

Apple iPhone/iPod Touch - iEffect

Mobile Guitar Effect Accessory & Application

Preliminary Design Report with Diagrams

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Team: iGuys

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Project Abstract:

We plan to design an accessory for Apple iPhone. Our accessory, the iEffect, will be a mobile guitar effect pedal add-on to the iPhone. It will allow the users to simply plug in the device to the audio port or 30-pin connector (depending on Apple access restriction). The user will interact through the iPhone touch screen interface with an effect pedal type structure that will change depending on the effect he/she has chosen. The interface will have a menu system to allow the user to choose what effect to control, whether it is a distortion, delay or numerous other effects.

The iEffect will be an external guitar effect module to modify a guitar's unamplified signal and provide a ¼" jack to output to an amplifier. An MSP430 will be used to modify the waveform after the preamplification circuit. The iPhone will be used to choose and control the effect that the user wants to implement. For example, if distortion is selected, the user could control the volume and gain through a custom touch screen interface.

Introduction:

Guitar effect pedal is a popular tool for guitar players to add effects to the sounds generated by a guitar. Common guitar effects include the following:

- **Distortion** – A simple effect that “clips” or flattens the signal at assigned limit values.
- **Noise Gate** – This effect completely cuts the signal down to the center value at assigned limit values.
- **High Boost** – This effect simply increases the amplitude only above assigned limit values to simulate a high boost.
- **Waveform Overlap** – This effect overlaps (averages) a waveform stored in memory with the signal. With a faster processor, this could be implemented to use a potentiometer to control the averaged waveform and use better averaging algorithms.
- **Delay** – Simple delay, storing the current value in the current location within a circular buffer and retrieving the oldest value and averaging it with the current signal.
- **Volume Wah** – This effect oscillates the volume by multiplying the signal by a fraction that's proportional to a varying (sequentially incrementing then decrementing) multiplier value from three to nine. The volume never exceeds the original level of the signal to maintain controlled gain.

In the market, there are varieties of guitar effects pedals from several tens of dollars to several hundreds of dollars. Interfaces for the guitar effect pedals are knobs and buttons. The Interface to the iPhone touch screen will allow the user to control the effect easily while playing guitar. Also the iPhone interface will reduce the size of the pedal and manufacturing process. One major benefit of this device is that it will be sold as iPhone application device in the huge iPhone market.

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Figure 1 -- iPhone (left) and Boss Effect Pedal DD-6 (right)

Features:

Users of the iEffect will be able to

- Carry around a handy iEffect
- Turn the iPhone to the guitar effect pedal simply by plugging a iEffect into an audio port or 30-pin connectors of the iPhone
- Select an effect
- Control the effect using the iPhone touch screen interface

Technical Objectives:

--Hardware Digital Component

MSP430 is used to generate guitar pedal effects. Capabilities of A/D and D/A converters are mainly utilized for the iEffect application. A large memory is more desirable to store the guitar signals and add/generate the effects in a real time.

MSP430 is also well known as a low power consumption microprocessor. Battery life of the iEffect should be long enough to be useful as a portable device.

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--Hardware Analog Component

Analog Circuit in this object has two parts. One is to amplify signals generated by guitar and feed them to MSP430. Output signals from guitars are usually 300mV peak to peak maximum. The signals are amplified to 3V peak to peak centered at 1.5V for MSP to detect the signals. The other analog part is a low pass filter for output signals from MSP430. The output from MSP430 is a digitized signal with very high frequency components, so a low pass filter will smooth-out the signal.

--iPhone Component:

The iPhone component is quite complex. iPhone programming is written in objective-c with the XCode program in the iPhone SDK. I will be creating various object class source files (.m/.h files) to accommodate:

- Audio signal generation (manually created waveforms)
- Interface controllers for each “screen”
- Timer control for button queues

I will be using the interface builder SDK tool to design the user interface for each screen and connecting the interface objects to the main source controller methods. Hopefully, if we receive clearance from Apple to view the documentation for the 30-pin proprietary connector, we will be able to send digital data to the MSP430 and greatly expand the functionality and control of the unit.

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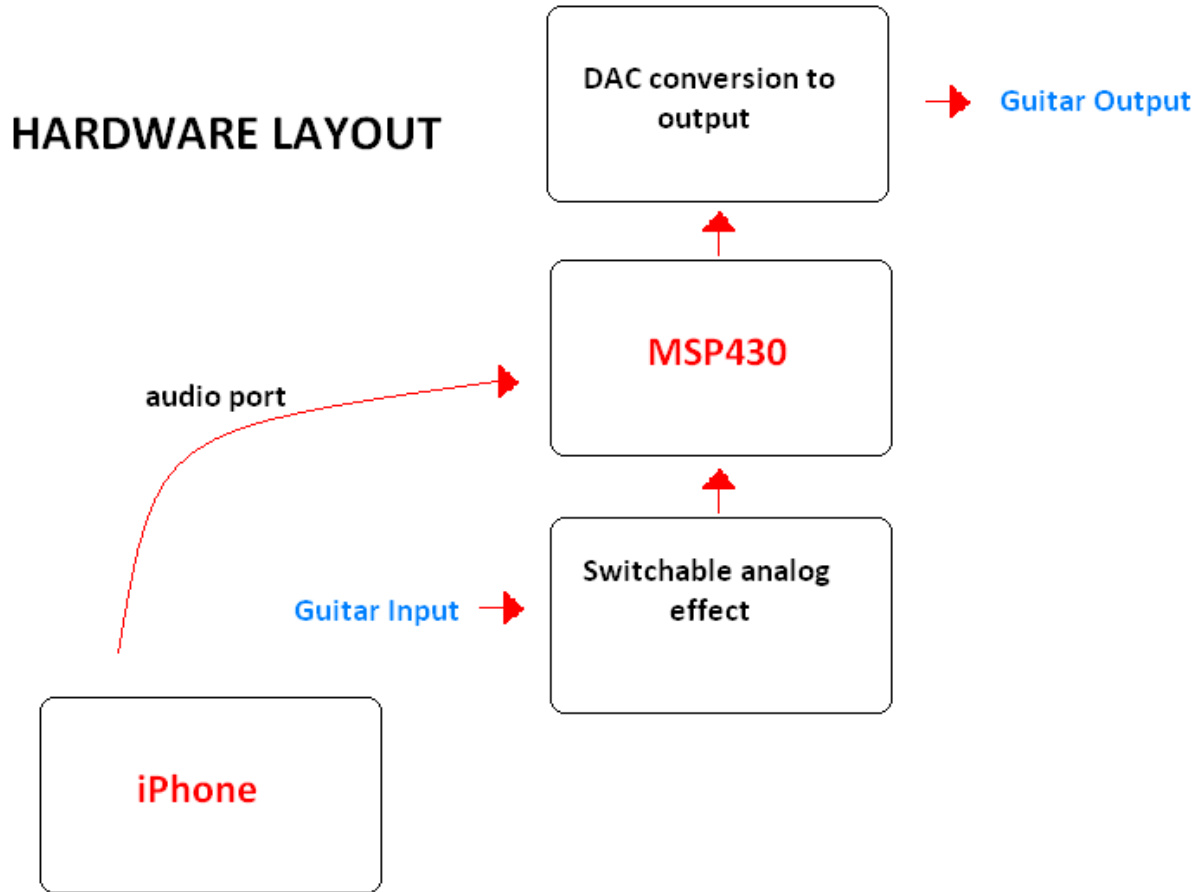


Figure 2-- iEffect Hardware Diagram

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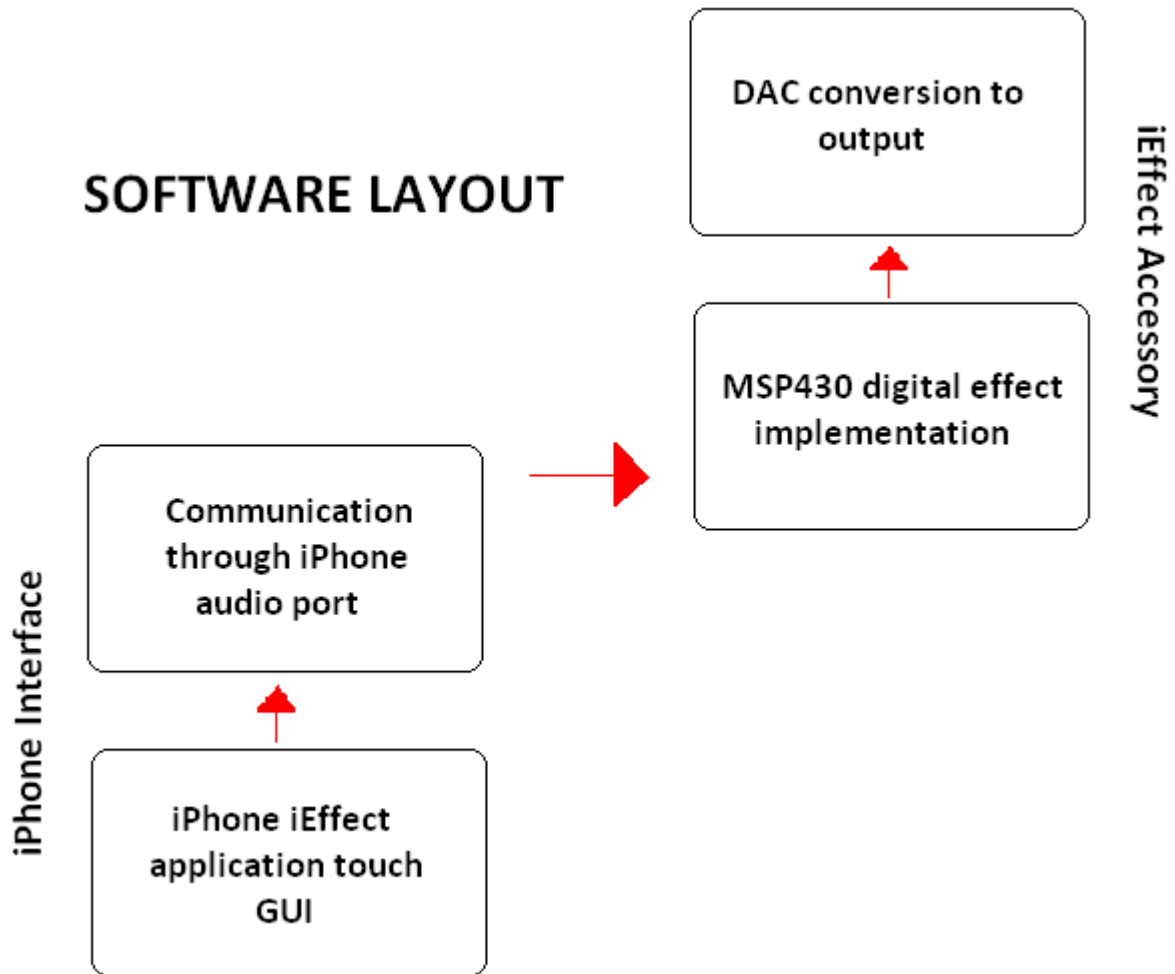


Figure 3 -- iEffect Software Diagram

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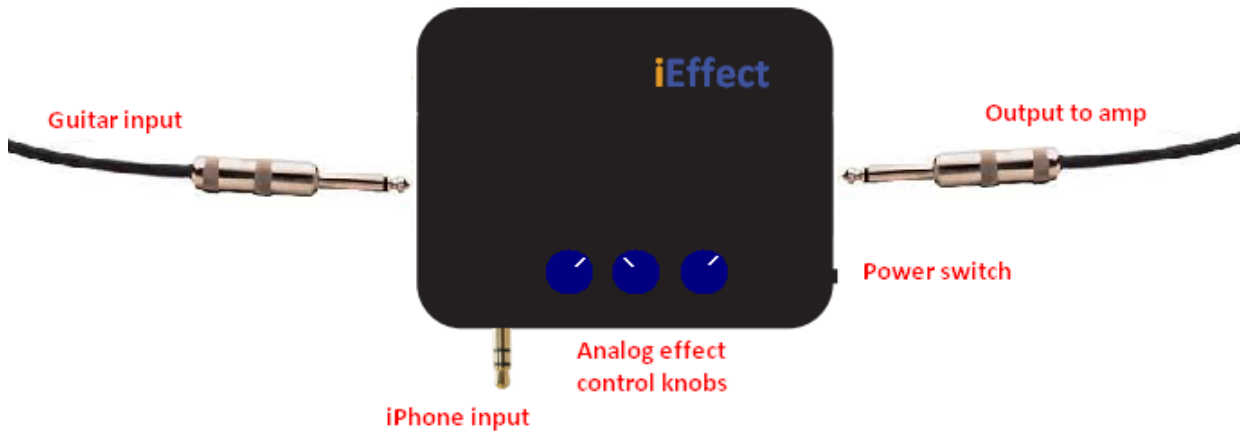


Figure 4 -- Image of iEffect

Cost Objectives:

Cost per iEffect Unit

Component	Cost
MSP430	\$9.15
Misc. (resistors, capacitors, etc.)	\$3.00
PCB board (if 1000+ units built)	~4.00-
Total	~\$21.15-

One Time Costs

Component	Cost
Apple iPhone OS 3.0 Development Tools (1 year license)	\$100.00
MSP430 USB Programmer	\$50.00
Total	\$150.00

The iEffect can be constructed cheaply. There are no competitive commercial products on the market.

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Division of Labor:

- Shuji Fujimaru is responsible for hardware design.
 - Design analog circuits
 - Write MSP430 guitar effect codes

- Ryan Nuzzaci is responsible for iPhone programming
 - Build a guitar effect mode interface on iPhone
 - Send a detectable signal to MSP430 from iPhone
 - Design PCB boards for hardware components
 - Write MSP430 'receive iPhone button data' code

Both of team members will cooperate to seamlessly integrate guitar effect pedal accessory and iPhone.

Gantt Chart:

Our planned time line is shown in an attached Gantt Chart. Numbers shown on the top of the chart represents a number of weeks. Available weeks in the summer 2009 are 12 weeks.

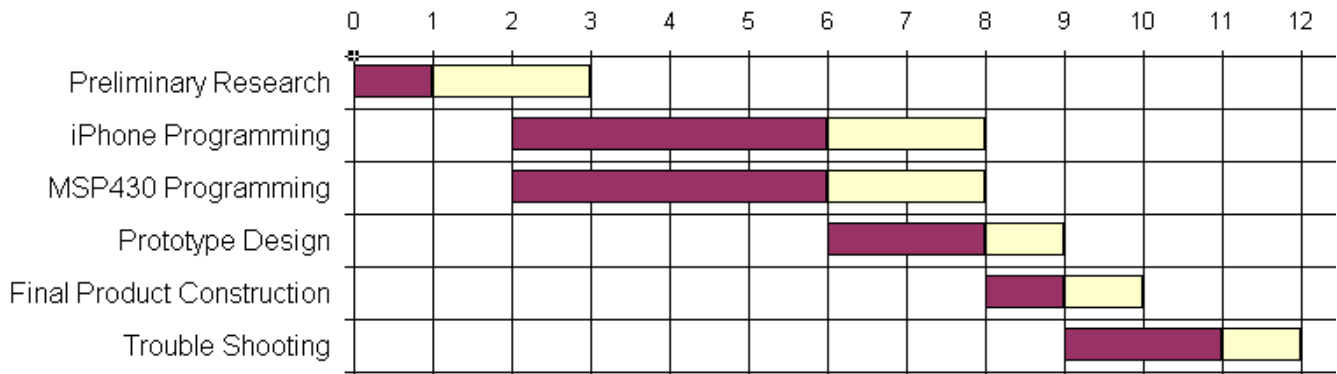


Figure 5 -- Gantt Chart