Google Assistant Self Driving Robot

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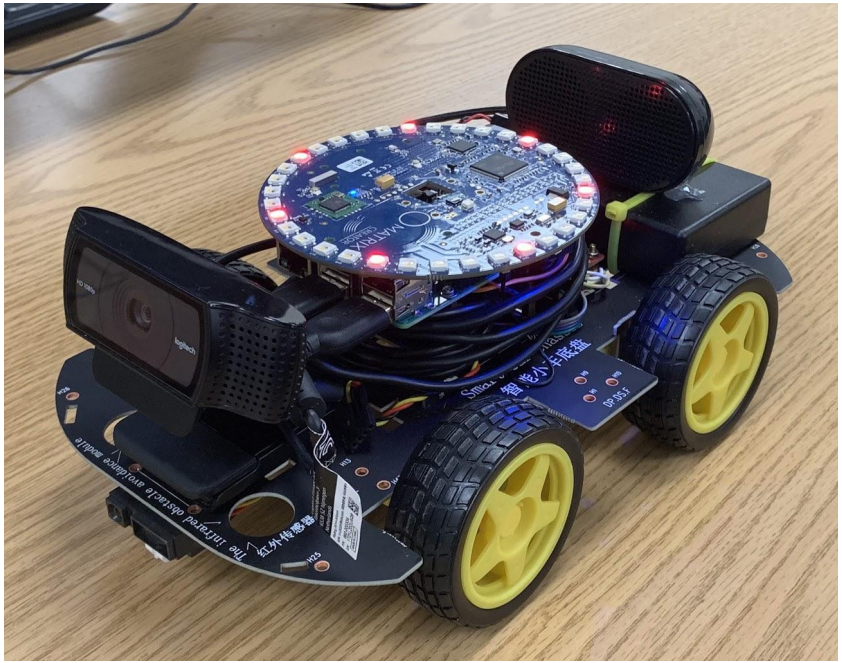
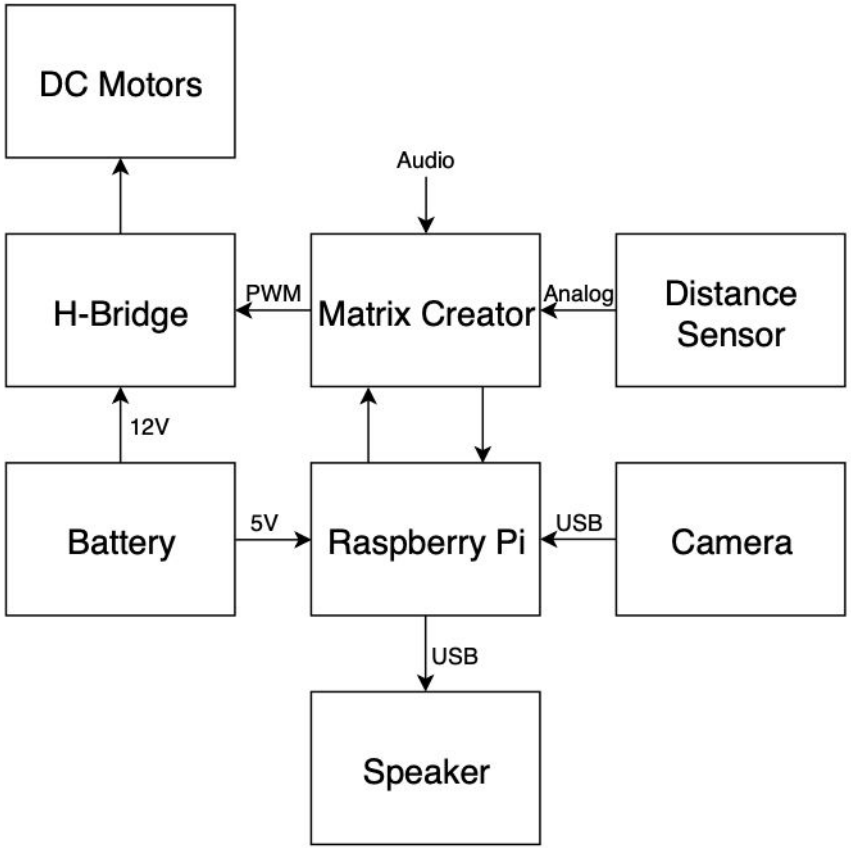
ECE M202A - Winter 2019

Project Description

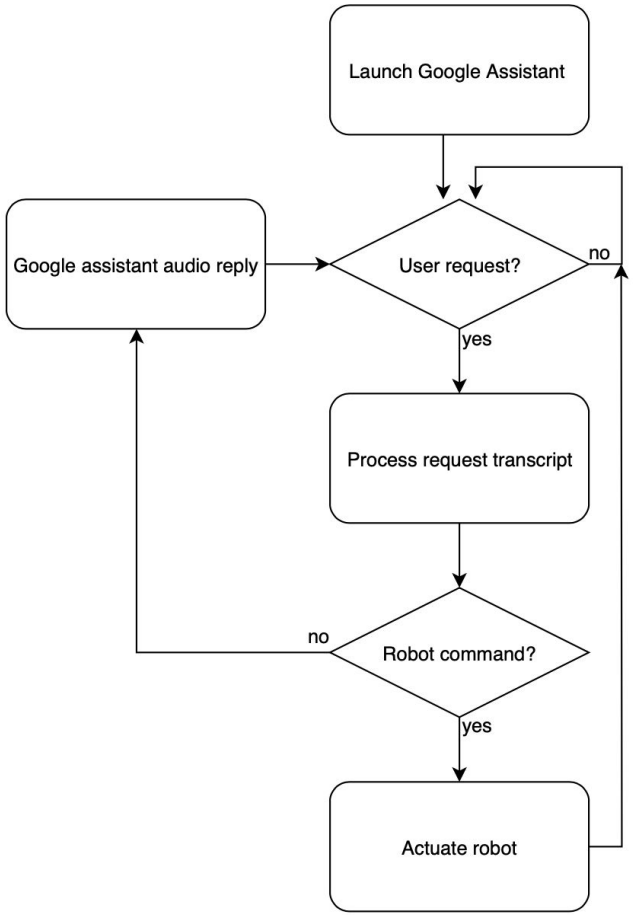
- Autonomous robot built on top of the Google Assistant SDK
- OpenCV python API to detect people
- Matrix Creator board and API for sensors and motor control



Hardware Block Diagram

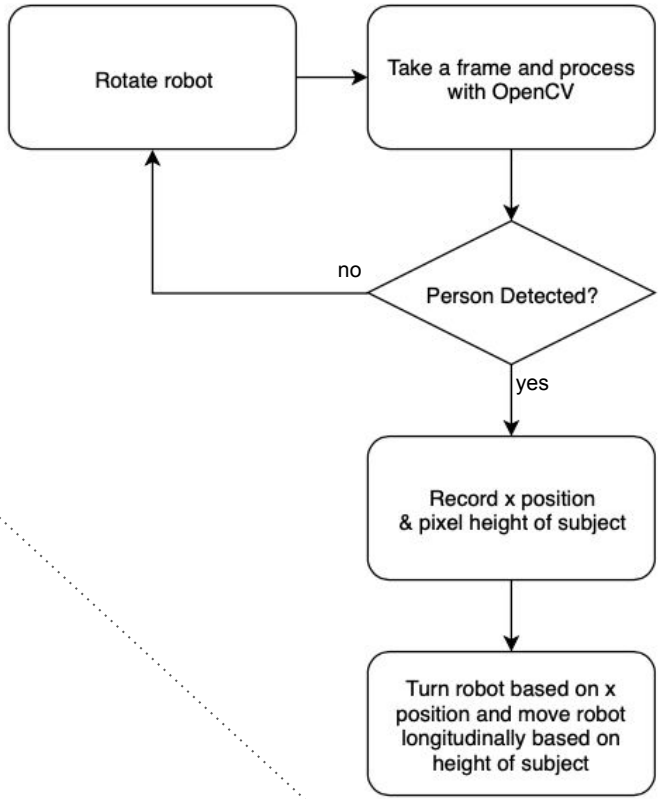


Program Flow Block Diagram

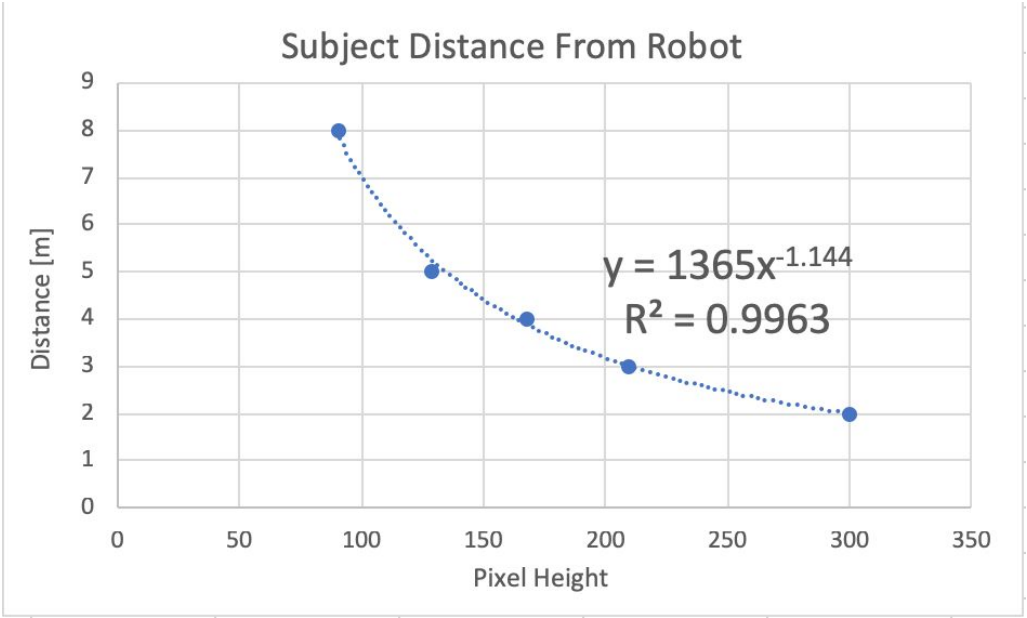


Robot Commands

- Come to me
- Follow me
- Go forward
- Go backward
- Turn right (90°)
- Turn left (90°)
- Turn around (180°)



Inferring Subject Distance From Robot



Project Dependencies

1. Google Assistant SDK - C++ (skip micriphone setup)
   https://github.com/googlesamples/assistant-sdk-cpp
2. Matrix Creator HAL
   https://github.com/matrix-io/matrix-creator-hal
3. Matrix Creator Microphone Array
   https://matrix-io.github.io/matrix-documentation/matrix-creator/resources/microphone/
4. OpenCV (Use OpenCV 4.0 for our project build install)
   https://www.pyimagesearch.com/2018/09/26/install-opencv-4-on-your-raspberry-pi/
5. Imutils (sample library that has openCV sample tools)
   pip install imutils

Project Dependencies

6. Use modified source code from project github page. Follow github readme for proper directory placement. https://github.com/Steve123er/Follow_Me_Robot
7. Remember to compile code by running the “make” command in the /home/pi/assistant-sdk-cpp directory
8. Configure ALSA audio output (skip microphone setup) https://developers.google.com/assistant/sdk/guides/service/python/embed/audio

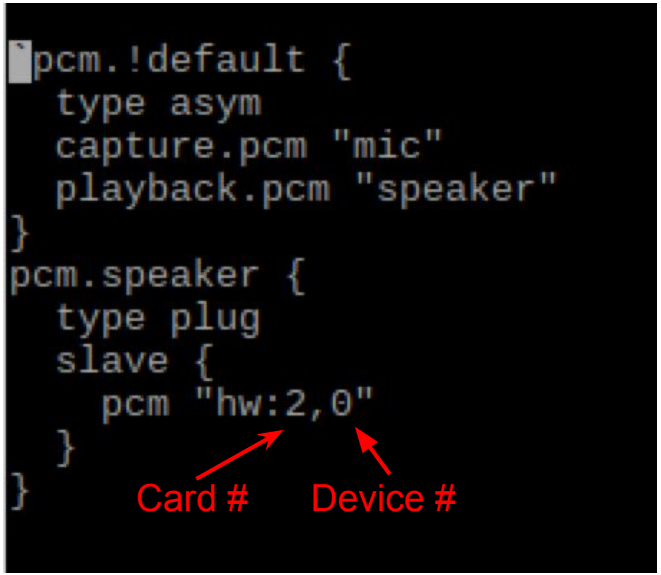
Running the Project

- Verify ALSA audio output is setup properly

```
pi@raspberrypi:~ $ aplay -l
**** List of PLAYBACK Hardware Devices ****
card 0: ALSA [bcm2835 ALSA], device 0: bcm2835 ALSA [bcm2835 ALSA]
  Subdevices: 7/7
  Subdevice #0: subdevice #0
  Subdevice #1: subdevice #1
  Subdevice #2: subdevice #2
  Subdevice #3: subdevice #3
  Subdevice #4: subdevice #4
  Subdevice #5: subdevice #5
  Subdevice #6: subdevice #6
card 0: ALSA [bcm2835 ALSA], device 1: bcm2835 ALSA [bcm2835 IEC958/HDMI]
  Subdevices: 1/1
  Subdevice #0: subdevice #0
card 1: Dummy [Dummy], device 0: Dummy PCM [Dummy PCM]
  Subdevices: 8/8
  Subdevice #0: subdevice #0
  Subdevice #1: subdevice #1
  Subdevice #2: subdevice #2
  Subdevice #3: subdevice #3
  Subdevice #4: subdevice #4
  Subdevice #5: subdevice #5
  Subdevice #6: subdevice #6
  Subdevice #7: subdevice #7
card 2: Device [USB2.0 Device], device 0: USB Audio [USB Audio]
  Subdevices: 1/1
  Subdevice #0: subdevice #0
card 3: SOUND [MATRIXIO SOUND], device 1: matrixio.pcm-out.0 snd-soc-dummy-dai-1 []
  Subdevices: 1/1
  Subdevice #0: subdevice #0
pi@raspberrypi:~ $ nano .asoundrc
```

Running the Project

- File /home/pi/.asoundrc must match output from aplay -l



Running the Project

- Run the following terminal commands:

```
pi@raspberrypi:~ $ source .profile
pi@raspberrypi:~ $ workon cv
(cv) pi@raspberrypi:~ $ cd assistant-sdk-cpp/
(cv) pi@raspberrypi:~/assistant-sdk-cpp $ ./run_assistant_audio --credentials ./credentials.json
```

- The Google Assistant self driving robot should now be running.

Shutting Down the Raspberry Pi

- The Matrix Creator prevents the Raspberry Pi from shutting down. Follow the link for a work around for this issue. https://community.matrix.one/t/cant-shutdown-always-reboots/1770/4
- Once steps are followed to resolve issue, create the following script:

```
#!/bin/bash

cd /usr/share/matrixlabs/matrixio-devices
sudo openocd -f cfg/sam3s_halt.cfg
sudo shutdown -h now
```

Project Shortcomings/Future Work

- No Google Assistant hotword detection
- Google Assistant audio processing and OpenCV image processing does not discriminate between different people
- No proximity/distance sensor due to nonexistent low level ADC driver on the Matrix Creator board
- No audio direction of arrival due to audio input conflict with Google Assistant SDK