Designing a 36 Segment Display for Bengali Compound Character

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Summary
Characters can be represented in hardware using dot matrix system or segmented display. Dot matrix display costs extra memory, power and time compared to segmented display as large numbers of dots are required to be manipulated in dot matrix system. But due to the high cost and complexity of matrix displays, segment display is generally used to display characters. Although recently different segmented display models for Bangla characters have been proposed, the quality of the characters stay below the mark. In this paper, 36-segments display for Bangla compound character has been proposed. From the review it appears that it is the first proposed display in the world for Bangla compound Character.

Keywords:
Compound Character,36-segment display.

1. Introduction

Bangla language is now one of the popular languages in the world. About 200 million people use Bangla as their communicative medium. As a natural language, Bangla was neglected in research for many years. But now scientists all over the world are trying to computerize Bangla language. To do this computerization, recognition of characters plays an important role in research. Many researches have been done for recognizing Bengali simple characters. In this paper an idea to recognize compound Bengali character is presented.

2. Literature Review

Md. Abul Kalam Azad,Rezwana Sharmin and S. M. Kamruzzaman proposed uniform display architecture to display multiple language digits and mathematical expression with higher and simplicity by using 16 segment displays. Their proposed 16 segment display can be used to display numbers of 12 languages and mathematical expression.(2004). Ahmed Yousuf Saber,Mamun Al Murshed Chowdhury,Suman Ahmed and Chowdhury Mofizur Rahman designed an 11-segment display system to manipulate only 7-segments which saves considerable amount of memory and storage space.(2002). Sabbir Ahmed and Serajum Monira developed a segment display for the bengali and english digits where no segment interacts with each other and its easy to design and they used only single circuit to represent Bangla and English as well as two different circuits for these two numeric.(2004). Tanzin Rahman, Tanvir Khan, Sarder Saadat Ahmed , Chandan Kumar Karmakar proposed a 26-segemented display, which represents the unavoidable, distinct curves present in Bangla numerals, without using curved segments(2005)

2. 1 Segment Model Design

We have discovered a grid structure consisting of 36 segments as shown in fig 1.

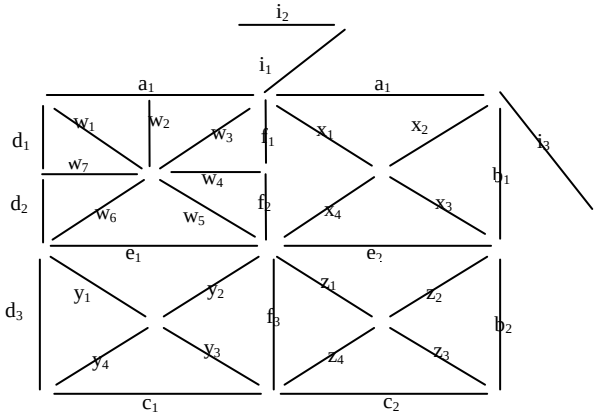

Fig 1: 36 segment display

Manuscript received March 5, 2013
Manuscript revised March 20, 2013

2.2 Activated segments to display different Bengali compound characters:

স্ত	{w_2, w_6, w_5, f_1, f_2, z_1, z_4, y_3, a_1, a_2}	
ন্ন	{b_1, x_3, x_4, w_5, w_6, b_2, z_3, z_4, y_3, y_4, a_1, a_2}	
গু	{y_2, w_5, w_3, x_1, x_3, b_1, b_2, z_3, z_4}	
ঞ্চ	{d_2, w_7, w_5, f_1, f_2, f_3, y_2, y_4, c_1, x_1, x_4, z_1, z_4, a_1, a_2}	
ক্ক	{w_3, w_5 , y_3, f_1, f_2, f_3, x_1, z_1, a_1, a_2}	
ন্ধ	{d_2, w_7, w_5, f_1, f_2, f_3, y_2, y_3, x_4, x_3, b_2, a_1, a_2 }	
ষ্ট	{w_1 w_3 a_1 f_1 f_2 y_2 z_1 z_4 c_1 d_3 a_2 }	
ল্লা	{d_1, w_1, w_3, f_1, f_2, z_1, z_4, x_4, x_3, b_1, b_2}	
জ্ঞা	{w_2, w_3, f_1, w_4, w_5, y_2, y_1, d_1, d_2, z_4, z_1, x_4, x_3, b_1, b_2}	
ম্ম	{w_2, w_6, d_2, w_7, w_5, f_1, f_2, f_3, y_3, y_2, z_1, z_3, b_1, b_2, a_1, a_2}	
ম্ভ্র	{w_2, w_5,w_6, d_2, w_7, f_1, f_2, y_3, y_4, a_1, a_2,}	
ষ্ঠ	{w_1, w_6, e_1, f_1, f_2, w_4, y_2, y_3, z_4, z_2, x_3, x_1, a_1, a_2, i_1, i_2}	
ষ্ট	{w_1, w_6, e_1, f_1, f_2, w_4, f_3, z_4, z_2, x_3, a_1, a_2, i_1, i_2}	
ন্ট	{d_2, w_2, w_5, f_1, f_2, f_3, z_4, z_2, x_3, a_1, a_2, i_1, i_2 }	
শ্ব	{w_1, w_6, d_2, f_2, w_5, w_3, x_1, x_3, b_1, b_2, z_2, z_3}	
অ্ম	{w_1 w_6 e_1 f_1 f_2 w_4 z_1 z_4 f_3 z_3 b_1 b_2 a_1 a_2}	
ষ্ঠ	{d_2w_7 w_5 f_1 f_2 y_2 y_3 z_4 z_2 x_3 x_1 a_1 a_2 i_1 i_2}	
ক্ষ	{a_1, w_1, w_2, w_7, w_6, d_2, w_5, y_2, y_3, c_2, b_1, b_2, a_1, i_2}	
ন্য	{a_1, a_2, f_1, f_2, f_3, x_2, x_3, z_2, z_3}	
জ্ব	{w_3, w_4, f_2, y_2, y_1, d_2, x_1, x_3, z_2, z_3, b_2, a_1, a_2 }	
দ্ব	{a_1, f_1, f_2, x_4, x_3, z_2, z_3, b_2}	
শ্চ	{w_1, w_6, w_5, w_3, f_1, f_2, f_3, z_4, z_1}	
ষ্ট্র	{d_1 d_2 w_6 w_2 w_5 f_1 f_2 x_1 x_4 e_2 b_1 i_3 b_2 z_3 z_4 y_3 y_4}	
দ্ধ্ব	{d_1 d_2 w_6 w_5 y_2 y_3 f_3 e_2 b_2 a_1 a_2}	
স্ত	{w_6 w_5 f_2 f_1 z_1 z_4 y_3 a_1 a_2}	
য্ঃ	{w_1 w_6 y_1 y_3 f_3 f_2 f_1 w_4 x_1 x_4 z_1 z_4 a_1}	
কৃ	{w_3 w_6 e_1 y_2 y_3 f_1 f_2 x_1 a_1 a_2}	

স্ব	$\{w_2\ w_6\ w_5\ f_1\ f_2\ y_2\ y_3\ a_1\}$	
ন্	$\{w_6\ w_5\ y_4\ y_3\ f_1\ f_2\ f_3\ a_1\}$	
ট্রি	$\{f_1\ f_2\ z_1\ z_2\ z_3 c_2\ y_3 y_4\ i_1\ i_2\ a_1\ a_2\}$	
চ্চ	$\{d_1\ d_2\ d_3\ y_4\ y_2\ e_1\ f_1\ f_2\ f_3\ z_4\ z_2\ e_2\ a_1\ a_2\}$	
ব্দ	$\{w_3\ w_5\ f_1\ f_2\ x_4\ x_3\ b_2\ a_1\ a_2\}$	
ন্দ	$\{\ d_2\ w_7\ w_5\ f_2\ f_1\ x_4\ x_3\ b_2\ a_1\ a_2\}$	
ব্ব	$\{w_3\ w_6\ y_1\ y_3\ f_1\ f_2\ f_3\ x_2\ x_4\ z_1\ z_3\ b_1\ b_2\ a_1\ a_2\}$	
স্ম	$\{w_2\ w_6\ w_5\ f_1\ f_2\ y_2\ y_3\ f_3\ z_1\ z_3\ b_1\ b_2\ a_1\ a_2\}$	
ক্ত	$\{d_1\ w_7\ w_2\ a_1\ f_1\ f_2\ f_3\ c_1\ e_1\ x_4\ x_3\}$	
ক্স্র	$\{w_1\ w_2\ a_1\ f_1\ f_2\ w_7\ d_2\ w_6\ w_5\ y_2\ y_4\ c_1\ f_1\ f_3\ x_1\ z_4\ z_3\ b_1\ b_2\ a_2\}$	
দ্দ	$\{d_1, d_2, w_6, w_4, f_2, f_3, z_4, z_2, b_2, a_1, a_2\}$	

2.3 The truth table:

	A6	A5	A3	A2	A1	A0	a1	a2	b1	b2	c1	c2	d1	d2	d3	e1	e2	f1	f2	f3	I1	I2	I3	w1	w2	w3	w4	w5	w6	w7	x1	x2	x3	x4	y1	y2	y3	y4	z1	z2	z3	z4
0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	1	0	1	0	0	1
1	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1	1	0	0	1	1	0	0	1	1
2	0	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	1	0	0	1	0	0	0	0	1	1	1
3	0	0	0	0	1	1	1	1	0	0	1	0	0	1	0	0	0	1	1	1	0	0	0	0	0	0	0	1	0	1	1	0	0	1	0	1	0	1	1	0	0	1
4	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	1	0	1	0	0	1	0	0	0	0	0	1	0	1	0	0	0
5	0	0	0	1	0	1	1	1	0	1	0	0	0	1	0	0	0	1	1	1	0	0	0	0	0	0	0	1	0	1	0	0	1	1	0	1	1	0	0	0	0	0
6	0	0	0	1	1	0	1	1	0	0	1	0	0	0	1	0	0	1	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	1
7	0	0	0	1	1	1	0	0	1	1	0	0	1	0	0	0	0	1	1	0	0	0	0	1	0	1	0	0	0	0	0	0	1	1	0	0	0	0	1	0	0	1
8	0	0	1	0	0	0	0	0	1	1	0	0	1	1	0	0	0	1	0	0	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1	0	0	1	0	0	1
9	0	0	1	0	0	1	1	1	1	1	0	0	0	1	0	0	0	1	1	1	0	0	0	0	1	0	0	1	1	1	0	0	0	0	0	1	1	0	1	0	1	0
10	0	0	1	0	1	0	1	1	0	0	0	0	0	1	0	0	0	1	1	0	0	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	1	1	0	0	0	0
11	0	0	1	0	1	1	1	1	0	0	0	0	0	0	0	1	0	1	1	0	1	1	0	1	0	0	1	0	1	0	1	0	1	0	0	1	1	0	0	1	0	1
12	0	0	1	1	0	0	1	1	0	0	0	0	0	0	0	1	0	1	1	1	1	1	0	1	0	0	1	0	1	0	0	0	1	0	0	0	0	0	0	1	0	1
13	0	0	1	1	0	1	1	1	0	0	0	0	0	1	0	0	0	1	1	1	1	1	0	0	1	0	0	1	0	0	0	0	1	0	0	0	0	0	0	1	0	1
14	0	0	1	1	1	0	0	0	1	1	0	0	0	1	0	0	0	0	1	0	0	0	0	1	0	1	0	1	1	0	1	0	1	0	0	0	0	0	0	1	1	0
15	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	1	0	1	1	1	0	0	0	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	1	0	0	1
16	0	1	0	0	0	0	1	1	0	0	0	0	0	1	0	0	0	1	1	0	1	1	0	0	0	0	0	1	0	1	1	0	0	0	0	1	1	0	0	1	0	1
17	0	1	0	0	0	1	1	1	1	1	0	1	0	1	0	0	0	0	0	0	0	1	0	1	1	0	0	1	1	1	0	0	0	0	0	1	1	0	0	0	0	0
18	0	1	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	1	0
19	0	1	0	0	1	1	1	1	0	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	1	1	0	0	0	1	1	0
20	0	1	0	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	1	1	0
21	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	1	0	1	0	1	1	0	0	0	0	0	0	0	0	0	1	0	0	1
22	0	1	0	1	1	0	0	0	1	1	0	0	1	1	0	0	0	1	1	1	0	0	0	1	0	1	0	0	1	1	0	0	0	0	1	0	0	1	1	0	0	1
23	0	1	0	1	1	1	1	1	0	1	0	0	1	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	1	1	0	0	0	0	0
24	0	1	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	1	0	1	0	0	1
25	0	1	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	1	0	0	1	0	1	0	1	0	0	1	1	0	1	0	1	0	0	1

26	0	1	1	0	1	0	1	1	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0	1	0	0	1	0	1	0	0	0	0	1	1	0	0	0	0	0
27	0	1	1	0	1	1	1	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	1	0	0	1	1	0	0	0	0	0	0	1	1	0	0	0	0	0
28	0	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	1	1	0	0	0	0
29	0	1	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	1	1	0	0	0	0
30	0	1	1	1	1	0	1	1	0	0	0	1	0	0	0	0	0	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0
31	0	1	1	1	1	1	1	1	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	1
32	1	0	0	0	0	0	1	1	0	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0
33	1	1	0	0	0	1	1	1	0	1	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	1	0	1	0	0	1	1	0	0	0	0	0	0	0	0
34	1	1	0	0	1	0	1	1	1	1	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	1	0	0	1	0	0	1	0	1	1	0	1	0	1	0	1	0
35	1	1	0	0	1	1	1	1	1	1	0	0	0	0	0	0	0	1	1	1	0	0	0	0	1	0	0	1	1	0	0	0	0	0	0	1	1	0	1	0	1	0
36	1	1	0	1	0	0	1	0	0	0	1	0	1	0	0	1	0	1	1	1	0	0	0	0	1	0	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0
37	1	1	0	1	0	1	1	1	1	1	1	0	0	1	0	0	0	1	1	1	0	0	0	1	1	0	0	1	1	1	1	0	0	0	0	1	0	1	0	0	1	1
38	1	1	0	1	1	0	1	1	0	1	0	0	1	1	0	0	0	0	1	1	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	1	0	1
39	1	1	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	0	0	0	0	0	1	0	0	1	0	1	0	0	0	1	0	1	0	0	0	1	1
40	1	1	1	0	0	0	1	1	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	1	1	0	0	1	1
41	1	1	1	0	0	1	1	0	1	0	0	1	1	0	0	1	0	1	1	0	0	0	0	0	1	0	0	0	0	1	0	0	0	1	0	1	1	0	0	0	0	0
42	1	1	1	0	1	0	1	1	0	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	1	0	0	0	1	1	0	0	0	0	0	1	1	0

2.4 The Boolean functions to design the circuit

From the Truth Table 2.3, we can write the following logic functions for different 36-segments in sum-of-product

$a1 = \sum 0,1,5,6,7,8,11,12,13,14,15,17,18,19,20,21,22,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44$

$a2 = \sum 0,1,5,6,7,8,11,12,13,14,15,17,18,19,20,21,25,26,28,32,33,34,35,36,37,39,40,41,42,44$

$b1 = \sum 1,2,9,10,11,16,17,19,24,36,37,39,41,42,43$

$b2 = \sum 1,2,7,9,10,11,16,17,19,21,22,24,25,34,35,36,37,39,40,41,42,44$

$c1 = \sum 5,8,38,39,41$

$c2 = \sum 19,32,43$

$d1 = \sum 9,10,24,25,33,38,40,43$

$d2 = \sum 5,8,10,11,12,15,16,18,19,21,24,25,33,35,39,40$

$d3 = \sum 8,33$

$e1 = \sum 13,14,17,28,33,38,43$

$e2 = \sum 24,25,33,42$

$f1 = \sum 0,5,6,7,8,9,10,11,12,13,14,15,17,18,20,22,23,24,26,27,28,29,30,31,32,33,34,35,36,37,38,39,41,43,44$

$f2 = \sum 0,5,6,7,8,9,11,12,13,14,15,16,17,18,20,21,22,23,24,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,43,44$

$f3 = \sum 5,6,7,11,14,15,17,20,23,25,27,30,31,33,36,37,38,39,40,41$

$I1 = \sum 13,14,15,18,32$

$I2 = \sum 13,14,15,18,19,32$

$$x1 = \sum 2,3,4,11,14,25,26,37,39$$
$$x2 = \sum 18,34,40$$
$$x3 = \sum 1,2,5,7,8,11,12,13,14,18,20,32,33,36,42$$
$$x4 = \sum 1,3,5,7,8,19,20,22,25,32,33,34,36,40,41,42$$
$$y1 = \sum 8,19,25,34,39$$
$$y2 = \sum 2,3,5,6,8,9,11,16,17,19,23,26,27,31,35,37,41$$
$$y3 = \sum 0,1,4,5,9,10,11,16,17,22,23,24,25,26,27,28,29,30,34,35,39,40,41$$
$$y4 = \sum 1,3,10,22,28,29,30,31,37,40$$
$$z1 = \sum 0,3,4,6,7,8,,9,21,24,25,30,34,35$$
$$z2 = \sum 11,12,13,14,16,18,19,20,30,31,38,42$$
$$z3 = \sum 1,2,9,14,18,19,20,22,30,34,35,37,39,40,42$$
$$z4 = \sum 0,1,2,3,6,7,8,11,12,13,15,16,21,22,24,25,31,37,38,39,40$$

Conclusion

In our proposed 36 Segment display all the segments are of uniform size. The proposed segmented display is the unique segmented display that proposes a single circuit with straight segments of uniform size. Although we have used minimum number of segments, this display still provides appearances of digit to extended level of accuracy. So it is expected that this segment display may be used as an ideal circuit for displaying maximum number of Bengali compound characters.

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