EECS192 Lecture 4
Feb. 7, 2017

Notes:
Check off-
- 2/10: Motor drive/stall, steering servo
- Quiz 2: power MOSFET/motor drive Tues 2/14

Topics
- Polarized capacitor
- Project proposal feedback
- Quiz 1
- RC servo basics
- PWM and motor drive
- Power supplies
- Boost converter
- Buck Converter

47uF, 16V electrolytic, polarized
Not all same- ESR…
Project proposal feedback

Motor Driver

Schematic
- Estop: what to switch?
- Motor drive from battery, not voltage regulator
- Snubbing capacitors and diode
- Drive/brake/enable/dir- shoot through protection
- Conventions: L->R, top to bottom

Circuit Layout
- Mounting holes
- Big wires, short distances
- QFN vs SOIC package
- Heat sinks
- Estop switch
- Signal connectors- include ground
- Power connectors

Software
- Threads vs interrupts vs main() vs RtosTimer
PWM for Steering Servo

**Gotchas:**
- 4.8 or 6V, (Not 7.2V!)
- max current 2A
- May be sensitive to noise on supply line
- Performance depends on voltage
## PWM

https://developer.mbed.org/handbook/PwmOut

<table>
<thead>
<tr>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>PwmOut</code></td>
<td>(PinName pin) Create a <code>PwmOut</code> connected to the specified pin.</td>
</tr>
<tr>
<td><code>write</code></td>
<td>(float value) Set the output duty-cycle, specified as a percentage (float)</td>
</tr>
<tr>
<td><code>read</code></td>
<td>() Return the current output duty-cycle setting, measured as a percentage (float)</td>
</tr>
<tr>
<td><code>period</code></td>
<td>(float seconds) Set the PWM period, specified in seconds (float), keeping the duty cycle the same.</td>
</tr>
<tr>
<td><code>period_ms</code></td>
<td>(int ms) Set the PWM period, specified in milli-seconds (int), keeping the duty cycle the same.</td>
</tr>
<tr>
<td><code>period_us</code></td>
<td>(int us) Set the PWM period, specified in micro-seconds (int), keeping the duty cycle the same.</td>
</tr>
<tr>
<td><code>pulsewidth</code></td>
<td>(float seconds) Set the PWM pulsewidth, specified in seconds (float), keeping the period the same.</td>
</tr>
<tr>
<td><code>pulsewidth_ms</code></td>
<td>(int ms) Set the PWM pulsewidth, specified in milli-seconds (int), keeping the period the same.</td>
</tr>
<tr>
<td><code>pulsewidth_us</code></td>
<td>(int us) Set the PWM pulsewidth, specified in micro-seconds (int), keeping the period the same.</td>
</tr>
<tr>
<td><code>operator=</code></td>
<td>(float value) A operator shorthand for <code>write()</code></td>
</tr>
<tr>
<td><code>operator float</code></td>
<td>() An operator shorthand for <code>read()</code></td>
</tr>
</tbody>
</table>
PWM for Main Motor control

\[ \langle i_m \rangle = \left( \frac{T}{T_o} \right) i_{\text{max}} \]

Is \( i_{\text{max}} \) constant?
On board: what does this look like electrically (as a schematic)?
Power supply wiring- Star is better!

On board: what does this look like electrically (as a schematic)?
``7.2V'' supply waveforms with motor PWM

- Battery model
- Waveforms on board
- Wiring to reduce voltage resistance effects of wiring

Linear Regulator $V_{IN} > V_{REG}$
Boost Converter $V_{IN} < V_{REG}$
Boost Converter

Waveforms on board
(also see boost converter notes)
Boost Converter - LT1370

**Block Diagram**

5V to 12V Boost Converter
Buck Converter
LM2678
Buck Converter

On-State

Off-State

https://en.wikipedia.org/wiki/Buck_converter