

Creating Advertising Models and Signs with a CNC Router

Mariela Todorova¹

1 – Technical University of Varna, Department of Industrial Design, 9010, 1 Studentska Street, Varna, Bulgaria

Corresponding author contact: mariela.todorova@tu-varna.bg

Abstract. This topic explores the use of CNC routers for the development and production of advertising models and signs, focusing on the advantages of this technology in the advertising industry. CNC routers enable precise cutting and the creation of detailed, custom designs from various materials such as wood, plastic, and metal, making them suitable for producing high-quality and durable advertising products. The key stages in the process are discussed – from design preparation and machine setup to the final finishing touches, which include techniques for achieving an aesthetic finish.

Keywords: CNC router, advertising signs, custom design, precision, finishing

1 Introduction to Advertising Models and Signs

Advertising models and signs serve as a vital tool in marketing and branding, as they form the first visual impression clients have of a brand. They not only capture attention but also play a significant role in building brand identity and establishing trust. Well-designed signs and models convey essential messages about a brand's quality, style, and values, while making the company recognizable and memorable. This is particularly important in a competitive environment, where every detail in customer communication matters.

The application of advertising signs and models is diverse and commonly used across different business sectors, such as stores, offices, and events. In stores, they not only communicate the name and offerings but also create an atmosphere that attracts customers. In offices, signs help build corporate identity, serve as directional tools for departments or key areas, and add a professional touch to the space. During events like trade shows and conferences, advertising signs help distinguish a company among many exhibitors. They act as focal points that draw visitors in and introduce the company at first glance. Whether used for orientation, capturing attention, or emphasizing a brand, advertising signs and models are an integral part of successful visual communication.

2 CNC Router Technology

A CNC router is an advanced machine that uses computer control to precisely process various materials, primarily through cutting, engraving, and shaping. The main components of a CNC router include a computer, a control system, motors, a spindle, and a worktable. The computer processes a pre-made design and converts the instructions into commands, which the router follows with high accuracy. Its operation relies on transmitting these commands to the spindle, which moves along designated axes (typically X, Y, and Z) to perform precise movements on the material, shaping it according to the design. The ability for automated control makes CNC routers highly efficient for complex projects that would be difficult to achieve manually with the same level of detail and consistency.

CNC routers are suitable for working with various materials, making them a versatile tool across many industries. One of the most common areas of application is woodworking, where they enable the creation of intricate and detailed shapes, decorative elements, and custom wooden signs. Some routers can also work with composite materials or acrylic, further broadening the potential for creating diverse models. This capability allows designers and manufacturers to be creative and produce advertising products that meet a wide range of requirements and conditions.

Thanks to computer control, the router operates with high precision and can repeatedly produce the same design without deviations, which is particularly valuable for series production of advertising

products. Additionally, the speed of a CNC router greatly reduces production time compared to manual methods, optimizing manufacturing processes and enhancing efficiency. Another key benefit is the ability to personalize designs, as the CNC router can easily create custom designs to match exact client specifications. This makes the machine an ideal choice for producing unique advertising models and signs that stand out in the market and capture consumer attention.

3 Process of Creating Advertising Models and Signs with a CNC Route

The creation process of advertising models and signs with a CNC router begins with careful design preparation. The first step involves creating a digital model using specialized computer-aided design (CAD) software. This stage considers both the functional requirements of the sign or model and the client's aesthetic preferences. Once the design is complete, it is prepared for processing by the CNC router through computer-aided manufacturing (CAM) software, which converts the digital model into a code that the router can understand. This preparation ensures that the model's details are accurately executed and meets expectations, taking into account material specifications that may influence the design and processing technique.

Next is the setup of the CNC router, which involves selecting appropriate parameters such as spindle speed, cutting depth, and tool type. Different materials require different settings for efficient and safe processing. For example, wood needs different parameters compared to plastic or metal. The operator must also set precise starting coordinates to avoid errors and material waste. Small test cuts are often done to confirm the settings are correct. Proper setup is crucial for achieving the desired result and maximum precision.

Once the CNC router is set, production of the signs and models begins. The router follows the pre-defined design, cutting or engraving the material with precision. This allows for the creation of detailed elements, complex shapes, and 3D models, producing attractive and unique advertising products. Depending on the design, the machine may operate at different depths or perform tasks like cutting and engraving. The speed and accuracy of the CNC router are invaluable for mass production, enabling consistent replication of the same design.

The final step involves finishing, giving the product its polished appearance and durability. After the main processing, the item often has sharp edges and residual material that need smoothing. Depending on the material, methods like polishing, painting, or coating may be applied. For outdoor use, a protective layer might be added. Finishing touches can also include adding lighting elements or mounting details, enhancing the product's visual appeal and functionality. This stage ensures that the final product stands out and effectively represents the brand. (see Fig. 1)



Fig. 1. Embossed detailed sign with a fishing theme.

4 Examples and Applications

The creation of this wooden sign involves several stages that require careful planning and precision. The process begins with preparing the digital design, which is created using computer-aided design (CAD) software. The design in this case is a detailed emblem with text and decorative elements, requiring an accurate and well-thought-out model to avoid losing details during engraving. Afterward, the model is converted into code using CAM software, which provides the CNC router with movement and cutting depth instructions based on the design's shapes and depths. For the purposes of this example, the popular logo of Liverpool Football Club has been used. (see Fig. 2)

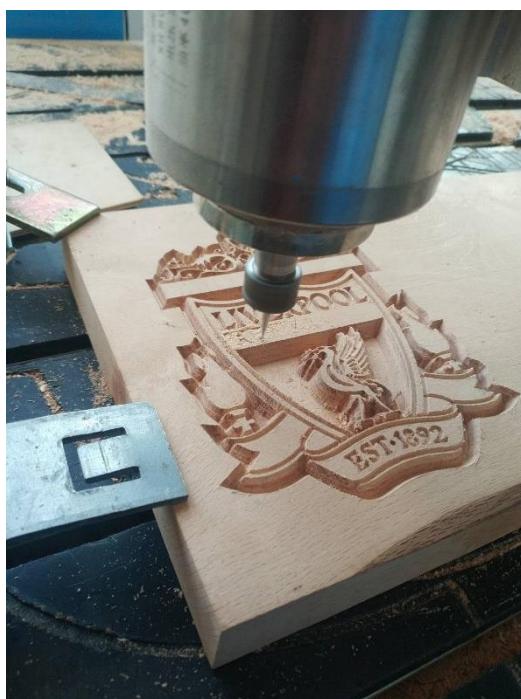


Fig. 2 Logo of Liverpool F.C.

The next step is setting up the CNC router, which involves selecting the correct spindle speed, cutting depth, and tool type. For this wooden sign, choosing the right engraving tool is important since fine details require a small cutter diameter to achieve maximum precision. The cutting speed and force are also adjusted to suit the wood type, preventing cracking or overheating. The CNC router then moves through different layers of the wood following the set coordinates, creating the 3D elements and text in the design.

The actual creation of the sign involves multi-layer engraving, where the router moves along the X, Y, and Z axes to cut material at varying depths. The emblem's design includes detailed volumes and text, achieved through cutting and engraving at different levels. Layered cutting creates contours and depths that give the emblem a realistic and volumetric look. Dust and chips are removed during cutting to maintain engraving accuracy.

The final stage involves finishing the sign, which may include sanding to smooth out any rough areas and provide a pleasant surface finish. Depending on the client's preference, the sign may be varnished or painted to highlight details and increase the wood's durability. A protective layer may also be applied if the sign will be used outdoors to protect it from the elements. The

finishing process gives the product a professional and aesthetic appearance, emphasizing quality and attention to detail. (see Fig.3.)



Fig.3. Example of the difference between finishing processes - before and after

Comparing the two images of the sign, the differences between the stages of production and finishing are clear. In the first image, the sign is at its initial stage after the main cutting by the CNC router. The outlines and volumes of the faces are visible, but there is no finishing, making it appear flat with a rough texture. The faces and details are defined, but the wood surface looks light and unfinished, with visible tool marks.

The second image shows the sign after finishing, possibly involving burning or staining the wood. This technique adds contrast and depth to the image, making the details more pronounced and the faces more recognizable. Burning gives the sign darker, richer tones that accentuate the volumes and distinguish the light and dark areas, creating a sense of realism and three-dimensionality. This method is effective in highlighting the details and gives the sign a completed look.

The difference between the two images is significant, showing how finishing processes can change the overall perception of a product. While the second image shows the sign in a more finished state, the burning is applied more aggressively, resulting in overly dark tones. This might obscure some finer details in the faces and make certain areas less clear. Aggressive burning adds depth and contrast, but in this case, it may have reduced the lightness and realism of the images. While the effect draws attention and gives the sign a dramatic appearance, a more subtle approach could achieve a cleaner, more natural result that better emphasizes the complexity of the original design.

5 Advantages and Disadvantages of CNC Router Manufacturing

CNC router manufacturing offers significant advantages that make it a preferred technology for producing custom advertising signs and models. One of the main benefits is the high precision that CNC routers can achieve. They allow for the processing of complex designs and details that would be difficult

to create manually. Technology uses computer control, which eliminates human errors and ensures repeatability of the process—something crucial in mass production. Additionally, CNC routers can work with a variety of materials, such as wood, plastic, and metal, making them suitable for creating products with different applications. The ability to personalize and create unique designs adds considerable value, allowing businesses to produce items that meet specific customer requirements. Furthermore, the speed and automation of CNC router processes make production faster and more efficient, which is key for achieving higher productivity and profitability.

Despite the numerous advantages, CNC router manufacturing also has its drawbacks that need to be considered. One of the main disadvantages is that technology often requires significant initial investments for equipment purchase and staff training. Additionally, although CNC routers operate with high precision, sometimes the finishing processes can be challenging. For example, excessive burning or insufficient finishing of a sign can result in overly dark areas and lost details, as seen in previous examples. CNC router manufacturing can also limit design creativity when it comes to very fine or organic shapes, which are difficult to reproduce with automated tools. Furthermore, complex designs with many details may require additional settings and time, which can sometimes delay the process and increase production costs.

6 Conclusion

The CNC router is a tool that allows for high-precision manufacturing and the creation of unique designs suitable for various business needs. Technology gives manufacturers the ability to work with a wide range of materials, such as wood, metal, and plastic, and to create products that meet the individual requirements of the client. The processes of setting up the machine and preparing the design are important steps that require attention and expertise to achieve the highest quality and functionality in the finished products. Whether it's for indoor or outdoor advertising signs, CNC routers allow businesses to stand out and offer products that impress with their appearance and precision.

Despite the advantages of CNC technology, it also has its drawbacks that should not be underestimated. Final finishing processes play a crucial role in the quality of the product, and techniques such as coloring and burning should be applied carefully. Overly aggressive methods can lead to the loss of fine details, as seen in the example of burning the wood, which darkens the surface and reduces the clarity of the image. Additionally, using a CNC router requires significant investment and staff training, which can be a challenge for smaller companies. Technology also has limitations in recreating organic shapes and highly detailed elements, which require manual intervention to achieve the final effects. Despite these limitations, CNC routers are a powerful tool for creating high-quality and attractive advertising products, contributing to the successful presentation of a business and its distinction in the market.

References

H. Loc Nguyen, V. Thuy Tran, Design of the CNC Router Structure for Machining Wood Materials Using Reliability-Based Design Optimization Method, In book: Lecture Notes in Mecanical Engineering, Recent Advances in Manufacturing Engineering and ProcesseChapter: Electromechanical System and Engineering DesignPublisher: Springer Nature, February 2023

A. Çakmak, Abdulkadir malkoçoğlu, Sukru Ozsahin Optimization of wood machining parameters using artificial neural network in CNC router, February 2023, Materials Science and Technology

H. Pelit, Mustafa Korkmaz, Mehmet Budakci Surface Roughness of Thermally Treated Wood Cut with Different Parameters in CNC Router Machine, BioResources 16(3):5133-5147, May 2021.

K. Huseyin Koc, E. Seda Erdinler, E. Hazir, E. Öztürk, Effect of CNC Application Parameters on Wooden Surface Quality, Conference: Proceedings of the 58th International Convention of Society of Wood Science and Technology June 7-12, 2015 - Grand Teton National Park, Jackson, Wyoming, USA, June 2015.

K. Bangse, A. Wibolo, I. Kadek Ervan Hiryanta, Design and fabrication of a CNC router machine for wood engraving, Journal of Physics Conference Series 1450(1):012094, February 2020

P. Zlateva, A. Terziev, K. Yordanov, Study of regime parameters of the fermenter in the production of biogas from animal liquid waste materials, (2021) E3S Web of Conferences, 286, <https://doi.org/10.1051/e3sconf/202128602010>.