Embedded Systems' Programming

Introduction

IoT Course Timeline

Rust Language

Embedded Systems Programming

Web Applications

Voice Applications

Cloud Computing

Introduction to Embedded Systems

Embedded (definition):

An object fixed firmly and deeply in a surrounding mass; implanted.[1]

Example : “a gold ring with nine embedded stones”

Introduction to Embedded Systems (cont.)

Embedded Systems:

1. "An embedded system is a combination of computer hardware and software, either fixed in capability or programmable, designed for a specific function or functions within a larger system."

2. "An embedded system is a controller with a dedicated function within a larger mechanical or electrical system, often with real-time computing constraints."

Examples of Embedded Systems

Examples:

1. HVAC(Heating, ventilation, and air conditioning) Systems
2. ABS(Anti-lock braking) System

Components of Embedded Systems' Programming

- Microprocessors/ Microcontrollers
- Peripherals
- Sensors & Input devices
- Actuators & output devices
- Registers
- Protocols

Microprocessors/ Microcontrollers

Microprocessor:

It is a computer processor that incorporates the functions of a central processing unit on a single IC. The microprocessor is a multipurpose, clock driven, register based, digital integrated circuit that accepts binary data as input, processes it according to instructions stored in its memory and provides results as output.

Microcontroller:

A microcontroller is a **system on a chip**. Unlike computers those have many discrete parts it has all CPUs(Processors cores), memory and input/output **peripherals**. This makes it possible to build systems with minimal part count.

Difference between Microcontroller & Microprocessor[1]

Microprocessor

- Its an IC which only has CPU (Processing power).
- They find application where task are unspecified like developing games, websites, photo editing etc.
- They runs operating systems.

Microcontroller

- It has a CPU along with RAM, ROM and other peripherals all on a single chip.
- They are designed to perform specific tasks. (i.e. cars, bikes, microwave)
- They run bare-metal

Microcontrollers

Peripherals

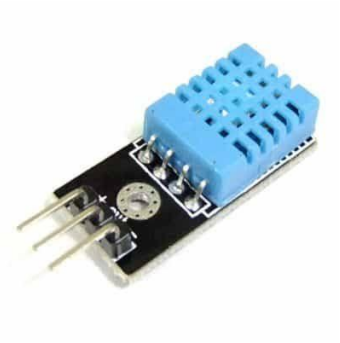
A peripheral or peripheral device is "an ancillary device used to put information into and get information out of the computer".[1]

Sensors & Input devices

Sensors are sophisticated devices that are frequently used to detect and respond to electrical or optical signals.

Examples:

- Temperature sensor
- IR(PIR) sensor
- Touch sensor
- Pressure sensor



Actuators & output devices

An actuator is a component of a machine that is responsible for moving and controlling a mechanism or system, for example by opening a valve.

Example:

- Electric motor
- Screw jack
- Hydraulic Cylinder

Registers

A processor register (CPU register) is one of a small set of data holding places that are part of the computer processor.[1]

A register may hold an instruction, a storage address, or any kind of data (such as a bit sequence or individual characters). Some instructions specify registers as part of the instruction. For example, an instruction may specify that the contents of two defined registers be added together and then placed in a specified register.

Protocols

A protocol is a standard set of rules that allow electronic devices to communicate with each other. These rules include what type of data may be transmitted, what commands are used to send and receive data, and how data transfers are confirmed.

Examples:

I2C : Inter-Integrated Circuit

SPI : Serial Peripheral Interface

USART/UART : Universal Synchronous/Asynchronous Receiver Transmitter

Books and References

Books and References

Book:

- Discovery[1]

References:

The Embedded Rust Book[2]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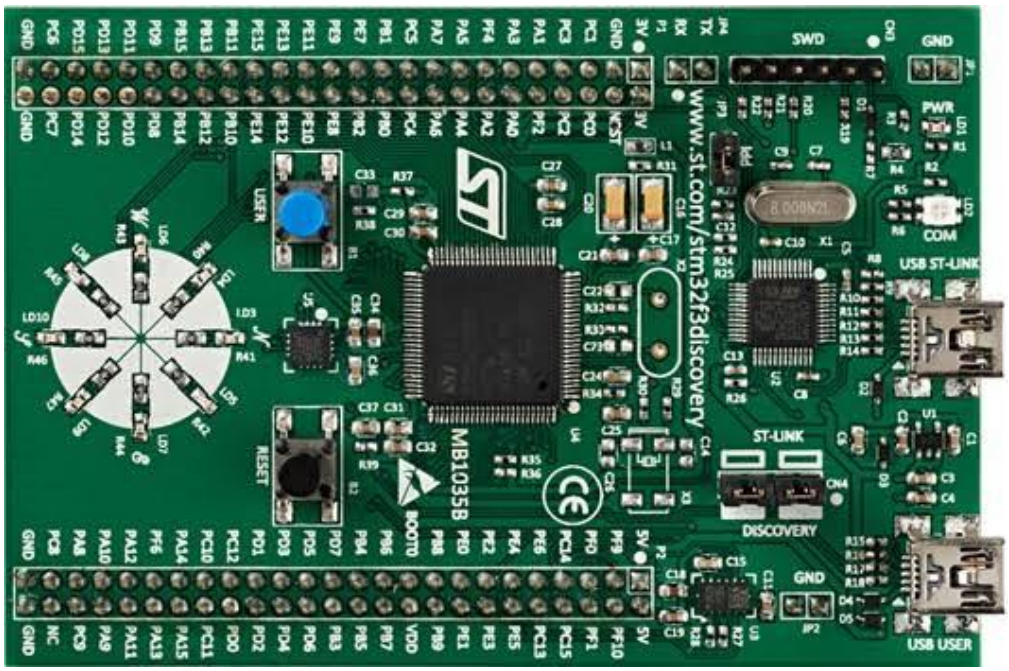
Hardware

Hardware Required

Primarily we'll be required the following hardware:

- STM32F303 Board
- 3.3V USB <-> Serial Module
- Mini-b USB Cable
- 10 jumper wires each (Female to female, Female to male)

STM32F303 Board



3.3V USB <-> Serial Module

Mini-B USB Cable

That’s all