Double Edge Trenching Machine To Suit Reusable Wood Composite Material Tiles With Windows Embedded Controller- A Review.

[1]Prof. Dr. B. N. Mohapatra [2]Yash Lokhande, [3]Rajwardhan Patil.

[1]Assistant Professor, [1.]Student, [3]Student.

[1]Department of Instrumentation Engineering,

[1]All India Shri Shivaji Memorial Society Institute of Information Technology, Pune, Maharashtra, India.

Abstract:

The industrial sector has seen significant change in recent years, moving towards efficient and cutting-edge technologies that have decreased waste production, improved product quality overall, and sped up the time it takes to make goods. Within these industrial areas, where technology has advanced to such an extent that project completion times are a fraction of what they were just a few years ago, is the wood cutting industry. It is not possible to say that this is true for devices that are between two and three decades old. These devices employ antiquated technology and procedures, which results in much reduced accuracy, imprecision, and energy consumption, needless energy, and it is quite difficult to get replacement components for the antiquated systems in the event of a malfunction. The owner of the machine is compelled by these issues to discard these outdated devices. It brings up another issue with getting rid of these computers. Modernising these devices can readily solve the solutions to these issues. The latest systems available on the market offer significantly more processing power and greater connectivity with contemporary devices, enhancing machine precision and facilitating improved operator communication to save energy and time usage. The aspects of the machines will be significantly enhanced by updating them with the aforementioned contemporary technology.

Keywords:

Wood working, CNC, Multi-headed, high speed spindle, up-gradation, energy conservation.

Introduction:

Aesthetic appeal and eco-friendliness, Reusable Wood tiles, often referred to as bio-based composite tiles, are becoming more and more popular in the building and design sectors. These tiles, which have several benefits over conventional wood or ceramic tiles, are made of wood fibres bonded together with a calcium sulphate (Reusable Wood) binder.

- Sustainability: Reusable Wood tiles reduce their negative effects on the environment by using recycled wood fibres.
- Durability: They can withstand wear and tear, fire, and dampness.
- Versatility: To meet a range of design requirements, they are available in a variety of colours, textures, and sizes.

But handling Reusable Wood wood tiles' distinct material qualities provide difficulties. Using traditional edge cutting techniques frequently causes the tile edges to chip or get damaged. A specific double edge trenching machine is needed to solve this problem.

A CNC router tool used to make wood things is called a wood router. Computer numerical control is known as CNC. For 3D motion control, the CNC uses the Cartesian coordinate system (X, Y, Z). Earlier models included induction motors and dc servo motors. spindle motors that use a lot of power and have lower power factors, together with the best accuracy and auctionability.

Fig. Double edge trenching machine with windows embedded controller.

These days, complicated work that must be completed quickly and accurately requires 3D machining. New AC servos, fast spindles, and contemporary Windows OS-based control systems will fully meet these needs. Newer technology and more accurate motor controls also result in lower power usage. An outdated equipment may be brought back to life with the use of modern control system software and mechanical design, providing better, faster, more accurate performance. Rebuilding historic woodworking machines to produce 3D patterns and other vintage-like applications is possible with the use of modern motion control systems, low frequency, and ultra-low backlash mechatronics equipment.

Literature survey:

Author: Suhua Xiao
Publication: IEEE
The author explains, An open-architecture Windows CE-based Computerized Numerical Control (CNC) system described how it uses a master-slave architecture and is a multi-task embedded real-time operating system. Master is related to Windows CE, which manages low-level real-time duties such as the editor for NC code, the simulator function block, the translator, the detection and correction of faults, and the monitoring and control of input and output, among other things. Even so, the slave is connected to a motion control card that charges complex real-time duties including electromotor control and interpolation using a Field Programmable Gate Array (FPGA) and Digital Signal Processor (DSP). [1]

Author: Erol
Publication: IEEE
A user-friendly, customizable, segmented monitoring and control system for CNC machine tool controllers and machining process monitoring is described by the author. Software modules on one or more Digital signal processing boards and the host Windows NT machines can be connected via an unambiguous communication protocol. Using a scripting language, the communication can be set up in real time. Using straightforward script language commands, ORTS can be adjusted to manage machine tools, robots, or other processes. It allows for the modular integration of various or new functions that are built in C.[6]

Author: SUK-HWAN SUH

Publication: Elsevier Science Ltd

The writer states To cope with a competitive market needing ever growing flexibility, complexity, and accuracy, advancement of production technology is a fundamental concern for the modern machine shop. Because NC machining is so important, the capabilities of the NC machine and the component programming technique have a big impact on the machine shop's productivity. Modern markets provide complex solutions due to the quick development of CAD/CAM and NC technologies. Nevertheless, since new systems are costly and soon become outdated, buying the newest technology equipment may not always be the best option for the majority of sectors, particularly small and medium-sized businesses. If the older ones are still available, ways to use them must be discovered. [2]

Author: Juan David Contreras Pérez

Publication: International Journal of research and analysis

Author says, Small and medium-sized businesses (SMEs) are a major driver of economic growth and job creation, according to the author. It is anticipated that these SMEs would be able to secure their competitiveness in a future market by looking towards new production paradigms like Industry 4.0. However, these businesses see Industry 4.0 more as a challenge than as an opportunity or a means of creating new value-added prospects. In order to define a step-by-step process for manufacturing resources to migrate to Industry 4.0 through digital retrofitting, this article reviews the literature on Industry 4.0 official reports and standards. It does this by defining hardware and software requirements, systems structure, and necessary technology mapping for the Industry 4.0 implementation over. [3]

Author: T. V. Gupta.

Publication: ijmerr

According to the author, because new equipment is so expensive and there isn't enough foreign exchange available to buy machinery, refurbishing outdated equipment is important in developing nations like India. A machine's reliability rapidly declines as its life lifetime is exceeded, making spare component planning challenging. The parts could break down at any time because of their short residual life. Repairs, whether whole or partial, tend to reinforce specific regions, while parts that are not continuously reconditioned run the risk of breaking down.

 [4]

Author: Christopher Kuhnhen.

Publication: sciencedirect.com

According to the author, traditional retrofitting serves as the foundation for smart retrofitting, therefore understanding traditional upgrading is essential before going on to smart machine tool upgrading. For instance, as part of typical retrofitting, the machine must first have smart sensors added before installing an external embedded system or CPS.Before starting the smart retrofitting procedure, it is also crucial to identify which machine tool generations are being utilized in the factories in order to upgrade them conventionally to the necessary level. There are now different generations of machine tools in use in factories as a result of the industrial revolutions' quick modification of machine tools as well.[5]

Author: Chen, B..

Publication: ncbi.nlm.nih.gov

The COVID-19 pandemic's recent effects on the global economy have increased the pressure on businesses to make manufacturing facilities adapt to erratic fluctuations and maintain industrial output. The need for specialized shop floor assistance and asset monitoring solutions has grown in importance as a digital priority in the industry, driving advancements in human-machine technologies and digital workforce skills evaluation. Small and Medium-sized Enterprises (SMEs) in traditional manufacturing face the difficulty of handling Industry 4.0 and digital technology.[7]

Author: Özçelik, Ö.`

CNC machines are essential to the industrial sector, but they have a lot of complicated problems that take time to solve. Axial movements, material properties, toolpath techniques, machine cutting parameters, cutting tool characteristics and selection, and so on are some of these issues. An advancement in one of these fields, which have been researched and developed for many years, has a simultaneous impact on the other fields. Toolpath techniques have been evolving for years, keeping pace with advancements in other domains.[8]

Proposed Methodology:

In this section we are going to discuss the proposed work analogy:

- Assessment and Planning.
  Condition Assessment: Assess the old CNC router machine's present condition and determine which parts need to be upgraded or replaced.

  Analysis of Requirements: Establish the precise specifications, such as those related to power consumption, speed, accuracy, and capacity for 3D machining, for the updated equipment.

  Project Planning: Create a thorough project plan that includes all of the required processes, deadlines, materials, and financial information.
- Component Selection.
  Control System: Pick a Windows-based CNC controller that works well for you, like the Syntec CNC controller WA60.

  Motors and Drives: Select high-speed spindles with the right specifications and absolute AC servo motors with excellent resolution.

  Mechanical Components: To increase movement precision, use LM guideways and ball screws with excellent accuracy.

  Power Supply: Use high-frequency variable frequency drives (VFDs) and a three-phase isolation step-down transformer to ensure a steady power supply.

- Design and Customization.
  Control System Integration: Design a customized GUI-based application for easy control access and programmability.

  Mechanical Redesign: Plan the mechanical modifications required to fit the new components, ensuring compatibility and optimal performance.

  Electrical Wiring: Design the electrical system to accommodate new components, focusing on reducing field wiring through serial remote IO systems.

- Procurement.
  Acquisition of Components: Buy the chosen parts, such as the VFDs, spindles, ball screws, servo motors, CNC controller, and other required items.

  Software Tools: Get the necessary software tools, such as a machine-to-machine (M2M) router for remote communication and CAM software for G-Code conversion.

- Implementation.
Disassembly: Remove obsolete parts from the old machine with care, making that the mechanical framework is preserved.

   Mechanical Installation: Assemble the new mechanical parts, such as ball screws and LM guideways, to guarantee exact alignment and seamless motion.

   Installation of the Motor and Spindle: Install the new AC servo motors and high-speed spindles, then adjust their calibration for best results.

   Control System Installation: Assemble the motors, spindles, and other parts by attaching the Syntec CNC controller WA60 to them.

- System Integration.
Software Integration: Set up the CNC control program and Windows CE-based operating system, then design the graphical user interface (GUI) for easy navigation.

   Electrical Integration: Connect every electrical part, making sure that power distribution and wiring are done correctly.

   Establish remote connectivity by configuring the M2M router to allow for remote diagnostics and control.

- Testing and Calibration.
First Testing: Make sure all the parts are working properly and integrating together without any issues by running some preliminary tests.

   To attain the required precision and accuracy, calibrate the servo motors, spindles, and mechanical parts.

   Fine-tuning: To maximize performance, modify the control settings, such as feed rates, spindle speeds, and tool offsets.

- Validation and Documentation
Performance Validation: Run a number of tests to confirm that the machine satisfies the necessary requirements for accuracy, speed, and power usage.

   Documentation: Keep a record of every step of the update process, including wiring schematics, software settings, component specs, and design modifications.

- Training and Hardware
Operator Education: Provide the machine operators with instruction on the new system, emphasizing the maintenance protocols, remote connectivity features, and personalized GUI.

   Handover: formally turn over the upgraded device to the end users while offering all required assistance and documentation.

- Monitoring and maintenance
Post-Upgrade Monitoring: Keep an eye on the machine's functionality for a predetermined amount of time and take care of any problems that crop up.

   Maintenance Plan: To guarantee that the machine keeps performing at its best, set up a regular maintenance plan.

By following this methodology, the project aims to effectively upgrade the old CNC router machine, enhancing its capabilities, efficiency, and precision while extending its operational lifespan and promoting sustainable practices.

Conclusion:

It is being developed to construct a double-edge trenching machine specifically for reusable wood tiles, using the Syntech controller and Windows embedded system. The study discussed the benefits and drawbacks of the approach, as well as its potential applications and implications for the production of reusable wood tiles. Numerous manufacturing processes have significantly improved as a result of the industrial sector's evolution toward more technologically sophisticated and efficient technologies. The design and execution of a double-edge trenching machine specifically made for reusable wood composite material tiles with embedded windows have been examined in this review study, along with its complexities and developments. This study addresses several important topics, such as the necessity of upgrading, the constraints of conventional machinery, power consumption issues, and the significant benefits attained.

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