Overview of Interfacing Data Converters with 8085 Microprocessor and its application

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Abstract- Sometimes the information available for processing in a microprocessor-based system is in digital form while in most cases it is available in analog form. For example, the outputs of the digital voltmeter, digital frequency meter, digital clock, and calculators, etc. are available in digital form but most physical quantities such as temperature, pressure, light, voltage and current, etc. gives information in analog form. It is often necessary to convert the information in one form to another form for interfacing with the system.

Index terms- A/D and D/A converters, binary ladder, comparator, control unit, binary counter, clock pulse, integrator, logic gates, integrated circuits.

Introduction

It converts digital data into the equivalent analog current. Therefore I to V converter is used to convert analog output current of DAC to an equivalent analog voltage. PA0-PA7 pins of Port A are connected to D0-D7 pins of DAC. ADC (Analog to Digital Converter) works with Intel 8085 Microprocessor. The Analog to Digital Conversion is a quantizing process. Here the analog signal is represented by equivalent binary states. The A/D converters can be classified into two groups based on their conversion techniques [1].

In the first technique, it compares given analog signal with the initially generated equivalent signal. In this technique, it includes successive approximation, counter and flash type converters. In another technique, it determines the changing of analog signals into time or frequency. This process includes integrator-converters and voltage-to-frequency converters. The first process is faster but less accurate; the second one is more accurate. As the first process uses flash type, so it is expensive and difficult to design for high accuracy [2].

II. HISTORY

Initially Microprocessor was designed by the United States of America and BUSICOM of Japan in the year 1971. The first Microprocessor Intel 4004 was a 4 bit P-type Metal Oxide Semi-Conductor (PMOS) Microprocessor. [3] Intel introduced two 8 bit microprocessors 8008 in the year 1972 and 8080 in 1973. The 2nd one was the most popular microprocessor of the early 70s. 8080 was an NMOS microprocessor. NMOS microprocessor is popular than PMOS as NMOS technology is faster and provide higher density than that of PMOS. The enhanced version of 8080 was 8085 [1, 7]. Microprocessor 8085 was introduced by Intel in the year 1977 [8]. The clock and controller of Intel 8080 were on a separate chip and it utilizes two separate power supplies. So 8080 was not a complete CPU on a single chip. But Intel 8085 has its clock and control circuit fabricated on a single chip [1]. The model number “5” came from the fact that Intel 8085 requires only +5-volt (V) power supply by using depletion-mode of transistors. This kind of chip requires a minimum of external units like RAM, ROM, 8-bit latches, etc [8].

III. MICROPROCESSOR COMPATIBLE D/A CONVERTER

Nowadays microprocessor compatible D/A converters are also available, which are designed to directly interface with the microprocessor without the use of external latch. Among such converters, AD558 is a very simple, inexpensive and commonly used D/A converter to be connected directly to the microprocessor.
The ADC 0808/0809 is an 8-bit A/D converter with 8-channel multiplexer which can be interfaced with the microprocessor. It is the most popular, inexpensive and widely used A/D converter. It is a monolithic CMOS device which uses the method of successive approximation A/D converter. It does not require external zero and full scale adjustment. The device operates with +5 V d.c. supply. The conversion time is 100 μsec at clock frequency of 640 KHz. The 8-channel multiplexer can directly access any of the 8 single ended analog signals.

The ADC 0808 / 0809 offers following features:
- High speed
- High accuracy
- Minimal temperature dependence
- Excellent long term accuracy and repeatability
- Consume minimal power

The pin diagram and schematic block diagrams of this IC ADC 0808 / 0809 are shown in figures 4.1 respectively. The pin description of this IC is given as:

Pins 26-28 and 1-5 – are 8 input channels IN0– IN7 (multiplexed), which are selected by the three (address) lines ADD A, ADD B and ADD C.
Pins 6 SOC – Start of conversion pin. A high to this pin starts the conversion.
Pins 7 EOC – End of conversion. This an output terminal and gives high signal when the conversion ends.
Pins 21-18, 8, 15-14 & 17 8-bit outputs (latch) pins to be connected to the port of 8255.
Pins 9 OE – Output enable pin which is connected to the positive supply.
Pins 10 CLK – Clock terminal. It is to be connected either to the external clock of frequency between 10 to 1280 KHz or the clock out frequency of the 8085A after dividing it by a factor of four may be connected to this pin.
Pins 11 VCC – Supply pin (+5 V).
Pins 12 Ref (+) – Reference pin which is to be connected to the + supply.
Pins 13 GND – Ground terminal.
Pins 16 Ref (-) – Reference pin to be connected to the ground.
Pins 25-23 – Address pins (ADD A, ADD B and ADD C). These pins are used to select the channels as given below (Table 4.1):

<table>
<thead>
<tr>
<th>Channels Selected</th>
<th>Address lines</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>C</td>
</tr>
<tr>
<td>IN0</td>
<td>0</td>
</tr>
<tr>
<td>IN1</td>
<td>0</td>
</tr>
<tr>
<td>IN2</td>
<td>0</td>
</tr>
<tr>
<td>IN3</td>
<td>0</td>
</tr>
<tr>
<td>IN4</td>
<td>1</td>
</tr>
<tr>
<td>IN5</td>
<td>1</td>
</tr>
<tr>
<td>IN6</td>
<td>1</td>
</tr>
<tr>
<td>IN7</td>
<td>1</td>
</tr>
</tbody>
</table>
The timing diagram of IC is shown in figure 4.2.

![Timing Diagram]

Fig. 4.2 interfacing connection of ADC 0808/0809

The interfacing connection of ADC 0808 / 0809 with the microprocessor 8085A is shown in figure 4.2. In this circuit an analog voltage, whose equivalent digital value is to be obtained, is applied to IN0. The output terminals of the ADC are connected to Port A of 8255 PPI. This port is to be used as the input port. The PC7 terminal of the Port CUpper is connected to the End of Conversion terminal of the ADC. This port is also used as the input port. The port CLower is used as the output port. The three terminals PC0 to PC2 are connected to the three address pins of the ADC 0808 / 0809 for the selection of input channel. The PC3 terminal is connected to the SOC (Start of Conversion) and the ALE terminals of the converter.

V. A/D CONVERTER USING D/A CONVERTER AND SOFTWARE

The A/D converter can also be realized using the D/A converter and the software. For this purpose the software is used to implement successive approximation A/D converter. Figure 5.1 shows the interfacing connection for this. The input analog voltage is applied to a comparator. This voltage is compared by the output of the D/A converter. The output of the comparator is sensed by the microprocessor through the PC7 of the 8255. A digital input is applied to the D/A converter, through port A of 8255.

![Interfacing Connection]

Fig. 5.1 interfacing connection

The microprocessor first applies 00 H as the digital input to the DAC 0808 and checks through PC7 for high signal. If a high pulse does not appear at the output terminal of the comparator, the microprocessor increments the digital input by 1 and the process is repeated till a high signal appears at the output of the comparator. As a high signal appears the microprocessor stops successive approximation and the corresponding digital input value is stored in the memory location. This digital value is equivalent to the analog signal applied at VIN terminal of the comparator [5].

VI. APPLICATION

Basically, Microprocessor is designed for small and dedicated applications. But gradually they are used in variety of applications from small household to large applications. They include day to day applicable equipment like gaming console, DVD players, television, tools of car, test instruments, light dimmers, smoke alarms, hi-fi audio visual components, credit card processing systems. It is used in communication systems like digital telephone sets, satellite communication system, radar system etc. It is also used in various medical devices like ECG (Electro cardiogram), EEG (Electro Encephalogram), Ultra sound machine, alcometer etc. Some applications require powerful low cost microprocessors and some having costly, complex one. Usually non programmable controls would require bulky, costly and complex implementation to obtain the results possible with microprocessor. One of the advantages of microprocessor is that it allows
upgrading in performance with minimal redesign of the product and minimum production cost. Intel 8085 has a set of instructions like MOV, MVI, STA, ADD, DIV, JMP etc. Using these kinds of instructions, microprocessor performs various operations like transfer of data, addition, subtraction, branching, storing etc [6, 8].

Some other following applications are:
- Real time clock with on/off timer
- Microprocessor based led dial clock
- Design of microprocessor based running light
- Microprocessor based automatic school bell system
- Microprocessor based traffic light
- Microprocessor based stepper motor control
- Microprocessor based washing machine controller
- Microprocessor based water level controller
- Microprocessor based temperature controller

VII. CONCLUSION

After the study of all the details of microprocessor 8085, including the assembly language programming and peripheral devices we are now in a position to design some microprocessor based systems. Real time clock with on/off timer, running light, washing machine control, water level control etc. This process includes integrator-converters and voltage-to-frequency converters. The first process is faster but less accurate; the second one is more accurate. As the first process uses flash type, so it is expensive and difficult to design for high accuracy.

Microprocessor reduces cost of processing power, increases reliability focuses on real time applications and it is faster in speed also. It is used in smallest embedded system to largest main frames and super computers. Due to its wide verities of uses it has revolutionized the human civilization.

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