Motor-Driven Laser Alignment Station

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The Problem

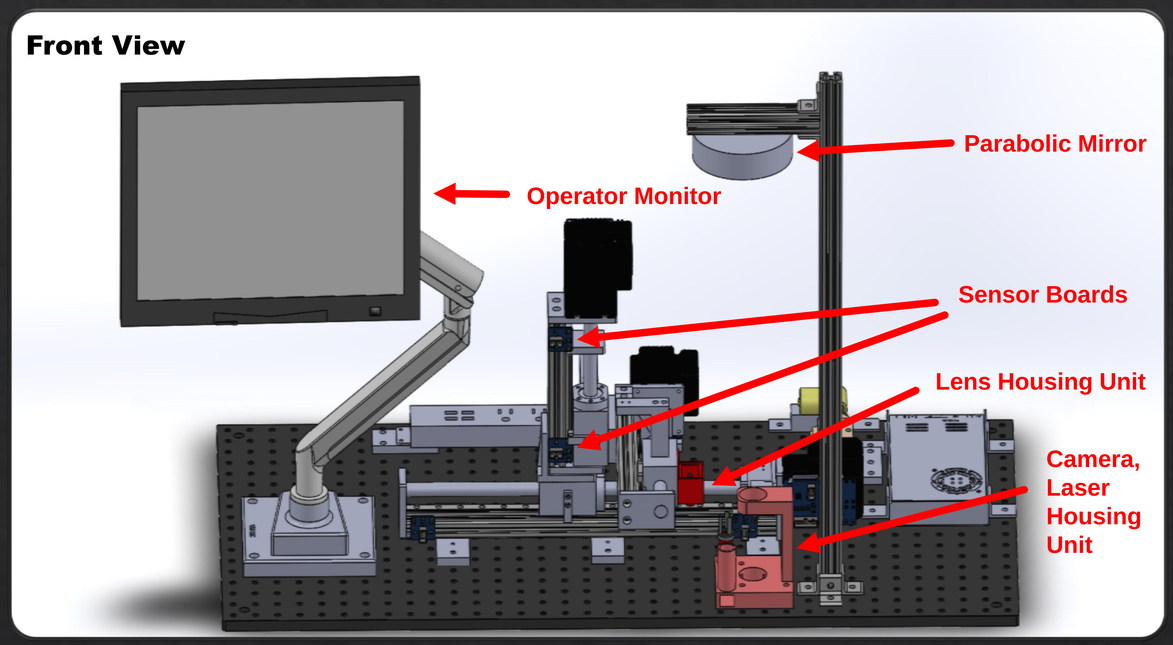
Lasers are used in an ever-expanding range of applications, from range-finding systems to laser surgery equipment—from classroom laser pointers to a soldier's rifle-mount aim assist. In general, laser beams are created using two main components: a laser diode and a lens. As it stands alone, the laser diode emits light in all directions. The lens is used to focus the light emitted by the diode onto certain point, and for the perfect beam to be produced, precise alignment of the lens is required.

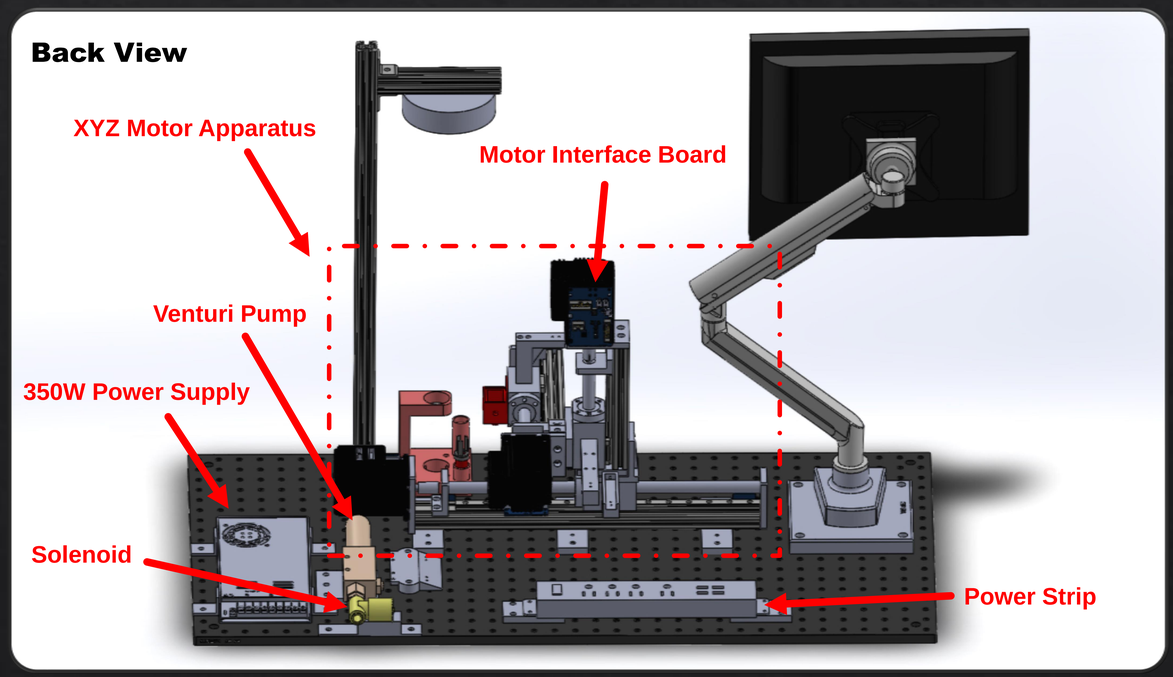
Market Solutions

Laser lens alignment is performed manually by technicians every day at laser manufacturing facilities, but manual alignment is a tedious process. Aligning a single lens can take up to a minute or more, and the technician who performs the alignment only has control over one axis of motion. It is also relatively unsafe to perform alignment manually. Stray light from a laser (or even more dangerous, from an infrared or invisible laser) can be very harmful to the human eye.

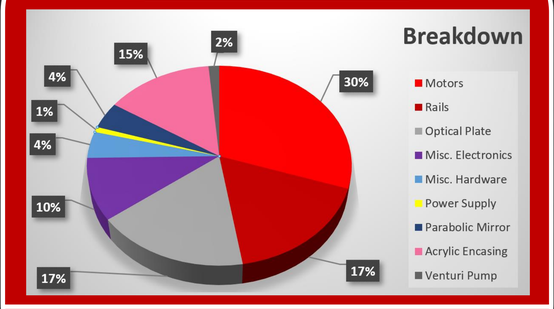
Our Solution

We propose a machine which automatically aligns a lens with a laser diode to produce a product-ready laser. The station consists of three stepper motors which receive feedback from an image processing unit, driven by an algorithm which monitors the current shape, position, and intensity of the beam and commands the motors to adjust the lens position accordingly. Compared to current market solutions, our system offers high efficiency, sufficient 3D range of motion, and can be enclosed for safety purposes.





Cost Analysis



Total: $3480.00

Other Applications

The hardware component of the Motor-Driven Laser Alignment Station can be used in a number of applications outside of laser lens alignment. The hardware is versatile, and simply changing the software or program stored on the MCU can change the entire application of the system. For example, one such implementation could use the camera to check for fiducials on a printed circuit board panel, and the system could be used for pick-and-place functionality in assembling PCBs.

Future Improvements

Future work can be done on this project to improve performance both electrically and mechanically. Some improvements include:

- Complete automation of operation
- Improve code efficiency to increase speed
- Include options in GUI to control more motor parameters (acceleration/deceleration rate)
- Include more try/catch statements to remove bugs and limit program crashes
- 3D print parts out of aluminum for mechanical stability