NEVER GONNA GIVE

ECE 490-ST
Wireless Computing

Course Overview

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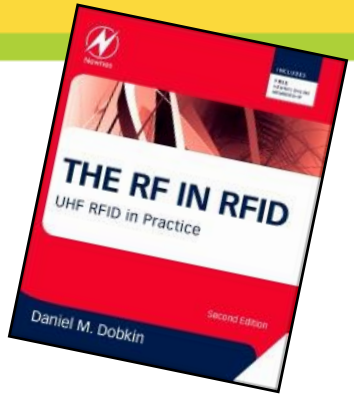
SJT

Syllabus



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- Office Hours
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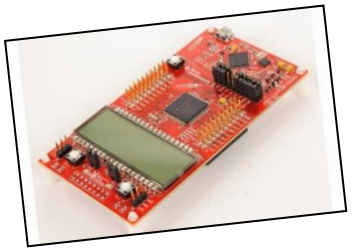

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But first …

A Quiz!

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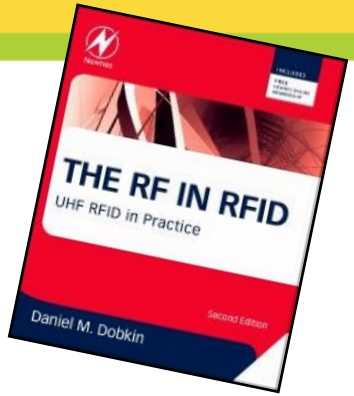
Syllabus



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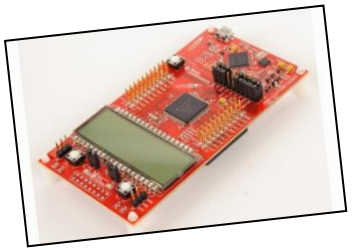

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Instructional Objectives

- Upon successful completion of ECE 490-ST, you should be able to:
  1. Describe the key features of an RFID system and how they differ from traditional communication systems.
  2. Draw and use a Smith Chart to aid in engineering decisions.
  3. Describe the function and utility of a Vector Network Analyzer (VNA).
  4. Create a link budget using a propagation model.
  5. Characterize a wireless power system.
  6. Design low-power microcontroller programs.
  7. **Build a battery-free device.**

VU – WiCPU Board

You will:

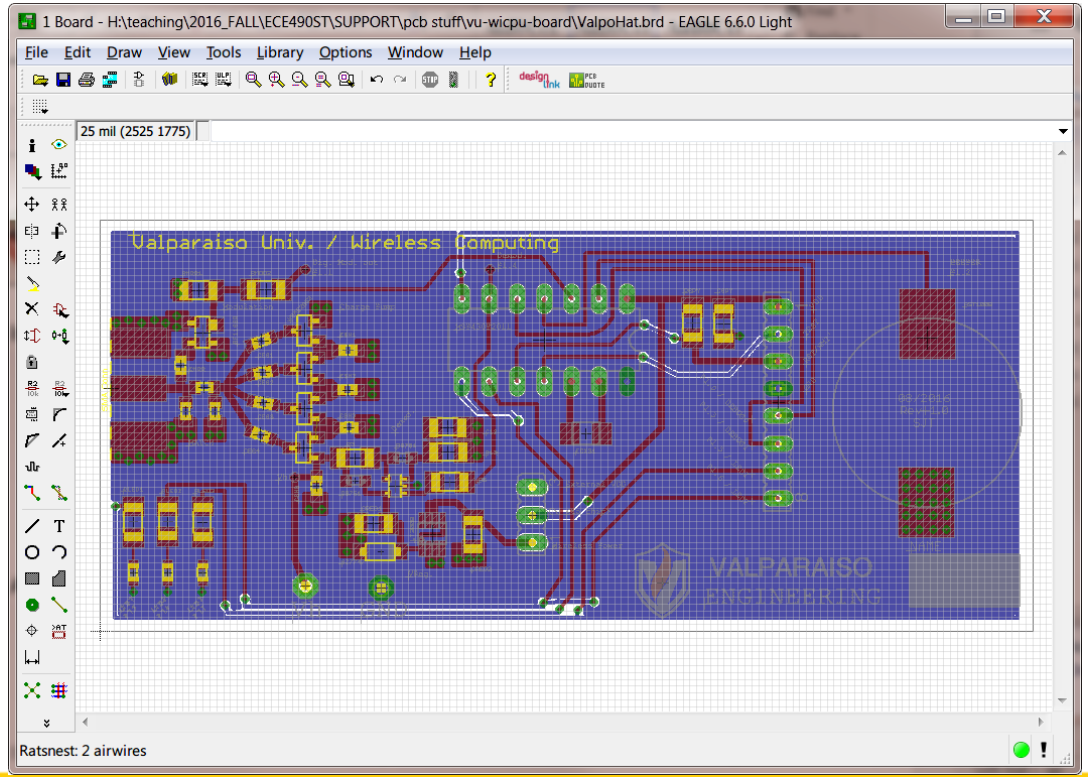
Solder it up.

Test it out.

Characterize it.

Use it.

Do a final project.



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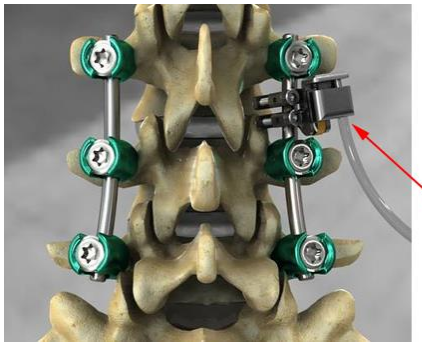
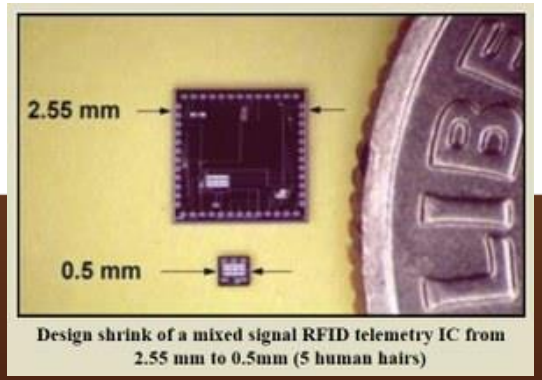
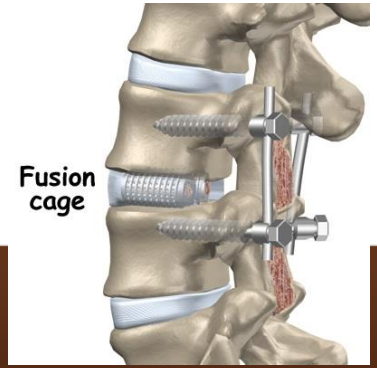
Who is your prof?

- Univ. of Louisville
  - Digital readout for wireless pressure sensor





Design shrink of a mixed signal RFID telemetry IC from 2.55 mm to 0.5mm (5 human hairs)



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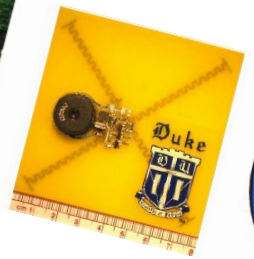
- Duke University
  - Major Accomplishment: Saw the Blue Devils win 2 Nat'l. Championships
  - Smarthat – Worker Safety Helmet



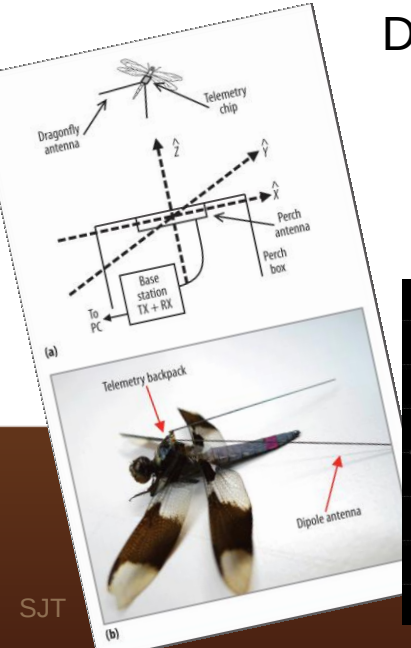
Dragonfly neural/EMG

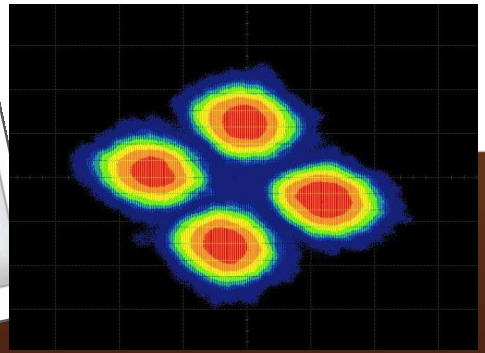
Improvements to tag data rate

Power harvesting from WiFi signals

Secure important materials

Fully-passive radiation sensor





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So … What is wireless computing?

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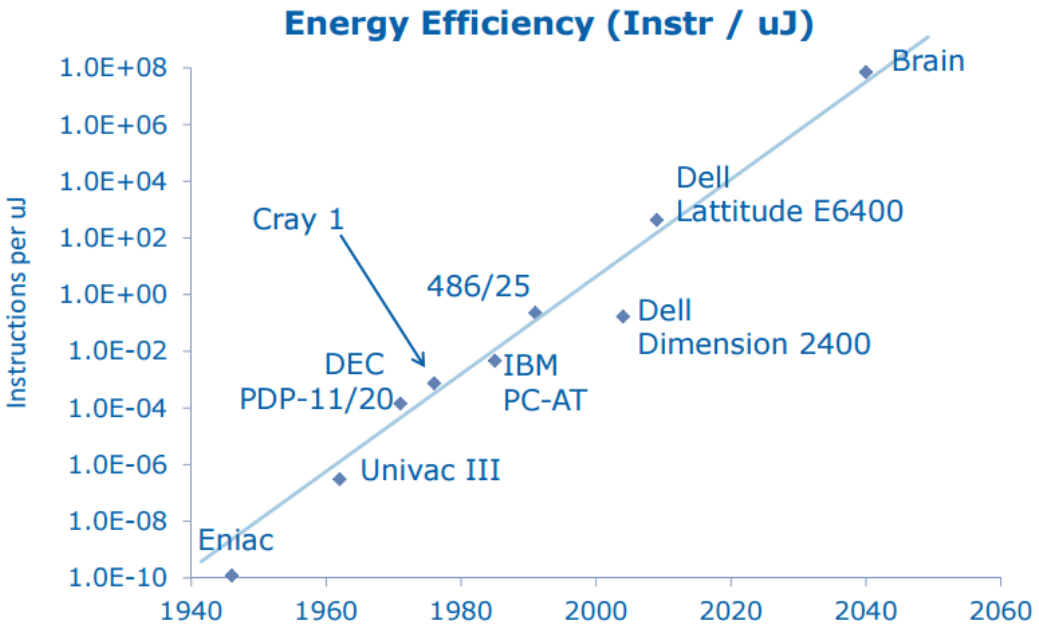
Wireless Computing

Emerging technology

Combines:

- Low-power computing
- Distributed computing
- Wireless power transfer
- Built on RFID technology
- Not *exactly* the same as IoT (Internet of Things)



Data: ***Implications of Historical Trends in the Electrical Efficiency of Computing***
Koomey, Berard, Sanchez et al, IEEE Annals of the History of Computing, 2011

Wireless Computing

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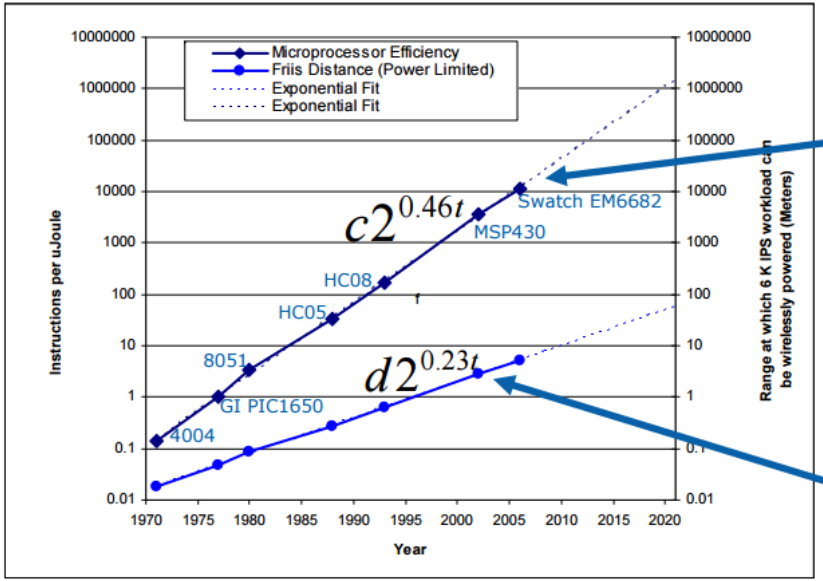
Range scaling of far field WPT



Inst/uJ doubling time 2 years

Range doubling time 4 years

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Wireless Computing

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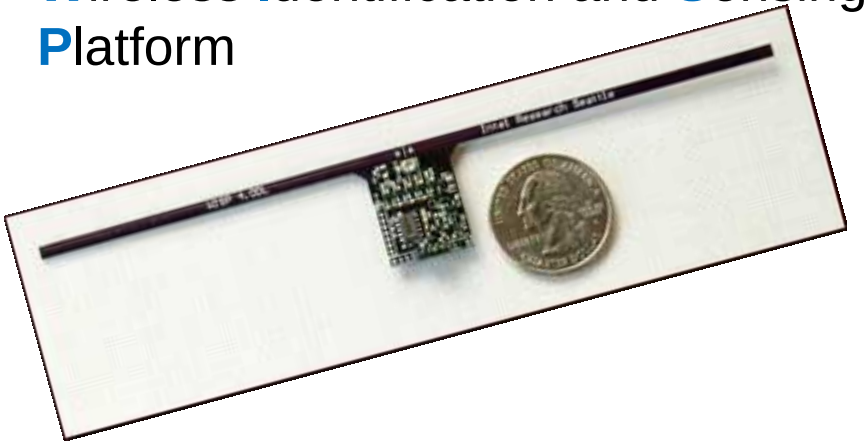
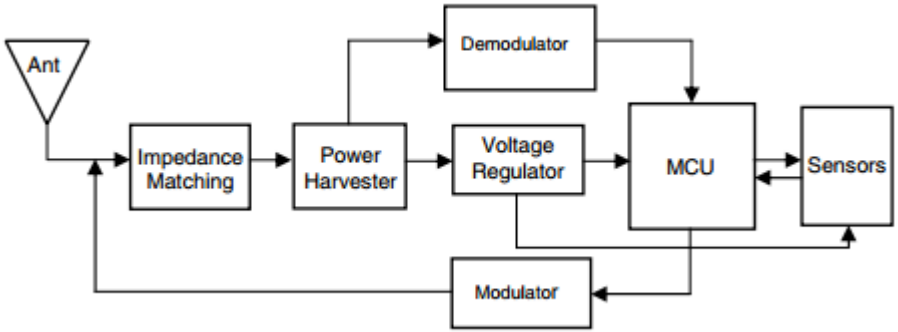
- Intel WISP
  - **W**ireless **I**dentification and **S**ensing **P**latform



  - Key Components:
    - Wireless
    - No Battery
    - Talks to Sensors

Block Diagram of a Wireless Computer



- In-Class Fun Times


Reflections

So … What is RFID?

1. System – Reader, tags
2. Radio link
3. Radio (transceiver)
4. Tag (transponder)
5. Antennas
6. Protocols

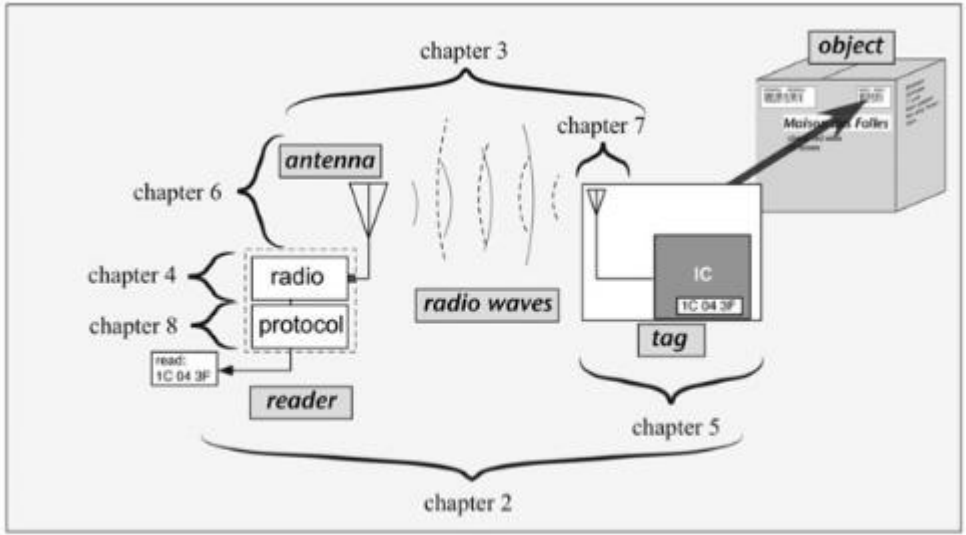


Figure 1.1
Overview of this book.

So … What is RFID?

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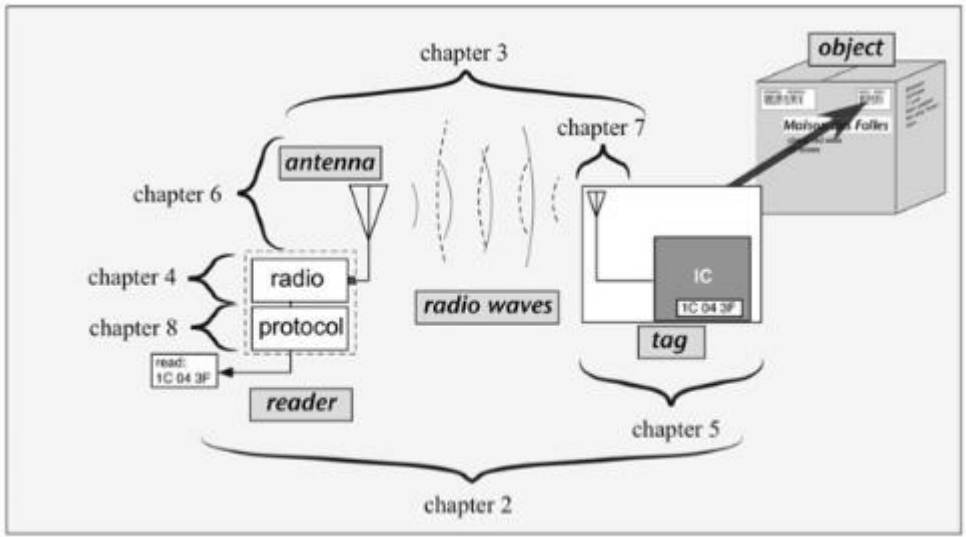

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KEY – no battery on tag

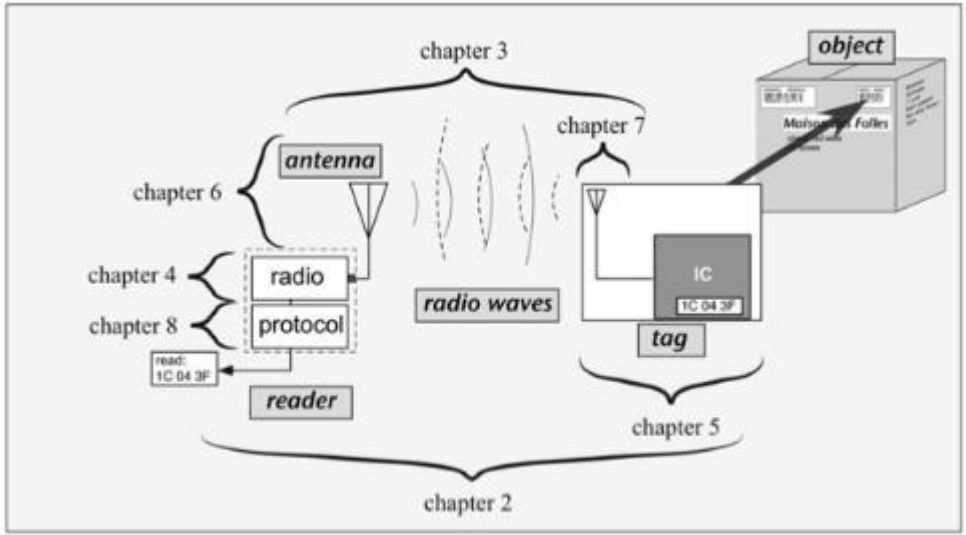

Figure 1.1
Overview of this book.

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Under the RFID Umbrella

- Main goal of **identification**
- No transmitter
- No battery
- Simple circuitry
- Standing out of the noise

Under the RFID Umbrella

- Main differentiator is **frequency**
- Inductive coupling
  - Shorter distance (10's of cm)
  - Instantaneous communication (~4 ns)
  - A single magnetic transformer
- Radiative coupling
  - Larger distances (10-20 m)
  - Non-instantaneous communication (22 ns, 4 m)

LF – Low Frequency
125 kHz
HF – High Frequency
13.56 MHz
UHF – Ultra High Frequency
915 MHz
2450 MHz

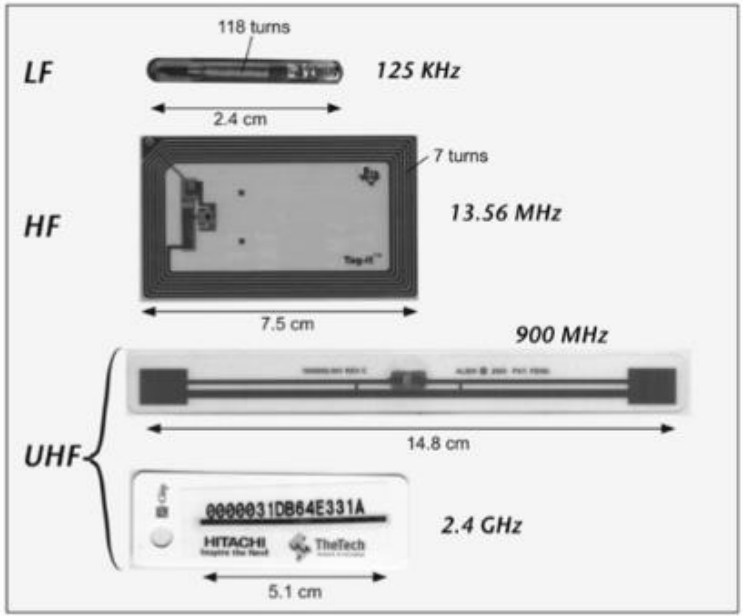

Figure 2.14
Examples of tag antenna configuration designed for different operating frequencies.