

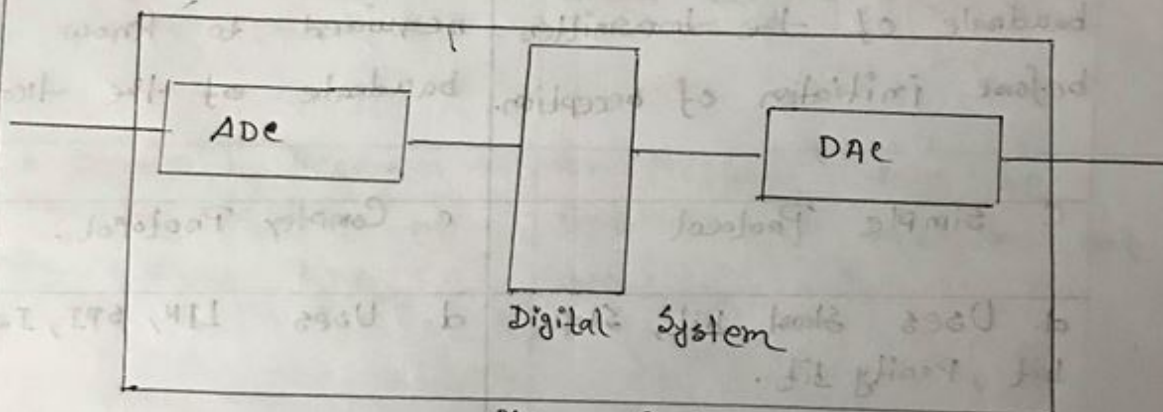
Slide → analog - digital

18. Define Sensor

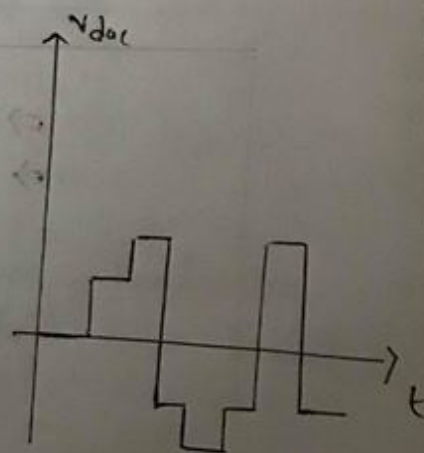
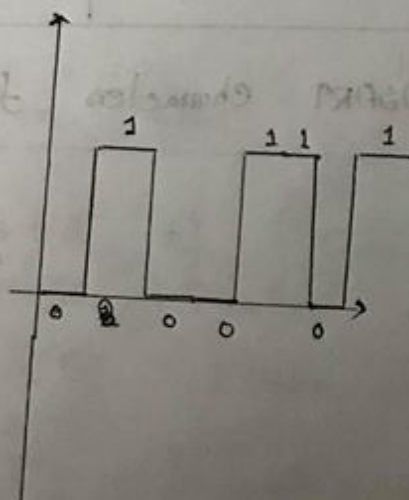
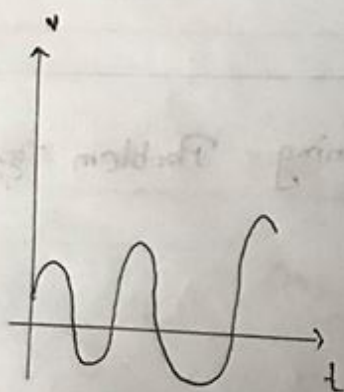
Ans:

A sensor is an object whose purpose is to detect events or changes in its environment, & then provide a corresponding output.

Digital Communication System



Micro-Controller



19. Write the advantages & disadvantages of Analog Sensors.

Ans:

Advantage

- a. Simple Sensor diagram
- b. No negative ; Positive Pin
- c. Low cost

Disadvantage

- a. Analog signal produced by the analog sensor could be distorted during long distance transmission.

20. Write the advantages & disadvantages of Digital Sensors

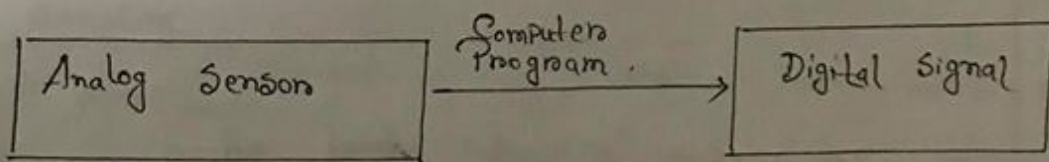
Ans:

Advantage:

- a. Digital signal produced by the digital sensor could be transmitted long distance

Disadvantage:

- a. Usually Complex sensor diagram
- b. Expensive



21. What are the components of a digital sensor.

Ans:

- a. sensor
- b. cable
- c. Transmitter

⇒ Analog Sensor → Thermistor, LDR, Flex
 ⇒ Digital Sensor → PIR sensor, Ultrasonic sensor
 ⇒ LDR (Light Dependent Resistor)
 → Light intensity বাড়লে resistance কমবে,
 → Light intensity কমলে resistance বাড়বে

⇒ Light source থেকে আসা Value এর Max Value.
 উদাঃ R এর Value এর Max Value.

⇒ 0.76V [Voltage Across Drop হবে লেভেল এর]

২২. Define Pulse Code Modulation

Ans:

It's a technique for digitizing information signals for electronic data transmission.

⇒ PCM signal is a serial digital signal

২৩. Describe PCM

Ans:

PCM works at 3 steps

a. Sampling:

i. Sample is a single measurement of amplitude.

ii. The larger sampling rate, the better accuracy of conversion

b. Quantization

i. Both sampling & quantization result in the loss of information. The quality of a quantized output depends upon the numbers of quantization levels used.

⇒ ADCs Can vary greatly between micro-Controllers

⇒ The ADC on the Arduino is a 10-bit ADC meaning it has the ability to detect 1024 (2^{10}) numbers of discrete levels.

Some microControllers have 8-bit ADCs ($2^8 = 256$ discrete levels) & some have 16-bit ADCs ($2^{16} = 65535$ discrete levels)

⇒ The ADC reports a ratio-metric value. This means that the ADC assumes 5V is 1023 & anything less than 5V will be a ratio between 5V & 1023

Voltage	Digit Value
5V	1023
2.5V	512
2.12V	439
0V	0

$$\frac{\text{Resolution of the ADC}}{\text{System Voltage}} = \frac{\text{ADC reading}}{\text{Analog Voltage Measured}}$$

Question. The 10 bit ADC of the Arduino on a 5V system. If the analog voltage is 2.12V then what will be the ADC report as a value.

Ans.

$$\frac{\text{Resolution of ADC}}{\text{System Voltage}} = \frac{\text{ADC Reading}}{\text{Analog Voltage measured}}$$

$$\Rightarrow \frac{1023}{5.00} = \frac{x}{2.12}$$

$$\Rightarrow 5.00 x = 1023 \times 2.12$$

$$\Rightarrow 5.00 x = 2168.76$$

$$\Rightarrow x = \frac{2168.76}{5.00}$$

$$\Rightarrow x = 433.752$$

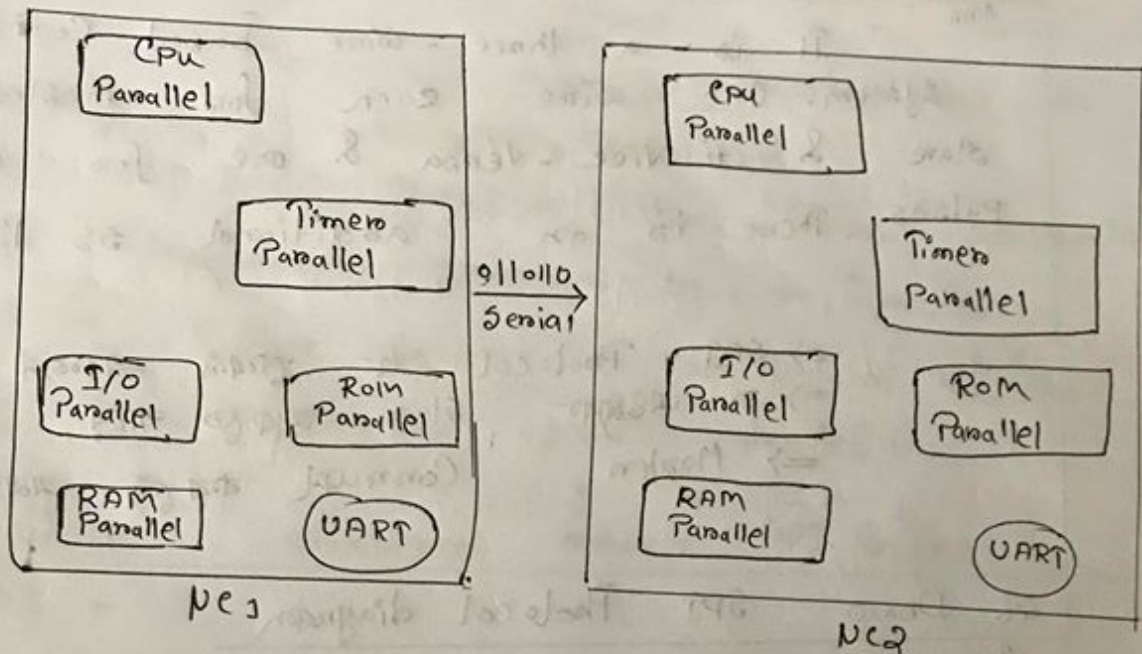
$$\Rightarrow x \approx 434$$

Ans

⇒ ADC reading fraction allowed नहीं.

⇒ Ceiling / Floor Value निकालें
क्योंकि Digital value 0, 1, may be

within 0-1 है.



- * ভিতরে Parallel
- * বাইরে Serial
- UART হল Converters Protocol
- Serial. begin (9600); যাতে Serial Communication active করে.
- RS 232 - দিয়ে Serial Data Transfer হয়.

- Serial Communication Protocol হলো হল
 - a. Ethernet
 - b. USB
 - c. RS 232
 - d. SPI
 - e. I2C

25. Describe SPI Protocol

Ans.

It is a three-wire based communication system. One wire each for master to slave & vice-versa & one for clock pulses. There is an additional ss line.

⇒ SPI Protocol - 4- ২০০০-২০০০ master
 ⇒ ৩- ২০০০-২০০০ slave- ২০০০-২০০০
 ⇒ Master- ২০০০-২০০০
 Connect করলে অর্থ্যাৎ,

26. Draw SPI Protocol diagram

Ans.

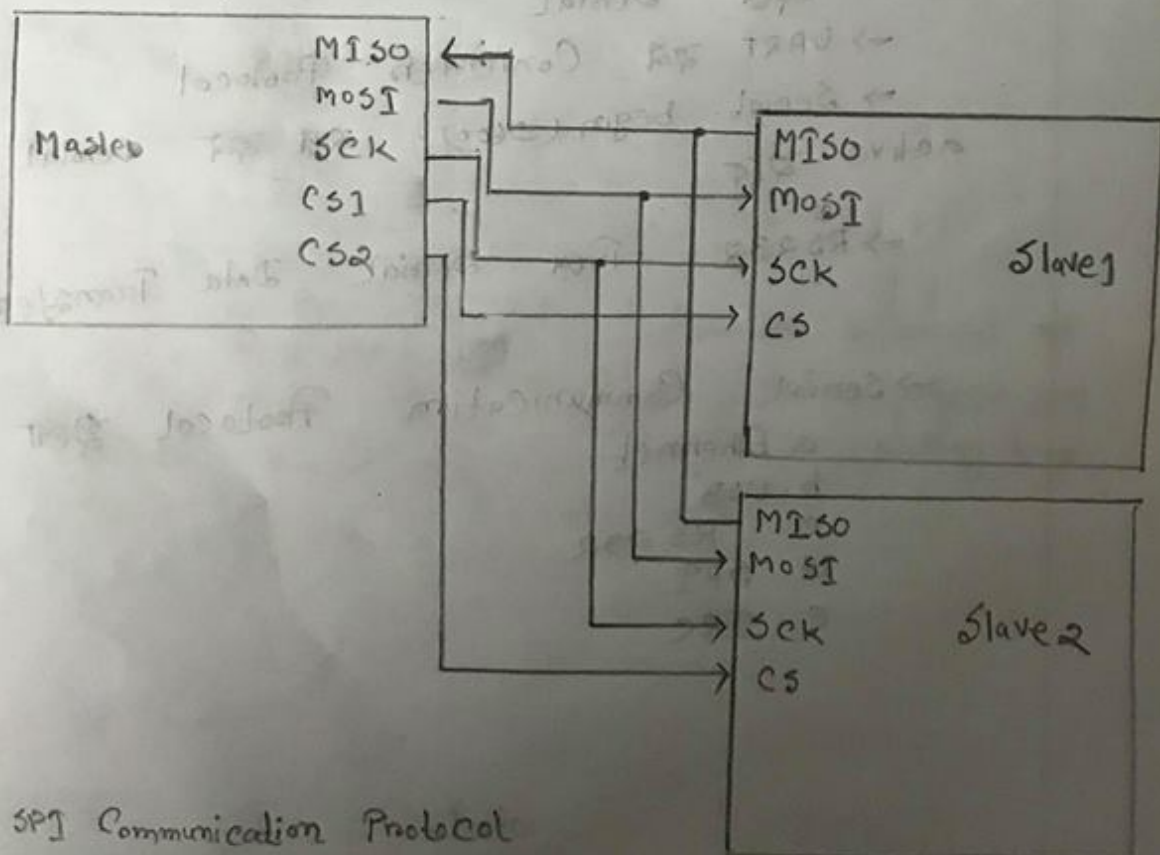


Fig: SPI Communication Protocol

- MISO \rightarrow [Master In Slave Out] \Rightarrow Slave line for sending data to the master.
- MOSI \rightarrow [Master Out Slave In] \Rightarrow Master line for sending data to the peripherals.
- SCK \rightarrow [Serial Clock] \Rightarrow Clock pulses synchronize data transmission generated by the master.
- SS \rightarrow [Slave Select] \Rightarrow Master can use to enable & disable specific devices.

Q7. Write differences between SPI vs I2C

Ans:

SPI	I2C
a. Serial Peripheral Interface	a. Inter Integrated Circuit
b. SCK, MOSI, MISO, SS Pins	b. SDA, SCL Pins
c. Synchronous	c. Asynchronous
d. Only one master	d. One or more than one master
e. Simple hardware	e. Complex hardware

Q8. Write the Advantages & Disadvantages of SPI

Ans:

Advantage

a. The receiver / sender hardware can be a simple shift register.

b. It supports multiple slave

Disadvantage

a. Master must control all communications

b. Requires separate SS lines to each slave.

* Digital Device - যে ডিভাইস যি axis এর voltage - মাপে, যাতে আলাদা করে নেবে।

* 16 MHz \approx 16 Cycle s^{-1}

16 $\times 10^6$ Cycle যদি কয় $\rightarrow 1s$ এর

অংশ 1 " ২৬৫ $\frac{1}{16 \times 10^6}$

$\approx 16 \mu s$

\Rightarrow Arduino board - যে ডিভাইস $\rightarrow 10 \text{ bit } [0-1023]$
Analog to digital

\Rightarrow Arduino digital \rightarrow Analog 8 bit

In the micro-controller, 12 bit digital to analog (DAC) resolution is set. During the digital to analog conversion programming, you have called "[analogWrite \(1024\)](#)" instruction. Calculate the duty cycle. Draw the duty cycle diagram. Consider system voltage is 5 V.

Solve:

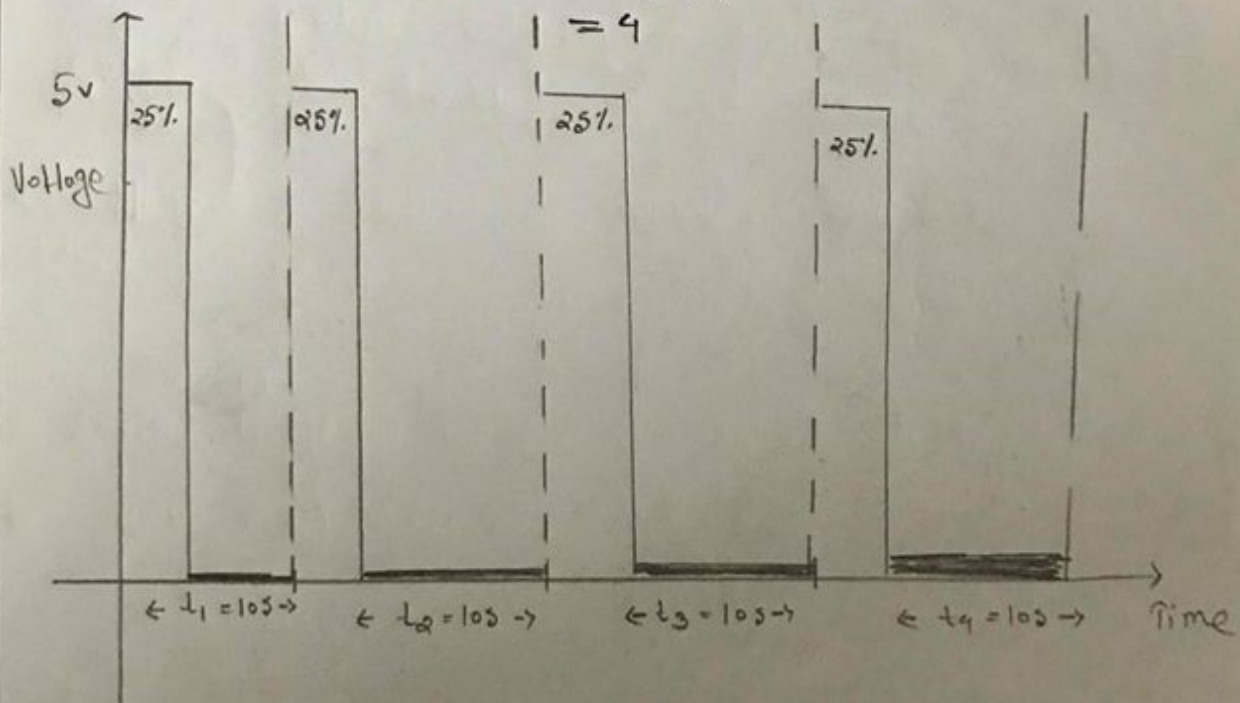
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Given 12 bit digital to Analog

$$\text{So } 2^{12} = 4096$$

analogWrite (1024)

$$\text{Duty Cycle} = \frac{4096}{1024}$$



20. Define Duty Cycle

Ans: A duty cycle is the fraction of one period in which a signal or system is active.

\Rightarrow On & off cycle
 \downarrow \downarrow
Active Inactive