Realisation a machine CNC

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03-05-2017
Summary

Our study is not just based on realisation a CNC (Computer Numerical Control) machine but to find a way to minimise the price too, we collect a lot of information about CNC machine, how it work and the difference between them.

Computer Numerical Control (CNC) is one in which the functions and motions of a machine tool are controlled by means of a prepared program containing coded alphanumeric data. [4] The machine CNC comes with different sizes and different jobs, But they are so expensive. Our objective is to minimise the price of CNC machine without affecting the job of the machine and try to realise the solution.

Key Words:

Machine CNC, CNC, Machine, Minimise the price, Implementation
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1 Introduction

Computer Numerical Control (CNC) is one in which the functions and motions of a machine tool are controlled by means of a prepared program containing coded alphanumeric data. CNC can control the motions of the work piece or tool, the input parameters such as feed, depth of cut, speed, and the functions such as turning spindle on/off, turning.[4]

On the market machine CNC is so expensive and there is different in the price because it’s depend on the type of machine and the size, for example:

<table>
<thead>
<tr>
<th>Machine</th>
<th>Size</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>CNC Router</td>
<td>1.21X2.50m</td>
<td>19,500$</td>
</tr>
<tr>
<td>CNC Router</td>
<td>5X8m</td>
<td>30,000$</td>
</tr>
<tr>
<td>Foam Cutting CNC</td>
<td>8X4X4m</td>
<td>10,000$</td>
</tr>
<tr>
<td>3D CNC</td>
<td>200X200X180mm</td>
<td>350$</td>
</tr>
</tbody>
</table>

Table 1: Price of some CNC machine from eBay and Amazon

The price of The machine that are exist on the market is too expensive otherwise the working area is small

the objective is to find a way to minimise the price without affecting the quality of the work in bigger work area
this rapport have tow section, in the first one we tried to explain more about a CNC machine and the elements of CNC and how it work and the benefits of it. in the second one we explain our solution and our realisation of a CNC machine.
2 CNC machine

2.1 Definition

CNC means Computer Numerical Control. This means a computer converts the design produced by Computer Aided Design software (CAD [page6]) into numbers. The numbers can be considered to be the coordinates of a graph and they control the movement of the cutter. In this way the computer controls the cutting and shaping of the material. [2]

![CNC Machines](image1.png)

Figure 1: CNC Machines

2.2 Elements Of A CNC

A CNC consists of three basic components:

2.2.1 Part Program

is a set of commands which the machine will be followed, the command set the position, state, and the motion of the CNC machine, there is 2 way to write the program manually or by automated programming tool.

![Screen Shot From Universal GCode Sender](image2.png)

Figure 2: Screen Shot From Universal GCode Sender
the commands write with a GCode, the G Code is a special programming language that is interpreted by Computer Numerical Control (CNC) machines to create motion and other tasks. It is a language that can be quite complex at times and can vary from machine to machine. The basics, however, are much simpler than it first appears and for the most part follows an industry adopted standard. [1]

2.2.2 Machine Control Unit

The machine control unit (MCU) is a microcomputer that stores the program and executes the commands into actions by the machine tool.

![Figure 3: The MCU Of CNC Milling Machine(Anayak Bed mill HVM-2300)](image)

2.2.3 Machine Tool

The machine tool could be one of the following: lathe, milling machine, laser and plasma.

![Figure 4: CNC Machines Tool](image)

Together these three components are the CNC machine.
2.3 The Benefits Of The CNC Machine

- High accuracy in manufacturing
- Short production time
- Greater manufacturing flexibility
- Simpler fix truing
- Reduced human error

2.4 The Limitations

- The drawbacks include high cost, maintenance
- The requirement of skilled part programmer
3 Realisation

3.0.1 Definition

After knowing and understand the parts of CNC machine we tried to use a row material if it’s possible to minimize. we replace MCU with this replacement we saved money between 500$-5,500$, and in part program we use an Open source application to generate the code and by that we saved money between 50$-499$, and for the machine we try to build the framework.

3.1 Implementation

3.1.1 Part Application

We could generate the code with inkscape (page6) after adding a tool to it and the code is 100% right and can work in any CNC machine without problem.

```
1 G90
2 G21
3 G0 X7.0799 Y4.8945
4 M03
5 G1 F30.000000
6 G02 X7.2437 Y5.7973 I2.5695 J0.
7 G02 X7.6234 Y6.3428 I1.3621 J-0.4737
8 G02 X8.1165 Y6.6286 I1.6073 J-1.1696
9 G02 X8.7304 Y6.7339 I0.6139 J-1.7377
10 G02 X9.4013 Y6.6044 I-0.0001 J-1.18936
11 G02 X9.9168 Y6.2582 I-0.554 J-1.3821
12 G02 X10.248 Y5.7866 I-1.0425 J-1.00998
13 G02 X10.3775 Y4.9442 I-2.2376 J-0.7844
14 G02 X10.3147 Y4.2802 I-3.5445 J0.
15 G02 X10.1737 Y3.8754 I-1.4389 J0.2744
16 G02 X9.9234 Y3.3314 I-1.2886 J0.6745
17 G02 X9.5804 Y3.2706 I-1.0654 J1.045
18 G02 X9.1766 Y3.1108 I-0.82 J1.4825
19 G02 X8.7304 Y3.0551 I-0.4463 J1.7609
20 G02 X8.0469 Y3.1858 I0.21 J1.8535
21 G02 X7.5356 Y3.5291 T6.535s J1.3498
22 G02 X7.2159 Y4.0578 I1.0121 J0.9732
23 G02 X7.0799 Y4.8945 I2.5072 J0.8367
24 G1 X7.0799 Y4.8945 M05
25 G0 X7.693 Y4.8945
26 G0 X7.693 Y4.8945
27 M03
```

Figure 5: GCode File Generated From Inkscape

3.1.2 Machine Control Unit

We replace the MCU with Raspberry Pi, after editing an open source application writ in python, that program convert the raspberry Pi to an MCU.
Raspberry Pi is a low-cost, basic computer that was originally intended to help spur interest in computing among school-aged children. The Raspberry Pi is contained on a single circuit board and features ports for:

- HDMI
- USB 2.0
- Composite video
- Analog audio
- Power
- Internet
- SD Card

The computer runs entirely on open-source software and gives students the ability to mix and match software according to the work they wish to do. [3]

3.1.3 Machine Tool

We tried to build the framework in size of 21.0 x 29.7cm (A3) but we did not find the material in our state and some of component did not find them in our country, so we try to build the CNC machine in size of 3.5 x 3.5cm.

The Component

The basic things we did not find are

Aluminium Bars: the idea was to build a CNC frame from aluminium much cipher and effective but we did not find aluminium bars with this shape.
Laser Head: We did not find it in our state but we did find it in other states but it was expensive for us (60,000 - 80,000 DA).

Figure 8: Laser Head

3.2 How We Did Make It?

We needed to use a stepper motor and frame and a laser to build our CNC, so we use a DVD-ROM motor they are a small stepper motor too, after we used DVD-ROM tow problem solved which are the frame and the motor but we lost the size, now our CNC work in 3.5X3.5cm.

Figure 9: DVD-ROM Frame Plus The Stepper Motor

We needed a head to our CNC so we tried the DVD-ROM laser, we build the laser Diver and we extracted the laser.

Figure 10: DVD-ROM Frame Plus The Stepper Motor

But it did not work out for us, so we get other idea which is to use other axes for a pen instead of laser but it did not work out for us either because we are using raspberry Pi. so we keep the pen as a head but we did not raise it up or down and this is how our CNC look like.
Figure 11: Our CNC machine
4 Conclusion

By define what is the CNC machine and how it works we was hoping to find a solution to the price and if there is a way to minimise it without effecting the quality of the product, our search and this work did answer that question.

Yes there is a way to implementation the solution that we give by using open source application and raw materials.

There a limitation in our solution that is we pretend that the human that using the machine is 100% aware about the safety and he is protecting his self, and we know for sure that some times our solution is dangerous for human if he did not take care of his self.

Our perspective is to develop our solution to make it more safe for human and always to minimise the price even to our solution.
References


5 Annexes

Figure 12: Generate A GCode Of Design

Figure 13: Printing A Design Using Our CNC
6 glossary

**CAD (Computer-aided design):**

is software used by architects, engineers, drafters, artists, and others to create precision drawings or technical illustrations. CAD software can be used to create two-dimensional (2-D) drawings or three-dimensional (3-D) models. CAD software is used to design products such as electronic circuit boards in computers and other devices.[from WhatIs.com]

**Inkscape:**

Inkscape is a free and open-source vector graphics editor; it can be used to create or edit vector graphics such as illustrations, diagrams, line arts, charts, logos and complex paintings.