

ECE 471 – Embedded Systems

Lecture 17

Vince Weaver

`http://web.eece.maine.edu/~vweaver`

`vincent.weaver@maine.edu`

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Announcements

- How did HW#5 go
- Courses next semester: ECE574



Homework 6 notes

- Handout should cover most of it
- bit-banging i2c
- Use the sysfs gpio interface and driving the SDA and SCL lines manually to talk to the 4x7 LED display
- Still easier than full bitbang, where you'd have to write to various i/o addresses
- A lot of the code is provided for you, follow the directions
- How do you set SDA low?
Set to output, write a '0'



- How do you set SDA high?
Do not write a '1'!
Open collector, need to let it float.
Set to 'input' works.
- Static in C?
- Why not bitbang everything? A pain. Hardware does it for you. Hardware even does more, can often buffer or DMA, timing more exact.
- Why might you want to bitbang i2c? Only have one i2c bus? Or no i2c bus, only GPIOs? kernel has bitbang driver



Real Time Constraints

What are real time constraints?

- Time deadlines that hardware needs to respond in.
- Goal not performance, but response time



Types of Real Time Constraints

- Hard – miss deadline, total failure (people die?)
Antilock brakes?
- Firm – result no longer useful after deadline missed
lost frames in video, missed frames in video game
- Soft – results gradually less useful as deadline passes.
Caps lock LED coming on?



Constraints depend on the Application

Can almost always come up with a scenario where a soft constraint could become hard.

For example: Unlocking a car door taking an extra second? Not hard real-time, except maybe if your car is about to crash and you need to escape quickly.



What can cause problems with real-time?

Sources of “Jitter”

- Interrupts. Taking too long to run; being disabled (cli)
- Unpredictable nature of modern CPUs. Caches, branch-predictors, etc.
- Operating system. Scheduler. Context-switching.
- Dynamic memory allocation, garbage collection.
- Slow/unpredictable hardware (hard disks, network access)



Real Time OS

Who uses realtime?

- Timing critical situations. Cars, medical equipment, space probes, etc.
- Industrial automation. SCADA. Stuxnet.
- Musicians, important to have low-latency when recording
- High-speed trading

