

# \*\*\*\* Microcontroller Unit (MCU)

## ○ Microcontroller

A smaller computer on a CHIP, on-chip RAM, ROM, I/O Ports, Timer, Serial Controller...Example: Motorola's 6811, Intel's 8051, Atmel 32. It is a programmable integrated circuit (IC) that consists of a small CPU, RAM, and I/O pins. Microcontroller units (MCUs) are widely used in many devices.

### ➤ Pin Description of the 8051

- Have 40 pins dedicated for various functions such as I/O, RD, WR,
- address, data, and interrupts.
- RESET pin is an input and is active high (normally low)
- EA', "external access", is an input pin and must be connected to Vcc or GND. EA pin must be connected to GND to indicate that the code or data is stored externally.
- PSEN' and ALE
- The four 8-bit I/O ports P0, P1, P2 and P3 each uses 8 pins.

### ➤ 8051 Stack

The stack is a section of RAM used by the CPU to store information temporarily. This information could be data or an address.

### ➤ 8051 TIMERS

Find the timer's clock frequency and its period for various 8051-based system, with the crystal frequency 11.0592 MHz when C/T bit of TMOD is 0.

### ➤ 8051 Serial Port

Computers transfer data in two ways:

Parallel: Often 8 or more lines (wire conductors) are used to transfer data to a device that is only a few feet away.

Serial: To transfer to a device located many meters away, the serial method is used. The data is sent one bit at a time.

### ➤ 8051 Interrupts

An interrupt is an external or internal event that interrupts the microcontroller to inform it that a device needs its service.

### ➤ Interrupt Priority

the priority scheme is nothing but an internal polling sequence which the 8051 polls the interrupts in the sequence listed and responds accordingly.

## ○ Microprocessor

The microprocessor is the central unit of a computer system that performs arithmetic and logic operations, which generally include addition, subtracting, transferring numbers from one area to another, and comparing two numbers.

## ○ Embedded System

Embedded System is a system composed of hardware, application software and real time operating system. It can be small independent system or large combinational system.

EXAMPLES: RFID based access control system 8051, solar panel, water level, ultrasonic range.

## ○ Harvard Architecture

In Harvard Architecture the data and instructions are, stored in separate memory units each with their own bus.

Advantages:

Speeding up the data transfer rate,

Permits the designer to implement different bus widths and word sizes for program and data memory space.

## ○ Von Neumann Architecture

In Von-Neumann architecture, there is no separate, data and program memory. Instead, a single memory connection is given to the CPU. Speed of execution is slower since it cannot fetch the data and instructions at the same time.

## ○ Arm Cortex M4 Processor

The Cortex-M4 processor is a low-power processor that features low gate count, low interrupt latency, and low-cost debug. The Cortex-M4 includes optional floating point arithmetic functionality. The processor is intended for deeply embedded applications that require fast interrupt response features.

## ○ STM32L4

The STM32L4 Discovery kit for the IoT node (B-L475E-IOT01A) allows users to develop applications with direct connection to cloud servers. The STM32L4 Discovery kit includes an ST-LINK debugger/programmer and comes with the comprehensive STM32Cube software libraries together with packaged software examples to seamlessly connect to cloud servers.

**STM32** is a family of 32 bit microcontroller integrated circuits STMMicroelectronics Features

- 64-Mbit Quad-SPI Flash memory
- Wi-Fi module InvenSense system ISM43362-M3G-L44 (802.11 b/g/n compliant)
- On-board ST-LINK/V2-1 debugger/programmer with USB
- re-enumeration capability: mass storage, Virtual COM port and debug port

## ○ RTOS

An RTOS makes development easier for many projects, and it makes them more expandable, maintainable, portable, and secure. Time and cost savings result. The scheduler in a Real Time Operating System (RTOS) is designed to provide a predictable (normally described as *deterministic*) execution pattern. This is particularly of interest to embedded systems as embedded systems often have real time requirements.

## ○ General-purpose timer cookbook for STM32 microcontrollers

The timer peripheral is part of the essential set of peripherals embedded in all the STM32 microcontrollers. The number of timer peripherals and their respective features differ from one STM32 microcontroller family to another, but they all share some common features and operating modes.