EECS192 Lecture 1
Jan. 16, 2018

• What is Mechatronics?
• Project Description
• Autonomous system example
• Course Organization
• ARM Cortex M4 overview
• FreeRTOS
• Electronic Components
What is Mechatronics?

- Moore’s Law for electronics
- Moore’s Law for mechanics(?)

Key Technologies for Mechatronics:
- Signal processing
- Control
- ...

Folded mirror array
**Project Description**

- Design Autonomous Race Car
- Unknown track
- Follow track without hitting cones.
- Stop at end of track.
- Winning speed: 3.3 m/sec (Spring 2017 Natcar winner)
- Learning allowed (though only have 5 minutes total for best run)

**Schedule**

- Tues Lecture -> Wed/Thurs Lab Demo -> 8 days -> Fri checkoff hour (tba)
Hardware
adapted from Thrun et al, JFR 23(9) 2006
adapted from Thrun et al, JFR 23(9) 2006
Course Organization

• Tues Lecture -> Wed/Thurs Lab Demo -> 8 days -> Fri checkoff hour (tba)
• Partners: 3 ideal. Only have 12 teams, so priority to teams of 3. $300 deposit for car+CPU+battery+camera+motor+servo
• Checkoffs "better is enemy of good"- robustness: needs to work in a window
• Checkpoint sequence:
• CPU -> drive motor+servo -> power supply -> line sense -> line follow/fig 8 -> velocity control -> CalDay/Round 1/Round2/NatCAR
Course Organization (cont)

• Emphasis: robustness, simplicity. Design/Simulate/Build/Test

• Goal: 10 hours per week per team member.

• What about Complexity?

• Reliability of the overall system \((90\%)^N\) (connectors, power supply, heat sinks, solder joints, CPU stack, car mechanics, camera mount, control stability, lighting robustness,...)
ARM Cortex M4 Overview
ARM Cortex M4
1 MB Flash
256 KB RAM
32 bit ARM 7 core
120 MHz
A/D, D/A
3x SPI
Timers
K64F Power Supply

5-9 volt input
FreeRTOS
Mastering the FreeRTOS™ Real Time Kernel

26. Execution pattern highlighting task prioritization and pre-emption in a hypothetical application in which each task has been assigned a unique priority.
Challenge: Embedded real-time programming

Figure 12.10: Illustration of the priority inheritance protocol. Task 1 has highest priority, task 3 lowest. Task 3 acquires a lock on a shared object, entering a critical section. It gets preempted by task 1, which then tries to acquire the lock and blocks. Task 3 inherits the priority of task 1, preventing preemption by task 2.
Electronic Components
EE192- Soldering Notes
• Oxide has lower energy than clean metal
• Higher energy surfaces attract molten solder
• Oxides have higher melting points than metals
• Oxides have lower thermal conductivity than metals
• Flux helps to prevent oxide formation, but is an insulator
Resistor Color Code
From: http://www.hep.fsu.edu/~wahl/phy3802/exprinfo/electronics/res-color-code.gif

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**EXAMPLE**
47,000 Ohms or 47-KΩ

1st Digit — Yellow | violet | orange | gold
2nd Digit — 5% - Gold
Multiplier — 100
Tolerance — Red

Better be right or your great big venture goes west…

Capacitor Codes
From: http://www.applefritter.com/sites/default/meta/replicacreation/images/fige-10.png

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Yellow | violet | orange | gold
Capacitor Types - ceramic

- CAP CER 0.1UF 50V X7R RADIAL
- CAP CER 0.1UF 630V X7R RADIAL
- CAP CER 0.1UF 50V X7R 0805

Capacitor Types - 47 uF 50V

Ripple Current
600mA

Eletrolytic Ripple Current
169mA @ 120Hz

Metalized film
CAP TANT 22UF 50V
20% 2917

https://industrial.panasonic.com