جامعة المستقبل
AL MUSTAQBAL UNIVERSITY

كلية الهندسة و التقنيات الهندسية

قسم هندسة تقنيات الحاسوب

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Introduction to digital system

A digital system is a system that uses numbers as distinct independent values and is a translation of the Latin word digital. Digital system is an expression often used in devices that rely on electrical tension as their input, and often refers to the binary system in counting based on values 1 and 0 and is different from the analogue system (Analog). The difference between the digital and analog system lies in the quality and shape of the signal in terms of its amplitude or value, as well as in terms of the time it occupies. An analogue signal can take any value in continuous and uninterrupted time, while a numeric takes only one of the values recognized in the system within continuous or intermittent times.

More deeply, the term digital refers to the fact that the signal is limited to only a few possible values. In general, digits signals are represented by only two possible voltages on a wire - 0 volts (which we called "binary 0", or just "0") and 5 volts (which we call "binary 1", or just "1"). We sometimes call these values "low" and "high", or "false" and "true". More complicated signals can be constructed from 1_s and 0_s by stringing them end-to-end, like a necklace. If we put three binary digits end-to-end, we have eight possible combinations: 000, 001, 010, 011, 100, 101, 110 and 111. In principle, there is no limit to how many binary digits we can use in a signal, so signals can be as complicated as you like. The figure below shows a typical digital signal, firstly represented as a series of voltage levels that change as time goes on, and then as a series of 1s and 0s.

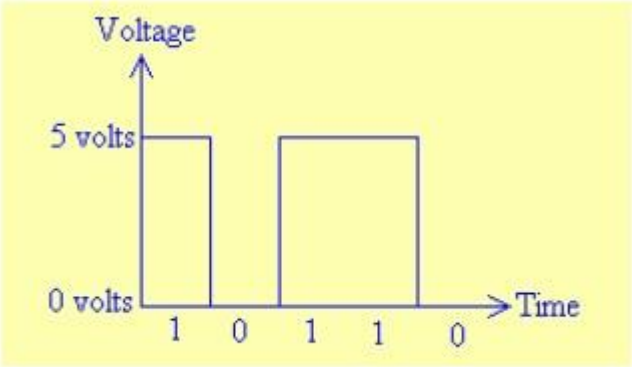

Figure 1: A digital signal

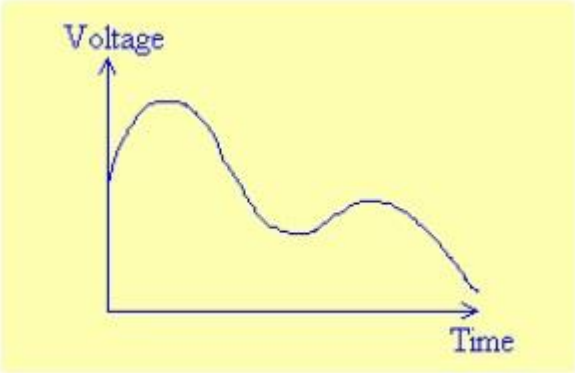

Figure 2: An analog signal

The broader scope of use of a digital or binary system is computers and electronic devices in general. The digital system is electrically expressed by electrical impulses often where in a digital system based on the binary system the values can be represented as follows: 1 there is a positive pulse (a voltage of a specific value (e.g. 5 V) for a specific duration), 0 there is no voltage (e.g. 0 V) for the same duration.

Different topics in digital systems

Many different topics in the digital system. Perhaps the most important topics are:

- ***Data Representation***

Data is represented in a digital system as a vector of binary variables. In a digital system, i.e. a system in which data variables take on a finite number of discrete values, it is always possible to represent or code these values as a vector of binary variables. A binary variable corresponds to a binary digit and is called a BIT. A binary variable has only two possible values. It is standard practice to designate these two values with the symbols 0 and 1. Other common symbols for binary variables are:

0 == False == Low

1 == True == High

Electrical Representation of digital data

Virtually all digital logic components in existence today are designed to generate binary signals only. Each binary state is represented by a range of voltages. The specific definition of logic levels in terms of voltage ranges can vary with different integrated circuit technologies, but for most circuits, can be defined as follows:

Logic 0: 0 - 0.8 volts

Logic 1: 2.0 - 5.0 volts

Any voltages between 0.8 volts (the upper limit of a logic 0) and 2.0 volts (the lower limit of a logic 1) are undefined. Digital components will not generate voltages in this undefined zone (unless they are faulty). Thus there can be no confusion between a logic 0 level and a logic 1 level because they are separated by this "no-fly zone".

In an electronic digital system, each bit is represented by a unique electrical signal. One of the implications of this is that in order to perform a function on a multi-bit variable, multiple circuits are needed. For example, to add two 16 bit numbers, 16 adder circuits are required - one for each pair of bits.

In an analog electronic system, data is represented by the magnitude of the signal voltage. For example, a value of 4 may be represented by a voltage of 4 volts, and a value of 7 by a voltage of 7 volts, etc. To perform a function only a single circuit is required. At the same time, very low signal voltages (less than a few millivolts) can be obscured or distorted by low level electrical noise that is always present in an electronic circuit.

Digital Representation of Data

For variables which must take on a range of values beyond that of a single bit, multiple binary variables can be weighted and grouped together. Example: The variable COUNT whose range of values is to be 0 through 7, can be made up of the binary variables C2, C1 and C0.

COUNT	C2	C1	C0
0	0	0	0
1	0	0	1
2	0	1	0
3	0	1	1
4	1	0	0
5	1	0	1
6	1	1	0
7	1	1	1

When, in an electronic digital system, groups of signals are used to represent multi-bit variables, they are often referred to collectively as a bus. The signals C2, C1, and C0 depicted above, could be referred to as the COUNT bus.