COE 718 – Lecture 1: Introduction to Embedded Systems

Topics

- What are embedded systems
- Applications of embedded systems
- Typical subsystems in an embedded system

Introduction

- You all have grown up in a computer age
  - You see computers everywhere
- Not the case in your parents or grandparents age
- Really thanks to VLSI technology

Types of Computers available

- Desktops
- Laptops
- Servers
- Mobile phones

Embedded Systems

- Another computing system is often hidden in our environment
- These are called "embedded" system
- They are much more in common in fact
- But often hidden in the environment they were created for

Embedded Systems

- Essentially any system that is not a laptop or desktop can be thought of a embedded system
- Example systems
  - Air conditioning system
  - Washing machines
  - Printers
  - Digital cameras

Example Embedded Systems

- Processors for embedded are often very simple and inexpensive
- Simply driven by cost
- Example: microwave oven
  – Intel Pentium 4?
- But not always the case
  – Example: Missile system

Features of Embedded Systems

- ## Almost always special-purpose or single-functions
  - Executes a single program
  - May have inputs from the environment
    - Sensors that take environmental variables
    - Users input values taken from control panel
- ## Example: Air conditioning
  - Sensor detects temperature
  - User can set temperature

Features of Embedded Systems

- Most have tight constraints on
  - Cost
  - Energy
  - Form factor
- Consequently, most embedded systems
  - Low cost
  - Low power
  - Small size
  - Relatively fast

Features of Embedded Systems

- ## Most must react to events in real-time
  - Respond to inputs from the system's environment
  - Must comptue results and respond in real-time with minimum delay
  - Delay depends on application

Typical Design Constraints

- So based on features, design constraints follow
- Low cost
  - Generally means low end processor
- Low Energy Consumption
  - Many applications require battery power
- Limited Memory
  - Due to processors
- Real time response

Architecture of an Embedded System

- Most embedded systems are micro-controller based systems

- Microcontrollers are special types of processors that have features we discussed
  - Complete computer in one VLSI cheap

- Generally, embedded systems are not meants to be programmed by end user
  - Comes to you factory programmed

Architecture of an Embedded System

- Generally, embedded systems are not meant to be programmed by end user
  - Comes to you factory programmed
  - Cannot make modifications to the software
  - Can add inputs
- Programmability aspect is changing…
  - Trend is towards more programmability

Schematic of an Embedded System

Other attributes of Embedded Systems

- Embedded system is not a microprocessor sitting inside a traditional computing system (desktop, laptop)

- An embedded system controls another system

- Typically embedded systems are single-chip devices
  - Contain memory, I/O interfaces, processor

Applications

- **Consumer Segment**: Refrigerator, washing machine, A/C machine, camera, microwave oven, TV, security system, etc
- **Office Automation**: Printers, fax machines, photocopying machines, scanners, keycard access, security camera
- **Automobiles**: air bags, ABS, engine control, door lock, GPS system

Applications

- **Communication**: Mobile phones, network switches, WiFi hotspot, modems
- **Other**: automatic door locks, car door opener, car starter