Modified Method of Document Text Extraction from Document Images Using Haar DWT

Navjot Kaur

Abstract— This paper extends the technique used for Document Text Extraction from Images using 2-D Haar Wavelet. The discrete wavelet transform is a very useful tool for signal analysis and image processing, especially in multi-resolution representation. It can decompose signal into different components in the frequency domain. Two-dimensional discrete wavelet transform (2-D DWT) decomposes an input image into four sub-bands, one average component (LL) and three detail components (LH, HL, HH). The multi-resolution of 2-D DWT has been employed to detect edges of an original image. We select an appropriate threshold value and preliminarily remove the non-text edges in the detail component sub-bands. Then we use the logical AND operator to further removes the non-text regions. Another idea of removing the large size area in the image is merged with this idea to eliminate the non-text region from Document Images.

Keywords— Average component, Detail components, Document text, DWT, Multi-resolution of 2-D DWT, Non-Text Edges, Sub-band images, Text extraction, 2-D Haar Wavelet

1 Introduction

Large amounts of information are embedded in images which are often required to be automatically recognized and processed. Texts in images contain useful information which can be useful to fully understand images. Text recognition from document images receives a growing attention because of potential applications in content based indexing, archiving documents.

The term *document* in no longer confined to scanned pages and any camera based image can be subject to operations like text information extraction (TIE) for applications such as optical character recognition (OCR), image/video indexing, mobile reading system for visually challenged persons etc.

Data capture of documents by optical scanning or by digital video yields a file of picture elements, or pixels, that is the raw input to document analysis.

Some examples of Document Images are as shown in the figure:

fig 1. Document Image example 1

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Corporation takes over Victoria Public Hall

Proposes to restore the 125-year-old building after the elections

Deepa H Ramakrishnan

CHENNAI: With effect from April 1, 2009, the Chennai Corporation has taken over the Victoria Public Hall that is situated near the Ripon Building.

With the Board of the Victoria Public Hall Trust resolving to hand over the hall and other related property to the civic body at a meeting held last month, it has paved the way for the Corporation to renovate the property.

Corporation sources said that the board members who met on March 11 unanimously resolved to hand over the property including assets, savings and deposits to the civic body.

The civic body proposes to restore the over 125-year-old building, which was designed as a town hall. The civic body would call for tenders after the election and the restoration work is expected to commence in July.

The Municipal Corporation of the city of Madras had leased out about 3.14 acres in the People's Park for 99 years to the Trustees of the Victoria Public Hall Trust beginning April 1, 1886, for the hall. The hall, built in 1887, hosted lectures, balls and stage performances.

The lease rent was eight annas a pound or Rs.28 for the property. The lease expired in 1985 and as the civic body did not want to extend the lease, a legal battle ensued. Now as a compromise has been reached in the matter, a petition to this effect would be submitted in the court. The Corporation is also likely to take action against sub-leases.

A view of the Victoria Public Hall in Chennai. – PHOTO: M.VEDHAN

fig 2. Document Image example 2

Text extraction is a critical and essential step as it sets up the quality of the final recognition result. It aims at segmenting text from background, meaning isolated text pixels from those of background. A text extraction system usually assumes that text is the major input contributor, but it also has to be robust against variations in the detected text's bounding box size. A very efficient text extraction method could enable the use of commercial OCR without any other modifications.

OBJECTIVES

To extract text from Document images using 2-D Haar Wavelet and by eliminating large size areas in the image. In case we have larger area components in the image, we can get better result.

RESEARCH METHODOLOGY

The edges detection is accomplished by using 2-D Haar DWT and some of the non-text edges are removed using thresholding. Afterward, we connect the isolated candidate text edges in each detail component sub-band of the binary image. Although the color component may differ in a text region, the information about colors does not help extracting texts from images. If the input image is a gray-level image, the image is processed directly starting at discrete wavelet transform. If the input image is colored, its RGB components are combined to give an intensity image Y as follows:

$$Y=0.299\ 0.587\ 0.114\ Y\ R\ G \qquad (1)$$

Image Y is then processed with discrete wavelet transform and the whole extraction algorithm afterward. If the input image itself is stored in the DWT compressed form, DWT operation can be omitted in the proposed algorithm.

To remove the large size area in the image, the outline of the suggested idea (MATLAB code) is as follows:

```
[CC NOB] = bwlabel(final, 8);
S = regionprops(CC, 'Area');
Binary=final;
Stats = regionprops(CC, 'Area', 'pixelidxlist');
Cleaned = binary;
For p=1:length(stats)
Ara(p)=stats(p).Area;
End
Area=sort(ara,'descend');
MIN_AREA=area(2)+10;
For region = 1 : length(stats)
If stats(region).Area > MIN_AREA
Cleaned(stats(region).pixelidxlist) = 0;
End
End
Cl=imresize(cleaned,[512 512]);
B=[0 1 0; 1 1 1;0 1 0];
K=imdilate(IM2,B);
J = immultiply(cl,k);
B=[1 1 1; 1 1 1;1 1 1];
K=imdilate(J,B);
J = immultiply(IM2,k);
Final = bwareaopen(final,20);
```

where

- bwlabel(final,8) returns matrix CC, of the same size as final, containing labels for the connected objects in final having 8-connected objects.
- regionprops measures a set of properties for each connected component (object) in CC, which is a structure returned by bwconncomp.
- length(stats) finds number of elememts along the largest dimension of an array.
- B is the dilation operator.
- Imdilate(IM2, B) dilates the gray-scale, binary, or packed binary image IM2.
- Immultiply(cl, k) multiplies each element in array cl by the corresponding element in array k.
- bwareaopen(final, 20) removes from a binary image all CCs that have fewer than 20 pixels, providing another binary image.

Results & Discussion

The experimentation of the proposed algorithm was carried out on a data set consisting of different document images. Currently the data set consists of 10 images (All images are given in the Appendix A).

We tried the implemented technique on a set of test images and get the results as follows:


ਭਾਜਪਾ ਪ੍ਰਧਾਨ ਵੀ ਲੜ ਸਕਦੇ ਹਨ ਚੋਣ- ਜੇ. ਪੀ. ਨੱਢਾ

10 ਲੱਖ ਨੌਜਵਾਨ ਭ੍ਰਿਸ਼ਟਾਚਾਰ ਖ਼ਤਮ ਕਰਨ ਦੀ 25 ਨੂੰ ਚੁੱਕਣਗੇ ਸਹੁੰ

ਜਲੰਧਰ, 21 ਅਗਸਤ (ਸ਼ਿਵ)- ਪੰਜਾਬ ਭਾਜਪਾ ਦੇ ਚੋਣ ਇੰਚਾਰਜ ਸ੍ਰੀ ਜੇ. ਪੀ. ਨੱਢਾ ਨੇ ਕਿਹਾ ਹੈ ਕਿ ਅਗਲੇ ਸਾਲ ਫਰਵਰੀ ਵਿਚ ਹੋਣ ਵਾਲੀਆਂ ਵਿਧਾਨ ਸਭਾ ਚੋਣਾਂ ਲਈ ਟਿਕਟ ਵੰਡ ਮਾਮਲੇ ਵਿਚ ਬਦਲ ਖੁੱਲ੍ਹੇ ਹਨ ਤੇ ਇਸ ਮਾਮਲੇ ਵਿਚ ਮੌਜੂਦਾ ਵਿਧਾਇਕਾਂ ਨੂੰ ਟਿਕਟਾਂ ਦਿੱਤੀਆਂ ਜਾਣੀਆਂ ਪੱਕੀਆਂ ਨਹੀਂ ਹਨ ਤੇ ਭਾਜਪਾ ਪ੍ਰਧਾਨ ਵੀ ਚੋਣ ਲੜ ਸਕਦੇ ਹਨ। ਪੱਤਰਕਾਰਾਂ ਨਾਲ ਗੱਲਬਾਤ ਕਰਦੇ ਹੋਏ ਸ੍ਰੀ ਨੱਢਾ ਨੇ ਲਾਂਭੇ ਕੀਤੇ ਗਏ ਮੰਤਰੀਆਂ ਨੂੰ ਚੋਣਾਂ ਵਿਚ ਟਿਕਟਾਂ ਪ੍ਰਦਾਨ ਕਰਨ ਬਾਰੇ ਪੁੱਛੇ ਸਵਾਲ 'ਤੇ ਕਿਹਾ ਕਿ ਹਟਾਏ ਗਏ ਮੰਤਰੀਆਂ ਤੋਂ ਪਾਰਟੀ ਦਾ ਕੰਮ ਲਿਆ ਜਾ ਰਿਹਾ ਹੈ ਅਤੇ ਨਾਲ ਬੈਠੇ ਅਸ਼ਵਨੀ ਸ਼ਰਮਾ ਪੰਜਾਬ ਭਾਜਪਾ ਪ੍ਰਧਾਨ ਵੱਲ ਸੰਕੇਤ ਕਰਦੇ ਹੋਏ ਕਿਹਾ ਕਿ ਉਹ ਵੀ ਚੋਣ ਲੜ ਸਕਦੇ ਹਨ। ਜ਼ਿਕਰਯੋਗ ਹੈ ਕਿ ਟਰਾਂਸਪੋਰਟ ਮੰਤਰਾਲੇ ਤੋਂ ਲਾਂਭੇ ਕੀਤੇ ਗਏ ਪਠਾਨਕੋਟ ਦੇ ਮਾਸਟਰ ਮੋਹਨ ਲਾਲ ਪਹਿਲਾਂ ਹੀ ਕਹਿ ਚੁੱਕੇ ਹਨ ਕਿ ਪੰਜਾਬ ਪ੍ਰਧਾਨ ਆਪ ਚੋਣ ਲਈ ਉਨ੍ਹਾਂ ਨੂੰ ਲਾਂਭੇ ਕਰਨ ਦੀ ਤਿਆਰੀ ਕਰ ਰਹੇ ਹਨ। ਸ੍ਰੀ ਨੱਢਾ ਨੇ ਟਿਕਟਾਂ ਲਈ ਕੀਤੇ ਜਾ ਰਹੇ ਸਰਵੇ ਬਾਰੇ ਜਾਣਕਾਰੀ ਦਿੰਦੇ ਦੱਸਿਆ ਕਿ ਪਾਰਟੀ ਆਪਣੇ ਪੱਧਰ 'ਤੇ ਜਾਣਕਾਰੀ ਲੈਣ ਲਈ ਗੁਪਤ ਸਰਵੇ ਕਰਵਾਉਂਦੀ ਰਹੀ ਹੈ ਤੇ ਇਸ ਬਾਰੇ ਜਾਣਕਾਰੀ ਜਨਤਕ ਨਹੀਂ ਕੀਤੀ ਜਾ ਸਕਦੀ। ਪੰਜਾਬ ਵਿਚ ਚੋਣ ਤਿਆਰੀਆਂ ਬਾਰੇ (ਬਾਕੀ ਸਫ਼ਾ 2 ਕਾਲਮ 7)

ਜੇ. ਪੀ. ਨੱਢਾ ਪੱਤਰਕਾਰਾਂ ਨਾਲ ਗੱਲਬਾਤ ਕਰਦੇ ਹੋਏ ਤੇ ਉਨ੍ਹਾਂ ਨਾਲ ਅਸ਼ਵਨੀ ਸ਼ਰਮਾ, ਅਜੇ ਜਾਮਵਾਲ ਤੇ ਰਾਜੇਸ਼ ਬਾਘਾ ਨਜ਼ਰ ਆ ਰਹੇ ਹਨ। ਤਸਵੀਰ: ਮੁਨੀਸ਼

fig3. Original image


ਭਾਜਪਾ ਪ੍ਰਧਾਨ ਵੀ ਲੜ ਸਕਦੇ ਹਨ ਚੋਣ- ਜੇ. ਪੀ. ਨੱਢਾ

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fig4. Resultant image obtained after applying AND operation on the dilated horizontal, vertical and diagonal sub-band images

We will check the performance of the implemented technique using the following Statistical measures of the performance.

1) Sensitivity/ Recall rate: Sensitivity relates to the test's ability to identify positive results.

$$\text{sensitivity} = \frac{\text{number of true positives}}{\text{number of true positives} + \text{number of false negatives}}$$

2) Specificity: Specificity relates to the ability of the test to identify negative results.

$$\text{specificity} = \frac{\text{number of true negatives}}{\text{number of true negatives} + \text{number of false positives}}$$

3) Precision: Precision is defined as the proportion of the true positives against all the positive results (both true positives and false positives)

$$\text{precision} = \frac{\text{number of true positives}}{\text{number of true positives} + \text{false positives}}$$

4) F-measure: The F-measure can be used as a single measure of performance of the test. The F-measure is the harmonic mean of precision and recall.

$$F = 2 \times \frac{\text{precision} \times \text{recall}}{\text{precision} + \text{recall}}$$

5) Accuracy: The accuracy is the proportion of true results (both true positives and true negatives).

$$\text{accuracy} = \frac{\text{number of true positives} + \text{number of true negatives}}{\text{number of true positives} + \text{false positives} + \text{false negatives} + \text{true negatives}}$$

where

- True positive: wrong is correctly diagnosed as wrong
- False positive: right incorrectly identified as wrong
- True negative: right is correctly identified as right
- False negative: wrong incorrectly identified as right

FINDINGS

Measures are obtained in case of the test images (given in the Appendix-A). The average of those measures is as follows.

Table1. Various measures obtained in case of 10 test images (All images are given in Appendix A)

Image/ Measures	Recall-rate (%)	Specificity (%)	Precision (%)	Accuracy (%)
1	72	88.67	86.36	80.56
2	52	74.81	27.65	71.25
3	38	75	52.85	59.64
4	51.5	88.21	53.96	80.44
5	65.9	87.68	63.04	82.41
6	56.5	60.75	37.58	59.52
7	75	86.80	57.53	84.53
8	41.05	88.96	70.90	70
9	56.25	58.39	24	57.98
10	41.09	78.75	59.40	62.53

Taking all test images into consideration (All images are given in Appendix-A),

- Average Recall Rate = 54.87%
- Average Specificity= 78.80%
- Average Precision Rate= 53.327%
- Average Accuracy= 70.886%
- Average F-measure=54.090%

RECOMMENDATIONS/SUGGESTIONS

For the procedure to be effective, a priori knowledge about the structure of the page is necessary. This technique is therefore particularly useful when the layout is constrained, such as is often the case when considering pages from scientific journals.

CONCLUSIONS

We have implemented an effective document text extraction method based on the fact that in text regions, horizontal edges, vertical edges and diagonal edges are mingled together while they are distributed separately in non-text regions. Larger areas are detected to ease the method and try removing the non-text regions which are left even after the above processings.

Bottom-up technique merge evidence at increasing scales to form, e.g., words from characters, lines from words. Actually the processing of document image segmentation and classification comes under an OCR pre-processor step. The text blocks that are detected by this technique are used as an input to the OCR system.

SCOPE FOR FURTHER RESEARCH

Despite the many efforts spent on the subject, there is still much room for improvement in document segmentation techniques, which is the key factor to improve the overall perfor-

mance of an automatic reading/processing system.

APPENDIX A

List of Test images


ਮਰਨ ਵਰਤ 6ਵੇਂ ਦਿਨ 'ਚ
ਲੋਕ ਪਾਲ ਬਿੱਲ ਪਾਸ ਨਾ ਹੋਇਆ ਤਾਂ ਸਰਕਾਰ ਨੂੰ ਚਲਦਾ ਕਰਾਂਗੇ-ਅੰ
ਪ੍ਰਧਾਨ ਮੰਤਰੀ ਤੇ ਸੰਸਦ ਮੈਂਬਰਾਂ ਦੇ ਘਰਾਂ ਦੇ ਬਾਹਰ ਧਰਨੇ

fig5


ਆਲ ਇੰਡੀਆ ਸਿੱਖ ਸਟੂਡੈਂਟਸ ਫੈਡਰੇਸ਼ਨ ਵੱਲੋਂ ਅੱਜ ਅੱਧਾ ਦਿਨ ਪੰਜਾਬ ਬੰਦ ਦਾ ਸੱਦਾ

fig6


'ਅਜੀਤ ਹਰਿਆਵਲ ਲਹਿਰ'
ਦੇਵੀਗੜ੍ਹ ਇਲਾਕੇ ਦੇ ਦਸ ਸਕੂਲਾਂ 'ਚ 795 ਬੂਟੇ ਲਗ

fig7


ਅੰਨਾ ਹਜ਼ਾਰੇ ਦੇ ਹੱਕ 'ਚ ਥਾਂ-ਥਾਂ ਰੈਲੀ

fig8


ਅਜੀਤ ਈ-ਪੇਪਰ
ਦੁਆਬੇ ਦੇ ਉੱਘੇ ਕਾਂਗਰਸੀ ਆਗੂ ਚੌਧਰੀ ਦਰਸ਼ਨ ਸਿੰਘ ਨਹੀਂ ਰਹੇ

fig9


ਸਿੱਖ ਬੁੱਧੀਜੀਵੀ ਕੌਂਸਲ ਵੱਲੋਂ ਅੰਨਾ ਹਜ਼ਾਰੇ ਦੀ ਹਮਾਇਤ 'ਚ ਜਥੇ ਦਿੱਲੀ ਭੇਜਣ ਦਾ ਫ਼ੈਸਲਾ

fig10


ਕਾਹਲਾਂ ਵਲੋਂ ਬਜ਼ੁਮਾਨ ਦੇ ਹਕ 'ਚ ਮਜਾਰਾ ਦਾ ਸਿਲਸਿਲਾ ਤੇਜ਼

fig11

fig12

fig13

fig14

List of Resultant images

fig15. Result of fig.5

fig16. Result of fig.6

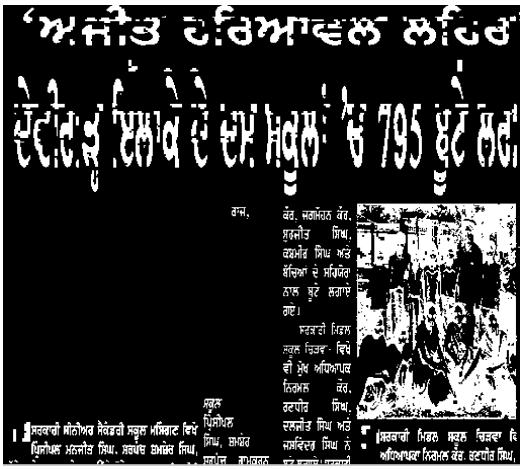

fig17. Result of fig.7

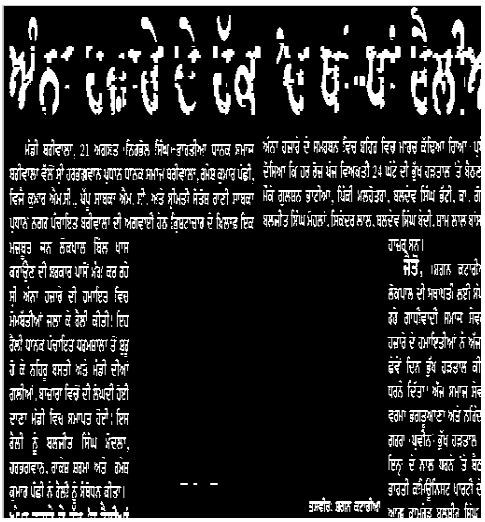

fig18. Result of fig.8

fig21. Result of fig.11

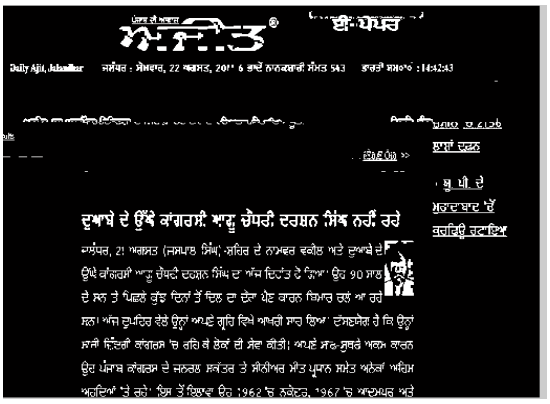

fig19. Result of fig.9

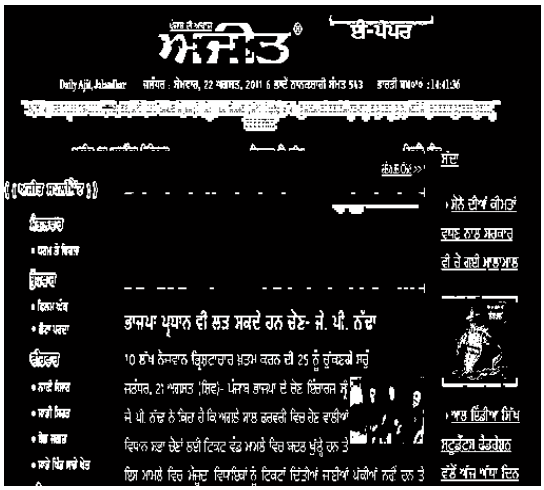

fig 22. Result of fig.12

fig20. Result of fig.10

fig23. Result of fig.13

fig24. Result of fig.14

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