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An Efficient Approach to Extract Characters from License Plate

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***Abstract*— Vehicular Telematics has become one of the emerging research topics for intelligent transport systems. In this paper we present a novel approach to contour and extract characters from License plates with 90% efficiency. The aim of this proposed algorithm is to find the connected components in a vehicle License plate to extract characters as the isolated characters belong to one set of connected components. We have also compared the results with other existing algorithms like Moore neighborhood pixel, and modified Moore neighborhood pixel etc. and found our proposed algorithm to be 20-27% more efficient than the existing algorithms.**

Keywords- Image Processing, Contour, Moore neighborhood pixel, License plate

I. INTRODUTION

The developed countries have started to use intelligent transport systems to minimize congestion on roads and to keep track of all vehicles. One such project is License plate recognition system which deals with extraction of characters from License plate for pattern recognition. But there is a huge challenge to isolate the characters from the license plates as in India, where no standard fonts and languages are used [1]. The other problem which we faced while isolating the characters from the License plate is that when we initially used different existing neighborhood algorithms to extract characters, we found that in real time they were only 70 - 80 % [5] successful. Hence this motivated us to propose a more efficient algorithm.

In India scant attention is paid by the transport department to standardize the License plates and people awareness is also abysmally low. Initially while implementing the automatic License plate detecting system we decided to use the existing Moore algorithm [2] and the results obtained were not up to our expectations. We then used the modified Moore algorithm [2]. In this algorithm scanning is done in different directions to get the best possible dimensions of all the characters in each direction. Once we get the desired dimension, we can easily crop out each character from the License plate. We implemented the above algorithm in Java® and found about 80% success rate.

Our proposed algorithm is more efficient than both the Moore algorithms. The existing Moore algorithms work well with some images only but fail to isolate the characters in most cases.

II. PRESENT SYSTEM

We have focused basically on two existing methods presently used in isolating the characters. These two approaches are as follows:

- Moore neighborhood pixel method.
- Modified Moore neighborhood pixel method.

A. Moore Neighborhood Pixel Method

The main idea behind Moore neighborhood pixel method is to extract the contour by going around the pattern in clockwise direction. Also it does not matter which direction we choose to traverse, as long as we stick with our choice throughout the algorithm.

Contour lines:

These are imaginary lines that join points of equal elevation in the image, with reference to the coordinate axes or contiguous points of a curve on the same altitude. The Moore neighborhood pixel method is also known as 8-neigbors or indirect neighbors due to following criteria.

- 8-neighbors : when we traverse in clockwise direction, then we have to visit all the 8-pixels around that black pixel.
- Indirect neighbors :Suppose we get the first black pixel p1,from p1 we will get p2. After traversing from p2 we would reach another black pixel p3.Then p1 and p3 are indirect neighbors.

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Disadvantages of Moore neighbor:

a. Unable to visit the pixel second time. Example: Tracing the contour of a character in a license plate. There are so many unwanted thin lines(non directional) that lie on the edge of a character and hence, the direction of traversing changes and gets stuck.

b. The algorithm uses Jacob stopping criteria to terminate the program. In other words, the algorithm stop after visiting the starting pixel for the second time, but there is a possibility it will not visit the same at all.

Algorithm of Moore neighborhood:

1. Take a digital pattern containing a group of black pixels on a background of white pixels.
2. Store the pixel value of the image into a matrix(the value will be either 0 or 1).
3. Locate a black pixel and declare it as your start pixel. Locating a star pixel can be done in number of ways. One can either scan the image from the top left corner or from bottom left corner of the image.
4. Once we get the first black pixel in the matrix, we can take it as the starting point.
5. Search for another black pixel in clock-wise direction.
6. The general idea is that every time we hit a black pixel(q),backtrack and go back to the white pixel we were previously standing on and also set q as the starting pixel and keep traversing in clock-wise direction from that white pixel.
7. The algorithm will terminate when the start pixel is visited second time.
8. The black pixel we have visited is the contour of the binary image as show in figure 1.

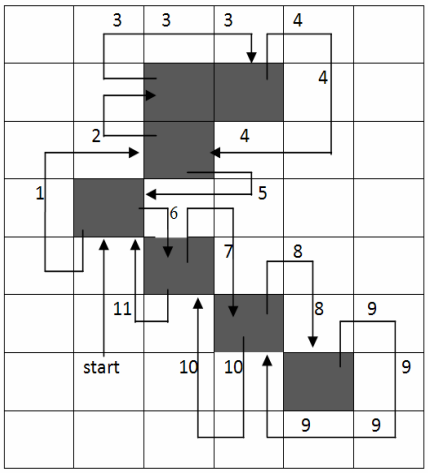

Figure 1. Figure1: Working Model of Moore Algorithm

B. Modified Moore neighbor Method

Modified Moore neighbor contour tracing algorithm: In Moore method traversing only takes place in clockwise direction, while in this case traversing takes place in both directions(clockwise and anticlockwise).

Working of modified Moore method: When the first black pixel(p1) is found ,then traversing in clock-wise direction takes place until no more black pixels are encountered. Then traversing in anticlockwise direction takes place from same pixel(p1).

Advantage over Moore:

It help in retrieving the complete boundary of image where Moore is un successful [3].

Disadvantage over Moore:

Modified Moore has solved the problem of Moore by giving the idea of traversing in anticlockwise direction, but in case of real time problem this algorithm is far behind the expectations. For example, the method fails to extract the image in Figure 2. It gets stuck in both directions because of unwanted edges lying on the edge of image. Hence we did not get the desired output. The image In figure 4 is the output of Moore modified method. As we know that if all the 8 connected pixels are traversed and does not meet with a new black pixel coordinate, then the algorithm will stop. But in designing a real time application, we have gone through a lot of images where Moore modified method is inefficient. Similarly in case of figure 4. The algorithm found different roots and reached at the end of unwanted edges and got stuck. It is impossible to get smooth edges or single width characters without retrieving the character or digit from License plate. Once we get the character it is possible to fill the character and make the contour smooth.

Figure 2. Input Image

Figure 3. Moore Neighborhood Output

Figure 4. Output of Moore Modified

Algorithm of Moore Modified method:

Input: We convert the whole binary image into pixel values and store it into a m*n matrix.
Output: We get the pixel value of the contour in the form of a matrix and hence we use that matrix to retrieve the monochrome image.

1. We take a matrix(b[][]) and fill it with white pixels (value 1) completely.
2. From bottom left corner and from left to right scan the image until a black pixel is found.
3. Store 0 in the b[i][j] at the same co-ordinate. Set the current pixel as c.
4. Scan for the next black pixel in clockwise direction from c.
5. After getting the next pixel store 0 in the b[][],at the same coordinate.
6. Set c as the next clockwise pixel .
7. While c is not added in b[][] if c is black
   a)insert c in b[][].
   b) set c the next pixel.
   end if
8. End while.
9. Move towards the next pixel.
10. Set b[i][j] as the starting coordinate.
11. Scan for the next black pixel in anticlock-wise direction
12. Set c the next clockwise pixel .
13. While c is not added in b[][] if c is black
    a)insert c in b[][].
    b) set c as the next pixel.
14. End if
15. End while.
16. Move towards the next pixel.
17. End

And hence b[][] would contain the pixel value of image and it is converted into an image.

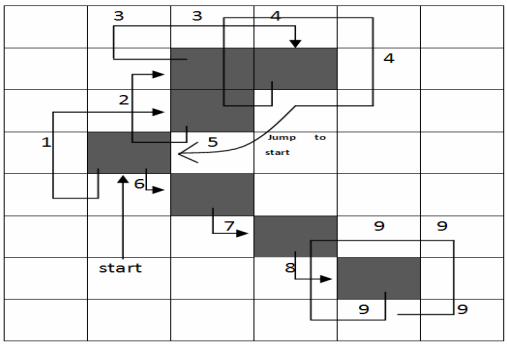

Figure 5. Working Model of Moore Modified.

So, we see that Moore and Moore modified fails for input image in figure 2 to determine the boundary and hence our algorithm can detect such boundary in the above complex images.

III. PROPOSED SYSTEM

We have modified "Moore modified" algorithm. The Proposed Moore modified algorithm for isolating the characters are done by the prescribed method. We are not able to retrieve the character by scanning in clockwise or anticlockwise direction using Moore modified method. So, we propose three priorities for scanning, because it is not possible to traverse the complete contour of characters as shown in figure 4.Hence, we decided to get the maximum value of image dimension by traversing in each direction i.e. vertical (up and down) and horizontal (right and left) and use the obtained dimension for cropping the character. We have applied this on different License plate and have received upto 97% success rate. So, our proposed algorithm becomes easy to retrieve the character from License Plate and filling that cropped place with white pixel.The Proposed Modified Moore Algorithm is as follows:

Input: A monochrome image of license plate containing the connected components of license plate characters.

Output: Extracted characters of the license plate.

Begin

1. Read the values of image width and image height.
   a. WIDTH=IMAGE_WIDTH;
   b. HEIGHT=IMAGE_HEIGHT;
2. Store the pixel values in a matrix "I" of WIDTH X HEIGHT.
3. Start scanning the matrix from bottom to top and left to right. Consider the first pixel as "R" which is the reference pixel.
4. If "R" is a white pixel (bit value 1) then continue scanning until a black pixel (bit value 0) is found. Call this black pixel as "P".
5. Now we traverse as follows:

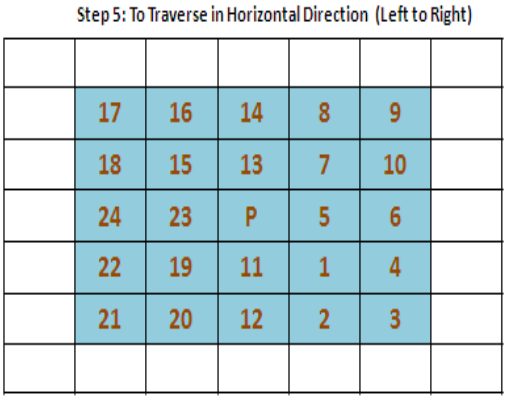

Figure 6. To Transverse in Horizontal Direction (Left to right)

We now check the pixel marked "1" .If it is found to be black, then "1" becomes "P" and we repeat this step for checking the priorities.

If pixel "1" is found to be white, then we check pixel "2" and continue the process as per the priorities shown in the figure 6.

This step provides us with four values namely, minimum and maximum of row and column co-ordinates. We call it as row_{min1}, row_{max1}, col_{min1} & col_{max1}.

6. We now traverse as follows:

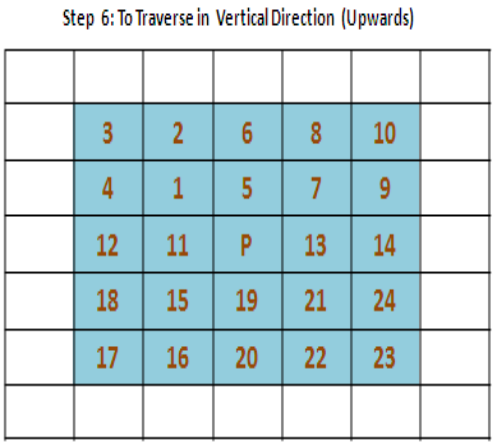

Figure 7. To Transverse in Vertical Direction (Upwards)

The traversal logic is similar to the above step and we obtain four values namely, row_{min2}, row_{max2}, col_{min2} & col_{max2}.

7. We now traverse as follows:

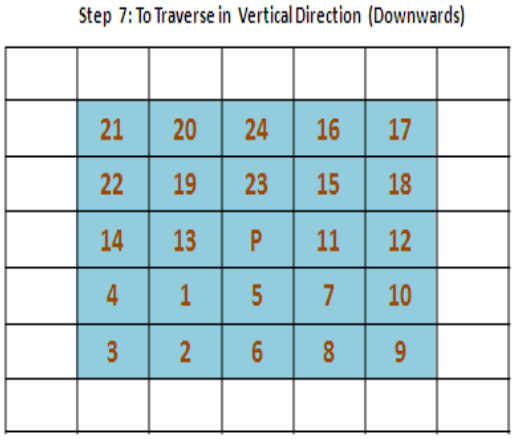

Figure 8. To Transverse in Vertical Direction (Downwards)

Similarly for step 7 we obtain row_{min3}, row_{max3}, col_{min3} & col_{max3}.

8. We now calculate the following:
   - Find the minimum value amongst row_{min1}, row_{min2} & row_{min3} which becomes the row co-ordinate of the starting pixel value of the character to be cropped.
   - Find the minimum value amongst col_{min1}, col_{min2} & col_{min3} which becomes the column co-ordinate of the starting pixel value of the character to be cropped.
   - Find the maximum value amongst row_{max1}, row_{max2} & row_{max3} which becomes the row co-ordinate of the end pixel value of the character to be cropped.
   - Find the maximum value amongst col_{max1}, col_{max2} & col_{max3} which becomes the column co-ordinate of the end pixel value of the character to be cropped.
   - Thus, START_CROP[row_{min} , col_{min}] and END_CROP[row_{max} , col_{max}] are the coordinates of the image character to be cropped.
9. Crop the image character and repeat steps 3 to 9 till the image dimensions end.
10. End

IV. RESULTS

As per our implemented and proposed algorithm we have taken the same two inputs shown above in section II for Moore and Modified Moore methods. The results are as follows:

Figure 9. Input Image

Figure 10. Output Image

V. CONCLUSION

The above output proves that our proposed algorithm works fine to extract characters from License plate. As in many of the License plates in India, characters are not aligned properly and hence extraction becomes difficult. So, we claim with full confidence that our proposed algorithm is successful in 90% of test cases which we have tested. Further information and more output can be found https://sites.google.com/site/gauravsanthalia.

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