Robotics

2nd Semester 2024

FINAL PROJECT

Document all the stages

Project: Creating a Voice-controlled Robotic Subsystem

In this project, you will go through the steps of creating a voice-controlled robotic subsystem to move a step motor clockwise or counterclockwise.

In this project, you should at least create the project using three classes:

- Right
- Left
- Noise (Try with some background noise)

Required Hardware

For collecting sound data, you should have access to a recording device. This can be an Arduino 33 BLE Sense (TinyML Kit), smartphone, webcam, laptop, etc.

For deployment, you must have the Arduino Nano 33 BLE Sense, 28BYJ-48 Stepper Motor, and ULN2003 Driver Board.

Required Software

For creating a machine learning model for deployment, you must use the Edge Impulse platform.

For deployment on the Arduino Nano 33 BLE Sense, you must use the Arduino IDE.

Create a Dataset

Collect about 200 samples of each of the following classes of data:

- Keyword #1 “right” (label: right) (length: 1 second)
- Keyword #2 “left” (label: left) (length: 1 second)
- “noise” words that are not the keyword and background noise (label: noise) (length: 1 second)

Ensure the sound source is in different environments and distances away from the recording device. This will help create a more robust model to differentiate that sound from other noises.

NOTE: You can also collect audio data straight from your Edge Impulse project. Go to Data Acquisition in a new project and connect your smartphone or Arduino board.

Upload Dataset

- Create a new project in Edge Impulse
- Head to the Data Acquisition page
- Click Let’s collect some data
- Select the Go to the Uploader option
- On this new page, click Choose Files
- Select all of the files from your curated sample set
- Click Open
- Click Begin upload
- Click on the Data Acquisition link to go back to the Data Acquisition page. Here, make sure that all of your samples are present and that they are divided between the training and test sets (there should be about 20% of the pieces in the test set)

Impulse Design

Navigate to the Impulse design page of your project.

- Explore 5 processing blocks available in the Edge Impulse platform including
  - MFCC
  - MFE
  - SPECTROGRAM
  - SYNTIANT
  - RAW DATA
- Include the feature extraction diagrams for each processing block in the report

Model Training

- Navigate to the NN Classifier page
- Explore the default NN architecture provided by the platform and briefly explain each layer of the network
- Explain the training settings including the cycles and the learning rate
- Leave all of the hyperparameters at their defaults and click Start training
- When it's done, scroll down to view the Confusion matrix of the validation data

Model Testing

- Head to the Model testing page and classify all of the test data
- Eventually, you can try Live Tests using the Kit
- If you're happy with the test results, continue to the deployment step (I hope to see an accuracy better than 75%, if not, go back to collect more data and adjust hyperparameters)

Model Deployment

- Head to the Model Deployment page
- Search for the Arduino Library
- Build the library and record the hardware results generated
- Include the Arduino library in the Arduino IDE
- Integrate the stepper motor code into the project and run the inference