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[DESIGN DOCUMENT: IPOD BARCODE SCANNER]

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Introduction:

I. Technical Terms Definition

Terms	Description
DTMF	Dual-Tone Multi-Frequency signaling is a standard to generate analog tones.
TRRS	A four contacts connector typically used for analog signals, primarily audio. Two channels are typically used for stereo sound output and an additional one for microphone input. They all share the same common ground.
RS232	A standard used for serial binary data bi-directional communication.
Microcontroller	A scaled down computer on a single physical device called an integrated circuit containing a core processor, memory, and programmable input and output pins.
Barcode	An optical representation of a small piece of data which can be easily read by a machine.
iPod Touch	A small, lightweight, wireless-internet capable mobile device used mainly as a media player, personal digital assistant and game console.

II. Executive Summary

This project's client is Marshalltown Company, a leader in construction tool manufacturing. The goal of this project is to help implement a user friendly and cost effective product for the company's warehouse employees to use. This requires a design that effectively interfaces an inexpensive barcode scanner to an iPod Touch. The obtained barcode data will be fed into the iPod Touch through the TRRS audio jack. Transferring data using the 30-pin connector is a more expensive option and thus avoided. This device will have a hardware button used for initiating a scan which then transfers the barcode data to the iPod Touch automatically. A software library will also be created for iPod Touch so that it is capable of receiving the data through the TRRS audio jack.

III. Project Description

A barcode scanning engine will scan for a barcode when the push button is pressed and will send a signal to a microcontroller. The microcontroller will translate the signal provided by the barcode scanner into a stream of bits to be sent through a TRRS plug to an iPod touch. The microcontroller and barcode

scanning engine will be powered through the 30 pin connector on the iPod. The iPod will have an application that is listening for a bitstream. The application will convert the bitstream from an analog signal to a digital signal. The application will analyze the bitstream to determine if the bitstream is error free. If the bitstream is determined to be corrupt the application will send a message to the microcontroller to continue scanning the barcode until a valid barcode has been read by the application or until the push button has been released. Once a barcode has been successfully read the application will store the barcode information in a library. The library of successfully scanned barcodes will be queried by an existing application developed by Marshalltown Company.

System Overview:

I. Functional Requirements

Upon discussions with our client the following are what we consider functional requirements:

Primary:

- Software designed will act as a utility that must conform to an existing inventory app the client has already made
- The design must use the TRRS audio jack for communication, not the 30 pin connector
- The system must be able to be used for a consecutive 8 hours without being charged
- A physical hardware trigger must be used to initiate a scan
- When charged, the entire system must have a connected source of power (ie the user must be able to charge both the iPod and the power circuitry for the barcode engine together)

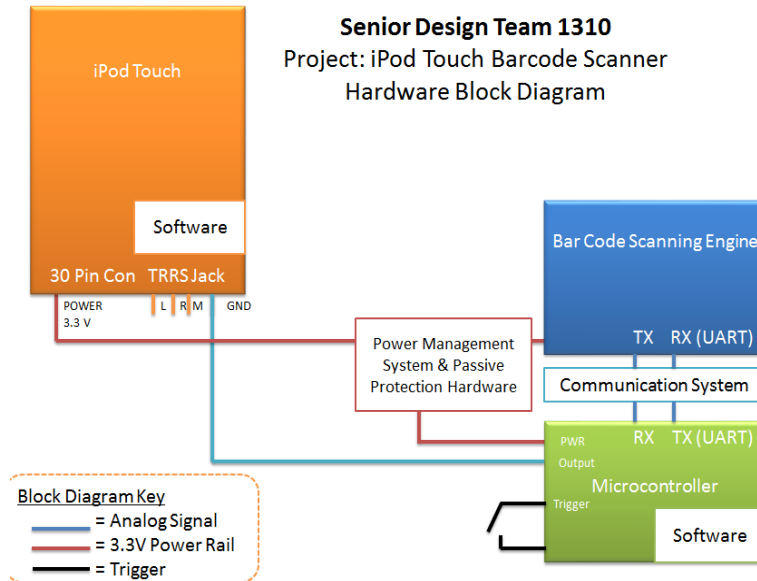
In our discussion a list of non-functional requirements have also been discussed. These are not deal breaking requirements. Meaning, that without the non-functional requirements our client would still be able to use our design but would like the following considered and explored.

Non-Functional Requirements:

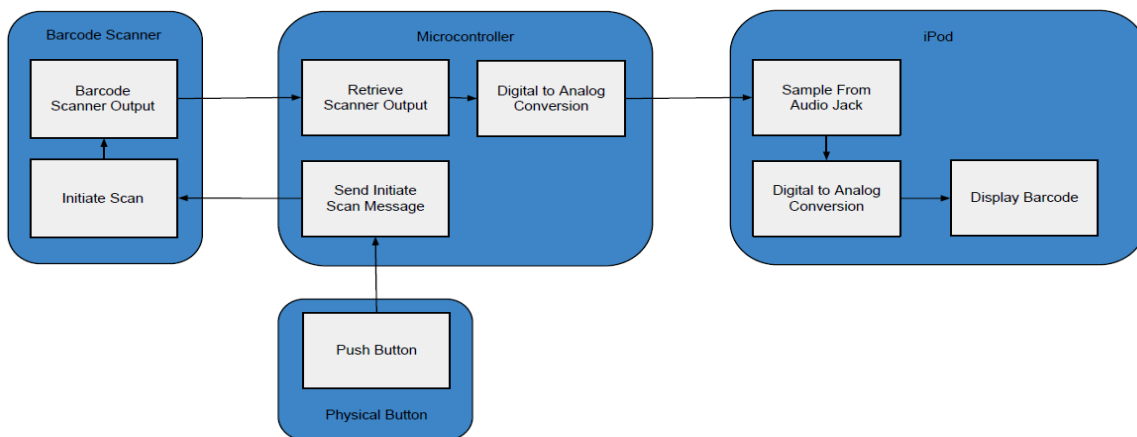
- Bi-directional communication through the TRRS audio jack to have a the iPod button work as a trigger
- If an external battery is used, find a way for this battery to charge the iPod when the iPod is not being charged and is running low on power

II. Hardware Requirements

An MDL 1000 laser scan engine will read a barcode after a pushbutton is pressed. The scan engine will then transmit an encoded value for the scanned barcode using RS232 to a PSoC CY8C29466-24PX1 microcontroller. The microcontroller will receive the RS232 signal and translate the encoded values into DTMF tones. The DTMF tones will be sent to a male TRRS audio jack to be mated with an iPod Touch. Power will be taken from the 30-pin connector on the iPod Touch. Onboard power management will be implemented to ensure safe power levels are provided to the scanning engine and microcontroller.



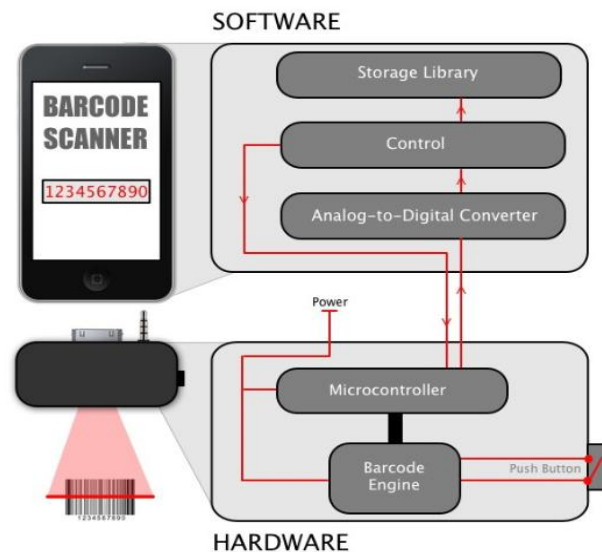
III. Software Requirement



The microcontroller is the source of the majority of our software. There needs to be a module to bring in an input from the barcode scanner and decode that signal. That signal then needs to be mapped to an audio signal that can be sent to the iPod through the audio jack. It is then sent out through the audio jack to the iPod. The iPod will have our last piece of software of which we will decode the audio signal and store the barcode value into a library on the iPod

IV. System Overview

The following figure displays how the software and the hardware will interface in our design.



Design Details:

I. User Interface

There will be no user interface for this project. The software for the iPod Touch will be a generic library that will support the functionality to receive communications from the barcode scanner. There will be a test application that will be developed for the iPod Touch. However, this will only consist of a single text box used to display the received barcode.

II. Design Considerations and Tradeoffs

When designing the barcode scanner we had to make several important decisions that would reduce total cost and development time.

- When choosing a microcontroller we wanted one that had digital-to-analog functionality as well as low power consumption, since this device would have limited power. We have decided to use the PsoC <INSERT MODEL #>. This microcontroller was recommended to us by our client Marshalltown Company. It supports some powerful modules such as UART for serial communication and DTMF that will be used for DTA conversions.
- Another consideration that we made was choosing the correct barcode scanner. We needed a scanner that was small enough that an iPod Touch case could be built around it. It also needed to be low in power consumption so that the iPod Touch would have maximum battery life. We decided on the Opticon MDL1000. This scanner fits our requirements and does not have extra functionality that is not required that would increase the cost of the device.

Project Details:

I. Standards

TRRS is a standard for a connector that carries analog signals. It is mainly used in audio devices, such as the iPod Touch. We will be using this standard because that is the connector that the iPod Touch supports. Also, it is easy to create analog signals that will communicate with the TRRS connection.

RS-232 is a standard for serial communication between devices. We will be using RS-232 to communicate between the barcode scanner and the microcontroller. This is going to be a useful standard because it is what our barcode scanner uses for communication. The microcontroller that we have chosen also supports serial communication as well.

DTMF - DTMF (Dual-tone multi-frequency signaling) is a standard that is mainly used for telephones so that they can dial numbers. We will be using DTMF not to dial numbers but to transfer the barcode data as an analog signal across the TRRS jack of the iPod Touch.

GS1 Standard for Universal Product Code (UPC) - Barcode symbology used for tracking trade items in stores in the most common form, UPC-A, consisting of 12 numerical digits uniquely assigned to each trade item. This standard defines the formatting and encoding of UPC.

IPC/EIA J-STD-001 -Requirements for Soldering Electronics and Electronics Assemblies This standard provides requirements and specifications for the manufacture of soldered electronics. This will provide insight and guidance as to insure functional quality and understanding when the hardware is assembled.

ISO/IEC 9899:2011 specifies the form and establishes the interpretation of programs written in the C programming language.

II. Expected Deliverables

The expected deliverable to our client, Marshalltown Company, is a complete and functional design that can easily be implemented and manufactured. For software we will be delivering essentially a library that can be used in conjunction with a current inventory iPod app our client has created. We will also provide the code needed to program a Cypress microcontroller. From a hardware standpoint, we will deliver at least one working printed circuit board as well as all of the design documents necessary to produce more in the future.

III. Cost

The cost of the components to our device will be under \$100. Given that the barcode engine module is \$60 this leaves the rest of the design to be less than \$40. The current product available to our client is \$500 and the main goal is to create product that is cheaper than this.