TiresiaScope
Fall Quarter Design Review

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Introduction - What is the TiresiaScope?

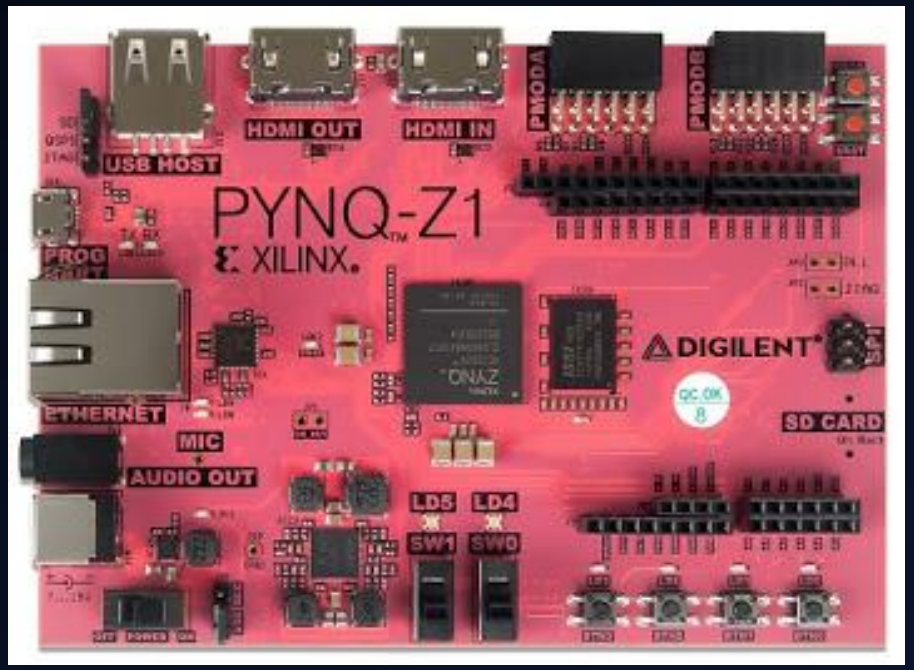
- A proximity-sensing device for the blind
- Detects nearby objects with ranging sensors, recognizes text on signs with camera
- Relays information to user through sound: musical tones for object location, synthesized speech for text reading

Development Team

- Devon Porcher: Team Leader, Prototyping, Software Design
- John Bowman: System Design Lead, Software Design
- Brian Young: PCB Design Lead, System Design
- Timothy Kwong: Software Design Lead
- Trevor Hecht: Apparatus Design Lead

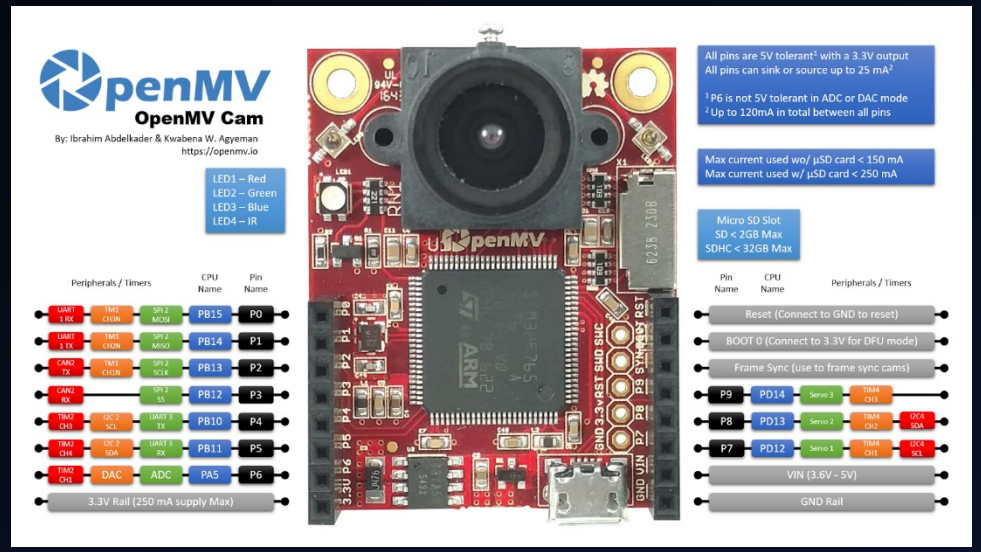
PYNQ

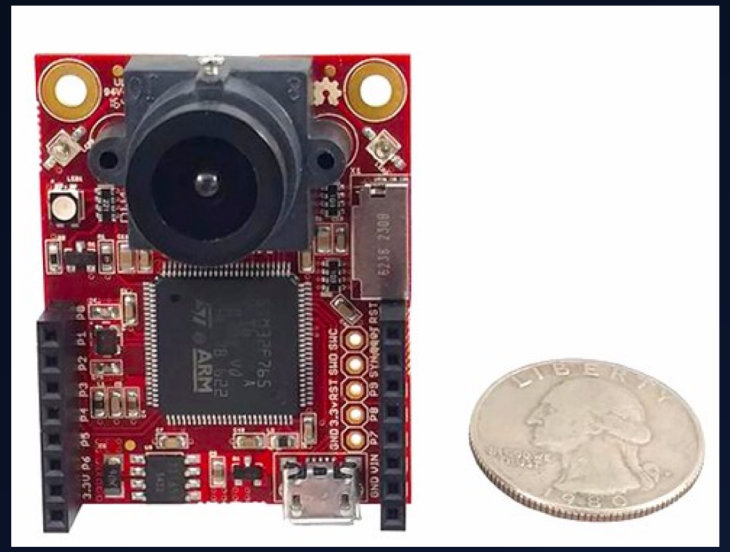
- Dual-Cortex ARM Cortex A9 processor supports coding in Python
- Individual Microblaze processors on FPGA control I/O for arduino and PMOD headers
- Microblazes communicate with processor using shared memory
- HDMI, USB, Ethernet also supported
- Audio out is mono only



Camera:
OpenMV M7

- On board STM32F765VI ARM Cortex M7 processor running at 216MHz with 512KB of RAM and 2MB of flash
- The OV7725 image sensor is capable of taking 640x480 8-bit grayscale images or 320x240 16-bit RGB565 images at 30 FPS

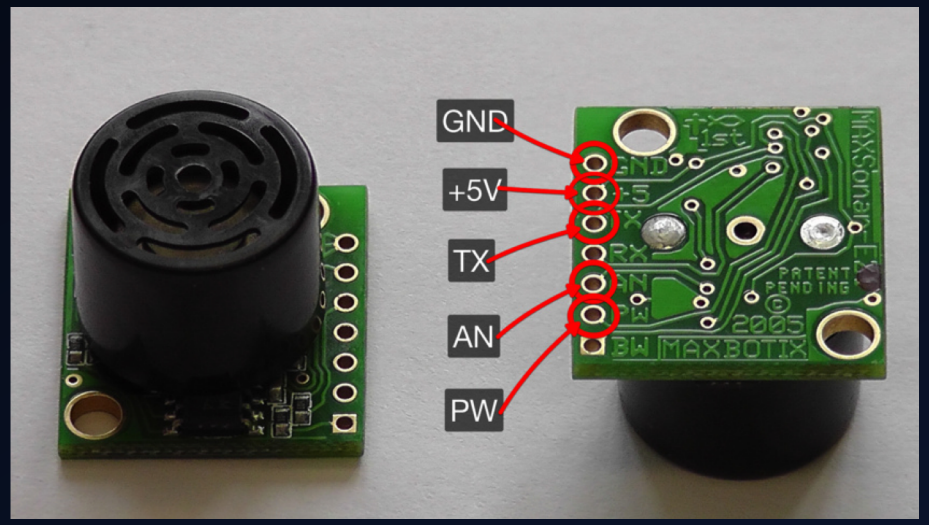




Ultrasonic Sensor:

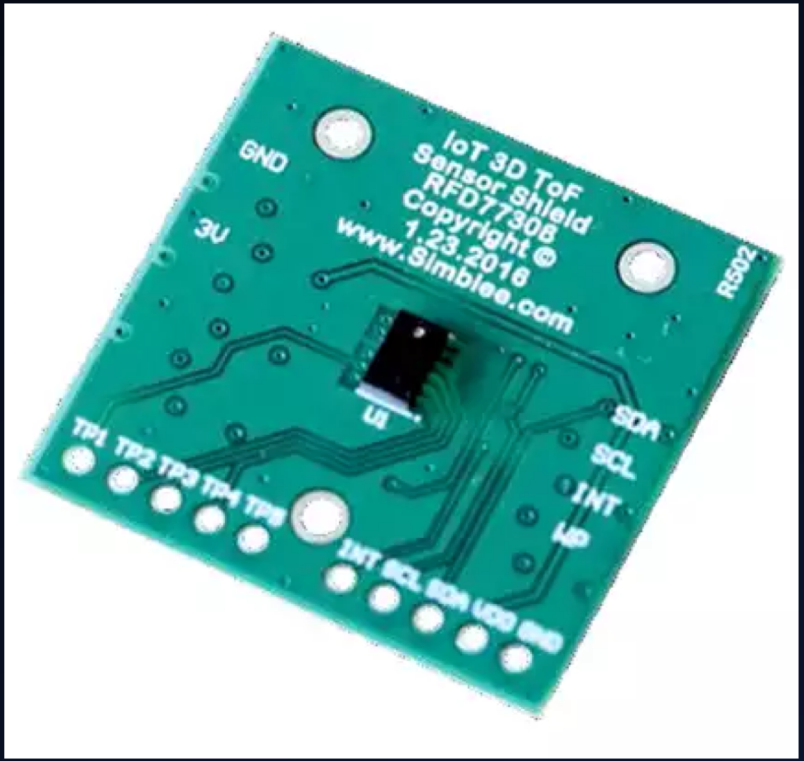
Ultrasonic Range Finder - LV-MaxSonar-EZ1

- Detection range: 160mm to 6.45m
- 20-Hz refresh rate
- Reliable and stable range data
- Pulse-Width, Analog, Pseudo-UART Interface options
- Operates at 5V



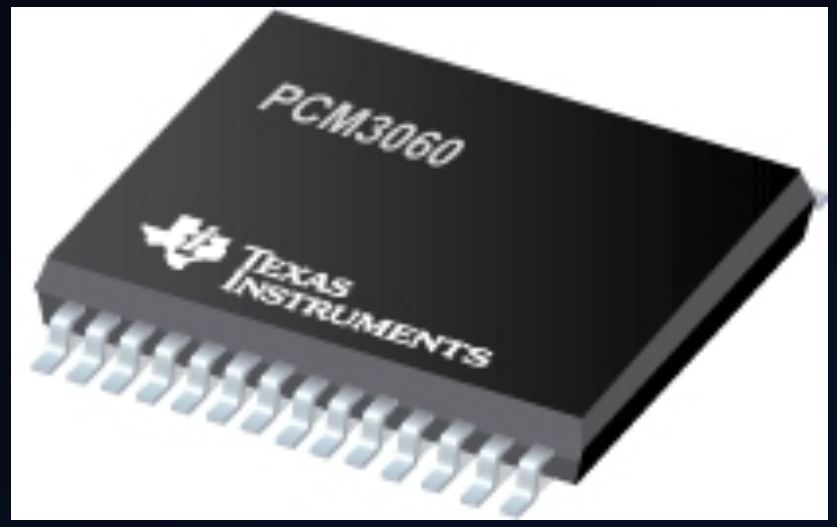
Optical Sensor:
Simblee™ IoT 3D ToF Sensor Module

- Detection range: 100 mm to 2 meters
- 10-Hz refresh rate
- Breakout Board for mounting
- I2C interface
- Operates at 3.3V

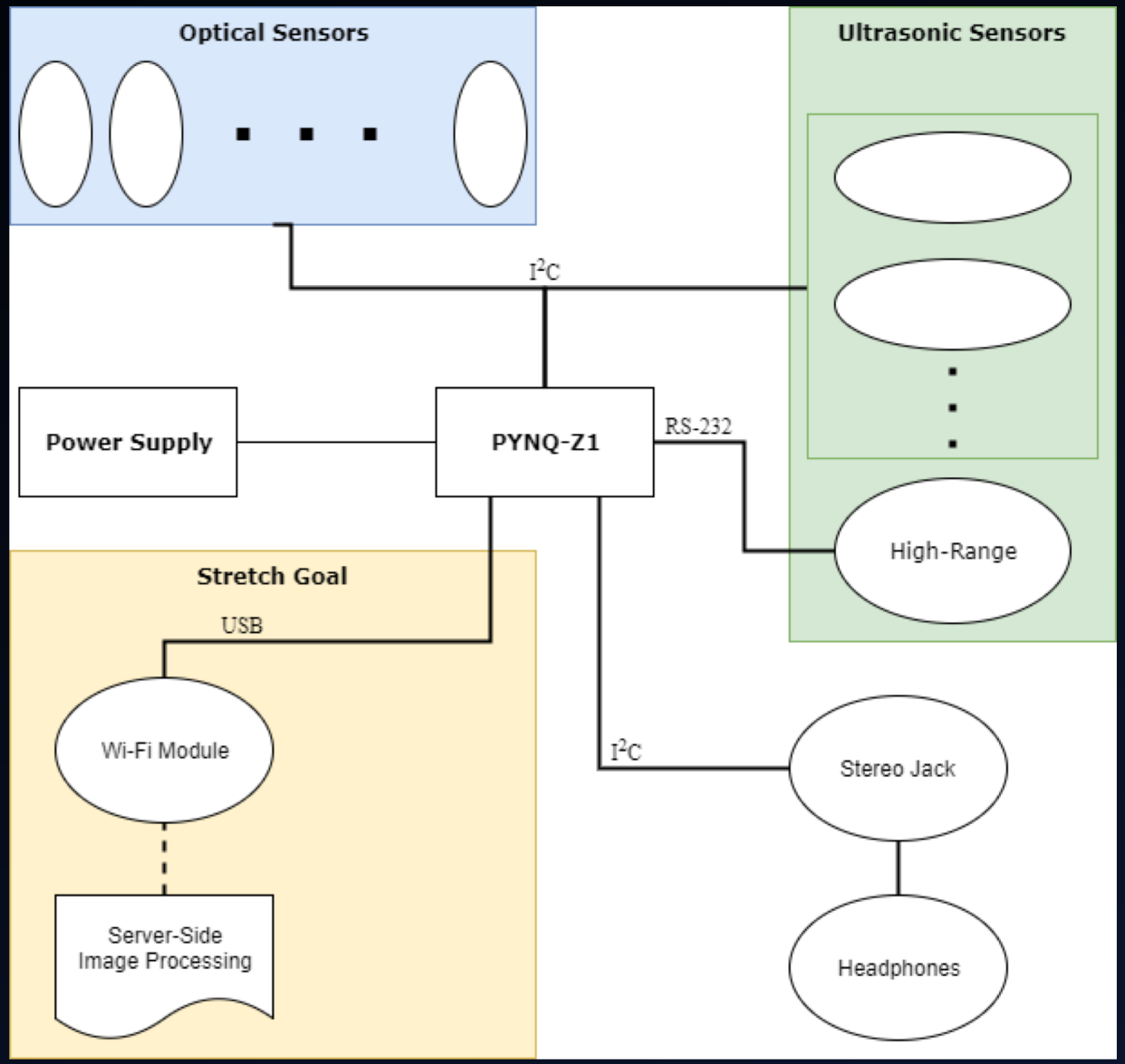


Audio Codec:
PCM3060

- Stereo audio output (and input)
- SPI or I2C control interface
- I2S, left-justified or right-justified formats for audio interface
- Used commonly in digital TVs

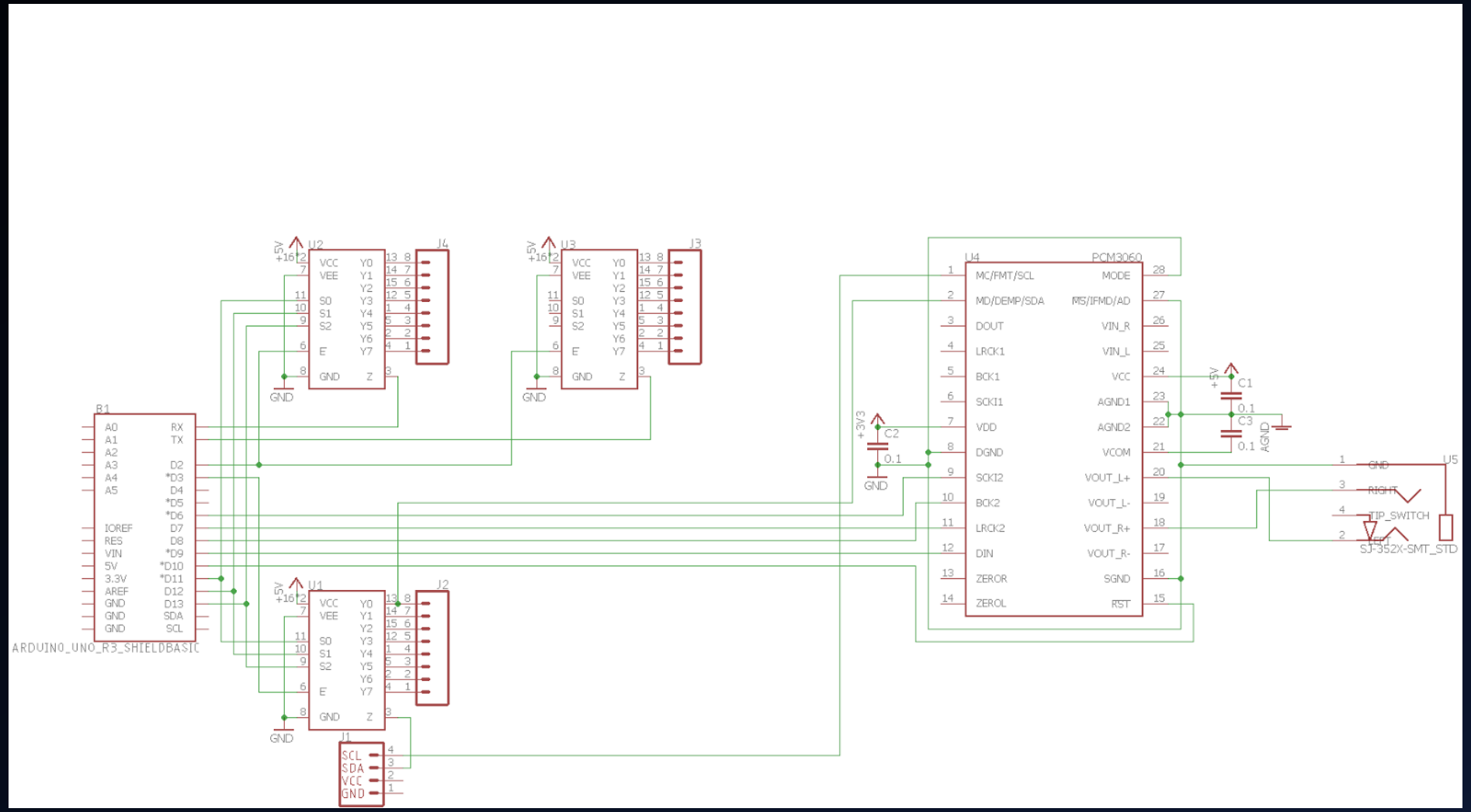


Block Diagram



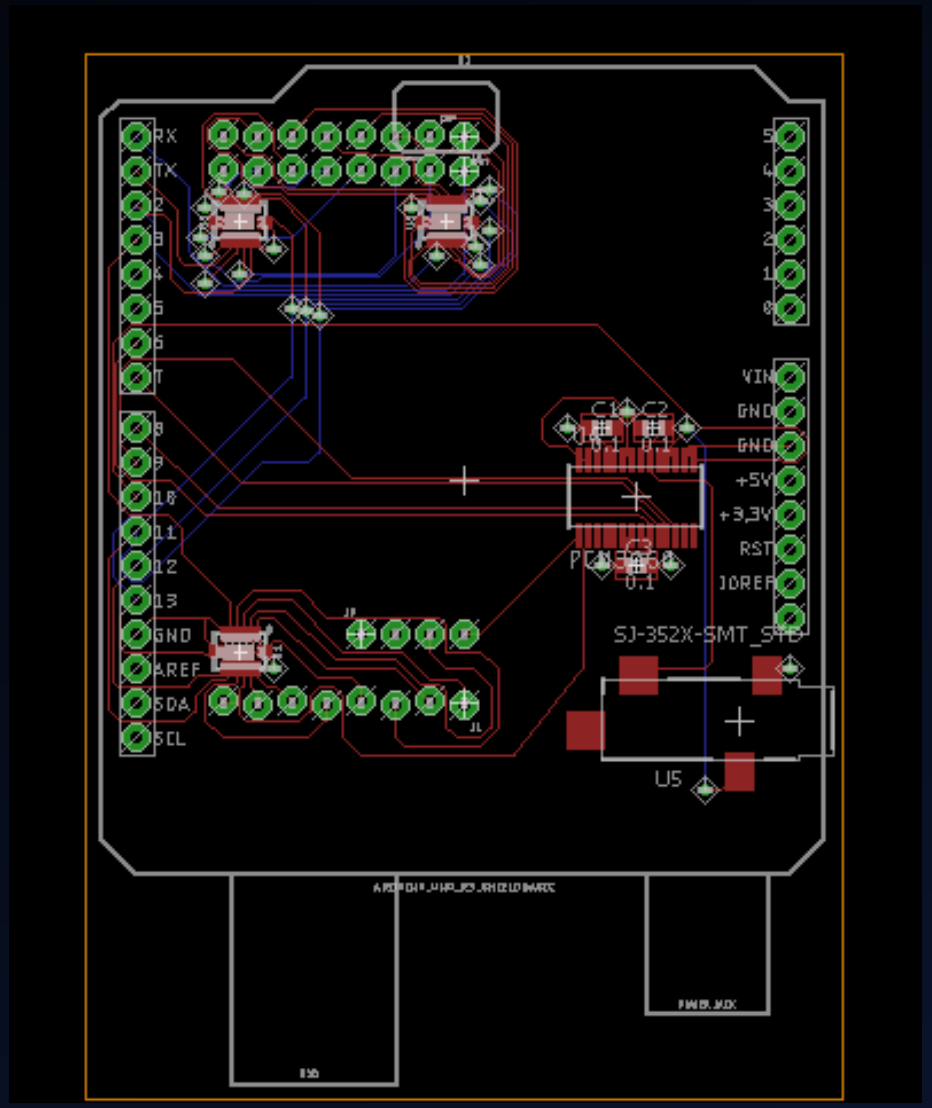
Printed Circuit Board

Schematic



Printed Circuit Board

Routing



Software

Python is used for the backend processing

Sensors

- Converts sensor value inputs into noise frequency outputs of a certain tone depending on the range
- Uses multithreading in order to have each sensor read and output values independently

Camera

- Will capture images caught into words and output using text-to-speech

Wearable Apparatus

Current plan:

- Skateboard helmet, with sections removed to make space for mounting

Mounting:

- PYNQ set into top of the helmet
- Camera at front
- Sensors distributed around all sides

Critical Elements

Text Recognition with the OpenMV camera

- Has on-board facial recognition, but not text recognition

Reliability of sensors

- Detecting lower objects
- Lighting for reliable images

Bill of Materials

	Part Label	Manufacturer	Manufacturer Part Number	Vendor	Vendor Part Number	Package/ Cell	Pins	Total Units	Unit Price	Total Price	Description
PCB Components											
	Audio Codec	Texas Instruments	PCM3060PWR	Digi-Key	296-38201-1-ND	TSSOP, SMT	24	1	$5.65	$5.65	Stereo Audio Codec
	Headphone Jack	CUI Inc.	SJ-3523-SMT-TR	Digi-Key	CP-3523SJTR-ND	Custom (Stereo Jack), SMT	4	1	$1.02	$1.02	3.5mm Stereo Jack
	8-Way Multiplexer	Nexperia USA Inc.	74HC4051BQ,115	Digi-Key	1727-6049-1-ND	VFQFN, SMT	16	3	$0.45	$1.35	8 x 1 Multiplexer/Demultiplexer
	8-Pin Header	Sullins Connector Solutions	GRPB081VWVN-RC	Digi-Key	S9014E-08-ND	Through-Hole	8	3	$0.72	$2.16	0.50" 8-Position Header Connector
	4-Pin Header	Sullins Connector Solutions	GRPB041VWVN-RC	Digi-Key	S9014E-04-ND	Trough-Hole	4	1	$0.37	$0.37	0.50" 4-Position Header Connector
									Total Cost:	**$10.55**	
Headset Components											
	PYNQ Microprocessor	Digilent	6003-410-017	Digilent	6003-410-017	Development Board	54	1	$100.00	$100.00	Python Productivity for Zynq
	Camera	SparkFun Electronics	SEN-14186	SparkFun Electronics	SEN-14186	Breakout Board	16	1	$68.75	$68.75	OpenMV M7 Camera w/ ARM Processor
	Optical Sensor Board	Adafruit Industries LLC	3317	Digi-Key	1528-1814-ND	Evaluation Board	7	8	$14.95	$119.60	VL53L0X Evaluation Board, 2m Ranging
	Ultrasonic Sensor	SparkFun Electronics	SEN-00639	Digi-Key	1568-1311-ND	Evaluation Board	7	8	$26.25	$210.00	LV-MAX Ultrasonic Range Finder
									Total Cost:	**$498.35**	
Miscellaneous Parts											
	Helmet Mount					N/A	N/A	1	TBD	TBD	3D-Printed Attachments for Components
	Helmet					N/A	N/A	1	TBD	TBD	Skateboard Helmet
	Headphones					N/A	N/A	1	TBD	TBD	Stereo Headphones
									Total Cost:	**TBD**	

Conclusion

Moving Forwards:

- Prototyping full sensor system
- Camera functionality
- Designing software to function with the sound system

Thank you to professor Yogananda Isukapalli, Celeste Bean, and Caio Motta

Questions?