Embedded Systems Design (0630414)

Lecture 15

Single-Board Microcontrollers

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Single-Board Microcontrollers:

- There is a wide variety of single-board microcontrollers available from different manufacturers and suppliers of microcontrollers.
- The most common microcontroller boards are:
  - Intel Boards: based on Intel microcontrollers.
  - ARM Boards: based on ARM7 microcontrollers.
  - Cortex Boards: based on Cortex microcontrollers.
  - AVR Boards: based on Atmel AVR microcontrollers.
  - MSP430 Boards: based on Texas Instruments microcontrollers.
  - PIC Boards: based on the Microchip PIC microcontrollers.
  - Motorola Boards: based on Motorola microcontrollers.
  - ARDUNIO Boards: based on Atmel AVR microcontrollers.

| Specifications	PIC Development Board ICSP	Olimex PIC-IO	Open 1343-P-A	EK-EVALBOT	Arduino UNO
Microcontroller	PIC16F877A	PIC16F628	ARM Cortex-M3 LPC	Stellaris LM3S9B92	ATmega 328
Operating Voltage	USB or 6-12V	12V	2-3.6V	USB or Battery	USB or 5 V
Digital I/O Pins	33	16	42	EPI	14
Aanlog I/P Pins	8	4	8	16	8
Flash Memory	8KB	2KB	32 KB	256K	32 KB
SRAM	368B	224B	8KB	96K	2 KB
Clock Speed	20MHz	20MHz	72 MHz	80MHz	16 MHz
Others	- RS232 port. - ICSP Program Emulator.	- RS232 interface. - 4 Optocoupler i/ps. - 4 relay o/ps.	- Interfaces: 1 x SPI, 1 x SSP, 1 x UART, 1 x I2C, 11 x PWM, 8 x ADC	- Ethernet interface. - Wireless comm. port. - Robot features. - DC motor control.	- UART serial. - Supports I2C & SPI communication.

•It is not easy to decide on which microcontroller to use in a certain application. However, Arduino is becoming one of the most popular microcontrollers used in industrial applications and robotics.

•There are different types of Arduino microcontrollers which differ in their design and specifications. The following table shows comparison between the Arduino microcontrollers.
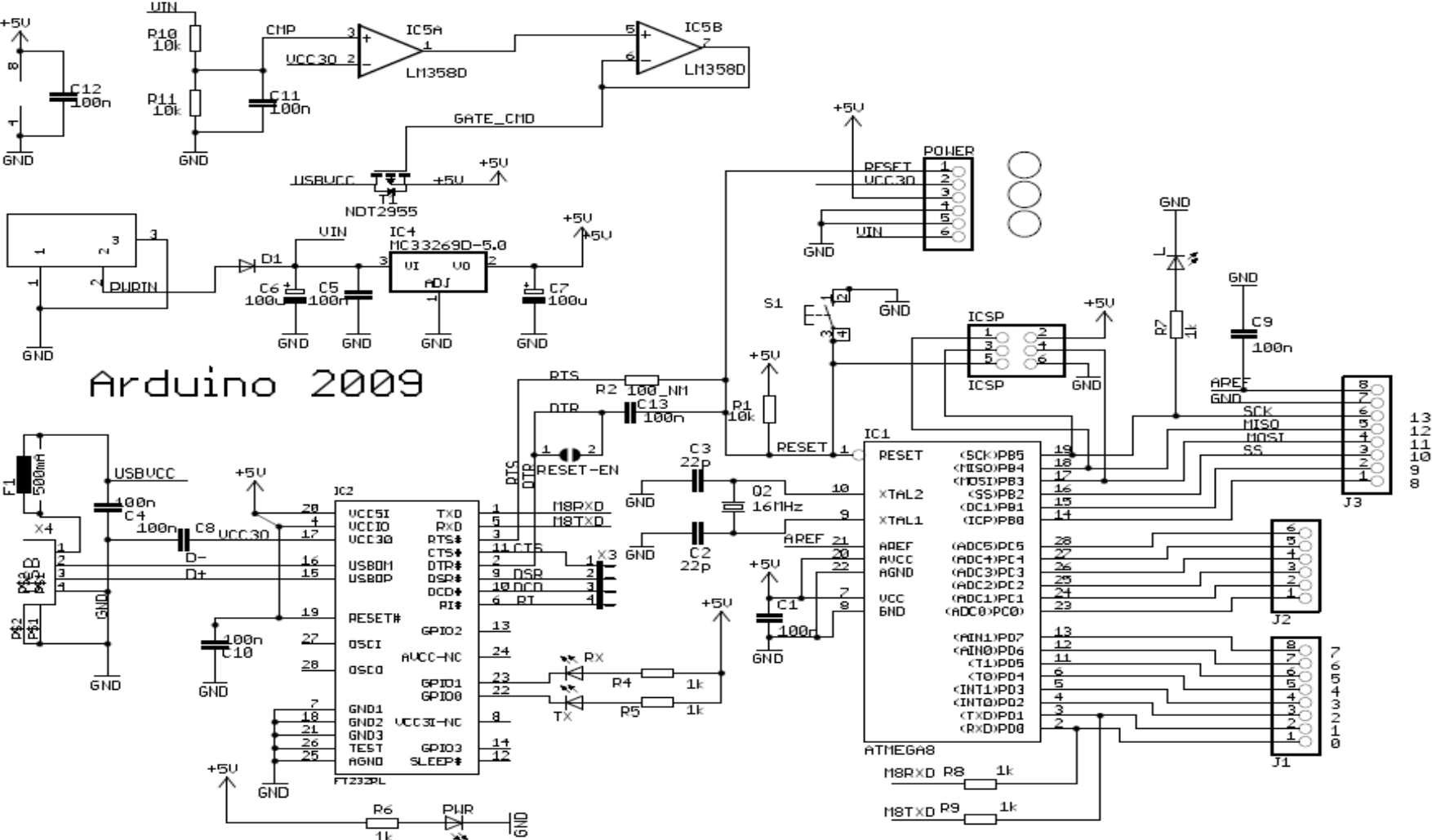
Specifications	Arduino Mini Light	Arduino UNO	Arduino Bluetooth	Arduino MEGA
Microcontroller	ATmega 168	ATmega 328	ATmega 168	ATmega 1280
Operating Voltage	5 V	5 V	5 V	5 V
Input Voltage	7-9 V	7-12 V	1.2-5.5 V	7-12 V
Digital I/O Pins	14	14	14	54
Analog I/P Pins	8	8	8	16
DC Current per I/O Pin	40 mA	40 mA	40 mA	40 mA
Flash Memory	16 KB	32 KB	16 KB	128 KB
SRAM	1 KB	2 KB	1 KB	8 KB
EEPROM	512 Bytes	1 KB	512 Bytes	4 KB
Clock Speed	16 MHz	16 MHz	16 MHz	16 MHz

Ref: http://www.robotshop.com/arduino-microcontroller-comparison.html
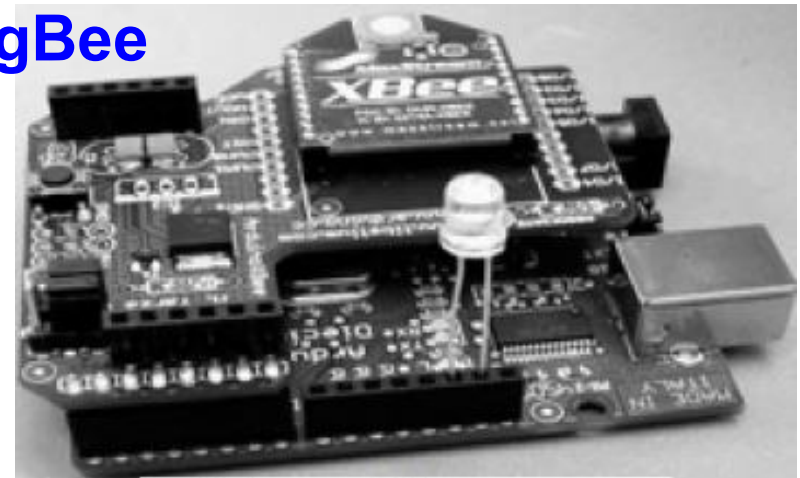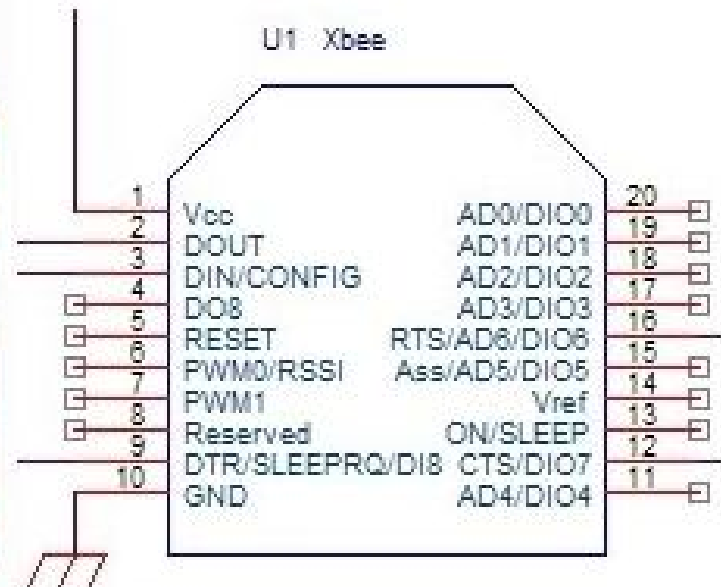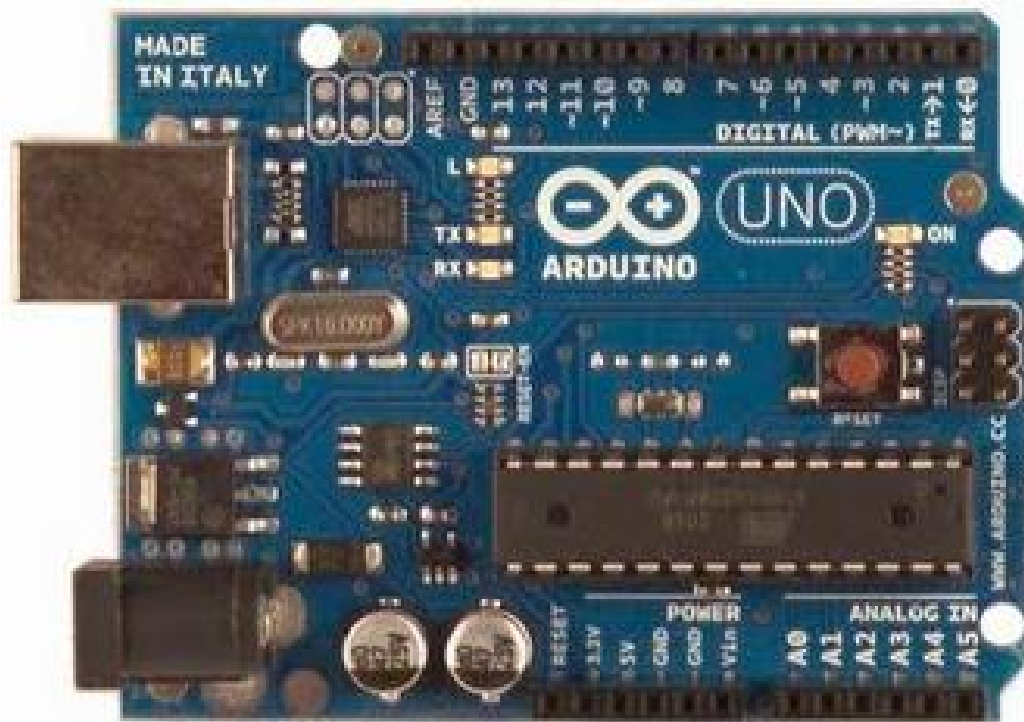
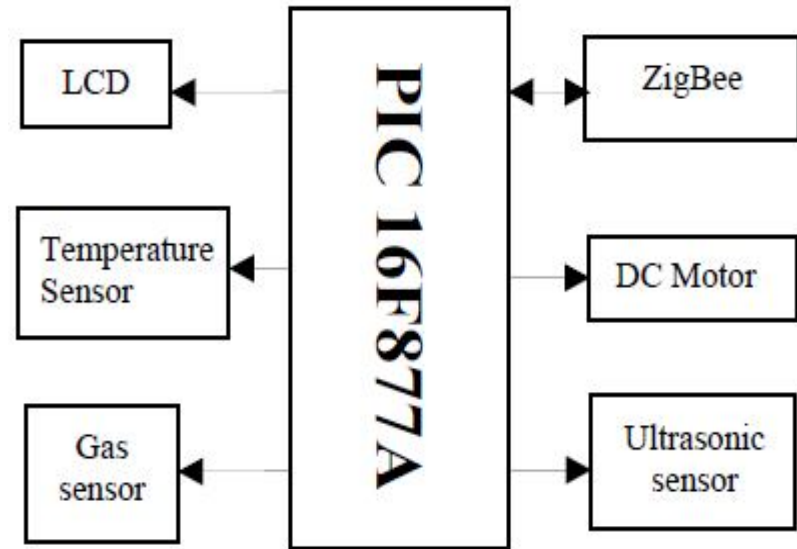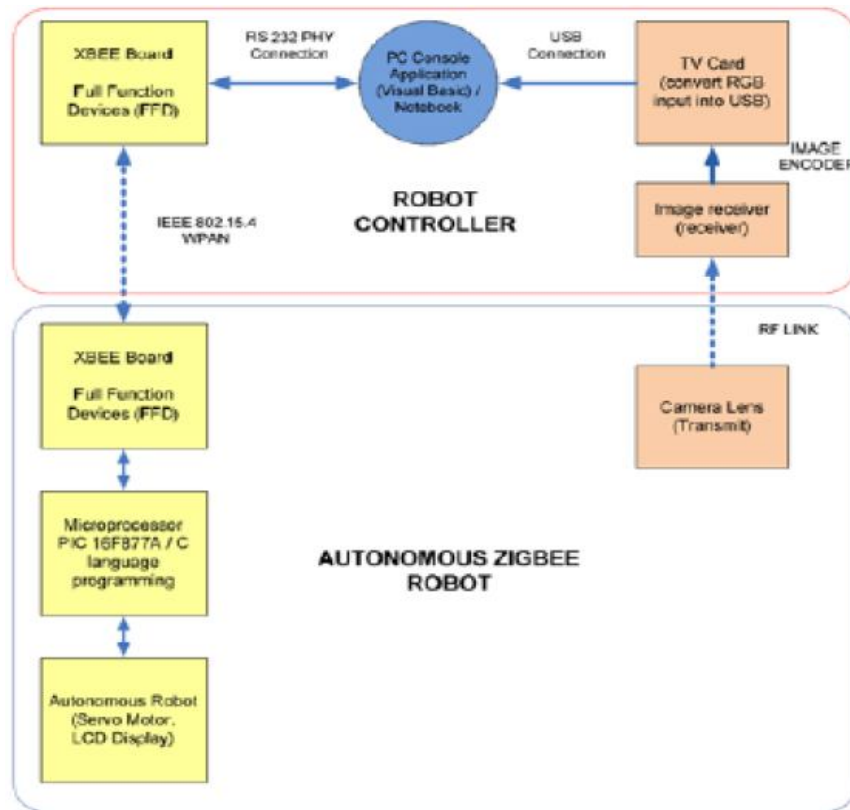# The Arduino Uno board:
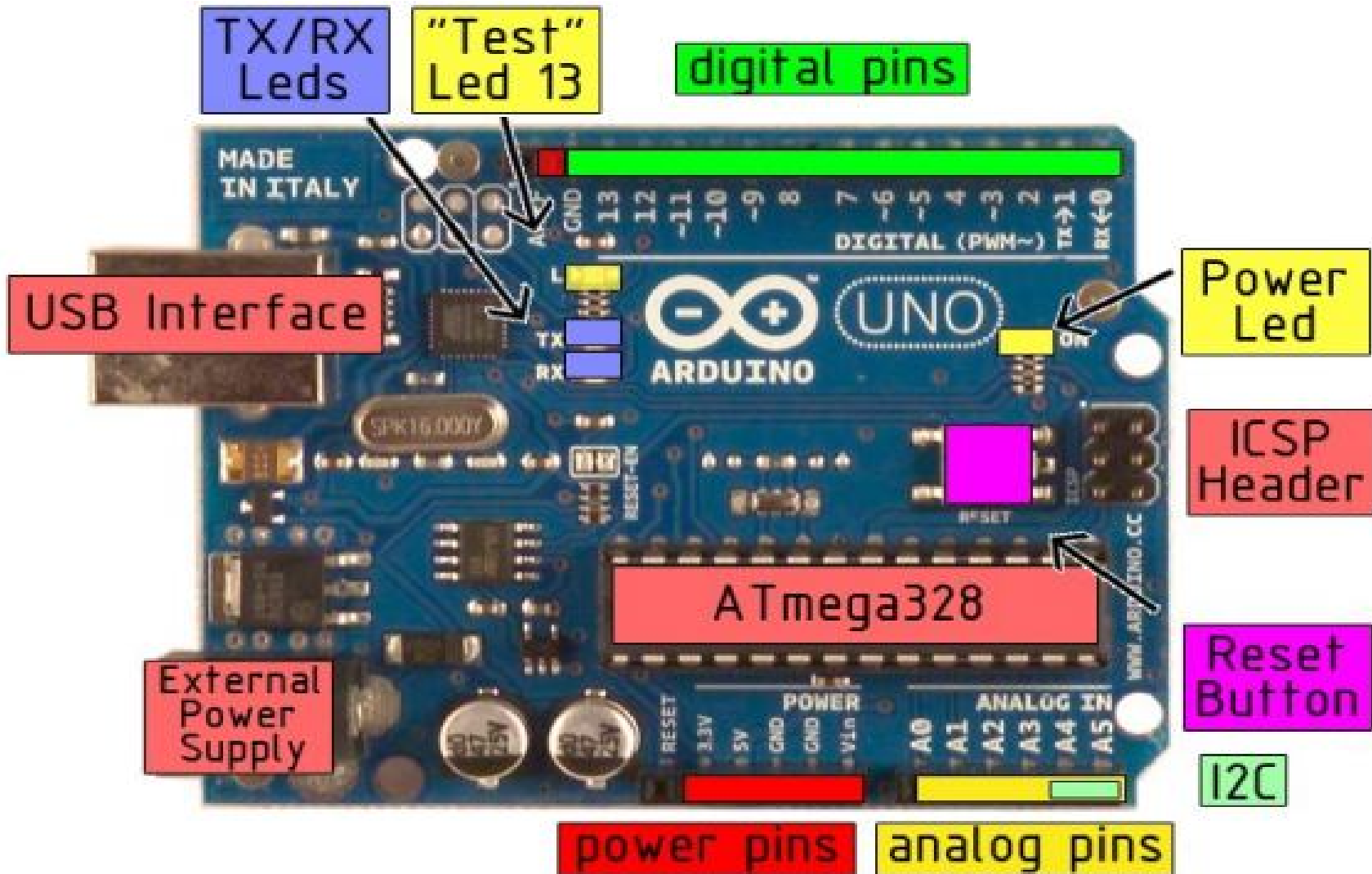
Hardware design of the Arduino Uno board:

Single-Board Microcontroller + ZigBee

Arduino + X-bee.

U1 Xbee

	Pin		
1	Vcc	AD0/DIO0	20
2	DOUT	AD1/DIO1	19
3	DIN/CONFIG	AD2/DIO2	18
4	DO8	AD3/DIO3	17
5	RESET	RTS/AD6/DIO6	16
6	PWM0/RSSI	Ass/AD5/DIO5	15
7	PWM1	Vref	14
8	Reserved	ON/SLEEP	13
9	DTR/SLEEPRQ/DI8	CTS/DIO7	12
10	GND	AD4/DIO4	11

Example: Mobile Robot control using Zigbee Technology

Client computer

Arduino + X-bee
(sender of data)

End

End

End

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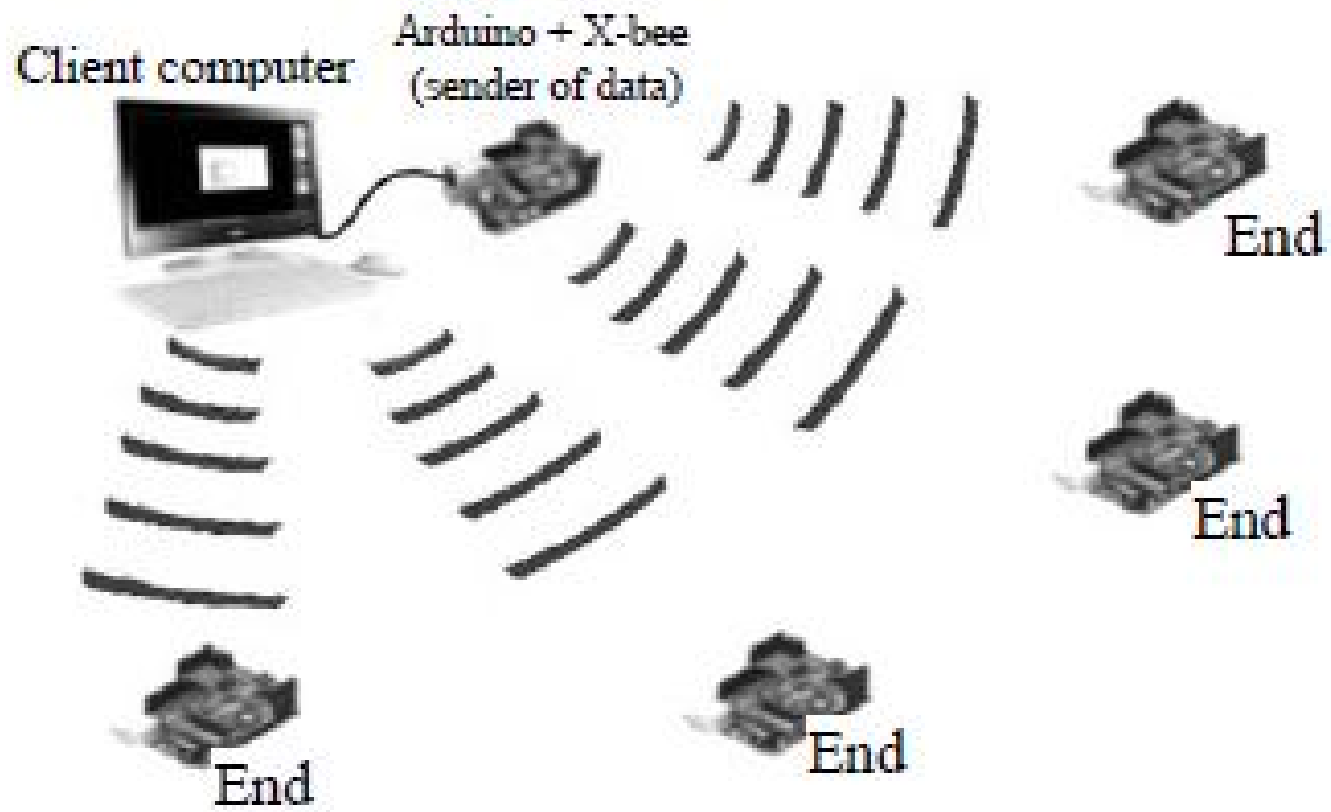
Single-Board Microcontroller Selection:

The selection guide for using the suitable microcontroller includes:

1. Meeting the hardware needs for the project design;

    - number of digital and analog i/o lines.

    - size of flash memory, RAM, and EPROM.

    - power consumption.

    - clock speed.

    - communication with other devices.

2. Availability of software development tools required to design and test the proposed prototype.

3. Availability of the microcontroller.