What is an Embedded System?
What is an Embedded System?

- Computing system with a non-standard interface (often no keyboard or screen)
- Often involved in sensing and control (and may not even talk to a human)
- Typically a custom system for a very specific application
What is an Embedded System? (cont)

• Limited processing capabilities:
  – Can be extremely small
  – Can require a small amount of power

• Can have significant real-time constraints
  – Act on inputs very quickly
  – Generate high-frequency outputs

• Often a higher expectation of reliability
Examples of Embedded Systems
Robotics

Mark Tilden
Los Alamos National Labs
and Wowwee

picture from *Robosapiens*
Humanoid Robotics

NASA/JSC Robonaut

UMass Torso
Dual-Limb Coordination
Personal Satellite Assistants

NASA Ames Research Center

picture from *Robosapiens*
Wearable Computing
Intelligent Prosthetics

Hugh Herr
MIT Leg Lab

picture from Robosapiens
Sensor Networks

1000 sensor nodes
Embedded Systems Challenges
Embedded Systems Challenges

• Sensing the environment:
  – Sensors are typically far from ideal (noise, nonlinearities, etc.)
  – Sensors fail
  – Hard to get a ‘complete’ view of the environment

• Affecting the environment through “actuators”
  – Application can require fast, precise responses
Embedded Systems Challenges (cont)

• Testing/debugging can be very difficult:
  – Hard to identify and replicate all possible situations
  – Often involves the interaction of many different components
  – Often no standard user interface
  – Limited on-board resources with which to record system state

• Competing requirements of cost, complexity, design time, size, power…
Embedded Systems Challenges (cont)

• Lack of reliability can be a killer ..... literally
My Assumptions About You

• Background in Computer Organization and Operating Systems

• Programming in C

• Everyone has a laptop that can be used for the projects
Skills You Should Learn Here

• Read (and understand!) technical documentation
• Design and implement embedded systems involving a microcontroller, sensors, actuators, and the necessary “glue”
• Design, program, and debug embedded software for sensing and control
• Work in collaborative teams
Sources of Information

• Required textbooks:
  – Also reading the Atmel Mega 8 specification (downloadable)

• Class web page: www.cs.ou.edu/~fagg/classes/ame3623_s07/
• Desire2Learn: learn.ou.edu

You are responsible for making sure that you have access to all of these resources
(available at the Engineering Library)
Class Schedule

www.cs.ou.edu/~fagg/classes/embedded_systems_2008/schedule.html

- Lecture plans
- Required reading

As changes are made, they will be posted here
Channels of Communication

• Lecture
• Class email list: time-critical messages to the class
• Desire2Learn announcements
• Desire2Learn discussion group: you may post questions (and answers)
• Private email or office hours for non-public questions/discussions