iContact

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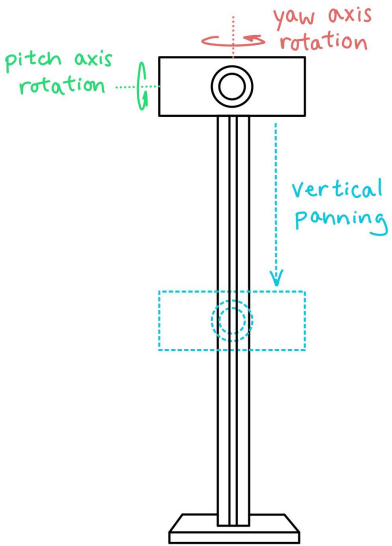
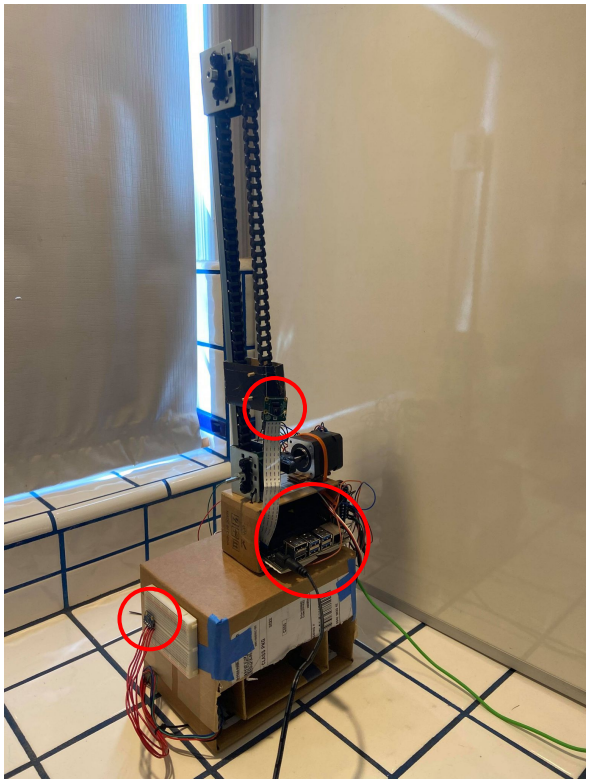
Application Area

- Video calls have become an indispensable part of our daily lives
  - Classes
  - Virtual hangouts with friends
  - Work/internships
- Even before COVID, video calls were becoming essential
  - Conference calls in the workplace
  - Keeping in touch with friends and family
- Video calls have become more crucial, but have not evolved much
- **How can we better immerse the remote viewer into a video call?**
  - **Our solution: An agile camera that keeps the focus on you**

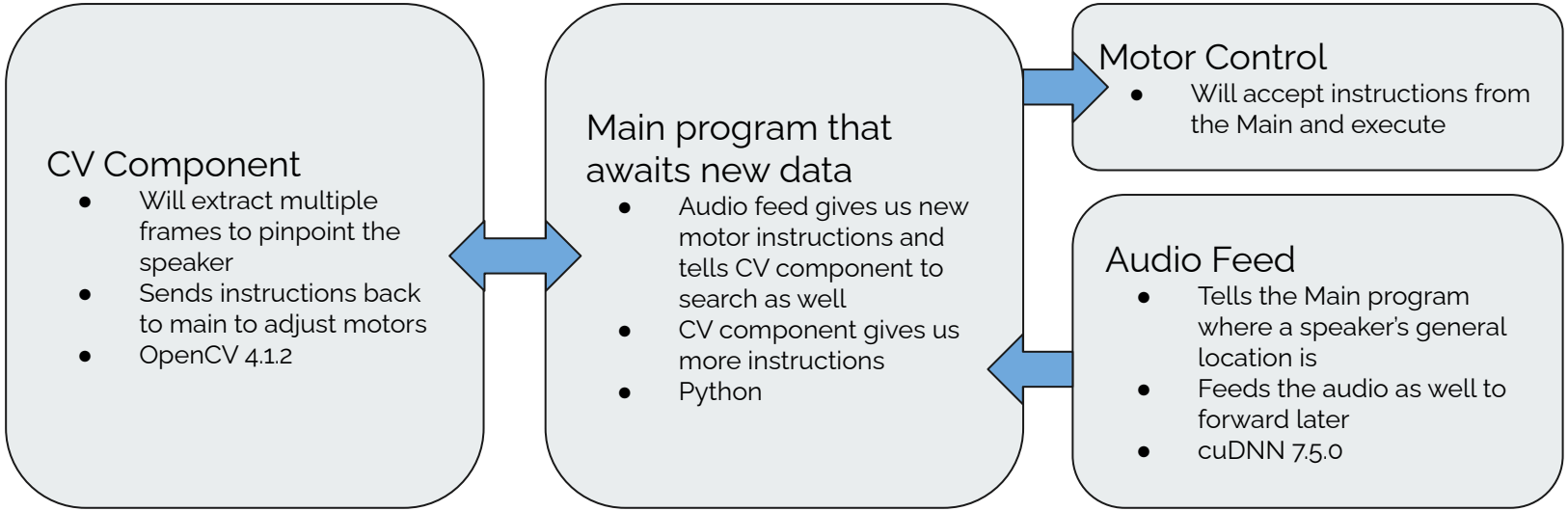


Solution Approach

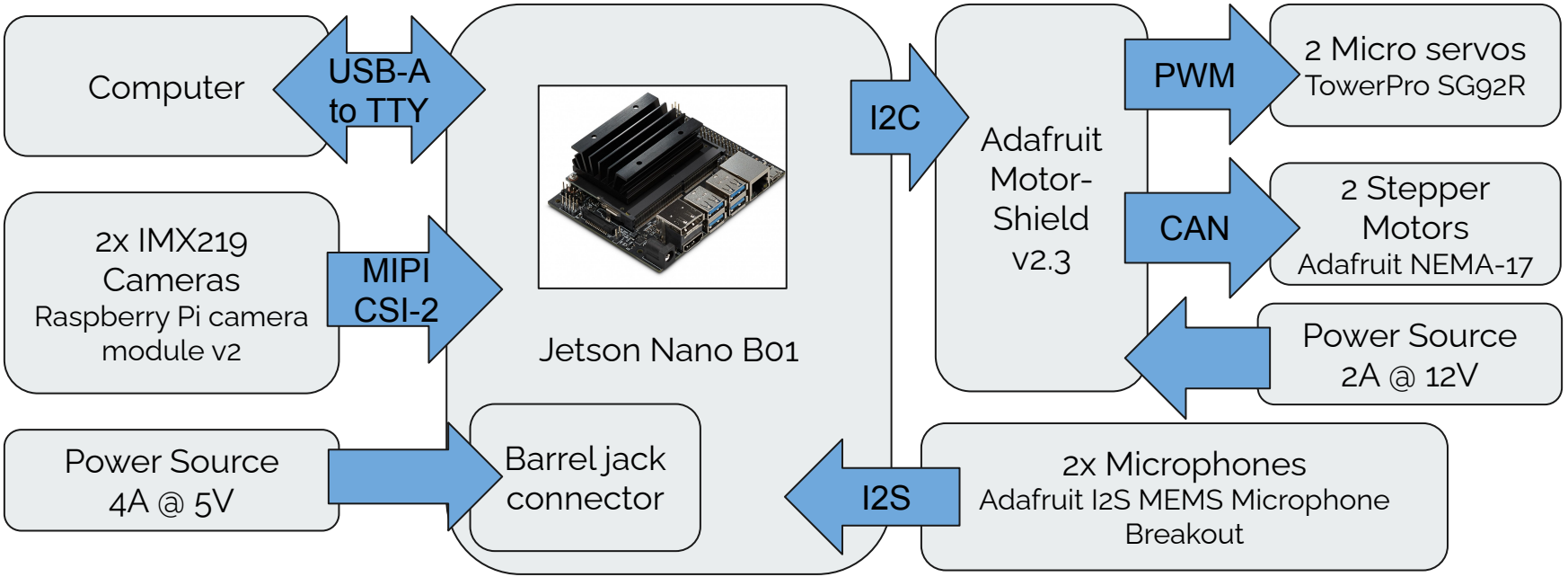
- A bi-camera mechanism on a motorized tripod
  - Can raise/lower
  - Rotates side-to-side
  - Tilts up/down
  - Utilizes audio detection and CV to locate and physically reposition the camera to focus on the current speaker



Software System Specification



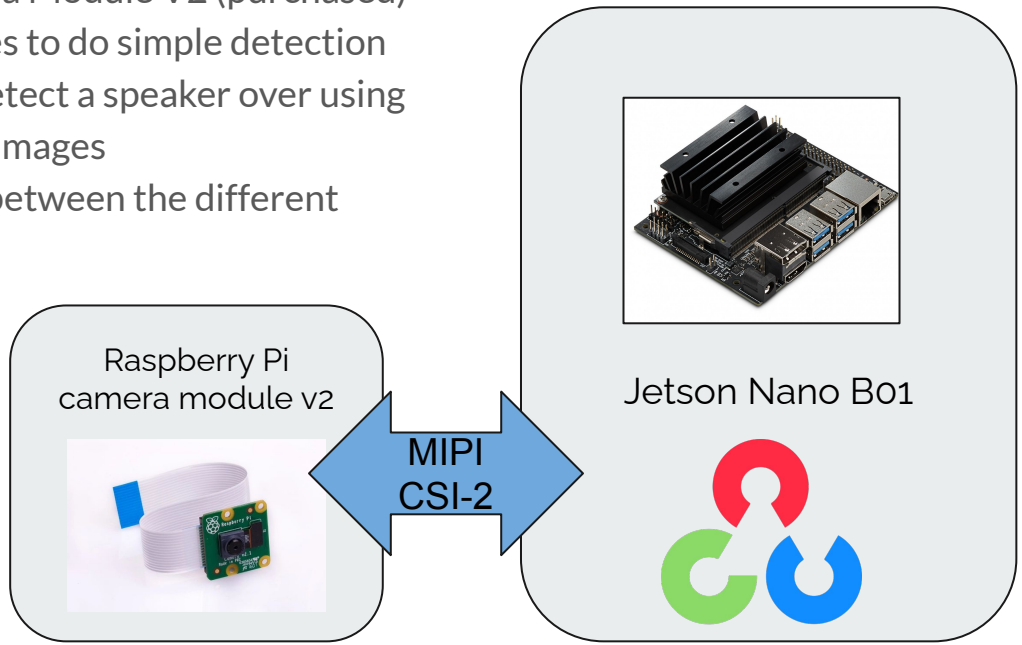
Hardware System Specification



CV Implementation Plan

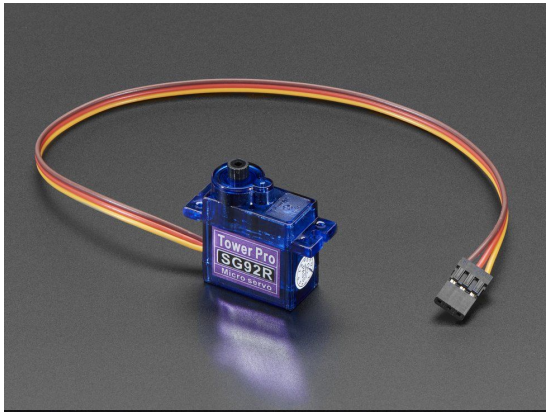
Software Module: OpenCV (downloaded library)
Hardware Component: Raspberry Pi Camera Module V2 (purchased)

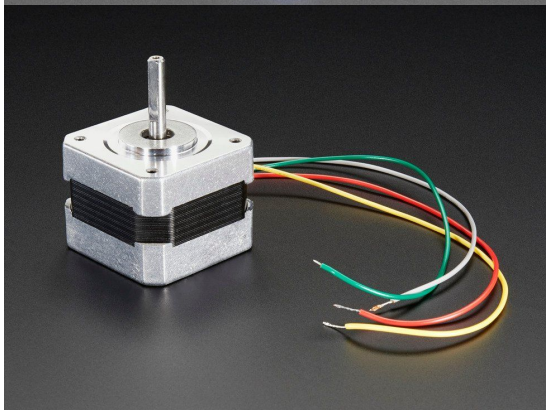
- Making use to available Haar Cascades to do simple detection
- Creating our own new algorithm to detect a speaker over using multiple frames rather than constant images
- Creating the communication system between the different software components



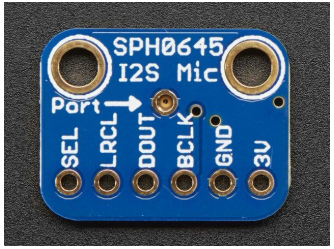
Motor Implementation Plan

- 2 Stepper Motors connected to Adafruit Motor Hat
- 2 Micro servos connected to Adafruit Motor Hat
- Use the adafruit_motorkit library to communicate motor control between motor hat and Jetson via I2c
- Based on audio detection and CV face detection, rotate motors
- Keep track of angle rotated for stepper motors
    - For base motor, this is to track which microphone is closer
    - For elevation motor, this is to make sure don't go "past" elevation

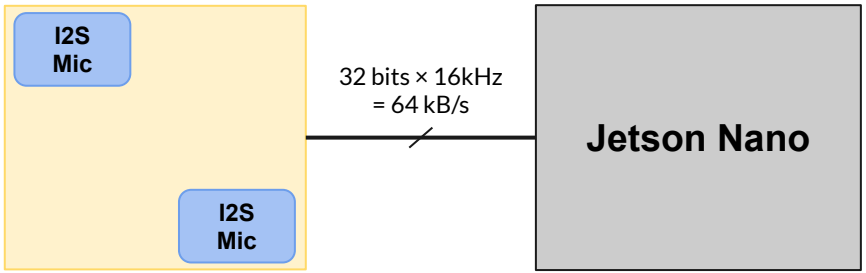


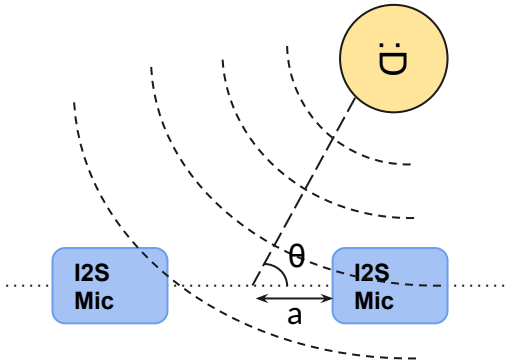


Audio Implementation Plan



- Two I2S MEMS microphones sending their digital output to the Jetson Nano
- Can determine direction of source (the person speaking) using the distance between the microphones, the time difference between when the sound reaches each mic, and the speed of sound
- Just like how the human ears operate!





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Metrics & Validation

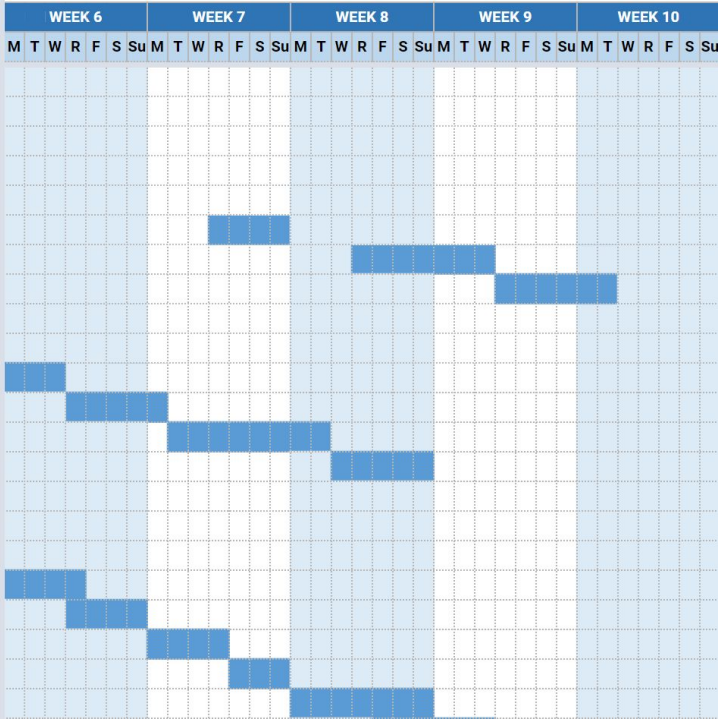
Functionality	Requirements	Testing
Viewing	Compatible with any conferencing software 1080p @30fps	Run with Zoom, Webex, and Google Hangouts
Working range	360-degree field of view 3ft vertical panning range 10ft microphone pickup range 10ft person detection radius	Stationary or moving speaker around the room at various distances and angles from iContact
Algorithm accuracy	90% centering accuracy 90% speaker identification accuracy ~~90% verbal command comprehension~~ 95% preset position alignment	Stationary speakers converse back and forth (identification accuracy) Subject moving while continuing to talk (centering accuracy)
Speed	<1s motor control for camera adjustment <1s audio input processing latency <1s video input processing latency	Stationary speakers conversing back and forth, taking turns speaking one sentence at a time

Division of Labor

Area	Task	Anna	Edward	Heather
Signals	Audio processing	✔		
Software	Video processing (CV)		✔	✔
Hardware	Motor control			✔
	Camera input to Jetson		✔	✔
	Microphone input to Jetson	✔		✔
	Transmitting audio feed to computer	✔		
	Transmitting video feed to computer		✔	

Schedule

Phase	Task	Assigned to	Start Date	End Date	Number of Days
Physical Product	Purchase Hardware Components	All	9/22/20	9/25/20	4
	Review Datasheets for Components	All	9/22/20	9/27/20	6
	Verify multiple motor control	Heather	9/29/20	10/2/20	4
	Test timing for rotations	Heather	10/3/20	10/4/20	2
	Design model for product	All	9/24/20	9/30/20	7
	Assemble first draft of physical model	All	10/15/20	10/18/20	4
	Make alterations to original design after tests	All	10/22/20	10/28/20	7
	SLACK	All	10/29/20	11/3/20	5
Audio	Verify stable multi mic connection	Anna	9/29/20	10/2/20	4
	Research algo to detect speaker's general location	Anna	9/24/20	9/28/20	5
	Build microphone array	Anna	10/3/20	10/6/20	4
	Write/test acoustic location algorithm for 2-mic array	Anna	10/7/20	10/12/20	6
	Assemble/test 4-mic array	Anna	10/13/20	10/20/20	8
	SLACK	All	10/21/20	10/25/20	5
Computer Vision	Meet with CV Professor	Edward	9/25/20	9/25/20	1
	Basic setup and installation for Jetson	All	9/29/20	9/30/20	2
	Create a simple videofeed for a computer	Heather	10/2/20	10/4/20	3
	Verify multi camera communication	Heather	10/5/20	10/8/20	4
	Extract single frames	Edward	10/8/20	10/11/20	4
	Facial and Body detection	Edward	10/12/20	10/15/20	4
	Zooming in on a portion of the frame	Edward	10/16/20	10/18/20	3
	SLACK	All	10/19/20	10/25/20	7



Schedule (cont.)

Phase	Task	Assigned to	Start Date	End Date	Number of Days
Integration	Integrate the video passthrough	Edward	10/23/20	10/28/20	6
	Integrate audio into the passthrough	Anna	10/23/20	10/28/20	6
	Integrate motor movement with presets	A/H	10/29/20	11/2/20	4
	Integrate motor movement with CV component	E/H	10/29/20	11/2/20	4
	SLACK	All	11/3/20	11/9/20	7
Testing	Test Latency of the system	All	11/12/20	11/17/20	6
	Optimize Latency	All	11/17/20	11/22/20	6
	SLACK	All	11/23/20	11/29/20	7
Course Logistics	Project Proposal	All	9/14/20	9/21/20	8
	Design Presentation	All	10/12/20	10/14/20	3
	Demo 1	All	11/9/20	11/11/20	3
	Demo 2	All	11/30/20	12/2/20	3
	Final Presentation	All	12/3/20	12/9/20	7
	Final Report	All	12/8/20	12/13/20	6