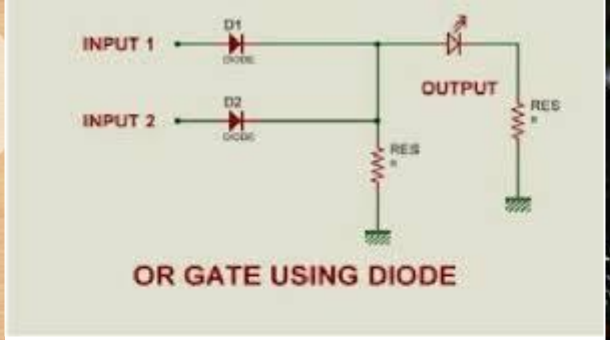
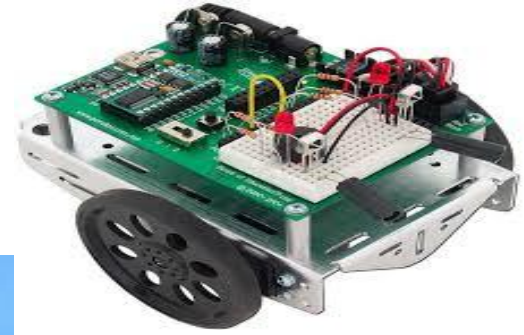
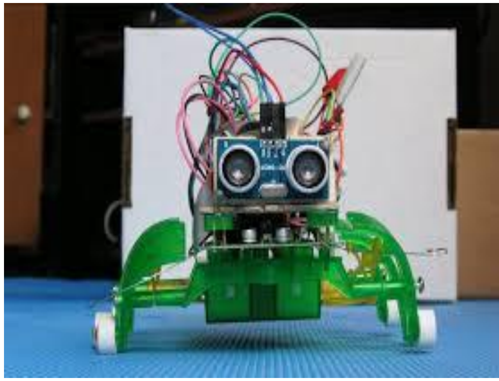
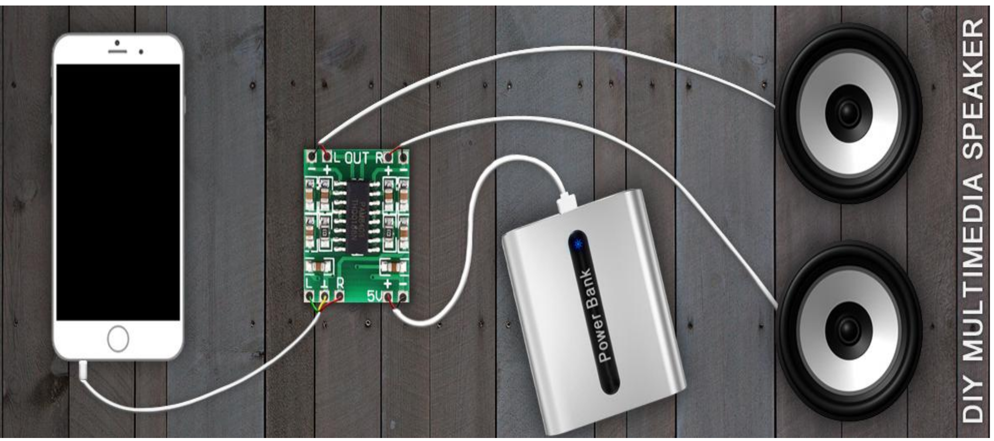

BASIC ELECTRONIC COMPONENTS
Variable Resistors
Resistors
Capacitors
Transistors
LDR
Inductors
Transformer
Microphone
12V Power Supply
Adapter
Diodes
LEDs
16x2 LCD
Buzzer
IR Transmitter
Receiver
7-Segment Display
ICs
Battery
Relays
Switches
Motors
(Stepper, Small DC, Servo)
Multimeter

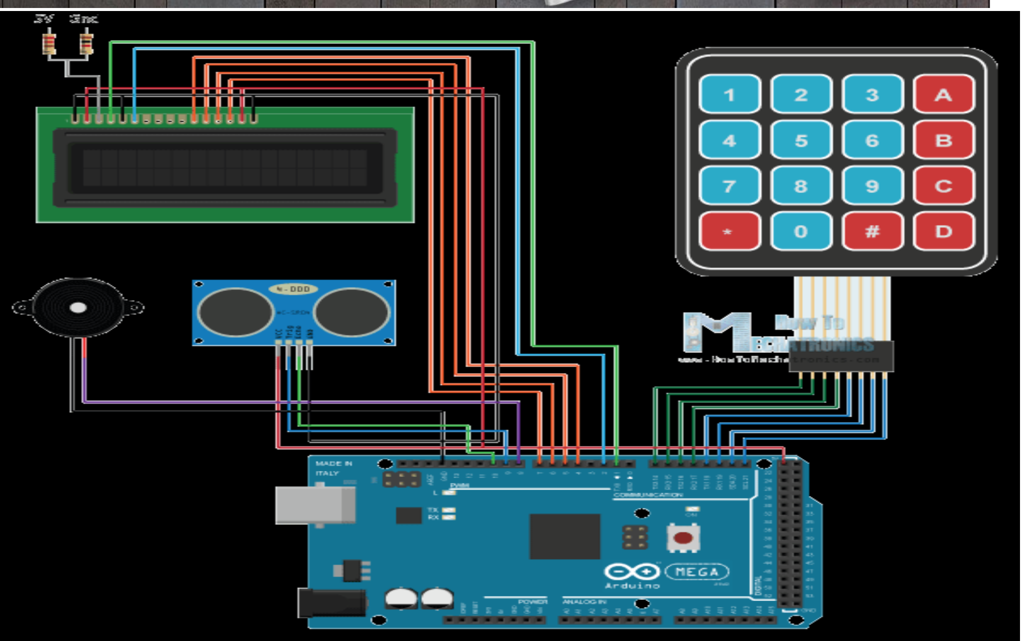

INPUT 1
INPUT 2
D1
D2
OUTPUT
RES
RES
OR GATE USING DIODE




Cathode Ray Oscilloscope
Digital Oscilloscope
Mini DIY Oscilloscope
OSCILLOSCOPES




DIY MULTIMEDIA SPEAKER
L OUT R
5V
Power Bank


1 2 3 A
4 5 6 B
7 8 9 C
* 0 # D
MEGA
Arduino





Applications

Introduction to Digital Systems

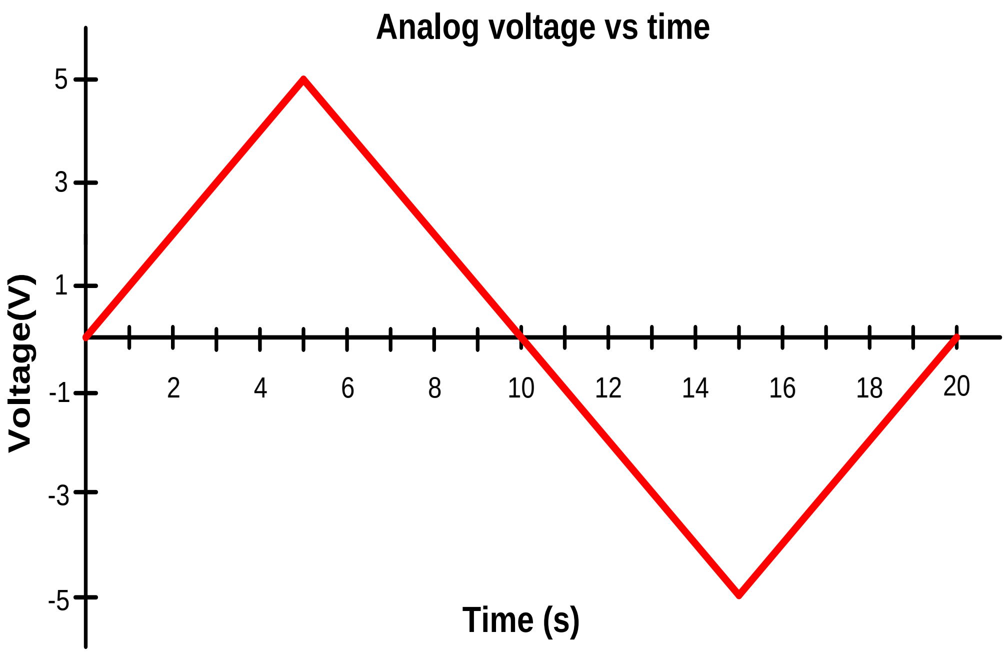
Introduction

- In science, technology, business, and, in fact, most other fields of endeavor, we are constantly dealing with quantities.
- Quantities are measured, monitored, recorded, manipulated arithmetically, observed, or in some other way utilized in most physical systems.
- It is important when dealing with various quantities that we be able to represent their values efficiently and accurately.
- There are basically **two** ways of representing the numerical value of quantities: ***analog*** and ***digital.***

Digital versus Analog systems

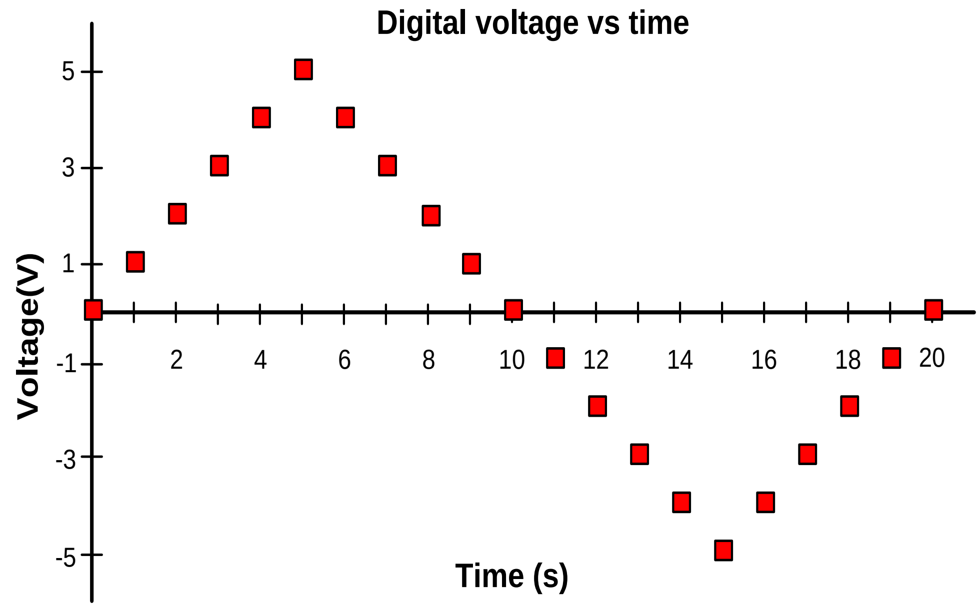
Analog Representation:

- In analog representation a quantity is represented by a voltage, current, or meter movement that is proportional to the value of that quantity.
- Analog quantities such as those cited above have an important characteristic: they can vary over a continuous range of values.



Digital Representation:

- In digital representation the quantities are represented not by proportional quantities but by symbols called digits.
- As an example, consider the digital watch, which provides the time of day in the form of decimal digits which represent hours and minutes (and sometimes seconds).
- As we know, the time of day changes continuously, but the digital watch reading does not change continuously; rather, it changes in steps of one per minute (or per second).
- In other words, this digital representation of the time of day changes in discrete steps, as compared with the representation of time provided by an analog watch, where the dial reading changes continuously.



The major difference between analog and digital quantities is

Analog ≡ Continuous

Digital ≡ Discrete

Advantages and Limitations of Digital Techniques

- **Advantages**
- **Digital systems are easier to design.**
  - The switching circuits in which there are only two voltage levels, HIGH and LOW, are easier to design. The exact numerical values of voltages are not important because they have only logical significance; only the range in which they fall is important.
- **Information storage is easy.**
  - There are many types of semiconductor and magnetic memories of large capacity which can store data for periods as long as necessary.
- **Accuracy and precision are greater.**
  - Digital systems arc much more accurate and precise than analog systems, because digital systems can be easily expanded to handle more digits by adding more switching circuits. Analog systems will be quite complex and costly for the same accuracy and precision.
- **Digital systems are more versatile.**
  - It is fairly easy to design digital systems whose operation is controlled by a set of stored instructions called the program. Any time the system operation is to be changed, it can easily be accomplished by modifying the program
- **Digital circuits are less affected by noise.**
  - Unwanted electrical signals are called noise. Noise is unavoidable in any system. Since in analog systems the exact values of voltages are important and in digital systems only the range of values is important, the effect of noise is more severe in analog systems. In digital systems, noise is not critical as long as it is not large enough to prevent us from distinguishing a HIGH from a LOW.

Limitation

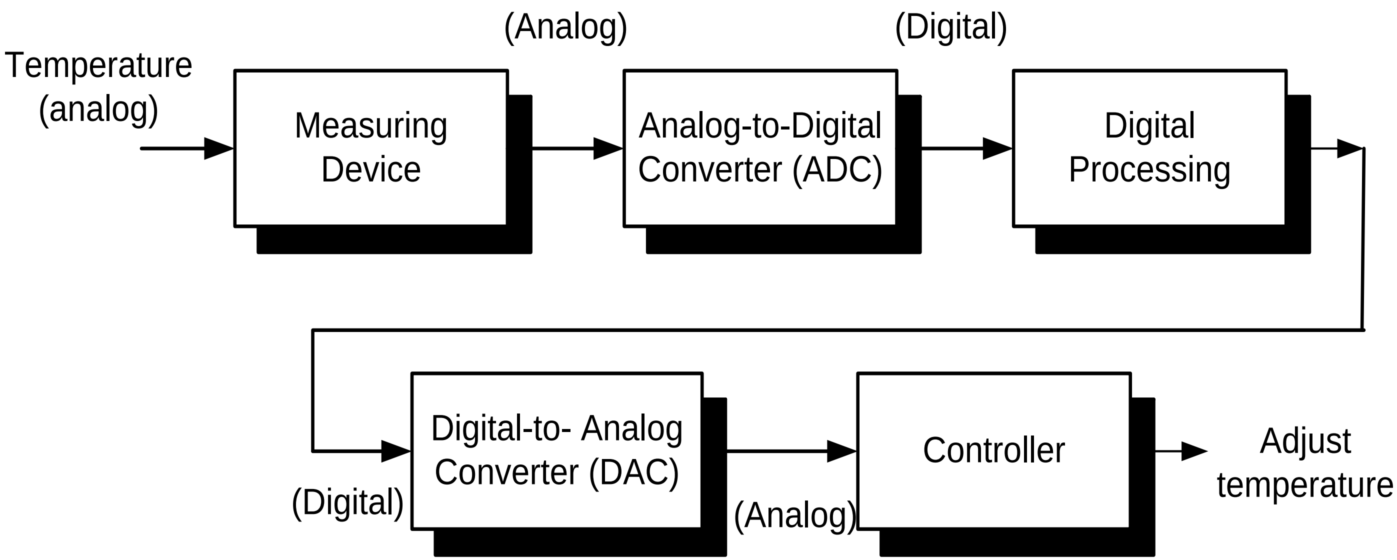
There is really only one major drawback when using digital techniques:

" The real world is mainly analog"

To take advantage of digital techniques when dealing with analog inputs and outputs, three steps must be followed:

- Convert the real-world analog inputs to digital form. (ADC)
- Process (operate on) the digital information.
- Convert the digital outputs back to real-world analog form. (DAC)

The following diagram shows a temperature control system that requires analog/digital conversions in order to allow the use of digital processing techniques.



Block diagram of a typical temperature control system.

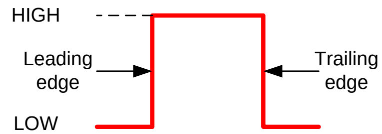
- The need for conversion between analog and digital forms of information can be considered a drawback because of the added complexity and expense.
- Another factor that is often important is the extra time required to perform these conversions.
- In many applications, these factors are outweighed by the numerous advantages of using digital techniques, and so the conversion between analog and digital quantities has become quite commonplace in the current technology.
- There are situations, however, where using only analog techniques is simpler and more economical.
  - ✓ For example, the process of signal amplification is most easily accomplished using analog circuitry.
- It is becoming more and more common to see both digital and analog techniques employed within the same system in order to profit from the advantages of each.
- In these hybrid systems, one of the most important parts of the design phase involves determining what parts of the system are to be analog and what parts are to be digital.

Binary logic Gates

- The general public as being ***magical*** sometimes looks upon computers, calculators, and other digital devices.
- Actually, digital electronic devices are extremely **logical** in their operation.
- The basic building block of any digital circuit is a **logic gate.**
- The logic gates we will use operate with binary numbers, hence the term **binary logic gates.**
- Logic gates are the building blocks for even the most complex computers.
- Logic gates can be constructed by using simple switches, relays, transistors and diodes, or ICs.
- Because of their availability, wide use, and low cost, ICs will be used to construct digital circuits.
- A variety of logic gates are available in all logic families including **TTL** and **CMOS.**

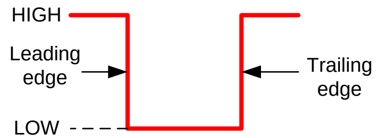
Digital Signals

- Digital systems use the binary number system.
- Therefore, two-state devices are used to represent the two binary digits 1 and 0 by two different voltage levels, called HIGH and LOW.
- If the HIGH voltage level is used to represent 1 and the LOW voltage level to represent 0, the system is called the positive logic system.



a) Positive pulse

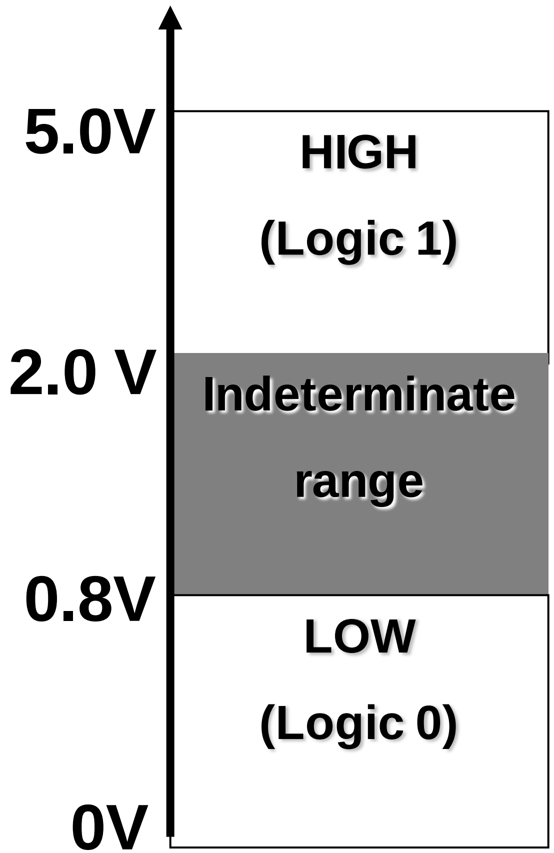
- On the other hand, if the HIGH voltage level represents 0 and the LOW voltage level represents 1, the system is called the negative logic system.



b) Negative pulse

- Normally, the binary 0 and 1 are represented by the logic voltage levels 0V and +5 V.
- So, in positive logic system, 1 is represented by + 5 V (HIGH) and 0 is represented by 0 V (LOW); and in a negative logic system, 0 is represented by + 5 V (HIGH) and l is represented by 0 V (LOW).
- Both positive and negative logics are used in digital systems, but the positive logic is more common.

- In reality, because of circuit variations, the 0 and 1 would be represented by voltage ranges instead of particular voltage levels.
- Example of Voltages Level in TTL family



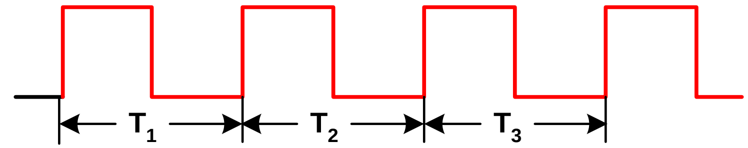
Waveform Characteristics

- Most waveforms encountered in digital systems are composed of series of pulses, sometimes called pulse trains, and can be classified as either periodic or nonperiodic.
- A **periodic** pulse waveform is one that repeats itself at a fixed interval, called a **period (T).** The **frequency (f)** is the rate at which it repeats itself and is measured in hertz (Hz).
- A **nonperiodic** pulse waveform, of course, does not repeat itself at fixed intervals and may be composed of pulses of randomly differing pulse widths and/or randomly differing time intervals between the pulses. An example of each type is shown in Figure.
- The frequency (f) of a pulse (digital) waveform is the reciprocal of the period. The relationship between frequency and period is expressed as follows:

$$f = \frac{1}{T} \Longleftrightarrow T = \frac{1}{f}$$

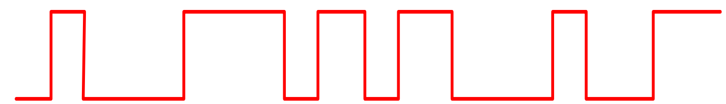
- An important characteristic of a periodic digital waveform is its duty cycle. The **duty cycle** is the ratio of the pulse width (t_W) to the period (T) and can be expressed as a percentage.

$$\text{Duty cycle} = \left(\frac{t_W}{T}\right)100\%$$

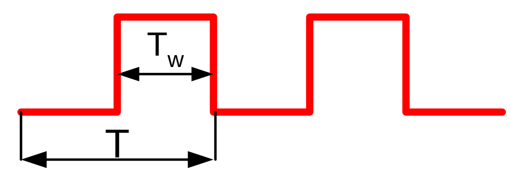


Period = $T_1 = T_2 = T_3 = \ldots = T_n$
Frequency=1/T

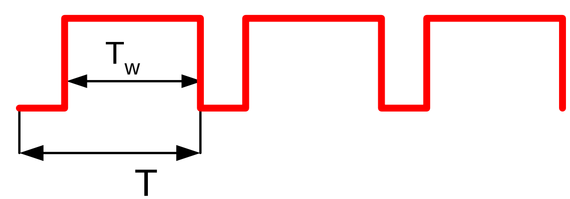
Periodic pulse-train



Non-Periodic pulse-train



Duty cycle = 50%



Duty cycle = 75%