CHAPTER 2.
2. **Data System Components**

Certain details of data system components like A/D, D/A, comparator & filters are given in this chapter. When used in systems, these are often used in conjunction with (analog and/or digital) converters to measure input signal or to perform processing[15].

With digital techniques, the principal challenge is the combinational ingenuity, equipment architecture, decreasing the cost and complexity of inter connections. In both techniques debugging is required wherein anticipation fails. Digital circuits have high noise immunity, no drift, high speed and low cost. The rules for selecting and using them are simple [16].

2.1. **Sample Hold Circuits**

In several interface systems, the signal varies quite rapidly calling for some subtlety in the interface linkage. Because A/D converter takes a finite time to digitize the input signal, changes
in this signal level during the actual conversion process could result in gross errors. The finite conversion period would result into erroneous digital values and never truly represent the data level prevailing at that instant.

Sample-hold devices are typically introduced to make a fast acquisitions of the varying analog signal, and to hold this steady signal for the duration of the conversion. However, these devices increase the effective cost of the system. Samplehold circuits are also used in multichannel systems where they enable each channel to receive and hold individual signal levels for activation of different output processes, usually, a data acquisition samplehold circuit can update more leisurely (in milliseconds or seconds) [16].

2.2. A/D Converters:

These devices convert analog input data—usually voltage into its equivalent digital form. Key characteristics of A/D converters may include absolute
and relative accuracy, linearity, monotonicity, resolution, conversion speed, stability, and price[16]. Other aspects open to choice include input range digital output codes, and physical size.

The successive approximation technique is used for a very large numbers of applications due to its excellent compromise between speed and accuracy. The popular alternatives include counter-comparator types and dual ramp approaches. The dual ramp is widely used in digital voltmeters. The other converters are described [16].

2.3. D/A converters:

These devices reconstitute the original analog data after processing, storage or even simple transmission from one location to another in digital form. The basic converter consists of an arrangement of weighted resistance value (or divider ratios), each controlled by a particular level or significance of digital input data, that develops varying output voltages or currents in accordance with the digital input code.
Although converters have fixed references, for most applications, a special class of D/A converters exist, having a capability of handling variable and even ac reference sources. These devices are termed multiplying DAC's because their output value is the product of the number represented by the digital input code, and the analog reference voltage. In some instances, such as ac measurements and resolver synchro conversion the multiplying convert's weighted divider circuitry is based on tapped transformers (instead of precision resistors). The turns ratio have excellent long-term stability and immunity to temperature effects.

2.4 Filters:

Filters are used on the input side of an A/D converter to remove undesirable components of the input signal. Noise and line frequency pickup are also attenuated in this process, but at the expense of reduced transient response. Filters are also used on the analog output from D/A converters, in
order to smooth out the lumps created by discrete digital values. Often, the electromechanical device being actuated by a D/A converter (e.g. d'Arsonval meter, servo motors, magnet coils, loud speakers etc.) acts as a filter in its own right owing to substantial electrical inertia.

2.5 **Comparators:**

Conversion systems involve both analog and digital comparators. For example the A/D conversion process involves balancing the unknown input voltage against some form of internally produced reference. A comparator responds to the polarity of the inequality between input and reference. More rarely, comparators are used as fast, high gain (open-loop) amplifiers [16]. Digital comparators, as their name implies, are used on digitized, rather than analog forms of data. For example, a digital comparator might be used in set-point control to provide considerably better accuracy, resolution, and stability, than is possible with an equivalent analog process.
2.6. **Multiplexers:**

If data from many independent signal sources are to be processed by the same computer or communication channel, a multiplexer is usually introduced to couple the input signal into the A/D converter in some sequence. Additional logic keeps track of the specific data source to be coupled to the converter at any instant.

Multiplexers are also used in reverse. For example, when the converter must distribute analog information to any different channels, the multiplexer, fed by a high-speed output D/A converter, continually refreshes the various output channels with computer-generated information [16].

2.7. **Digital Multiplexing:**

Often, digital distribution system uses no device that specifically goes under the label of digital multiplexer. Unlike the comparable process of shunting analog information, from one to many output channels (through a single D/A converter or from many sources to a single A/D converter) the
digital multiplexing function is often delegated to the digital devices being multiplexed.

For example, if many digital sources must be multiplexed into a central computer or data transmission channel, they are usually tied to the computer by a common set of parallel bus lines [16].

Commands from the computer then instruct the individual sources which one among these is freed from its burden. Conversealy if the computer is bent on updating a number of digital output registers (each of which might be connected to a D/A converter), the updating process is accomplished by computer commands that strobe the selected register to accept the data being transmitted. Since only the register instructed to receive the data can do so, the remaining registers are ignored [16].

It is necessary to strike a compromise between ideal requirements and cost criteria depending upon the required level of accuracy [6].