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Low Cost Thermal Printing Solution for Devnagari Font

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Abstract
Receipting in retails market nowadays becomes basic need. Markets like mall, product collection, product selling has to give receipt to customers. In counties where population are illiterate requires receipt to be printed in their regional language for better understanding and proper communication. This paper proposes a system for thermal printing in Devnagari which is regional language of Maharashtra India. The algorithm is developed and implemented on hardware and tested. For printing devnagari, font is created using kiran font and is printed by thermal printer when English string is supplied to it. The performance of the printer is calculated based on speed, quality of printing and how all characters of Marathi will be printed.
Index Terms—Thermal Printer, Devnagari, Printer head, Marathi

I. INTRODUCTION

Thermal printers are non impact type of printer. Which not uses impacting mechanism and cartridges for print instead of it they use thermodynamics principle for printing. Its print mechanism uses small tiny dot which generates heat when activated, this generated heat will be transfers to the paper for print small tiny dot on paper. This dot is print on paper due to special paper coating. This special coated paper is used for printing is known as thermal paper [1][2].

Thermal dot is activated by giving pulse, a heat is generated at the end point, and now this heat is transferred to paper area beneath of it. The area will affected due to chemical reaction happen on coated material by heat. The darkness in the pixel depends on the amount of heat transferred. The printing can be done using printing such no of dots. The quality of print depends on dot pitch, size of pixels and amount of voltage for heat generation. Dot pitch is no of pixels per mm (millimeter) area. Normally dot pitch of thermal paper is 8 dots per mm. This makes 384 dots per line when the width of printing is 48mm.The quality can be improved by increasing dot pitch [1][3][6].

For printing purpose the print data or print image has to be decomposed into image lines as shown in figure 1. Then each individual image line has to be transmitted to printer for printing. The print head produces a black dot for each pixel that present in image line. As the print head is only able to print single dot, the complex image characters are to be reduced by the computer software or printer side driver.

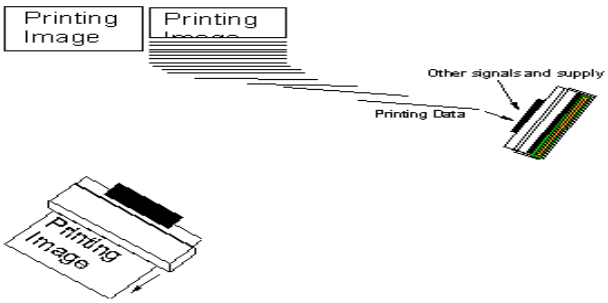

Figure 1: Decomposition of image for printing

II. THERMAL PRINTER MECHANISM

The thermal printer mechanism contains the logic circuit for driving tiny dots, several Input Output and stepper motor to rotate or move paper. The printer will take the input for interfacing card which will driver the mechanism and generates the printed data as sent by card.

Figure 2: PT486F thermal printer mechanism

The fig. 2 shows the PT486F thermal printer mechanism from PRT Technology which has paper loading mechanism using stepper motor and 90˚ vertical paper feeding. This printer mechanism is used for designing and testing.

III. CURRENT PRINTING SYSTEMS

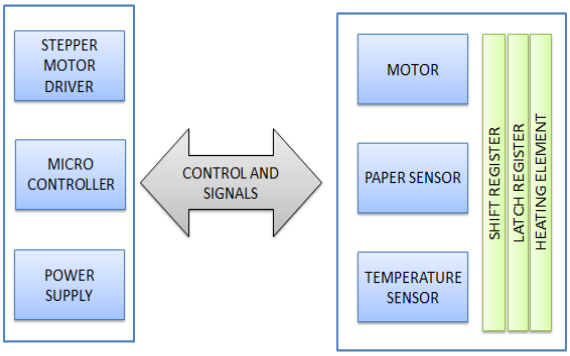

Figure 3: Block diagram of thermal driver and printer

Block diagram of thermal printer mechanism and driver card consists of

1. Power supply block which will provide the supply voltage to work by all components.
2. Microcontroller generates control signal, decomposing information that has to be sent to printer, input string or image for printing.
3. Stepper motor driver logic: it will drive the stepper motor present insight the thermal printer mechanism. 4 phase stepper motor will be moved in forward side after each line print.
4. Temperature sensor provides the temperature at dots of head and paper sensor will detect the presence of paper.
5. Shift register and latch register are used for the latching of data send by the microcontroller

Thermal printer driver will prints the English, Chinese and some other font. Printing in other languages required special character set generation and algorithm to convert normal string to that font. The devnagari font is printed by Personal Computer (PC) side software where the decomposition job will be carried out by software and decomposed data has to be given to printer. But this will not work when the printer accept the serial data for printer. As the drivers created for the printer are universal this accepts the serial data for printing [7].

To print data in English the driver designing will follows the following steps:

1. Font Selection: Select the type of font which has to be used for printing. The font type can be any normal font like Arial, times new roman etc.
2. Once font has been selected the character set of that font needs to be created. The character set is collection of matrices of individual characters. Each matrix contains the pixel information for representing that character. Which pixel has to be set or which has to be not set. The size of matrix depends on the height and width of the characters requires and the no of dots present in print head.
3. The character set is stored into non volatile memory. The data stored is access based on their ASCII value. The matrix of 'A' will be accessed by ASCII value 65.
4. Printing takes place as string for printing has been received. When string comes pixels information for complete string is formed by selecting individual bitmap pixel of each character by their matrix accessed by ascii value of characters. Now generated information for printing is decomposed in to no of lines. Each line contains the information of pixel has to be set or unset in that line. Each line is send to the printer for printing.

IV. PROPOSED DESIGN

Proposed system will reduced the cost in electronic driver design for printer and also supports the devnagari language for printing. For the development system uses 8051 based microcontroller, stepper motor driver and power supply component for printer driving. It also provides design methodology to design driver card which will prints the data in devnagari language. The driver card design will follow the similar steps of designing thermal printer. The steps for system development methodology are:

1. Selecting devnagari Font:

Devnagari font Kiran is selected for printing in devnagari in proposed system. This font is non Unicode type of font when used in PC but here its used as reference for creating character set.

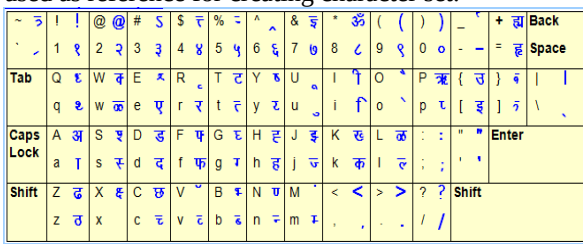

Figure 4. Keyboard layout of KIRAN font

Proposed system used this keyboard layout for printing in devnagari. This keyboard layout is converted into the ascii bitmaps for each character.

2. Generates the character set for the selected font based on ASCII characters.

In this steps the matrix vector is created for each character which is shown in keyboard layout is generated in the form on 32x16 matrixes. Where corresponding data in matrix represent the dot is present in the paper or not. Each character is stored in 32x16 pixel or dotted matrix. The text character is divided into three parts upper zone, middle zone and lower zone. The upper part is above the headline

which is known as "shirorekha" in Marathi and headline in Hindi. Fig 5 Shows these three division and pixel used by each portion in the character map.[4][5]

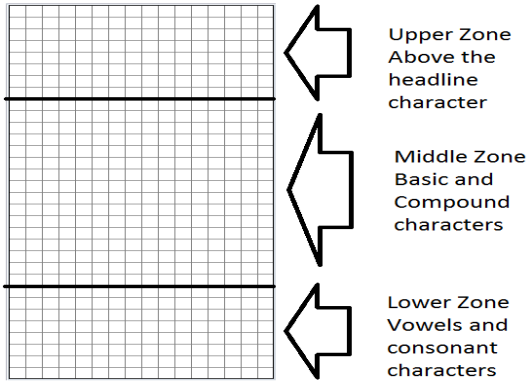

Figure 5: character bitmap division

Upper zone is used by character which is above the bar in devnagari font. While generating the character set for this type of character is only in above 8x16 matrixes. The example of characters which is resides in upper zone shown in Fig. 6.

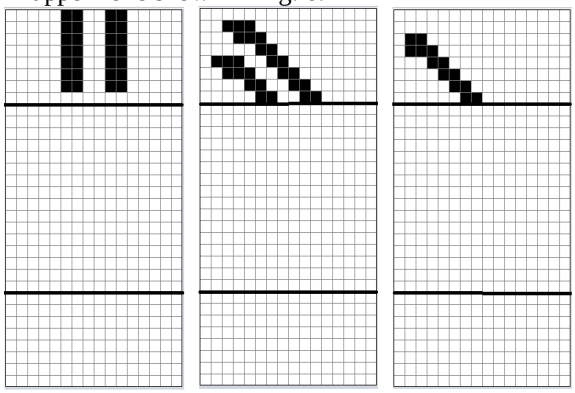

Figure 6: Upper zone characters

Middle zone character are the basic characters like 1 2 3 4 5 6 7 8 9 0 A k K g G c C d D t h m N Q e r " etc. These characters are formed insight the 16x16 pixel in bitmap. Figure 7 shows " 1 2 and k" in middle zone.

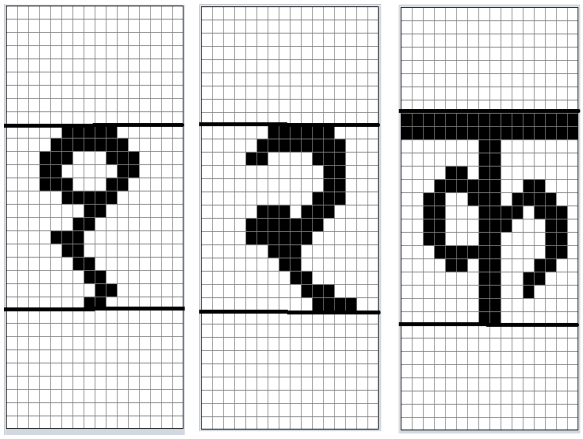

Figure 7: Middle Zone characters

Lower zone is used for creating vowels and consonant characters. Which are shown in Fig. 8.

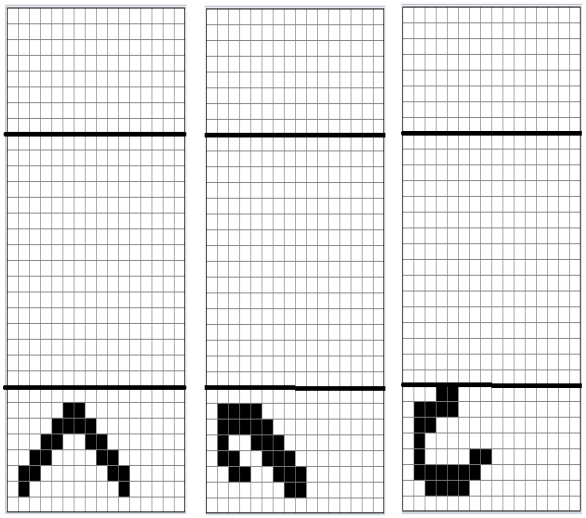

Figure 8: Lower Zone character

3. After the character is generated this will Now stored into nonvolatile memory storage. In proposed system data is stored into 16 column wise matrix of size [128][4]. Where the index 128 represents the no of ascii chars used for printing and 4 is no of bytes used for representing single column of print data. 4 bytes of information stores the 32 bits of each row and 16 represent the no of columns in each character formation.
4. Proposed system also generated [128][2] array for shifting logic. This is used for shifting column information between two characters. There are two shifting is required. Pre-shift is used when character has to be pre-shift by some column value and post shift used for post shifting the column information.

When the input string "Aa" comes it has to print "Aa". For this when A comes it will pick up bitmap "A" from memory it has pre and post shift value of 2 pixel i.e. for leaving small space. when 'a' comes it has bitmap "a" so it has to be shift 8 columns left side so it can combine with "A" and forms "Aa" otherwise it will look like "A a"

5. In last step this generated information is decomposed into image line, each of which is given to printer for printing.

V. ALGORITHM

The algorithm is divided into two functions. Printmarathitext function is used to generate the information in Marathi from the text given as input.

Function: Printmarathitext
Input: Text to be printed
Output: Marathi information for printing

1. Begin
2. //Printing is divided into four parts.
3. Initialize PIXEL_ARR[1.384]=0;

```
4.        for(i=0;i<4;i++)
5.              fill_marathi_buffer(i);
6.               line_count = 0;
7.              While(1)
8.                    Print_Dotted_line();
9.                   //prints single dotted line of 384
pixels
10.                   If line_count > 7
11.                      Break
12.             While end
13.          End for
14.        End
```

```
Fill_marathi_buffer(part_division)
Input: part devision,print message
Output: dotted line for the part_division
1.        Begin
2.        BUF_PRINT[0...7][0…47]=0;
3.        BAR_MSG[0..383]=0;
4.        Ptr=0;
5.              While ptr<384 and max_char_line<48
6.                    j=j-pre_shifting_value;//Shifts
pointer left
7.                   While(col_count<16)
8.                         BAR_MSG[j]=Retrive
Column information
9.                         col_count++;j++;
10.                  While end;
11.                  j=j-post_shift; //no of pixel to
shift right
12.       .       End while
13.             If(j<384)
14.                BAR_MSG[j]=0;
15.                J++;
16.             End if;
17.         End
```

The print dotted line is used for printing single line of 384 dots. The data is sent by controller to the printer for printing.

VI. PROTOTYPE AND RESULT OUTPUT

For the prototype we have used the PT486F thermal printer mechanism form PRT Technology. It has low voltage operation, compact in size and low weight, high resolution printing with 8 dots/mm and best advantage is very low noise as compared to impact type printers. Driver circuit has been developed which will drives the printer mechanism and prints the devnagari script.

The below are the images which is printed in devnagari language using the developed system.

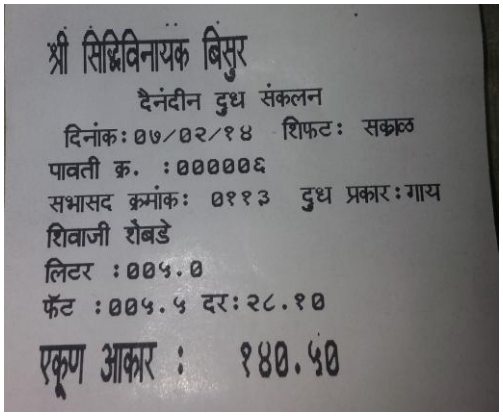

Figure 9: Daily milk collection slip in devnagari

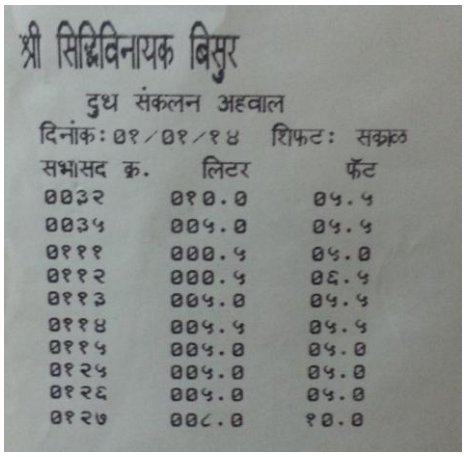

Figure 10: Total milk collection slip

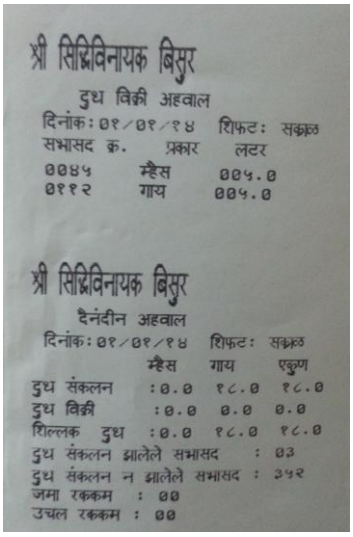

Figure 11: Milk collection report and daily report

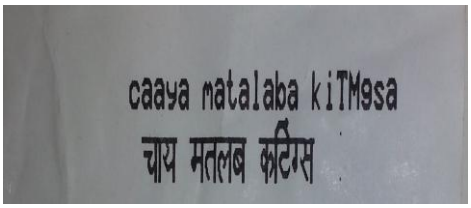

Figure 12: string printed in English and devnagari

In fig 9, 10, 11 and 12 are the images that are printed by the proposed system. In fig 12 the string is printed in English as well as in devnagari. for printing in devnagari the above English string is given as input. The "caaya" will print "caaya" and similar for others characters.

VII. RESULT AND CONCUSION

The proposed solution is able to print devnagari language based on the input string is presented to it. It will print 95 percent of devnagari words efficiently. The remaining 5 percent words are not printed as they are very complex to form.

The speed of proposed system is 80mm / sec which very high as compared to other printers. This speed is achieved using the increase the speed of microcontroller operation. Reduces power consumption by the reducing the power used while printing.

Proposed system can be improved in future by improving by its character set as now the character set from 32 to 128 are used for printing. The proposed algorithm for printing can be improved to increase the speed and reduced size complexity. Speed of operations can be increased by uses of faster microcontroller and thermal mechanism.

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