Microcontroller Based Electronic Control Board for Laser Cutter and Engraver

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Abstract —Lasers have found various applications across various fields. Particularly in electronic field, the use of laser is unavoidable. From small scale industries to biomedical industries laser perform critical operations in the field of engineering as well as complicated surgeries in the field of medical science. In this paper, we propose a system to operate at laser at different modes to perform various operations in the field of metal sheets cutting and engraving. The proposed system uses a controller board for laser which acts as the heart of the system. User inputs are captured through the panel keys. Depending upon the mode of operation user can select power. We have used a red led diode to show output, but in real time the system can be interfaced with laser module to obtain desired outcome. We have UV lamp to show the power variation. A graphical LCD is used in our system to make the user interface more attractive and easy.

Keyword — NIR, DUV, SSRRISC, USART

I. INTRODUCTION

Lasers are devices that produce intense beams of light which are monochromatic, coherent, and highly collimated. The wavelength colour of laser light is extremely pure monochromatic when compared to other sources of light, and all of the photons that make up the laser beam have a fixed phase relationship with respect to one another. Light from a laser typically has very low divergence. It can travel over great distances or can be focused to a very small spot with a brightness which exceeds that of the sun.

Because of these properties, lasers are used in a wide variety of applications in all walks of life. For cutting and engraving operation in an industrial application we propose a system to operate laser at different modes. Depending upon the metal, user can select power on laser through the panel keys, to reduce power consumption and wastage of material.

II. LITERATURE SURVEY

[1] In the machine manufacturing industries, cost estimation and costing are critical. In order to obtain maximum of technical and economic efficiency, in these cases, very important is to estimate the production costs and the production rates. Knowledge of investment and operating costs represents a base for investment in plasma arc cutting machine. For different plasma arc cutting machines typical investment costs and operating costs depend from the power of the plasma cutting machine and important system components. Knowledge of a plasma arc cutting system’s investment and operating costs should form the basis for evaluating its profitability. The high investment and operating costs, compared to conventional methods, must be justified according to economic criteria with corresponding financial advantages.

In this paper, a mathematical model for determining the cost of plasma arc cutting machining is presented. Laser machining can remove material in very small portions while traditional machining removes material cannot. Laser machining processes are said to remove material by atomic layers. For this reason, the kerf in laser cutting is usually very narrow, the depth of laser drilling can be controlled to less than one micron per laser pulse and shallow permanent marks can be made with great flexibility. In this way, material can be saved, which may be important for precious materials or for delicate structures in micro-fabrications.

[2] The Metals Industry Research and Development Center (MIRDC) designed and developed a 3-axis computer numerically-controlled (CNC) plasma cutting machine for the local metalworking industry. This CNC machine was dubbed as ‘Plasmanoy’ short for ‘Plasma ng Pinoy’. The said equipment is capable of cutting steel and other metals with a plasma torch. It uses high-temperature plasma to melt the metal being cut.

To produce precise and clean sharp cuts, computer control was introduced. However, the automation cost is quite expensive. With that, this study presents the development of a low-cost controller for the 3-axis CNC plasma cutting machine. The developed controller is capable of digitally-controlling the mechanical motion of the three (3) axes (X, Y and Z) and the plasma generator.
For the tool path generation and post-processing. Different variants of plasma arc cutting techniques are actually applied to practical purposes. Nowadays, the cutting process can be done either in atmosphere or under water. The following variants are available: dual flow gas technique; water injection plasma cutting; air plasma (or compressed air technique); high tolerance. Plasma cutting refers to metal cutting by melting with a constricted arc, then blowing the molten metal out of the kerf with a high-velocity jet of ionized gas.

[3] A novel variant of thermal laser dicing of crystalline silicon has been studied in this paper, by using fluid assistance to improve the reliability, flexibility and operational window of the current process. High quality laser cutting of mono crystalline and polycrystalline silicon is demonstrated by using a diode laser focused on a 1 mm spot, assisted with the use of a water or glycerol layer, and resulting in Zero Kerf cuts with low total roughness and enabling freeform cutting. This variant process is compared with conventional thermal cleaving, with and without the use of an initial stress concentrator, as well as compared with optimized conventional approaches (ablation and gas assisted cutting). Besides the effective cutting speed, the laser induced damage is studied for each alternative, as well as the potential for photovoltaic applications on mono and multi crystalline silicon, is presented. Several parameters have been studied, to achieve highest effective speed values without damage in the surface of the wafer and a homogeneous cutting quality. The high quality, speed and flexibility of water-assisted direct diode induced thermal cutting are demonstrated.

[4] Parameters and configuration of power systems are continuously prone to change. This might negatively affect the performance of load frequency controllers. PI controllers are widely used for load frequency control (LFC) in power systems. Hence, enhancing the performance of these controllers is of great importance. In this paper, an adaptive set-point modulation (ASPM) method is proposed to enhance the performance of PI controllers. Simulation studies carried out on a two-area power system with different types of generating units and HVDC link prove the superiority of the proposed adaptive set-point modulation assisted proportional integral (ASPM-PI) over the conventional proportional integral (PI) and proportional integral derivative (PID) controllers. Where ASPM-PI controller is robust The master timing system (MTS) is a computer-controlled tool for Synchronizing the laser oscillator and power amplifier [3]. It functions as an optical shutter by the controlling of the delay, too. The MTS provides the MOPA power supplies with triggering signals of controlled delay time. Depending on the delay the second laser acts as an amplifier or as an absorber (shutter). We have to note that best results for laser divergence we had at certain delay times.

III. BLOCK DIAGRAM

Establishing physical connection between microcontroller and LCD. Creating fonts to be displayed in the GRAPHICAL LCD using font creator tools and loading start up images. Setting up timers and interrupts for generating PWM outputs and capture the same in the DSO. Getting user configuration for different modes and display the same in the LCD.

Interfacing Laser module with the microcontroller and generating PWM outputs. Interface with SSR and to check power variations in an AC load (UV lamp). Analyze and capture PWM outputs for different.

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Motorola can be termed as a single on chip computer which includes number of peripherals like RAM, EEPROM, Timers etc., required to perform some predefined task. The computer on one hand is designed to perform all the general purpose tasks on a single machine like you can use a computer to run a software to perform calculations or you can use a computer to store some multimedia file or to access...
internet through the browser, whereas the microcontrollers are meant to perform only the specific tasks, for e.g., switching the AC off automatically when room temperature drops to a certain defined limit and again turning it ON when temperature rises above the defined limit.

There are number of popular families of microcontrollers which are used in different applications as per their capability and feasibility to perform the desired task, most common of these are 8051, AVR and PIC microcontrollers.

IV. CIRCUIT DIAGRAM FOR LCD INTERFACING

The first top most Page address is 0x0b8 and the lowermost page is 0x0c0. Likewise the left most column has an address of 0x040 and the rightmost column is at 0x080. Whenever you write data into the display RAM, the column address alone is incremented automatically by one. And when the increment happens after the last column (0x080) it rolls over and overwrites on the first column in the current page. To change the page use X address set instruction.

This can be useful for chemical processing, or it can be damaging to materials and living tissues. This damage can be beneficial, for instance, in disinfecting surfaces, but it can also be harmful, particularly to skin and eyes, which are most adversely, affected by higher energy UVB and UVC radiation.

WORKING PRINCIPLE:

The AC voltage, typically 220V rms, is connected to a transformer, which steps that ac voltage down to the level of the desired DC output. A diode rectifier then provides a full-wave rectified voltage that is initially filtered by a simple capacitor filter to produce a dc voltage.

This resulting dc voltage usually has some ripple or ac voltage variation. A regulator circuit removes the ripples and also remains the same dc value even if the input dc voltage varies, or the load connected to the output dc voltage changes. This voltage regulation is usually obtained using one of the popular voltage regulator IC units. Block diagram of power supply is shown in 3.22.

IONIZATION:

UV radiation has enough energy to break chemical bonds. Due to their higher energies, UV photons can cause ionization, a process in which electrons break away from atoms. The resulting vacancy affects the chemical properties of the atoms and causes them to form or break chemical bonds that they otherwise would not.

The potential transformer will step down the power supply voltage (0230V) to (0-6V) level. Then the secondary of the potential transformer will be connected to the precision rectifier, which is constructed with the help of op-amp. The advantages of using precision rectifier are it will give peak voltage output as DC, rest of the circuits will give only RMS output.

When four diodes are connected as shown in figure, the circuit is called as bridge rectifier. The input to the circuit is applied to the diagonally opposite corners of the network, and the output is taken from the remaining two corners.

Let us assume that the transformer is working properly and there is a positive potential, at point A and a negative potential at point B. The positive potential at point A will forward bias D3 and reverse bias D4. The negative potential at point B will forward bias D1 and reverse D2. At this time D3 and D1 are forward biased and will allow current flow to pass through them; D4 and D2 are reverse biased and will block current flow.
ISP FREQUENCY

The higher the ISP frequency, the faster you can program the target AVR, but the ISP frequency must be less than a quarter of the target AVR’s clock frequency. The ISP Frequency can be set in Atmel Studio as well as in the Configuration Utility, but the frequencies listed in the Atmel Studio user interface do not match the actual frequencies used by the Pololu USB AVR programmer.

<table>
<thead>
<tr>
<th>Frequency Listed in Atmel Studio</th>
<th>Actual Frequency</th>
<th>Allowed Frequency</th>
<th>Target Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.843 MHz</td>
<td>2000 kHz</td>
<td>&gt; 8 MHz</td>
<td></td>
</tr>
<tr>
<td>460.8 kHz</td>
<td>1500 kHz</td>
<td>&gt; 6 MHz</td>
<td></td>
</tr>
<tr>
<td>115.2 kHz</td>
<td>750 kHz</td>
<td>&gt; 3 MHz</td>
<td></td>
</tr>
<tr>
<td>57.6 kHz</td>
<td>200 kHz</td>
<td>&gt; 800 kHz</td>
<td></td>
</tr>
<tr>
<td>28.36 kHz</td>
<td>4.0 kHz</td>
<td>&gt; 16 kHz</td>
<td></td>
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<tr>
<td>14.07 kHz</td>
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<td></td>
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<tr>
<td>7.009 kHz</td>
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<td></td>
<td></td>
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<tr>
<td>4.00 kHz</td>
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<td></td>
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<tr>
<td>3.498 kHz</td>
<td>1.5 kHz*</td>
<td>&gt; 6 kHz</td>
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<tr>
<td>1.748 kHz</td>
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</tbody>
</table>

IV. OUTPUT

The simulation of continuous mode

The output of continuous mode:

V. V. CONTINUOUS MODE:

In continuous mode user can select the power and beam of laser light will fall on metal sheet continuously in millisecond is shown in Figure 5.2

V. CONCLUSIONS

Thus by using this paper, we can interface the control board to the laser module to get desire outcome. This concept helps in reducing the power consumption and time consuming.
REFERENCES


