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Segmented Display for Alphanumeric Bangla, English and Arabic Characters

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Abstract: On the era of globalization multicultural, multinational people are working under the same roof. As a consequence sometimes it becomes necessity to display the delivered information into Multi-languages. This study presents a 32-Segment display model to display Multi-languages characters such as all alphanumeric of Bengali and English and Arabic numerals. It is well known that 7-Segments display model is used commonly to display the English numerals from 0 to 9. A 16 segment display is used to display the English characters. Many researches are going on to display the Bengali and English alphanumeric by a single design. But unfortunately, in our best knowledge, there is no proper model exists to represent both Bengali and English alphanumeric. In this study, we propose an excellent 32-Segment display model which is not only successful to display Bengali and English alphanumeric but also become successful to display Arabic numerals.

Key words: 32-Segment display, Bengali alphanumeric, Arabic numerals

INTRODUCTION

In this study, we proposed a 32-Segment display model for displaying Bengali, English alphanumeric and also Arabic numerals. The effective segmented display for displaying Bengali digits and characters is a new research area for researchers. Lot of researches is going on in this new field. Sabbir and Monira (2004) proposed an 11-Segment model for displaying Bengali digits. But the design had some problem like, the segments were not uniform in size (Niaz *et al*., 2003) and the segments intersected each other. Rahman *et al*. (2003) also proposed an 11-Segment display model for displaying only Bengali numerals. The model comprises of almost uniform sized segments and no segment intersected between each other. Arefin *et al*. (2004) designed a 24-Segment display model for displaying Bengali digits and characters. They considered all characters available in Bengali language. Islam *et al*. (2003) designed a 17-Segment display model for displaying Bengali vowels only. Besides recently some other works (Hossain and Ashfaq, 2005; Sabbir and Serazam, 2004; Hossain, 2003. Mahmud and Rahman, 2003) done on Segmented display methods. As per our concern it was the first segmented display model for displaying Bengali vowels. Before that only dot matrix approach was used in that purpose. As per our knowledge, no work has done for displaying both Bengali digits and characters into the same segmented display model. Considering these entire practicalities we become motivated to design a model which would be able to display both Bengali and English digits and characters. In addition the proposed display model has the ability to display Arabic numerals into the same module.

The proposed 32-Segment display model indeed claims some significant features: Firstly, it is designed in such a way that out of 32 Segments no two segments were intersected each other; Secondly, it looks very compact i.e., takes less space to implement; Thirdly, it can display three languages; Fourthly, most of segments are linear; Finally, it has a symmetric look which seems attractive.

From the above discussions, it can be concluded that this model will be easier to implement in hardware. Besides it will be also cost effective due to the fact that it can display all Bengali and English alphanumeric and also Arabic numerals. Besides its symmetric, compact, non-interceptive segments, make it more understandable. In the 32-Segment proposed model, 3-bit used for selecting the category of the character i.e. whether the character is Bengali numeral, Bengali vowel, Bengali consonant, English numeral, English character, or Arabic numeral. And another 6-bit is used for identifying the exact character or digit corresponds to that category. In the following study description of proposed model, different

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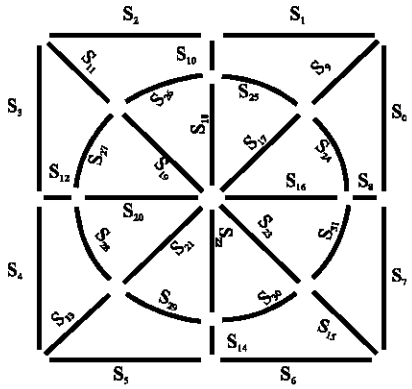

Fig. 1: Proposed 32-Segment display model

characters and their corresponding representation in proposed model, required active segments for different characters, essential Truth Tables, necessary logic circuits etc.

PROPOSED 32-SEGMENT MODEL

In this study our main objective to display both alphanumeric Bengali and English and also Arabic numerals. Figure 1 represents the proposed 32-Segment model and also mentioning the 32 individual segments (S_1 to S_{32}). The following section furnishes how this 32-Segmented model displays the different characters from different languages.

MULTILANGUAGE CHARACTERS AND THEIR LAYOUT PRESENTATION

To implement this model, first we arrange the segments in such a way that all Bengali and English digits, vowels, consonants and Arabic numerals can be represented by this model. Thereafter, determine the individual character and its corresponding activated segments for all of the characters. Finally derive the required logic circuits for different characters and draw the block diagram.

Table 1-4 represents Bengali Vowels, Bengali Consonants, English Characters and all Numerals (Bengali, English and Arabic) by proposed 32-Segment Display Model.

DESIGNING REQUIRED CIRCUITS AND DIAGRAMS

The study shows the layout representation of 32-Segment Display Model for different characters. In this study we would identify the activated segments those will are required to display the different characters and numerals. Table 5-10 show the active segments for Bengali Vowels, Bengali Consonants, English Characters, Bengali Numerals, English Numerals and Arabic Numerals.

Table 1: Bengali Vowels represented by 32-Segment display model

Model			
Char.	Pattern	Char.	Pattern
A		F	
B		G	
C		H	
D		I	
E		J	

Notes: In this study Av is not represented. To represent this character it needs another segment. So, if one more segment adds at the right side of the 32-segmrnt model then it will be possible to display Av character

Table 2: Bengali Consonants represented by 32-Segment display model

Model					
Char.	Pattern	Char.	Pattern	Char.	Pattern
K		X		i	
L		Y		j	
M		Z		k	
N		–		l	
O		`		m	
P		a		n	
Q		b		o	
R		c		p	
S		d		q	
T		e		r	
U		f		s	
V		g		t	
W		h		u	

Table 3: English Characters represented by 32-Segment display model

Char.	Pattern	Char.	Pattern	Char.	Pattern
A		J		S	 or 
B		K		T	
C		L		U	
D		M		V	
E		N		W	
F		O		X	
G		P		Y	
H		Q		Z	
I		R			

Table 4: Bengali, English and Arabic Numerals represented by 32-Segment display model

Digits	Bengali numerals pattern	English numerals pattern	Arabic numerals pattern
0			
1			
2			
3			
4			
5			
6			
7			
8			
9			

After identifying the targeted segments for corresponding characters it would be urgent to derive the Truth Tables for different character sets. Table 11-16 show the Truth Tables for Bengali Vowels, Bengali

Table 5: Active Segments for Bengali Vowels

Char	Segments activated
A	S_0 S_1 $S_2S_7S_{15}S_{17}$,$S_{18}S_{24}S_{25}S_{28}S_{29}S_{30}S_{31}$
B	S_1 S_2 S_9 S_{16} S_{20} $S_{24}S_{25}$ S_{26} S_{28} S_{29} S_{30}
C	S_1 S_2 S_9 S_{13} S_{17} S_{21} S_{25} S_{26} S_{29} S_{30}
D	S_2 S_{10} S_{17} S_{18} S_{24} S_{26} S_{28} $S_{29}S_{30}S_{31}$
E	S_2, $S_4S_{10}S_{13}$ S_{17} S_{18} S_{24} S_{26} S_{28} $S_{29}S_{30}S_{31}$
F	S_0 S_1 S_7 S_{10} S_{11} S_{15} S_{18} $S_{22}S_{23}$ S_{26} S_{27} S_{28} S_{29}
G	S_5 S_{14} S_{18} S_{22} S_{26} S_{27}
H	S_2 S_5 S_{10} S_{14} $S_{18}S_{22}$ S_{26} S_{27}
I	S_{17} S_{23} S_{25} S_{26} S_{29} S_{30}
J	S_0 S_8 $S_{16}S_{17}$ S_{23} S_{25} S_{26} S_{29} S_{30}

Table 6: Active Segments for Bengali Consonants

Char	Segments activated
K	S_1 S_2 S_{10} S_{18} S_{22} S_{24} S_{25} S_{26} S_{27} S_{28} S_{29}
L	S_0 S_4 S_5 S_6 S_7 S_{10} S_{11} S_{12} S_{18} S_{20} S_{26}
M	S_0 S_1 S_2 S_7 S_8 S_{19} S_{21} S_{24} S_{25} S_{26}
N	$S_0S_1S_2S_3S_5S_6S_7$, S_{12} S_{13} S_{20} S_{21} S_{25} $S_{28}S_{29}S_{30}S_{31}$
O	S_1S_2 S_9S_{10} $S_{16}S_{18}$ S_{25} $S_{28}S_{29}S_{30}S_{31}$
P	S_1S_2 S_6S_7 $S_{10}S_{16}$ $S_{18}S_{22}S_{30}S_{31}$
Q	S_1S_2 S_6S_7 S_8S_{10} $S_{16}S_{18}$ $S_{22}S_{30}$ S_{31}
R	S_0 S_1 S_2 S_{10} S_{17} S_{18} S_{24} S_{27} $S_{28}S_{29}S_{30}S_{31}$
S	S_0 S_1 S_2 S_7 S_{10} S_{15} S_{18} S_{22} S_{23} S_{26} S_{27} $S_{28}S_{29}$
T	S_5S_{14} S_{17} S_{18} S_{22} S_{23} S_{25} S_{26} S_{27} S_{30}
U	S_2 S_6S_7 S_8S_{10} $S_{14}S_{18}$ $S_{22}S_{25}$ S_{26}
V	S_{11} S_{19} S_{21} S_{24} $S_{25}S_{26}$ $S_{29}S_{30}S_{31}$
W	S_1S_2 S_{10} S_{17} S_{18} S_{24} S_{27} $S_{28}S_{29}$ $S_{30}S_{31}$
X	S_1S_2 S_{10} S_{18} S_{22} $S_{30}S_{31}$
Y	S_1S_2 S_4S_{10} $S_{12}S_{13}$ $S_{14}S_{18}$
Z	S_1S_2 S_{17} S_{18} S_{24} S_{25} $S_{27}S_{28}S_{29}S_{30}S_{31}$
-	S_0 S_2 S_4 S_5 S_6 S_7 S_{10} S_{11} S_{12} S_{18} S_{20}
`	S_1S_2 S_7S_8 $S_{10}S_{16}$ S_{18}
a	S_1 S_{10} S_{11} S_{18} S_{22} S_{26} $S_{27}S_{28}S_{29}$
b	S_1 S_4 S_{10} S_{12} S_{13} S_{14} S_{18} S_{20} S_{22}
c	S_1 S_{10} S_{14} S_{18} S_{19} S_{21} S_{22} S_{27} S_{28}
d	S_1 S_5 S_{10} S_{11} S_{13} S_{14} S_{18} S_{19} S_{21} S_{22} S_{24} S_{25}
e	S_0 S_1 S_9 S_{15} S_{17} S_{23}
f	S_1 S_2 S_{16} S_{18} S_{25} S_{27} $S_{28}S_{29}S_{30}S_{31}$
g	S_0S_1 S_2 S_7 S_{10} S_{15} S_{18} $S_{20}S_{22}S_{23}S_{28}S_{29}$
h	S_0 S_1 S_7 $S_{10}S_{15}$ S_{17} $S_{23}S_{25}$
i	S_0 S_1 S_7 S_9 $S_{14}S_{15}$ S_{17} S_{23}
j	S_0S_1 S_2 S_7 S_8 S_{17} S_{19} $S_{24}S_{27}S_{28}$
k	S_0S_1 S_7S_9 S_{15} S_{17} S_{23}
l	$S_0S_1S_2$ S_7S_{16} S_{18} S_{20} S_{24} S_{25} S_{26} S_{27}
m	S_0 S_1 S_7 $S_8S_{10}S_{15}$ S_{17} S_{23} $S_{24}S_{25}$
n	S_0 S_2 $S_5S_7S_{10}$ S_{15} $S_{18}S_{22}$ S_{23} S_{28} S_{29}
o	S_0 S_1 S_2 S_4 $S_5S_6S_8S_{11}$ S_{12} S_{17} $S_{18}S_{19}$ S_{21} S_{22} S_{23}
p	S_1 S_2 S_{10} S_{14} S_{17} S_{18} S_{24} $S_{28}S_{29}S_{30}S_{31}$
q	S_1 S_2 S_{10} S_{14} S_{18} S_{22} $S_{30}S_{31}$
r	S_0 S_1 S_7 S_{10} S_{14} S_{15} S_{17} $S_{23}S_{25}$
s	S_{17} $S_{18}S_{23}$ $S_{25}S_{30}$
t	S_{15} $S_{18}S_{19}$ S_{23} S_{25}
u	S_{17} $S_{18}S_{22}S_{23}$ $S_{25}S_{30}$

Table 7: Active segments for English characters

Char.	Segments activated
A	S_0 S_7 S_8S_9 S_{13} S_{16} S_{17} S_{21}
B	S_1 S_6S_9 S_{10} S_{14} S_{15} S_{18} $S_{19}S_{22}$ S_{23}
C	S_{17} $S_{18}S_{25}$ S_{26} S_{27} S_{28} S_{29} S_{30}
D	$S_{18}S_{22}$ $S_{24}S_{25}$ S_{30} S_{31}
E	S_1 S_6 $S_{10}S_{14}$ $S_{16}S_{18}$ S_{22}
F	S_1 $S_{10}S_{14}$ $S_{16}S_{18}$ S_{22}
G	$S_{16}S_{25}$ S_{26} S_{27} S_{28} S_{29} S_{30} S_{31}
H	S_3 S_4S_{10} S_{12} $S_{14}S_{18}$ S_{20} S_{22}
I	S_{10} $S_{14}S_{18}$ S_{22}
J	S_2 S_{10} S_{18} S_{22} S_{28} S_{29}
K	S_9 S_{10} S_{14} S_{15} S_{17} S_{18} $S_{22}S_{23}$
L	S_3 S_4 S_5
M	S_0 S_3 S_4 S_7 S_9 S_{11} S_{17} S_{19}
N	S_0 S_3 S_4 S_7 S_{11} S_{15} S_{19} S_{23}

Table 7: Continue

Char.	Segments activated
O	S_{24} S_{25} S_{26} S_{27} $S_{28}S_{29}S_{30}S_{31}$
P	S_0 S_1 S_8 S_{10} S_{14} S_{16} S_{18} S_{22}
Q	S_{15} S_{23} S_{24} S_{25} S_{26} $S_{27}S_{28}S_{29}S_{30}S_{31}$
R	$S_0S_1S_8$ $S_{10}S_{14}S_{15}S_{16}$ $S_{18}S_{22}S_{23}$
S	S_1 S_2S_3 S_5 S_6 S_7 S_8S_{12} S_{16} S_{20}
T	$S_1S_2S_{10}S_{14}S_{18}S_{22}$
U	S_0S_3 S_4 S_5 S_6 S_7
V	S_3S_4 S_9S_{13} $S_{17}S_{21}$
W	S_0 S_3 S_4 S_7 S_{13} S_{15} S_{21} S_{23}
X	S_9 $S_{11}S_{13}$ S_{15} S_{17} $S_{19}S_{21}$ S_{23}
Y	S_9 S_{11} S_{14} S_{17} S_{19} S_{22}
Z	S_1S_2 S_5 S_6 S_9S_{13} S_{17} S_{21}

Table 8: Active segments for Bengali numerals

Char.	Segments activated
0	S_{24} S_{25} S_{26} $S_{27}S_{28}S_{29}S_{30}S_{31}$
1	S_{22} $S_{23}S_{24}$ S_{25} $S_{30}S_{31}$
2	S_{17} $S_{21}S_{25}S_{26}S_{29}S_{30}$
3	S_{17} S_{18} $S_{24}S_{25}$ $S_{28}S_{29}S_{30}S_{31}$
4	S_{17} $S_{19}S_{21}$ S_{23} $S_{25}S_{26}S_{29}S_{30}$
5	S_{17} $S_{23}S_{25}$ S_{26} $S_{27}S_{28}S_{29}S_{30}$
6	S_{17} $S_{18}S_{24}$ $S_{28}S_{29}S_{30}$ S_{31}
7	S_{14} $S_{18}S_{20}$ $S_{22}S_{26}S_{27}$
8	S_8 $S_{16}S_{18}$ $S_{22}S_{30}$ S_{31}
9	$S_{21}S_{23}$ $S_{24}S_{25}S_{30}$ S_{31}

Table 9: Active segments for English numerals

Char.	Segments activated
0	$S_0S_1S_2S_3S_4S_5S_6S_7$
1	$S_{10}S_{14}S_{18}S_{22}$
2	$S_0S_1S_2S_4$ S_5S_6 $S_8S_{12}S_{16}S_{20}$
3	$S_0S_1S_2$ S_5S_6 S_7 $S_8S_{16}S_{20}$
4	$S_0S_2S_7$ $S_8S_{12}S_{16}$ S_{20}
5	$S_1S_2S_3S_5S_6S_7S_8S_{12}S_{16}S_{20}$
6	$S_1S_2S_3S_4S_5S_6S_7$ S_8 S_{11} S_{16} S_{20}
7	S_1S_2 S_9 S_{14} S_{17} S_{21}
8	$S_0S_1S_2S_3S_4S_5S_6S_7$ S_8 S_{12} S_{16} S_{20}
9	$S_0S_1S_2S_3S_5S_6S_7$ S_8 S_{12} S_{16} S_{20}

Table 10: Active segments for Arabic numerals

Char.	Segments activated
٠	$S_{16}S_{17}$ S_{24} S_{25}
١	$S_{10}S_{14}$ S_{18} S_{22}
٢	S_0 S_8 $S_{10}S_{14}$ S_{16} S_{18} S_{22}
٣	S_4 S_{12} $S_{16}S_{18}S_{20}$ S_{24} S_{27}
٤	S_{19} S_{21} $S_{25}S_{26}S_{29}$ S_{30}
٥	S_{21} S_{23} $S_{24}S_{25}S_{26}$ S_{27} $S_{28}S_{31}$
٦	S_4 S_{10} $S_{12}S_{14}S_{18}S_{20}$ S_{22}
٧	S_9 $S_{11}S_{17}S_{19}$
٨	S_{13} $S_{15}S_{21}S_{23}$
٩	S_{14} $S_{18}S_{20}S_{22}$ S_{26} S_{27}

Table 11: Truth Table for Bengali Vowels

Char	SL0	SL1	SL2	A0	A1	A2	A3	A4	A5	S0	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	S19	S20	S21	S22	S23	S24	S25	S26	S27	S28	S29	S30	S31
A	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0	1	1	0	0	1	1	1	1
B	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	1	1	0	1	1	1	0
C	0	0	0	0	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	1	0	0	1	1	0
D	0	0	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1	0	0	0	0	0	1	0	1	0	1	1	1	1
E	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	1	0	0	1	0	0	0	0	1	1	0	0	0	0	0	1	0	1	0	1	1	1	1
F	0	0	0	0	0	0	1	0	1	1	1	0	0	0	0	0	1	0	0	1	1	0	0	0	1	0	0	1	0	0	0	1	1	0	0	1	1	1	1	0	0	
G	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	1	0	0	0	0					
H	0	0	0	0	0	0	1	1	1	0	0	1	0	0	1	0	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	1	0	0	0	0					
I	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	1	1	0	0	1	1	0			
J	0	0	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	1	0	1	1	0	0	1	1	0	

Table 12: Truth Table for Bengali Consonants

Char	SL0	SL1	SL2	A0	A1	A2	A3	A4	A5	S0	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	S19	S20	S21	S22	S23	S24	S25	S26	S27	S28	S29	S30	S31
K	0	0	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	1	0	1	1	1	1	1	1	0	0
L	0	0	1	0	0	0	0	0	1	1	0	0	0	1	1	1	1	0	0	1	1	1	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	1	0	0	0	0
M	0	0	1	0	0	0	0	1	0	1	1	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	1	0	1	0	0	1	1	1	0	0	0	0	0	0	
N	0	0	1	0	0	0	0	1	1	1	1	1	1	0	1	1	1	0	0	0	0	1	1	0	0	0	0	1	1	0	0	0	1	0	0	1	1	1	1			
O	0	0	1	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	1	0	0	1	1	1	
P	0	0	1	0	0	0	1	0	1	0	1	1	0	0	0	1	1	0	0	1	0	0	0	0	0	0	1	0	1	0	0	0	1	0	0	0	0	0	0	1	1	
Q	0	0	1	0	0	0	1	1	0	0	1	1	0	0	0	1	1	1	0	1	0	0	0	0	0	0	1	0	1	0	0	0	1	0	0	0	0	0	0	1	1	

Table 12: Continued

R	0	0	1	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1	0	0	0	0	1	0	0	1	1	1	1	1
S	0	0	1	0	0	1	0	0	0	1	1	1	0	0	0	0	1	0	0	1	0	0	0	0	1	0	0	1	0	0	0	1	1	0	0	1	1	1	0	0
T	0	0	1	0	0	1	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1	1	0	0	0	1	1	0	1	1	0	0	1	0
U	0	0	1	0	0	1	0	1	0	0	0	1	0	0	0	0	1	1	1	0	1	0	0	0	1	0	0	1	0	0	0	1	0	0	1	0	0	0	0	0
V	0	0	1	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	1	1	1	0	0	1	1	1	1	1
W	0	0	1	0	0	1	1	0	0	0	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1	0	0	0	0	0	1	0	1	1	1	1	1
X	0	0	1	0	0	1	1	0	1	0	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	1	1	1
Y	0	0	1	0	0	1	1	1	0	0	1	1	0	1	0	0	0	0	0	1	0	1	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Z	0	0	1	0	0	1	1	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	1	1	0	1	1	1	1
_	0	0	1	0	1	0	0	0	0	1	0	1	0	1	1	1	1	0	0	1	1	1	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	0	0
`	0	0	1	0	1	0	0	0	1	0	1	1	0	0	0	0	1	1	0	1	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0
a	0	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	1	0	0	0	1	0	0	0	1	1	1	0	0
b	0	0	1	0	1	0	0	1	1	0	1	0	0	1	0	0	0	0	0	1	0	1	1	1	0	0	0	1	0	1	0	1	0	1	0	0	0	0	0	0
c	0	0	1	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	1	0	1	1	0	1	1	0	0	0	0	1	1
d	0	0	1	0	1	0	1	0	1	0	1	0	0	0	1	0	0	0	0	1	1	0	1	1	0	0	0	1	1	0	1	1	0	1	1	0	0	0	0	0
e	0	0	1	0	1	0	1	1	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0
f	0	0	1	0	1	0	1	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	1	0	1	1	1	1
g	0	0	1	0	1	1	0	0	0	1	1	1	0	0	0	0	1	0	0	1	0	0	0	0	1	0	0	1	0	1	0	1	1	0	0	0	0	1	1	0
h	0	0	1	0	1	1	0	0	1	1	1	0	0	0	0	0	1	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
i	0	0	1	0	1	1	0	1	0	1	1	0	0	0	0	0	1	0	1	0	0	0	0	1	1	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0
j	0	0	1	0	1	1	0	1	1	1	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	1	0	0	1	1	0	0
k	0	0	1	0	1	1	1	0	0	1	1	0	0	0	0	0	1	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0
l	0	0	1	0	1	1	1	0	1	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0	0	1	1	1	0	0	0
m	0	0	1	0	1	1	1	1	0	1	1	0	0	0	0	0	1	1	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0	1	1	1	0	0	0	0
n	0	0	1	0	1	1	1	1	1	1	0	1	0	0	1	0	1	0	0	1	0	0	0	0	0	1	0	0	1	0	0	0	0	1	1	0	0	0	1	1
o	0	0	1	1	0	0	0	0	0	1	1	1	0	1	1	1	0	1	0	0	1	1	0	0	0	0	1	1	1	0	1	1	1	0	0	0	0	0	0	0
p	0	0	1	1	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0	1	0	0	0	1	0	0	1	1	0	0	0	0	0	1	0	0	1	1	1	1
q	0	0	1	1	0	0	0	1	0	0	1	1	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0	1	0	0	0	1	0	0	0	0	0	1	1

Table 12: Continued

r	0	0	1	1	0	0	0	1	1	1	1	0	0	0	0	0	1	0	0	1	0	0	0	1	1	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0	0
s	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	1	0	1	0	0	0	0	1	0
t	0	0	1	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	0	0	0	1	0	1	0	0	0	0	0	0
u	0	0	1	1	0	0	1	1	0	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	1	0	0	0	0	1	0

Table 13: Truth Table for English Characters

Char	SL_0	SL_1	SL_2	A_0	A_1	A_2	A_3	A_4	A_5	S_0	S_1	S_2	S_3	S_4	S_5	S_6	S_7	S_8	S_9	S_{10}	S_{11}	S_{12}	S_{13}	S_{14}	S_{15}	S_{16}	S_{17}	S_{18}	S_{19}	S_{20}	S_{21}	S_{22}	S_{23}	S_{24}	S_{25}	S_{26}	S_{27}	S_{28}	S_{29}	S_{30}	S_{31}
A	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1	1	0	0	0	1	0	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0
B	0	1	0	0	0	0	0	0	1	0	1	0	0	0	0	1	0	0	1	1	0	0	0	1	1	0	0	1	1	0	0	1	1	0	0	0	0	0	0	0	0
C	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	1	1	1	1	1	0
D	0	1	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	1	1	0	0	0	0	1	1
E	0	1	0	0	0	0	1	0	0	0	1	0	0	0	0	1	0	0	0	1	0	0	0	1	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0
F	0	1	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	0	0	1	0	0	0	1	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0
G	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1
H	0	1	0	0	0	0	1	1	1	0	0	0	1	1	0	0	0	0	0	1	0	1	0	1	0	0	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0
I	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0
J	0	1	0	0	0	1	0	0	1	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	1	1	0	0
K	0	1	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1	1	0	1	1	0	0	0	1	1	0	0	0	0	0	0	0	0
L	0	1	0	0	0	1	0	1	1	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
M	0	1	0	0	0	1	1	0	0	1	0	0	1	1	0	0	1	0	1	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
N	0	1	0	0	0	1	1	0	1	1	0	0	1	1	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0
O	0	1	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
P	0	1	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0	1	0	1	0	0	0	1	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0
Q	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1
R	0	1	0	0	1	0	0	0	1	1	1	0	1	0	0	0	0	0	0	1	0	0	0	1	1	1	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0
S	0	1	0	0	1	0	0	1	0	0	1	1	1	0	1	1	1	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
T	0	1	0	0	1	0	0	1	1	0	1	1	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0
U	0	1	0	0	1	0	1	0	0	1	0	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V	0	1	0	0	1	0	1	0	1	0	0	0	1	1	0	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0
W	0	1	0	0	1	0	1	1	0	1	0	0	1	1	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0
X	0	1	0	0	1	0	1	1	1	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	0	0	0	0	0	0	0
Y	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	1	0	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0
Z	0	1	0	0	1	1	0	0	1	0	1	1	0	0	1	1	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0

Table 14: Truth Table for Bengali Numerals

Char	SL_0	SL_1	SL_2	A_0	A_1	A_2	A_3	A_4	A_5	S_0	S_1	S_2	S_3	S_4	S_5	S_6	S_7	S_8	S_9	S_{10}	S_{11}	S_{12}	S_{13}	S_{14}	S_{15}	S_{16}	S_{17}	S_{18}	S_{19}	S_{20}	S_{21}	S_{22}	S_{23}	S_{24}	S_{25}	S_{26}	S_{27}	S_{28}	S_{29}	S_{30}	S_{31}
0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
1	0	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	1	1
2	0	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	1	0	0	1	1	0
3	0	1	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	1	1	0	0	1	1	1	1
4	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	1	0	1	1	0	0	1	1	0
5	0	1	1	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	1	1	1	1	1	1	1
6	0	1	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	1	0	0	0	1	1	0	1
7	0	1	1	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	1	0	1	0	0	0	1	1	0	0	0	0
8	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0	1	1
9	0	1	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	0	0	0	0	1	1

Table 15: Truth Table for English Bengali

Char	SL_0	SL_1	SL_2	A_0	A_1	A_2	A_3	A_4	A_5	S_0	S_1	S_2	S_3	S_4	S_5	S_6	S_7	S_8	S_9	S_{10}	S_{11}	S_{12}	S_{13}	S_{14}	S_{15}	S_{16}	S_{17}	S_{18}	S_{19}	S_{20}	S_{21}	S_{22}	S_{23}	S_{24}	S_{25}	S_{26}	S_{27}	S_{28}	S_{29}	S_{30}	S_{31}
0	1	0	0	0	0	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	0	0	0	0	0	0	0	0	0
1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0
2	1	0	0	0	0	0	0	1	0	1	1	1	0	1	1	1	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
3	1	0	0	0	0	0	0	1	1	1	1	1	0	0	1	1	1	1	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
4	1	0	0	0	0	0	1	0	0	1	0	0	1	0	0	0	1	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
5	1	0	0	0	0	0	1	0	1	0	1	1	1	0	1	1	1	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
6	1	0	0	0	0	0	1	1	0	0	1	1	1	1	1	1	1	1	0	0	1	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
7	1	0	0	0	0	0	1	1	1	0	1	1	0	0	0	0	0	0	1	0	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0
8	1	0	0	0	0	1	0	0	0	1	1	1	1	1	1	1	1	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
9	1	0	0	0	0	1	0	0	1	1	1	1	1	0	1	1	1	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0

Table 16: Truth Table for Arabic Bengali

Char	SL_0	SL_1	SL_2	A_0	A_1	A_2	A_3	A_4	A_5	S_0	S_1	S_2	S_3	S_4	S_5	S_6	S_7	S_8	S_9	S_{10}	S_{11}	S_{12}	S_{13}	S_{14}	S_{15}	S_{16}	S_{17}	S_{18}	S_{19}	S_{20}	S_{21}	S_{22}	S_{23}	S_{24}	S_{25}	S_{26}	S_{27}	S_{28}	S_{29}	S_{30}	S_{31}
?	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
?	1	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0
?	1	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	1	0	1	0	0	0	1	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0
?	1	0	1	0	0	0	0	1	1	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	1	0	1	0	1	0	0	0	1	0	0	1	0	0	0	0
?	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	1	1	0	0	1	1	0	0	0
?	1	0	1	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	0	0	1	0	0
?	1	0	1	0	0	0	1	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0
?	1	0	1	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
?	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0
?	1	0	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0
?	1	0	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0
?	1	0	1	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0

Consonants, English Characters, Bengali Numerals, English Numerals and Arabic Numerals. The Truth Tables show category selecting 3-bits, character selecting 6-bit and corresponding different segments status.

Now try to identify the standard Sum of Product (SOP) Expressions from Truth Tables. After simplifying the expressions the minimum SOP expression for different segments (using K-map) will be as follows:

For Bengali Vowels the segments SOPs are

S_0 = (0, 5, 9);
S_1 = (0, 1, 2, 5);
……..
……
……
S_{31} = (0, 3, 4)

To determine the block diagram of 32-Segment display models is the only remaining task. To do this first look into the input characters identifiers (SL_0, SL_1, SL_2, A_0, A_1, A_2, A_3, A_4, A_5) and their corresponding outputs required to display the targeted characters. Figure 2 shows the block diagram of the proposed 32-Segment Display Model.

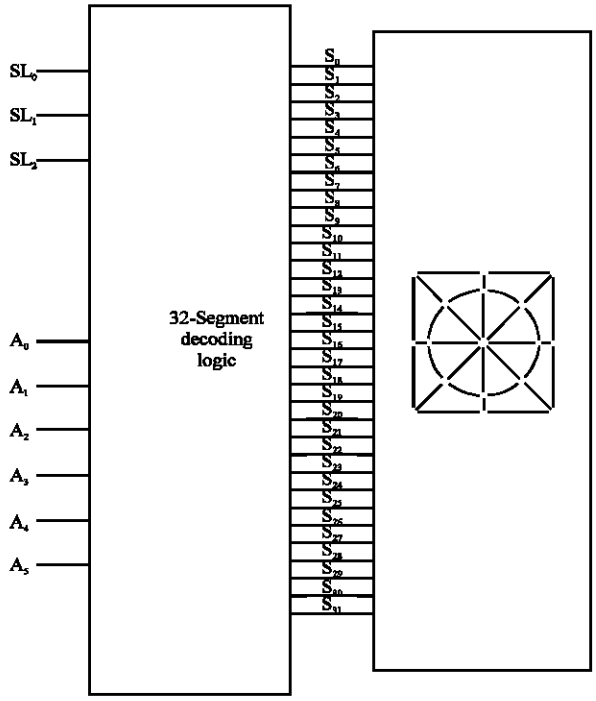

Fig. 2: The 32-Segment display block diagram

CONCLUSION

In this study an innovative and unique 32-Segment display model proposes to display for Bengali and English alphanumeric and Arabic Numerals. In this research, we not only propose the layout but also determine which segments will be active/inactive for displaying a particular digit or character and finally develop the Truth Tables and Boolean Expressions in minimum SOP form and Block Diagram. As per our knowledge this is the first segmented display model that is successful to display characters in tri-languages: Bengali, English and Arabic. The compactness of the design, required small space and intersection-less segments make this design novel and convenient. Since the model covers three languages, so ultimately its implementation will be cost effective due to its diversified utilization. Besides, the display quality of the characters is also significantly impressive.

It is well known that segmented display model is a new research area, so it is expected that this innovative display model will open a new dimension to research on displaying Multi-language characters by a single display model. In future we believe that this model will be extended for displaying more languages characters.

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