Keyboard And LED Grid Display

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Introduction

We have made a Keyboard and a LED Grid Display system .One can write anything from keyboard and it will be displayed on the grid.Our project can be used in places like Bank to show a token number ,on shops to show prises etc.

System Overview

A block diagram of the system is given in Fig. 1.

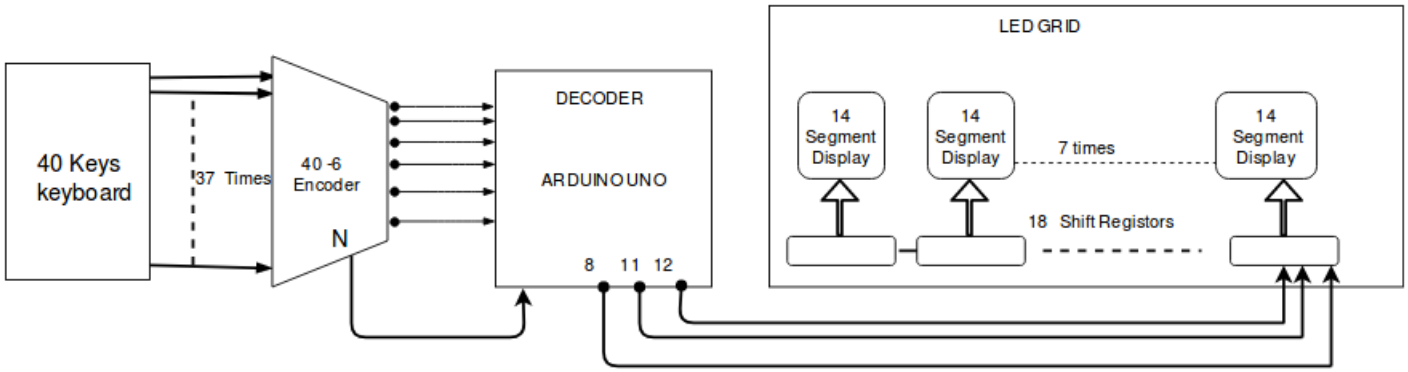

Fig. 1: Block Diagram

Keyboard

- Keyboard is having 40 keys 0-9,A-Z,decimal point,space,backspace and reset.
- We have used Momentary Push button Normally open switches to make it.
- Output of keyboard is 40 bit one hot code.
- Output of keyboard is named as I_0 to I_{39}.

Encoder

- Output of Keyboard is the input to the encoder.
- It encodes 40 bits into 6 bits which represents the number of the key pressed.
- Equations for encoder are as follows

$$Q_0 = I_1 + I_3 + I_5 + I_7 + I_8 + I_9 + I_{11} + I_{13} + I_{15} + I_{17} + I_{19} + I_{21} + I_{23} + I_{25} + I_{27} + I_{29} + I_{31} + I_{33} + I_{35} + I_{37} + I_{39}$$

$$Q_1 = I_2 + I_3 + I_6 + I_7 + I_{10} + I_{11} + I_{14} + I_{15} + I_{18} + I_{19} + I_{22} + I_{23} + I_{26} + I_{27} + I_{30} + I_{31} + I_{34} + I_{35} + I_{38} + I_{39}$$

$$Q_2 = I_4 + I_5 + I_6 + I_7 + I_{12} + I_{13} + I_{14} + I_{15} + I_{20} + I_{21} + I_{22} + I_{23} + I_{28} + I_{29} + I_{30} + I_{31} + I_{36} + I_{37} + I_{38} + I_{39}$$

$$Q_3 = I_8 + I_9 + I_{10} + I_{11} + I_{12} + I_{13} + I_{14} + I_{15} + I_{24} + I_{25} + I_{26} + I_{27} + I_{28} + I_{29} + I_{30} + I_{31}$$

$$Q_4 = I_{16} + I_{17} + I_{18} + I_{19} + I_{20} + I_{21} + I_{22} + I_{23} + I_{24} + I_{25} + I_{26} + I_{27} + I_{28} + I_{29} + I_{30} + I_{31}$$

$$Q_5 = I_{32} + I_{33} + I_{34} + I_{35} + I_{36} + I_{37} + I_{38} + I_{39}$$

- Q_0 to Q_5 remain zero when there is no input available.

- There is one more output 'N' which goes high whenever a key is pressed.
- When key corresponding to Zero is pressed ,Q_0 to Q_5 remain zero.
- Therefore equation for 'N' we got is

$$N = Q_0 + Q_1 + Q_2 + Q_3 + Q_4 + Q_5 + I_0$$

- We used Diode logic to implement these equations.
- Components used
  - 108x1N4148 Diodes.
  - 1xGeneral Purpose PCB.
  - 40xFemale and 7xmale wire holders.
  - 7x10k resisters.
  - 7xLEDs

Decoder

- It decodes 6 Bits received from Encoder into 14 Bits which are required to light the LEDs on 14 segment Display
- We wrote 14 boolean functions of 6 variables (received from Encoder) corresponding to each LEDs.
- To implement these functions in hardware were requiring 97 AND Gates and 67 OR gates and one GATE was costing 10 rupees,thus it was not cost efficient.
- We Implemented these functions in Arduino UNO which is easy to program.

LED Grid

- 14 Segment display is made to display a character.
- To give a better appearance of character one segment is made using 30 LEDs although it is 14 segment.
- Grid contains 10 such segments.
- Components used
  - 300xLEDs
  - 7xGeneral Purpose PCBs

Memory Element

- A memory element to store 140 bits were required on the Grid.
- We have used shift registers as memory elements.
- 18x 74HC595 shift registers are used
- They are serial IN and serial and parallel OUT type shift registers and one register can store 8 bits at a time.
- We have connected serial OUT of one register to serial IN of other and input is feed to serial IN of first register.
- Parallel OUT of each register is connected to LEDs on LED Grid.

Results

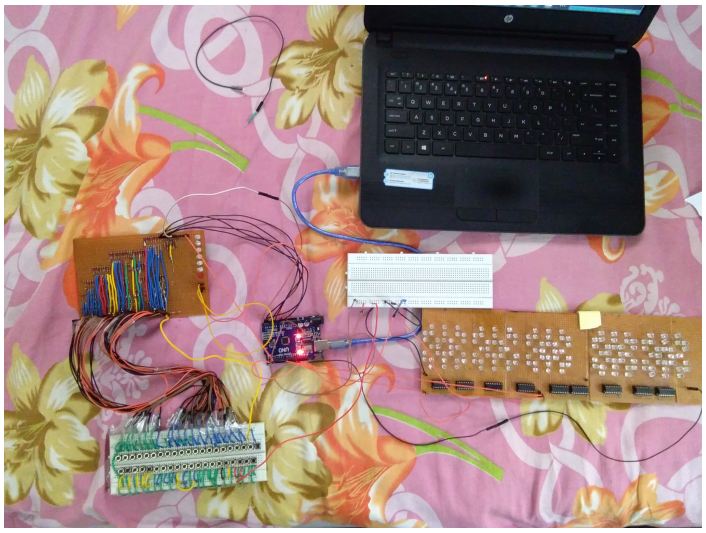

Fig. 2 A Photograph of project

Conclusion

Logically the project was easy but actual load was in hardware implementation.There were many milestones in the project as for hardware implementation of decoder was requiring 164 Gates which was not practically good, for this we decided to use Programmable Logic Array ICs but they were not available commercially and are outdated thus we have chosen micro-controller (Arduino UNO) for this job.And also for storing 140 bits first we decided to use D-Latches but they were also not available thus we used Shift Registers instead. 70% of the total work in project was of *Soldering* which required lot of patience and effort.

References

[1] Tutorial for using shift registers `https://www.arduino.cc/en/Tutorial/ShiftOut`