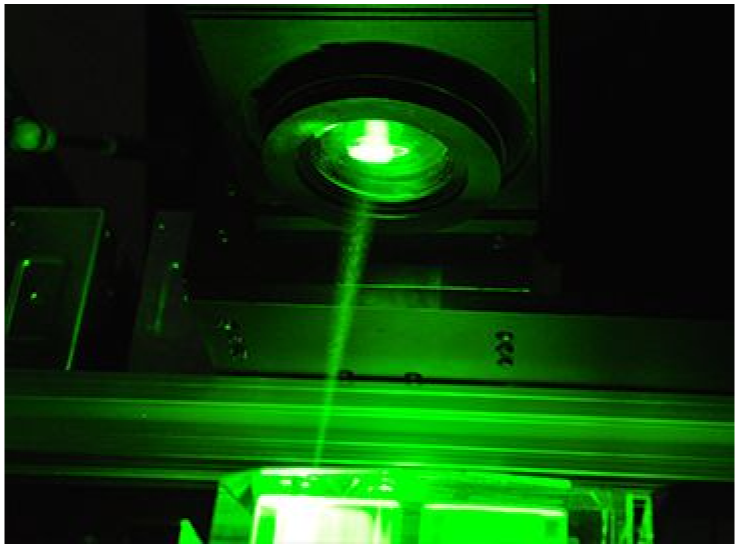
3-Dimensional Glass Laser Etching System



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Initial Project Document and Group Identification
Divide and Conquer

Group 20

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Project Narrative

Description, Motivation, and Purpose

There are many laser etching systems that exist for many purposes: 2D and 3D glass engraving, material cutting, and surface engraving just to name a few. However, they become bulky and include more capability than what's needed by the user. The current customer is in need of a 3D Glass Laser Etching System that can provide 3-D engravings. Instead of buying an existing system, customizing one will avoid spending on capabilities and features that may never be used.

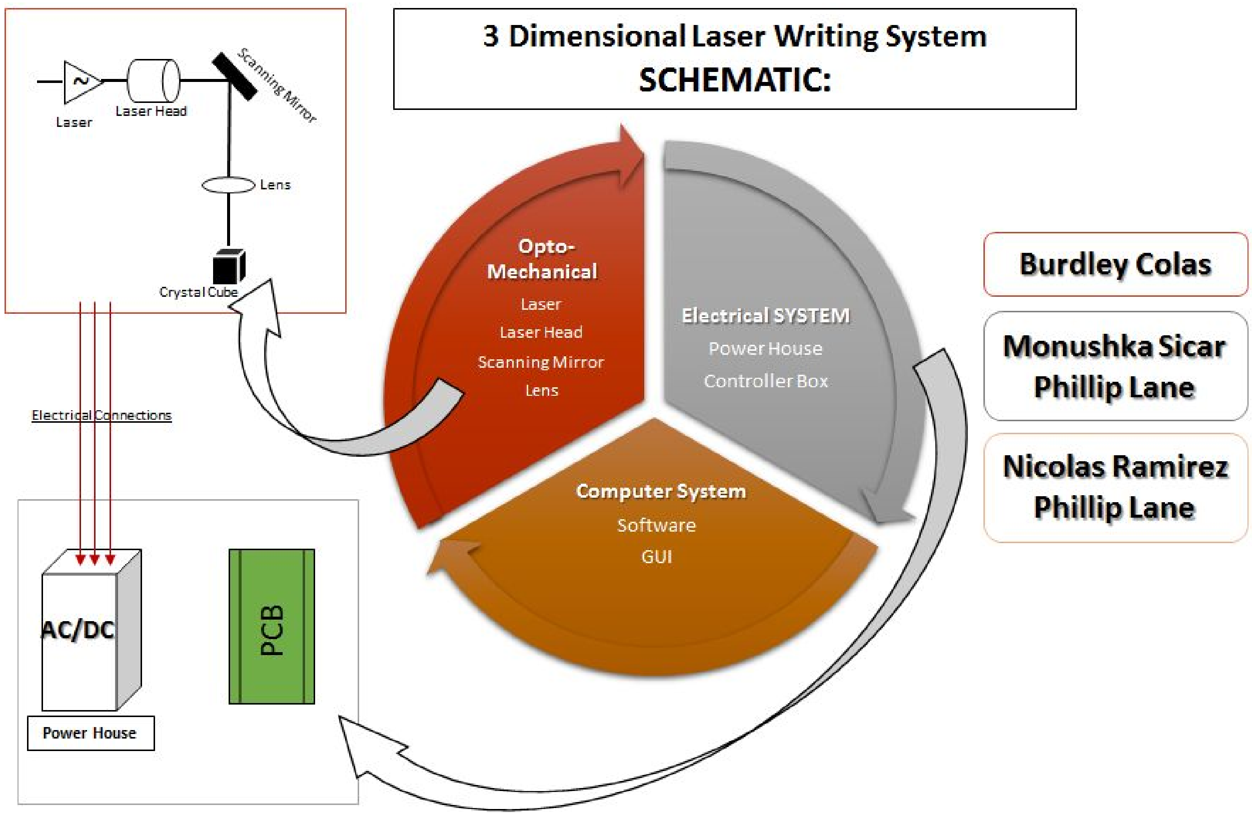
The customer has an existing 3D laser etcher, but its technology is 10 years outdated. The existing system is capable of engraving 3D images into pure glass and up to 6 of the same engravings (in separate glass) simultaneously. Its disadvantages include its immense size in volume and weight, lack of user friendliness, safety hazards during operation, subsystems that aren’t integrated, and large time consumption.

The motivation of the project is to resolve all disadvantages of the existing system by designing a new one more suitable for the customer’s needs. In terms of size, the existing system is large considering that it’s designed to simultaneously etch up to 6 glass engravings. Doing so requires additional platform spacing as all glasses share the same platform. The new system will engrave a single glass at any given time, eliminating the need for additional platform spacing. This will also allow the use of smaller motor systems since there is less weight to be repositioned (i.e. the platform); smaller motor systems also means more size reduction in the overall system and increased its ability to be carried.

Additionally, the new system design will be user friendly by allowing the user to control all subsystems (i.e. engraving settings and laser on/off power) via a graphical user interface (GUI). Finally, an increase in safety is a must. Unlike the existing system, the new system will be placed into a protective casing to prevent physical interaction with the system during operations.

Overall, the new system will provide the customer with a modernized, safe, and user friendly features that exceeds the proposed requirements.

Block Diagram:

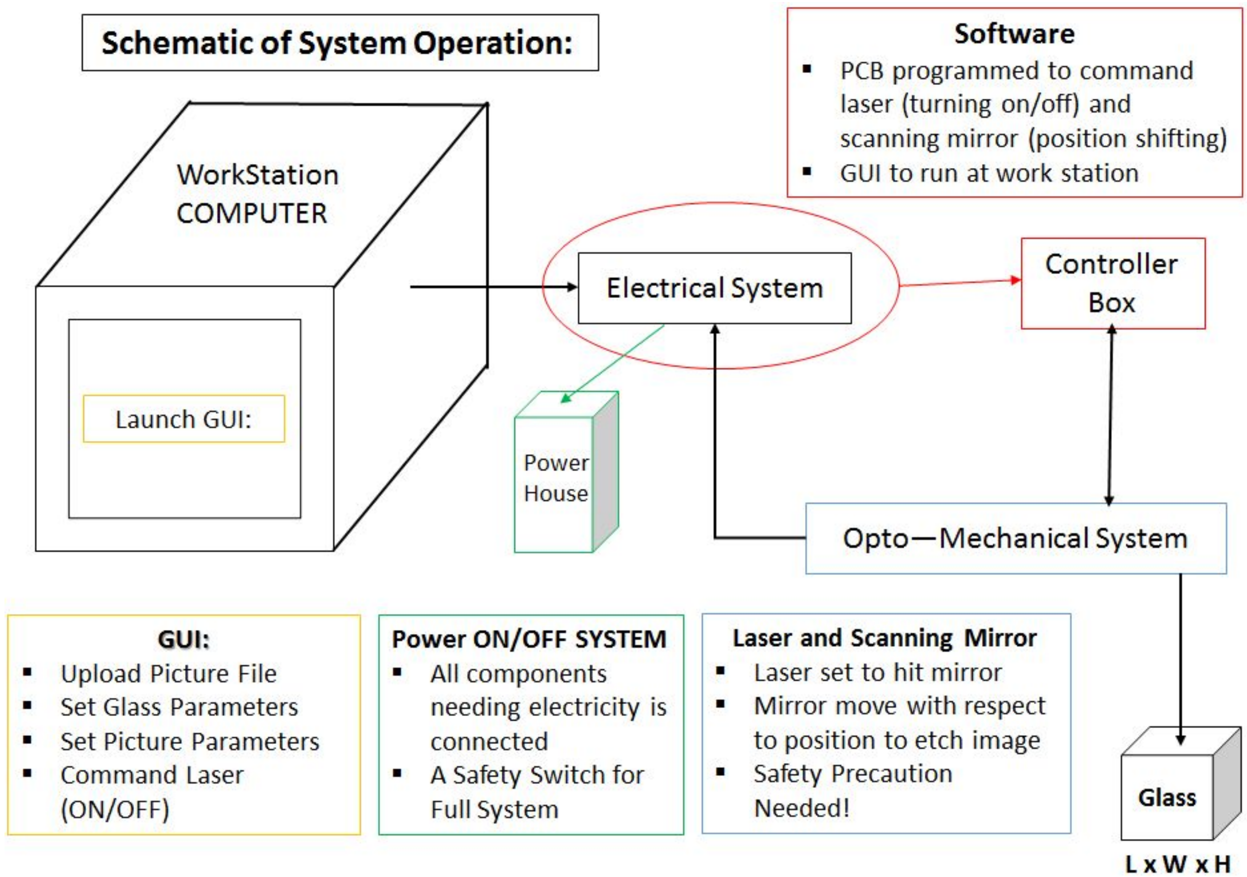


Opto-Mechanical:
Research optical components such as laser and scanning mirrors, and other opto-mechanical components to construct the framework of the end product. Also, to have a compact system, the end product must be designed such that the electrical components (i.e. Power House, and Controller Box) to be enclosed not stand alone.

Electrical System:
To create a safe and systematic system, two important aspects of the end product is to have all electrical connection enclosed in a separate system (the Power House) which will be categorized into AC and DC. Also, per importance of the Software and GUI

running on the customer computer, a Controller Box will be designed such that components can be sanctioned to command.

Computer System:
The developed software is to command the components from the opto-mechanical system such as the laser and the scanning mirror. The PCB will be programed for these commands. A GUI is to be developed to run the system (user end). The GUI set to be the interface for the user to input images and set parameters before starting etching process.



Project Budget

Cost and Budget
Note: This list of prices is tentative and may change in the future as options from different suppliers are explored.

Description	Quantity	Cost ($)	Total Cost ($)
New Computer	1	0	0
Laser	1	300	300
Custom PCB + Components	10	100	1000
Scanning Mirror	1	2,260	2,260
System Shielding	1	500	500

Funding

The sponsor of this project has provided a budget of up to $10,000 to be spent on any necessary components. As seen from the estimated costs, the cost of this project is not expected to exceed, or even come close to, the maximum allotted amount. The only possible item that could make the cost of the project come close to the maximum is the new laser system.

Budget Distribution

The most expensive item in the project is the scanning mirror. The reason as to why a large part of the budget is being allotted to the scanning mirror is because it gives the design the desired speed, precision, and it helps to make the system more compact. One of the most important items is the laser system. The estimated price of this laser system is known to not exceed $500. While the laser system needs to have certain technical characteristics as described in the technical requirements and specifications, the laser itself does not have uncommon specifications and is therefore not overly priced. A new computer to run the engraving software is an important part in the list. The reason as to why the price is not currently yet known is because a computer could be provided by CREOL. If a computer cannot be provided by CREOL, a new computer system can be built by choosing specific parts or an already-built can be purchased.

Specifications

- New Computer with updated Windows
  - Allows for new coding software to be upload
  - Faster processing
- Green Laser

  - For etching into glass
- Motor System
  - Assist in the position control of laser for engraving into the glass
- Laser Sensor
  - Monitor power of laser while in use
- Print capabilities
  - 3D and 2D images
  - One glass cube at a time
- Optical Box
  - Allows viewers to watch etching while in process
- Compact in size
- No crack propagation
- Control spacing of spots
- Reasonably fast
- Turn laser OFF
  - Offset mode
  - Idle
- Dot Matrix
  - Multiple shots/intensity per point
- Versatility
  - Different images, words, faces into one cube
- Cost no more than $10K
- Portability/Size Reduction
  - Etch one glass a time, eliminating volume used for multiple glasses
  - Limit individual glass volumes that can be etched into
  - Use smaller motor subsystems as volume reduction would allow for them
  - All subsystems will be integrated together, aside from the external GUI
- User Friendly/Repeatability
  - Graphical User Interface (GUI)
    - Motor Positioning
    - Image Positioning
    - Laser “Burn/Spot” Spacing
    - On/Off Laser Control
- Increased Safety
  - Include walls around system to act as a barrier when laser is on
  - Stabilize glass position on platform during etching operations
  - Use polarized glass for visually exposed parts of the laser during operations to eliminate the need for protective eyewear

Project Milestones

Milestone	**Range**	**Specification**
Create Group	August 22 – August 27	
Project Selection	August 29 – September 3	Acquire sponsor and vote on project
Project Planning	September 5 – September 23	Research and customer meeting
Finalizing Project Blueprint	September 25 – October 21	Research and acquiring data sheet for parts
First Draft of Document	October 24 – November 11	
Final Draft of Document	November 14 – December 2	
Part Acquisition	December 12 – December 23	Purchasing parts
Part Characterization / PCB Design / Software Design	January 9 – January 23	Testing
Opto-Mechanical Assembly	January 23 – February 3	Testing
Prototype Assembly	February 6 – March 10	Testing
Prototype Testing	March 20 – April 14	
Final Prototype Run	April 17 – May 2	**DEMO READY!**

House of Quality

		Quality	Efficiency	Cost	Dimensions
		+	+	-	-
Versatility	+	↑↑	↓	↓↓	
Size (Compact)	-			↓	↑↑
Speed	+	↑↑	↑↑	↓↓	↑↑
Time Efficiency	+	↑↑	↑↑	↓	
User Friendly	+	↑	↑↑		
Cost	-	↓↓	↓	↑↑	↑↑

Group Break Down:

First Project Leader: Burdley Colas

Second Project Leader: Phillip Lane

Conclusion

Since the invention of the laser, researchers and engineers have found numerous applications for the laser, among which laser induced damage in optics is one of them. Over the years, the understanding of having a laser focused in a glass medium, at some energy level, a portion of the glass medium can is damage. This phenomena occurs into the interaction of the light and the medium at the state of plasma. This scientific discovery allows us to create 3D Laser Writing into Glass, where an image can be programed to be engrave into a glass medium. To design and fabricate such device, an understanding of optics, electronics, and computer science is needed in order to control moving parts of optomechanical and electromechanical elements to have the laser beam hitting this glass medium at the accurate light intensity and position with a reasonable speed to have desired image resulting to be inside the glass medium without having to damage the outer surface.