Student Proposal: Mobile Electronic Aids for Daily Living

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Summary

The past work has already shown the effectiveness of the accessibility of mobile device through wheelchair control and Bluetooth Serial Port Protocol. However, further work needs to be done for the complete design of the system. My proposed design has three major components -- Input Processing Module, Mobile Application for Basic Functional System, and Accessibility to Mobile Device Features. The system will be designed to be extensible to any feature add-on requested in the future.

Goal

To enable wheelchair users who have decreased mobility to access a mobile device, with functionalities that improve the quality of life for the client

Requirements

- client accesses the mobile device through the Environmental Control Unit (ECU) mode of the wheelchair where the input for the mobile device can be set with at least a single binary switch and at most four binary switches.
- client has the ability to access at least the basic features of a mobile device (e.g.: phone service, location based services, mp3 player, text messaging) .
- the system shall be extensible to other capabilities for accessibility beyond wheelchair use and basic mobile device services, to further improve quality of life for wheelchair users (e.g.: accessibility to home ECU).

Proposed Design

My proposed design has three main components – Input Processing Module, Mobile Application for Basic Functional System, and Accessibility to Mobile Device Features.

System Overview

The user sends the input through the wheelchair control, where the input can be configured to be at least a single binary switch and at most four binary switches. The input can then be sent to the Arduino BT board through the ECU module. In the past completed work of this project, an Arduino BT board was

already programmed for this purpose and it already demonstrated the ability to communicate with a mobile device with a single binary switch and Bluetooth communication. We can modify the existing code to implement a configurable switch access for the input. A mobile application will also be written for an Android phone to receive the input through bluetooth communication, where this mobile application will be either implemented in the form of a background service to directly access other Android applications, or in the form of a user interface to gain access to mobile services. Please refer to Figure 1 for the system block diagram.

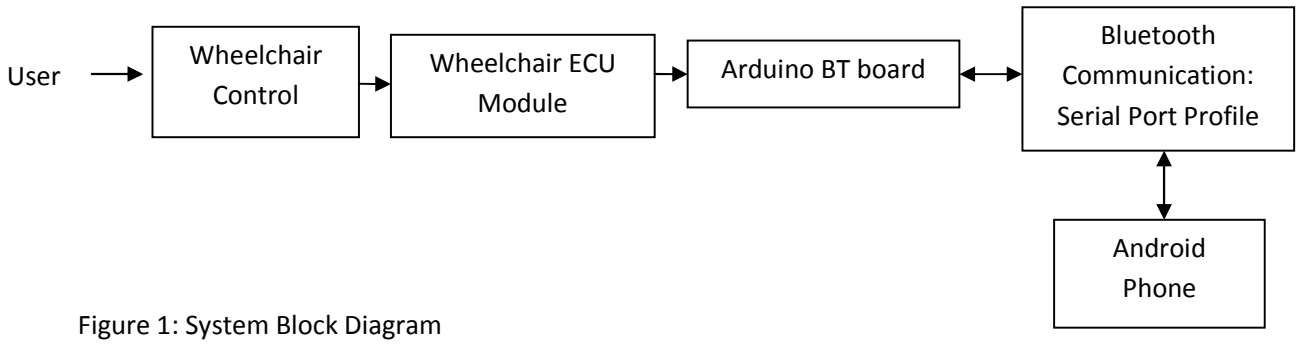

Figure 1: System Block Diagram

Input Processing Module

We need to first design a module for the Android device to receive input through the Bluetooth Serial Port Profile. The number of switches needs no configuration at the wheelchair end. With each switch being assigned with two distinct integers (i.e.: used for rising edge and falling edge) , the Arduino BT board can send a distinct integer through Bluetooth SPP for each switch at the moments the switch is pressed or released. Thus, there are eight distinct integers, and processing method is written in the input processing module in the Android device. This input processing module needs to be configurable to process 1, 2, 3, or 4 switches.

Mobile Application for Basic Functional System

For the basic system to be functional, we need the Input Processing Module to translate the switch inputs into key inputs and a mobile application to use the key inputs to access the mobile services. The Input Processing Module was described above and it needs to be integrated into the mobile application. For the mobile application, here are two approaches for the design: Background services to directly send key inputs to the Android environment, and user interface to receive inputs to navigate through the user interface to access the mobile device services.

Please refer to Table 1 for the advantages and disadvantages of each approach.

	Advantages	Disadvantages
Background Service	- eliminates the need to write custom code to access most of the mobile services. -	- may require the accessibility of onscreen keyboard and additional key pad buttons to access some mobile services and other Android applications .

		-
User Interface	- has better control of accessibility of mobile services -	- more development work for accessibility of mobile services -

Table 1: Comparison of the Two Proposed Approaches in Designing the Mobile Application

Accessibility to Mobile Device Features

Regardless of the approach in the design of the mobile applications, it is necessary to write custom algorithms for some mobile services, for the wheelchair user to properly gain access to the services. A feature list shall be determined, depending on the mobile application design approach and available development time, before the beginning of the coding phase of the project (please read below for information on the proposed software development process.

Proposed Development Process

An iterative development process to biweekly deliveries of demo of functional components may work well for this project.

In the design phase, I will be gathering as much technical information as possible for the project. My mentor and I will come to agreement on the details of the requirements. We will be discussing the technical details of the design. A detailed written documentation will be delivered to the mentor. Once the design is approved by the mentor, we can move into the iterative part of the development process.

In the coding phase, I will be focusing on the coding of the agreed components to be demonstrated in the current iteration. A reserved amount of time will be dedicated to the coding phase. Once the period expires, I will document a brief report on any work that is behind or ahead of schedule. I will then begin the testing and debugging phase.

The purpose of the testing and debugging phase is to resolve any current issues and prepare the code for the biweekly demo. I will be fixing any major and minor bugs, and temporarily removed defective features if necessary. The goal during this period is to deliver a functional demo.

By the end of the iteration, a demo will be presented to the mentor. A plan for the new iterative cycle will be discussed. And the design will be refined if necessary.

The iterative cycles will continue either till all agreed components are implemented to the mentor's satisfaction, or till the end of the summer work period. If work is not completed by the end of the summer, the final demo shall still be functional.

Please refer to Figure 2 for a sketch of the development process.

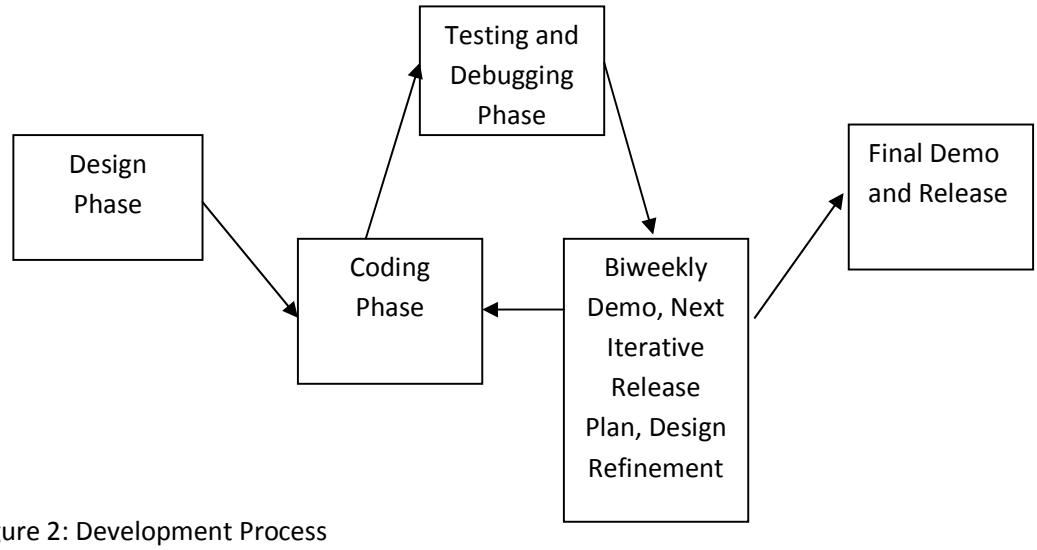

Figure 2: Development Process

Future Work

As the proposed design is made to be extensible to any new features, much work can be defined in the future to further improve the quality of life for people with disabilities, with the help of mEADL. For example, the mobile device can be programmed to remotely access the home environmental control unit. It can be programmed to seek for help if the wheelchair user is stranded in quiet streets. As the mentor suggests, possibilities are endless.