Electrical Overview

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1.0 Electrical Overview

Hand for the Deaf is expected to incorporate a microcontroller, SD card, servomotor controller, simple tactile switch interface, LCD display, and robotic hand as its primary components. A system block diagram, which further details the components and their expected interconnection, is provided in Appendix 1.

The primary data being collected is the text input which is to be converted into signed characters; this will be received either over the USB interface to the microcontroller or via the SPI SD card interface. Additionally, simple user navigation and selection input will be available over the tactile switch interface when the device is operating in standalone mode. Data being transmitted includes robotic hand control and timing data, which will be transmitted to the motor controller over an as-of-yet undetermined interface, as well as operating data which will be transmitted to the LCD screen when the device is operating in standalone mode.

2.0 Electrical Considerations

The primary voltage-related drivers of the electrical design include the USB interface, the SPI SD card interface, and the PWM interface used by the motor controller to control the servo motors. The USB interface utilizes a VDD of 5.0 volts for standards-compliant operation [1], the SPI interface used on the SD card requires 3.3 volts for correct operation [2], and the PWM interfaces used to drive servomotors are expected to require 4.8 – 6.0 V based on the datasheet of a typical servomotor [3].

Major frequency considerations for the electrical design involve operation of the USB interface, which will require an expected clock rate of 24MHz. This rate can be attained through the use of a PLL or dedicated oscillator; a lower system clock rate of 8MHz is anticipated.

Hand for the Deaf is expected to use wall power. As previously stated, although power dissipation is important, no special design considerations are currently being provided to power dissipation for the device. However, the device is expected to work in an international setting, and for this reason care must be taken to ensure the device can operate under the various national power grids that exist. An international power supply adapter will be used in concert with the Hand for the Deaf to supply 5-6 volts to the inner device circuitry. A tiered regulation system will then be used to ensure a "clean" 5 volts for the USB interface and servomotors as well as 3.3

volts for the SD card interface, microcontroller, and associated electronics. Level conversion circuitry may be necessary for successful communication between the microcontroller and the servomotor controller.

3.0 Interface Considerations

The primary interfaces in use in this design are the USB interface, SPI SD card interface, LCD interface, and interface to the servomotor controller.

The USB interface is used for communication to and from a host PC, primarily in the form of sign language characters to be transmitted to the Hand for the Deaf. Additional uses for this interface include feedback information to the host PC about the progress of signing out the provided text file, and writing servo command and sign language files to the SD card for use when the device is operating in standalone mode. It is expected to be run at the USB1.0+ standard "Full Speed" rate of 12Mbit/s.
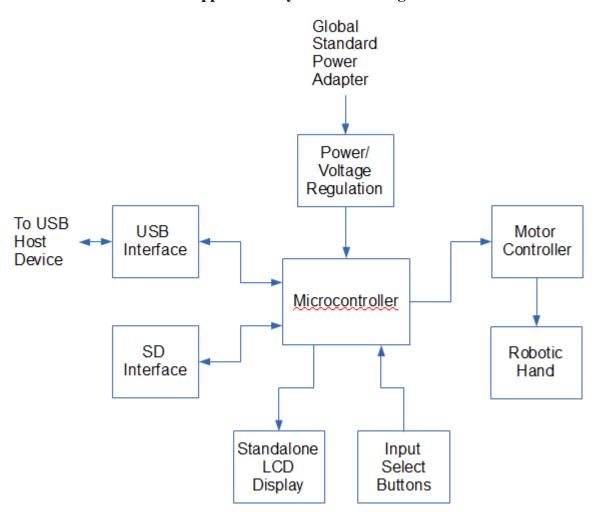
The SPI interface is to be used for communication between the microcontroller and the onboard SD card. Sign language files, servomotor command libraries, and fetch requests for additional data are expected to be transmitted over this interface. The interface is expected to be clocked at the standard system clock frequency (anticipated to be 8MHz), with the microcontroller acting as the master and the SD card acting as a slave device. This interface is intended to be dedicated; no other devices shall share this SPI bus.

The servomotor controller interface shall be utilized between the microcontroller and the servomotor controller to relay position and timing information to the servomotor controller. The interface type to be utilized is currently unknown and specific details on the interface cannot be provided at this time. Probable interface candidates include SPI, UART, and I2C, as they are ubiquitous and common within embedded designs.

The LCD controller interface shall be utilized for communication with the embedded LCD, particularly during standalone operation. The interface type to be utilized is currently unknown and specific details on the interface cannot be provided at this time. Probable interface candidates include SPI, I2C, and GPIO, as these are ubiquitous interfaces for embedded LCD communication.

4.0 Sources Cited:

[1] Wikipedia. *Universal System Bus.* Available: http://en.wikipedia.org/wiki/USB
[2] Wikipedia. *Secure Digital.* Available:
        http://en.wikipedia.org/wiki/Secure_Digital#Technical_details
[3] Lee, Jun Hee. *Announced Specification of HS-311 Standard Servo.* Available:
        http://www.robotshop.com/media/files/pdf/hs311.pdf

Appendix 1: System Block Diagram

Global Standard Power Adapter

Power/ Voltage Regulation

To USB Host Device

USB Interface

SD Interface

Microcontroller

Motor Controller

Robotic Hand

Standalone LCD Display

Input Select Buttons