NarrAUTOr

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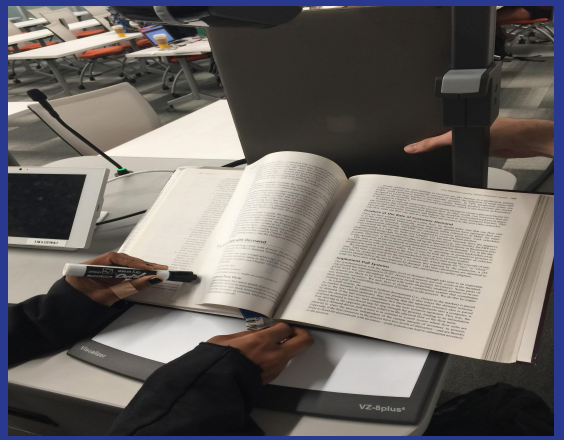
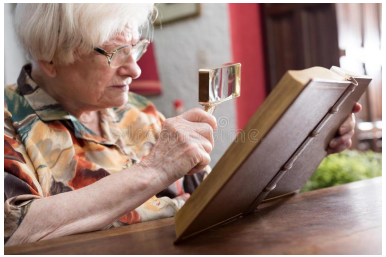


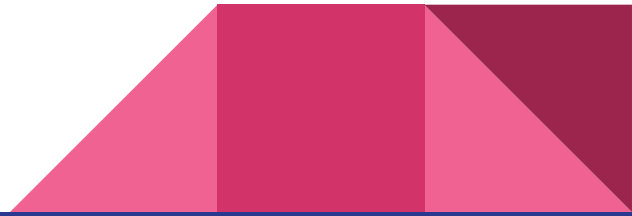
Application Area

- Unlike audio books, physical books are not easy to use hands-free, but are still what we all use most
- Project: Build a hands-free device that will read physical books aloud for user



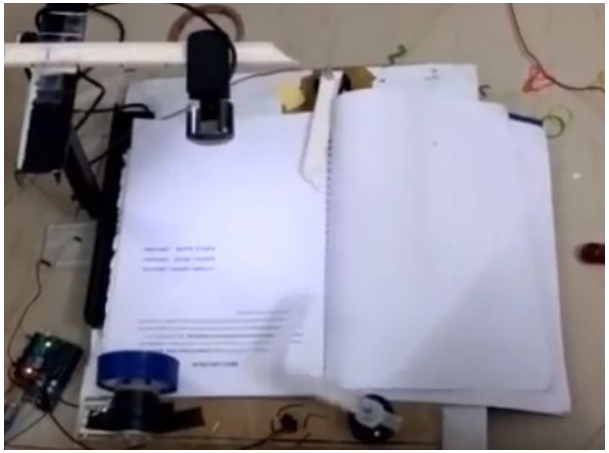
Example Use Cases

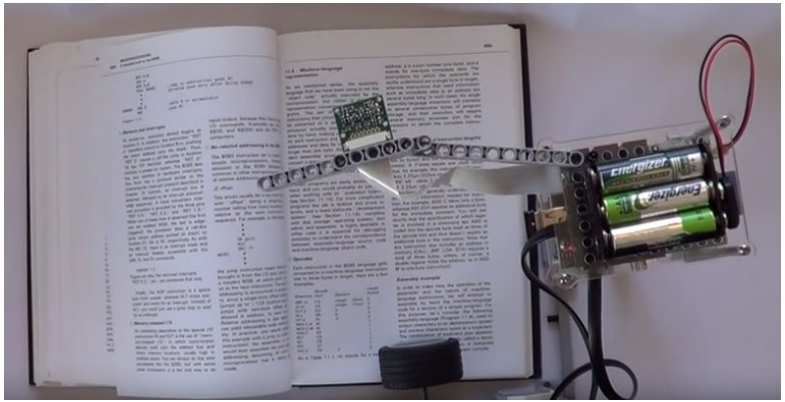
- People looking to multitask
  - Students doing assignments and using physical textbook
  - Cooking with recipe book
- For those who are visually / physically impaired
- For children who cannot read yet
- Everybody has books!



Previous Work

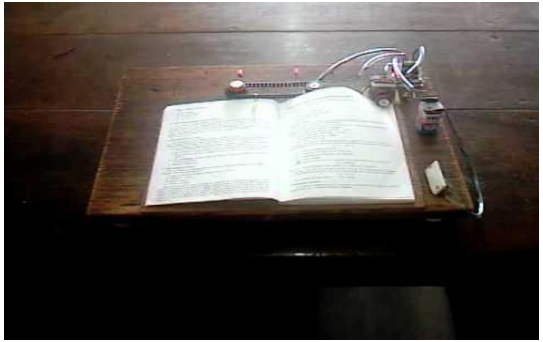
- Voice-automated page reader
  - https://www.youtube.com/watch?v=OBqZgKLyn60
- BrickPi reader
  - https://www.youtube.com/watch?v=TDYRHIGLAuM





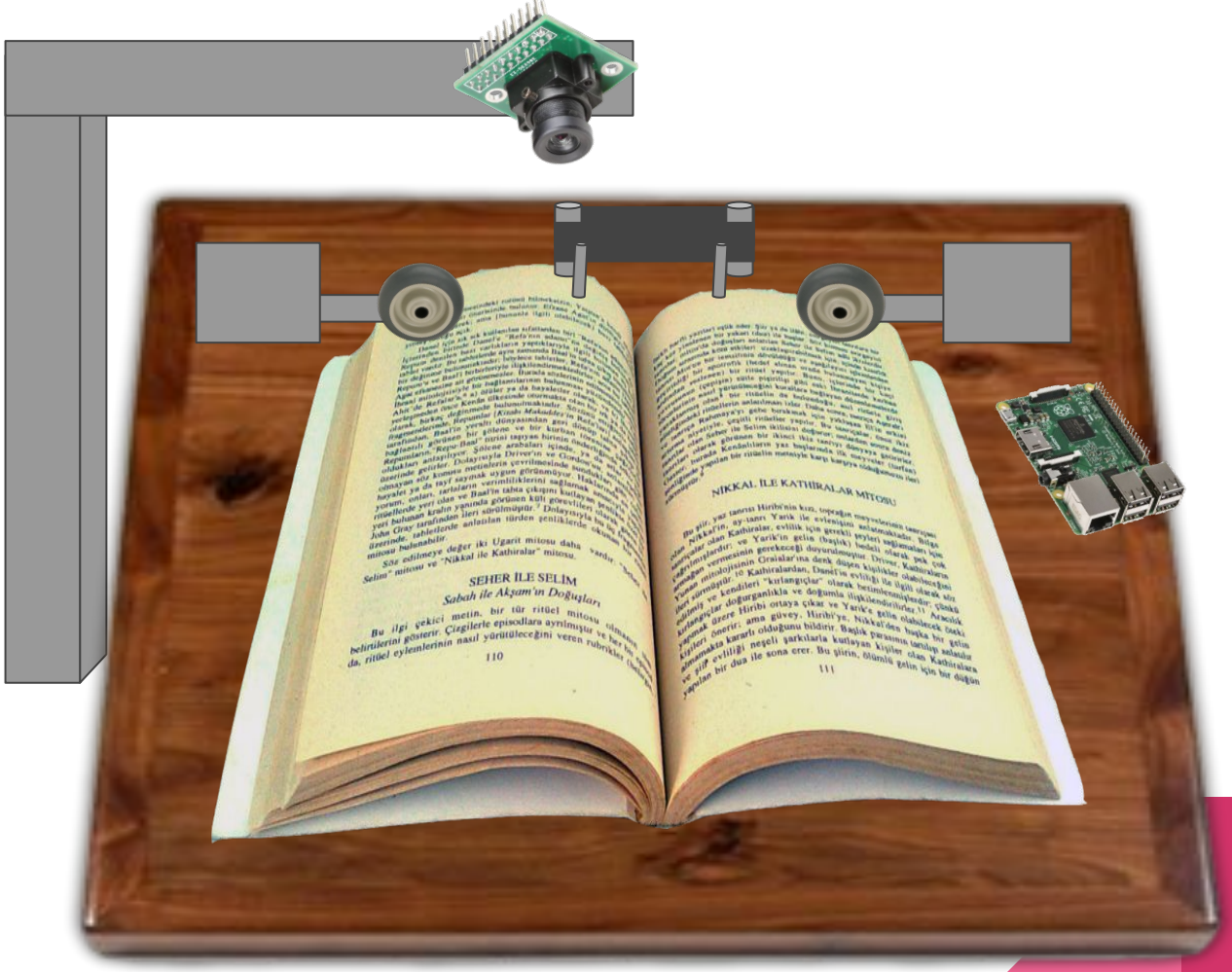
Previous Work: Page Turning

- Turn pages by hand and take pictures
  - https://youtu.be/tE7U-2z5py4?t=2m24s
- Lego NXT page turner
  - https://www.youtube.com/watch?v=b4vtJnKFtM8
- Vacuum page turner
  - https://www.youtube.com/watch?v=0d21XOV4NPE
- Pegs on a belt page turner
  - https://www.youtube.com/watch?v=oeZaoGRgdkI
- High-speed page scanner
  - https://www.youtube.com/watch?v=03ccxwNssmo
- Fan page turner
  - https://www.youtube.com/watch?v=1eKYomgIySQ
- Lift scanner
  - https://youtu.be/hlOQuuLYavY?t=55s



Proposed Solution

- Page turning mechanism
- Stand to hold camera for camera and lights to take picture of book page
- Image-to-Text & Text-to-Speech processing
- Read book page out loud through speaker
- Microphone to control speed, operation


SEHER İLE SELİM
Sabah ile Akşam'in Doğuşları
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NIKKAL İLE KATHİRALAR MİTOSU
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How will it work?

For this book reading device we propose the following strategy:

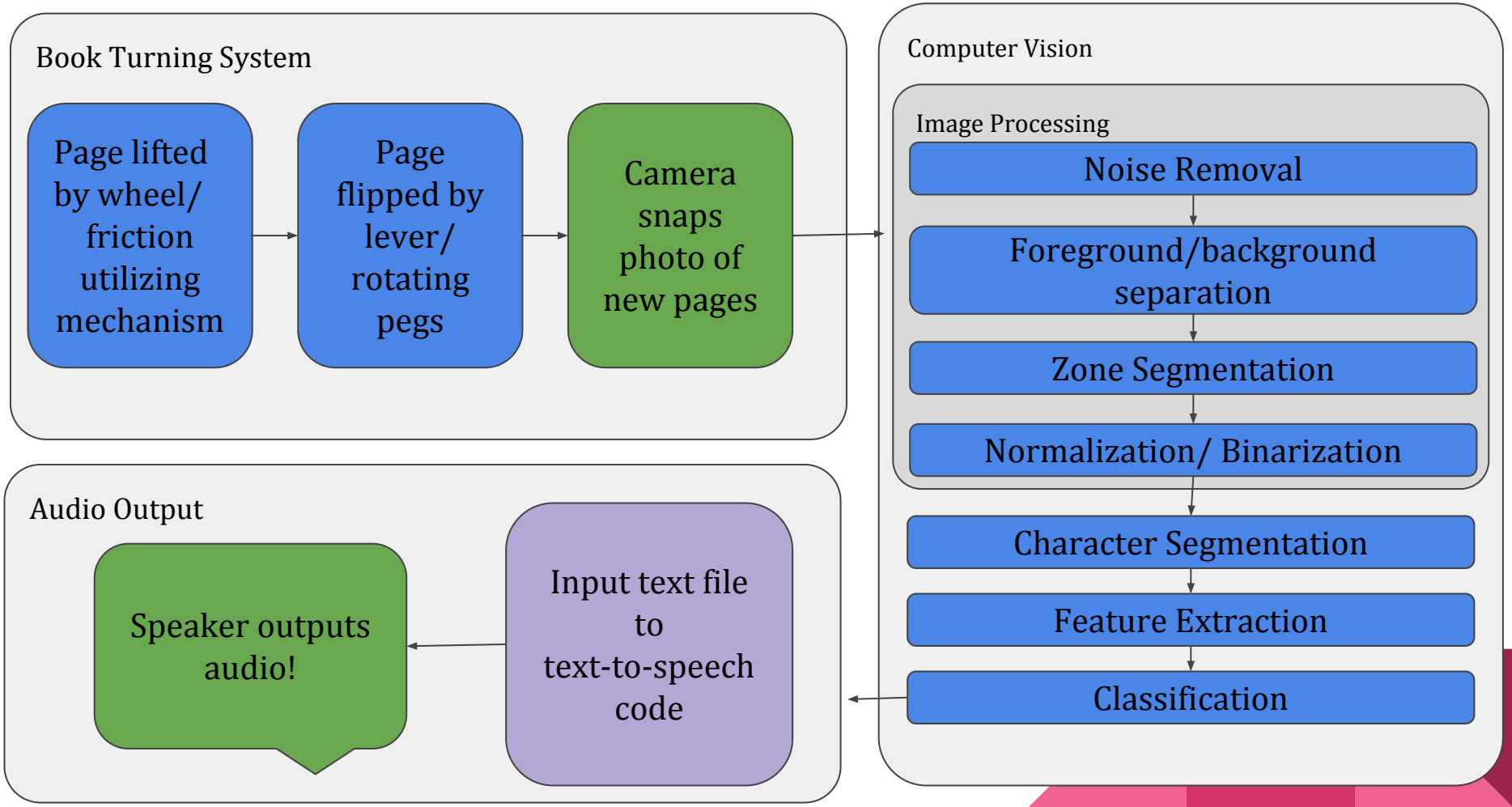
A stand would hold several servos/motors/actuators that together controlled by a Raspberry Pi would comprise a page-turning mechanism for the physical book. There would be a speaker attached to our device, through which the pi will play back the text in audio format

Stretch Goal: In addition there would be a microphone and speaker though which one can voice operate the device

Input Constraints

Input

1. Only hardback textbooks/binders will be used
2. Subject should optimally lie flat when open
3. Not doing title pages or figures (images) as of now

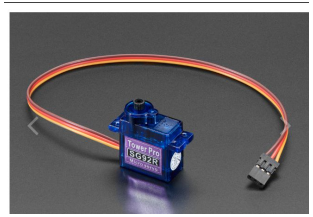

Book Turning System
Page lifted by wheel/ friction utilizing mechanism
Page flipped by lever/ rotating pegs
Camera snaps photo of new pages
Computer Vision
Image Processing
Noise Removal
Foreground/background separation
Zone Segmentation
Normalization/ Binarization
Character Segmentation
Feature Extraction
Classification
Audio Output
Speaker outputs audio!
Input text file to text-to-speech code

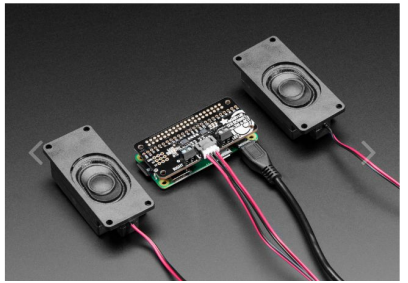
Page Scan and Text-to-Speech

- Standard image pre-processing
- Page recognition
- Text segmentation/ignoring images
- Optical Character Recognition Library
- Text-to-Speech API
  - SpeechSynthesis API
    - Ex. https://codepen.io/SteveJRobertson/pen/emGWaR
    - https://github.com/AurelioDeRosa/HTML5-API-demos/blob/master/demos/speech-synthesis-api-demo.html

ToolBox: Parts, Hardware, Software, etc.

- ArduCam (8MP)
- Speaker
- ArduCam CSI to HDMI extension cable
- Pi Cobbler (to extend pin access to breadboard)
- Microphone
- Servos
- Motor/Chain
- Raspberry Pi w/ Linux
- Solidworks/Lasercutting
- OpenCV, Tesseract





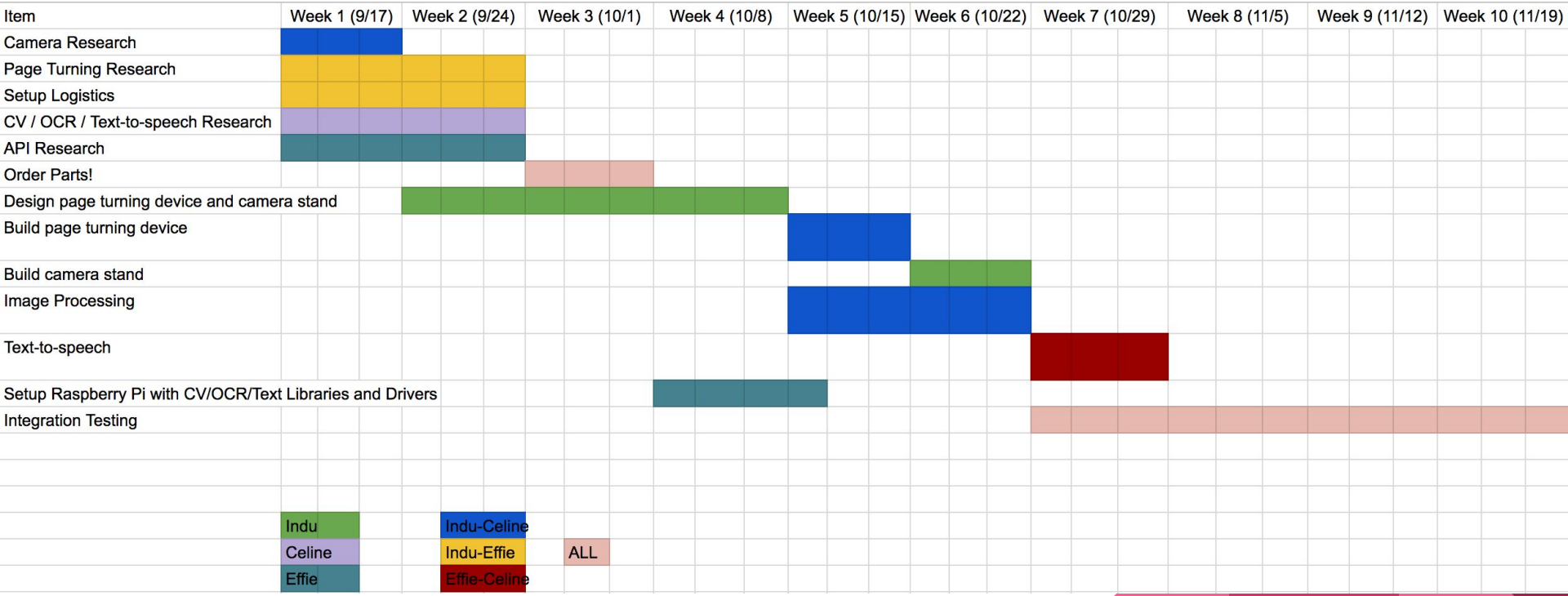
Project Requirements

Stand Design	• Adjustable camera support arm • Support use of hardcover books of a variety of sizes • Must be easy for user to swap books • Ensure book pages lie flat after turning
Page Flipping	• Gentle enough motion to prevent page rips • Flip pages forwards and backwards • Wait until done reading page to flip page
Image Processing and Image to Text	• Properly segment images and text • Handle a variety of fonts and text sizes • Transcribes text in correct reading order
Text to Speech	• Provide volume control • Provide speech speed/accent control

Testing Metrics

Stand Design	● Enable use of books of up to 12 inches in height, 8 inches in width, and 3 inches in thickness
Page Flipping	● Limit multiple page flip incidences to 1 in 20 page flips ● Flip page in under 5 seconds
Image Processing	● Correctly process text at ~95% accuracy at minimum ● No lags in audio after processing first set of pages
Text to Speech	● Limit lag time between taking first photo and initial output of audio to ~1-2 minutes

Tentative Project Timeline



Risk Factors

- In page separation, if using wheel, it can start to move off
  - Secure page separation part, such as bar preventing outside movement
- Ripping page during page turn
  - We believe peg solution is gentlest method
- Accuracy will definitely not be perfect
  - Will it be enough that people can understand?

THANK YOU

Links to possible parts

Camera: https://bit.ly/2xv52Lw
Extension cable for camera to pi thru hdmi: http://www.uctronics.com/arducam-csi-to-hdmi-cable-extension-module-with-15pin-80mm-fpc-cable-for-raspberry-pi-camera-specific-pack-of-2.html
Conveyer Belt: pulleys for chain to go over x4: https://www.adafruit.com/product/1251
Chain: https://amzn.to/2MIFobN
Servos: https://www.adafruit.com/product/155
Pi: https://bit.ly/2PLzDw1
Sd Card for pi: https://bit.ly/2PEhHDm
Wires for pi: https://www.robotshop.com/en/dfrobot-assorted-jumper-wires-premium.html
Assembled Pi Cobbler Plus - Breakout Cable - for Pi B+/A+/Pi 2/Pi 3-https://www.adafruit.com/product/2029
Pi LCD Screen? Not sure if need - https://www.adafruit.com/product/1115
Potential Pi Hat w/ speakers and mic and headphone jack? https://amzn.to/2MItn6i
Microphone for pi's USB slot - https://amzn.to/2NQp9OJ
Stepper Motor HAT for Raspberry Pi - https://bit.ly/2pgv5CN
Motor driver chip - **L293NE** https://bit.ly/2PITN9T
Motors - https://bit.ly/2NScTNz
Shtender/Lectern https://www.judaicawebstore.com/-solid-wood-book-stand-shtender--jerusa[illegible]13.aspx