Creating a Prototype for a Smart Watch
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Goals

The goal of this project is to develop a prototype for a smart watch with footstep detection, distance measurement, alarms/timekeeping, fingerprint sensing, and wireless communication functionalities.

Approach

Our project will involve modularizing various smart watch functionalities to make it easy to integrate distinct processes and make a fully-functioning system. We plan to model the functionalities into different states, which transition based on external cues (such as button presses, fingerprint detection, timer interrupts, voice commands) and output a specific action (display information on the screen, transmit data over Bluetooth, unlock device, etc.)

We plan to break up the project into the following "chunks":
- Sensor measurements
  - footstep detection, distance measurements, geolocation, floors climbed, temperature, humidity.
  - Implement fingerprint detection using an off-the-shelf capacitive fingerprint sensor.
- Timekeeping/alarms.
  - Update a clock with the current date and time to the minute.
  - Create custom alarms for various times, and use a vibration motor to "sound" the alarm.
- Wireless communication.
  - implement a Bluetooth interface for the system
  - When connected to a master device (laptop/smartphone), stream all stored data to that device, when prompted by the user.
- User interface
  - Allow users to interact with the system either using a button press or with programmable voice commands.
  - Display the current task/mode of the smart watch system on an LCD screen.

Resources

Our plan is to create a prototype of a fully-functioning smartwatch embedded system using the Buckler board as the hub for processing and sensing. In detail, we plan to use:
- nRF52832 SoC to run the project firmware, interface with sensors, and communicate wirelessly with other bluetooth devices
- 3-Axis accelerometer, gyroscope
- temperature, pressure sensors
- capacitive fingerprint sensor

- LCD screen for smart watch display
- vibration motor
- external microphone

Schedule
- 10/23
  - Create a statechart modeling our smart watch FSM with associated states, inputs, outputs, guards, and actions.
  - Outline a test suite to unit test our prototype in different environments.
- 10/30 - Milestone 1
  - Implement the sensor measurement functionalities, including footstep detection. Write an algorithm that interprets the accelerometer measurements meaningfully to determine footsteps and distance traveled measurements.
  - Use a preliminary dataset for voice commands and test its accuracy.
- 11/6
  - Write and test firmware that establishes a Bluetooth connection to another device and transmits data.
  - Implement fingerprint detection to unlock the device and test.
  - Use the LCD screen to debug system functionality and output when in use.
- 11/13 - Milestone 2
  - Implement the timekeeping and alarms modules.
- 11/20
  - Finish up sensor measurements, voice commands and test.
  - Finish up voice commands and test.
- 11/27
  - Finalize wireless communication and test.
- 12/4
  - System-wide testing
- 12/11
  - Demo

Risks and Feasibility

Mapping voice-based commands to system functions can be tricky and requires a solid training dataset. Testing this prototype in a "wearable" setting is tricky due to the large size of the components. Accuracy is a huge challenge in terms of wearable sensors: for example, how to accurately map accelerometer data to actual steps and movement while minimizing the amount of false positives. Lastly, proper integration and timing of all the features will also be a challenging task.

Github: https://github.com/arvind0sundararajan/smartwatch