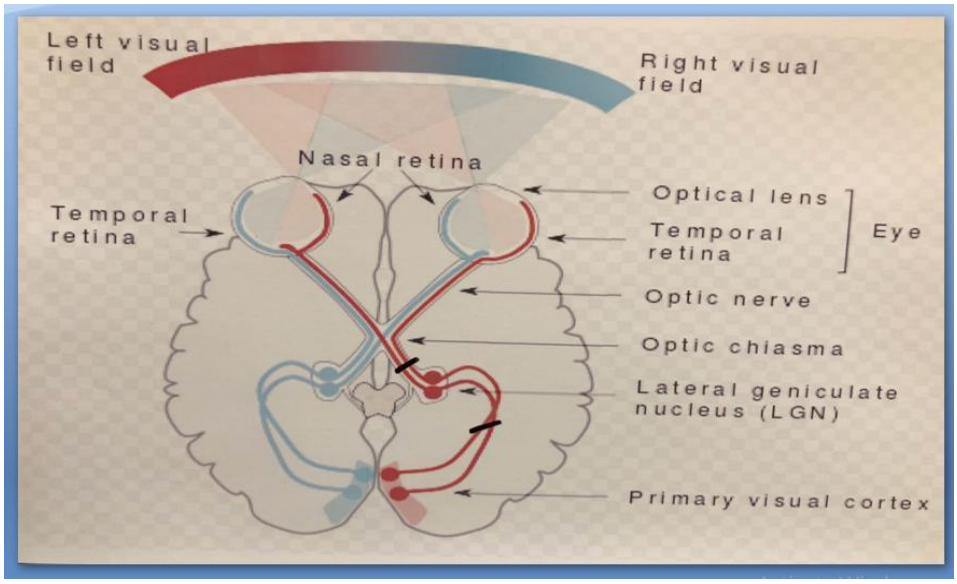
SMART Glasses for Visual Deficits:
Integration of Open Sources Technology to Create A Practical Solution for Visually Impaired patients

INTRODUCTION

Visual Deficits are one of the most disabling neurological problems that patients are burdened with due to brain damage from fatal injuries or diseases, inducing strike, traumatic brain injury (TBI), and tumors, specifically, stroke make up 60% of all cases, while TBI and tumors account for 28% of all cases. The most common visual deficit is homonymous hemianopia (HH) which results in loss of sight in half of the visual field in each eye. Currently the most common management for HH is occupational therapy, vision training, and the use of prisms however, these solutions are only partially effective, and many patients are left visually disabled or even housebound. To improve the standard of life these patients, I explored whether SMART Glasses could be used to treat patients with visual field deficits.





PRELIMINARY QUESTION

Is it possible to create a hardware prototype that has potential of assisting patients with homonymous hemianopia through use of open source technology?

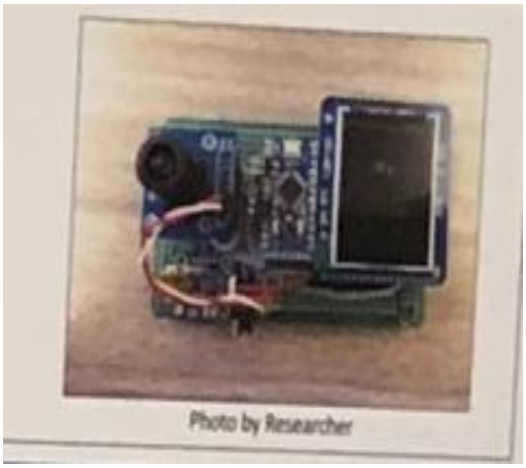
ENGINEERING GOAL / HYPOTHESIS

Developing a hardware model for Smart Glass based on open source technology to assist patients homonymous hemianopia is possible

METHODS AND MATERIALS

Using an interactive approach I produced four prototype model.

The first prototype used an "Arduino Pro Mini" processor, a llithium– polymer battery, a Thin-Film-Transistor (TFT) display, and a camera module assembled on a perforated prototyping board. This prototype demonstrated that the battery effectively powered the system.



Components

* Arduino Pro Mini (3.3V, 8MHz)

* OV7670 Camera Module

* HiLetgo 1.8* ST7735R SPI 128160 TFT Display

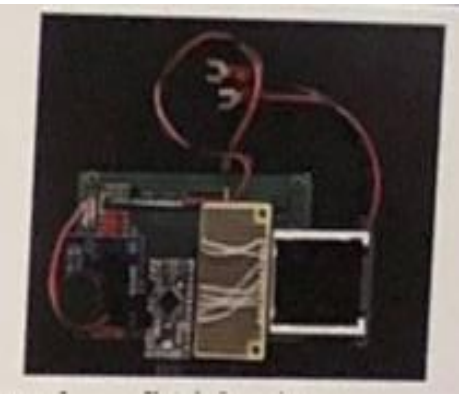
* Double-sided Prototyping Board

* Lithium Polymer (LiPo) Battery

* Adafruit Mini Lipo with a Mini-B US8 Jack

* 10k Resistors (2X)

The second prototype used an 'Ardunio Pro Mini". A Smaller TFT display (128*128 rather than 160*128), and a camera module. This prototype demonstrated that the hardware can be complied in a more compressed manner which, in effect, increases efficiency.



Components

* Arduina Pro Mini (SV, 16MHz)

* OV7670 Camera Module

* Adafruit 1.44* Color 128128 TFT Display ST7735R

* Bidirectional Level Shifters (3X)

* Regulator

This prototype connects to a voltage supplier rather than a battery

The third prototype is composed of a pre-programmed organic Light Emitting Diodes (OLED) display which showed the ideal light emission, clarity, and contrast for image

projection in SMART Glasses hardware. To demonstrate the practical application of the third prototype, an optical model was shaped out of cardboard and masking tape as a supplement to the OLED. The Primary piece of optics used in this prototype is a 50-50 beam splitter which transmits and reflects both an incoming image as well as the projected image from the display screen therefore, the deflected visual field is projected into a corner of the intact visual field allowing the patients to see both visual fields.



Components

* Arduino Pro Mini (SV, 16MH2)

* Newhaven Display Int NHD-127-12896063

* 50/50 Beam Splitter

* Cardboard Optical Model

    * Five pieces of cardboard

        * Four Pieces: 445 cm'276 cm (wl)

        * One Piece: 3.175 cm*3.175 cm (wl)

*This prototype connects to a voltage supplier rather than a battery"

Finally, the fourth prototype was created to explore the potential of an OLED based on the conviction of processing through the hardware rather than software. A large variable is the speed of the projection on the screen. This prototype. The software runs general purpose

programming making the displayed images slower. However, the hardware which is built directly into the chip, independently updates the image, thus allowing the display to present the image faster.



Components

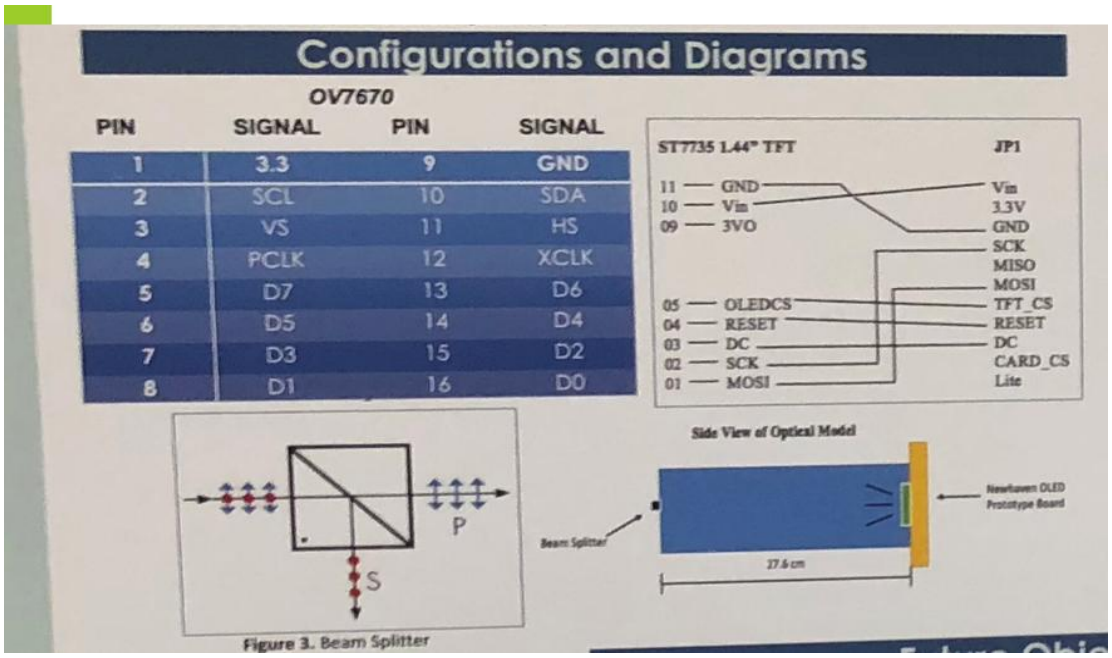
* Arduino Pro Mini (SV, 16MH2)

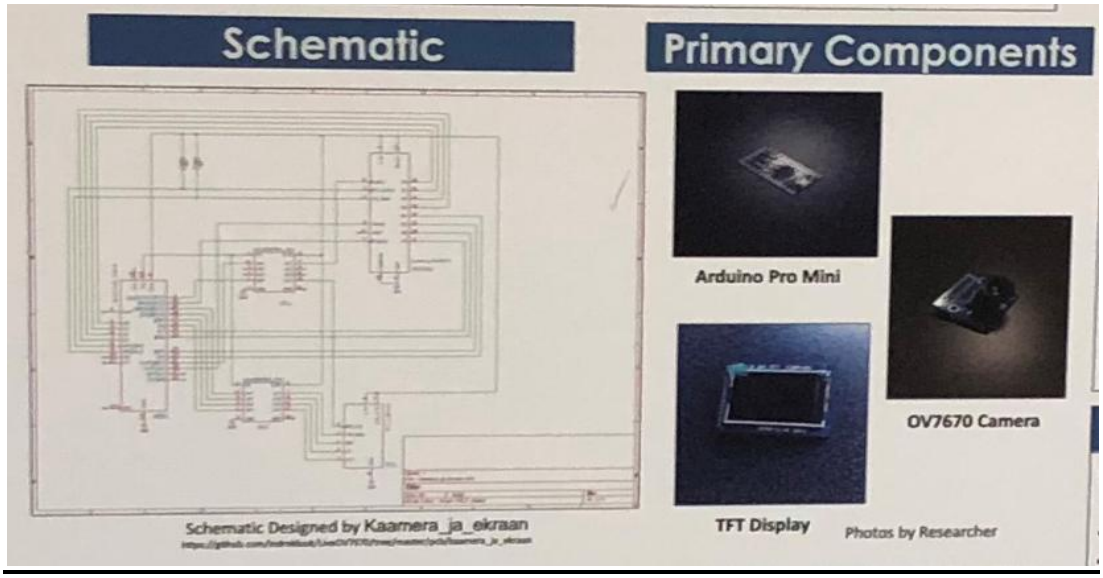
* Adafruit OLED Breakout Board - 16 bit Color 1.5*

* Arduino Genuino Uno

* Optional Perforated Board

This prototype connects to a computer's USB port rather than a battery





PROTOTYPE MODELS RESULTS & VARIABLES:

Prototype One

Variables:

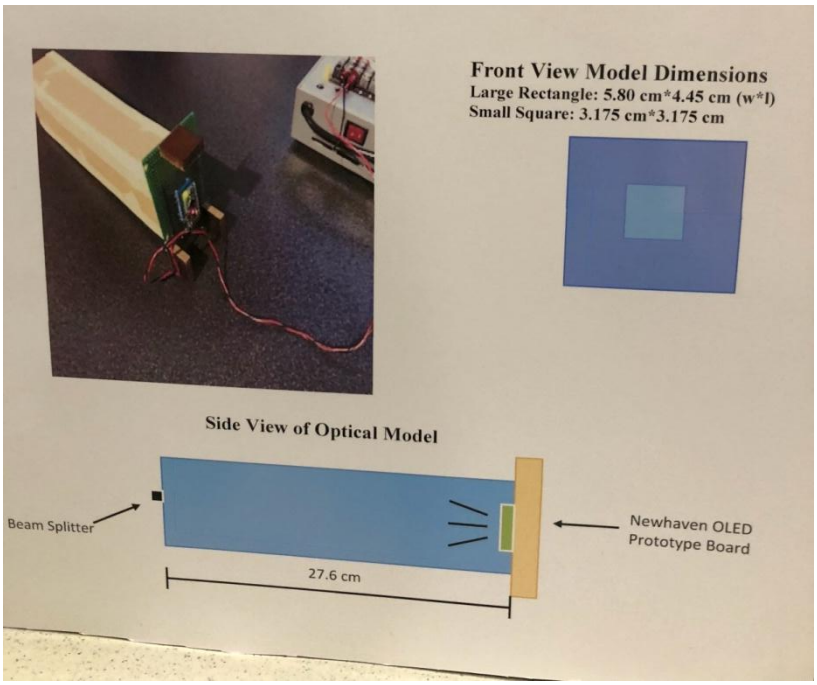
*Add a regulator → The power needs to be distributed evenly from the LiPo battery

*Regulator drains power from the system → Add two 10k resistors to supply proper voltage to the camera, display, and Arduino → Vertical Syne every tenth of a second 110 fps)

*Attempt to switch to gray scale in order to bring device up to 20 fps→ Software folders and libraries did not respond properly

*After charging the battery for over eight hours, its voltage supplied increases from about 3.7V to 4.09V→ Causes the system to go awry due to excess power supply to the camera which has a 3,3V capacity, Therefore, the image on the TFT flickers.

Variables in Prototype Three are given in the figure:



RESULTS

The use of open-source technology to produce a useable solution was challenging, the focus of these prototypes was to create a system using the OV7670 camera module, the "Arduino Pro Mini," and a TFT/OLED display. The processing power was not sufficient to integrate a system that can be implemented into a medical device. The fourth prototype

shows that the system has to be processed through the hardware system rather than the software because the hardware increases efficiency. Therefore, this project was success in terms of creating model through the use of open-source technology.