Project Proposal

ECE167 Sensing and Sensors Technologies

Final Project: Dits and Dahs

2/16/24

Niki Mobtaker, Aleida Diaz-Roque, Jacob Gutierrez

Introduction

"Dits and Dahs" is an interactive Morse code training game designed to enhance both writing and listening skills in Morse code. The game will have 3 different sensor inputs for interpreting the morse code: the Capacitive Touch Sensor from the lab kit, home-made capacitive touch sensor, and flex sensors. When the user is triggering the sensors, tone will output through the speaker for the dits and dahs. The user can encode morse code through the duration of touch of the capacitive sensors. The user can also wear the two flex sensors on their thumb and index finger, bending one finger for dit and one for dah.

To determine the most effective sensor for Morse code transmission, we will conduct a comparative evaluation of both homemade and commercially bought capacitive touch sensors, as well as flex sensors. These tests will focus on key performance metrics such as sensitivity and accuracy to determine which sensor is best suited for morse code generation.

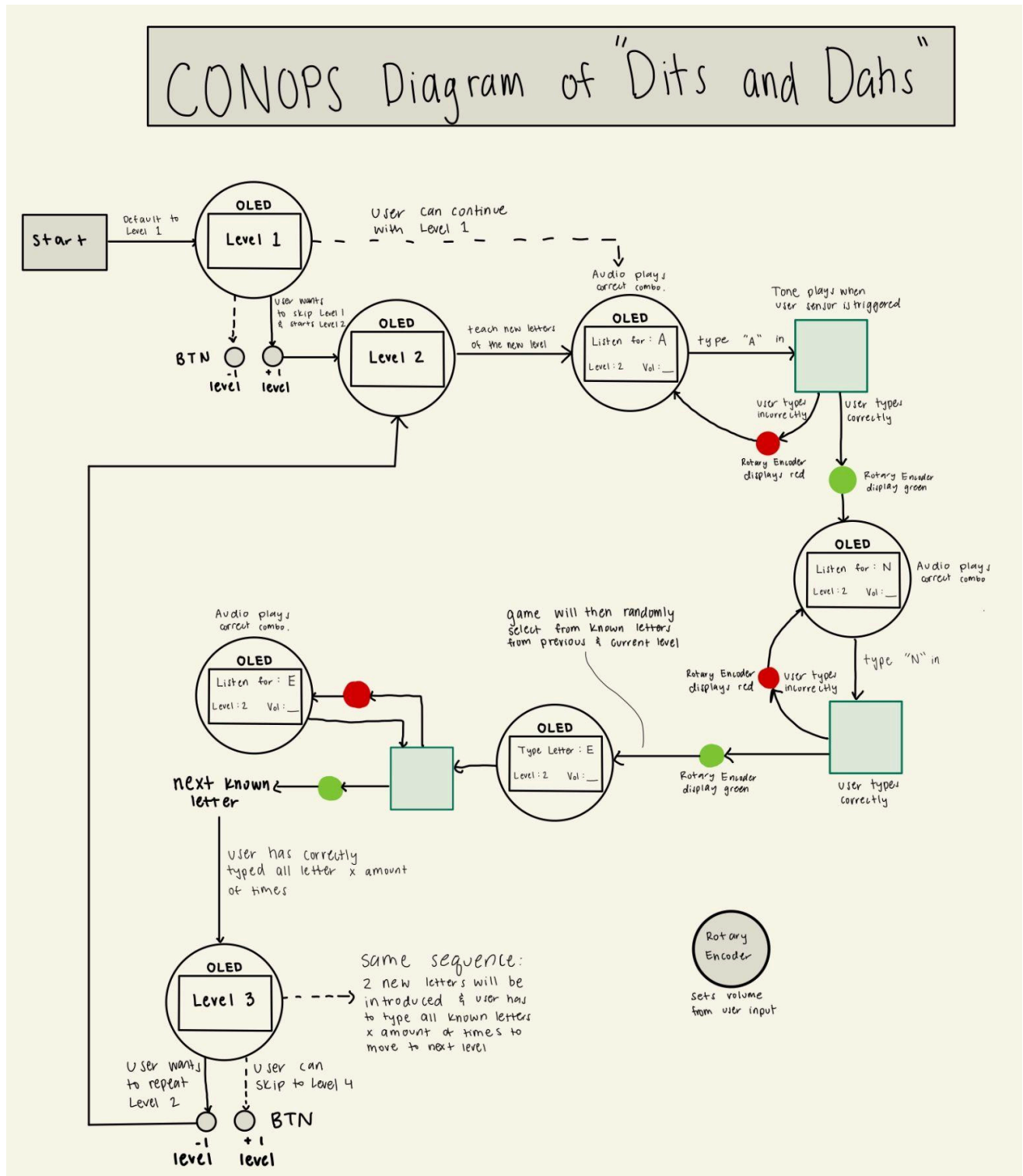The concept of operations of the game is described in Figure 1.

Figure 1

Each level of the game introduces two new letters. In one level round, the user will learn two new letters and practice correct combinations of all letters known from previous and current levels. The rotary encoder will indicate to the user if the combination they typed was correct or

incorrect. If incorrect, the game will reteach that letter and move on to generate other known letters. Users can change the level they are on by pressing one button of the I/O for minus one level and another for plus one level. Users can set the volume by turning the rotary encoder.

Parts List & Resources Acquired

Component	Quantity
STM32 Microcontroller	1
Custom ECE167 Capacitive Touch Sensor	1
SEN-10264 Flex Sensor + Mount	2
Homemade Capacitive Touch Sensor (Materials TBD)	1
COM-10982 Rotary Encoder w/ BOB-11722 Breakout	1
LM555 Timer IC	1
COM-11089 Speaker	1
TPA2005D1 Mono Audio Amp Breakout	1
Passive Electronic Components (Resistors, Capacitors, etc.)	As Needed

Evaluations

To quantitatively assess the measured data, we will utilize the following criteria matrix:

Indicator	Measurement Strategy	Units	Goal
Capacitive Touch Sensor $(C_L)^*$ - Sensitivity	Measure the minimum detectable change in frequency due to touch.	Hertz (Hz)	$\Delta f >$ Threshold [Hz]
Homemade Capacitive Touch Sensor (C_H) - Sensitivity	Measure the minimum detectable change in frequency due to touch.	Hertz (Hz)	$\Delta f >$ Threshold [Hz]
Homemade Capacitive Touch Sensor (C_H) - % Error	Compare the performance of the homemade capacitive touch sensor with the provided sensor.	Percentage	Error $\leq$ 10%
Flex Sensor - Accuracy	Measure the minimum change in resistance required to accurately trigger dits/dahs.	kΩ	$\Delta R >$ Threshold (MΩ)
Entire System - Accuracy	Create a test set to cover a range of morse code characters and record the outputs. Compare the total number of characters in the test set (N_{Test}) vs the number of correctly interpreted characters $(N_{Correct})$.	Percentage	$\frac{N_{Correct}}{N_{Test}} \times 100\% \geq 90\%$
Entire System - Performance	Test code's performance with users of varying input speed.	Percentage	Error $\leq$ 10%
All Sensors - Accuracy	Create a test to compare the sensors' accuracy to detect full combinations with varying input speeds of the user.	Percentage	Error $\leq$ 10%

$(C_L)^*$ - Both capacitive touch sensors will be connected to the LM555 IC Timer, configured to produce a square wave relaxation oscillator. The change in period that the LM555 outputs will vary by the capacitive sensor's state of touched or untouched.

Timeline

2/16/24:
-   Discuss Game Rules and Expectations

~~2/19/24:~~
-   ~~Assign Roles & Responsibilities~~
-   ~~Finalize Game Rules and How To Play~~
-   ~~Catch up on STM~~

~~2/24/24:~~
-   ~~Design homemade capacitive touch sensor~~

2/27/24:
-   Assign Roles & Responsibilities
-   Finalize Game Rules and How To Play
-   Catch up on STM
-   Design homemade capacitive touch sensor

2/28/24:
-   Test sensitivity of sensors (C_L, C_H, Flex) to determine Thresholds
-   Discuss State Machine and Flow of Game

3/3/24:
-   Initial Prototype of Game

3/8/24:
-   Incorporate level and volume with buttons and rotary encoder respectively.

3/16/24:
-   Test Game Functionality
-   Improve as necessary
-   Quantitative Assessment of all three sensors

3/17/24:
-   Submit All Deliverables (final commit to repo, project slides, writeups, self and peer evaluations)

3/18/24:
-   Present Project and Demo Game

Conclusion

The "Dits and Dahs" project focuses on exploring capacitive touch and flex sensors for a Morse code training game. Our evaluation criteria prioritize sensitivity, accuracy, and the overall performance of the system to identify the most effective sensor for the game. Through a process of testing and refinement, our objective is to create a user-friendly Morse code learning experience. The outlined timeline reflects our commitment to a structured development process.

We eagerly anticipate the learning experience we will gain from this project and the realization of our vision.