An Improved Method for 7- Segment Numeric Character Recognition

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Abstract—**Text information recognition is very important because of its vast application. Also for the digitalized system, now a day's in many applications numeric characters are represented in a digital manner i.e 7- segment representation. And recognition of the digital numerical character is getting more popularity day by day. In this paper we proposed a new method for recognizing the 7-segment numeric character. For this purpose we take each segment as a video frame input by web-cam using a red colored object. And then we apply our proposed algorithm which works into three steps: 1) detecting the red color from a frame and finding the frame either it is a row frame or column frame 2) applying a process called numeric character grouping which is done to set the frames into a certain category 3) and then according to the position of row and column of the segment or number of row and column of the segment, a particular numeric character is recognized. The results of the experiments are very promising. In our proposed method, if the frames can take properly then the recognition rate is 100%.**

Keywords-7-segment numeric character; color detection; row frame and column frame; numeric character grouping; character recognition.

I. INTRODUCTION

Now a day's character recognition is getting more popularity due to its wide application. There has been many method applied for detecting the characters and recognize them. Among them hand written character has been recognized [1], [2], [3], car license plate has been recognized [4], [5], [6], and character recognized from natural image [7], [8], [9]. In some work different type of classifiers has been used to detect and recognize the characters [10] and some works without using any classifiers. The work of character recognition which is done by using a classifier that is not always gives the perfect result or it cannot detect correctly all the time. And also when a classifier is used to recognize characters it's become very complex because there always needs a training set and a testing set of data. Depending on the change of pixel value of image the neural network can identify a wrong character, and it is a severe problem when its need an accurate recognition. Also when there is no classifier is used then sometimes there some of the characters remain unrecognized. For hand writing recognition, segmentation is one of the most important problems for cursive words and it affects the recognition process [11]. So for this purpose many segmentation processes has been proposed such as recognition based segmentation [12], over segmentation [13] fusion based segmentation [14].

And for license plate recognition there are commercial systems which are very costly. So there developed some process using edge detection or color segmentation [15], also by using classifier which is cost effective. Though natural image character recognition is a difficult task there has been many work done for this purpose. So based on the different application there has been different types of character recognition process developed.

In this paper a method for recognition of the 7- segment numeric character is proposed. Fig. 1 shows the different 7-segment numeric character. For this work for any number, each segment taken as a single video frame. And the segment is indicated by a red colored object. So when the frame is taken by red colored object then from the frames the red colored object position is detected as a segment of a character. When the red color object position is defined by the threshold value of red color, then in the next step the image is converted into a binary image so that on the frames the red color position remains white and the background becomes black. After that, the frames are defined as either row frame or column frame. According to the number of row frame and column frame the taken frame goes to a certain category which is known as the numeric character grouping. This grouping is done as follows: if the row frame is greater than the column frame, if the row frame is less than the column frame and if the row frame is equal to the column frame. When the frames fall into a definite category or group then for recognition of the numeric character each group applies different process. And according to that process the numeric character can be identified or recognized correctly. Then the recognized numeric character can be displayed as an image. The result of this work is outstanding as compared to the other numeric value detection process. And in this process if the frames can taken properly then the recognition rate is 100%.
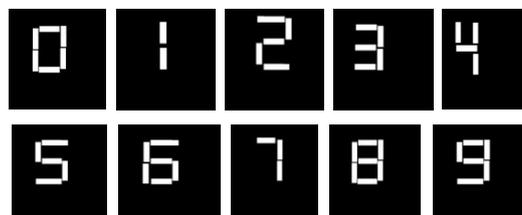
Figure 1.   7- segment numeric character

The remainder of this paper is organized as follows. Section II briefly overviews the proposed method. Section III shows

the calculation algorithm of number of row frame and column frame. Section IV describes the numeric character grouping process and recognition of number. The experimental study given in section V and section VI concludes the paper with our future plan.
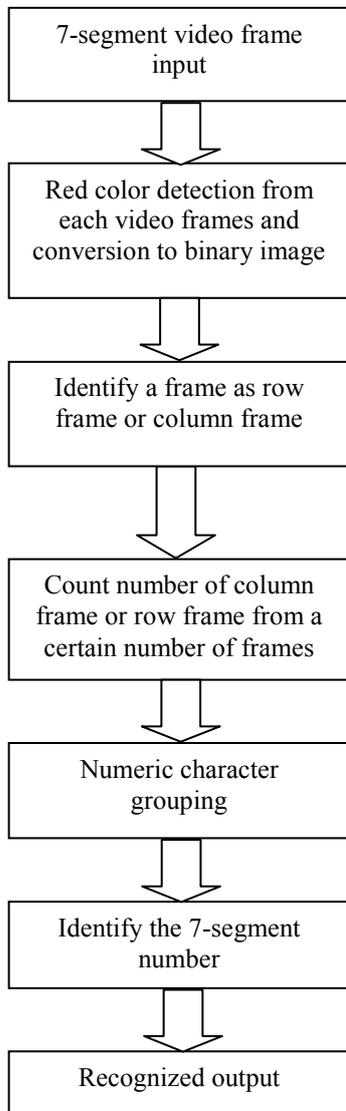
II. OVERVIEW OF OUR PROPOSED METHOD

Figure 2. Flow chart of our proposed method

In this paper, we propose a new method to recognize the 7-segment numeric characters. Fig. 2 depicts the flow chart of our proposed method. Our proposed method consists of three main steps, given here.

Step 1) Detecting the red color in a frame and finding the frame either it is a row frame or column frame. For this step at first it needs to take the video frames by any red color object which represents a segment. Here a segment is represented by a single frame. And the important task is to detect the red color position on the frame then it needs to convert the image into a binary image. So now the red color position becomes white and the whole background becomes black. And from this image the detected red color position value is found and its column value and row value is calculated. If the row value is higher than the column value then it is defined as a column frame otherwise it is a row frame. Also it should be remembered that the row value and column value cannot be equal for the red colored object or simply it cannot be a square sized red object.

Step 2) Applying a method called numeric character grouping to place the frames into a certain category. In this step the number of row frames and column frames are calculated and according to the number of row frame and column frame the frames fall into three categories: First if the number of row frame is equal to the column frame. In this category there are two numeric character- six and nine. Second if the number of row frame is greater than to the column frame. In this category there are three numeric characters- two, three and five. Third if the number of row frame is less than to the column frame. In this category there are five numeric characters- zero, one, four, seven and eight. So in this step the frames fall into a single group among the three groups which defined above.

Step 3) in this step the 7- segment numeric character is recognized or identified according to the position of row and column of the segment on a frame or the number of row segment and column segment on the frames. And then finally the output is displayed by a numeric character image as well as on the command window.

III. IDENTIFY THE RED DETECTED FRAME EITHER ROW FRAME OR COLUMN FRAME

To identify the frame as a row frame of column frame at first from a input frame the number of red color pixel value is calculated, if it exceeds a threshold value then the frame is considered for further process otherwise discard the frame, and get next frame. The algorithm of this process is given below:

Step 1. Import a frame
Step 2. if the number of red pixel on a frame > threshold
　　　Then store it as a valid frame
　　　else
　　　Remove this frame for further process & go back
　　　to **step1**
Step 3. Identify row frame or column frame
　　　Import all valid frames.
　　　Number of column frame =0;
　　　Number of row frame =0;
　　　for k=1:1: total number of valid frame
　　　I=0;
　　　J=0;
　　　Where,
　　　I= total number of row that contains 1
　　　J= total number of column that contains 1
　　　for x=1:1:row of input frame
　　　　for y=1:1:column of input frame

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        if (frame(x,y)==1)
            I=I+1
            break;
        end
    end
end
for y=1:1:column of input frame
    for x=1:1:row of input frame
        if (frame(x,y)==1)
            J=J+1;
            break;
        end
    end
end
if (I>J)
'Column frame'
Number of column frame = Number of column
frame+1;
else
'Row frame'
Number of row frame = Number of row frame+1;
end
end
end of step 3
```

IV. NUMERIC CHARACTER GROUPING AND IDENTIFICATION

According the number of row frame & column frame we can divide our next step in three parts.

Loop1. if number of row frame = column frame:

Figure 3.   Equal row and column frame numeric character

Then eliminate those frame which are detected as row frames previously.

Figure 4.   Image after eliminating row frame

And the frame which contains minimum average value of row and column position of the frame is now eliminated.

Figure 5.   Minimum average valued row and column position frame eliminated image

Now **if** absolute value of (column1-column2) > absolute value of(row1-row2)
Then the output is six.
else output is nine.

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end if
end loop1
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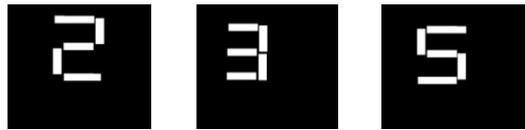**Loop2.** if number of row frame > column frame:

Figure 6.   Greater row frame than column frame characters

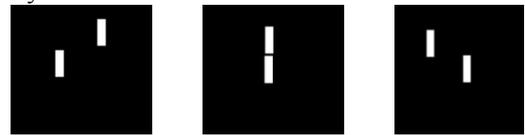Then eliminate those frame which are detected as row frames previously.

Figure 7.   Image after eliminating row frame

if (row2 > row1) & (column1-column2 > threshold), then the output is two.
end if
if (row2 > row1) & {absolute value(column1-column2) < threshold}, then the output is three.
end if
if (row2 > row1) & (column2-column1 > threshold) then the output is five.
end if
end loop 2
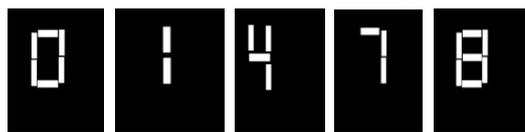**Loop3.** if number of row frame < column frame:

Figure 8.   Greater column frame than row frame characters

Then eliminate those frame which are detected as column frames previously.

Figure 9.   Image after eliminating column frame

if it contains two row frame, then the output is zero.
end if
if it contains no row frame, then the output is one.
end if
if it contain three row frame then the output is eight.
end if
if it contains one row frame then the output is four or seven. For detecting the target either four or seven we eliminate the row frames and again consider the column frame.

Figure 10.   Recalled only the column frames

Now **if** it contain three column frame then the output is four.
else the output is seven.
end if
end if
end of loop3

V. Experimental Study

A. Experimental process

We evaluated the performance of the proposed approach by taking the input video frame using webcam. Here we used the frame rate 1 because we need to take one segment within a single frame. So for 7-segment number we took 7 frames to represent each segment individually. After taking the frames they are used for further processing. At first the red color is detected from the frames and then made the image binary. Then from the frames the row frame and column frames are calculated as mentioned above as well as the grouping is also done for recognition of the number.

B. Experimental Results

We have tested this algorithm for all the 10 numeral digits. But here we show our experimental result for only four numeral characters.

1. Recognition of two & five:

For recognition of two and five they fall into the group where the number row frame is greater than the column frame. After falling this category the row frames are eliminated and also find the column position value of each segment for recognizing either two or five. For this, the upper frame is defined as row1 and column1 and the lower frame is defined as row2 and column2. And then from the difference of this column value the numeral number two or five is detected. For two the lower positioned frame's column value is lesser than the upper positioned column value. And for five the lower positioned frame's column value is greater than the upper positioned column value. The whole process is shown through Fig. 11 to Fig. 16.
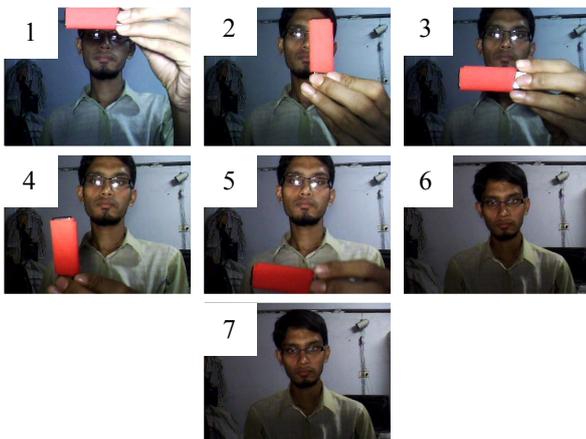

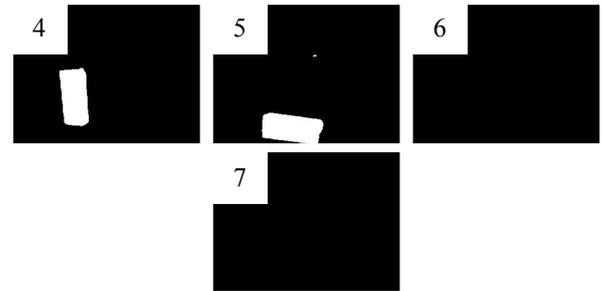Figure 11.   Input frames for two detection

Figure 12.   Red detection and conversion to binary image

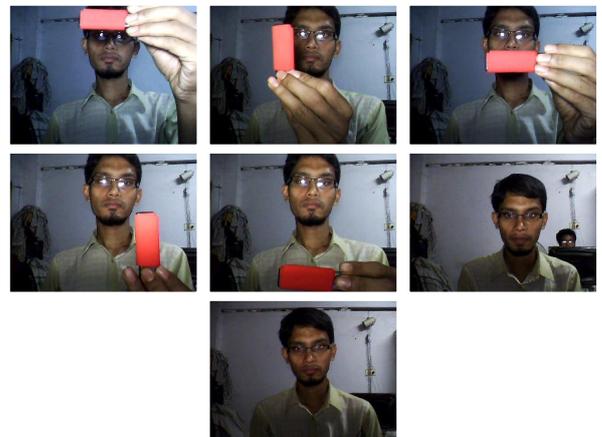Figure 13.   (a) After combining all frames (b) Identified output
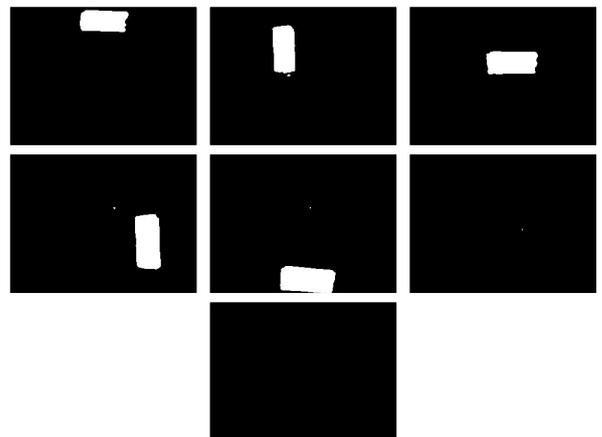

Figure 14.   Input frames for five detection

Figure 15.   Red detection and conversion to binary image

Figure 16.   (a) After combining all frames (b) Identified output

2. Recognition of six:

Fig. 17, Fig. 18 and Fig. 19 shows the process of 7-segment numeral six recognition. For six identification when number of column frame and number of row frame is calculated then our algorithm finds the equal number of row and column frames. So then it falls into the equal row frame and column frame group. In this group there is only two numbers, one is six and another is nine. Now to differentiate the number between six and nine the row frames are eliminated and then the frame which have minimum average value of row and column is also eliminated. After that the difference of rows and the difference of columns of each segment are calculated. Now if the row difference is greater than the column difference then it is six otherwise it is nine. In this gradual step the output is detected as six for this data.
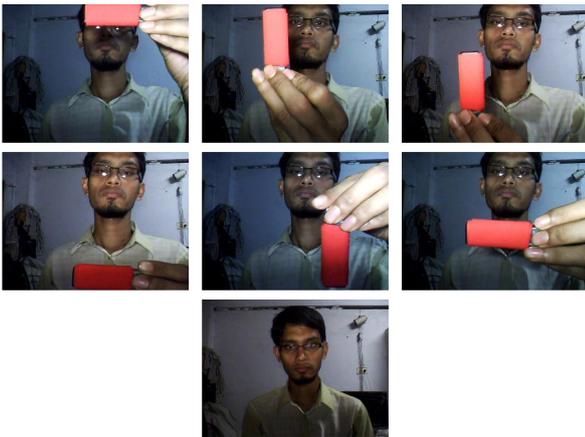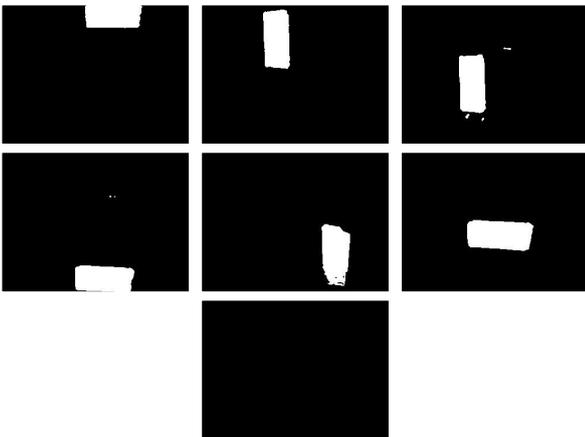

Figure 17.   Input frames for six detection

Figure 18.   Red detection and conversion to binary image

Figure 19.   (a) After combining all frames (b) Identified output

3. Recognition of four:

In the similar manner four is identified and the whole process is described in the Fig. 20, Fig. 21 and Fig. 22. For four identification where row frame is found less than column frame then first the column frame is eliminated. Now there only one row frame present for four and seven. So to find the difference between four and seven again the column frames are recalled. If the there three column frame is present then it is identified as four otherwise it is seven.

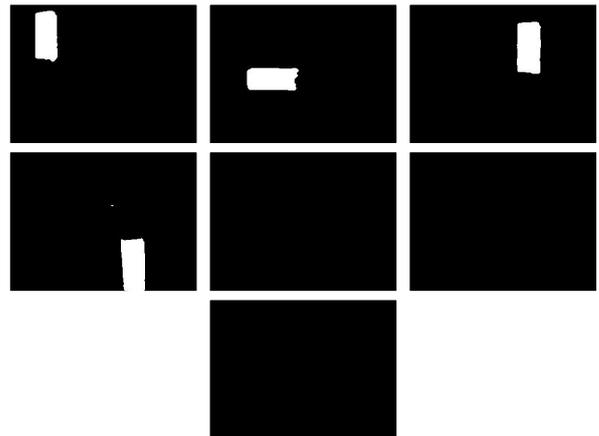Figure 20.   Input frames for four detection

Figure 21.   Red detection and conversion to binary image

Figure 22.   (a) After combining all frames (b) Identified output

VI.   CONCLUSION AND FUTURE WORK

In this paper we present a new approach for recognition of 7-segment numeral characters. This method can be used in airport where the 7-segment numeric character is used to represent the time schedule for any robotic system if the row and column frame can be identified by segmentation from a natural image. This method employs by calculating the

number of row frame and column frame. And finally according to the position of row and column of the segment or number of row and column of the segment, a particular numeric character is recognized. Our experimental result demonstrated that the proposed method is very effective for the detection of 7-segment numeral characters. If the frames could take properly then the recognition rate is 100%.

Our future plan is focused on detecting the 7-segment characters from natural image and then we make individual segments from the image to apply this method we proposed here and not only for the numeric character but for the English character also.

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