Nick Minor
CSE 321 Project 3 Midpoint

Project Statement

This project determines if something has passed through an area of interest using an ultrasonic sensor and notifies the user. The system can sound a buzzer if anything passes within a certain distance and the distance to the object can be displayed on the LCD screen. Different modes and the desired distance can be modified using the matrix keypad. This system can be used for **safety** applications such as keeping people away from dangerous areas, as a security alarm or placed on a vehicle to help a driver avoid collisions.

Constraints / Specifications

Specifications:

- The user can set modes using the matrix keypad which are used for different applications.
    - Sounding a warning with the buzzer
    - Detecting distance to an object
    - Security Alarm with the buzzer
- The user can specify the distance that the buzzer will sound using the matrix keypad.
    - Mode for cm
    - Mode for inches
- The system will poll for objects every 60ms. This is done by a trigger pulse being sent to the ultrasonic sensor, eight 40kHz ultrasonic signals being output and echoing back.
- To get the distance to an object, the width of the returning pulse is divided by 58 to get the distance in centimeters. Similarly, the distance to the object in inches is the pulse width divided by 158. If no object is present, the output pin will give a 38ms high level signal

Constraints:

- Valid distances are between 2cm and 400cm.
- The ultrasonic sensor will be most reliable when trying to detect objects within a 30-degree angle.
- The time to detect if an object is present takes at least 50ms. This is the time for an electric signal to be sent to the sensor, the ultrasound burst to be emitted and consequently echoed back.
- Measurements may be less accurate when the area being surveyed is not a smooth plane or it is greater than 50cm.

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Asks

Purpose / Goal:

Create a system which notifies users if something passes through an area of interest. Useful in applications designed for increasing the safety of those around the system. An ultrasonic sensor detects the distance to any objects in front of it and an alarm is sounded if somebody or something comes within a certain vicinity.

Inputs:

- Matrix Keypad
  - 0-9: Specifying Distance
  - A: Security Alarm Mode
  - B: Distance Warning Mode
  - C: Specify new distance
  - D: Toggle specification between cm and inches
- Ultrasonic Sensor
  - Detects distance to an object in front of it

Outputs:

- LCD Screen
  - Prompts user for input via matrix keypad
  - Specifies distance to object that passed on display
- Buzzer
  - Sounds when an object passes or is within a certain distance

Constraints / IO relationships:

- Valid distances are between 2 centimeters and 4 meters
- Ultrasonic sensor works best within a 30-degree angle
- Time to detect an object is at least 50ms
- Measurements may be less accurate when the area being surveyed is not a smooth plane or it is greater than 50cm

BOM

Bill of Materials:

- Nucleo L4R5ZI
- LCD
- Matrix Keypad
- HC-SR04 (Ultrasonic sensor)
- Buzzer
- Solderless Breadboard

- Jumper wires
- USB-A to micro-USB-B cable
- Computer to run Mbed Studio (Windows, MacOS or Linux versions available at https://os.mbed.com/studio/)

Data sheets and User Manuals:

- Nucleo L4R5ZI:
  - UM2179
    - https://www.st.com/resource/en/user_manual/dm00368330-stm32-nucleo144-boards-mb1312-stmicroelectronics.pdf
  - RM0432
    - https://www.st.com/resource/en/reference_manual/rm0432-stm32l4-series-advanced-armbased-32bit-mcus-stmicroelectronics.pdf
- Ultrasonic Sensor:
  - https://www.electroschematics.com/wp-content/uploads/2013/07/HC-SR04-datasheet-version-2.pdf
  - https://cdn.sparkfun.com/datasheets/Sensors/Proximity/HCSR04.pdf
- Buzzer:
  - http://tinkbox.ph/sites/tinkbox.ph/files/downloads/5V_BUZZER_MODULE.pdf