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Questions and Answers Vol. 1

"The quick and the decaf." EAUUV

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But first...

A valuable message about safety...



But secondly...

Some house keeping

Calendar at a glance

Week	Dates	Lecture	Reviews	Demos	Assessment submissions
1	25/2 - 1/3	Introduction			
2	4/3 - 8/3	Principles of Mechatronic Systems design			Problem analysis
3	11/3 - 15/3	Previous years deconstruction case studies			
4	18/3 - 22/3	Professional Engineering Topics	Progress review 1		
5	25/3 - 29/3	PCB design tips			
6	1/4 - 5/4	Your soldering is (probably) terrible			
7	8/4 - 12/4	Introduction to firmware design	Progress seminar	25% demo	
8	15/4 - 19/4	Introduction to firmware design			
Break	22/4 - 26/4				
9	29/4 - 3/5	Q and A sessions		50% demo	
10	6/5 - 10/5	No lecture	Progress review		
11	13/5 - 17/5	Q and A sessions		75% demo	Preliminary report
12	20/5 - 24/5	Monday lecture!!			
13	27/5-31/5	Closing lecture		Final testing	Final report and reflection

You are here 🤄

No lecture next week

- I won't be there; neither should you
 - Do not show up
 - Do not pass go
 - Do not collect \$200
- Really, it would just be more Q&A, anyway
 - But you know you can always ask me questions
 via email I try to respond ASAP
 - But do expect slower responses while I'm away...

All's quiet on the western front

- Nothing is due this week.
- This is... strangely uncomfortable?

- But the 50% demo is this week!
 - You should already have an email from me about that if you requested one

Progress review 2 – Electric Boogaloo

- Next week is the second progress review
 - Just like the first progress review in every way that counts! Except with 300% more progress!
- Sign up via the Doodle poll that will be posted after the lecture closes Friday
- You know the drill!
 - Include your team number, plus your full name: Non-compliant sign-ups will be cleared

FAQ Roundup

• None as of yet

Here, have a mini lecture on RF

• Why? No particular reason – I had the notes and thought it might be helpful!

Wireless comms

To radio, and beyond!

Mini lecture on wireless comms

- Wireless communications is fascinating, and you can practically get a whole degree on just it alone.
- For mechatronics engineers, it boils down to "Which radio module should I buy?"

Every discussion of RF starts with the electromagnetic spectrum

ELECTROMAGNETIC RADIATION SPECTRUM



Quick comments the radio spectrum

- Radio spectrum is extremely valuable
 You don't get much to play with
- "Open" spectrum is predominantly concentrated in the ISM bands
 - ISM: Industrial, Scientific and Medical
- Fortunately, most of the RF compliance work has been done for you

Frequency, data rate and power

- The higher your radio frequency, the faster you can transfer data
 - But also the more difficult filtering becomes, thus shorter range
- The more power you transmit with, the greater your range
 - But also the more interference you cause

The ISM bands*

Frequency range		Bandwidth	Center frequency	Availability
6.765 MHz	6.795 MHz	30 kHz	6.780 MHz	Subject to local acceptance
13.553 MHz	13.567 MHz	14 kHz	13.560 MHz	Worldwide
26.957 MHz	27.283 MHz	326 kHz	27.120 MHz	Worldwide
40.660 MHz	40.700 MHz	40 kHz	40.680 MHz	Worldwide
433.050 MHz	434.790 MHz	1.74 MHz	433.920 MHz	Region 1
902.000 MHz	928.000 MHz	26 MHz	915.000 MHz	Region 2
2.400 GHz	2.500 GHz	100 MHz	2.450 GHz	Worldwide
5.725 GHz	5.875 GHz	150 MHz	5.800 GHz	Worldwide
24.000 GHz	24.250 GHz	250 MHz	24.125 GHz	Worldwide
61.000 GHz	61.500 GHz	500 MHz	61.250 GHz	Subject to local acceptance
122.000 GHz	123.000 GHz	1 GHz	122.500 GHz	Subject to local acceptance
244.000 GHz	246.000 GHz	2 GHz	245.000 GHz	Subject to local acceptance

[wikipedia "Radio Regulations", Internationla Telecommunications Union-R 2012]

* "ISM" is a great name for a rock band

A brief survey of radio standards

Module	Frequency	Typ. range	Typ. data rate	Typical application
FM	433/434 MHz 868 MHz 900/915 MHz	100 m 100 m 20 m	4.8 kbit/s 9.6 kbit/s 115.2 kbit/s	Garage door opener Wireless POTS phone
Zigbee	868 MHz 915 MHz 2.4 GHz	70 m 70 m 70 m	40 kbit/s 45 kbit/s 250 kbit/s	Wireless sensor networks
Nordic	2.4 GHz	50 m	1 Mbit/s	Wireless sensor networks
Bluetooth	2.4 GHz	10-100 m	0.7 – 2 Mbit/s	Laptop/cellphone peripheral
Wi-Fi	2.4 GHz	30 m	11 Mbit/s+	Mobile network
0G 1G 2G 3G 4G	Various 150 Mhz 0.9 – 1.8 GHz 0.4 – 3 GHz 1.7 – 1.8 GHz	80 km 40 km+ 35 km 30 km 5 km	9.6 kbit/s 14.4 kbit/s 144 kbit/s 2 Mbit/s 100 Mbit/s?	Cellular telephony and data

Pros, cons of comms systems

FM: Very cheap, lousy transfer rate Bluetooth: Good speed, limited range Zigbee: Mesh networking, limited speed Wi-Fi: Great speed, lots of overhead Cellular: Wide reach, very expensive Global reach, crazy expensive Satellite: High bandwidth, unreliable Pigeon:



And now...



- *Why* are you doing what you're doing?
 - Analysis is token and unconvincing across many teams
 - This is *easily* the difference between a 7 and a 4
- I will *not* cut you slack, nor save your butts
 - Follow the process: spec', analysis, design, test
 - I will let you fail this course if you do not put adequate analysis in

- No rhyme or reason to the placement of motors, transmissions, brackets, etc.
 - You really need to think this through!
 - Summation of error is death
- Are you wobbly? Probably!
 - This is a (potentially) really bad thing
 - Maybe you need a way to tweak it precisely...

- Your dynamical control is (almost certainly) terrible
 - No really it sucks. Your lousy approach will be your undoing. It will make you sad.
 - Slow and accurate or fast and sloppy?
 - How much give is there in your transmission?

Think very carefully about how to do this. There are (probably) no easy solutions to it.

- Find someone else's codebase and use it
 - Some other poor schmuck, somewhere, has probably already solved your problem
 - There is no shame in open source

Why do you need all that bulk, anyway?
Big, clunky, heavy things are stiffer, but much harder to move... and add sag





Tune-in next time for...

Questions and Answers Vol. 2

Or

"By caffeine alone do you set your mind in motion"

Fun fact: Money cannot buy happiness, but an annual income of US\$70,000 is correlated with the highest level of life satisfaction.