National Conference on Computer Processing of Bangla (NCCPB-2004), pp. 82-88, Dhaka, Bangladesh, February, 2004

12-SEGMENT DISPLAY FOR BENGALI NUMERICAL CHARACTERS

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Abstract:
For representing the Bengali numerical characters the researchers have been working for a long time. In this paper, the idea of 12-segment display is introduced which ensures better outlook than the existing or proposed display systems. A 12-segment display for Bengali Numerical Characters needs 4-bit inputs for representing each digit. Appropriate logic circuits are also designed for that purpose.

Keywords
12-segment display, Bengali numerals, Display driver, Truth table

1. INTRODUCTION

The representation of Bengali numerical characters is an interesting task on which several researchers have been working upon. But, some of them suffer from poor display of the shapes of the characters, some designs are difficult to implement, some are inefficient in term of memory utilization.

Some of the works that are done in this regard, are dot matrix system[1,2], 11-segment display[3] etc. The dot matrix system costs extra memory or storage space[4] while the 11-segment display saves memory but the shapes of the digits are not so good to look at. Moreover, the design of the grid structure is complex in that system.

In this paper, we have proposed 12-segment display system for representing the Bengali numerals. Comparing to the dot matrix system, our system saves more storage space as large number of dots are to be manipulated in dot matrix system. Our system obviously produces better outlook for the numerals than those of 11-segment display.

In our system, the grid structure consists of 12 segments. We need 12-segment display driver for Bengali numeral display. We designed our logic circuits so that we can represent all the ten digits (0-9). For that we used 4-bit inputs. We have determined which segments are to be activated for which digit, after analyzing.

The rest of the paper is organized as follows: Section 2 deals with the details of segmentation and logic circuits, Section 3 compares our system with the existing or proposed display systems, Section 4 tells about the implementation of 12-segment display system and Section 5 concludes the paper.

2. DETAILS OF 12-SEGMENT DISPLAY SYSTEM

2.1. Segmentation

In our system, the 12 segments are named as a,b,c,d,e,f,g,h,i,j,k and l. A model of this 12-segment display is shown in the Figure 1.

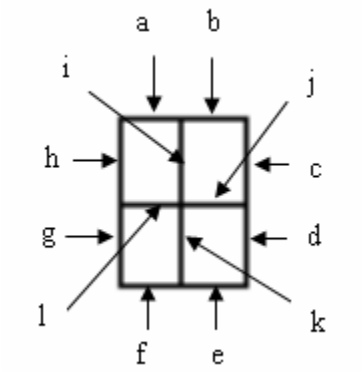


Figure 1: A model of 12-segment display

To represent Bengali numeral 0 the segments a,b,c,d,e,f,g,h are to be activated. For Bengali 1, segments a,b,c,d,e,f,g,k,l , for Bengali 2, segments a,b,c,e,f,g,j,l, for 3, segments b,c,d,e,f,g,h,i need to be activated. For displaying Bengali 4, segments a,b,c,d,e,f,g,h,j,l, for 5, segments a,d,e,f,g,h,i,j and for 6, segments d,e,f,g,h.i,j should be energized. Again, for 7, segments b,c,d,i,j, for 8 segments f,g,h,j,k,l and for 9, segments a,b,c,d,e,g,k,l are to be activated.

For our system, the truth table of 4 imputs (D,C,B,A) and 12 outputs (a,b,c,d,e,f,g,h,i,j,k,l) is shown in Table 1.

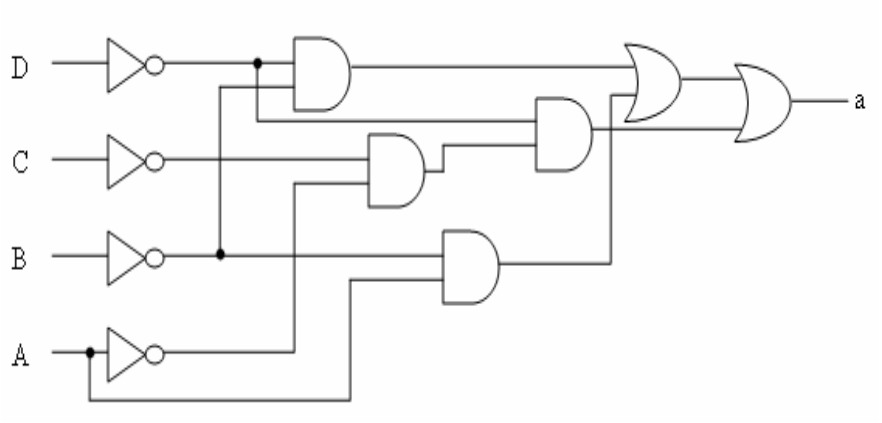
Table 1: Truth table for 12-segment display

D	C	B	A	a	b	c	d	e	f	g	h	i	j	k	l
0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0
0	0	0	1	1	1	1	1	1	1	1	0	0	0	1	1
0	0	1	0	1	1	1	0	1	1	1	0	0	1	0	1
0	0	1	1	0	1	1	1	1	1	1	1	1	0	0	0
0	1	0	0	1	1	1	1	1	1	1	1	0	1	0	1
0	1	0	1	1	0	0	1	1	1	1	1	1	1	0	0
0	1	1	0	0	0	0	1	1	1	1	1	1	1	0	0
0	1	1	1	0	1	1	1	0	0	0	0	1	1	0	0
1	0	0	0	0	0	0	0	0	1	1	1	0	1	1	1
1	0	0	1	1	1	1	1	1	0	1	0	0	0	1	1
1	0	1	0	x	x	x	x	x	x	x	x	x	x	x	x
1	0	1	1	x	x	x	x	x	x	x	x	x	x	x	x
1	1	0	0	x	x	x	x	x	x	x	x	x	x	x	x
1	1	0	1	x	x	x	x	x	x	x	x	x	x	x	x
1	1	1	0	x	x	x	x	x	x	x	x	x	x	x	x
1	1	1	1	x	x	x	x	x	x	x	x	x	x	x	x

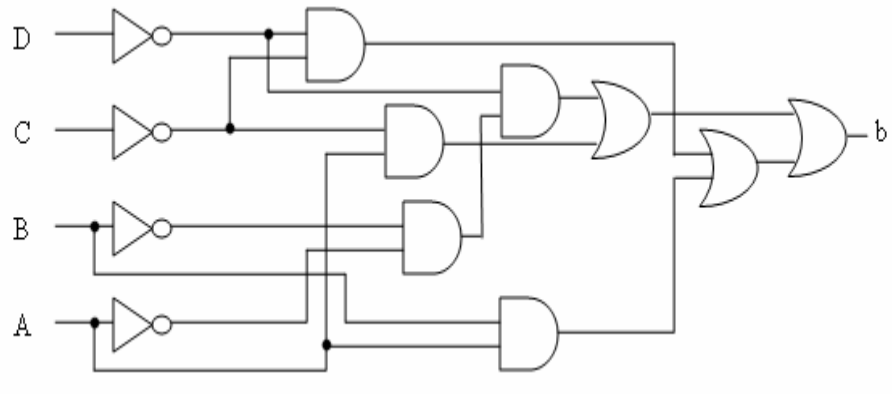
2.2. Designing logic circuits

From the truth table we derived the SOP expression for each segment and we used K-Map to minimize the segment logic.

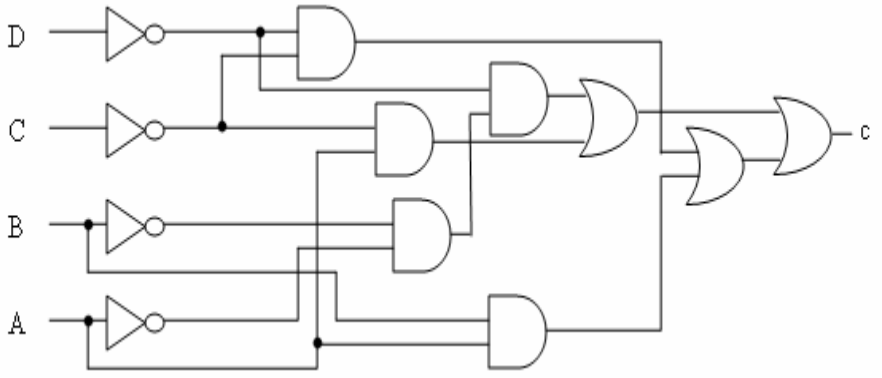
The logic circuits for the 12-segment display is shown in the Figure 2. Here, only AND, OR and NOT gates are used.



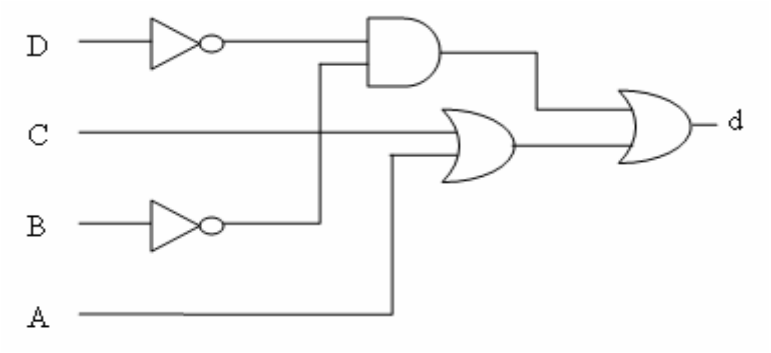
$$a = \bar{D}\,\bar{B} + \bar{B}\,A + C\,\bar{D}\,\bar{A}$$



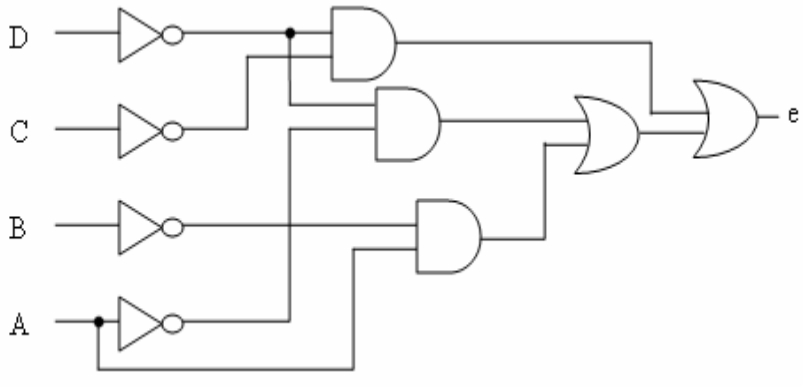
$$b = \bar{D}\,\bar{C} + B\,A + \bar{C}\,A + \bar{B}\,\bar{A}\,\bar{D}$$



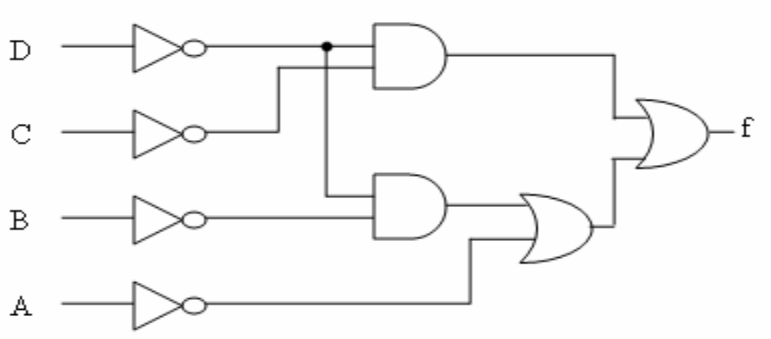
$$c = \bar{D}\,\bar{C} + BA + \bar{C}\,A + \bar{B}\,\bar{A}\,\bar{D}$$



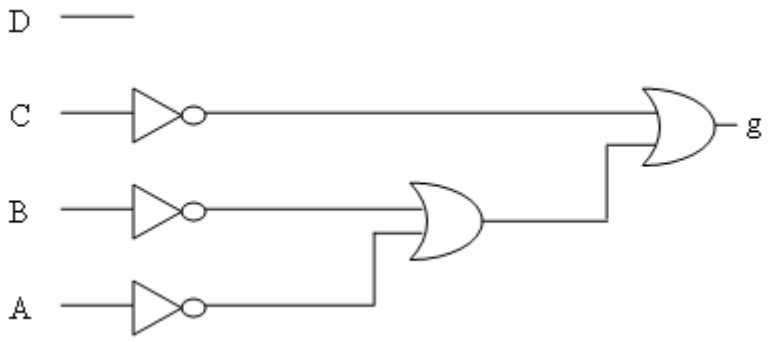
$$d = C + A + \overline{D}\,\overline{B}$$



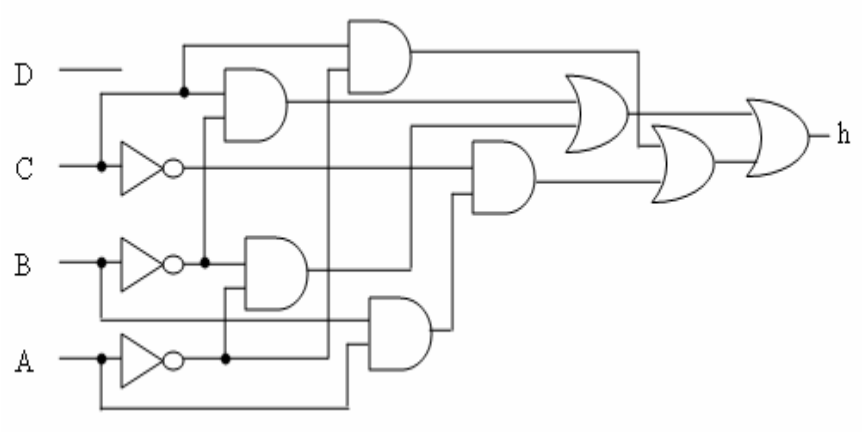
$$e = \overline{D}\,\overline{C} + \overline{D}\,\overline{A} + \overline{B}\,A$$



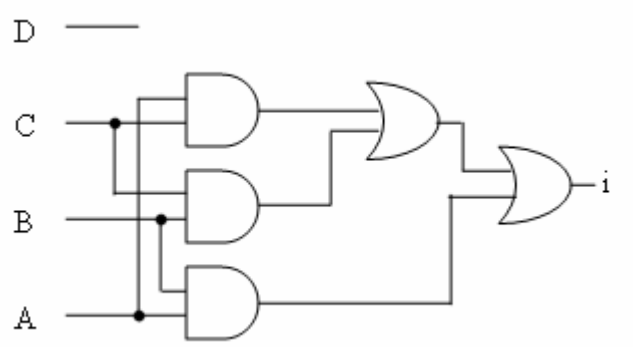
$$f = \overline{A} + \overline{D}\,\overline{B} + \overline{C}\,\overline{D}$$



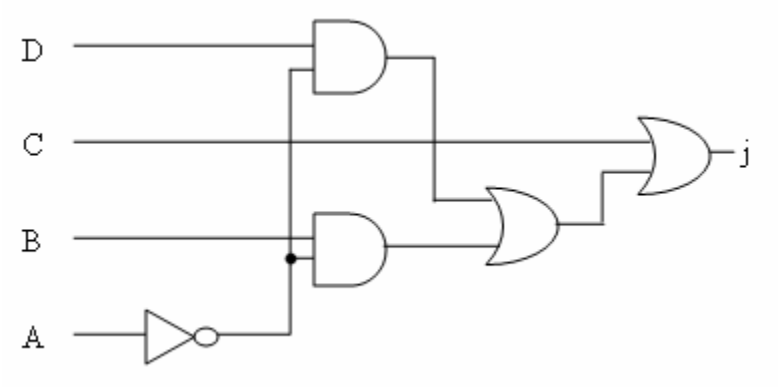
$$g = \overline{B} + \overline{A} + \overline{C}$$



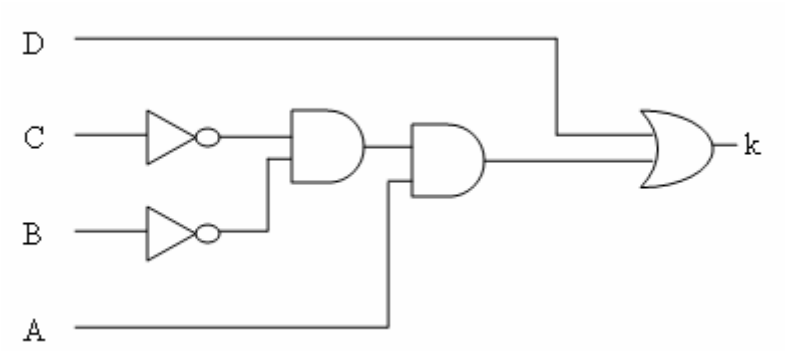
$$h = \bar{B}\,\bar{A} + C\,\bar{A} + C\,\bar{B} + \bar{C}\,BA$$



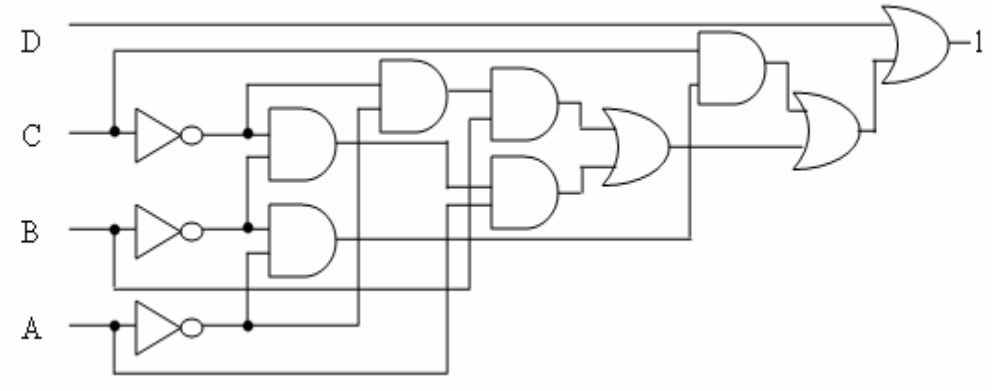
$$i = B\,A + C\,B + C\,A$$



$$j = C + D\,\bar{A} + B\,\bar{A}$$



$$k = D + \bar{C}\,\bar{B}\,A$$



$$l = D + C\,\bar{B}\,\bar{A} + \bar{C}\,\bar{B}\,A + \bar{C}\,B\,\bar{A}$$

Figure 2: Circuits of each segment

3. COMPARISON WITH THE EXISTING OR OTHER PROPOSED DISPLAY SYSTEMS

Our proposed 12-segment display obviously takes less storage space in comparison with the dot matrix system.

Saber, A. Y. et. al.[3] proposed an 11-segment display but it suffers from poor quality of visualization whereas the proposed 12-segment display gives better outlook and the circuit logics are also easier.

We expect that our system will take almost same amount of memory as 11-segment display but obviously the quality of visualization is improved specially for the characters 3,5,6 and 8.

4. IMPLEMENTATION OF 12-SEGMENT DISPLAY SYSTEM

For physical implementation of the 12-segment display system, we created an Integrated Circuit which basically acts as a 4-bit BCD to 12-segment Decoder. We used our 12-segment model to get the actual outputs.

The outputs of 12-segment Bengali Numeral display are shown in Figure 3.

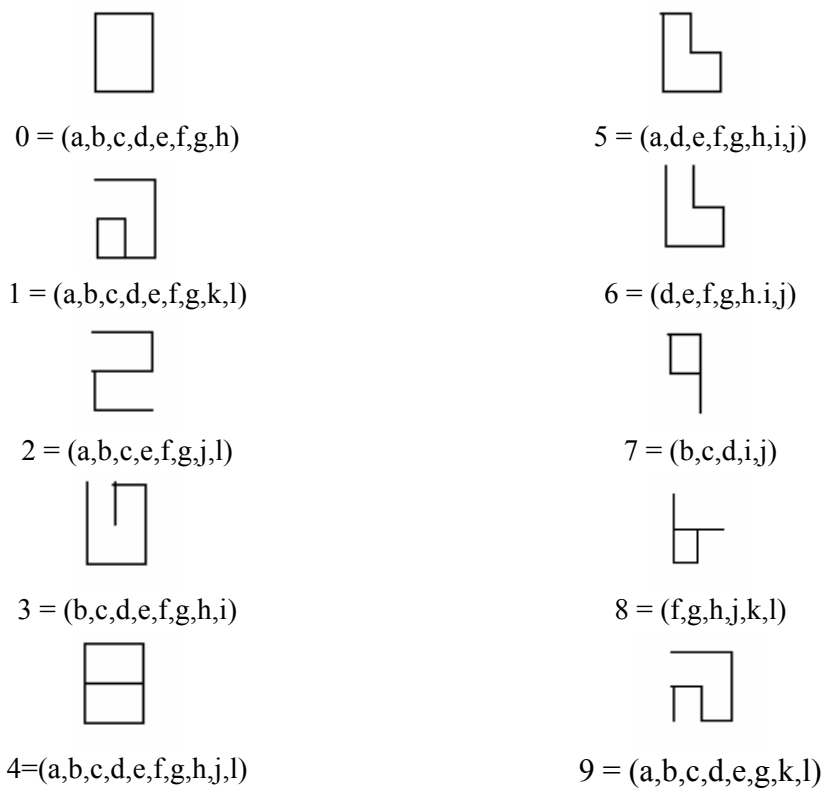


Figure 3: Outputs of 12-segment display using the segments

5. CONCLUSION

In this paper, we proposed the 12-segment display system for representing the Bengali numerals and to the best of our knowledge; this is the first approach to use 12-segments. This new idea ensures better visualization than the previously proposed 11-segment display system especially for the numerals 3, 5, 6 and 8. It surely requires less memory than the dot matrix system and the logic circuits are easier than the previously proposed techniques.

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