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What can you do with a Programmable System on a Chip (PSoc)?

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What can you do with a Programmable System on a Chip (PSoC)?

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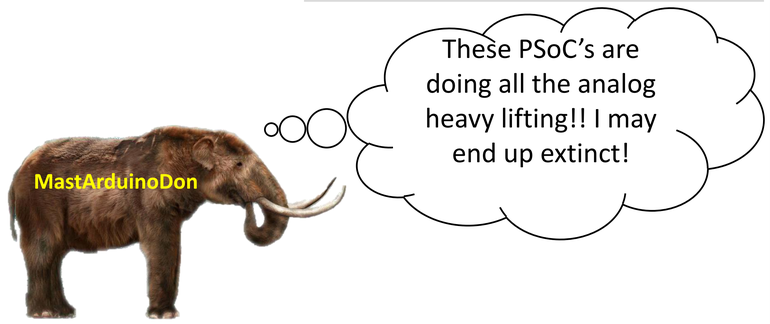
What can you do with a PSoC?: There are a number of options to chose from when working with microcontrollers. Typically these digital devices require external analog circuitry to interact with the world around them. The PSoC greatly simplifies this issue by including programmable analog circuitry built into the device! So what is a PSoC and what can you do with it?

PSoC or Programmable System on a Chip: What makes the PSoC unique and useful for instrumentation is that it has programmable analog circuitry on the chip along with the digital circuitry you expect from a microprocessor! It is FPGA like allowing you to design how the chip will function, but if you need an analog amplifier, you drop one in through the software which then configures this amplifier in the hardware! Even more exciting, this amplifier, or the whole chip can be reconfigured on the fly!

PSoC's come in different models (PSoC 1,3,4 and 5) each with different processors and digital/analog circuitry options allowing a great amount of application flexibility.



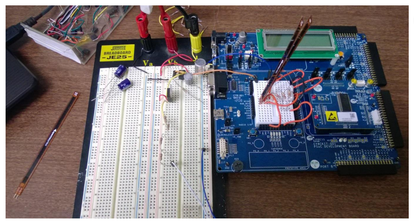
Students in our advanced electronics course worked on a variety of projects utilizing the PSoC1. These projects included thermocouple sensors, flex sensors, laser power meters, photo detectors, forces sensors and more.

Flex Sensor Based Music Glove: Marcello Ruffolo used a PSoC to prototype a glove that can play music by detecting the bend of the wearer's fingers.

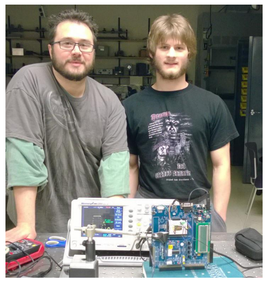
Image from Tactical Marcomms Limited. Used under the Creative Commons Attribution Share-Alike 3.0 License.

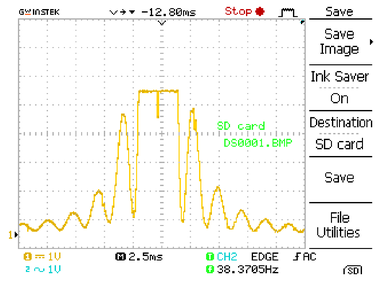
An angle displacement sensor, from Spectra Symbol, would be fit to the fingers of the gloves.

The PSoC detected two bent positions from two sensors allowing 4 notes to be played: 295 Hz (D), 394 Hz (G), 441 Hz (A) and 495 Hz (B). The voltages from the flex sensors controlled the frequencies of a PWM using the PSoC's programmable digital blocks producing square waves. The output of the PWM can be amplified and filtered with analog circuit elements "dropped" into the PSoC's programmable analog blocks!



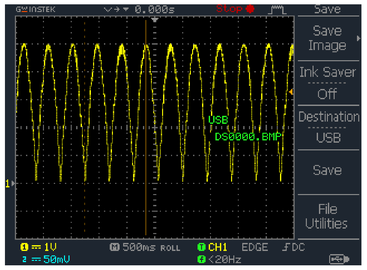
Linear Sensor Array: Skyler Stauffer and Dru Bolding used a PSoC to control and acquire data from a TAOS TSL1402R linear sensor array. Using counters the PSoC could trigger the sensor to output pixel voltages while associating the location of a pixel to a particular time after the initial trigger.



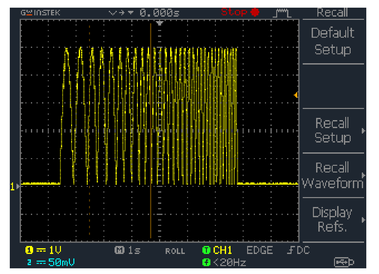


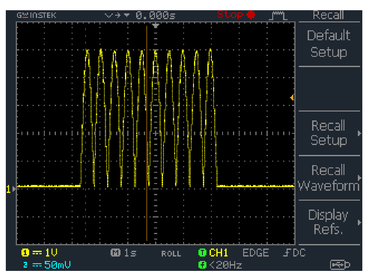
The sensor can be utilized for a variety of applications, for example, measuring the locations of the fringes from a single slit diffraction pattern shown in the previous figure. This could be used to measure the wavelength of the laser (or other light source) used to produce it.

Signal Generator: Mark Masters used the PSoC to generate a rectified sinusoid waveform using a 24kHz pulse width modulated, filtered signal. This signal generator was used in a mechanical analog of NMR!



NMR Signal Generator Options: Along with the continuous waveform the PSoC signal generator can run a user configurable frequency sweep or run in pulse mode generating pulses consisting of a user selected number of cycles.





PSoC as a Learning Tool: The PSoC is an excellent tool for advanced electronics courses. While much of the digital and analog circuitry is self contained students still need a firm conceptual understanding of how the elements work to design their projects while still being exposed to traditional analog circuitry as the PSoCs are often used to interact with external sensors or amplifiers. This gives students exposure to circuit design, programming firmware, designing and building a circuit board, and testing their prototypes!