Week-10-11

Microprocessors, Micro-controllers and Assembly Language Sessional

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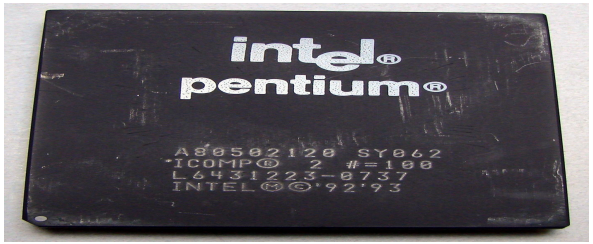
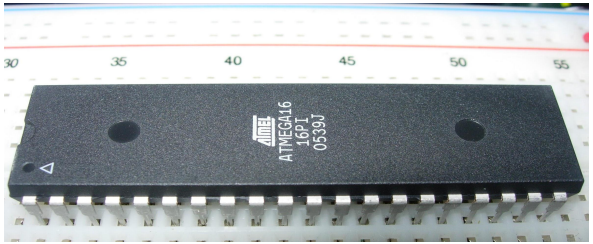
Topics

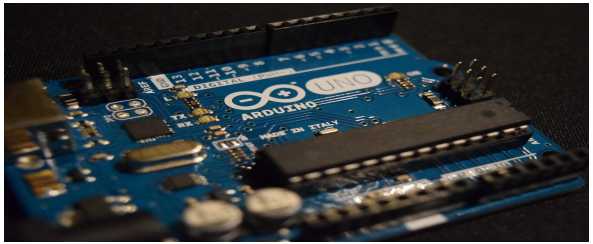
- Microprocessors, Micro-controllers
- Proteus Design Suite
- Arduino
- Pin Diagram

Microprocessors, Micro-controllers



Microprocessors





Micro-controllers

Microprocessors, Micro-controllers

- Microprocessor consists of only a CPU and Micro-controller contains a CPU, Memory, I/O all integrated into one chip.
- Microprocessor is used in PCs and Micro-controller is used in an embedded system.
- Microprocessor is complicated and expensive but Micro-controller is inexpensive and straightforward.

Proteus

- Proteus is a electrical suite for circuit simulation purposes.
- Proteus Download Link: https://drive.google.com/file/d/1aQ-QefxwPn7Coc0X_xKwAKFt6r3PQLiD/view
- Arduino IDE: https://downloads.arduino.cc/arduino-nightly-windows.zip
- Arduino Uno datasheet: https://www.farnell.com/datasheets/1682209.pdf

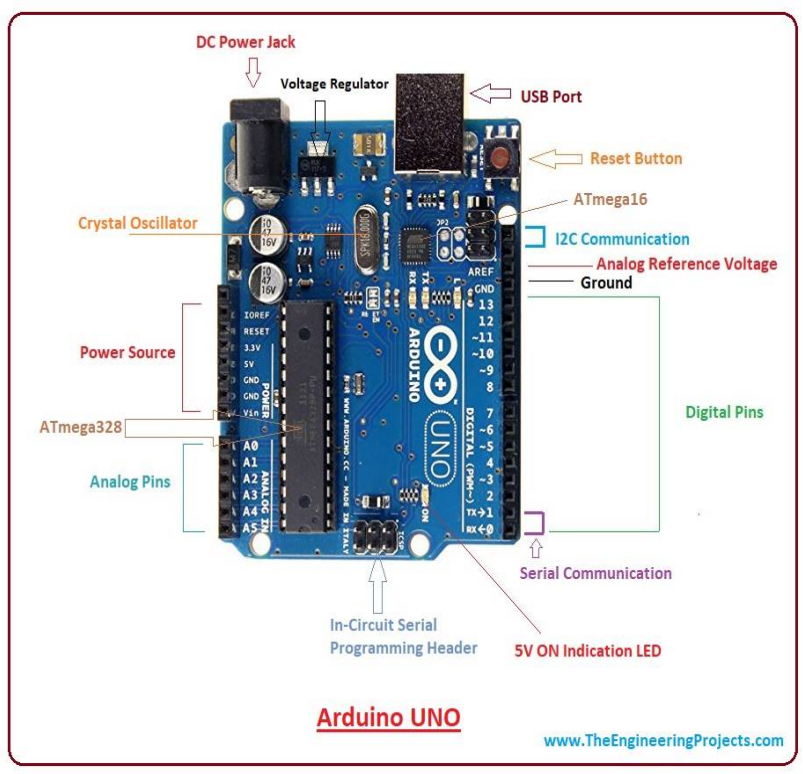
Arduino Uno

- Arduino is an open-source hardware and software company that designs and manufactures single-board microcontrollers and microcontroller kits for building digital devices.
- The Arduino Uno is a microcontroller board based on the ATmega328.

Arduino Uno

Pin Diagram

- 14 digital input/output pins (of which 6 can be used as PWM outputs)
- 6 analog inputs (also can be used as digital I/O)
- One UART interface found on pin 0 (RX0) and pin 1 (TX0)
- One I2C/TWI module
- And a SPI bus



Topics

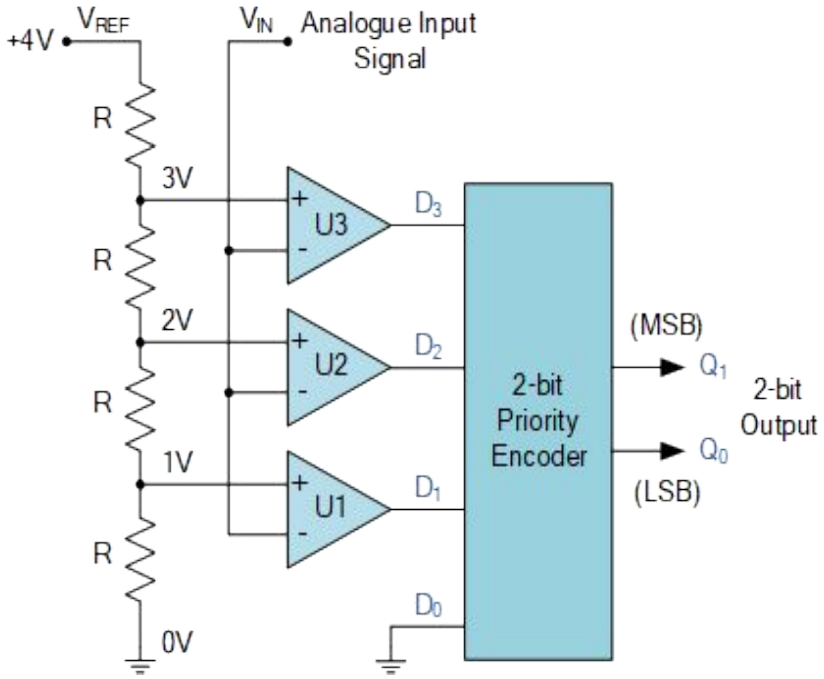
- ADC
- Serial Communication(Only UART)
- Sensors & Modules

Analog Inputs: 2-bit Analog to Digital Converter Circuit

- Analog signals can be continuous and provide an infinite number different voltage values.
- Digital circuits on the other hand work with binary signal which have only two discrete states, a logic “1” (HIGH) or a logic “0” (LOW).
- Analog signals come from various sources and sensors which can measure sound, light, temperature or movement.
- Many actuators may need analog signals for controlling purposes like motor speed.

Analog Inputs: 2-bit Analogue to Digital Converter Circuit

Comparator Outputs				Digital Outputs	
D_3	D_2	D_1	D_0	Q_1	Q_0
0	0	0	**0**	0	0
0	0	**1**	X	0	1
0	**1**	X	X	1	0
1	X	X	X	1	1



2-bit ADC will give digital value from 0 to 2^2 - 1 = 3, total 4 values. Hence for 10-bit it is 1024(0 to 1023).

Analog Inputs: Digital Output value Calculation

- **ADC Resolution = Vref / ((2^n) - 1)**
- **Digital Output = Vin / Resolution**

Where,

Vref - The reference voltage is the maximum value that the ADC can convert.[Uno has a **Vref pin**]

To keep things simple, let us consider that Vref is 5V,

For 0 Vin, digital o/p value = 0

For 5 Vin, digital o/p value = 1023 (10-bit)

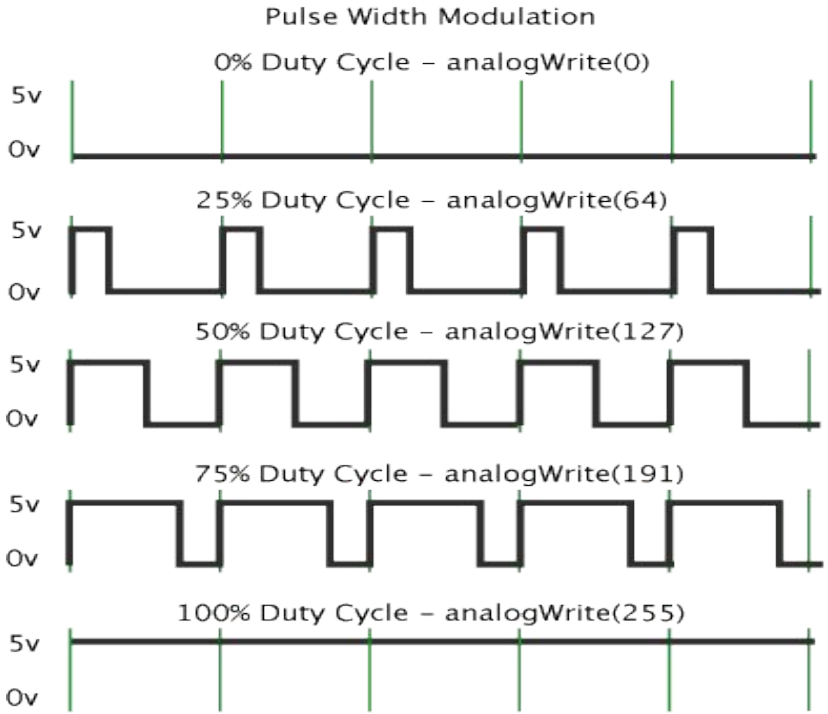
For 2.5 Vin, digital o/p value = 512 (10-bit)

Analog Outputs: PWM (Pulse Width Modulation) ‘~’

Arduino does not have in-board DAC. Instead, it uses PWM(‘~1’).

Can be used in:

- Controlling the brightness of LED
- Speed control of DC motor
- Controlling a servo motor or
- Where you have to get analog output with digital means



PWM voltage=(Duty cycle ÷ 256) x 5 V.

Serial Communication (UART)

Can be used in two ways:

- Pin
  - RX - Pin 0 - Used for receiving
  - TX - Pin 1 - Used for transmitting
- Computer via the USB port (Serial Monitor/Virtual Terminal)
  - Onboard USB-to-Serial converter (Atmega16U2)

By **Serial** command we can use UART.

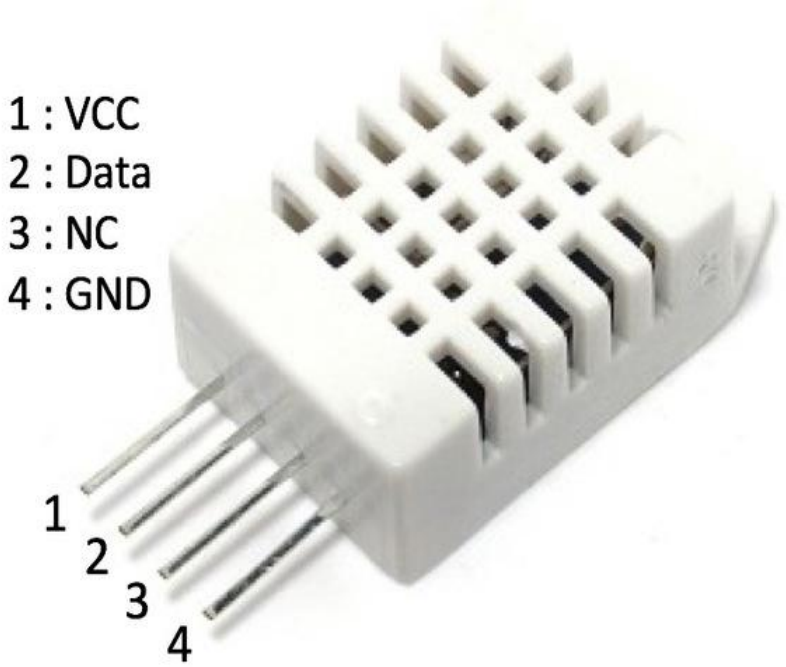
Some Sensors & Modules

Humidity Sensor (DHT22)

It’s a digital-output, relative humidity, and temperature sensor.

Pin Connection:

- First pin(VCC) on the left to 3-5V power,
- Second pin(Data) to any digital input pins,
- Third pin(NC) is no-connect pin,
- The right-most pin(GND) to the ground



Temperature Sensor (LM35)

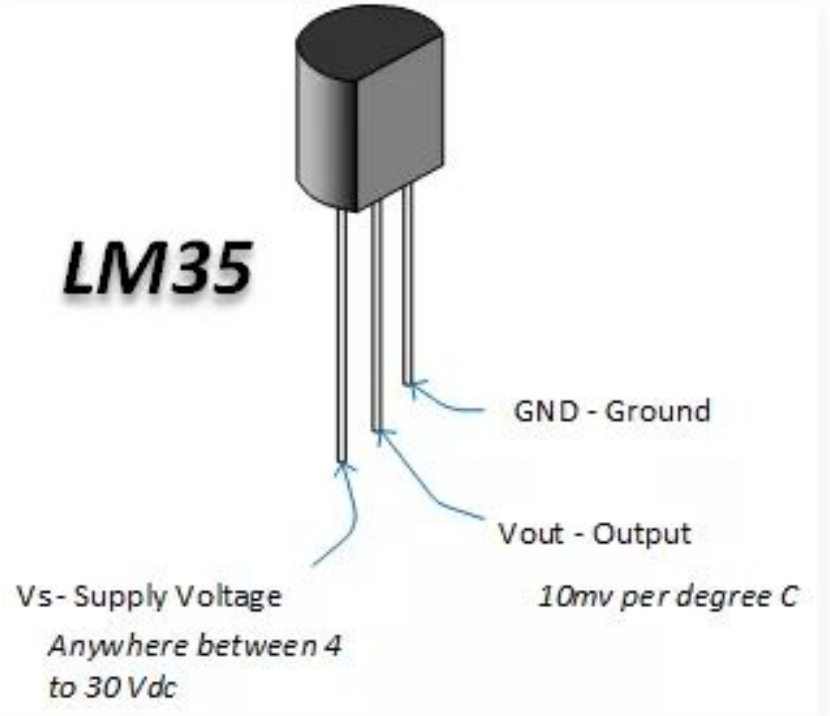
It’s a temperature device with an output voltage linearly proportional to the Centigrade temperature. Temperature range: −55°C to 150° C.

Pin Connection:

- First pin(Vs) on the left to 4-30V power,
- Second pin(Vout) to any analog input pins,
- Third pin(GND) to the ground

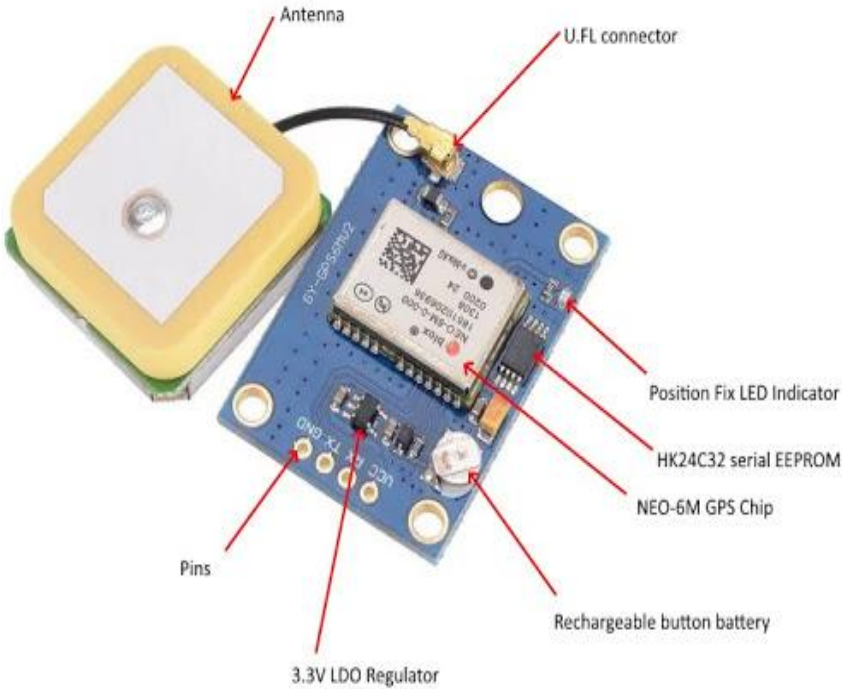
Formula,

- temp = (1/ 2.048) * analogRead(Vout)



GPS (Global Positioning System) Module

- Connect through serial communication
- Communicate with the Arduino using the UART pins
- Transmit information in NMEA format
- Need TinyGPS library to decode the information



GSM (Global System for Mobile Communications) Module

- GSM Library for Proteus:

  https://www.theengineeringprojects.com/2016/03/gsm-library-proteus.html

Arduino Communication Peripherals

Thank You