



NYU

TANDON SCHOOL
OF ENGINEERING

REFRESHABLE BRAILLE DISPLAY

ADVANCED MECHATRONICS

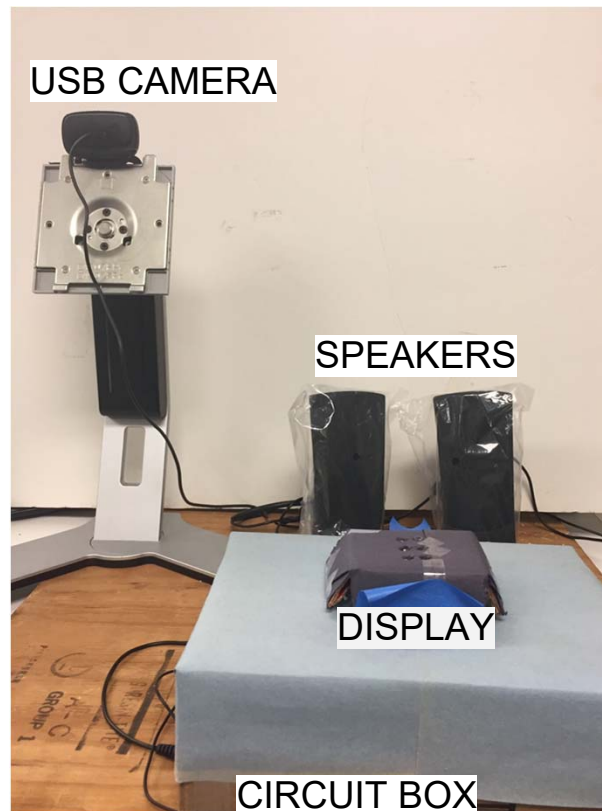
FINAL PROJECT

ARDUINO + RASPBERRY PI MICROCONTROLLER

HAIMING GANG

TANAYA BHAVE

REFRESHABLE BRAILLE DISPLAY



COMPONENTS USED

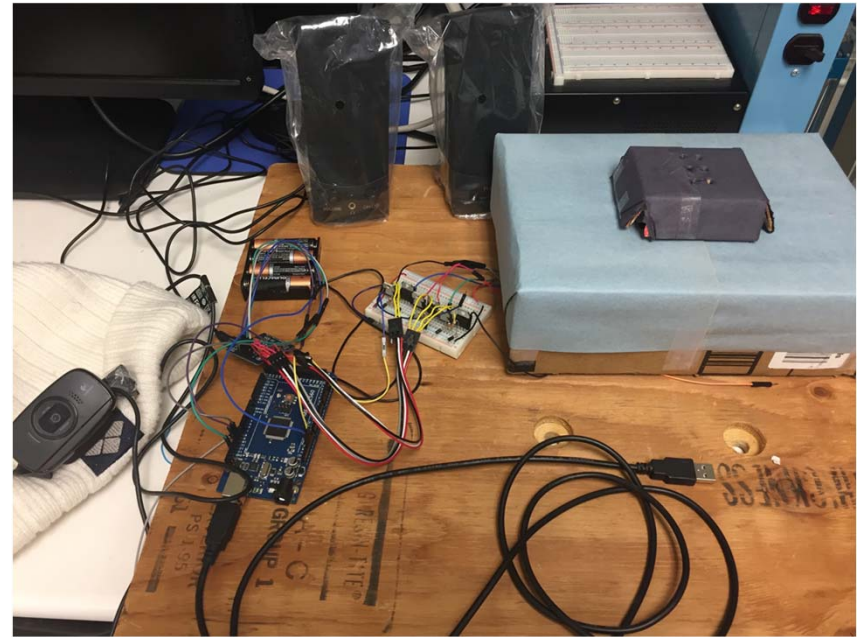
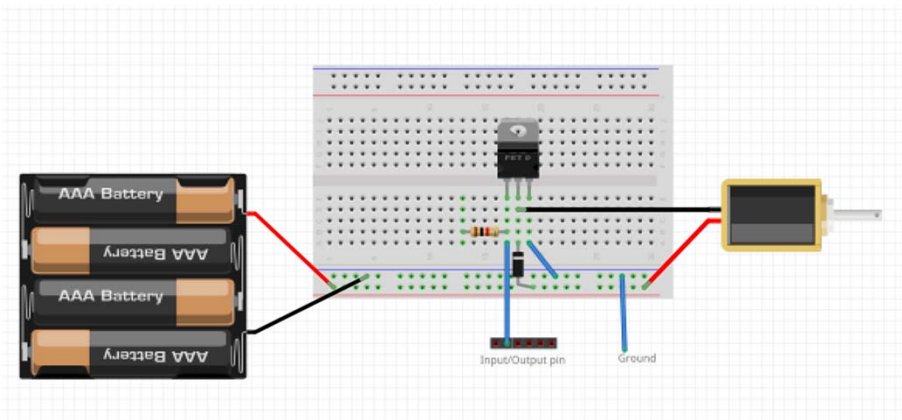
- Raspberry Pi- Raspberry Pi was used as the main microcontroller. It was used to capture the image from a USB camera and then store the characters of an image to string. The string is sent to Arduino serially
- Arduino- Arduino was used to receive string input from Raspberry Pi and then sends it to the mechanical refreshable Braille display. Also it send the string to the text to speech module
- Solenoids- Solenoids are used for the mechanical actuation of the Braille cells. 6 solenoids constitute one Braille cell. The solenoids are rated for 5volts and can be controlled using the Arduino
- Text to speech module- The text to speech module receives a string input from the Arduino and converts it speech
- Speakers- To hear the output from text to speech module

- USB Camera- To capture image from Raspberry pi using opencv
- Jumper Wires- To make connections
- Transistors and Diodes- To connect solenoids to the microcontroller

FEATURES

- Refreshable braille cells- The Braille cell changes according to the alphabet.
- Audio output- The display can also be used as an audio book to read files from SD card or any input from the USB camera.
- Read any physical book or newspaper using the display and USB camera

Circuit Diagram

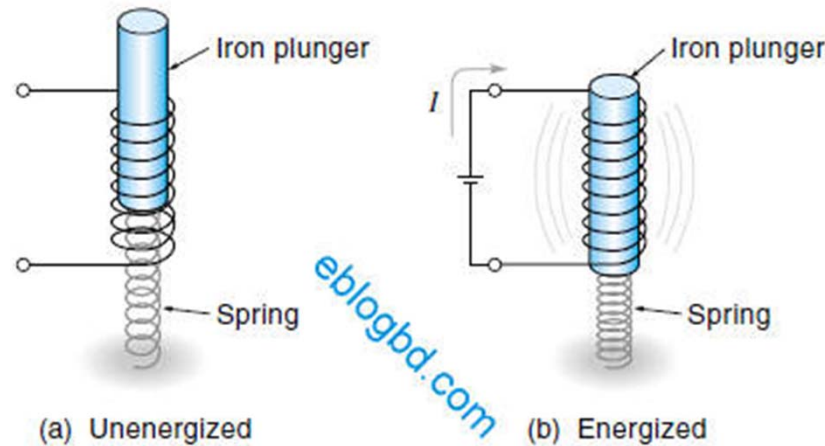


WORKING OF THE DISPLAY

To be able to read from images, we needed OCR software Tesseract. So we installed the Tesseract app on the Raspberry Pi. Next we needed a Python wrapper to use the Tesseract, so we downloaded PyTesseract to run it along with our code. So while running the program in a loop, we grab images using the USB camera and save it using opencv. The words in the image are converted to text using the Tesseract engine. Then this text is sent to Arduino serially and the Arduino code is run. We downloaded the Arduino IDE on the Raspberry Pi to be able to send commands to it.

The text received by Arduino is sent to the text to speech conversion module and then converted to speech. The speakers/headphones can be connected in the 3.5mm Audio Jack available in the text to speech “Emic-2” module. The Arduino then sends signal to the Braille cell for the actuation of each solenoid, forming different words on the display. When an electric current passes through the solenoid coil it creates a magnetic field. The magnetic field exerts a force on the plunger.

As a result, the plunger is pulled toward the centre of the coil so that the orifice opens. In this process, the pin attached to the solenoid moves up displaying a part of the Braille cell.



Cost for the display

Components	Quantity	Cost for 1(in \$)	Total(in \$)
Microcontroller	2	90	90
Solenoids	6	1.16	6.96
Jumper Wires	90	-	5.85
Magnetic Shielding tape	50m	-	11.5
Text to speech module	1	50	48.99
Magnetics	24	-	11
Transistors	12	0.725	8.7
Diodes	12	0.226	2.71
		Total:	186.67

Demo



Scope

- Fit the Braille cells to standard size
- Improve accuracy of word recognition

References:

- A compact electroactive polymer actuator suitable for refreshable Braille display Kailiang Ren a, Sheng Liu a, Minren Lin b, Yong Wang a, Q.M. Zhang a,b,* a Department of Electrical Engineering, The Pennsylvania State University, University Park, PA 16802, United States b Materials Research Institute, The Pennsylvania State University, University Park, PA 16802, United States Received 5 April 2007; received in revised form 18 October 2007; accepted 29 October 2007 Available online 13 November 2007
- <http://www.engin.umich.edu/college/about/news/stories/2015/december/bringing-braille-back-with-a-better-display-technology>
- <http://www.dotincorp.com/>
- <https://courses.engr.illinois.edu/ece445/getfile.asp?id=5200>
- American National Standard: Accessible and Usable Buildings and Facilities: 2003:Standard and Commentary. ICC/ANSI A117.1-2003. P151-163.
- National Library Service for the Blind and Physically Handicapped, Library of Congress.Specification 800: Braille Books and Pamphlets.<www.loc.gov/nls/specs/800_march5_2008.pdf>
- State of California, Department of General Services, Division of the State Architect. <www.dsa.dgs.ca.gov/Access/braille.htm>
- U.S. Access Board. ABA and ADA Accessibility Guidelines, 2004,<<http://www.accessboard.gov/ada-aba/guide.ht>
- <https://rdmilligan.wordpress.com/2014/11/21/ocr-on-raspberry-pi/>

THANK YOU