean more. It also depends on the material itself, namely on plywood and its variety. After grinding, the layers are assembled into a single structure and glued together (Fig. 5).

Then protective and decorative coating is applied to the article (Fig. 6). This operation is performed in order to protect the product from rotting, insects, atmospheric effects, and in some cases from burning (Fig. 7).
4. Use of laser and milling equipment for cutting plywood

The complexity of the drawing and the overall dimensions of the future product depend on the choice of equipment. If the project includes many small parts, complex intersections, angles and it is small in size, then cutting on a laser machine is used [2].

The laser cutting technique was specially designed to give wood a decorative effect. Laser cutting can produce small parts with complex bends and breaks. With the help of such equipment, it is possible to obtain a high-quality cut. With all the advantages, laser cutting has the disadvantage of limiting the thickness of the material. On average, it is possible to treat material from 0.8 mm to 60 mm using a laser. A feature of this method is that all parts or holes cut by a laser have a black edge. If such edging is not desired in the finished product, the plywood material can be painted [2].

Laser cutting technology consists of directed action of laser beam on plywood, temperature at cutting point increases, after which wood material is removed by evaporation [2].

Milling equipment has less accuracy, but thanks to a cutting tool-milling tool, it is possible on average to process workpieces having a thickness of 1 mm to 14 mm (and more depending on the machine used). The most popular method of processing plywood as a derivative of wood material on an industrial scale is plywood milling. In such machines they are cut not only in a straight line, but also in any given trajectory. Such machines help cut holes, make recesses, slots, and create a volumetric pattern [3].

Milling cutting is carried out using a cutter, which is essentially a cutting tool [4]. Unlike laser cutting, milling does not leave a black edge, but is not able to cut small holes and too sharp angles. Despite this, thanks to the mill you can make a chamfer, get a neat not only rectangular, but also shaped cut [4].

When performing laser cutting and transferring a drawing from Corel Draw to Laser Work, the lines should be indicated in red, since most often it is the cut color. The laser machine can be used and for engraving the material the color for the lines is black then.
5. Results and discussions

As a result of the study on the example of the manufacture of the "Cranes" decorative panel, the authors conclude that computer graphics influenced the creation of design products, making it possible to transfer lines to the material and carry out cutting. Thanks to the developed technologies, the cutting of various materials was simplified, it became possible to cut small parts, obtain a chamfer and a curly cut, cut to a certain thickness and according to given sizes and parameters, and apply engraving. Computer graphics allows you to create various design solutions and edit them. On the basis of one sketch, you can produce an entire batch of products without significant labor.

6. Conclusions

Computer graphics made it possible to create a picture from vectors that can be changed, deleted and created again. This made it possible to simplify the process of creating a drawing and it is possible to cut according to given vectors by obtaining a drawing exactly corresponding to the drawing.

Thanks to laser cutting technology, it is possible to process various materials, ranging from paper to metal, to obtain small size and complex shapes. Milling made it possible to process large parts and create a curly cut. It is mainly used in the furniture industry.

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