Undergraduate Academic Research Journal

Volume 1 | Issue 1 Article 15

July 2012

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Recommended Citation
Mitra, Sneha; Saha, Sohini; and Sinha, Sagnik (2012) "Alternative Keyboard Based on Infrared Technology," *Undergraduate Academic Research Journal*: Vol. 1 : Iss. 1 , Article 15.
Available at: https://www.interscience.in/uarj/vol1/iss1/15

Alternative Keyboard Based on Infrared Technology

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***Abstract* -** A keyboard is a commonly used input device that facilitates human computer interaction by allowing the user to enter commands by physically pressing units called keys. The keys can be physically embedded on the system or can be a logical concept (such as on touchscreens [x]).

In this paper we discuss the aspects of a novel keyboard, its circuit, its working model and efficiency. This keyboard uses the principle of infra red emission and reception which generates an active low signal on placing an obstruction between the emitter and receiver.

I. INTRODUCTION

The main problem with contemporary keyboards is dust accumulation under the keys and portability. Even though certain designs exist that partially cover these problems, we have proposed a design which using infrared emitters and digital logic can overcome most of these problems particularly with dust accumulation and durability of each key.

In this paper we consider a 16 key keyboard consisting of the hexadecimal digits. In order to demonstrate the working of this keyboard we shall be using 2 Seven Segment Displays(SSDs). Our concept however can be extended to any number of keys and is compatible with any conventional layout. This infrared keyboard's working principle is based on the fact that an active low infra-red receiver generates a signal when an obstruction is posed by the typist. The main objective of this design is to increase the efficiency of the pre-existing keyboards while maintaining the current cost of production.

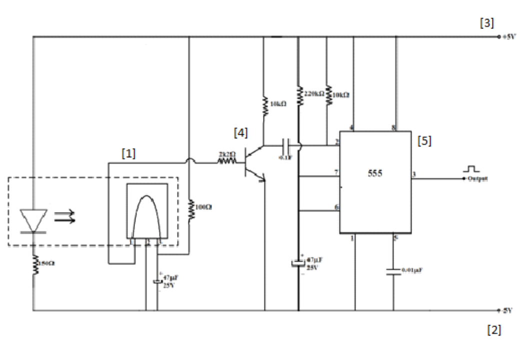

Figure 1

II. WORKING PRINCIPLE

Our working principle is divided into two parts. The first being the design of the individual keys and their working and the second, being how to make the keyboard collapse in order to save space.

A. *Key Design*

As mentioned before the keys have at least one infra red emitter and receiver pair. Our convention is that, if the user breaks the line of sight of any pair then that corresponding key is assumed as 'pressed'.

The following sections shall elaborate on how this is achieved.

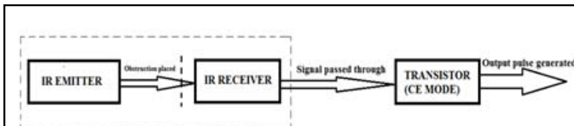

Figure 2

We use a 3 pin active low IR receiver (transmitter) (1838T)[1].

Some features of 1838T:

1. Photo detector and preamplifier in one package
2. Internal filter for PCM frequency
3. TTL and CMOS compatibility
4. Output active low
5. Improved shielding against electrical field disturbance

6. Suitable burst length ≥6 cycles/burst
7. Small size package
8. Enhanced immunity against all kinds of disturbance light
9. No occurrence of disturbance pulses at the output
10. Short settling time after power on (<200s)

Here the first pin generates the output, second one is grounded[2] and the third one is for Vcc [3]connection. The output if and when generated is 50mA (maximum) which is amplified using an npn transistor (BC547)[4] in common emitter mode to 100mA. The collector current is then transmitted to the 555 timer[5] through the capacitor. It generates a single pulse which acts as an input to the system. The circuit diagram of a single key is shown in Figure 1.
The dotted lines depict the part that will be visible to the user.

B. *System Design*

Our system has one infra red emitter and one receiver per key. However if the keys are large then we have also made an alternative proposal of having two emitters and receivers per key to make sure that no clicks are missed and the occurrence of errors is minimized.

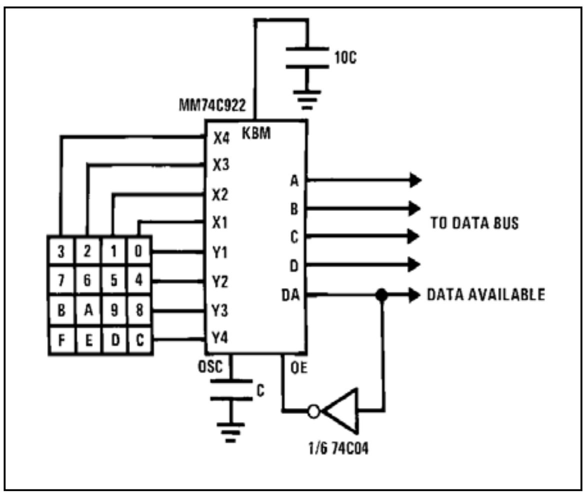

Figure 3 : IC 74922

Figure 3 shows the 16 keys arrangement in a 4x4 grid. We have taken a keyboard encoder IC 74922.

Some features of IC 74922:

1. 50 kΩ maximum switch on resistance
2. On or off chip clock
3. On-chip row pull-up devices
4. 2 key roll-over
5. Keybounce elimination with single capacitor
6. Last key register at outputs
7. 3-STATE output LPTTL compatible
8. Wide supply range: 3V to 15V
9. Low power consumption
    - Voltage at Any Pin VCC: − 0.3V to V CC + 0.3V
    - Operating Temperature Range: −40°C to +85°C
    - Storage Temperature Range: −65°C to +150°C
    - Power Dissipation (P D): Dual-In-Line- 700 mW Small Outline- 500 m
    - Operating VCC Range :3V to 15V
    - VCC :18V

The first, second, third and fourth column are connected to the pins x1, x2, x3, x4 respectively and the first, second, third and fourth rows are connected to the pins y1, y2, y3, y4 respectively as shown in figure 2.
When no keys are depressed, the row inputs are pulled high by internal pull-ups and the column outputs sequentially output a logic "0". These outputs are open drain and are therefore low for 25% of the time and otherwise off. The column scan rate is controlled by the oscillator input, which consists of a Schmitt trigger oscillator, a 2- bit counter, and a 2–4-bit decoder.

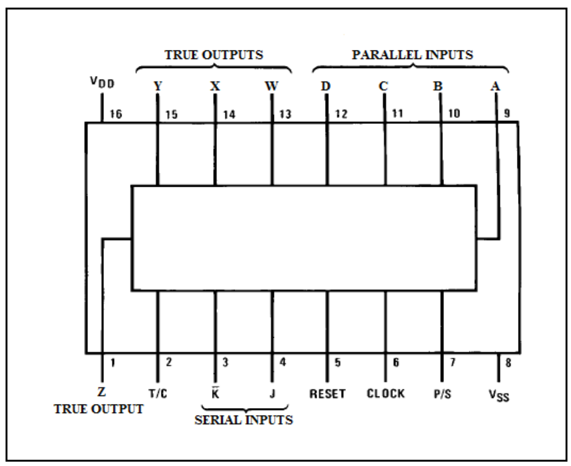

Figure 4 : IC 4035BM

When a key is depressed, key 8, for example, nothing will happen when the X1 input is off, since Y3 will remain high. When the X1 column is scanned, X1 goes low and Y3 will go low. This disables the counter and keeps X1 low. Y3 going low also initiates the key bounce circuit timing and locks out the other Y inputs. The key code to be output is a combination of the frozen counter value and the decoded Y inputs. Once the key bounce circuit times out, the data is latched, and the Data Available (DAV) output goes high. This causes the output lines A, B, C, D to generate the binary equivalent of 8, i.e., 1000, where A is the LSB.

The two-key roll-over feature can be illustrated by assuming a key is depressed, and then a second key is depressed. Since all scanning has stopped, and all other Y inputs are disabled, the second key is not recognized until the first key is lifted and the key bounce circuitry has reset. The output latches feed 3-STATE, which is enabled when the Output Enable (OE) input is taken low.

The signals generated by the pins A, B, C, D of IC 74922 serve as input for the parallel in parallel out register, IC 4035 B (Figure 4).

Some features of IC 4035B:

1. Wide supply voltage range 3.0V to 15V
2. High noise immunity 0.45 VDD (typ.)
3. Low power TTL Fan out of 2 driving 74L
4. compatibility or 1 driving 74LS
5. 4-stage clocked operation
6. Synchronous parallel entry on all 4 stages
7. JK inputs on first stage
8. Asynchronous true/complement control on all outputs
9. Reset control
10. Static flip-flop operation; master/slave configuration
11. Buffered outputs
12. Low power dissipation 5 mW (typ.) (ceramic)
13. High speed to 5 MHz
14. DC Supply Voltage (VDD) :0.5V to a18V
15. Input Voltage (VIN) :0.5V to VDD a0.5V
16. Storage Temperature Range (TS) :65C to a150C
17. Power Dissipation (PD): Dual-In-Line- 700 mW Small Outline- 500 mW

Hence, the serial inputs (J, K') are kept in "Don't care" mode. The Reset pin is grounded. At every rising edge of the clock pulse the value of A, B, C, D gets transferred to Z, Y, X, W respectively.

Figure 5 shows the shifting circuit. The outputs of the first register serve as the inputs for the second register which share a common clock. When a key is 'pressed', the output generated by IC 74922 serve as input to the first register which is displayed by the Seven Segment Display connected through Seven Segment Display decoder circuit. When the next key is 'pressed', the clock pulse goes high and the contents of the first register are copied to the second register and the output generated by IC 74922 serves as input for the first register. The outputs of both the registers are then displayed by their respective Seven Segment Displays through their respective decoder circuits.

The registers generate four output bits. We generate their sum of product expressions using Karnaugh Map logic in order to obtain the Sum of Product (SOP) values of each of the segments of the Seven Segment Display.

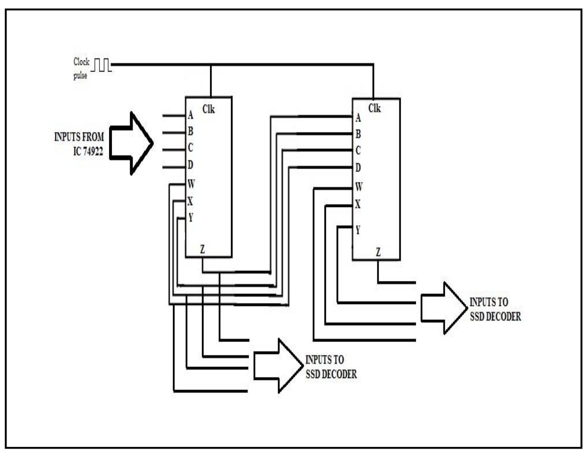

Figure 5

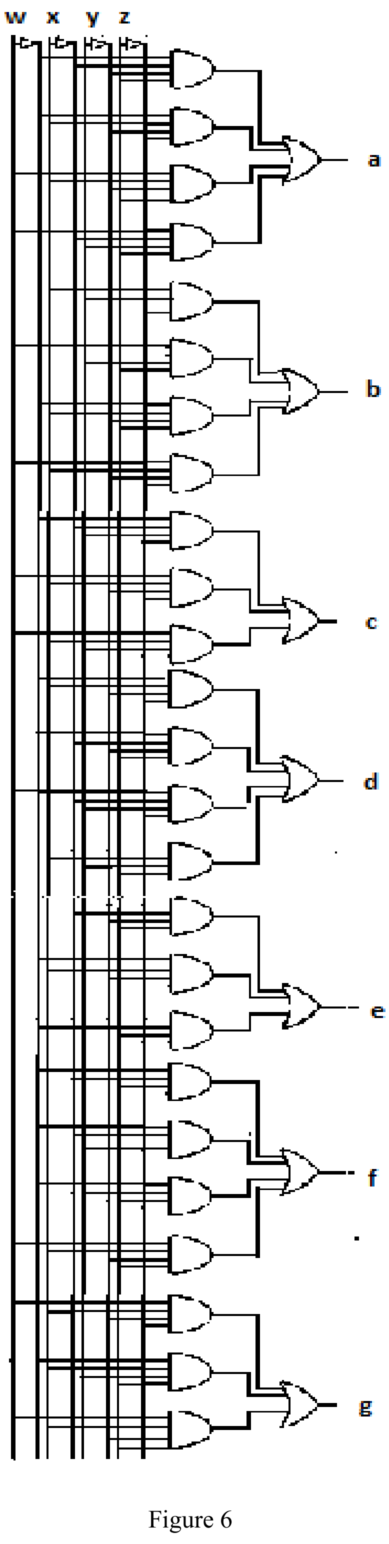

Figure 6

Truth Table

w	x	y	z	Hex	a	b	c	d	e	f	g
0	0	0	0	**0**	0	0	0	0	0	0	1
0	0	0	1	**1**	1	0	0	1	1	1	1
0	0	1	0	**2**	0	0	1	0	0	1	0
0	0	1	1	**3**	0	0	0	0	1	1	0
0	1	0	0	**4**	1	0	0	1	1	0	0
0	1	0	1	**5**	0	1	0	0	1	0	0
0	1	1	0	**6**	0	1	0	0	0	0	0
0	1	1	1	**7**	0	0	0	1	1	1	1
1	0	0	0	**8**	0	0	0	0	0	0	0
1	0	0	1	**9**	0	0	0	0	1	0	0
1	0	1	0	**A**	0	0	0	1	0	0	0
1	0	1	1	**b**	1	1	0	0	0	0	0
1	1	0	0	**C**	0	1	1	0	0	0	1
1	1	0	1	**d**	1	0	0	0	0	1	0
1	1	1	0	**E**	0	1	1	0	0	0	0
1	1	1	1	**f**	0	1	1	1	0	0	0

TABLE 1

SOP of Segment 'a': $w'x'y'z + w'xy'z' + wxy'z + wx'yz$

SOP of Segment 'b': $xyz' + wyz + w'xy'z + wxy'z'$

SOP of Segment 'c': $w'x'yz' + wxy'z' + wxy$

SOP of Segment 'd': $w'xy'z' + w'x'y'z + wx'yz' + xyz$

SOP of Segment 'e': $x'y'z + w'xy' + w'z$

SOP of Segment 'f': $w'x'z + w'x'y + w'yz + wxy'z$

SOP of Segment 'g': $wxy'z' + w'xyz + w'x'y'$

III. CONCLUSION

The main feature of the above project is the fact that the keys are made not in the form of a chord, key, spring structure but using an infra-red emitter, receiver pair. The keyboard can be made collapsible with a little implementation of design. A little bit of pressure may alter the angle at which the emitters and receiver are aligned to each other thus causing error. This keyboard in its fundamental stage will also not be resistant to pressure and may easily break.

By implementing the various principles of optics and physics this novel design can be further developed to create better and more efficient models. This design can be implemented in telephone keypads. This can even be a breakthrough in terms of high efficiency, touch sensory technology and can go a great mile in reducing the cost of production of the various electronic products available in the market

ACKNOWLEDGMENT

The authors would like to thank the Department of Computer Science, St Xavier's College, Kolkata for providing the necessary guidance and advice without which this paper would not have been a success. The idea for this design was conceived by Mr. Debdipto Ghoshal. The advice of Mr. Ghoshal regarding the purchase of the various chips and ICs during the

formation and testing phase of the model was very valuable and saved a lot of time.

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