Greetings Academics!

Welcome to this edition of the Academic Newsletter. Last year we saw the development of many new tools and academic resources including solutions that introduce PIC® microcontrollers to developers who traditionally may not have used embedded devices fearing that the learning curve would be too steep. These new products provide a high-level experience expanding embedded development into many new disciplines beyond EE or CSE.

**chipKIT™ Development Platform**

The chipKIT Platform was truly a team effort including hardware researched and developed by Digilent Inc., software from experienced Arduino™ developers from the Fair Use Building and Research Hacker Space in New Jersey, and of course Microchip hardware and software engineers. Using a forked version of the Arduino IDE to support PIC32 microcontrollers, great attention was paid to ensure that new users could leverage the vast existing resources of code examples, curriculum, reference materials and more from the [www.arduino.cc](http://www.arduino.cc) website.

**dsPIC® Blocksets for MATLAB/Simulink**

Microchip Technology developed dsPIC® Blocksets for MATLAB/Simulink continue to be updated with new blocks for Switch Mode Power Supplies, additional dsPIC® device support and more on the way. These blocksets provide a very intuitive, graphical method of developing digital signal processing and control designs within the very popular Simulink modeling tool from Mathworks. MPLAB® C Code for dsPIC Digital Signal Controllers is generated and imported into MPLAB IDE for simulation, programming and debug of the target device. In this way, the user never really needs to touch a single line of code!

**Flowcode 4 for dsPIC® DSCs and PIC24 MCUs**

Fans of the Matrix Multimedia graphical programming environment can now use this graphical programming environment to develop 16-bit applications. Using Flowcode 4 for dsPIC DSCs and PIC24 MCUs allows users with little to no programming experience to create complex electronic systems in minutes.

Now more than ever, Academics from many disciplines can take advantage of the products and technologies from Microchip. To learn more about these or any other Academic-friendly products please contact Microchip's Academic Team at academic@microchip.com or visit us at [www.microchip.com/academic](http://www.microchip.com/academic).

Thanks for reading!

Marc McComb, Editor

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**Calling All...**

Students, Professors & Third Party Tool Developers, want to submit an article for the Academic Newsletter?

Contact us at: academic@microchip.com

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First Quarter 2012
Introduction
The project “BassMasta” works with a similar look and feel of the Guitar Hero® game series only functional using a full size bass guitar. BassMasta will act as a personal bass guitar trainer and is intended for beginner and intermediate level players.

BassMasta is developed on a PIC32 Multimedia Expansion Board (MEB) and contains an embedded MP3 Player, Color GLCD Display and SD Card interface.

This prototype is capable of detecting the frequency of the string that the user is pulling and the time at which it was pulled. All of these notes are compared with the actual notes of the MP3 version that the user is expected to play along with. Accuracy is measured and displayed on the screen as the resulting score.

But, if my bass is not tuned, how can the user play or select the options?
A tuner loads at the start of the game and when any string is pulled, the tuner software will indicate whether the user needs to tighten or loosen the string that is being played. This will ensure that the user can accurately control the system.

How Do We Detect the String that was Played?
This PIC18F4620 (two timers, one ADC and five output bits of GPIO) performs the string detection. The signal carries the harmonics of the sound, so we establish a threshold. If the voltage is less than the threshold, we treat it as 0V, thus we remove the harmonics.

We have two objectives: determine the string that was played, and when it was played. For the first objective, we use a timer. The timer collects time between waves; with this we can determine the frequency. We take 5 samples and troubleshoot how to achieve better results. The problem is when we encounter unusual frequency. We solve this by setting the mode of the results with ±5 Hz of mode; this operates as a filter when the average of frequency is on ± near the mode. For example: samples = {3, 53, 20, 54, 55, 240}; mode: 50; average: (53+54+55)/3 and we receive an average frequency of 54.

How Does the User Interact with the Device?
The user can select options and songs with the string of the bass acting as buttons. Everything is displayed on a screen which is controlled by the master PIC32 MCU and the MEB. A scheduler RTOS runs the tasks on time, depending on the music tempo, so the music and the notes to be played can be synchronized.
The next objective is to determine when a new string is played. The bass outputs a signal that detects when a string is pulled. There's a brief moment when the signal is down (when string is stopped by a finger.) As a result, we've established a backup timer. If the silent (0V) of the signal is greater than the lowest frequency, (it ensures detection of frequency with the longer period between waves) we've set a flag to wait for another string. The ADC detects voltage when another string is pulled.

For more information please visit:
http://www.wix.com/byshox/bassmasta
Microchip recently announced the lowest-cost development tool supporting 3.3V 16-bit and 32-bit PIC® microcontrollers (MCUs), as well as 16-bit dsPIC® Digital Signal Controllers (DSCs) in 28-pin SPDIP packages. The flexible Microstick II tool features everything Academics need to get started with these devices, including an integrated debugger and programmer, user LED, reset button and DUT socket for easy device swapping.

The USB-powered tool can be used standalone or plugged into a prototyping board for extremely flexible development, and is supported by the MPLAB® Integrated Development Environment (IDE). This tool makes it easy to evaluate and develop with Microchip’s broad range of 16- and 32-bit products, while providing an ideal student solution at a cost effective price point.

Key Features:
- Low cost
- Integrated USB programmer/debugger – no external debugger required
- USB powered – ease of use, no external power required
- MPLAB support
- DUT socket – flexible, easy device replacement
- 0.025˝ pin headers – enables plug-in to breadboard with room for jumper wires
- Easy access to all device signals for probing
- Small size – smaller than a stick of gum at 20x76 mm – easily portable
- On board user LED and reset switch
- Free demo code

Kit Contents:
- Microstick II board
- USB cable
- 2 – 1x14 header pins for proto board use
- 1 – PIC24FJ64GB002

chipKIT™ and Arduino™ Support

Microchip and Digilent have announced expanded capabilities for the 32-bit PIC32 microcontroller-based chipKIT Development Platform for the Arduino community. The companies recently unveiled two shields for the chipKIT platform – the chipKIT Basic I/O and Network Shields. In addition new online support resources for the community are now available, including software library support for Ethernet, CAN and USB, as well as an online chipKIT forum and wiki. The shields and online support resources enable users to take advantage of the high-performance, 32-bit PIC® microcontroller-based chipKIT development platform to add more features and functionality to their projects. The chipKIT development platform is a 32-bit Arduino solution that enables hobbyists and academics to easily and inexpensively integrate electronics into their projects, even if they do not have an electronic-engineering background.

The platform consists of two PIC32-based development boards and open-source software that is compatible with the Arduino programming language and development environment. The chipKIT hardware is compatible with existing 3.3V Arduinoshields and applications, and can be developed using a modified version of the Arduino IDE and existing Arduino resources, such as code examples, libraries, references and tutorials.

The chipKIT Basic I/O Shield recently announced is compatible with the chipKIT Uno32™ and Max32™ boards and offers users simple push buttons, switches, LEDs, I²C™ EEPROM, I²C temperature sensor and a 128x32 pixel organic LED graphic display. The chipKIT Network Shield enables users to use the chipKIT Max32™ development board to implement 10/100 Ethernet, USB OTG and CAN communications.

“The introduction of these two new shields for the chipKIT platform demonstrates Microchip and Digilent’s commitment to the Arduino community,” said Fred Eady, hobbyist and editor with Nuts & Volts and SERVO Magazines. “Not only will users have additional I/O functionality with the chipKIT Basic I/O Shield, they will be able to integrate advanced communications such as Ethernet, CAN and USB into their projects with the Network Shield.”
The New Lowest-cost PIC32 Microcontrollers

Feature-Packed 32-bit Microcontrollers Include I²S Interface for Audio Playback Applications; Plus Capacitive Touch, USB 2.0 and Digital Pin Remapping.

Microchip recently announced a new series of low pin count 32-bit PIC32 microcontrollers (MCUs) that provide 61 DMIPS of performance in packages as small as 5x5 mm for space-constrained and cost-sensitive designs. The PIC32 “MX1” and “MX2” MCUs are the smallest and lowest-cost PIC32 microcontrollers, and are the first PIC32 MCUs to feature dedicated audio and capacitive-sensing peripherals. These new MCUs include a host of additional useful features that make them suitable for applications in the consumer, industrial, medical and automotive markets.

Rated for operation up to 105°C, the PIC32 MX1 and MX2 MCUs include up to 32 KB of Flash, and 8 KB of SRAM; two I²S interfaces for audio processing; Microchip’s Charge Time Measurement Unit (CTMU) peripheral for adding mTouch™ capacitive touch buttons or advanced sensors; and an 8-bit Parallel Master Port (PMP) interface for graphics or external memory. The new devices also feature an on-chip 10-bit, 1 Msps, 13-channel Analog-to-Digital Converter (ADC), as well as USB 2.0 and serial-communications peripherals. The MCUs bring eight new packages to the PIC32 MCU product line, from 28- to 44-pins, with sizes down to 5x5x0.5 mm. Further easing the design effort is Microchip’s Peripheral Pin Select (PPS) feature, which allows developers to “remap” most digital-function pins in the chip, making layout and design modifications significantly simpler. The PIC32 MX1 and MX2 devices are compatible with Microchip’s 16-bit PIC24F product line for easy migration, and are supported by the MPLAB® X IDE – the single development environment for all of Microchip’s 8-, 16- and 32-bit MCUs.

More designs in the consumer, industrial, medical and other markets are requiring high-quality audio, touch-sensing and graphics capabilities, as well as USB communication. With their numerous on-chip peripherals and features in small packages, the PIC32 MX1 and MX2 enable designers to add all of this functionality, while keeping design size and costs low.
Flyport Wi-Fi openPICUS:  
When the Microcontroller Goes on the Web

Flyport Wi-Fi is a miniature web server module featuring a fully integrated 802.11 b/g/n Wi-Fi interface, and several interfaces to the "real world". The module is powered by openPICUS technology (www.openpicus.com), open source framework and a serial boot loader. The free openPICUS IDE allows users to create applications, import web pages, compile and download code to the module.

Flyport integrates a powerful Microchip PIC24FJ256 16-bit processor, which runs your custom applications, and has a Microchip MRF24WBOMA/RM Wi-Fi certified transceiver handling the connectivity.

This provides the embedded world with a powerful "internet engine" to a browser-based interface over a LAN, Internet, or GPRS network, with a small footprint, at low power and low cost. Real-time data can be both displayed and/or updated from a standard web browser, smart phones or tablets, since Flyport supports dynamic web pages.

The application code allows Flyport to manage the external interfaces (I/O, PWM, Analog, SPI, I²CTM and UART), internet communication protocols and web pages. openPICUS framework, based on freeRTOS (www.freertos.org), leaves the developer free from handling the complex communication stack, focusing only on his application.

Dynamic web pages are supported using an innovative, yet simple method. This method allows "real world" variables and information from the host system. For example; temperatures, speeds, levels, voltages, switch positions etc. are displayed or changed using simple HTML or advanced jQuery. Flyport connects to a Wi-Fi network through access points and routers, or you can connect directly by Wi-Fi Ad hoc mode. Additionally, WEP, WPA and WPA-2 security protocols are supported.

The internal Flash storage area is 256 Kbytes. This is comprised of the embedded web server, communication stack and your application. Stunning web pages can be created to provide a browser-based user interface for any system.

Flyport is also suitable for battery powered systems since the openPICUS framework allows your application to control (power on/off) the Wi-Fi transceiver with one step.

The module is equipped with a standard 2*13 ways male pin header connector. Most pins are Peripheral Pin Select (PPS) enabled; they can be configured for UART, SPI, PWM, timer input, interrupt and so on, because it is internally connected to the PIC 24F microcontroller. Additional features include an on-board PCB antenna and an external uFL connector version.
Flyport Wi-Fi also supports HTTP, TCP, UDP, SNTP, FTP and SMTP. Your application can send e-mail, tweet a message or log data to a remote file. The Flyport application offers a wide range of capabilities.

**Facts**
- Little development required to get products "on the net"
- Zero investment, free IDE and boot loader
- Web page creation using standard authoring tools
- Supports dynamic web pages
- Small-scale – 35*48 mm
- Low-power – hibernation mode supported
- Flyport is a low-cost module
- 16-bit, 16 MIPS, PIC 24F processor
- 802.11 b/g/n Wi-Fi certified transceiver
- 256 Kbyte Flash
- openPICUS framework, based on freeRTOS
- Serial boot loader: web pages and files can be uploaded via serial port
- UART, I²C™, SPI interfaces
- Analog and digital I/O pins available
- Expansion boards available
- Built-in security features
- Ad hoc or infrastructure mode supported

**Applications**
- Industrial automation
- Home automation
- Process monitoring and control
- Remote on/off switching of electric motors, pumps, lighting etc.
- Environmental monitoring
- Vending machines
- Factory machinery and processes
- Power generation plants
- IT system monitoring
- Heating, cooling and refrigeration equipment
- Security systems
- Medical and pathological equipment

**About Us**
Eikon offers wireless electronic solutions to system designers and integrators. Our company is a professional partner offering design, manufacturing and technical support. Our slogan “be wireless” signifies a range of “technology bricks” which are easy to use and easy to integrate into your systems.

**Links**
openPicus Get Started Page for requirements and links to software: [www.openpicus.com/cms/started.html](http://www.openpicus.com/cms/started.html)
FlyPort smart Wi-Fi 802.11 module: [www.openpicus.com/cms/flyport.html](http://www.openpicus.com/cms/flyport.html)
Eikon homepage: [www.eikonsite.it](http://www.eikonsite.it)
MikroElektronika recently introduced version 7 of its popular EasyPIC™ Development System (TMIK013). Now with dual power supplies (3.3V and 5V), it supports over 250 different PIC® MCUs. EasyPIC 7 accepts DIP packages from 8- to 40-pins and comes with a PIC18F45K22 installed. It features amazing connectivity, with four different connectors for each port, along with pull up/down resistors, buttons and LEDs on every I/O line. A fast programmer and in-circuit debugger are included. It also accepts an optional 2x16 character LCD (TMIK005) as well as a 128x64 Graphic LCD with Touch Panel (TMIK004). You can prototype many applications quickly with this versatile tool.

**Note:** The previous version (EasyPIC 6 Development System) is still available on microchipDIRECT for a limited time.

### EasyPIC™ 7 Development System

MikroElektronika recently introduced version 7 of its popular EasyPIC™ Development System (TMIK013). Now with dual power supplies (3.3V and 5V), it supports over 250 different PIC® MCUs. EasyPIC 7 accepts DIP packages from 8- to 40-pins and comes with a PIC18F45K22 installed. It features amazing connectivity, with four different connectors for each port, along with pull up/down resistors, buttons and LEDs on every I/O line. A fast programmer and in-circuit debugger are included. It also accepts an optional 2x16 character LCD (TMIK005) as well as a 128x64 Graphic LCD with Touch Panel (TMIK004). You can prototype many applications quickly with this versatile tool.

### RetroBSD for PIC32 MCUs

RetroBSD is a port of 2.11BSD Unix intended for embedded systems with fixed memory mapping. The current target is Microchip PIC32 microcontroller with 128 Kbytes of RAM and 512 kbytes of Flash. PIC32 processor has MIPS M4K architecture, executable data memory and flexible RAM partitioning between user and kernel modes.

**Features**

- Small resource requirements. RetroBSD requires only 128 kbytes of RAM to be up and running user applications.
- Memory protection. Kernel memory is fully protected from user application using hardware mechanisms.
- Open functionality. Usually, user application is fixed in Flash memory – but in case of RetroBSD, any number of applications could be placed onto an SD card and run as required.
- Real multitasking. Standard POSIX API is implemented (fork, exec, wait4 etc).
- Development system on-board. It is possible to have C compiler in the system, and to recompile the user application (or the whole operating system) when needed.

The lead developer of RetroBSD is Serge Vakulenko. Serge recently ported RetroBSD to Microchip’s PIC32 Ethernet Starter Kit (DM320004). Since RetroBSD requires a file system, he added the I/O Expansion Board (DM320002) and SD/MMC PICTail™ board (AC164122).

Other development boards supported by RetroBSD include:

- chipKIT™ Max32 (TDGL003)
- Explorer 16 Development Board (DM240001)
- Multimedia Board for PIC32MX7 (TMIK008)
- Maximite Computer ([http://geoffg.net/maximite.html](http://geoffg.net/maximite.html))

### Mini-32 Board

Now available from MikroElektronika, the amazing Mini-32 (TMIK015) is a small development board containing a PIC32MX534F064H microcontroller. It operates on 3.3V power supply, with an on-board voltage regulator that allows the board to be powered directly from a USB cable. It is pin compatible with PIC16F887 and PIC18(L)F45K20 MCUs and it fits perfectly into a standard DIP 40 socket. The board is equipped with an SMD crystal oscillator, and a 32.768 KHz crystal which can be used for an internal RTCC module. It has a reset button and three signal LEDs. This board comes preprogrammed with fast USB HID bootloader, so no external programmers are needed for development. Imagine upgrading an existing 8-bit application with 80 MHz performance and USB 2.0 On-The-Go!
Microchip and Digilent® Announce Embedded Motor Control – Cerebot™ MC7 Development Kit for Academia and Hobbyists

Microchip Technology and Digilent®, announced the availability of a Microchip dsPIC33 Digital Signal Controller (DSC) based development kit. The Digilent® Cerebot™ MC7 Development Kit addresses the growing interest in embedded motor control from the academic and hobbyist markets, and is ideal for learning about microcontrollers and solving real problems. The kit includes a demonstration board that provides four half-bridge circuits, eight RC servo motor connectors, the ability to use Digilent Pmod™ peripheral modules, and an integrated programming/debugging circuit that is compatible with the free MPLAB® IDE. Example applications include university embedded systems and communications classes, senior capstone projects and numerous other academic and hobbyist projects.

The Cerebot MC7 board features four half-bridge circuits that are rated for 24V at up to 5A. These half bridges can be used to control two Brushed DC motors, two bi-polar stepper motors, one Brushless DC motor and one uni-polar stepper motor. An onboard 5V, 4A switching regulator with an input voltage up to 24V simplifies operation of the board, enabling it to operate from a single power supply in embedded applications such as robotics. The onboard dsPIC33 DSC features 128 KB internal Flash program memory and 16 KB internal SRAM, as well as numerous on-chip peripherals, including an advanced 8-channel motor-control PWM unit, an enhanced CAN controller, two Serial Peripheral Interfaces (SPIs), timer/counters, serial-interface controllers, an Analog-to-Digital Converter (ADC), and more. The Cerebot MC7 board combines two push buttons and four LEDs for user I/O, as well as connections for two I²C™ busses, one of which contains an integrated serial EEPROM device.

“The Cerebot MC7 board is an ideal embedded motor control and general-purpose microcontroller experimentation platform for academics and hobbyists. It’s our latest entry in the engineering education market.” said Clint Cole, president of Digilent Inc.

Microchip continues to see an interest in advanced robotic applications in the academic and hobbyist markets. The Cerebot MC7 board is ideal for these types of applications, among many others requiring the advanced motor-control peripherals found on Microchip’s industry-leading dsPIC33 DSCs.

For development support, the free version of Microchip’s MPLAB IDE can be downloaded. The MPLAB C Compiler for dsPIC® DSCs is also available for download.

The Cerebot MC7 Development Kit is available today. It can be purchased from Digilent or from microchipDIRECT (TDGL007).

About Digilent Inc.

Digilent Inc. is a leader in providing academic and research solutions in high end electronics fields. Their headquarters are in Pullman Washington, with offices in Taiwan, China and Romania. Currently, over 1000 universities, training centers and research laboratories in more than 70 countries use Digilent products and services. For more information, please visit the Digilent web site: www.digilentinc.com.
A Low-Cost Solution for a Surface EMG-Actuated Prosthetic Hand Control System

By: Pascal Laferriere, Guillaume Perrault-Archambault, Christopher Hahn, Andrew Croskery and Long Dinh Phi Tran, Electrical and Computer Engineering Students, University of Ottawa

Introduction
This ongoing project is being undertaken as an undergraduate Project Design course. Our main goal is to address the problem of costly prosthetics for amputees by designing a low cost prosthetic hand control system. Our final system will make use of surface electromyographic (EMG) signals to control the motion of a powered transradial prosthetic device. In order to design and develop our prosthesis control solution, the following building blocks have been developed for integration into our final design:
1. EMG signal amplifiers and filter networks
2. Simultaneous digitization of multiple EMG channel inputs
3. Feature extraction from the EMG signals
4. Pattern classification of 6 different hand movements
5. Generation of control signals for the prosthetic hand actuators
6. Temperature feedback

The system is being conceived with portability in mind; meaning that low power consumption and single supply operation are also going to be featured in the final design.

System Overview
Figure 1 shows the block diagram for the proposed system. The input data is measured by EMG electrodes whose signals are fed differentially to an instrumentation amplifier; this signal is then gained and filtered. Digitization of the signal is performed by the analog to digital converter (ADC) present in the microprocessor. The digitized signal is then fed to our feature extraction algorithms to provide meaningful data to the pattern classification algorithm. Once pattern classification has determined the desired movement to be performed by the hand, control signals are then generated to control the prosthetic hand’s actuators. These actuators would be used to provide a set of six hand movements to the user: hand close, hand open, wrist flexion, wrist extension, wrist supination and wrist pronation. We have also developed a simple temperature measurement system. This system could easily be incorporated into a hand prosthetic to provide users with additional information of their environment in the form of basic tactile feedback.

Implementation
The EMG electrodes that are currently being used are commercially available silver-silver chloride (Ag/AgCl) pre-gelled electrodes. The first iteration of our EMG amplifier circuit consisted of an instrumentation amplifier (AD620) and five operational amplifiers (OP97) to generate the signal gain, band pass filtering as well as to provide a virtual ground. Five stages were incorporated into this circuit. The first stage was the instrumentation amplifier providing a gain of 100. The second stage was an operational amplifier (op-amp) providing an additional gain of 5. The next three stages consisted of a high pass filter followed by a unity gain buffer and a low pass anti-aliasing filter. The total gain of the system was set to 500 and the selected cut-off frequencies of the high pass and low pass filters were 30 Hz and 500 Hz respectively. In the next iteration of our EMG amplifier we will be replacing our amplifier ICs with models capable of rail-to-rail, low voltage single supply operation.
Data acquisition and signal processing will all be performed by a microcontroller. The dsPIC33FJ256MC710A motor control digital signal controller from Microchip was chosen due to its simultaneous sampling capabilities, high processing speeds and its onboard pulse width modulation (PWM) module. Sampling of simultaneous inputs is necessary for our system, due to the need for proper inter-channel signal correlation during feature extraction since several EMG signals are used to determine the hand movements desired by the user. Our system is currently set up to measure 4 simultaneous inputs at a sampling rate of 1 kHz. Three of these inputs are being used for EMG data and the fourth input being used for data acquired from a temperature sensor (LM35.) The three pairs of electrodes were placed over muscles groups found on the forearm near the elbow joint.

High processing speeds were desirable in order to process the incoming information in real-time and keep delays of motor control actions at a minimum. The processing required for our system consists of calculating six different features for each of our EMG input signals and, based on those features, map the incoming signal to a hand movement. The features we have selected are Mean Absolute Value (MAV), Slope Sign Changes (SSC), Variance (VAR), Willison Amplitude (WAMP), Waveform Length (WL) and Zero Crossings (ZC). The calculations are performed on sets of 64 samples for each of the three channels. The output generated is an 18 element vector. We chose to use a vector space classification method as a starting point. The devised algorithm compares a new incoming vector to one of the six predetermined vectors corresponding to each movement. These predetermined vectors are obtained from a set of data, previously recorded, and meant to act as a form of user calibration. The distances between the new vector and the other six hand movement vectors are then calculated with the shortest distance obtained corresponding to the selected hand movement.

The onboard PWM module allows for the control of several independent motors by providing multiple PWM signals of different duty cycles. These PWM signals are used to control the position of servo motors which would be found inside a prosthetic hand. Our current goal is to provide control signals to three servo motors, one for the hand open and hand close movements, one for the wrist extension and wrist flexion movements, and another for the wrist supination and wrist pronation movements.

Finally, the temperature sensor could be embedded into the prosthetic hand to measure the temperature of the objects being grasped. The information obtained from the sensor is returned to the user by means of a three LED display. A green LED indicates a safe range of temperatures, a yellow LED indicates heated objects that should cause no physical harm, and a red LED indicates temperatures above the human pain threshold.

Preliminary Results

In order to analyze the types of signal we would be dealing with, one of the first tasks that we completed was collecting sample EMG data. We collected, on average, 565,500 samples of 3-channel data for each movement. we wished to differentiate. This was done using a readily available EMG data acquisition system. The collected data was necessary in order to examine the properties of the different signals and to come up with our pattern classification algorithms. This data will also serve as a baseline for comparing the quality of our signal conditioning circuit as well as our training data for the pattern classification. The data collected was imported into MATLAB for algorithm development to be completed concurrently with the programming and configuration of the microcontroller. To simulate
the data acquisition process of the microcontroller, the samples were divided into sample sets of 64 samples. From these we were able to extract, on average, 3300 sets of contraction information for each of the movements. For each sample set, we computed 6 time domain features for each channel, resulting in 18 values. This provided us with, on average, 3300 individual 18 dimensional vectors of which the mean was calculated to produce six individual reference points for each movement.

When testing our algorithm, we treated the 3300 sample sets of reference data for each movement as a stream of incoming samples. For each sample set, the corresponding movement was identified by the devised classification algorithm. From the testing we have done so far using this method we were able to successfully classify movements with the following accuracies:

- Hand Close – 83.0%
- Hand Open – 98.8%
- Wrist Extension – 61.7%
- Wrist Flexion – 93.5%
- Wrist Pronation – 98.9%
- Wrist Suppination – 90.0%

The operation of the microcontroller’s required modules has been successfully verified. Using Microchip’s MPLAB® IDE we were able to configure the ADC module to sample four simultaneous inputs at a rate of 1 kHz. The data being sampled was verified in software by using a potentiometer tied to the ADCs Vref+ and Vref-reference voltages, and ensuring that values ranging from 0 to 1023 were obtained as the potentiometer wiper moved through its resistance range. The sampling rate was verified by toggling the value of an output pin, within the same interrupt routine used to trigger the ADCs sampling, and displaying that value on an oscilloscope. The operation of the PWM signals were examined in a similar manner with the PWM output being displayed on oscilloscopes to ensure that the duty cycles required from the servo motors being used were obtained.

Next Steps
In the coming months another amplifier circuit will be constructed so that the output signals generated will make better use of the ADCs voltage input range. Alternative pattern classification methods will be examined. The addition of a fourth EMG input will also be examined to determine its effects on the system’s pattern classification accuracy. Full integration of all the core components is planned to be completed by December 2011.
TURN A HOT IDEA INTO A COOL SOLUTION

DesignSpark chipKIT™ Challenge

Challenge your talent against other engineers worldwide to produce an energy efficient design solution using the Free DesignSpark PCB software and the chipKIT™ development board.

Achieve the most energy efficient design and you could win a share of $10,000 cash!

Plus, keep the DesignSpark community regularly informed through posts on the DesignSpark Project Pages and your updates will make you eligible for Community Choice Awards and random prize drawings!

FREE chipKIT™ Max32 dev kit for first 1,000 entries.*

In association with:

Elektor  Microchip  RS  Circuit Cellar  A  Digilent

Go to www.chipkitchallenge.com to register and find out more.

* Subject to Terms and Conditions of competition.
**Interact with Microchip at “MCHP Tube”**

Microchip’s Academic Program team has launched a brand new YouTube-based show called “MCHP Tube”. MCHP Tube is an online video newscast for all things Microchip with a focus on Academia. Here you’ll find the latest information on new products, technologies and software/hardware development tools from both Microchip and Third-party sources.

It will be a monthly show targeting academics worldwide and will be divided into four sections as follows:

**Headliners** – we will discuss new academic-friendly development resources brought to you by Microchip and our authorized Design Partners.

**University Student Project** – students can submit a video featuring a student project based on Microchip products.

**Ask Microchip** – viewers can ask a question and a qualified at Microchip support person will answer it.

**Where in the World is Marc McComb?** – Marc is Microchip’s academic sales engineer and in each edition will talk about new products and tools that are a good fit for academics.

To submit a video on a student project or ask a question for the “Ask Microchip” section, email us at mchptube@microchip.com.

You can also visit www.microchip.com/mchptube for more information on the show.

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