Stephen Bennett
Projects Portfolio

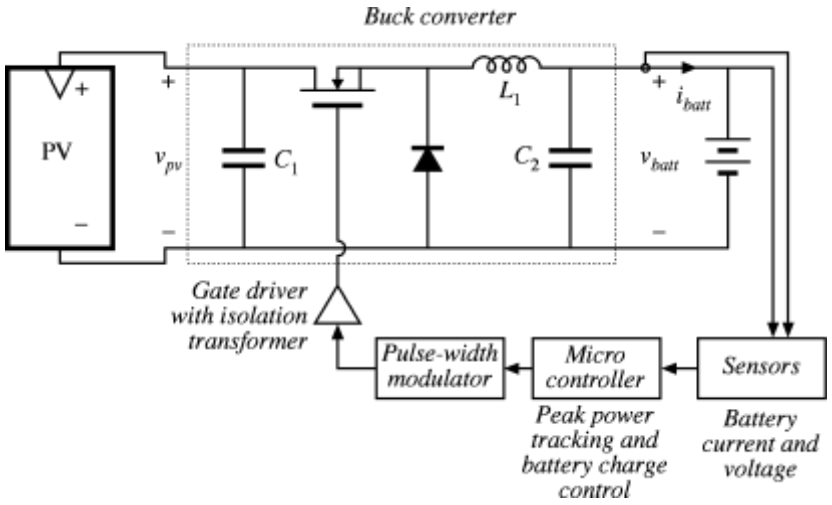
University of Colorado – Boulder
MS EE In Progress | BS ECE Spring 2013

CU-Surrey Payload

- CUSP is a student-designed payload to test low cost microelectronics in space
- The payload is currently scheduled to launch in 2015
- ITAR restricted project
- Tasks:
  - Programming microcontrollers
  - Schematic capture and PCB layout

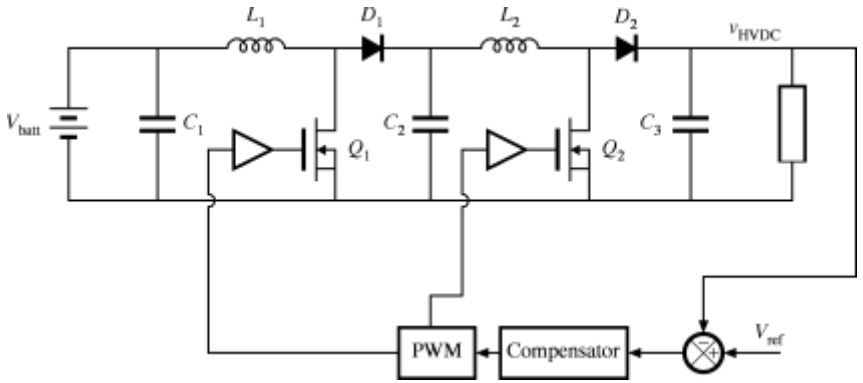
Solar Panel System: Buck Converter

- A DC/DC converter which bucks voltage from an $85W$ PV panel ($\approx 15V - 22V$) down to $11V - 13V$, using that power to charge a lead-acid car battery
- TI MSP430 (programmed in C) controller prevents battery overcharging and makes use of a *Perturb and Observe* maximum power point tracking algorithm
- No off-the-shelf magnetics used (inductor wound by hand)
- Part of a larger solar panel system with a final output of 120 VAC



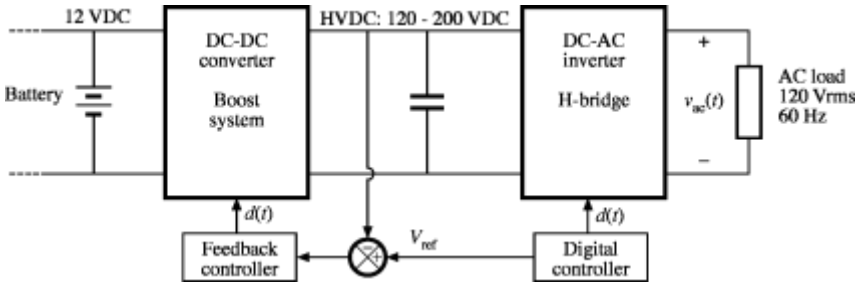
Solar Panel System: 12: $200V$ Double Boost Converter

- A DC/DC converter which boosts the same lead-acid car battery voltage as before to $120V - 200V$ to be used by follow-on $120\ VAC$ inverter
- Analog compensator designed manually to meet voltage set by MSP430 controller
- COTS PWM chip with chosen maximum duty cycle limit
- No off-the-shelf magnetics used (inductors wound by hand)



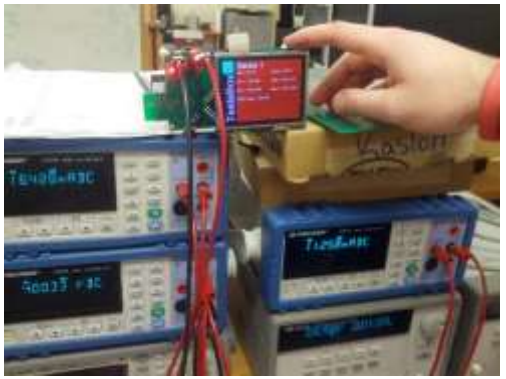
Solar Panel System: 120 VAC Inverter

- The same microcontroller in the Buck Converter also controls a H-bridge inverter, producing a 120 VAC output suitable to be used with household electronics
- One MSP430 timer module provides H-bridge with two gate drive signals, while another timer output is fed directly into a low-pass filter to achieve a simple DAC, used with a feedback controller in a separate (cascaded boost) part of the system



TeslaBox

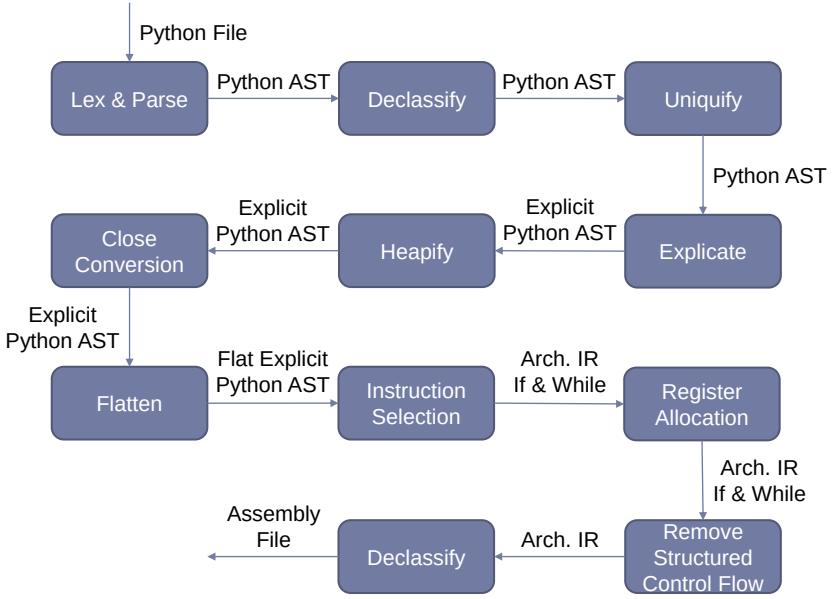
- Software and Communications Lead on a senior capstone project, consisting of a RF-shielded enclosure which uses radio waves to wirelessly charge a Li-Poly battery
- Charge control and monitoring is MSP430-based, makes use of SPI busses to wirelessly communicate using TI CC1101 transceivers
- Developed touch screen GUI to interactively view battery charging data and device status as well as send commands to the charging device
- All hardware (SEPIC board, power management board, base station board) designed in Altium Designer for schematic capture and PCB layout
- Serves as a proof-of-concept for wireless charging of consumer devices such as cell phones, toys, etc. using the far-field
- Mentor and sponsor Dr. Zoya Popović



Fall 2012 – Spring 2013

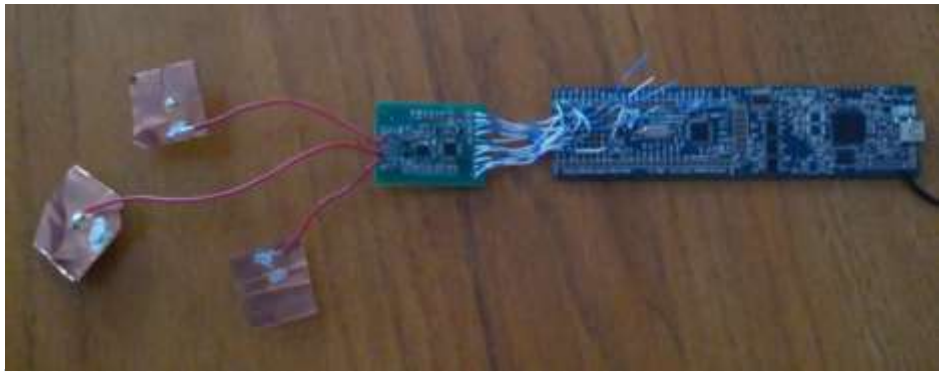
Python Compiler

- A compiler written in Python to compile Python code to x86 and ARM assembly using ASTs and the visitor pattern
- Supports Python semantics and was completed with support for:
  - (Nested) Classes
  - (Nested) Functions
  - (Nested) For and While loops
  - (Nested) Lists and Dictionaries
- Ported to compiling to ARM assembly once completed
- The project was done using test-driven development in a pair programming environment



EEG-Android Camera+

- Modified the source code for the AOSP camera app to support input from a rudimentary EEG monitor
- EEG signals were taken from three copper tape electrodes placed on the user's forehead
- ARM Cortex-M0 (programmed in C) performs two functions:
  - Sample Left/Center/Right EEG channels with ADC
  - Transmit sampled data over UART to a UART-Bluetooth module
- Android smartphone performs all other functions:
  - Receives Bluetooth data using a service
  - Modified camera app binds to Bluetooth service to receive EEG data
  - Received data is translated into a facial action (smiling, blinking, scrunching forehead, etc.) which is then translated into a camera action (zoom, focus, snap)



NES Rover

- Arduino-based project which wirelessly controls a three-wheeled robot with a NES controller
- D-pad controls direction, A and B buttons control speed
- A set of six non-inverting amplifiers gives each controller input a specific output voltage which is then translated into a distinct PWM signal
- After the wireless link, the PWM is low-pass filtered and interpreted by an Arduino, independently controlling left and right DC motors

Android – Utility Belt

- Developed an Android application that possessed:
  - Simple note taking (title, content)
  - Map with markers that could track position over time
  - Tip calculator
  - Customizable color scheme

12-Hour Clock

- $5V$ powered, 12-hour clock designed using Altium Designer
- Full design simulated and verified using Electronics Workbench prior to schematic capture and PCB layout
- Used 7400 series ICs
- Received highest grade in class for most compact layout and highest overall functionality