3 AXIS CNC MACHINE USING MICRO CONTROLLER

This project proposal is submitted to the department of Computer Science postgraduate Jahanzeb College swat on November 16th 2022 as partial fulfillment of BS Computer Science degree.

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Abstract:

As the technology is growing immensely in recent years, certain improvisation needs to be made. People are tired of using manual work. In this project we will design a CNC Machine which manipulate user design according to the given instructions. CNC Machine will be based on Arduino Microcontroller and this Microcontroller will be programmed to work just like human brain. The Arduino Microcontroller will process user design and will engrave it on the material user provided.

Introduction:

There are many types of CNC Machine [1] used in industries, which are heavy and expensive. The CNC Machine automatically cut the provided materials according to the instruction and design provided by the user. The CNC Machine can be used for multiple purposes like wood cutting, glass cutting, marble cutting and iron cutting. And also used for drawing, laser cutting and 3d printing. The drawing which user required to cut through materials (like wood, glass, marble etc.) will be converted to G-code [2] Language. G-code is low level language which is only be understood by the Arduino microcontroller.

In this project, a cheap CNC machine will be built to perform simple drawing and wood engraving in three axes X, Y and Z. X axis will move the gantry [3] to left and right side, Y axis will move the gantry back and forth and Z axis will move the gantry up and down respectively.

Main features of 3 axis CNC Machine:

- **Custom design**

  The machine will accept custom drawing design by the user and will work to draw or engrave [4] it on different materials.

- **Economical and affordable**

  The price of the machine will be significantly cheaper than other such machines used in the industries. It will help the small business owners to afford such machines, see table 1 for detail cost estimation.

- **Efficient and clean work**

  The output generated by the machine will be neat and clean and the resultant work will be efficient.

- **Portable**

  The machine will be portable and can easily be move from one place to another.

- **Low power consumption**

  The machine will be operate using 12v DC. The already available such machines in the market work only AC.

Tools and technology to be used

- **Hardware**
  - Micro Controller (Arduino Uno)
  - Stepper Motors [5]
  - Stepper Motors Driver [6]
  - CNC Shield [7]
  - USB Cable
  - 12v power supply
  - Lead screw or ball screw
  - Sliding Channels for movement
  - Jumper wires
  - Router for engraving wood [8]
  - Some woods or MDF
- **Software**
  - Arduino IDE
  - C++ programming language
  - Grbl Firmware [9]
  - Vector base software (Inscape or Aspire)
  - Universal G-code sender
  - Sketch up

Equipment and Cost Analysis

No	Component	Quantity	Price (PKR)	Remarks
1.	Arduino + CNC shield	1	19,000	https://store-usa.arduino.cc/products/make-your-uno-kit
2.	Stepper motor	3	9,000	https://www.adafruit.com/product/324
3.	Stepper motor driver	3	900	https://shorturl.at/fqwJO
4.	Ball screw	3	522	https://shorturl.at/clqN4
5.	Sliding channels	3	2,580	https://shorturl.at/fpMNT
6.	Jumper wires	40	180	https://shorturl.at/kFKWX
7.	Router	1	7,500	https:/shorturl.at/jwJY6
8.	12v power supply	1	750	https://shorturl.at/kCUYZ
9.	Elastic Coupling	2	450	https://shorturl.at/noqUX
10.	Cable	1	1,900	https://shorturl.at/ewNOO
11.	Motor brackets	3	960	https://shorturl.at/klpST
Total			43,742	

Table 1: Estimate of a single 3-Axis CNC

G. Key Milestone of the Project with dates			
S.No	**Elapsed time since start of the Project**	**Mile Stone**	**Deliverable**
1.	3 Weeks	Requirements Gathering	• Looking others' designs • Deciding electrical components to be used
2.	3 Weeks	Design	• Designing the final product in Sketch up
3.	3 Weeks	Circuit diagram	• Designing and understanding Circuit diagram. • Implementing circuit using online emulator
4.	4 Weeks	Assembling electrical components	• Buying all the required components • Bringing together all the components and making connection
5.	2 Weeks	Making frame	• Meeting Professionals to decide which material is best for making the frame • Draw a sketch and take measurements to cut the required material • Making the final frame
6.	2 Weeks	Installing Arduino IDE and grbl firmware	• Installing Arduino IDE • Installing grbl Firmware
7.	2 Weeks	Fitting electrical components on the frame	• Checking all the components to work properly • Putting all the components on the frame
8.	4 Weeks	Final project testing	• Final document of the project • Final product Testing
9.	4 Weeks	Final delivery of the project	• Presenting the final product
Total	25 Weeks	Done	Done

Glossary

CNC Machine: CNC stands for Computerized Numerical Control. It is a computerized manufacturing process in which pre-programmed software and code controls the movement of production equipment. [1]

G-code: G-code is a software programming language used to control a CNC machine. [2]

Gantry: a platform made to carry a traveling crane. [3]

Engrave: cut or carve (a text or design) on the surface of a hard object. [4]

Stepper Motor: A stepper motor, also known as step motor or stepping motor, is a brushless DC electric motor that divides a full rotation into a number of equal steps. [5]

Stepper Motor Driver: Stepper motor driver is an actuator which can transform pulse signal into angular displacement signal. [6]

CNC Shield: CNC shield CNC shield V3 is an open source hardware used to control stepper motors. [7]

Router: Wood router is a tool for making cutouts in wood. [8]

GRBL: (pronounced “gerbil”) is free and open-source firmware that controls the movement of CNC machines. [9]

REFERENCES

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