INTERNATIONAL INSTITUTE OF INFORMATION TECHNOLOGY
HYDERABAD

DIGITAL SYSTEMS AND MICROCONTROLLERS

Experiment - 4 **Monsoon 2018**

Multiplexing and Demultiplexing

A multiplexer (or mux) is a device that selects one of several analog or digital input signals and forwards the selected input into a single line A multiplexer of 2^n inputs has n select lines, which are used to select which input line to send to the output.

Conversely, a demultiplexer (or demux) is a device taking a single input signal and selecting one of many data-output-lines, which is connected to the single input. A multiplexer is often used with a complementary demultiplexer on the receiving end.

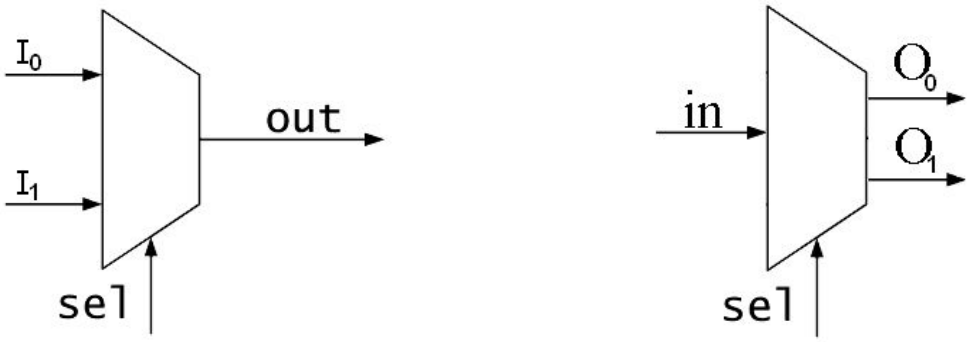
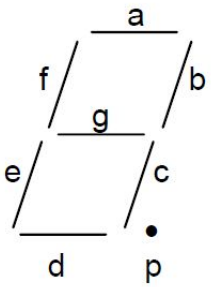


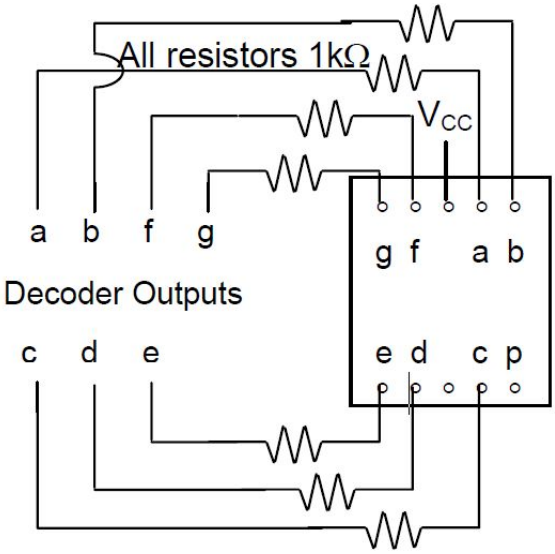
Fig.1 Multiplexer and Demultiplexer

7-Segment Display:

A 7-segment display consists of seven segments designated as a, b, c, d, e, f and g in a clockwise sequence, and a dot (p) for displaying the decimal point, if necessary, as shown in Fig. 4.1(a). In a 7-segment LED display, either all the anodes or all the cathodes of the LEDs in the seven segments are tied together and brought out at a single pin, and the device is accordingly called either a common-anode or a common-cathode display. In this experiment, we will use a common-anode display, and so the Arduino outputs are applied through resistors placed in series with the cathode of each segment. This arrangement, indicated in Fig. 4.1(b), has already been assembled on the breadboard for your use. Do not disturb it when you dismantle the circuit assembled by you after finishing the experiment. Note that each segment is lighted when the corresponding decoder output, also denoted by a, b, c, d, e, f and g, is LOW.



Digit	OFF Segments
0	g
1	a d e f g
2	c f
3	e f
4	a d e
5	b e
6	b
7	d e f g
8	-
9	e



(a) (b)

Fig.2 Nomenclature and Organisation of a 7-segment LED Display

Experiment:

The objective of this experiment is to design, assemble and test a Mux and Demux (whose select lines are through Arduino) in combination with a 7-segment Display.

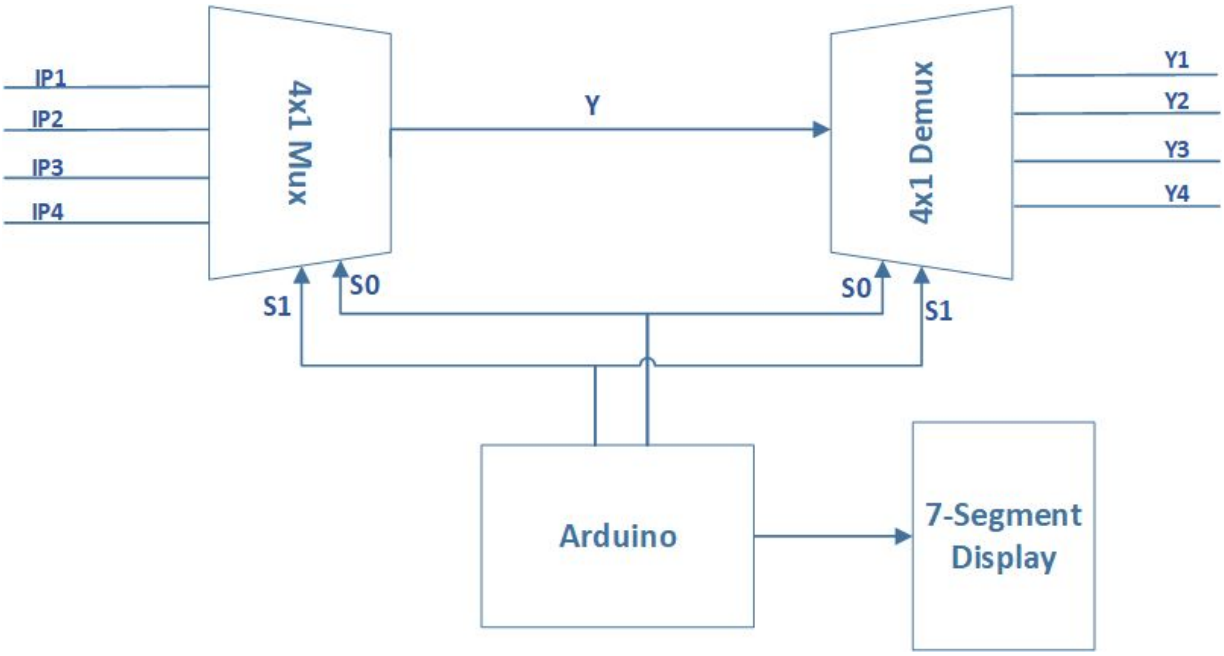


Fig.3 Block Diagram of the Experiment

Write a program to take input as number from the 'Serial Monitor' of arduino and corresponding number is put on the select lines (Eg: 0,1,2,3 puts 00, 01, 10, 11 respectively). Let's say if '2' is given as input, then the third input at mux should be seen at third output of demux as the select lines are 10 respectively. Also the number selected on 'Serial Monitor' should be displayed on the 7-segment display.

We will be using 4-input multiplexers (74LS153) and 4-output demultiplexers(74LS139). The pin connections of these ICs are as follows

For the IC 74LS153 (Mux) the data inputs are denoted by X0, X1, X2, X3, the data output denoted by Y, and the (negative-logic) output enable (strobe) input denoted by G' for each multiplexer, with 1 or 2 preceding the symbol to distinguish the two multiplexers. S1 and S0 are the select inputs common to the two multiplexers. For each multiplexer, Y = Xn (selected data input) if S1S0 = n (in binary code) only if G' = 0, and Y is LOW if G' = 1. Test the three given multiplexer chips one by one by connecting VCC and Gnd appropriately and applying G' and appropriate inputs from the Input Switches.

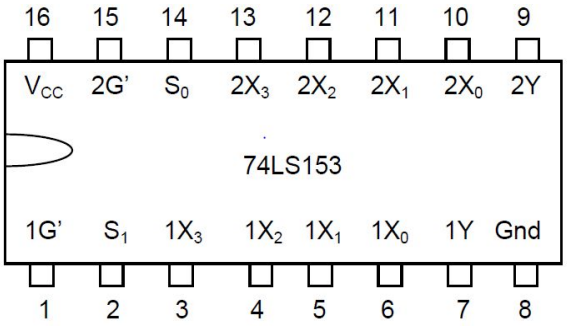


Fig.4 Mux IC 74LS153

Verify the multiplexer function by tabulating the values of the output(s) for all input combinations.

Similarly for the IC 74LS139 (Demux) the inputs are denoted by E_a and the data outputs are denoted by $O_{0a}O_{1a}O_{2a}O_{3a}$ and the select lines are A_{0a},A_{1a}. Test the given demultiplexer chips by connecting VCC and Gnd appropriately and appropriate inputs from the Input Switches. Verify the demultiplexer function by tabulating the values of the outputs for all input combinations.

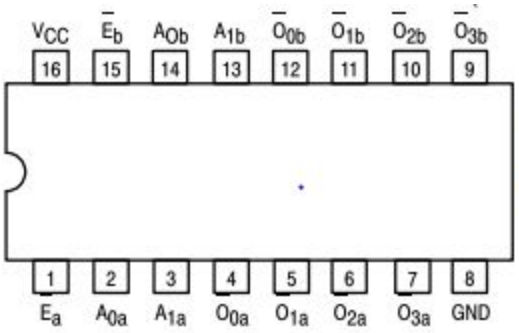


Fig.5 Demux IC 74LS139

Connections:

Connect VCC and GND to both mux and demux.The inputs of the mux IC are taken from any 4 of the IP1 to IP12 inputs on the kit. The output of the Mux is given as the input to Demux and the select lines for the both mux and demux are taken from the arduino.

Connect the outputs of the demux to the any of the 8 LED's of the Digital Kit. Use 7 digital pins from the arduino, connect them to 7 segment display to display the number given to the arduino as input.