CNC Laser Cutting Machine

Ammar Ahmed, Thomas Bock, Tan Hua and Michael Golez  
*California State University, Sacramento*

EEE-193B/CPE 191  
9-7-2016

# Introduction

In the industry, a widely used component for cutting and engraving materials is a CNC laser cutting machine. The machine operates by using a high-energy infra-red laser light beam. A focusing lens is attached to the laser in order to concentrate the energy into single focal point, thereby vaporizing and melting the material of interest. In order to alter the position of the laser into a desired location, a computer program known as CNC drives the positon of both the x and y axes. Asides the orientation of the axes, CNC codes can adjust the intensity of the laser to optimized the speed of the engraving or cutting of the material. Finally, by using machine vision, through the process of object orientation we can determine the position of the material. This process allows alteration of the material for better result, so that during the process the engraving or cutting is accurately done. The creation of the CNC Laser Machine will be conducted into four different parts: the mechanics between the positions of the CORE x-y axes, the laser machine circuit, CNC software for control and intensity, and finally detection system.

The machine operates through the use of a high-energy infra-red laser light beam. By implementing a focusing len towards the laser diode, the light beam is concentrated into a single focal point. The focal point allows maximum melting and vaporization of the desired material of interest. In order to alter the position of the laser into a desired location, a computer program known as CNC drives the positon of both the x and y axes. Asides the orientation of the axes, CNC codes can adjust the intensity of the laser to enhance the engraving or cutting of the material. Finally, by using machine vision, we can determine the position of the object relatively to the workspace through the process of object orientation. This process allows finer cutting and engraving for better result. The construction and programming of the CNC Laser Machine will be conducted into four different parts: the mechanics will handle the positions of the CORE X-Y axes, the Laser Diode will generate the light beam for the cutting and engraving, the CNC software will allow for control and intensity of the overall system, and finally detection system will detect the workspace for maximum efficiency.

# Construction

* 1. *Housing/Ventilation System*

In order to account for the emission of smoke during operation a ventilation/filtration system needs to be implemented. This will include a fan system, some ducting work and an extensive modification of the base of the laser cutter. There also needs to be a housing for the machine so that it is safe to operate without all participants wearing safety goggles. This will include a barrier around the laser itself as well as a housing/lid on the machine that must be kept closed while the machine is in operation.

* 1. *Stand Alone Management System****(S.A.M.S.)***

Previously, the control of the laser machine was through a laptop that was connected to it. In this semester we would like to implement a stand-alone computer system that operates the laser cutter, that way the laser cutter will be accessible through a network and allow for wireless communication to the laser cutter from the internet. The Camera System software and All In One software program would be incorporated to this management system.

* 1. *All in one Software Program*

As the semester ended our software program for the CNC machine were operated in different levels of software for each step to complete the entire process of cutting or engraving. In this semester, our objective is to implement just one program that is able to operate from the top level to machine level, so all of the current programs are no longer necessary. The program will be able to import the design and interpret its dimensions to locate on the object. Then it also needs to be able to interpret G-Code and operate it properly with the laser intensity level. This will be done by using Python along with PyQt and Numpy for front-end design and C++ for back-end to communicate with the laser and camera systems.

* 1. *Automation/Improvement of the Camera System*

At the end of the first semester the camera system functionality involves a lot of manual inputs in our software package. This is due to the use of Matlab to run our camera processing software. We would like to implement camera processing software using OpenCV so that the functionality is automated and is integrated completely into our software package. Along with the integration we would like to improve the algorithm we are using for the camera processing.We would also like to improve the mounting of the camera so that the enclosure doesn’t interfere with the enclosure of the machine.