Wren Hobbs
CSE 321 - Project 3 Initial statement

Project Statement

The goal of this project is to develop a communication accessibility device to allow communication between blind, deaf, and deafblind individuals. One user will use a braille keyboard to enter a string of text, which the system then outputs as morse code to the other user via a vibration motor. Neither party needs to be hearing or sighted to use this device, as the input and output are both purely tactile. Using a vibration motor makes this a more affordable option to a traditional braille printer, but would require knowledge of both braille and morse code, making it more difficult to learn and use.

There will be an ultrasonic sensor to detect the user's hands near the braille keyboard. If nothing has been detected, the system will enter sleep mode to conserve power. When the ultrasonic sensor detects the user, the system will exit sleep mode.

The braille keyboard is additionally fitted with a vibration motor to act as user input, providing tactile feedback for them. When the user enters a braille character or changes the system mode, the motor will vibrate briefly.

The user should have access to a "cancel" button which interrupts and stops output.

Two LEDs will also be used for a sighted user's UI. One will be on when the ultrasonic sensor detects a user, the other will blink with the morse code motor.

Constraints

- System must be fully usable with only the tactile UI. LEDs must not be necessary for full operation.
- System should only accept simple A-Z 0-9 braille characters as input. Capitalization and punctuation cannot be translated into morse easily.
- The input message can be no longer than 140 characters.
- The user must be within range of the ultrasonic sensor to use the system.
- Output takes time to do, which is the nature of morse code. The speed of the output cannot be modified.

Specifications

Threads

- Cancel button interrupt- stops printing thread, erases message string.
- Ultrasonic detector interrupt- when sensor stops detecting a user, system will enter sleep mode. In sleep mode, detecting a user will enable the system.
- ui motor: controls vibration motor attached to braille keyboard.
- keyboard interrupt: started when user presses "enter" button on braille keyboard- detects which bump buttons were pressed, interprets which character was entered, and stores it

- print thread: runs concurrently, “prints” characters it receives via morse code vibration motor

Global variables

- message: string pointer with 140 bytes allocated. stores text user inputs.
- awake: true when system is on, false when system is asleep.

Functions

- brailleToText: takes a 6-bit number (i.e. 0x111000) and interprets that as a braille character, each bit corresponding to one of the bumps. Returns the character that set of bumps is associated with.
    - e.g. 100110 → ⠙ → ‘d’; 111001 → ⠧ → ‘v’
- printMorse: takes a character and “prints” it to the motor as morse code. Must be able to be interrupted at any time.

External hardware

- Buttons:
    - 6x “bump buttons” associated with the 6 bumps that compose a braille character.
    - 1x “enter” button: user presses this while holding specific bump buttons to input a character (pressing this while holding no bump buttons inputs a space).
    - 1x “cancel” button: when the user presses this button, all morse output is stopped and the message string is cleared.
- Motors:
    - ui motor: attached to braille keyboard. provides tactile feedback for the user entering text.
    - morse motor: held by message receiver. Vibrates the input message in morse code.
- LEDs:
    - awake LED: enabled when the ultrasonic sensor detects a user is present.
    - morse LED: enabled/disabled with the morse motor.

Asks

Purpose

One-way communication device that allows one user to send remote tactile messages to another. Does not require vision or hearing for either party to use effectively.

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Inputs

- bumpTL, bumpTR, bumpML, bumpMR, bump BL, bump BR
    - one button for each bump in a braille character.
- enterButton
    - causes the system to scan bump buttons and add the input character to the message string.
- cancelButton
    - Interrupts all other services, stops output, and clears the message string.
- sensor
    - ultrasonic sensor that puts the system in sleep mode if no user is detected.

Outputs

- awakeLED
    - enabled when the system is not in sleep mode (i.e. the sensor detects a user).
- morseLED
    - The sender’s message is displayed in morse code by this LED.
- morseMotor
    - The sender’s message is displayed in morse code by this vibration motor.
- uiMotor
    - pulses when the message sender inputs a character to provide tactile feedback.

Constraints

- 140 character limit for message
- Alphanumeric text in message only
- Sender must be detected by the sensor
- System must allow time for morse code output to be sent

Preliminary Bill of Materials

- Nucleo L4R5ZI
- 8x push buttons
- 2x vibration motors
- 1x ultrasonic sensor
- 2x LEDs
- 2x 1kΩ resistor
- Breadboard
- Breadboard wires