SE101 Lab Proposal: Digit Recognizer

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Summary

Our idea is to use the accelerometer and gyroscope to track the position of the Tiva on a 3D plane. By frequently sampling the position of the Tiva, we can "draw" digits by mapping 3D coordinates to a 2D plane. We then plan to use machine learning (forward-feed neural networks) to classify the drawn digits from the 2D image. Finally we will output the digits in the visual display as well as in Morse code.

Software Components

- **Position Sampling**: Tracking and recording the 3D position of the Tiva over a period of a time using the accelerometer and gyroscope. The position is sampled at regular intervals when a specific button is held. The image is then fed to the data whitening step when another button is pressed.
- **Data Whitening**: Taking raw coordinates and processing it into a 28 pixel by 28 pixel image for image classification.
- **Neural Network**: Training a multilayer neural network with ten classes to classify digits.
- **Morse Code and Display**: Displaying the number on the LCD screen and flashing it in Morse code.

Hardware Components

- **Accelerometer**: For *Position Sampling*
- **Gyroscope**: For *Position Sampling*
- **LCD Screen**: For *Morse Code and Display*
- **Buttons**: For *Position Sampling*

Challenges

- Using the accelerometer and gyroscope to track the 3D position of the Tiva.
- Converting the 3D position to accurate relative 2D position.
- Training an efficient multi-layer neural network to recognize drawn digits.
- Using regularization during training to produce a more accurate model. Since our training data will be the MNIST dataset, it might not generalize well to the digits drawn by the Tiva.
- Properly displaying the number and Morse code to the LCD screen.