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Expanding Ports of Microcontroller Using Latches

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Abstract: This is an era of mini-computers. The growing demand of low cost automatic systems has brought our focus on microcontrollers in the field of embedded system. Today, microcontrollers are integrated into many appliances that are in use, e.g. household appliances, telecommunication, automotive industry, aerospace industry, industrial automation. While designing some appliances we find ourselves stuck with the number of input output ports available with the microcontroller. In this article, we present a way-out for this problem. This article describes how a single port can be expanded using latch.

Keywords: ATmega32, microcontroller, multiplexing, decoder, latch, seven-segment.

I. INTRODUCTION

A Microcontroller is a low-cost mini-computer on a chip designed to perform a dedicated task. Microcontroller contains on chip CPU, input/output interface, memory, clock, timer, etc embedded into a single unit. Hence, reduces the size and the cost. Today, microcontrollers are integrated into many appliances that are in use, e.g. household appliances (microwave, washing machine, coffee machine, etc), telecommunication (mobile phones), automotive industry (fuel injection), aerospace industry, industrial automation. While designing some appliances we find ourselves stuck with the number of input output ports available with the microcontroller. This paper article describes how to expand a port using latch. Here we have interfaced two dual digits 7-segments onto a single port. We know that driving a 7-segment requires eight pins. This means one complete port of a microcontroller. Let's see how this is done.

II. METHODOLOGY

To use a single seven segment we require eight pins to drive 8-bit data. Each port of a microcontroller used here is 8-bit wide. Therefore to interface four 7-segments we need 32 pins of microcontroller. This means using all four ports of the microcontroller which is not appropriate incase if we want port for other peripherals. Therefore, we have used a technique known as MULTIPLEXING. Multiplexing is done with the help of Latches and Decoders. A latch is a flip flop or combination of flip flops. The job of a flip flop is to hold/ store a single data bit at a time. With a latch circuit a simple output port can be implemented. Latches have data inputs data outputs and clock input. When clock input is supplied with low to high pulse, the data on the input pins are stored in the internal flip flop of the latch. In this system we have used 74LS373 IC for latching the data bits. It is a transparent latch with 20 pins.

It consists of an eight latches with three state outputs. It comprises of eight input data lines (D0-D7) and eight output lines (O0-O7). The two control pins are Output Enable (OE) and Latch Enable (LE/G). The remaining two pins are VCC and GND. The figure 1 shows the pin diagram of 74LS373. When the LE/G pin is high the latch data changes asynchronously. When the LE pin is pulled low, the data is latched so that the data appears on the output pins. When the OE pin is low, input data appears on the output is in high impedance state which means that there will not be any change in output even by changing the input.

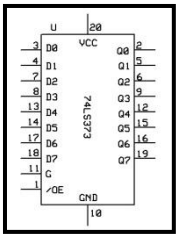

Figure 1: 74LS373 pin diagram [1]

The connections are as shown in circuit diagram below. Here we have used Atmega32 microcontroller. Both the latch ICs are multiplexed at PORT C of ATmega32 microcontroller IC. To decide, out of two latches which latch is enabled these two pins (PD4 and PD5) are made high and low accordingly. The decoder / driver that have been used here is 74LS47. It is a binary coded decimal to 7-segment decoder. This IC is used when there is a need to display numbers on 7segment without using a processor. It accepts a BCD as input and converts it into a pattern to drive 7segment for displaying digits 0 to 9. Binary coded decimal is an encoding in which each digit of a number is represented by its own binary sequence of 4-bits.74LS47 IC accepts 4 lines of BCD input and generates their compliments. The data is decoded with 7 AND / OR gates to drive indicator LED of 7-segments directly.

The dual digit 7-segment used in the system is connected in Common Anode mode and the output of 74LS47 corresponds to Common Anode (CA) configuration of 7-segment. Hence, this 74LS47 IC is the choice of requirement.

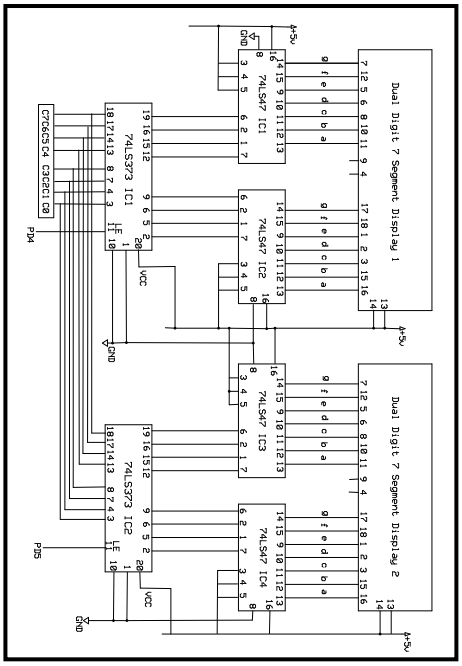

Figure 2: Multiplexing port using latch

III. RESULT

The result is shown figure 3. The two dual digits 7-segment display two different numbers at the same time as can be seen in figure.

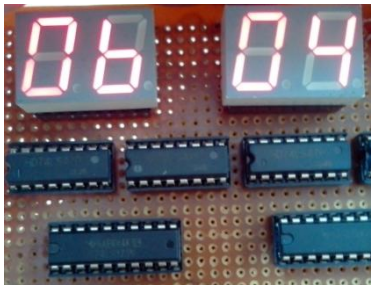

Figure 3: Snap of Experiment

IV. CONCLUSION

The result showed successful execution of the work. Hence in the same way we can multiplex other ports of microcontroller too thereby creating more than four ports.

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