
Eye-Art: Eye-tracking Art-making with Infrared LEDs and Webcam

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Abstract

We design an eye-movement guided drawing apparatus which utilizes infrared LEDs and a webcam as a low cost method to create visual art. Our design may be used as an accessible tool for hands-free drawing, as well as expanding the intersection of creative expression through movement.

1 Introduction

The irises' property of reflecting infrared light can be used to produce accurate eye-tracking within a low budget [1] [2] [3]. The key principle of our project utilizes a webcam with its infrared filter removed, which then captures the change in infrared light caused by the iris movements. To amplify the effect of infrared reflection change, we construct our apparatus with eye-safe infrared LEDs shining on the viewer's eye. In addition to aiding people with disabilities, eye-tracking represents a new tool for advancing interactive art. Our project uses existing technology to translate eye movement to visuals, making art accessible in a novel way.

1.1 Background

Infrared sensor eye tracking works through the change of reflected light: As the iris approaches one sensor, the reflected light decreases and the sensor value increases. Conversely, when the iris moves away, the reflected light increases and the sensor value of the photo reflector decreases. A webcam with its infrared filter removed allows for the camera to capture the infrared light reflected by the iris.

Hands-free drawing has been of interest especially for the disability community. Other projects with the goal of producing art with eye-movement include The EyeWriter by Free Art and Technology (FAT), OpenFrameworks, the Graffiti Research Lab, and The Ebeling Group. Another, TEMPTONE works with a graffiti artist who was paralyzed as a result of Lou Gehrig's disease (ALS). TEMPTONE's apparatus uses infrared sensors and a camera. However, their use of a micro CCD camera—which captures optical signals with high-sensitivity—is a far more expensive alternative to our proposed design.

Our design is related to process art—an artistic movement which includes the process of art-making as a prominent aspect of the completed work [6].

2 Components

Arduino: A micro-controller for processing webcam footage and output drawing on the display

Webcam: Captures infrared light reflected by iris after removing the infrared filter

Infrared LED x 8: Provide the infrared light to the eye.

22 AWG wire : Connects the infrared LED, Arduino, and the display.

Chin rest: Supports the viewer's chin as well as providing a stabilized view into the webcam. Our prototype of a chin rest is made with a cushion.

Graphic LCD 84x48, Nokia 5110: Displays the drawing.

Computer screen: Alternative display of the drawing.

3 Method

The first step is to remove infrared filter from webcam. This requires disassembly to remove the grating, therefore a cheaper camera is preferable. With this filter removed, the webcam senses infrared reflections, in this case specifically from the iris.

Next, we must modify the code for eye-tracking using Matlab to output coordinates.

Because the LCD display only takes inputs as lines, we will write program using the change of coordinates to write to display.

Once the coding is done, we will secure webcam close to where the participant's eyes would be when situated at the chin rest

Lastly, we will attach LEDs close to the sight of view and connect the LEDs to the breadboard. Once done, we can power the breadboard with Arduino outputs and output the visual art.

4 Discussion

4.1 Safety

Our design would subject the viewer to infrared light produced by infrared LEDs. An irradiance level less than 10 mW/cm² is considered safe for chronic IR exposure in the 720-1400 nm range. [5] Thus, the apparatus would be safe for longterm use.

A References

[1]: Using Active IR for eye detection and tracking. https://sites.tufts.edu/eeseniordesignhandbook/files/2017/05/Violet_Tufuor.pdf

[2]: Eye Motion Tracking Using Infrared Sensor - Arduino Project Hub. <https://create.arduino.cc/projecthub/H0meMadeGarbage/eye-motion-tracking-using-infrared-sensor-227467>

[3]: Eye tracking with a webcam, matlab and arduino. <https://www.youtube.com/watch?v=ztaJDjMQH68>

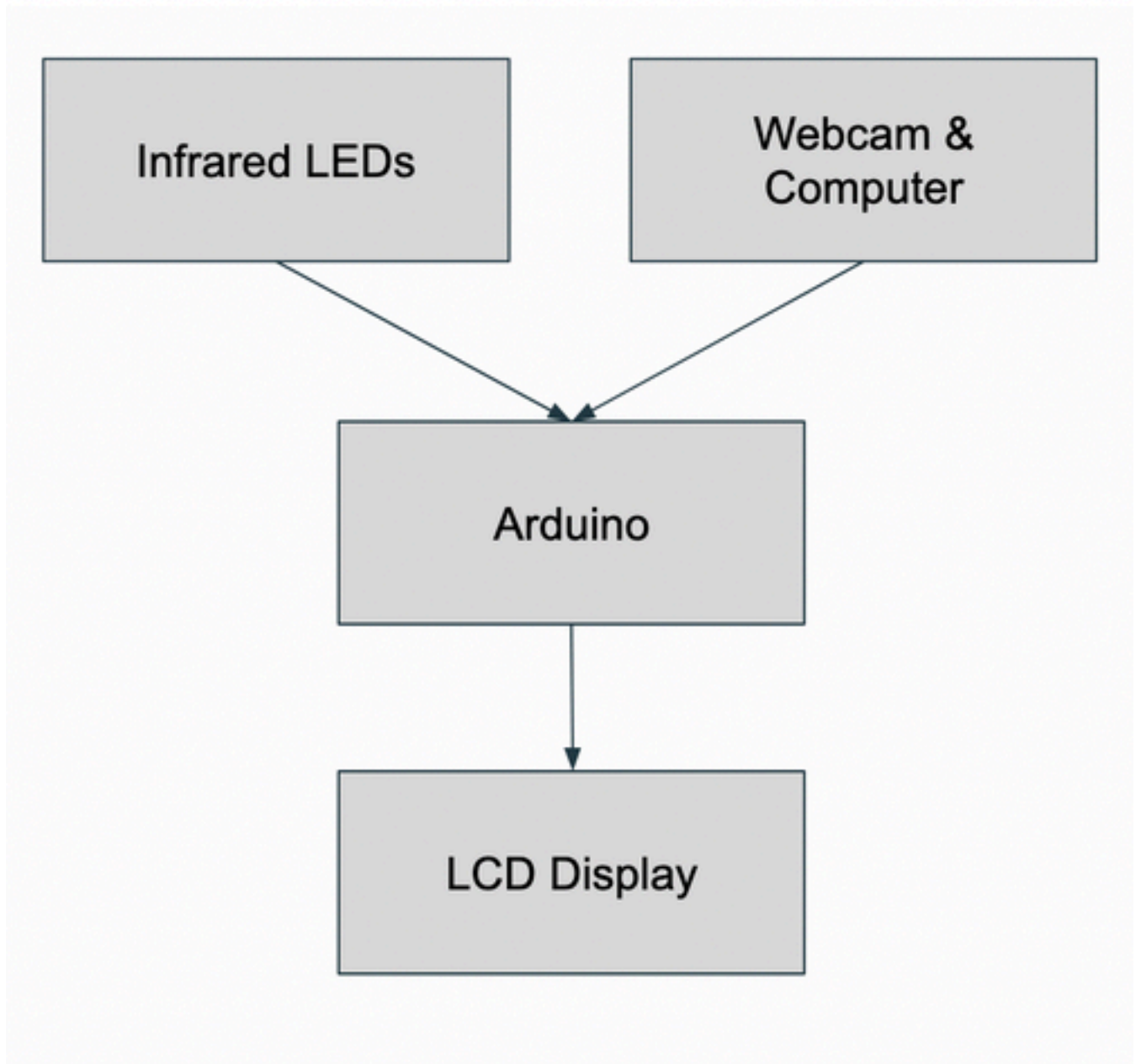
[4]: Art created with hydra (live-coding for visuals) <https://photos.app.goo.gl/1HGUDVvH2piYbUzu7>

[5]: Slinky, D., and M. Wolbarst. Safety with Lasers and Other Optical Sources. New York: Plenum Press, 1980.

[6]: Process Art. <https://www.tate.org.uk/art/art-terms/p/process-art>

B Appendix

B1: Block Diagram



B2: Schematics

