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Smart Home

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Abstract

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Acknowledgements

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2.1.1 Theory

Microcontroller Unit (MCU) is a small size, special purpose computer. It is small enough in order to be integrated on a small circuit in which will do specified tasks or applications. MCU itself comes with memory, input, output peripherals and processor. Program to run the MCU is stored in Read-only Memory (ROM) and usually not change in production. A microcontroller is usually designed to run in small size and at low cost, which is compatible to be embedded in other system in order to control actions of the system automatically.

Few advantages of MCU over a microprocessor can be listed as following:

- A MCU is already a standalone microcomputer.
- Because it can be considered as an independent computer, most needed components are integrated on a small size board.
- The above reason leads to the benefit that using MCU can make the system compact, highly mobile and cost efficiency.
- Time reduction because it is programed to run specified set of commands only.
- It is also easy to use and maintain.
- MCU nowadays usually designed to be used with low power in order to last longer under energy-limited condition.

2.1.2 Microcontroller structure

Figure **??** demonstrates the basic structure of a microcontroller. It is easily to see the basic design of a microcontroller and its components.

- CPU: is the central unit which is assembled with Arithmetic Logic Unit (ALU) and a Control Unit (CU). Its functions are connect parts of the MCU into a single system by doing fetch, decode and execution.

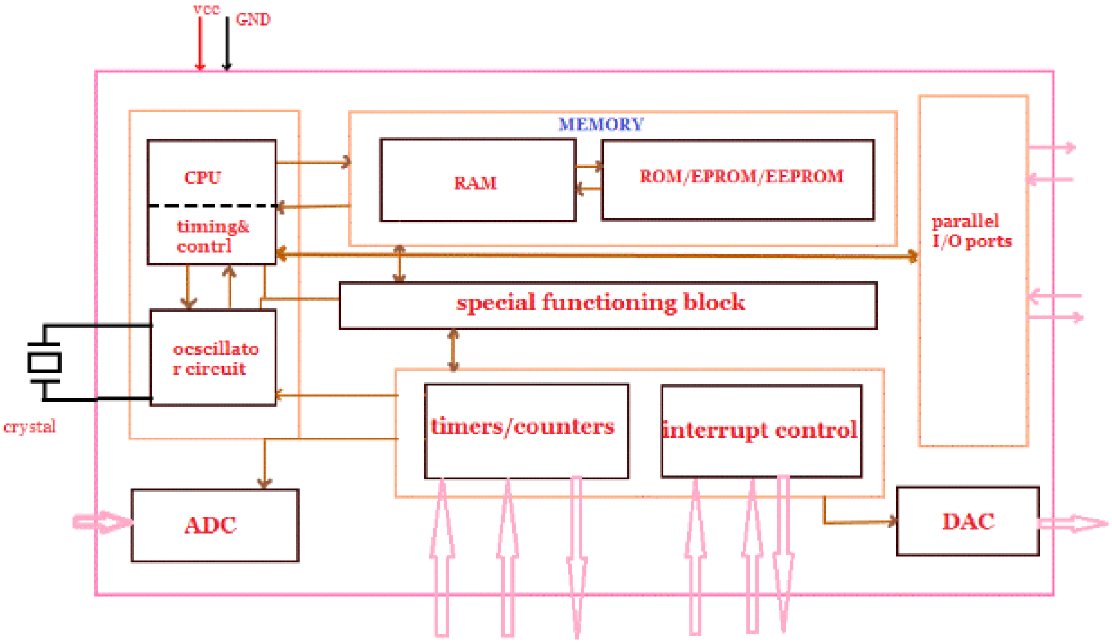

Figure 2.1: Structure of Microcontroller

- Memory: there are two types of Memory that are required, namely ROM and Random Access Memory (RAM). Each type has its own functions, in which ROM will handle the program and the written instructions and RAM can only store temporary data while the program is executing.

- Input/Output: the single board system needs input to execute the program as well as outputs to delivery the information for further handling. The I/O peripherals are the interface of the MCU to communicate with or to control other devices.

- Bus: bus is the system of wires that used to connect the Central Processing Unit (CPU) with other peripherals, which means it plays an important role but rarely discussed.

- Timers/Counters: they are built-in components for microcontroller, which is used to count in order to handle external events.

- Interrupts: is used to interrupt that can be an external or internal one, which helps to execute an instruction(s) while the main program is executing.

- ADC: Analog to Digital Converter (ADC), its name says it all, which is a circuit use to convert analogs signal to digital signals. The reason to use ADC is most sensors available on the market can read only analog signal but CPU of the MCU can read digital signal only, so a ADC is necessary for them to communicate.

- DAC: Digital to Analog Converter (DAC) similar to ADC, DAC is also a circuit which convert digital signals into analog signals for further processing.

2.1.3 Microcontroller market

There exists many microcontrollers on the market which come in various sizes and capacities. The list is only containing very few popular MCU that the author knows of.

- Intel 8051
- STMicroelectronics STM8S (8-bit), ST10 (16-bit) and STM32 (32-bit)
- Atmel AVR (8-bit), AVR32 (32-bit), and AT91SAM (32-bit)
- Freescale ColdFire (32-bit) and S08 (8-bit)
- PIC (8-bit PIC16, PIC18, 16-bit dsPIC33 / PIC24)
- Renesas Electronics: RL78 16-bit MCU; RX 32-bit MCU; SuperH; V850 32-bit MCU; H8; R8C 16-bit MCU
- PSoC (Programmable System-on-Chip)
- Texas Instruments Microcontrollers MSP430 (16-bit), C2000 (32-bit), and Stellaris (32-bit)

2.2 Communication

2.2.1 Introduction

Nowadays, there are various communication protocols can be used for the thesis, namely I2C, ISP, RS232, RS485, Bluetooth or Wi-Fi. Each protocol is designed to be suitable for specified purpose with different advantages or disadvantages, which means a perfect protocol does not exist. When making a decision to choose suitable protocols for the thesis, the trade-off between the stabilization and the speed of the communication protocol has been considered carefully.

In this thesis, RS485 is chosen as the main way for components in the system to communicate with each other. RS485 is defined in 1983 not as a protocol but an electrical interface standard and only specifies the drivers and receivers' characteristics. It is developed in order to make data rate and transmitting distance are inversely proportional. For instance, the data transmitting speed can reach 10 Mbps within distance of 16 meters or if the distance is extended to 1220 meters, the data rate is lower to 100 kbps. The advantage of RS485 over RS232, which is developed in 1960, is multiple nodes can be parallel connected to a bus. Additionally, the network can be extended in length and number of nodes easily by using simple connectors. Besides, Wi-Fi, Bluetooth, GSM and MQTT are also implemented in the thesis in order to take the advantages of different communication protocols in different circumstances.

2.2.2 RS485 specifications

Country List			
Country Name or Area Name	ISO ALPHA 2 Code	ISO ALPHA 3 Code	ISO numeric Code
Afghanistan	AF	AFG	004
Aland Islands	AX	ALA	248
Albania	AL	ALB	008
Algeria	DZ	DZA	012
American Samoa	AS	ASM	016
Andorra	AD	AND	020
Angola	AO	AGO	024
RS485 highlight specifications			

Table shows the highlight specifications of RS485. With these specifications, RS485 was a robust interface standard and was able to meet the requirements in industries, in which implemented applications that need stable, fast and reliable connection. Figure **??** demonstrates two ways to implement the connection with RS485, which are full-duplex and half-duplex. Full-duplex implementations require four-wire (two signal pairs) instead of two-wire in half-duplex implementations; But despite the downside of two-wire implementation is it is limited to half-duplex and needs attention to turn-around delay, in practical applications, half-duplex is most chosen. The reason is full-duplex solution depends on master-slave model, which means the slaves cannot communicate with each other. In modern designs of transceiver, the allowed number of nodes can connect to the bus is up to hundreds.

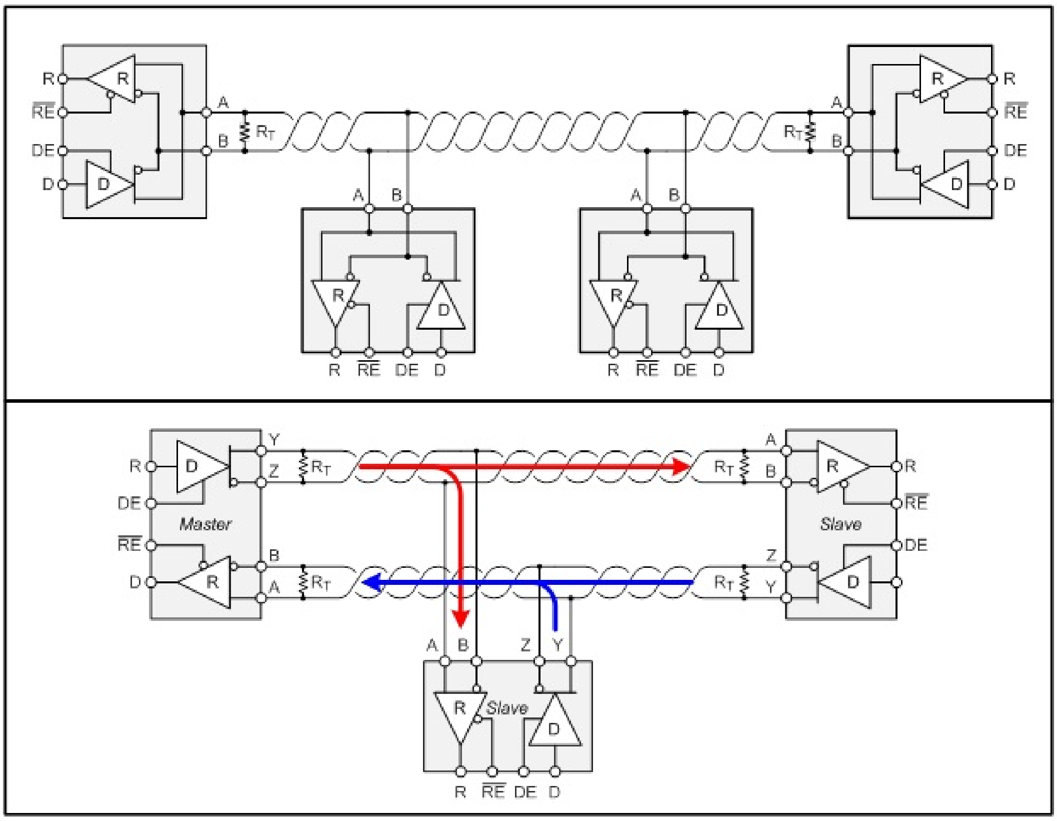

Figure 2.2: Half-duplex(upper) and Full-duplex(below) implementations

Chapter 3

Chapter Three Title

Chapter 4

Chapter Four Title

Chapter 5

Conclusion