ELECTRICAL ENGINEERING & COMPUTER SCIENCE
UNIVERSITY OF MICHIGAN

EECS 373: Introduction to Embedded System Design

Sign Language Interpretation Glove

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Problem at Hand

Sign language is not understood by 99% of people who are not deaf or hard of hearing.

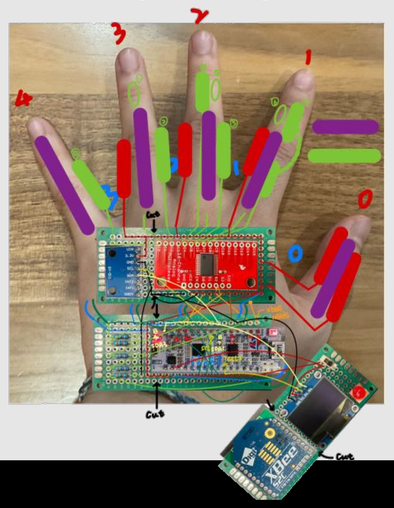
Even if someone knows sign, it can be hard to interpret in low light or high stress situations.

Solution

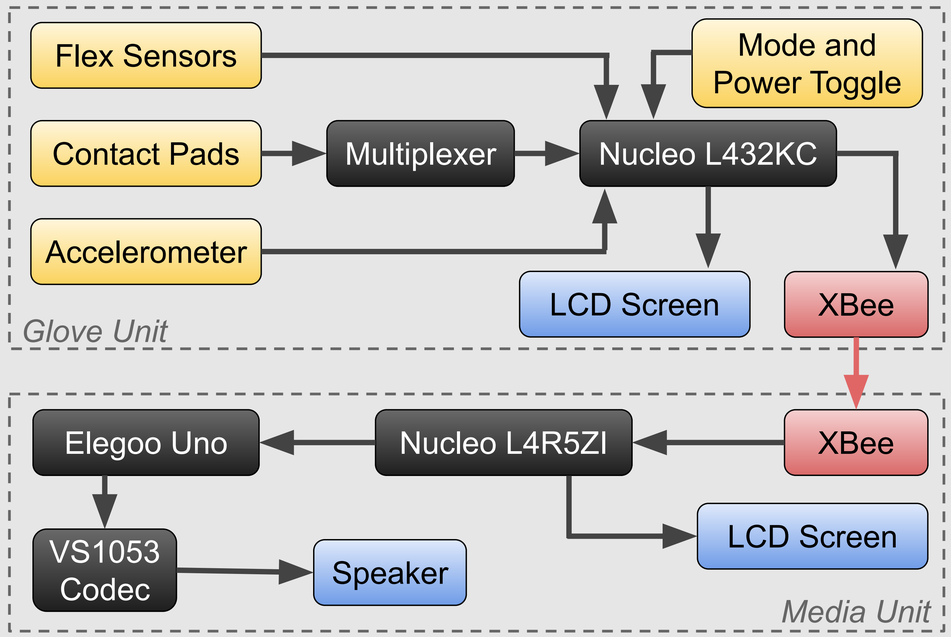
A sensor glove that can be worn by a signer. Static and motional data is deciphered and then displayed auditorily or visually.

- **Multiple Glove Modes:**
  - letter mode
  - number mode
  - word mode

- **Output Media:**
  - Audio jack for speakers or wireless dongles
  - Display screen for images and videos
  - SD card allows for enlarging auditory dictionary



System Diagram



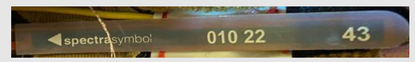
Challenges

- The original prototype could not differentiate between all of the signs, so a new sensor layout had to be created.
- The extra sensors in the new layout superseded the number of available GPIO pins on the L432KC. An analog multiplexer and polling system was needed to expand the range of the board.
- The video files are stored directly on the board. There was not enough space in ROM so they were moved into FLASH memory.
- The L4R5ZI did not have any inherent audio playback capabilities as originally expected, so the design was modified to include the VS1053 audio module.
- The XBee communication timeout rate needed to be increased to fix dropped packets.

Design

Glove Unit:

- **5 flex sensors:**
  - Detect the curve state of each finger.



- **8 conductive sensors:**
  - Detect when fingers are in contact.
  - Made from conductive thread sewn directly into the glove to achieve the best comfort and flexibility of the fingers.
  - Use 16 channel analog multiplexer to solve the problem of insufficient GPIO pins.

- **Accelerometer:**
  - Detect hand orientation and simple dynamic gestures.

Mode and Power toggle:

- **Mini LCD screen:**
  - Verify the gesture to the user.
  - Display the current mode of the glove.
  - Play the welcome interface
  - Turn on animation (optional)

- **Xbee transmitter:**
  - Send identified sign and mode information to Media Unit

Media:

- **XBee receiver:**
  - Receive data from Glove Unit
  - Parse raw transmission into mode and display information
- **Large LCD Screen:**
  - 3.5” 480x320 resolution screen
  - Display characters, images, and animations at 30 fps

- **Speaker:**
  - Driven by VS1053 chip
  - Audio files stored on SD card

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