Al-Mustaqbal University
College of Sciences
Intelligent Medical System Department

Embedded systems

Lecture 7 :

Introduction to Components of Embedded System

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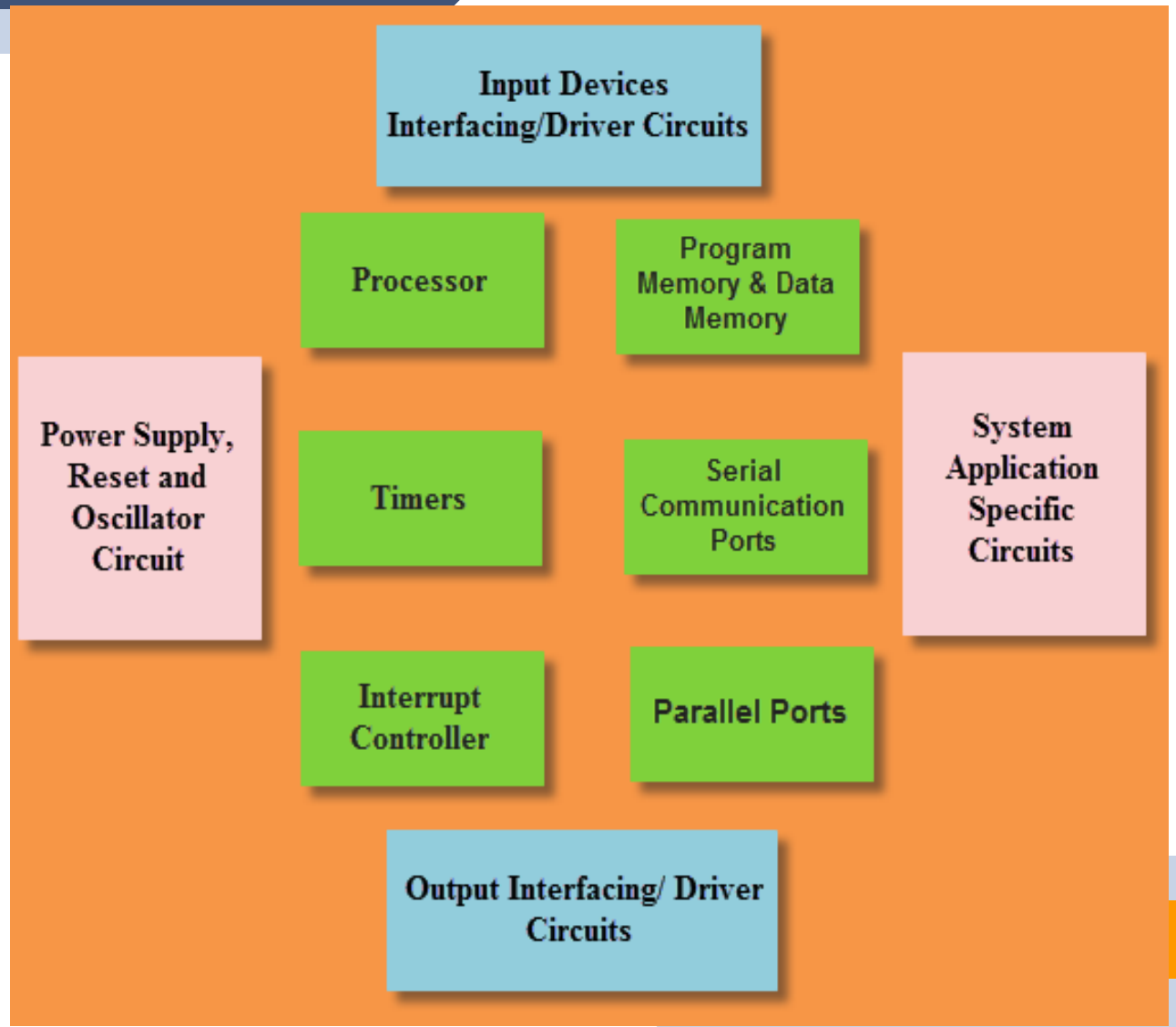
Introduction to Components of Embedded System

- The embedded system is classified as a type of system that is made up of software and hardware components that is used for performing specific functions.
- **Components of the Embedded System**

As the embedded system is made up of hardware and software components. In below section hardware components are described



Hardware Components of the Embedded System

- So hardware means you should be required amount of hardware it is not a general purpose system so you don’t need to put every hardware to the system.
- **1. Power Supply**
- For the embedded system the power supply is the key component to provide the power to the embedded system circuit. Usually, The power supply source can be battery or can be provided by a wall adaptor. The power supply is selected as per user requirements and application requirements. The power supply should also allow dissipation and should be as efficient as possible.

Hardware Components of the Embedded System

- **1. Power Supply**
- We know that to operate any system we require power to operate the system this power can be provided using three possible methods:
- The system will have its own power supply or if it is part of another larger system then it will be using power from the larger system.
- Supply from a system to which the **embedded system** interfaces for example in a network card
- Charge pump concept used in a system of little power in some cases if take ATM cards which is type of **embedded system**. So in the ATM card at the moment we insert the card in ATM machine at will get power so we called at charge pump. So this charge pump will provide the necessary power.

Hardware Components of the Embedded System

- **2. Processor**
- For any embedded system the processor acts as the brain of the system. The processor is responsible for deciding the performance of the embedded system. In the market there are multiple types of processors available and can be selected as per user requirement. The embedded system can act as a microcontroller and microprocessor. The processor can be an 8-bit processor, a 16-bit processor, and a 32-bit processor. The lesser the bit the smaller the application is for embedded systems. When large applications are used the higher bit processor is needed in the embedded system. The processor needs to be very fast, the price should be minimum, performance should be good so that functions can be performed very fast in an embedded system.

Hardware Components of the Embedded System

- **2. Processor**
- A processor is the heart of the embedded system. Processor can be of the following categories:
  - General purpose processor
  - Microprocessor
  - Microcontroller
  - Embedded processor
  - Digital signal processor
  - Media processor
  - Application specific processor
  - Application specific instruction processor
- Mostly we use microprocessor or microcontroller

Hardware Components of the Embedded System

- **3. Memory**
- As there are different microcontrollers is used in the embedded system the memory is present in the microcontroller itself. There are basically two types of memory RAM(Random access memory) and ROM (Read-only memory). As the RAM is volatile type memory the data can be stored temporarily in the memory and when system is switch off the data is lost from the memory. Read-only memory is classified as code memory. The ROM is used for storing the program and when the system is switch on the embedded system fetch code from ROM memory.
- Various forms of system memory are present in embedded system which are:

Hardware Components of the Embedded System

- **3. Memory**
- Various forms of system memory are present in embedded system which are:
- Internal memory at microcontroller
- RAM at system on chip or external RAM
- Flash / EEPROM
- Internal caches at microprocessor
- External RAM chips
- ROM / PROM

Hardware Components of the Embedded System

- **4. Timers counters**
- In some of the applications there is always a requirement of delay that needed to provide in the application. For example, in LED display applications there is a requirement of some delay so that LED can be continuing blink. And for that timer and counter can be used in the embedded system. The programming can be done in such a way so that delay can be generating the embedded system. The delay time span can be decided by using the crystal oscillator and system frequency so that delay can be generated as per user requirement.
- **Timer:** The **embedded system** requires the mechanism for performing the tasks at **regular intervals**. Tasks should be completed at specific time period. Timer is used for generating **delay** and for generating waveforms with specific delays. So these are the main functions or operation performed by the timers.
- **Clock:** The clock is used to provide the synchronization or timely execution of the instructions. The oscillating circuit will be used to generate the main clock

Hardware Components of the Embedded System

- **5. Communication ports**
- The communication port is the type of interface that is used to communicate with other types of embedded systems. In the embedded system there is multiple types of communication ports like UART, USB, Ethernet, RS-485, and many more. When an embedded system is used in small scale application then the communication ports can be used from the microcontroller. There are also serial protocols that can be used for sending data from one system board to another board.
- **Serial Port:** A serial port is a **serial communication interface** which information **transfer in or out one bit at a time**. Common serial protocols include **UART, SPI, SCI and I2C**.
- **Parallel Port: A parallel port is used for connecting peripherals**. The name refers to the way the data is **sent parallel ports send multiple bits of data at once**. Parallel port requires multiple data lines in their cables and port connectors and tend to be larger than contemporary serial ports

Hardware Components of the Embedded System

- **6. Output and Input**
- When the embedded system is used the input is needed to interact with the system. The input to the embedded system can be provided by the sensor or by the user itself. The processor used in the embedded system can be based on input and output. The proper configuration needs to be done for using the input and output port. In the embedded system there are fixed input and output ports so that devices can be connected to that specified ports only. For example, P0, P1, P2, and many more.
- **7. Circuits used in application**
- When the embedded system is design there are several hardware components that can be used for design purposes. The selection of the circuit is completely dependent on the application used for the embedded systems. For example, in temperature sensor applications there is a requirement of temperature sensors for measuring the temperature.

7. Circuits used in application

- software components for designing an embedded system.
- **1. Assembler**
- The assembler is sued when the programming language sued for designing the application is assembly language**. The assembly language program is then converted into the HEX code so that it can be further processed. And after writing the code the programmer is used for writing the program in the chip.**

7. Circuits used in application

2. Emulator

An emulator is a software tool that is used to execute the functions of the host system. All the components can be controlled by the emulator tool. **The emulator is also used for finding the bugs and for debugging code. The emulator also used to transfer the code from the host system to the target system**.

3. Compiler

The compiler is a type of software that is used to convert the programming language into some language that the target machine can understand and execute the functions. The basic use of the compiler is to transfer the high-level code into some low-level language. The low-level languages include machine code, object code, and assembly language.

Software Components of Embedded System

- Hardware and software modules come together to form an embedded system. The hardware-embedded system components have been outlined above. Embedded system software components are the focus of this section. Software for computers and embedded systems serves quite distinct functions. Computer software can be placed on various devices to accomplish the desired goals. However, embedded system software is created for a given device to accomplish a given goal.
- **1. Editor**
- The first tool you need for embedded system software is an editor. The text file you create in the editor will contain the code you write in the C and C++ programming languages. Geany is a nice illustration of a text editor. Many languages, including Java, C, HTML, Python, PHP, Pascal, and Pearl, are supported by this editor.

Software Components of Embedded System

- **2. Emulator**
- An emulator is a piece of software that enables you to use the features of the host system. All the parts are controllable through the emulator tool. The emulator is also used to debug applications and find bugs. The emulator was also used to transmit code from the host system to the target machine.
- The primary function of the emulator is to simulate a genuine system's behavior in the embedded system. You may simulate how the code will operate in real time by using an emulator. It is employed to simulate software performance and aids in obtaining the written code's optimal performance.
- One operating system can be run on another device using an emulator. For instance, you might run the Mac operating system on your Windows operating system using an emulator.

Software Components of Embedded System

- **3. Assembler**
- A machine language is created from written code by the assembler tool. It is briefly distinct from a compiler. The assembler transforms source code first into object code and then into the language that the machine can understand, whereas the compiler transforms written code into machine language.
- The assembler works when the programming language used to create the application is assembly language. After that, the assembly language program is converted to HEX code so it may be processed further. After the code is written, the programmer is used to write the program into the chip.

Software Components of Embedded System

- **4. Compiler**
- A text editor writes the code but how does a computer comprehend this code? This written code is converted into machine language by a compiler so that the machine can understand it. The creation of an executable application is the major goal of this tool.
- The written programs that translate source code from a high-level programming language into a low-level programming language are referred to as “compilers.”
- A compiler is a piece of software that transforms a programming language into a language the target machine can comprehend and use to execute the functions. The main job of the compiler is to convert high-level code to a low-level language. Low-level languages include those used in machine code, object code, and assembly language.
- An embedded system’s cost and intricate design are correlated with the increased number of components in the system.

Software Components of Embedded System

- **5. Linker**
- Software is written in discrete modules and components called “linkers.” A linker, often known as a link editor, is a program that merges one or more object files into a single executable code.
- **6. Debugger**
- A debugger is a tool used for testing and debugging. It examines the code, finds where errors and problems are present, removes them, and notes their locations. Programmers can confront and correct mistakes rapidly

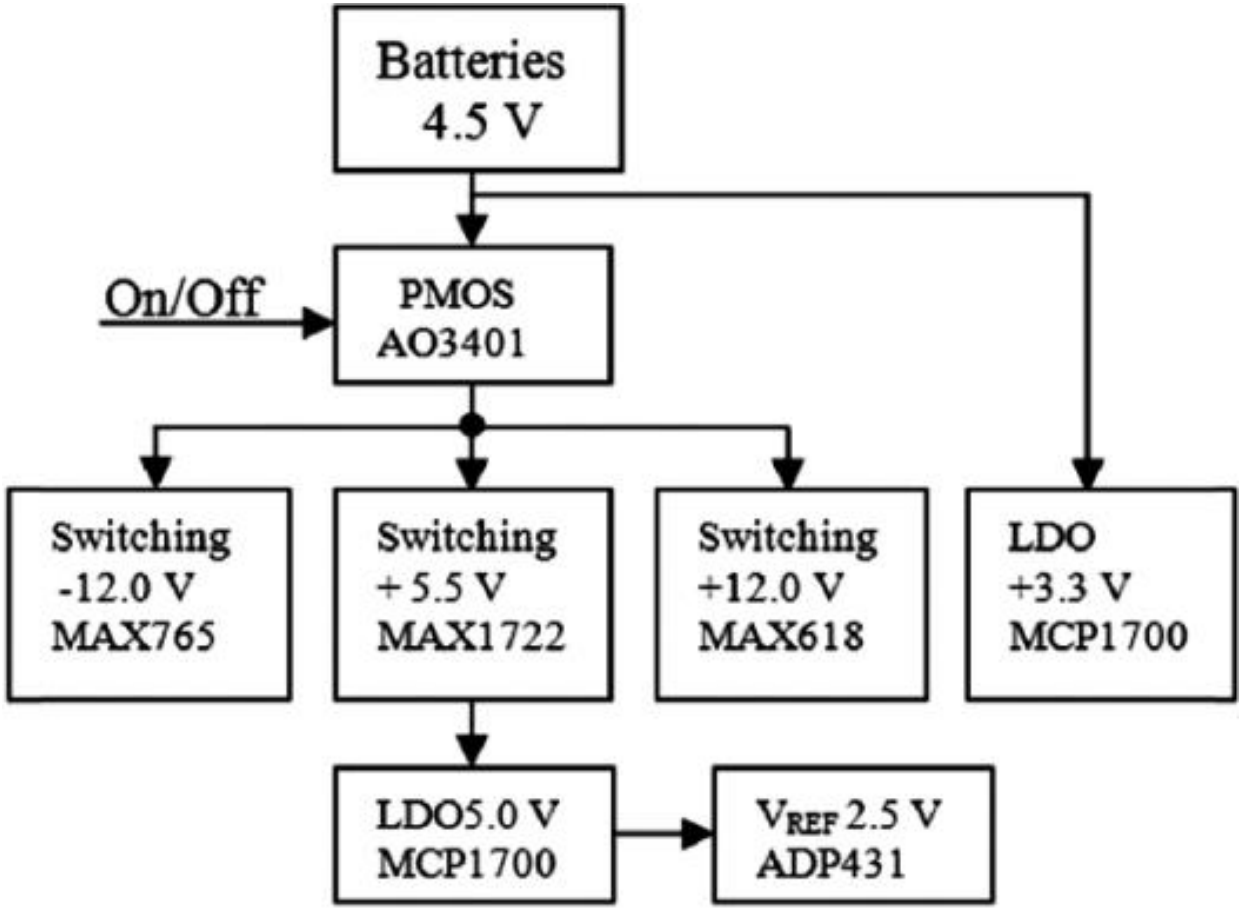
Communication Components of Embedded System

- In embedded system the main function of communication system is to enable a communication between core and input and output devices. To initiate that communication, Ethernet, SPI, I2c RS232, RS485, UART, USB, and so on.
- **RS232:**
- The Serial Communication Standard (RS232) is a widely used method of connecting external equipment to computers. It was developed by the EIA and TIA and defines the signals that are exchanged between DTEs and DCEs. Examples of DTEs include computers, data communication equipment (DCE), and data circuit terminators (DCEs).
- **Uart:**
- Universal asynchronous receiver transmission. It is half-duplex and is used for serial communication with short distances. Uart operates based on the baud rate.

Sensor Components of Embedded System

- Sensors are widely used in embedded systems to develop real-time applications. The sensors involve temperature proximity humidity and IR sensors. Using these sensors embedded system design develops crucial applications in an easier way. Sensors apply in all fields, including PLC cloud monitoring ABS in cars and automation. The sensors used in embedded systems are object detection (proximity sensor) and temperature detection, light sensors, and alcoholic sensors all embedded in the processor for real-time applications.

Power Management Components of Embedded System



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