Embedded Operating Systems

Outline

- Define Embedded system
- Components of an embedded system:
  - hardware
  - application software
  - RTOS (real time operating system)
- Any background terminology should be defined around here.
- Characteristics of an Embedded system (e.g. https://www.tutorialspoint.com/embedded_systems/es_overview.htm)
- Where are **embedded systems** used? Give the most popular examples.
- What are the characteristics of an embedded system **Operating System**
- Compare Embedded OS to a Network OS (e.g. http://smallbusiness.chron.com/network-operating-systems-vs-embedded-operating-systems-46508.html)
- Give some examples of existing platforms (e.g. https://en.wikipedia.org/wiki/List_of_operating_systems#Embedded)
- You should discuss some typical OS topics as applied to Embedded OS. You do not have to cover all of them, but any sub-topic that is relevant should be covered.
  - Virtual Memory
  - Caching
  - File System
  - Command Line Interface
  - Threading
  - Interrupts
- What are Embedded OS's be used as a solution for?
- What should Embedded OS's NOT be used for?

Define Embedded system

An embedded system is a computer system with a dedicated function within a larger mechanical or electrical system, often with real-time computing constraints. It is embedded as part of a complete device often including hardware and mechanical parts. Embedded systems control many devices in common use today.

- Embedded systems are computing systems with tightly coupled hardware and software integration.
- Designed to perform dedicated function

Define Embedded system(cont..)

- Embedded means that the system is a integral part of a larger system
- Multiple embedded systems can co-exist in a single system.
- General purpose processor are typically not aware of the applications.
- An embedded processor is application-aware

- Consists of ：

  Types of Chips

  Grades of Microcontrollers

  Downloading

  Programming

Examples of existing platforms

- Personal Digital Assistants
- Digital Media Players
- Mobile phones & Smart Phones
- Routers

Categories and types

Embedded systems are classified into four categories based on their performance and functional requirements:

- Stand alone embedded systems
- Real time embedded systems
- Networked embedded systems
- Mobile embedded systems

Embedded Systems are classified into three types based on the performance of the microcontroller such as

- Small scale embedded systems
- Medium scale embedded systems
- Sophisticated embedded systems

Components of an embedded system:

- Hardware
- Application software
- RTOS (real time operating system)

Hardware:

The following parts come under hardware

- Power Supply
- Processor
- Memory
- Timers
- Serial communication ports
- Output/Output circuits
- System application specific circuits

Application software

- The application software is required to perform the series of tasks.
  An embedded system has software designed to keep in view of three constraints:
  •Availability of System Memory
  •Availability of processor speed
  •The need to limit power dissipation when running the system continuously in cycles of wait for events, run , stop and wake up.

RTOS (real time operating system)

- It supervises the application software
  and provides a mechanism to let the processor run a process as per scheduling and do the switching from one process (task) to another process.
- Mainly used in automobile industry
- Almost every car that rolls off the production line these days makes use of embedded technology in one form or the other; most of the embedded systems in automobiles are rugged in nature, as most of these systems are made up of a single chip

Terminology

- Virtual Memory
- Cache
- File System
- Threading
- Interrupts
- Jitter
- Throughput

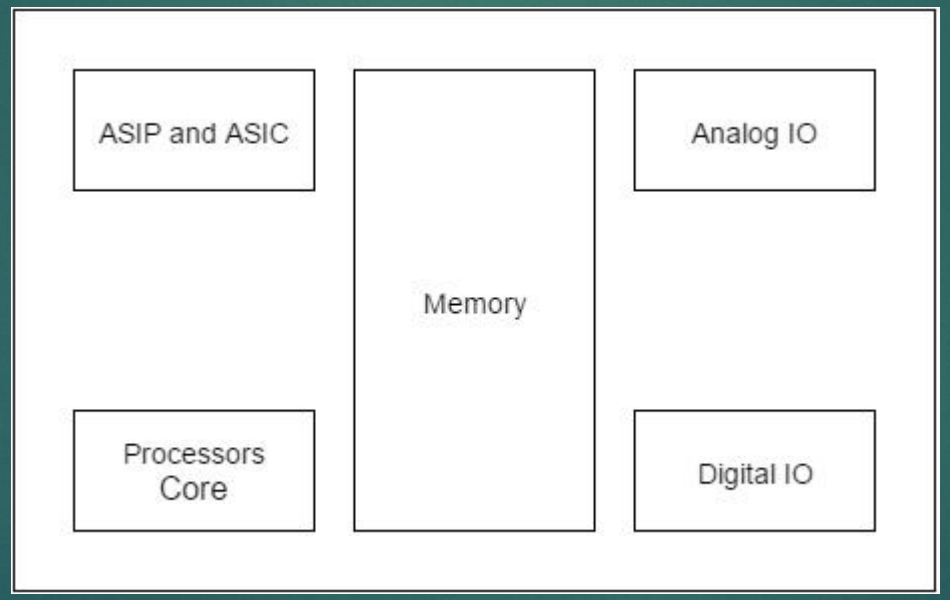
Characteristics of an Embedded System

- Single-functioned − An embedded system usually performs a specialized operation and does the same repeatedly. For example: A pager always functions as a pager.
- Tightly constrained − All computing systems have constraints on design metrics, but those on an embedded system can be especially tight. Design metrics is a measure of an implementation's features such as its cost, size, power, and performance. It must be of a size to fit on a single chip, must perform fast enough to process data in real time and consume minimum power to extend battery life.
- Reactive and Real time − Many embedded systems must continually react to changes in the system's environment and must compute certain results in real time without any delay. Consider an example of a car cruise controller; it continually monitors and reacts to speed and brake sensors. It must compute acceleration or de-accelerations repeatedly within a limited time; a delayed computation can result in failure to control of the car.

Characteristics of an Embedded System

- Microprocessors based − It must be microprocessor or microcontroller based.
- Memory − It must have a memory, as its software usually embeds in ROM. It does not need any secondary memories in the computer.
- Connected − It must have connected peripherals to connect input and output devices.
- HW-SW systems − Software is used for more features and flexibility. Hardware is used for performance and security.

Characteristics of an Embedded System



Where are embedded systems used? Give the most popular examples.

Automobile Sector
- Anti-lock braking system (ABS)
- Electronic Stability Control (ESC/ESP)
- Traction control (TCS)
- Automatic four-wheel drive

Aerospace and Avionics
- Creating Embedded systems on time.
- Taking the budgetary constraints into consideration.
- Ensuring that the complex software and hardware interactions are right.
- Assembling components that meet specifications and perform effectively together.
- Understanding the larger context of the embedded software.
- Adopting the latest in Embedded technology like the fly-by-wire

Where are embedded systems used? Give the most popular examples.

Electronic stuffs and gadgets
Consumer electronics experienced a lot of benefits. DVD players, cameras, MP3 players, GPS receivers and what not.

Telecommunication
The Telecom industry utilizes numerous embedded systems from telephone switches for the network to mobile phones at the end-user. The Telecom computer network also uses dedicated routers and network bridges to route data.

e-Payment solutions
Embedded engineers knowledgeable in trusted proprietary technology develop the secure, encrypted transactions between payment systems and major financial institutions.

What are the characteristics of an embedded system Operating System

- Embedded systems come in a variety of shapes and sizes, from the largest multiple-rack data storage or networking powerhouses to tiny modules such as your personal MP3 player or cellular handset. Following are some of the usual characteristics of an embedded system:
- Contains a processing engine, such as a general-purpose microprocessor
- Typically designed for a specific application or purpose
- Includes a simple (or no) user interface, such as an automotive engine ignition controller
- Often is resource-limited. For example, it might have a small memory foot-print and no hard drive
- Might have power limitations, such as a requirement to operate from batteries
- Not typically used as a general-purpose computing platform
- Generally has application software built in, not user-selected
- Ships with all intended application hardware and software pre-integrated
- Often is intended for applications without human intervention

What are Embedded OS's be used as a solution for?

An embedded operating system is a type of operating system that is embedded and specifically configured for a certain hardware configuration. Hardware that uses embedded operating systems is designed to be lightweight and compact, forsaking many other functions found in non-embedded computer systems in exchange for efficiency at resource usage. This means that they are made to do specific tasks and do them efficiently.