Principles of Measurement & Instrumentation I

Laboratory

PHYS417

Laboratory Report

Abdullah Burkan BEREKETOĞLU

2355170

Experiment 2- Arduino-Based Measurement Devices

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Question 1: Explain the difference between microprocessor, microcomputer and microcontroller.

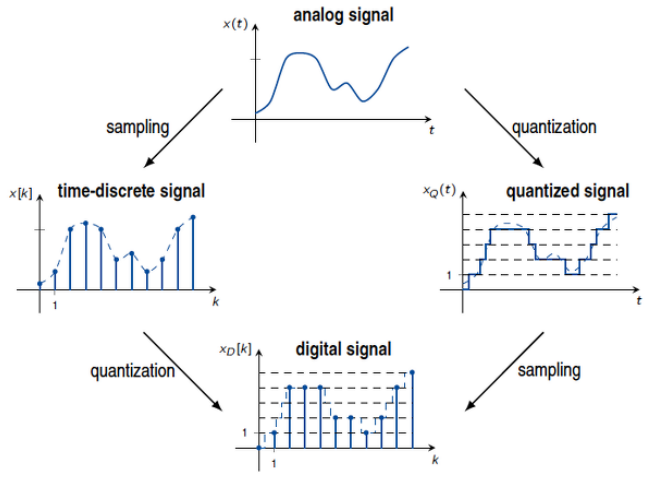
The microcomputer is a cheap and small computer, which has a microprocessor, memory, and a circuit in it that has inputs and outputs.

Microprocessors are similar to the central processing unit(CPU) of a computer for the microcomputers. In itself, it has a Control Unit (CU), and an Arithmetic Logic Unit (ALU) of the microcomputer.

The microcontroller is a product that does specific operations or works like a small computer in a much bigger system. E.g RAM, CPU can be given as common examples. For summarizing, a microcomputer can be said that a small computer does some operations in a cheaper and smaller way, the microprocessor is an essential part of the microcomputer as CPU, which is actually the microcontroller of computers.

Question 2: Explain the difference between an analog signal and a digital signal.

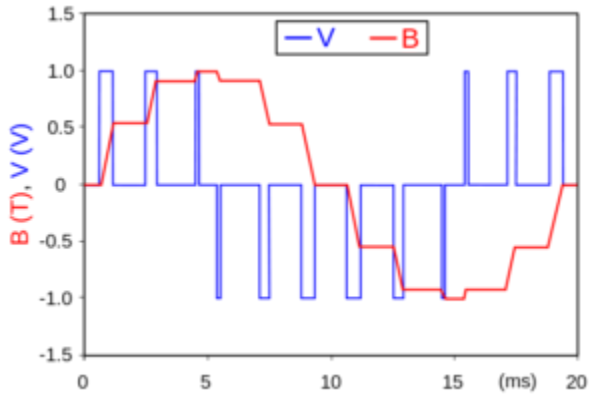
By the signals we carry information from one place to another, if the amplitude of this signal changes continuously such as sinusoidal or ramp it is in a time difference, it is named Analog Signal. In these types of signals, we examine the amplitude, period, frequency, and phase of the signal. On the other hand, we have another type of signal which is Digital Signal, which is a signal type that is changing in discrete amplitudes, in this signal type we examine it by the binary numbers, or on/off, something in two bases. Digital signals can be represented in square waves. One can give an example to analog is a dog voice, human voice, think of a glass breaking with an opera singer's voice. But if we record this voice on a CD, DVD, MP that is a digital signal. This type of change sometimes used to the infinite resolution of analog signal produce too much noise and hence we have a struggle in analyzing the system. So one can easily say that changing signals to one another is a necessity for different cases.



Question 3: Explain the basic principle of the PWM. (Pulse Width Modulation)

From Q2 we know that an analog signal has an infinite resolution in magnitude and time, therefore; we can control things directly in analog circuits. In this method, we can control analog signals by using digital sources. By changing the duty cycle which is a repeating a series of on and off pulses we can control analog signals by digital sources. When it is on off, it is off time and it applies DC, on time, when on at %30 of a period and off at % 70, %30 of the voltage is used from all voltage.

E.g;



If we apply 30 voltage; we get %30*30 = 9V in the first one, %60*30=18V in the second one, %90*30=27V in the third one, and finally %100*30=30V for the last one.

If our duty cycle is 10 seconds and the signal is on for 5 seconds and off for 5 seconds, It is %50 pulse width modulation. If our duty cycle is 4 seconds and the signal is on for 2 seconds and off for 2 seconds, it is still %50 pulse width modulation. When we change frequency, we change only the time of the duty cycle.

Question 4: Describe the purpose of the following functions in Arduino.

digitalRead()- Used for reading the pin number by writing the pin number between parentheses ().

analogRead()- Similar purpose usage with digitalRead(), but it's on a scale of 0 to 1024 due to the 10-bit system.

digitalWrite()- Function digitalWrite() sends 5V or 0V to the pin. There are only binary settings one or zero, true-false, high low…

analogWrite()- Sends values from 0 to 255. 255 means, pin takes all power 128 is half power of the time.

pinMode()- Provides power flow to pin, makes use choose output.

Serial.begin()- Corresponds to the data rate in bits per second for transmitting the data.

delay()- For a number of milliseconds pauses the programme.

millis()- Helps us to determine the certain time when something happens,

Serial.print()- Sends information to monitor.

Serial.println()- Similar to serial.print, Prevents us from printing many results in a straight line without spaces.

map()- Sets a range of values to another new range.

random()- Adjust numbers when its not known.

Question 5: What does Clock Speed mean for a microcontroller? How is it related to the time response of the microcontroller?

Clock speed is the rate of instruction per second executed at the CPU of the system, which means a number of pulses per second. It is measured mostly in MHz and GHz. 1MHz equals one million cycles per second and GHz is one billion. Microcontrollers as mentioned above does specific tasks, it is their instruction per second executed hence clock speed.

Question 6: Explain INTERRUPT on Arduino with an analogy.

Interrupt interrupts the processor quickly when there is an important thing. INTERRUPT is there for to interrupt, stop the processor rapidly when an important thing occurs that needs to be interrupted.

e.g, one can think of the current economic case that foreign currency exchanges increased hence Apple interrupted their sales in the Turkish market.

Question 7: What is the resolution of Analog-to-Digital Converter in Arduino UNO?

10-bit resolution is the resolution of Arduino ADC. So from 2^10, we have 1024 values since it starts from 0. 0 - 1023 our range. Hence, we can map our values into values between [0 - 1023].

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