Embedded Systems

Concepts Covered

- Introduction to Embedded Systems
- Applications of Embedded Systems
- Typical Subsystems in an Embedded Systems

Introduction

- We have been brought up in the age of computing.
  - Computers are everywhere (some we see, some we do not see).
- Types of computers we are familiar with:
  - Desktops and Laptops
  - Servers
  - Mobile phones
- But there's another type of computing system that is often hidden.
  - Far more common and pervasive...
  - Hidden in the environment.

Embedded Systems

What are Embedded System

- Computers are embedded within other systems:
  - What is "*other systems*"? - Hard to define
    - Any Computing System other than desktop / laptop/ server

- Typical Examples:
  - Washing Machines, refrigerator, camera, vehicles, airplane, missile, printer
  - Processor are often very simple and inexpensive
    (depending upon the application of course)

- Billions of embedded system units produced yearly, versus millions of desktop units

Common Features of Embedded System

- They are special purpose or single functioned.
  - Executes a single program, possibly inputs from the environment.
  - Image a microwave oven, a washing machine, an AC machine, etc.

- Tight constraints on cost, energy, form factor, etc.
  - Low cost, low power, small size, relatively fast.

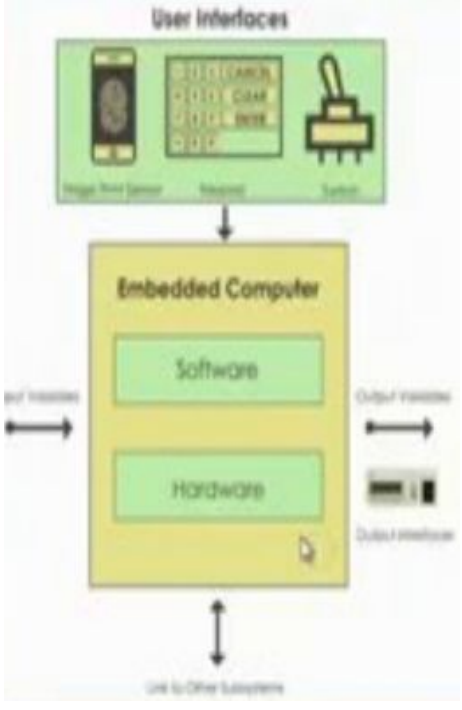
- They must react to events in real time.
  - Responds to input from the system environment.
  - Must compute certain results in real-time without delay.
    - The delay that can be tolerated depends on the application.

Typical Design Constraints

- Low Cost
  - A sophisticated processor can increase the cost of the embedded system
- Low Energy Consumption
  - Many embedded systems operate on battery
- Limited Memory
  - Typically constrained to finite and small amount of memory
- Real Time Response
  - Most embedded systems are used for controlling some equipment.
  - Must generate response within a specified time.

How to define an Embedded system?

- It is a microcontroller-based system that is designed to control a function or a range of functions, and is not meant to be programmed by the end user
  - The user may make choices concerning the functionality but cannot change them.
  - The user cannot make modification to the software.
  - Can you “program” your washing machine or refrigerator or car?
    - Not today … but very sure in the future.

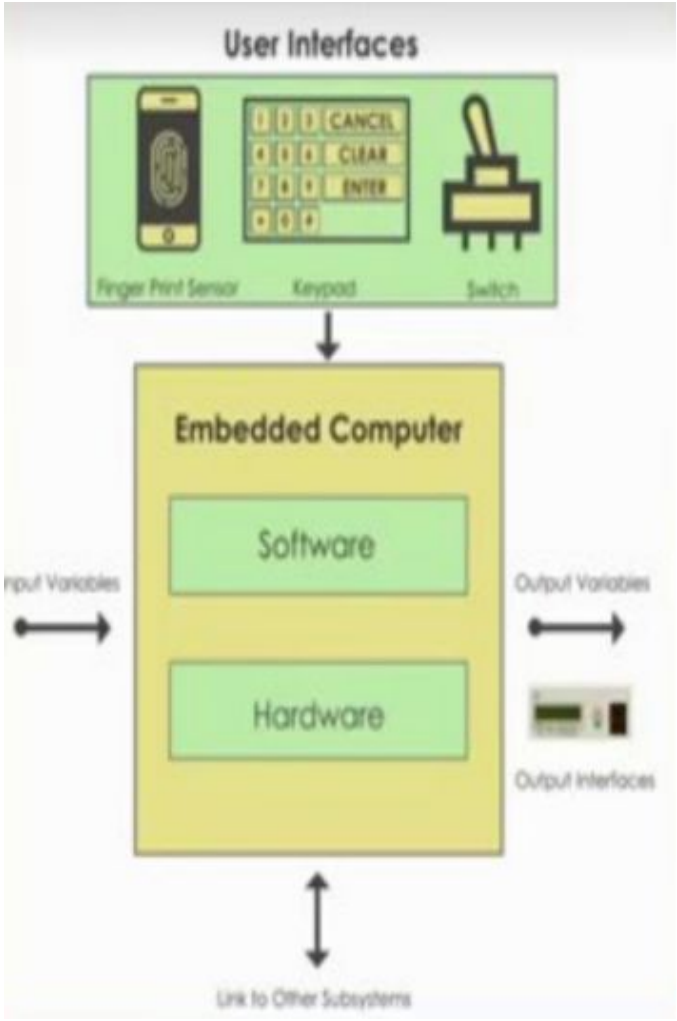


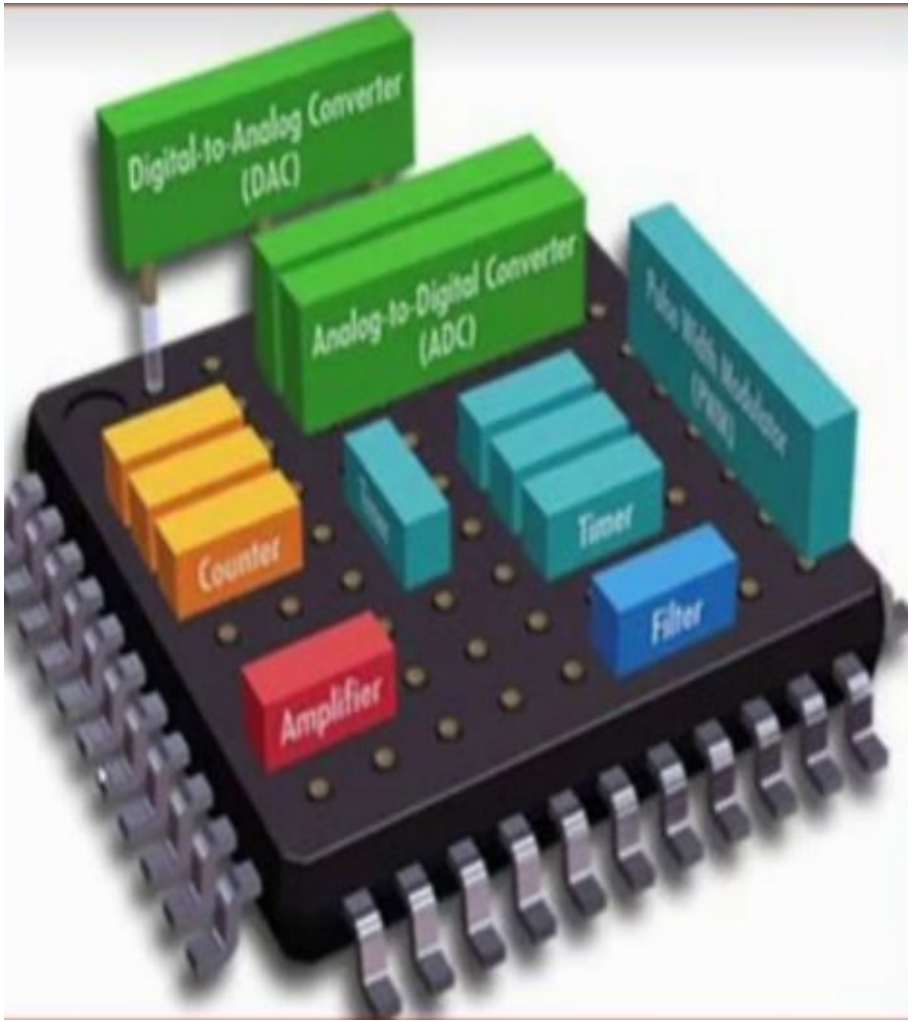
- What embedded system is not…
  - A microprocessor sitting inside a traditional computing system (like desktop, laptop, server, etc)

- It is actually:
  - A microprocessor used to control another piece of technology(dedicated, not general-purpose)
  - For low cost, microcontrollers that are typically user are single-chip devices containing processor, memory and I/O interfaces

Application of Embedded systems

- Limited by Imagination.
  - Consumer Segment : Refrigerator, washing machine, camera, etc…
  - Office Automation : Printers, fax machines, Photocopying machines, scanners, biometric, etc….
  - Automobiles : Air bags, ABS, Engine Control, door lock, GPS, etc…
  - Communication : Mobile Phones, network switches, WIFI hotspots, etc…
  - Miscellaneous : Automatic door systems, automatic baggage screening, surveillance systems, intelligent toilet, etc….


User Interfaces
CANCEL
CLEAR
ENTER
Finger Print Sensor
Keypad
Switch
Embedded Computer
Software
Hardware
Output Variables
Output Interfaces
Link to Other Subsystems



Notable subsystems:

a) Analog-to-digital (ADC) interfaces
b) Digital-to-analog (DAC) interfaces
c) Pulse-width-modulation (PWM) interfaces
d) Timers and counters
e) In addition to … processor, memory, digital I/O ports, etc.

Thank You