

## Displaying All Bangla Compound Letters & Alphabets By 32-Segment

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**Abstract:** Different approaches have been proposed for representing Bangla and English alphabets and numerals by segment display. But there is no complete and accurate scheme has been done yet for Bangla compound letters. The focus of our paper is on all compound letters to represent by 32 segments. By these 32 segments, we also represent all Bengali and English numerals and alphabets. Accurate recognition of compound characters is difficult due to their complex shapes. In this paper we try to present total 97 compound letters in simpler look. This proposed design performs well for complex-shaped compound characters, which were confusing to the existing methods.

**Keywords:** 32-segment display, alphabets, compound letters and numerals.

### I. INTRODUCTION

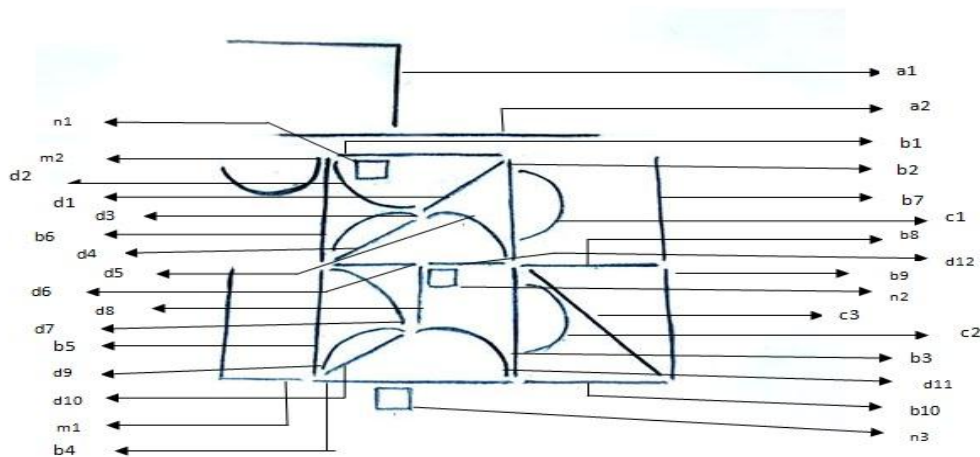
The representation of Bengali compound letters is an interesting task on which several researchers have been done for recognizing Bengali simple characters. But, some of them suffer from poor display of the shapes of the characters and some designs are difficult to implement. There are 11 vowels and 29 consonants in Bangla.

For display Bangla numerals several works as like 9 segment,10 segment,11 segment,12 segmented display [1],[2],[3],[4],[5],[6] are already proposed. Few researchers' already worked on Bangla vowels by using 14 and 17 segments [7], [8]. We found 44 segments just represented all Bangla consonant [9]. Another paper of 24 segments represented numeral, vowel and some consonant [10]. Some researchers designed 31 segments for few consonant and numeral [11]. One more paper shows 32 segments for all Bangla alphabets and numeral [12]. Another paper works on 26 segments for all Bangla alphabets [13]. We also found 34 segments for all Bangla and English alphabets and numeral [14]. Only one paper stands for some Bangla compound letters (but no vowel & consonant) by using 36 segments [15]. There is also a paper of n-segment [16] display for Bangla alphabets.

### II. Method

In this paper we try to draw a segmented display for Bangla alphabets, compound letters, numerals and also English alphabets and numerals, that's why firstly we have listed all compound letters [17] and found 97 available useable compound letters for Bangla. Our 32 segmented displays can show all of them. Here we show অ but do not show the 2<sup>nd</sup> alphabet আ because when we use the vowel sign (স্বরচিহ্ন) with our proposed design it can be easily displayed. Here the figure 1 shows 32-segmented display.

**Figure 1: proposed 32 segmented display**



In fig. 2 we show Bangla vowel and consonant by using this 32 segmented display.



Figure 2: Bangla vowel and consonant by using 32 segment displays

We found 97 compound letters and designed them by 32 segment display. Mainly we collect compound letter list from Bangla Academy Dictionary, there are some compound letters which have no use now a days, that's why by using Bangla font software (Avro, Bijoy) we cannot write them combined but we also design segmented display for them as like ডগ, নচ. The list of all compound letters shown on table 1.

Table 1: 97 Compound Letters And Their Segment List

no	compo und letters	segment numbers	no	compo und letters	segment numbers
1.	ক	d1,d5,b2,c1,d12,d8,d11,c2,b3,a2	25.	ঊ	a2,d1,d5,d12,d6,b6,d8,d11,b4,b5
2.	ক্ট	b1,d1,d5,b2,c1,b3,b10,b9,a1	26.	ডগ	a2,d1,d5,d12,d6,b6,d7,d10,b3
3.	ক্ত	a2,b1,b2,d12,b3,b4,b8,b9	27.	ক্ট	a2,d5,b2,a1,b3,b10,b9
4.	ক্ক	b1,b2,d1,d5,c1,d9,d11,b3	28.	কু	a2,d5,b2,d8,d11,b4,b5
5.	ক্ষ	b1,d2,d4,d3,d7,d10,d9,d11,d3,d2,c1	29.	নচ	a2,d5,b2,b3,b10,b9
6.	ক্স	a2,b2,d1,d5,c1,b7,b9,b10,d11	30.	ক্ব	a2,d5,b2,n2,d12,b3,b4,b5
7.	গ	d2,d4,b1,b2,b3,d11	31.	ক্ব্ব	a2,d5,b2,n2,d12,b3,b4,m1
8.	গ্	d2,d4,b1,b2,d12,d8,d11,b3,b8,b9	32.	ক্ব্ব্ব	a2,d5,b2,n2,b3,b10,b9,b7
9.	গ্ম	b1,d2,d4,d12,d8,d11,b3,c3,b7	33.	ন্দ	a2,d5,b2,b8,b9
10.	গ্ন	b1,d2,d4,d9,d11,b3	34.	ক্ক	a2,d5,b2,d12,d8,d11,b3,b8,b9
11.	ক্ক	m2,b6,d6,d12,d5,d2,n1,d8,d11,b3,c2	35.	ক্ক্ক	a2,d5,b2,d11,b3
12.	গ্ব	m2,b6,d6,d12,d5,d2,n1,d7,d8,d11,b3	36.	ক্ক্ব	a2,d5,b2,d12,d8,d11,b3,c3,b9,b7
13.	গ্গ	m2,b6,d6,d12,d5,d2,n1,d7,d10,b3	37.	ক্ব	a2,b1,b2,d12,b3,b4
14.	গ্গ্ব	m2,b6,d6,d12,d5,d2,n1,d7,d10,d9,d11,b3	38.	ক্ব্ব	a2,n1,b1,b2,d12,d6,b6,d11,b3
15.	ক্ক	a2,b6,d6,d12,b2,c1,b5,b4,b3	39.	ক্ব্ব্ব	a2,n1,b1,b2,d12,d6,b6,d8,d11,b3
16.	ক্ক্	a2,b6,d6,d12,b2,c1,b5,b4,b3,c3	40.	ক্ব্ব্ব্ব	a2,n1,b1,b2,d12,d6,b6,d8,d11,b3,c3,b9,b7
17.	ক্ক্ক	d1,d5,d6,d12,c1,b6,b5,b4,d11,d8,c2	41.	ক্ব্ব্ব্ব্ব	d2,d4,d6,d12,d7,d10,b4,b3
18.	ক্ক্ক্	d1,d5,d6,d12,c1,b6,d8,d11,b3,c3,b9	42.	ক্ক	b6,d4,d5,d6,d12,d7,d9,b3
19.	ক্ক্ক	d1,d5,d6,d12,c1,b6,d9,d11,b3	43.	দ	a2,b6,d6,d8,d11
20.	ক্ক্ক	d1,d5,b3,b4,c1,c2,m1	44.	দ্ব	a2,b6,d6,d12,d8,d11,b3,b8,b9
21.	ক্ক্ক	a2,d5,b2,d8,d11,b3,c1,c2	45.	দ্ব্ব	a2,b6,d6,d12,d8,d11,b3
22.	ক্ক্ক	a2,d5,b2,d8,d11,b4,b5,c1,c2,c3	46.	দ্ব্ব্ব	a2,b6,d6,d8,n2,d11,b4,b5
23.	ক্ক্ক	a2,d5,b2,d12,d8,d11,c1,c2,c3,b9,b7	47.	দ্ব্ব্ব্ব	a2,b6,d6,d8,d11,b3,d12,c3,b9,b7
24.	ট	a1,a2,b4,b5,b6,d8,d10,d11	48.	ধ্ব	d1,d2,d5,b2,d12,d8,d11,b3
no	compo	segment numbers	no	compo	segment numbers

	und letters			und letters	
49.	ঐ	b1,b6,d4,d1,b2,b3,b10,b9	74.	ল্ল	d3,d5,b2,a2,d9,d11,b3
50.	ঔ	b1,b6,d4,d1,b2,n2,d12,b3,b4,b5	75.	শ্চ	d2,d3,d5,d1,b2,b3,c2
51.	ঐ	b1,b6,d4,d1,b2,d6,d12,d7,d8,b3,	76.	শ্ছ	d2,d3,d5,d1,b2,b3,c2,b10
52.	ঐ	b1,b6,d4,d1,b2,d9,d11,b3	77.	শ্ল	d2,d3,d5,d1,b2,d11,b3
53.	ঐ	b1,b6,d4,d1,b2,d7,d10,d11,b3	78.	শ্ব	d2,d3,d5,d1,b2,d12,d8,d11,b3
54.	ঐ	b1,d1,d5,b2,d12,d8,d11,b4,b5,b3	79.	শ্ম	d2,d3,d5,d1,b2,d12,d8,d11,b3,c3,b9,b7
55.	ঐ	b1,d1,d5,b2,b8,b9	80.	ঙ্ক	d2,d3,d5,d6,d12,b2,d8,d11,b3,c2
56.	ক্র	b1,d1,d5,b2,d12,d8,d11,b3,b8,b9	81.	ষ্ট	d2,d3,d5,d6,d12,b2,b3,b10,b9,a1
57.	ল্ল	b1,d1,d5,b2,d9,d11,b3	82.	ফ্	d2,d3,d6,d12,b2,d7,d11,b3,c1,c2
58.	ব্ব	b1,d1,d5,b2,d12,d8,d11,b3	83.	ফ্প	d2,d3,d5,d6,d12,b2,d7,d3,b3
59.	বভ	b1,d1,d5,b2,n2,d8,d11,b4,b5	84.	ফ্ফ	d2,d3,d5,d6,d12,b2,d11,b3,c1,d7
60.	ম্ম	d2,d3,d4,d5,b2,d11,b3	85.	ম্ম	d2,d3,d5,d6,d12,b2,d8,d11,b3,c3,b9,b7
61.	ম্প	d2,d3,d4,d5,b2,d12,d8,d11,b3,b8,b9	86.	ফ্ফ	d2,d4,d5,b2,d8,d11,b3,c2,d12
62.	ম্ফ	d2,d3,d4,d5,b2,d8,d11,b3,c2	87.	শ্ম	d2,d4,d5,b2,d11,b3,d6,d7
63.	শ্ব	d2,d3,d4,d5,b2,d12,d8,d11,b3	88.	শ্চ	a1,a2,d2,d4,d5,b2,b3,b10,b9
64.	শ্চ	d2,d3,d4,d5,b2,n2,d8,d11,b4,b5	89.	শ্ছ	d2,d4,d5,b2,n2,d12,b3,b4,b5
65.	শ্ম	d2,d3,d4,d5,b2,d7,d10,d9,d11,b3	90.	শ্ব	d2,d4,d5,b2,n2,d12,b3,b10,b9
66.	শ্ল	d2,d3,d4,d5,b2,d9,d11,b3	91.	শ্ল	d2,d4,d5,b2,d11,b3
67.	ঙ্ক	a2,d3,d5,b2,d12,d8,d11,b3,c2	92.	ম্প	d2,d4,d5,b2,d6,d7,d8,d12,b3
68.	ক্র	a2,d3,d5,b2,d7,d10,d6,d12,b3	93.	ফ্ফ	d2,d4,d5,b2,d7,d11,b3,c2
69.	শ্চ	a2,d3,d5,b2,b3,b10,b9,a1	94.	শ্ব	d2,d4,d5,b2,d12,d8,d11,b3,
70.	শ্ছ	a2,d3,d5,b2,d8,d11,b4,b5	95.	শ্ম	d2,d4,d5,b2,d12,d8,d11,b3,c3,b9,b7
71.	শ্ল	a2,d3,d5,b2,d8,d11,b3,d12,b8,b9	96.	শ্ল	d2,d4,d5,b2,b9,d11,b3
72.	শ্ম	a2,d3,d5,b2,d8,d11,b3,d12,c3,b9,b7	97.	ফ্	a2,n1,d1,d4,d7,d11,d5
73.	শ্চ	a2,d3,d5,b2,n2,d8,d11,b4,b5			

Here table 2 shown segment numbers for English alphabets (capital & small) and table 3 shown segment numbers for Bangla & English numerals.

**Table 2: Segment Numbers For English Alphabets (capital & small)**

English alphabet (capital)	Segment numbers	English alphabets (small)	Segment numbers
A	b1,b2,b3,b5,b6,d6,d12	a	b3,b4,,b5,b10,d6,d12
B	b1,b2,b3,b4,b5,b6,d6,d12	b	b3,b4,b5,,b6,d6,d12
C	b1,b4,b5,b6	c	b4,b5,d6,d12
D	b1,b2,b3,b4,b5,b6	d	b2,b3,b4,b5,d6,d12
E	b1,b4,b5,b6,d6,d12	e	b4,b5,d3,d5,d6,d12
F	b1,b5,b6,d6	f	b5,b6,d2,d4,d6,d7,d10
G	b1,b3,b4,b5,b6,b8,b9	g	b1,b2,b3,b4,b6,d10
H	b2,b3,b5,b6,d6,d12	h	b5,b6,d9,d11
I	a2,b2,b3,b4,d11	i	b3
J	b1,b2,b3,b4,b5,d6,d8	j	b1,b2,b3,d8,d11
K	b5,b6,d1,d4,d7,d11	k	b5,b6,d8,d9,d11

English alphabet (capital)	Segment numbers	English alphabets (small)	Segment numbers
L	b4,b5,b6	l	b2,b3,b4,b10
M	b2,b3,b5,b6,d1,d2	m	b3,b5,d6,d8,d12
N	b5,b6,b7,b9,c3,d2,d5	n	b3,b8,b9,d12
O	b1,b2,b3,b4,b5,b6	o	b3,b4,b5,d6,d12
P	b1,b2,b5,b6,d6,d12	p	b1,b2,b5,b6,d6,d12
Q	b1,b2,b3,b4,b5,b6,c3	q	b3,b10,d3,d5,d6,d12
R	b1,b2,b5,b6,d6,d7,d11,d12	r	b5,d6,d8
S	b1,b3,b4,b6,d6,d12	s	b4,d6,d7,d11,d12
T	a2,b2,b3	t	b2,b3,b8,b10,d12
U	b2,b3,b4,b5,b6	u	b3,b4,b5,b10
V	b7,b9,c3,d2,d5	v	b5,d8,d10
W	b2,b3,b5,b6,d9,d11	w	b3,b5,d9,d11
X	d1,d2,d3,d5	x	d7,d8,d10,d11
Y	b2,b3,b4,b5,d6,d12	y	b2,b3,d2,d5,d8,d11
Z	b1,b2,b4,b5,d6,d12	z	b4,d6,d8,d10

**Table 3: Segment Numbers for Bangla & English Numerals**

English numerals	Segment numbers	Bangla numerals	Segment numbers
1	b5,b6	১	b1,b2,b3,b4,d9,d11
2	b1,b2,b4,b5,d6,d12	২	b1,b2,b4,b5,d6,d12
3	b1,b2,b3,b4,d12	৩	b1,b2,b3,b4,b5
4	b2,b3,b6,d6,d12	৪	b1,b2,b3,b4,b5,b6,d6,d12
5	b1,b3,b4,b6,d6,d12	৫	b1,b2,b3,b4,b5,b6,b8,b9,b10
6	b1,b3,b4,b5,b6,d6,d12	৬	b2,b3,b4,b5,b6,b8,b9,b10
7	b1,b2,b3	৭	b1,b2,b3,b6,d6,d12
8	b1,b2,b3,b4,b5,b6,d6,d12	৮	b5,b6,d6,d8,d10,d12
9	b1,b2,b3,b6,d6,d12	৯	b1,b2,b3,d8,d12

### III. Result & Discussion

Different segmented display units are compared based on display quality, number of characters to be displayed, number of segments, and average active segments. Display quality is considered as main criterion because it plays vital role for acceptability of the display unit.

By comparing with other published paper we found some paper only for vowels or only consonant or only some compound letters, few paper for both vowel and consonant and English alphabets too but display quality not fair or have design complexity. In our paper we try to make a segment that has all things like vowel, consonant, numeral, compound letters and also good display. Here table 4 shown comparisons between our proposed design and previous published design.

**Table 4: Comparison Table between Our Proposed Design & Published Design**

Number of segments	Number of characters to be display	Display Quality
9 [1]	10 ( only Bangla numerals)	Fair
10 [2]	10 ( only Bangla numerals)	Good
10 [3]	20 ( Bangla & English numerals)	Good
11 [4]	10 ( only Bangla numerals)	Good
12 [5]	10 ( only Bangla numerals)	Good
twin 7 [6]	10 ( only Bangla numerals)	Good
14 [7]	11(only Bangla vowels)	Fair
17 [8]	11(only Bangla vowels)	Fair
44 [9]	39 (only consonant)	Good
24 [10]	10 Bangla numerals, 11 vowels,11 consonant	Fair
31 [11]	36 consonant	Poor
32 [12]	10 Bangla numeral, 50 bangla alphabets	Fair
26 [13]	50 Bangla alphabets	Fair
34 [14]	120 (Bangla, English, Arabic)	Fair
36 [15]	38 ( only bangla compound letters)	Good
32 (our proposed design)	193 ( all Bangla letters,numerals,compound letters and English letters,numerals)	Good

#### IV. Conclusion

In this paper we have successfully used only 32 segments to represent all Bangla and English letters and numerals and also 97 compound letters. To our knowledge, it is the first segmented display design system for maximum Bangla compound letters. Our next effort will be try to reduce the number of segment, hardware implementation and more good looking display.

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