

Physics 262 Laser Show Project Introduction

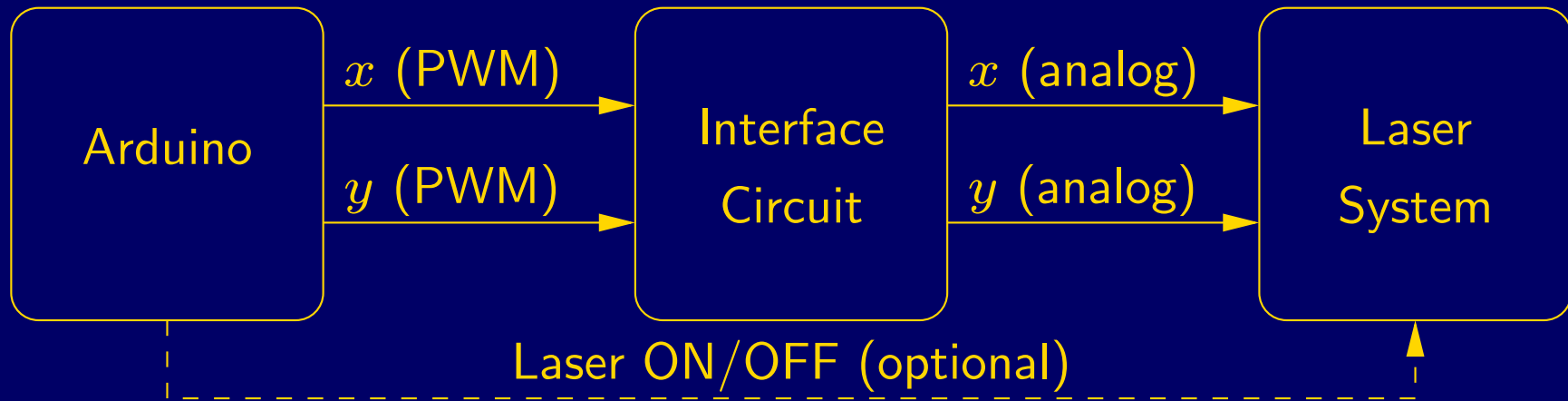
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Project Overview

Objective: Create a microcontroller-driven laser light show.



This project combines many of the things we've learned this semester, but many aspects of the content and implementation are open to your preferences and creativity.

Arduino

- Your program will generate a series of 8-bit digital x & y coordinates to steer the laser beam and trace figures on the wall.
- Output x & y using pulse width modulation (PWM, 0-5 V).
- Flash memory (32 kB) is available to store arrays of coordinates.
- Optionally, a digital output can turn the laser on & off.

Coordinates—how to generate them?

There are many options. For example:

- Create one or more frames (dot-to-dot pictures) ahead of time and store on the Arduino.
- Use any software or other tools available to you (e.g., Excel, drawing program, Matlab) to assist in generating coordinates.
- Use math functions in Arduino's programming language to transform the points. You can make things slide or rotate, or even create the illusion of 3D motion.¹
- Generate or modify the laser graphics interactively using digital or analog inputs.

¹The 16 MHz Arduino is not a fast computer. Don't expect to do lots of calculations between points.

Laser System (provided)

- Steerable mirrors control x & y beam position.
- Mirror actuators require significant current (100 mA or more).
- Minimize power and component heating by minimizing deviation from zero. ± 1 V is better than 0-2 V.
- Actuator inertia limits the bandwidth to about 200 Hz.
- Optionally, the “pen” can be lifted from the “page” via TTL logic input on the laser power supply.

Interface circuit

What does it have to do?

- Use an active filter to transform PWM into an analog signal.
- Rescale and offset the 0-5 V signal to ± 1 V.
- Provide capability to drive up to about 200 mA.

Build & test each section of the circuit separately. The implementation, including the order of operations, is up to you.

Your Job

- With your lab partner, design & test the interface circuit. Start today with active filters for x & y . Test with a sample Arduino program (provided) and oscilloscope in xy -mode and show your TA.
- Create an animation concept (pre-lab for next time!). Keep it simple at first. You can always make it more fancy if you have time!
- Develop Arduino program to implement your idea. You are free to use my examples as a starting point.
- Turn in an *individual* report electronically to your TA.
- Public demo at the annual Physics 261 Laser Show!

Project Grading

Content (20): You are responsible for a full write-up. Document the motivation, design (rationale, schematics, components), systematic testing of each module. Include photos of hardware and laser show. Provide your program and describe it clearly. Conclude with extensive comments on what was good and bad about the design/project, and how it could be improved.

Neatness and Organization (20): Write-ups are to be done individually, neatly written or typed, with clearly labeled figures. The sections, included data, figures, etc. should be well-organized. Your circuit board should have a neat layout. Arduino code should be well-commented.

Lab procedure and analysis (20): Work in a systematic way,

testing each sub-part of the project as you go. Record the results of your testing in your log book. Use screen captures from the scope when appropriate.

Prelab (20): Prior to next lab, prepare a preliminary description of your "frames". Show tabulated x & y points (0-255) and provide plots. If your points will be generated on the fly, describe as clearly as you can how this will be accomplished. Provide drawings, etc.

Laser Show (20): Successful demonstrations. Provide a PDF title page for your demo to the instructor the day before the show.