

## Mini CNC Drawing Machine

D.R.Cholke, Gayatri Gursal, Ashwini Bhalerao, Tanaya Bugde, Gayatri Ichake,  
Bhagyashri Jadhav.

Department of Computer Technology, Sanjivani K.B.P Polytechnic, Kopergaon

<p><b>Keyword:</b></p> <p>Mini CNC Drawing machine DIY CNC, Arduino Stepper motors Microcontroller, G-code Precision Linear motion system, Pen plotter 3D printing pen.</p>	<p><b>ABSTRACT</b></p> <p><i>The mini-CNC drawing machine designed in this project leverages the capabilities of the /PIC microcontroller to create a versatile and compact computer numerical control (CNC) system. This system allows for precise and automated control of a small-scale three-axis milling or engraving machine. By interfacing the PIC with appropriate stepper motor drivers and mechanical components, the CNC machine can be programmed to execute intricate and customized machining operations. The project aims to provide a cost-effective solution for hobbyists, students, and small-scale manufacturers to explore the world of computer-controlled machining, making it accessible and adaptable for various applications. The PIC open-source nature and extensive community support offer an excellent platform for customization and further development, making it an attractive option for those looking to experiment with CNC technology within a limited budget and space. This abstract summarizes the design and implementation of a user-friendly and affordable mini-CNC machine built around an PIC controller, highlighting its potential in diverse creative and small-scale manufacturing endeavors. Miniature CNC drawing machines have gained significant attention in recent years due to their versatility, affordability, and accessibility. These machines, often compact in size and utilizing open-source hardware and software, offer a cost-effective solution for hobbyists, educators, and small-scale manufacturers to create intricate designs with precision. This abstract explores the design, functionality, and applications of mini CNC drawing machines, highlighting their ability to translate digital designs into physical drawings on various surfaces such as paper, wood, and plastics. Additionally, it discusses the underlying technologies, including stepper motors, control boards, and software algorithms, that enable precise movement and coordination of the machine's components. The versatility of mini CNC drawing machines makes them suitable for a wide range of applications, including prototyping, artwork, educational demonstrations, and small-scale production. This abstract aims to provide insights into the growing field of miniature CNC drawing machines and their potential impact on creative expression, education, and rapid prototyping. Mini CNC drawing machines represent a fusion of traditional craftsmanship and modern digital technology, offering a versatile, affordable, and accessible solution for creative expression, education, and small-scale manufacturing.</i></p>
---	--

*Corresponding Author:* Email :mailto:Bhaleraoahwini402@gmail.com

## **INTRODUCTION**

Significant progress has been made in a number of areas, including manufacturing and automation, since the invention of technology. The creation of compact CNC (Computer Numerical Control) devices is one such invention. These small devices are able to create elaborate designs on a number of materials, including metal, plastic, and wood, by accurately controlling the movement of tools with the use of computer-aided design (CAD) and computer-aided manufacturing (CAM) software.

Compared to conventional manual machining procedures, mini CNC drawing machines have a number of benefits, such as improved accuracy, repeatability, and efficiency. They make it easy for people to realize their ideas and are appropriate for both professionals and enthusiasts. The PIC4550 microcontroller is used in this report's design and development of a small CNC drawing machine. Throughout this report, we will delve into the literature surrounding mini CNC drawing machines, exploring research papers from reputable sources to understand the current state-of-the-art technologies and methodologies. Additionally, we will define the scope of our project, identify potential challenges, and outline the software and hardware requirements necessary for its implementation. The report will also include detailed system design and modeling, providing insights into the operational and functional aspects of the mini CNC drawing machine. We hope that this in-depth analysis will offer a clear understanding of small CNC drawing machines and give a foundation for the creation of our PIC4550-based system. Small CNC (Computer Numerical Control) drawing machines have become more and more popular in recent years as a result of technology's democratization, completely changing how people approach small-scale production, prototyping, and artistic expression.

These little and functional gadgets have attracted a lot of interest because of their affordability, accessibility, and simplicity of use. We explore the design, operation, uses, and revolutionary effects of small CNC drawing machines on a range of communities and industries in this introduction to the field. Small CNC drawing machines are an example of how contemporary digital technology and old handicraft may come together. These devices, which are usually small in size, can convert digital plans into physical drawings with amazing accuracy and detail because they are outfitted with precision parts like stepper motors, linear guides, and control boards. Mini CNC drawing machines are intended for hobbyists, educators, artists, and small-scale manufacturers that are looking for an affordable and user-friendly way to bring their creative ideas to life, as opposed to their industrial counterparts.

The adaptability of small CNC drawing machines is one of its distinguishing qualities. They can draw on a variety of surfaces, including paper, wood, plastics, and even fabric, opening up a myriad of possibilities for artistic expression and prototyping. Whether creating intricate sketches, geometric patterns, or custom logos, The accessibility of mini CNC drawing machines is another key factor driving their popularity. Many of these machines are built using

open-source hardware and software, making them customizable and adaptable to individual needs and preferences. Moreover, their relatively low cost compared to traditional CNC drawing machines makes them accessible to a broader audience, including students, maker spaces, and small businesses, who may have limited budgets or space constraints. Educationally, mini CNC drawing machines serve as invaluable tools for teaching concepts related to computer-aided design (CAD), computer-aided manufacturing (CAM), and robotics. By engaging students in hands-on activities, these machines foster creativity, problem-solving skills, and a deeper understanding of STEM (Science, Technology, Engineering, and Mathematics) subjects. Additionally, they provide practical experience in digital fabrication processes,

In the realm of art and design, mini CNC drawing machines offer a new platform for experimentation and exploration. Artists can leverage the precise control and automation capabilities of these machines to push the boundaries of traditional drawing techniques and create intricate, multi-dimensional artworks. From generative algorithms to interactive installations, the integration of CNC technology into artistic practice opens up new avenues for creativity and expression.

Further more, mini CNC drawing machines are increasingly being used in small-scale manufacturing and prototyping applications. Whether producing custom signage, jewelry, or electronic enclosures, these machines offer a cost-effective solution for rapid prototyping and small-batch production. By streamlining the design-to-production process, they enable entrepreneurs and small businesses to iterate quickly and bring their products to market faster.

## **RESEARCH METHOD**

When embarking on research for a mini CNC drawing machine, start by defining your specific requirements, including size, precision, speed, and material compatibility. Utilize online platforms such as Amazon, eBay, and specialized stores to compare various models based on product descriptions, reviews, and specifications. Visit manufacturer websites for detailed insights into their offerings and customer support options. Engage with online forums and communities to gather recommendations and advice from experienced users. Supplement your research with YouTube videos and tutorials for visual demonstrations and assembly guides. Attend trade shows and events related to CNC machining to see machines in person and interact with representatives. Additionally, explore academic and industry publications for insights into the latest developments and emerging trends. Consider your budget and factor in additional expenses such as shipping and accessories to make an informed decision.



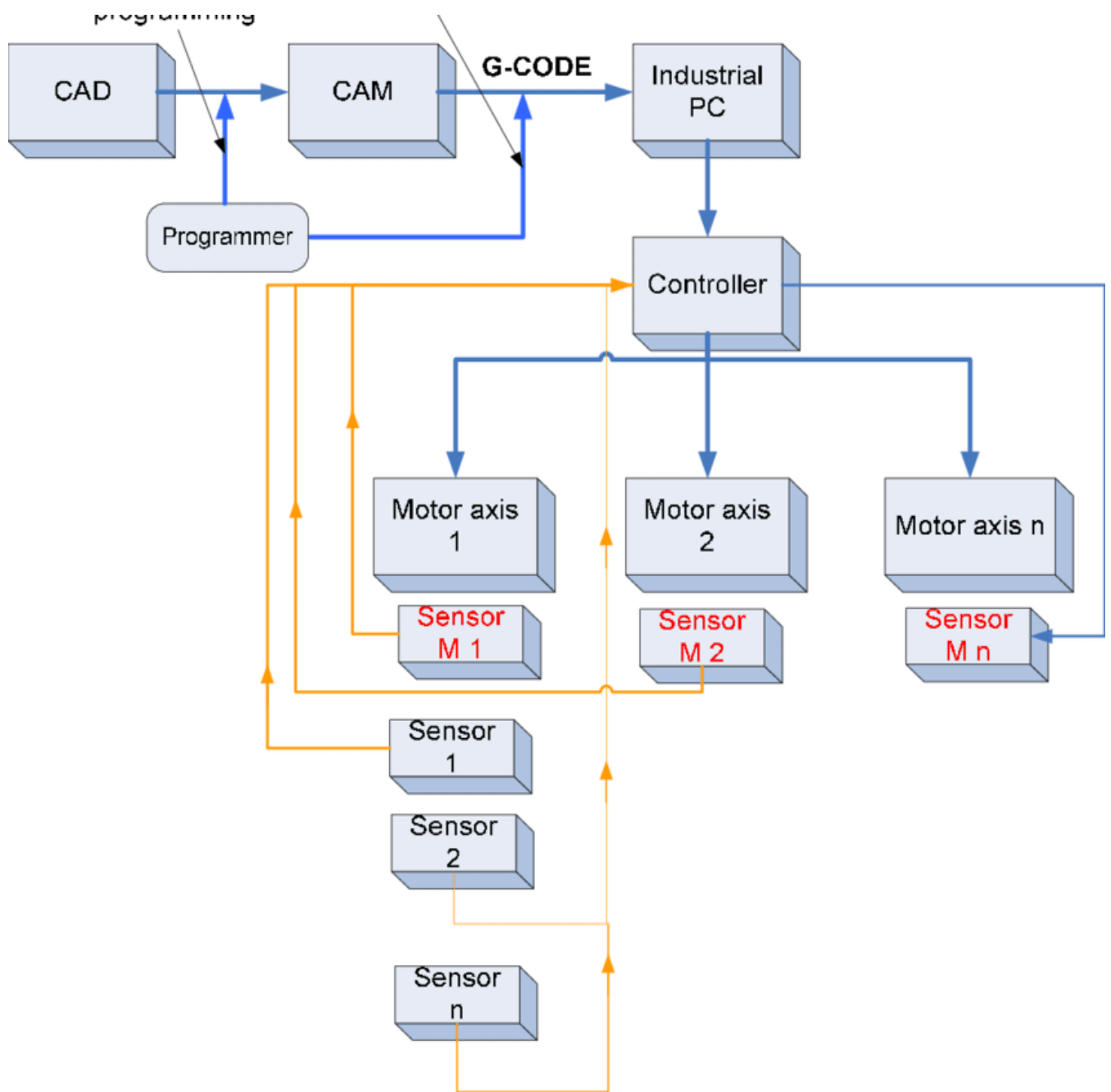


Fig No:1 Block Diagram

## RESULT AND ANALYSIS

Performance metrics provide quantitative information about the tiny CNC drawing machine's capabilities and limitations. These metrics could include: Accuracy is the percentage variation between target dimensions and actual machined dimensions, derived using measurement data gathered during experimental testing. Repeatability: Differences in machining results resulting

from repeated trials under same conditions, given as a standard deviation or coefficient of variation. Surface roughness: Average roughness (Ra) or maximum height of roughness (Rz) measurements obtained from machined surfaces, reflecting the degree of surface finish attained by the CNC machine. Productivity: Machining throughput measured in terms of material removal rate (MRR) or number of parts produced per unit time, indicating the CNC machine's efficiency for specific applications and materials. Speed describes how rapidly a machine can finish a task, such as sketching a design or engraving a surface. It comprises both rapid traverse speeds (how quickly the machine moves between different spots) and cutting or drawing speeds (how fast the machine moves during the actual process). Faster speeds often result in increased output, but they must be matched with precision to ensure quality. Resolution: Resolution refers to the level of detail that the machine can produce in its drawings or engravings. It depends on the precision of the stepper motors, the resolution of the control software, and the size of the drawing tool or cutting bit. Higher resolution enables finer details and smoother curves in the end. It depends on the precision of the stepper motors, the resolution of the control software, and the size of the drawing tool or cutting bit. Higher resolution enables finer details and smoother curves in the final product. Easy to Use: Ease of use measures how simple and straightforward the machine is to operate, program, and maintain. It considers things like the clarity of the user interface, the availability of educational resources, and the accessibility of controls. A user-friendly machine simplifies the operation and shortens the learning curve for operators, resulting in enhanced efficiency and productivity.

### 8.5 Discussion

The discussion part interprets the experimental testing and performance analysis of the tiny CNC drawing machine. Key Points. Key points of discussion could include: Comparison to design specifications: Determine whether the tiny CNC drawing machine fits the performance standards and requirements established during the design and development phase. Identifying the strengths and weaknesses: Analysis of the machine's performance in respect to its intended applications, emphasizing areas of strength and possibility for improvement. factors influencing performance.

## **DISCUSSION**

The discussion section interprets the results obtained from the experimental testing and performance analysis of the mini CNC drawing machine. Key points of discussion may include: Comparison with design specifications: Assessment of whether the mini CNC drawing machine meets the performance criteria and requirements outlined during the design and development phase. Identification of strengths and weaknesses: Analysis of the machine's performance in relation to its intended applications, highlighting areas of excellence and potential areas for improvement. Factors influencing performance: Discussion of external factors such as tooling selection, material properties, and environmental conditions that may impact the CNC machine's performance and results. Implications for future development: Recommendations for further research, design modifications, or software enhancements to enhance the performance, functionality, and usability of the mini CNC drawing machine for

practical applications in manufacturing, prototyping, and A mini CNC drawing machine is a compact, automated tool designed for creating drawings, engravings, or intricate patterns on various surfaces. Here's a discussion covering its components, applications. A mini CNC drawing machine represents a compact yet versatile tool tailored for intricate drawing, engraving, and prototyping tasks. Comprising essential components like stepper motors, a sturdy frame, and precise guide rails, these machines offer a scaled-down version of industrialgrade CNC capabilities. Their compact size makes them suitable for small spaces and DIY enthusiasts seeking to explore CNC technology without the space or budget for larger equipment. Despite their diminutive stature, mini CNC drawing machines deliver impressive versatility, capable of working on various materials such as wood, plastic, and soft metals. This versatility extends to applications ranging from art and design projects to educational endeavors and customized creations.

## **CONCLUSION**

In conclusion, a mini-CNC drawing machine controlled by an Arduino Uno is a highly versatile and accessible technology with a wide range of applications. It serves as a valuable educational tool, enabling students and hobbyists to gain hands-on experience in CNC technology, electronics, and programming. This fosters STEM education and empowers individuals to develop practical skills for the future. Beyond education, the mini-CNC machine is a powerful tool for creative expression. Artists and designers can use it to craft intricate and customized artwork, engravings, and sculptures on various materials, pushing the boundaries of artistic possibilities. Furthermore, small businesses and entrepreneurs can benefit from this technology for small scale manufacturing and rapid prototyping. It provides a cost-effective means of producing custom components and products, allowing them to explore niche markets and innovate in their respective industries. The open-source nature of the Arduino Uno and CNC control software encourages collaboration, knowledge sharing, and ongoing development within a thriving community of users. Its affordability and adaptability make it accessible to a wide range of individuals, democratizing CNC technology and fostering a culture of innovation. As technology continues to evolve, the scope of mini-CNC drawing machines controlled by Arduino Uno's is expected to expand, opening up new opportunities for creativity, learning, and small scale production. Overall, this system represents a valuable addition to the world of computer controlled machining and electronics, offering accessible and versatile capabilities for a diverse array of users. Mini CNC drawing machines represent a paradigm shift in how we approach creative expression, education, and small-scale manufacturing. Through their compact design, precision components, and open-source nature, these machines have democratized access to digital fabrication tools, empowering individuals from diverse backgrounds to explore, experiment, and innovate in new and exciting ways. In this conclusion, we reflect on the transformative impact of mini CNC drawing machines and the future possibilities they hold for shaping the creative landscape. The democratization of technology is perhaps one of the most profound implications of mini CNC drawing machines. By making digital fabrication tools more accessible and affordable, these machines have leveled the playing field, allowing hobbyists, educators, artists, and small businesses to engage

with advanced manufacturing processes that were once reserved for industry professionals. This democratization has unlocked a wealth of creativity and innovation, as individuals from various disciplines and skill levels collaborate, share ideas, and push the boundaries of what is possible. One of the key benefits of mini CNC drawing machines is their versatility. From drawing intricate sketches to engraving patterns on various surfaces, these machines offer a wide range of applications across different industries and domains. Artists and designers use them to create captivating artworks and sculptures with precision and detail, while educators integrate them into their curriculum to teach concepts related to STEM (Science, Technology, Engineering, and Mathematics) subjects and digital fabrication. In small-scale manufacturing, these machines enable entrepreneurs and makers to prototype, customize, and produce a diverse array of products with ease. Moreover, mini CNC drawing machines serve as catalysts for innovation and experimentation. Their open-source nature encourages users to modify, customize, and improve upon existing designs, fostering a culture of collaboration and knowledge sharing within the maker community. Through forums, online communities, and collaborative projects, users exchange ideas, troubleshoot issues, and collectively push the boundaries of what is possible with these machines. This spirit of innovation not only drives technical advancements but also fuels creativity and exploration in art, design, and engineering.

## **REFERENCES**

[1]Kajal J. Madekar<sup>1</sup>, Kranti R.Nanaware, Pooja R. Phadtare, Vikash S. Mane, “Automatic mini CNC machine for PCB drawing and drilling”, International Research Journal of Engineering and Technology, Volume:03, Issue:02, 2016.

[2]Pratik Kamble, Dr. Suchitra Khoje, Prof. Jyoti Lele, “Implementation of Paper PCB using Conductive Ink 2D Plotter”, Fourth International Conference on Computing Communication Control and Automation (ICCUBEA), 2018

1. Instructables: Instructables is a great platform where makers share step-by-step guides for various projects. You can find several tutorials and guides on building mini CNC drawing machines.

2. Hackaday.io: Hackaday.io is another community-driven platform where DIY enthusiasts share their projects. You can search for mini CNC drawing machine projects and find detailed build logs and discussions.



3. YouTube tutorials: Many creators on YouTube share tutorials on building CNC drawing machines. Search for keywords like "mini CNC drawing machine DIY" or "homemade CNC plotter" to find relevant videos.
4. GitHub repositories: Some developers share the code and design files for their CNC drawing machines on GitHub. You can explore repositories related to CNC, plotter, or drawing machines.

