

Automated Light Focusing

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(Dated: May 1, 2023)

The following is a proposal for a device capable of automatically focusing light to its near maximum achievable intensity. I will create a system that will be capable of automatically focusing light through focal lens manipulation to achieve focused light. A focusing lens mounted in the path of the light on a ball screw linear actuator will be controlled by an Arduino. This Arduino will adjust the lens position based on feedback from a photo-resistor. This will maximize the intensity of the light which indicates that it is focused properly. The results of this calibration will be displayed to the user on an LCD.

Usage: The usage of this product is vast and can be extended to scientific applications, laser engraving, and more

I. INTRODUCTION

Focal lens manipulation can produce light with a greater intensity than the source at a given point. Using a photo-resistor, we can detect changes in light intensity based on the output voltage of the photo-resistor, thus quantifying the light intensity. This project will feed light intensity information into an Arduino Uno for processing and automatically adjust the focusing lens to achieve near maximum intensity. The focusing lens is mounted on a linear actuator which is driven by the Arduino. Upon startup, the Arduino will move the lens to one end of the linear actuator and then scan the range for maximum intensity. This range is determined by limit switches on either end of the actuator so the movable length can be changed easily. The lens then moves to the position that maximizes intensity. The maximum scanned intensity is displayed on the LCD and the final achieved intensity is displaced after the lens moves to its maximum.

II. LIST OF PARTS REQUIRED

- Arduino Uno
- Photo-resistor
- Befenybay 200mm Linear Stage Actuator (\$83.80)
 - Based on NEMA17 Stepper Motor
 - <https://a.co/d/cmZhvf6>
- A4988 Stepper Motor Driver
- Convex Focusing Lens
 - Acquired from AdLab

- 5V Power Supply
- 12V Power Supply
- Lens Mount
- Liquid-Crystal Display
- 2x Limit Switch
- Breadboard
- 22 AWG Wire

III. PROJECT DIAGRAM

A. Hardware Block Diagram

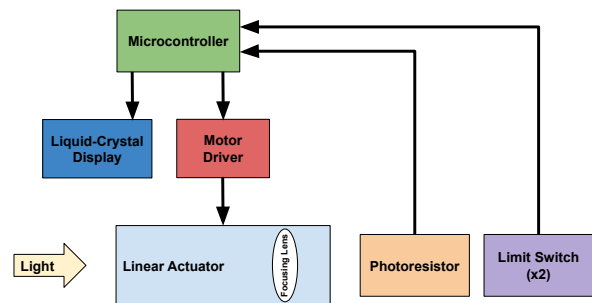


FIG. 1. Incoming light passes through a convex focusing lens mounted on a linear actuator. The light is focused through this lens and then passes through the pinhole before striking the photo-resistor. This photo-resistor gives feedback to the Arduino which manipulates the linear actuator to focus the light even more.

B. Software Block Diagram

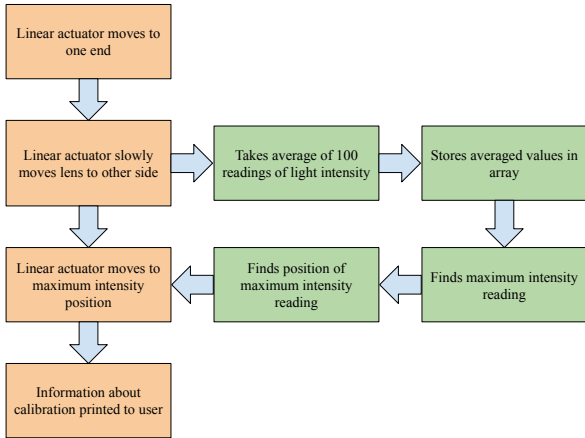


FIG. 2. Flow of events for software

C. Circuit Schematic

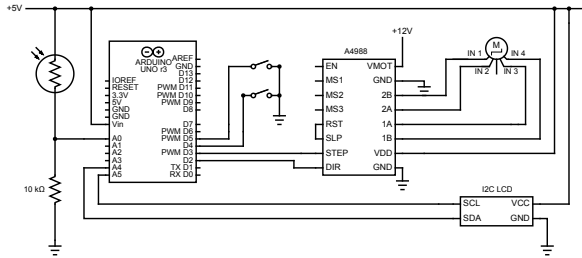


FIG. 3. Schematic of full circuit

IV. IMPLEMENTATION

- Week of 4/3/2023
 1. Test all individual components for functionality
 2. Write snippets of code for each individual component
- Week of 4/10/2023
 1. Assemble all parts
 2. Design necessary integration pieces
 3. Write functional code for focusing process
- Week of 4/17/2023
 1. Test system and identifying any issues
 2. Begin assembly into final enclosure
- Week of 4/24/2023
 1. Debug all identified issues
 2. Prepare demonstration of functionality

V. APPENDIX

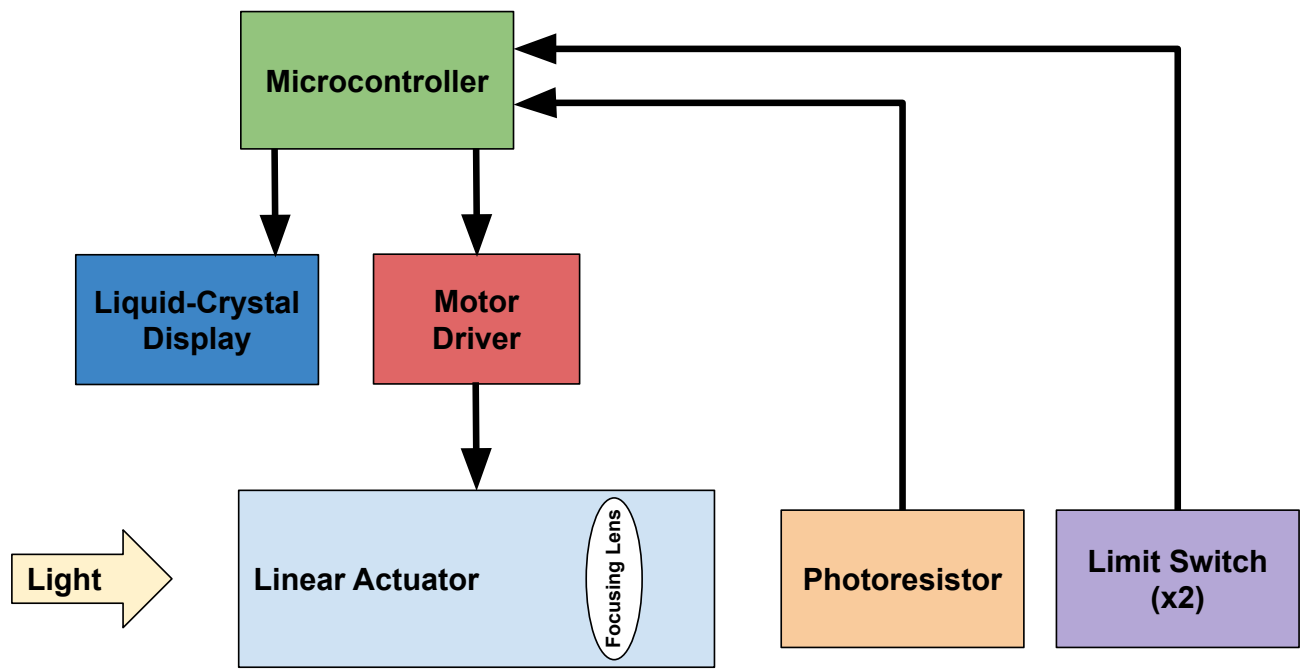


FIG. 4.

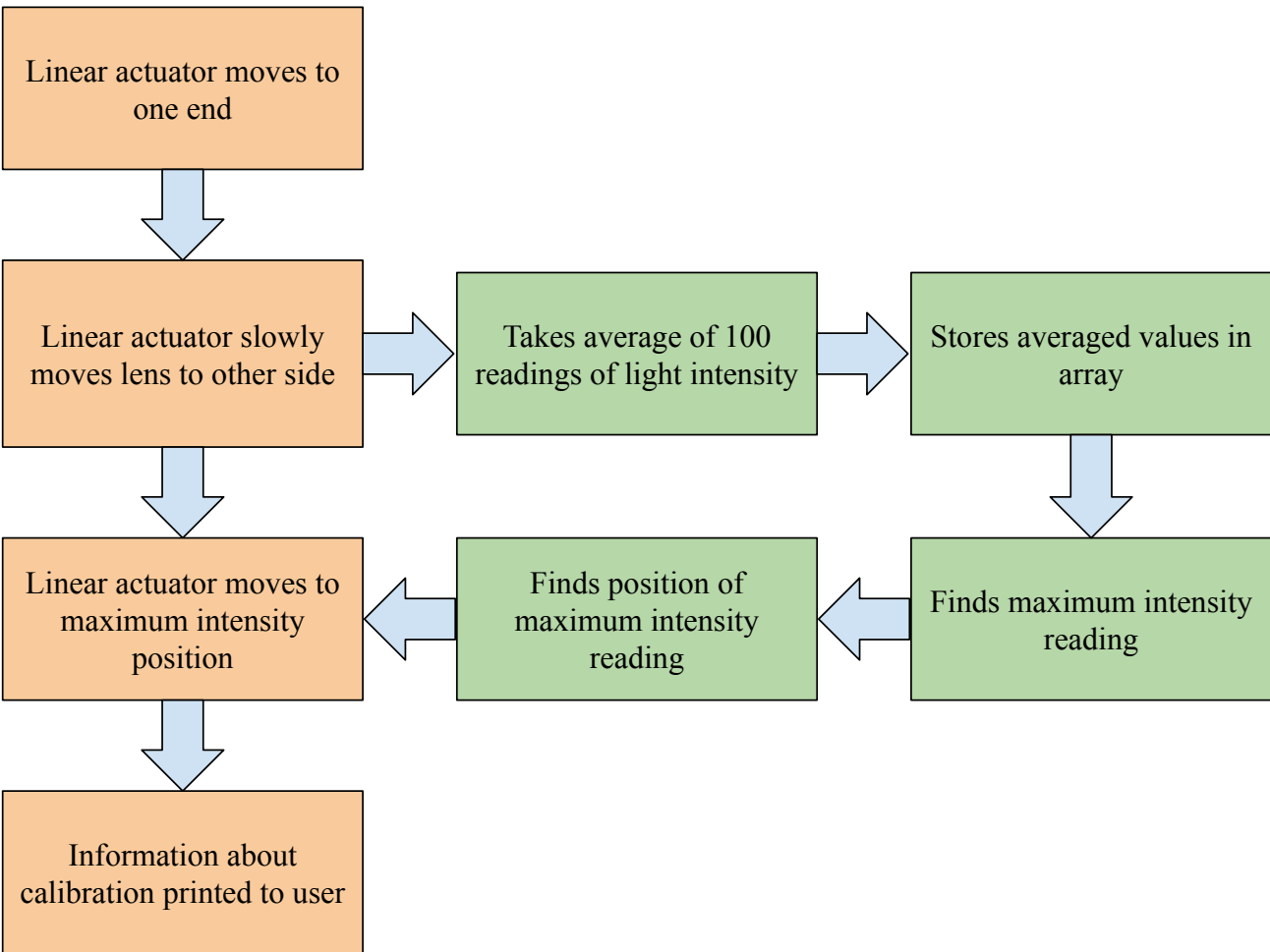


FIG. 5.

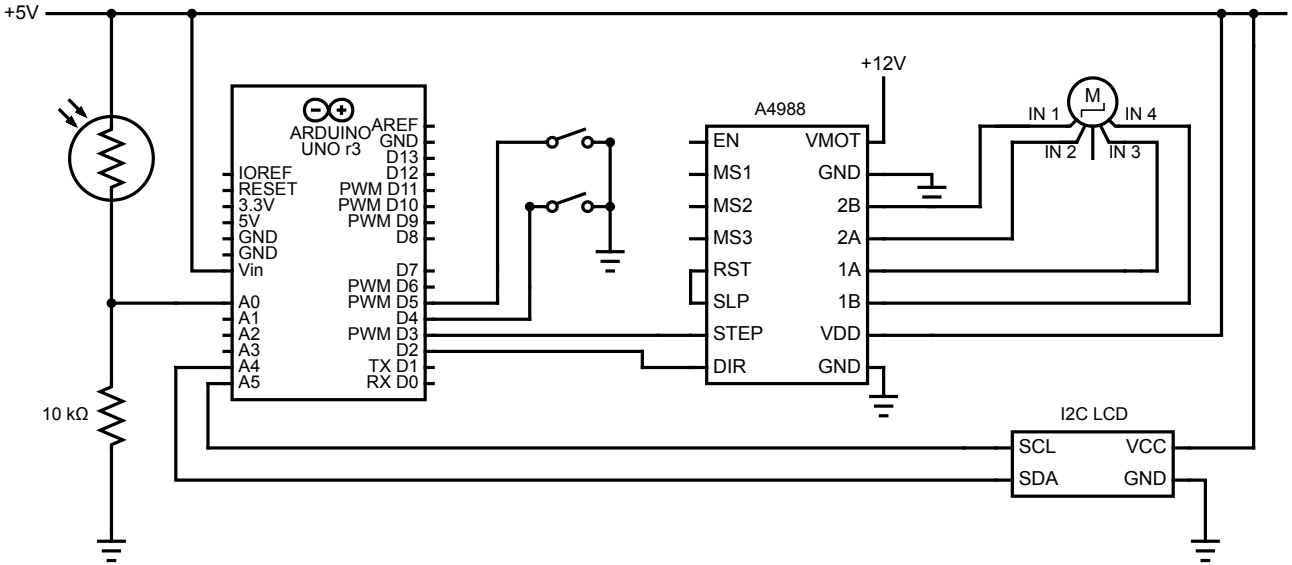


FIG. 6.