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Haptics Morse Code Communication for Deaf and Blind Individuals

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***Abstract*— Two individuals who are deaf and going blind need a way to communicate with the outside world. This project aims to develop a haptic communication device to transmit sentences to the patients in a series of patterns that implement Morse code. A mouthpiece allows the patients to transmit Morse code to another person by biting on an embedded force probe. The two individuals that used the setup were able to use it, but one of them did not like the feeling of the vibrations.**

I. Introduction

Several devices exist for people who are deaf-blind. One example is the Virtual Leading Blocks that researchers at the University of Tokyo created [1]. This is a great application of haptics, but is not suitable to this particular project since our participants are also bound to a wheel chair and have limited sensation and movement below the neck due to muscular degeneration and neuropathy. Another example of a wearable device for a deaf-blind person is OMAR, which uses vibration and movement of fingers to help user's read speech [2].

Morse code has been used in various applications. The code is like learning a new language in itself with a dit or dat used to signify long or short signals, respectively. The combination of the dits or dats form different letters of the English Alphabet. In this particular application of haptics, International Morse code is used to transmit English language from a keyboard input to Morse code. A simple vibration actuator turns on and off simulating the pattern of dits and dats. The first stage was to communicate with the individuals. In the second stage, we wanted a way for the users to be able to transmit Morse code, have a computer interpret the Morse code into English language, and display the text on a computer screen. The purpose of the computer screen is for another person to be able to read and type messages back and forth with the patients. Directly connecting the input/output would allow the two individuals to directly communicate with each other.

II. Methods

Stage one of the project needed to be simple to use and inexpensive (under $500.00). Keeping this in mind, a Raspberry Pi 2 with a Linux operating system was chosen as the main CPU. A Phidget 1012 was used for interfacing to the actuators and sensors due to its simplicity and also because it had open source codes available. Due to this open source code, C programming was implemented on the Raspberry Pi 2 to write the code for the sensor. The sensor chosen was a vibrotactile motor that is 10mm in diameter. When the code is run, a command window displays on the computer screen and prompts the user to insert a message. After the user types a message and presses enter, the code will run through the character inputs and turn the motor on and off corresponding to the Morse code pattern logic in the C program.

Stage two of the communication project, essentially does the same thing as stage one, but reversed. In this case we needed to design the prototype to be confined to the area above the neck so the patients could reach it without needing their lower extremities and arms. We decided to go with a mouthpiece. This first prototype of a mouthpiece was modeled after a sports mouth guard. Using food grade silicone molding, a layer of the mold was placed over the guard. After the first layer dried, we inserted the sensor and poured another layer of mold overtop. This particular sensor was the Tekscan piezioresistive Flexciforce a101, with a sensing area of 3.8mm. When a user starts the sensor program, the command prompt asks the user to press enter to begin the program. The program measures the responses from the sensor embedded in the mouthpiece. Once the program receives a response, it keeps track of timing to determine which letter the person is trying to communicate, displays the corresponding letter on the computer screen, and holds the letter in case it is a sentence.

III. Results

Overall the two patients were satisfied with the design and are learning Morse code to be able to use this system better. One of the patients did not like the vibration applied to her skin, while the other patient appreciated it. Another suggestion by the patients was to design the mouthpiece to be utilized outside of the mouth so it will not be cumbersome. A nice addition incorporated in the coding for both the probe and the actuator was being able to slow or speed up the code depending on the user. This was helpful since the patients had different preferences in interpreting the code.

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