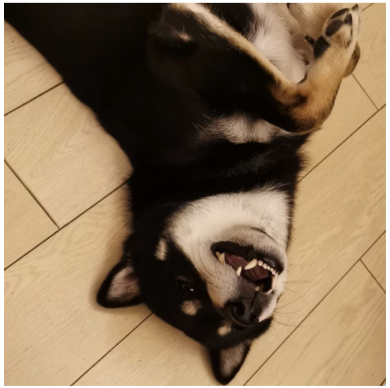
Lance Zhang
Tian Lu
Yuze Bian
Weiwei Wang

Team Member

Lance Zhang
(PM)



Tian Lu
(CTO)

Yuze Bian
(COO)

Weiwei Wang
(CPO)

Outline

Introduction and Background

Motivation

Business Case and Cost

Technical Case

Risk Management

Standards and Sustainability

Proof-of-Concept Demonstration

Self-Reflection

Schedule and Plan for 440

Conclusion

Introduction and Background

- Axial resistors are commonly used for academic purposes.
  - Breadboard Testing
  - PCB Design

- In SFU's engineering lab,
- each student/group will get a lab assignment every 2-3 weeks.
  - It usually requires the students to take 10-15 resistors
  - No One remembers the values after the lab
  - Finding desired value using DMM is inefficient

Motivation

Personal Experience

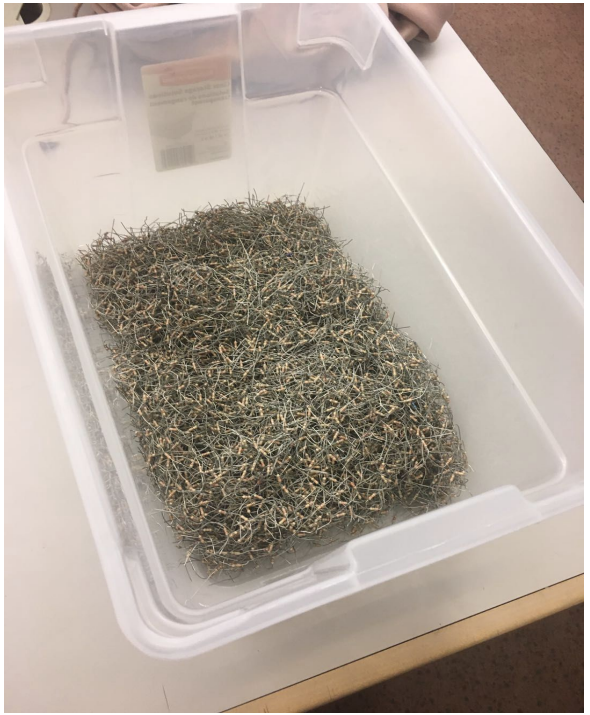
It all started with…

Us trying to sort out 1k to 10k resistors from a pile of used ones.

Motivation

Further Research

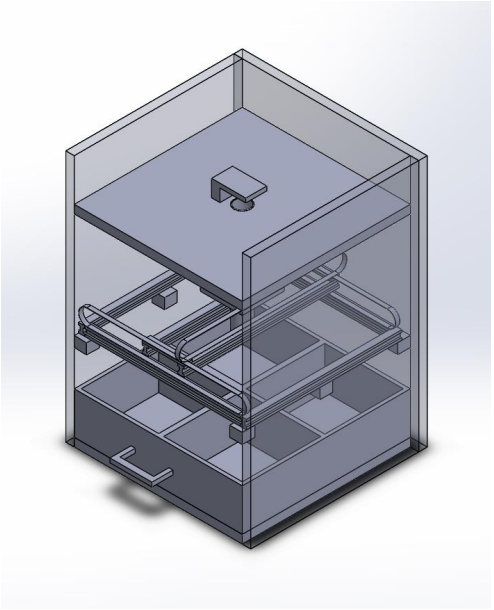
- Fred keeps a bin of used ones in his office
- Making students buy their own resistor?
- Ordering from China Manufacturer



The Star Today:

ResistWaste

Automated Resistor Sorter System



Market

Target Market:

- University labs
- Circuit design company

Current Market:

- A pack of 5 same value resistor is around $0.79 [1]
- One term of the total resistor cost is around 3000
  4*50*3*5=3000
  (4 courses per term -> 200 students -> 50 lab groups -> 3 lab experiments per term ->5 resistors per lab experiments)
- Huge price gap between different amount of resistors purchase [2]

Price Break	Unit Price	Extended Price
1	0.15000	$0.15
10	0.11200	$1.12
25	0.07760	$1.94
50	0.06020	$3.01
100	0.04300	$4.30
250	0.03356	$8.39
500	0.02666	$13.33
1,000	0.01893	$18.93
5,000	0.01462	$73.11

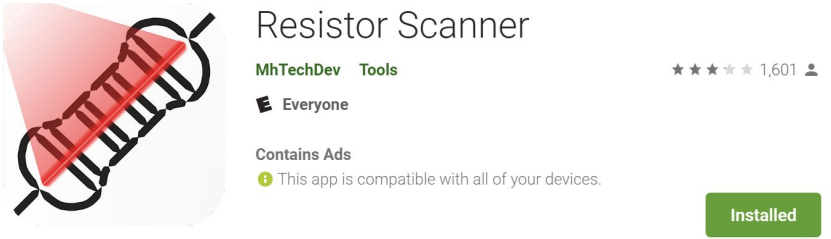
"Price Reference from Digi-Key.ca"

Competition

- The digital multimeter (DMM) is the current common tool to measure the resistor

- There is no any products like ResistWaste in market can perform
  - Measuring the value of the resistor without DMM
  - Recycling the resistor

- One similar phone application in Google Play call Resistor Scanner[3]
  - Hard to focus in some devices
  - Bad color detection
  - Doesn't recognize resistors



“Reference from google play”

Cost & Price

Costs for Prototype: $824.98

Step Motor	Motors used to drive X-Y Table	$50
Raspberry Pi	The main microcontroller used for image processing	$89.99
Arduino	The main microcontroller used for X-Y Table	$35.99
Pi Camera	Used for taking pictures of resistor	$43
X10 Macro Lens	Used to magnifying the resistor picture	$30
3D Printing Parts	The holders used for gears, motors, and camera	$180
Belt	Connect bar with gear	$25.5
Aluminum Bar	Establish the main structure of the X-Y Table	$89
Shaft	Connected with 2 belts	$19
Motor Driver	Used to control 2 motors	$10
Wheel	Used to move bars	$60
Holding Parts	Screw/Washer/Corner Brace/Coupler	$192.5

Cost & Price

Potential Costs: $160+$250 =$410

Total Maximum Costs: $1235

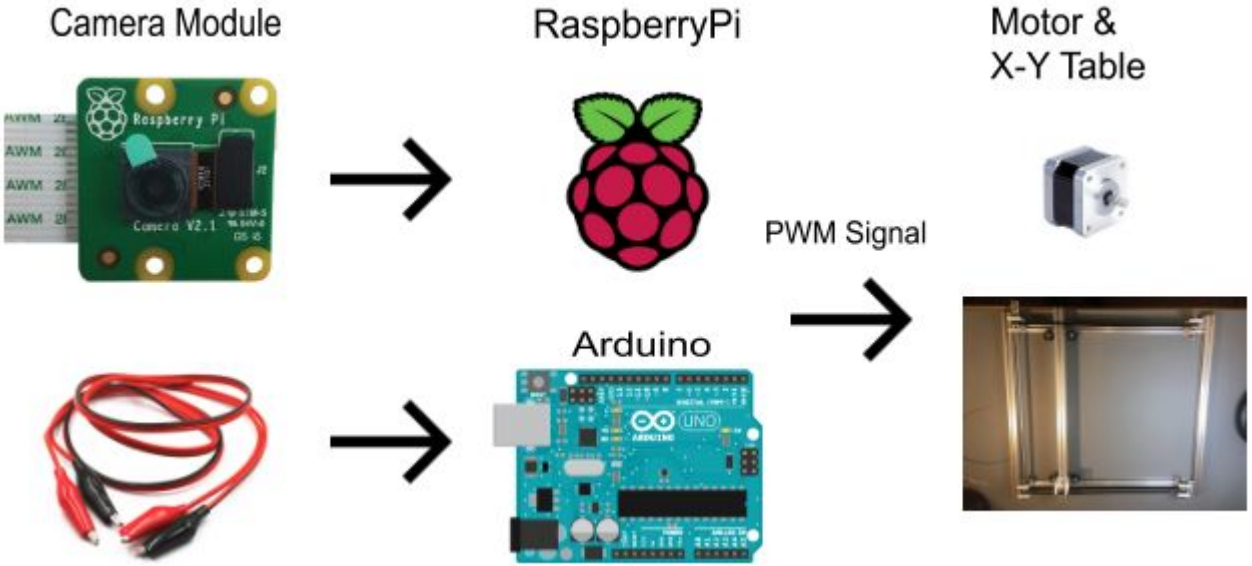
ResistWaste Market Price: $998

Resistor Container	Store the resistors that being recycled	$40
Wrapping Staff	Used to package each function and whole product (may include some 3D printing).	$100
Soft Tube	Used to release resistor from recognition platform to container	$20
Subtotal		$160
Contingency	25%	$250
Total		$1235

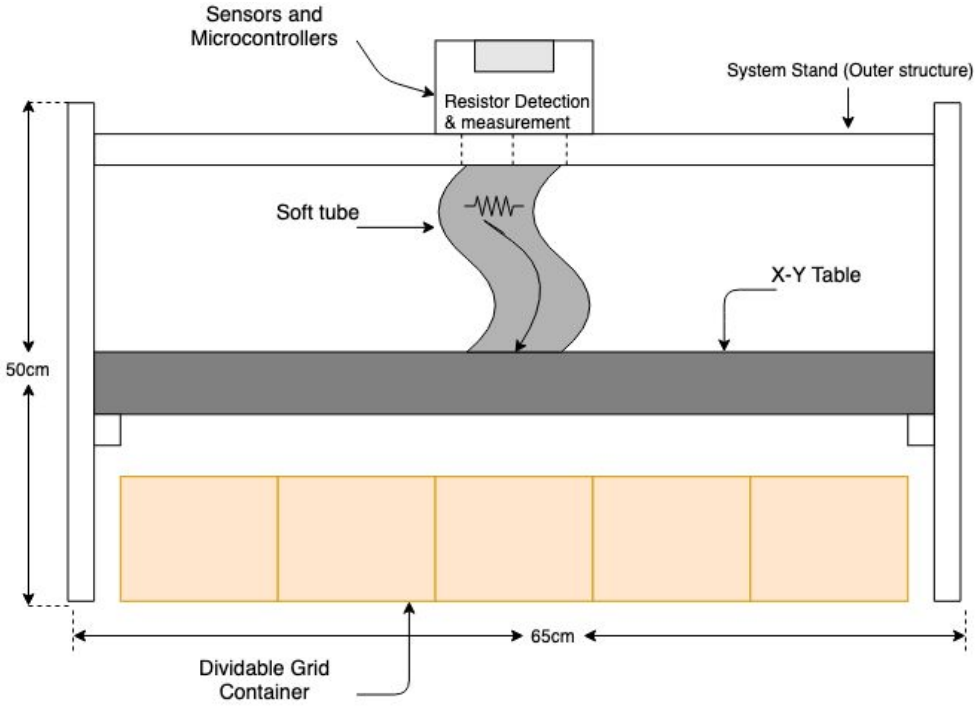
Ideal Customers

- University labs
- High school
- Places that consumes shared axial resistors
- Users have basic knowledge of electronics and circuits
- Students that have a hard time reading the color and memorizing the color code

Technical Case (High Level Overview)



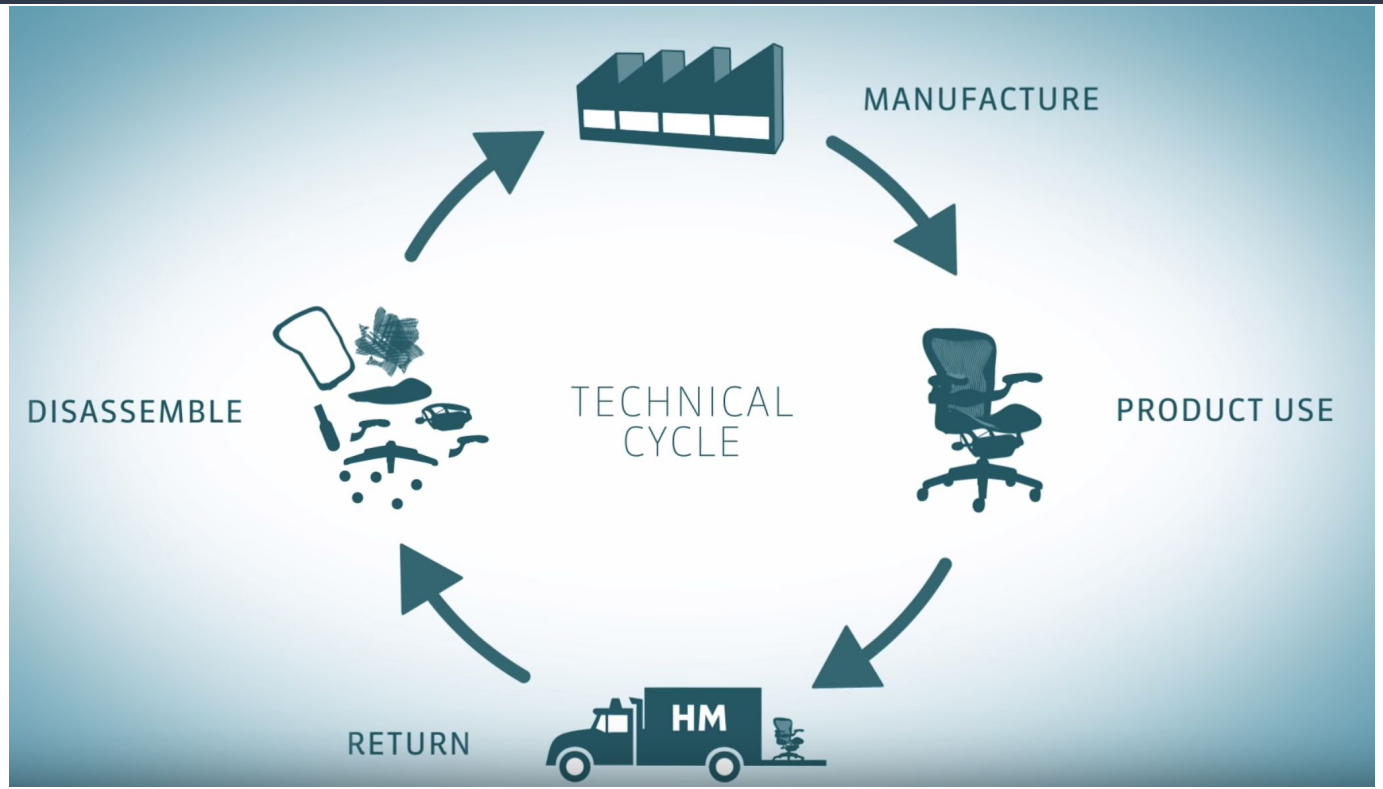
ResistWaste



Technical Case (Components and Parts)

For the materials and components used for ResistWaste system, we will introduce them in later sections by our techies.

Sustainability (Cradle to cradle)



[15]

Risk Management

Safety Risk:

- Electrical Safety
- Camera Privacy
- Human injuries due to mechanical movement

Our Plan to Mitigate them:

- Integrated power supply to the system
- Restrictive Camera Range
- Safe motors and enclosed system

Risk Management

Technical Development Risk

- Image Processing
- Soft Tube Material

Our Plan to Mitigate them:

- Backup Design Plans
  - Wheatstone Bridge
  - Other release mechanisms

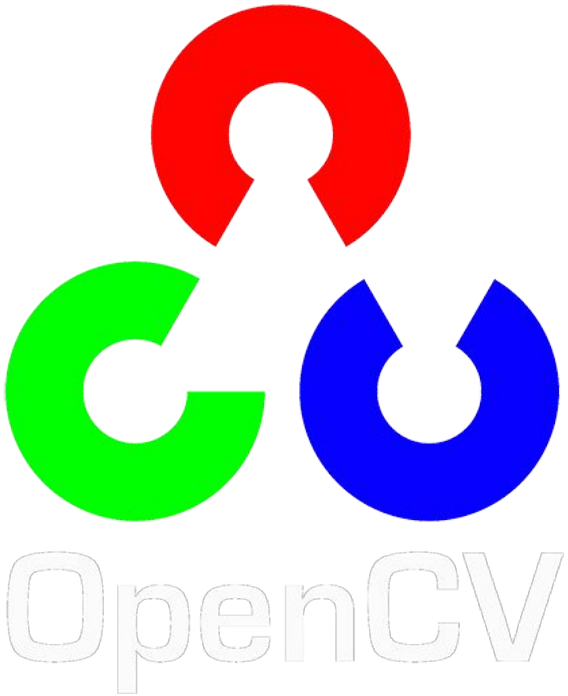
Standards

ISO/IEC 24786:2009	Information technology -- User interfaces -- Accessible user interface for accessibility settings. [2]
CAN/CSA-ISO/IEC 11581-3:02 (R2011)	Information Technology - User System Interfaces and Symbols - Icon Symbols and Functions - Part 3: Pointer Icons [5]
CAN/CSA-C22.1-18	Canadian Electrical Code, Part I (24th edition), Safety Standard for Electrical Installations [3]
IEC TS 60034-20-1:2002	Rotating electrical machines - Part 20-1: Control motors - Stepping motors [4]

Image processing

- OpenCV
- Raspberry Pi 3B+
- Camera
- Macro lens
- Algorithm

OpenCV



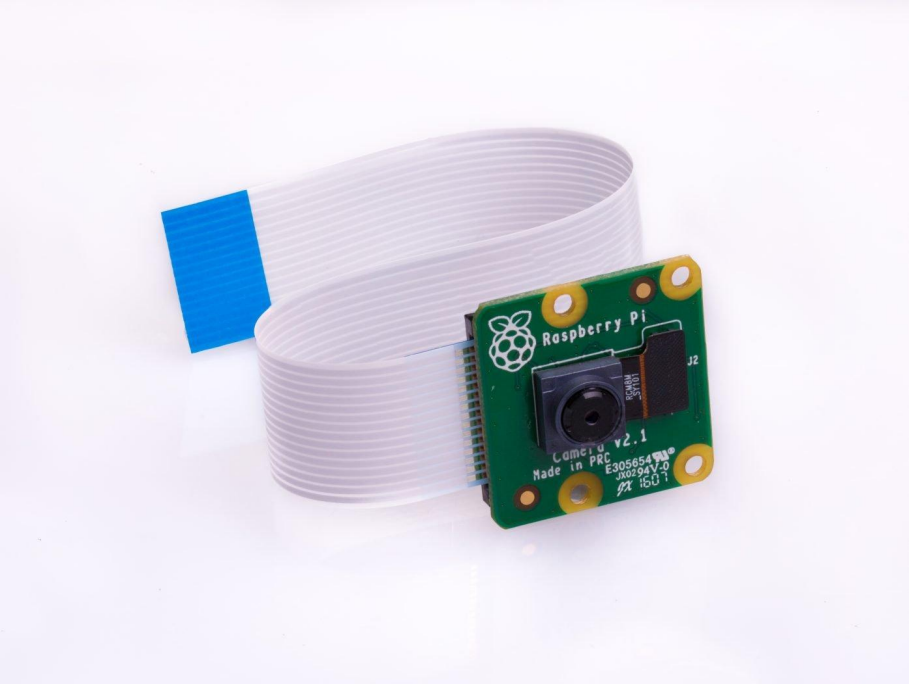
- C++
- Python
- Java
- Matlab

Raspberry Pi 3B+

Raspberry Pi 3B+

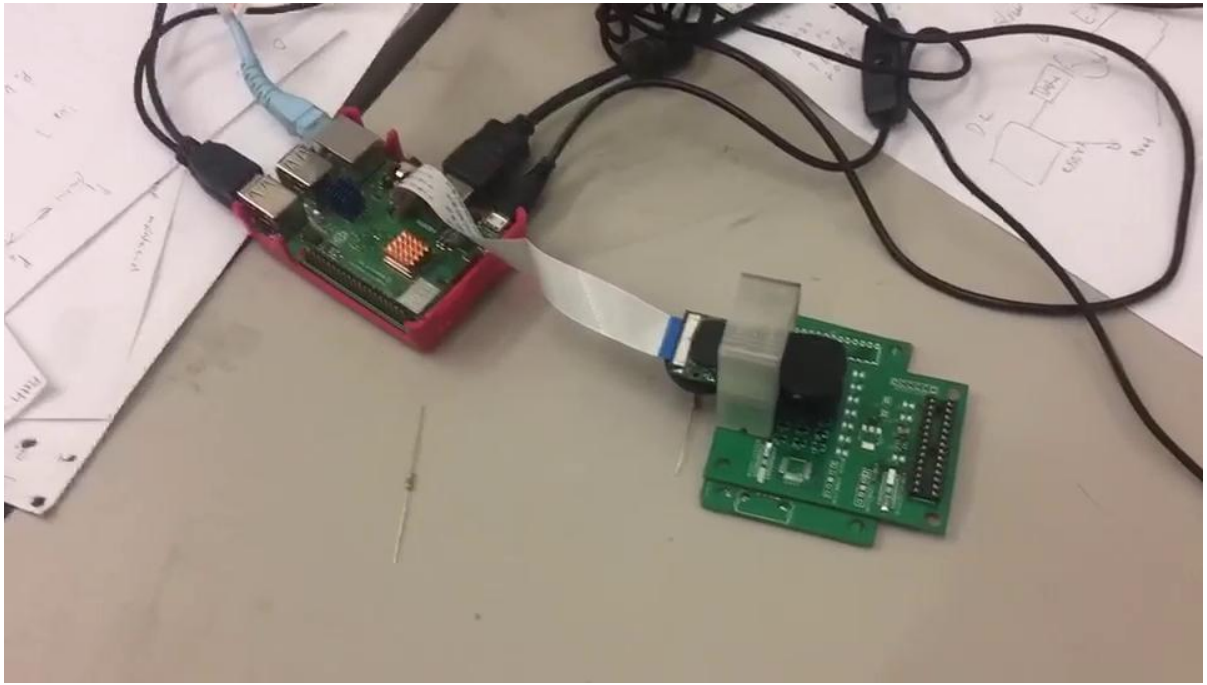
- Broadcom BCM2837B0, Cortex-A53 (ARMv8) 64-bit SoC @ 1.4GHz
- 1GB LPDDR2 SDRAM
- 2.4GHz and 5GHz IEEE 802.11.b/g/n/ac wireless LAN, Bluetooth 4.2, BLE
- Gigabit Ethernet over USB 2.0 (maximum throughput 300 Mbps)
- Extended 40-pin GPIO header
- Full-size HDMI
- 4 USB 2.0 ports
- CSI camera port for connecting a Raspberry Pi camera
- DSI display port for connecting a Raspberry Pi touchscreen display
- 4-pole stereo output and composite video port
- Micro SD port for loading your operating system and storing data
- 5V/2.5A DC power input

Camera



- 8 megapixel camera capable of taking photographs of 3280 x 2464 pixels
- Capture video at 1080p30, 720p60 and 640x480p90 resolutions

Macro lens

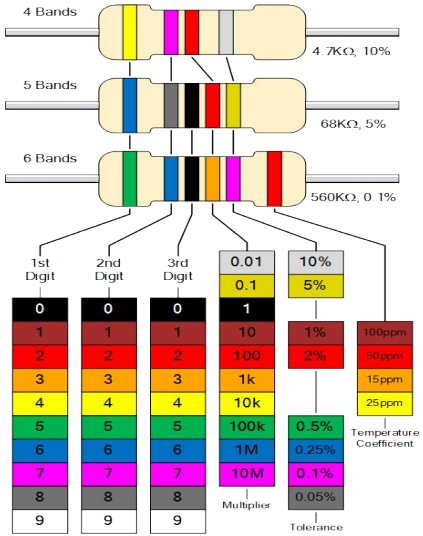


Background Information

RGB color model

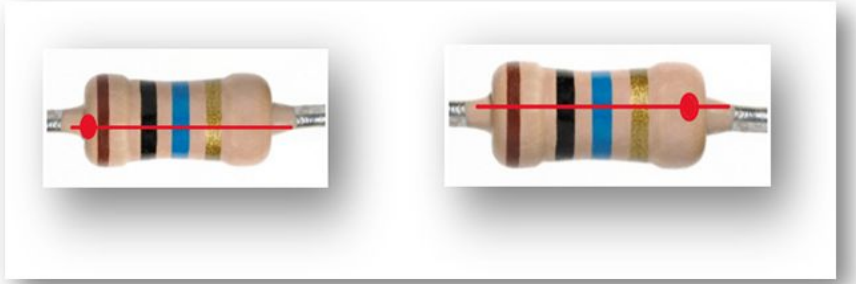
- RGB color values are supported in all browsers.
- An RGB color value is specified with: rgb(red, green, blue).
- Each parameter (red, green, and blue) defines the intensity of the color as an integer between 0 and 255.

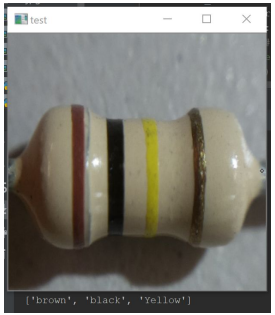
Resistor band color code[4]



Algorithm

1. Capture an image of the resistor
2. Extract a circle of the resistor image from leftmost to rightmost
3. Analyze the arrays of RGB values
4. Return the color of the circle and analyze three color band of resistor based on the total color array
5. Calculate the value of the resistor based on the resistor band color code





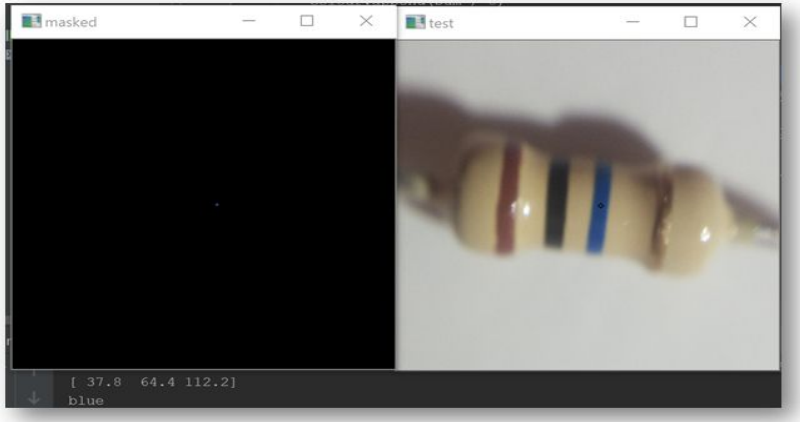
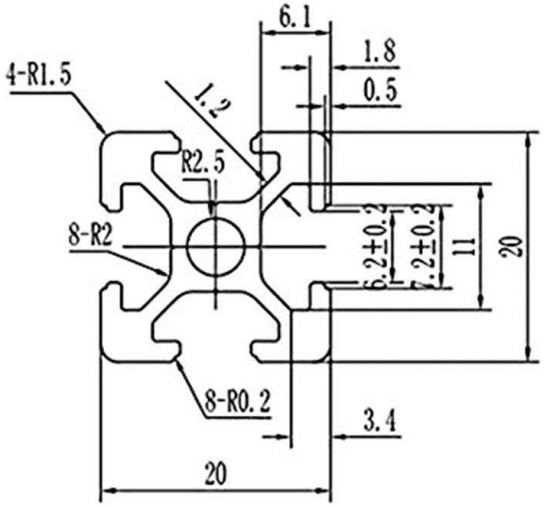


Image Processing Demo

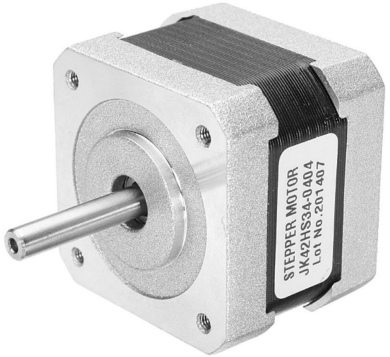
X-Y Table

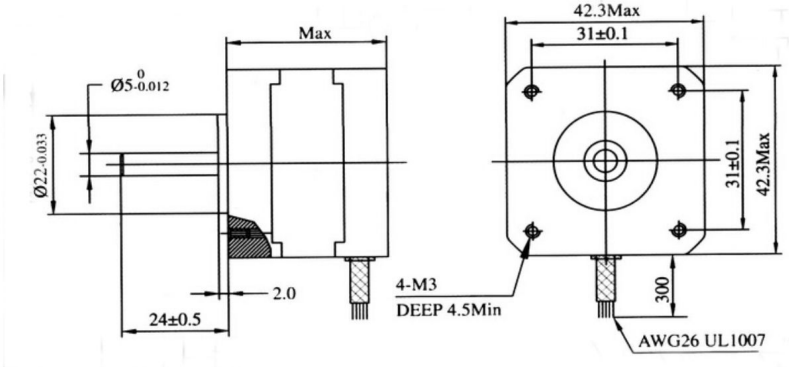
- Aluminum Profile Extrusion
- JK42HS34-0404 Stepper Motor
- Arduino Uno
- A4988 Motor Driver
- Pulley & V-wheel

Aluminum Profile Extrusion



JK42HS34-0404 Stepper motor



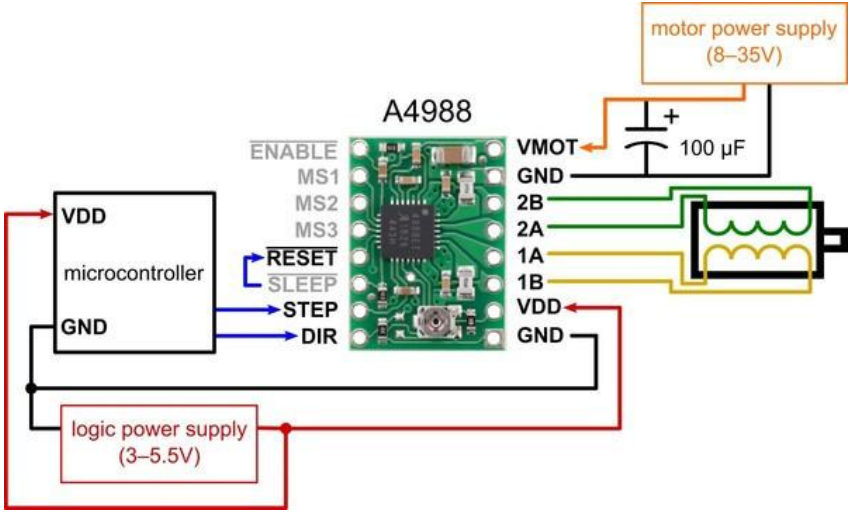


Model No.	Step Angle (°)	Rate Voltage (V)	Current /Phase (A)
JK42HS34-0404	1.8	12	0.4

Arduino

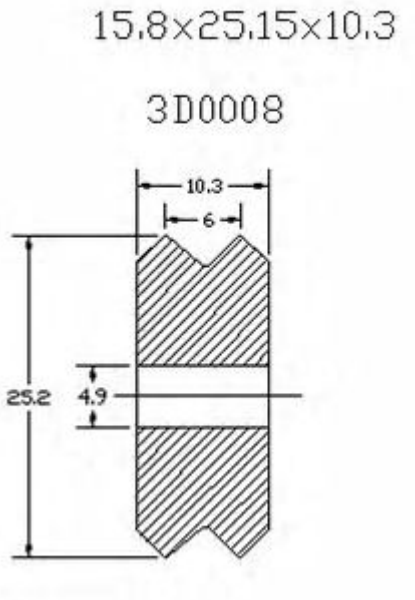
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limit)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
PWM Digital I/O Pins	6
Analog Input Pins	6
DC Current per I/O Pin	20 mA
DC Current for 3.3V Pin	50 mA

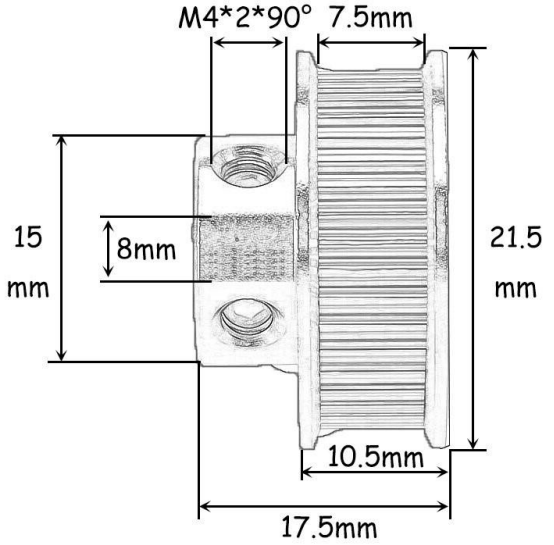
A4988



Minimum operating voltage:	8 V
Maximum operating voltage:	35 V
Continuous current per phase:	1 A
Maximum current per phase:	2 A
Minimum logic voltage:	3 V
Maximum logic voltage:	5.5 V
Microstep resolutions:	full, 1/2, 1/4, 1/8, and 1/16

Pulley & V-wheel

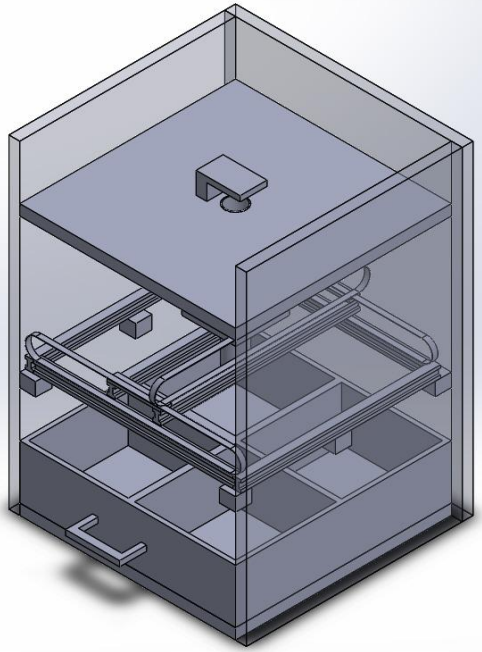


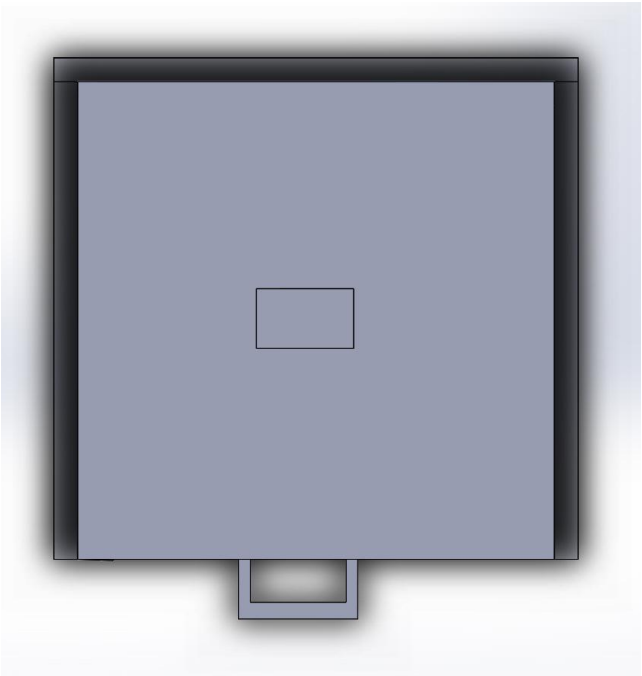


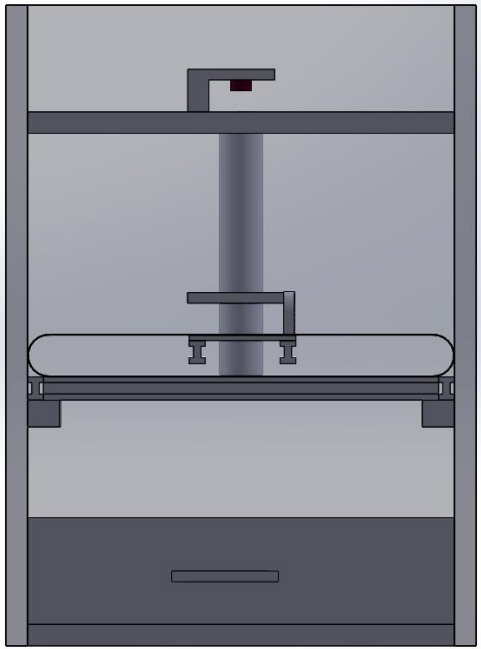
GT2 Timing Belt Pulley- 30 Teeth Bore 8mm

X-Y Table Demo

3D Modeled Appearance







Self-Reflection

- Weekly Meeting is important
- Internal deadlines keeps things organized
- Identifying the strength of teammates and maximize it
- Everyone's voices should be heard
- As a very small group, everyone has to do a little bit of everything

- Communicate more with TAs and the instructors.
- Open to input from friends and other colleagues

Future Plan and Schedule for 440

Aug. 14th	405W PoC Demonstration
Aug. 25th - Sep 4th	Pre 440 Development Cycle. Reflect on the feedback from the demo Improve the wiring Improve the image processing algorithm
Sep. 5th - Mid Sep.	Engineering Beta Prototype Development Finish the construction of overall system Complete basic enclosure
End of 440	Release of Final Product

Conclusion

Thank you for your time to attend our demo.

We highly value your opinions and suggestions and we will continue to deliver high quality work in 440.

Reference

[1] Resistor Price, Available at https://www.thesource.ca/en-ca/tvs-home-theatre/home-theatre-accessories/adapters-and-connectors/nexxtech-1-4-watt-5%25-carbon-resistors-%28value-pack%29/p/2719018
[2] Resistor Price, Available at https://www.digikey.ca/en/resources/resistors
[3] Resistor Scanner, Available at https://play.google.com/store/apps/details?id=com.mhdev.resistorscanner&hl=en_CA
[4] Resistor color code, Available at https://www.physics-and-radio-electronics.com/electronic-devices-and-circuits/passive-components/resistors/resistorcolorcode.html
[5] OpenCv at https://opencv.org/
[6] Arduino at https://store.arduino.cc/usa/arduino-uno-rev3
[7] Motor Driver at https://www.pololu.com/product/1182
[8] Stepper Motor at https://www.banggood.com/JKM-Nema-17-Two-Phase-Hybrid-Stepper-Motor-37oz-in-34mm-0_4A-p-942111.html?cur_warehouse=CN
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[10] Macro lens at https://www.amazon.ca/VicTsing-Clips】3-Fisheye-Degree-Smartphones/dp/B01JA7YTNW/ref=sr_1_9?keywords=macro+lens&qid=1565761745&refinements=p_85%3A5690392011&rnid=5690384011&rps=1&s=gateway&sr=8-9
[11] Pulley at https://www.amazon.com/Zzanggu-Timing-Printer-Aluminum-Synchronous/dp/B07F8MPWNL/ref=sr_1_1_sspa?keywords=GT2+Pulley+-+30+Teeth&qid=1562443014&s=gateway&sr=8-1-spons&psc=1
[12] Aluminum Profile Extrusion at https://www.amazon.ca/gp/product/B074DTDQZD/
[13] Raspberry Pi at https://www.raspberrypi.org/products/raspberry-pi-3-model-b-plus/
[14] Camera at https://www.raspberrypi.org/products/camera-module-v2/
[15] Cradle to Cradle https://www.youtube.com/watch?v=QMsF1P-_vWc