



S J P N Trust's

**Hirasugar Institute of Technology, Nidasoshi.**

*Inculcating Values, Promoting Prosperity*

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**ECE Dept.**

**ARM**

**VI Sem**

**2017-18**

## Department of Electronics & Communication Engg.

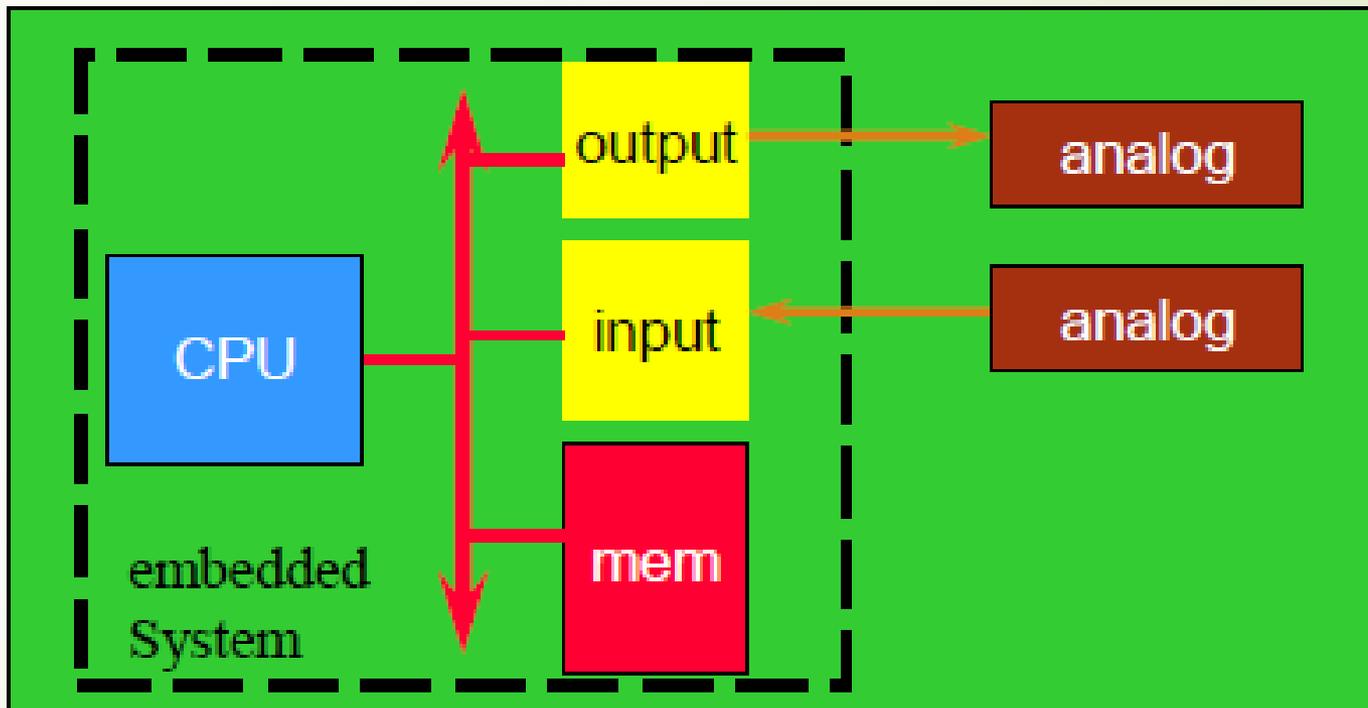
**Course : ARM Microcontroller & ES-15EC62. .      Sem.: 6<sup>th</sup> (2017-18)**

**Course Coordinator:**

**Prof. Sachin S Patil**

## What is an Embedded System?

- An ES is an electronic/electro-mechanical system designed to perform a specific Function And a combination of both hardware and firmware (software)
- Every ES is Unique and hardware as well as the firmware is highly specialized to the application domain
- ES are becoming an inevitable part of any product or equipment in all fields including household appliances, telecommunications, medical equipment, industrial control, consumer products, etc.



## Comparison of ES & General Purpose Computing System

Criteria	General Purpose Computer	Embedded System
Contents	A system which is a combination of a generic hardware and a General Purpose Operating System for executing <u>a variety of applications</u> .	A system which is a combination of special purpose hardware and embedded OS/firmware for executing a <u>specific set of applications</u>
OS	It contains a general purpose operating system (GPOS).	It may or not contain an operating system for functioning.
Alterations	<u>Applications</u> are alterable by the user.	<u>Applications</u> are not-alterable by the user.
Key factor	Performance is key factor.	Application specific requirements are key factors.
Power Consumption	More	Less
Response Time	Not critical	Critical for some applications
Execution	Need not be deterministic	Deterministic for certain types of ES like 'Hard Real Time' systems.

## Major Application Areas of ES

The application areas and the products in the embedded domain are countless.

1. Consumer electronics: Camcorders, cameras, etc.
2. Household appliances: Television, DVD players, washing machine, fridge, microwave oven, etc.
3. Home automation and security systems: Air conditioners, sprinklers, intruder detection alarms, closed circuit television cameras, fire alarms, etc.
4. Automotive industry: Anti-lock breaking systems (ABS), engine control, ignition systems, automatic navigation systems, etc.
5. Telecom: Cellular telephones, telephone switches, handset multimedia applications, etc.



- 6. Computer peripherals : Printers, scanners, fax machines, etc.
- 7. Computer Networking systems: Network routers, switches, hubs, firewalls, etc.
- 8. Healthcare: Different kinds of scanners, EEG, ECG machines etc.
- 9. Measurement & Instrumentation: Digital multi meters, digital CROs, logic analyzers PLC systems, etc.
- 10. Banking & Retail: Automatic teller machines (ATM) and currency counters, point of sales (POS).
- 11. Card Readers: Barcode, smart card readers, hand held devices, etc.



Hand Held Devices



Logic analyzers PLC systems



Point of Sales (POS)

## Purpose of ES

- Each embedded system is designed to serve the purpose of any one or a combination of the following tasks:
  1. Data collection/Storage/Representation
  2. Data Communication
  3. Data (signal) processing
  4. Monitoring
  5. Control
  6. Application specific user interface

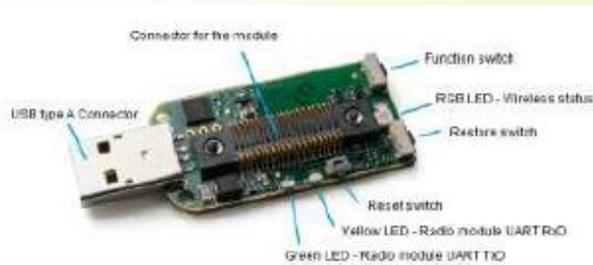


## 1. Data Collection/Storage/Representation

- ❑ Embedded systems designed for the purpose of data collection performs acquisition of data from the external world.
- ❑ Data collection is usually done for storage, analysis, manipulation & transmission.
- ❑ Data can be either analog (continuous) or digital (discrete).
- ❑ Embedded systems with analog data capturing techniques **collect data directly in the form of analog signal whereas embedded systems with digital data collection mechanism converts the analog signal to the digital signal using analog to digital (A/D) converters and then collects the binary equivalent of the analog data.**
- ❑ If the data is digital, it can be directly captured without any additional interface by digital embedded systems.
- ❑ A digital camera is a typical example of an embedded system with data Collection / storage / representation of data.
- ❑ Images are **captured and the captured image may be stored within the** memory of the camera. The captured image can also be **presented to the** user through a graphic LCD unit.

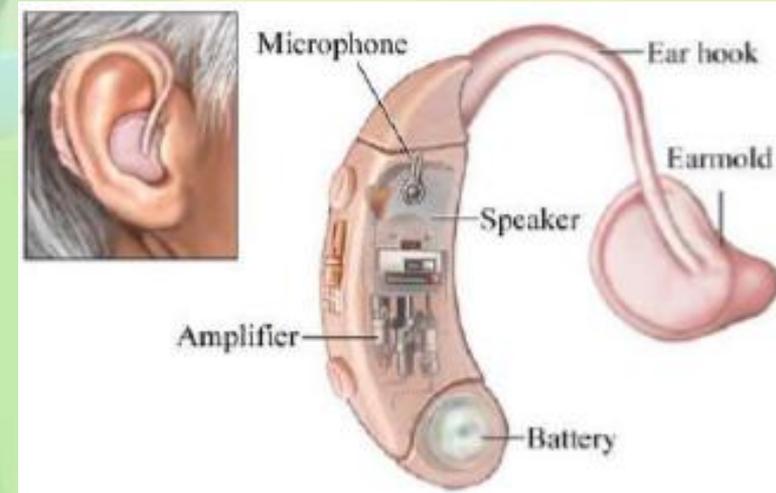
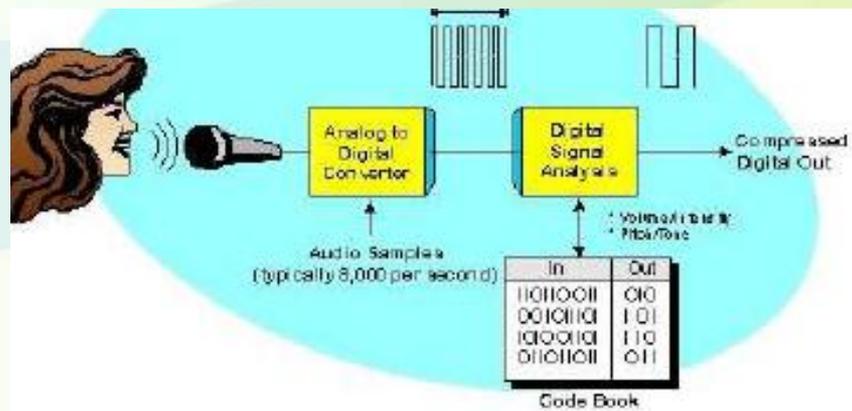
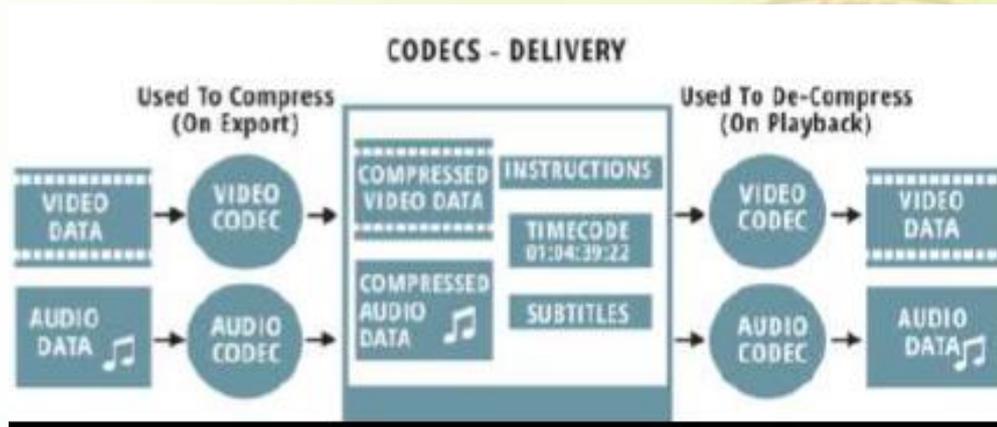
## 2. Data Communication

- Embedded data communication systems are deployed in applications from complex satellite communication systems to simple home networking systems.
- The transmission is achieved either by a wire-line medium or by a wire-less medium.
- Data can either be transmitted by analog means or by digital means.
- The data collecting embedded terminal itself can incorporate data communication units like Wireless modules (Bluetooth, ZigBee, Wi-Fi, EDGE, GPRS, etc.) or wire-line modules (RS-232C, USB, TCP/IP, PS2, etc).
- Network hubs, routers, switches, etc. are typical examples of dedicated data transmission embedded systems.



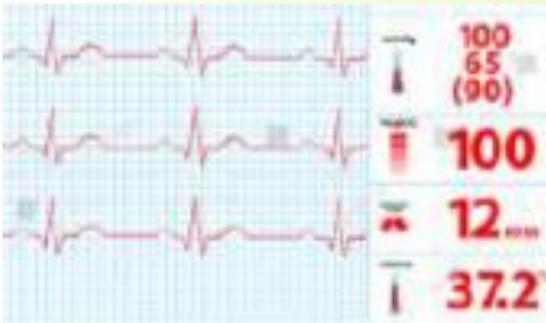
### 3. Data (Signal) Processing

- ❑ Embedded systems with signal processing functionalities are employed in applications demanding signal processing like speech coding, synthesis, audio video codec, transmission applications, etc.
- ❑ A digital hearing aid is a typical example of an embedded system employing data processing.
- ❑ Digital hearing aid **improves the hearing capacity of hearing impaired persons.**



## 4. Monitoring

- Almost all embedded products coming under the medical domain are with monitoring functions only.
- Electro cardiogram machine (ECG) is intended to do the monitoring of the heartbeat of a patient but it cannot impose control over the heartbeat.
- Other examples with monitoring function are digital CRO, digital multimeters, and logic analyzers.



## 5. Control

- A system with control functionality contains both sensors and actuators.
- Sensors are connected to the input port for capturing the changes in environmental variable or measuring variable.
- The actuators connected to the output port are controlled according to the changes in the input variable.
- Air conditioner system used in our home to control the room temperature to a specified limit is a typical example for ES for CONTROL purpose.



## 6. Applications specific user interface

- Buttons, switches, keypad, lights, speakers, display units, etc. Are application-specific user interfaces.
- Mobile phone is an example of application specific user interface.
- In mobile phone the user interface is provided through the keypad, graphic LCD module, system speaker, vibration alert, etc.



# Queries ....?

