Introduction to Digital system

Physical Quantity

A *physical quantity* (or "physical magnitude") is a physical property of a phenomenon, body, or substance that can be quantified by measurement.

1-Physical quantity representation

I. Analog quantity

An *analog quantity* or signal is one having continous values over limit range.

For example,the air temperature dose not go from,say,$70C^O$ to $71C^O$ instantaneously;it takes on all the infinit values in between.as shown in the figure (1):

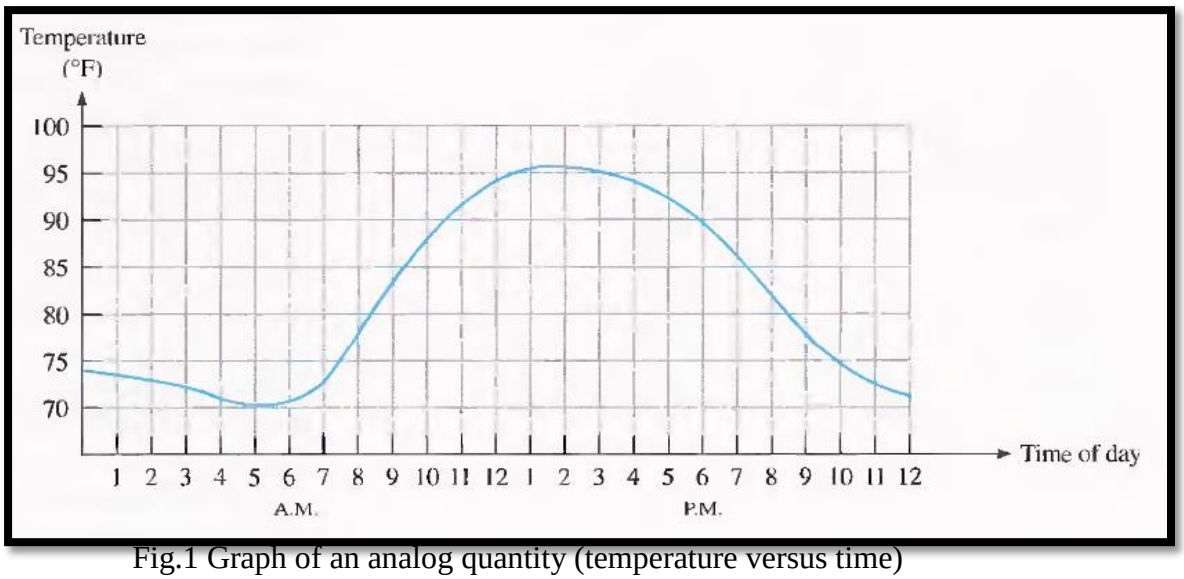

Fig.1 Graph of an analog quantity (temperature versus time)

Other examples of analog quantities are time, pressure, distance, and sound.

An **analog system** contain devices that manipulate physical quantities that are represented in analog form. In an analog system, the quantities can vary over a continuous range of values. Some of the more familiar analog systems include audio amplifiers, magnetic tape recording and playback equipment, and a simple light dimmer switch.

II. Digital quantities

The *digital quantity* or signal is one having a set of discrete values over limit range.In digital representation the quantities are represented not by proportional quantities but by symbols called ***digits.***

For example, suppose you just take a temperature reading every hour. Now you have sampled values representing the temperature at discrete points in time (every hour) over a 24-hour period as indicated in the figure (2):

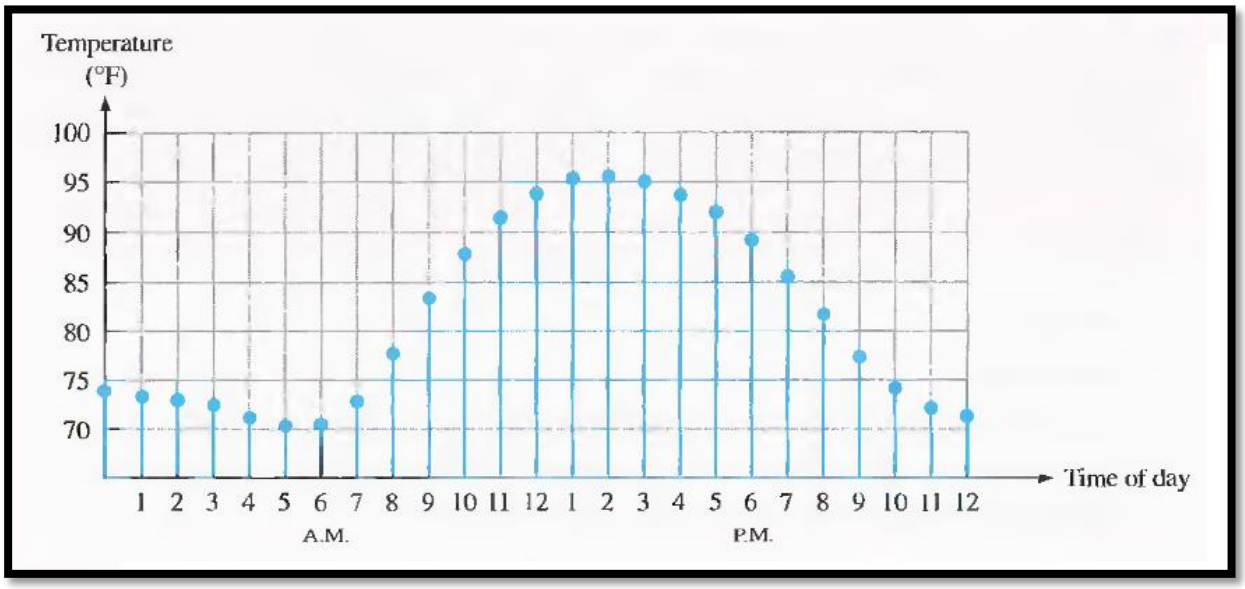

Fig.2 Sampled-value representation (quantization) of the analog quantity in fig.1, each value represented by a dot can be represented by ***binary digits***.

(Two level, or binary values are the most common values)

Digital system is a combination of devices designed to manipulate logical information or physical quantities that are represented in digital form. Some of the more familiar digital systems include digital computers and calculators, digital audio and video equipment, and the telephone system.

3-Digital system advantages

1) Digital system have small size.
2) Digital systems are generally easier to design.
3) Information storage is easy.
4) Accuracy and precision are greater.
5) Operation can be programmed.
6) Digital circuits are not affected by noise. (noise is fluctuations in voltage)
7) More digital circuitry can be fabricated on *IC* chips.
8) Transmitted more efficiently and reliably than, analog data.
9) Regenerative capability.
10) Digital data can be processed.

2-Limitations of Digital Techniques

There is really only one major drawback when using digital techniques

"The real world is mainly analog"

Most physical quantities are analog in nature, and it is these quantities that are often the input and output that are being monitored, operated on, and controlled by a system.

Fig 3 shows a block diagram of this for a typical temperature control system.as the diagram shows, the analog temperature is measured and the measured value is then converted to a digital quantity by an analog-to-digital converter (ADC)the digital quantity is then processed by the digital circuitry, which may or may not include a digital computer. Its digital output is converted back to an analog quantity by a digital-to-analog converter (DAC).this analog output is fed to a controller which takes some kind of action to adjust the temperature.

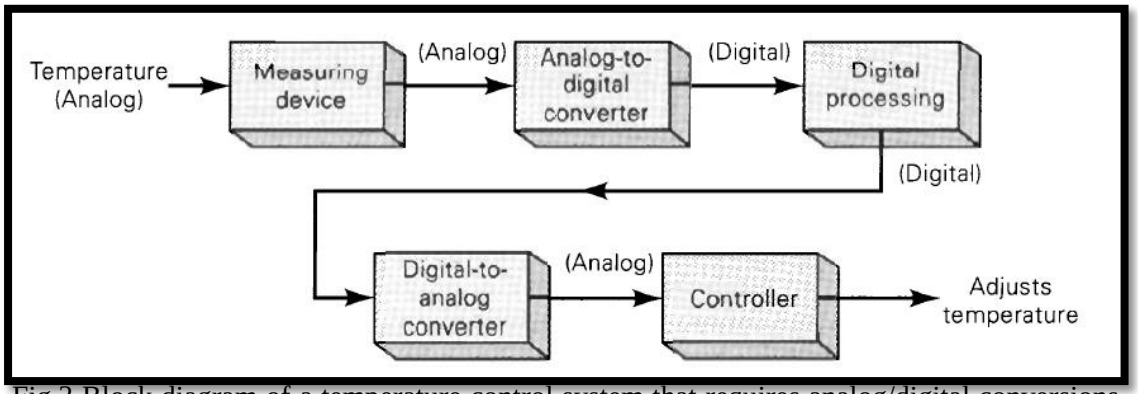

Fig.3 Block diagram of a temperature control system that requires analog/digital conversions in order to allow the use of digital processing techniques