Automatic Inspection of Food Packet Labels using Image Processing

Divyashree D R*, K. V. Suresh** and Sachin K J***
* - ** Department of Electronics and Communication, Siddaganga Institute of Technology,Tumakuru
*divyasindu26@gmail.com, **sureshkvsit@sit.ac.in
***Aspire Business Solutions, Tumakuru
sachin@aspireb2b.com

Abstract: Inspecting the food packets for proper printed labels is very essential in food manufacturing industries. Information about the manufacturing date printed on the food packets is a valuable source of information about the life of the packaged food product for consumers. Manual inspection systems are inaccurate and time consuming. This paper proposes an automatic printed label inspection system for food packets. The proposed algorithm can detect the defects like missing line, missing character, improper printing and the patches present in the labels printed on food packets. The image of the food packet acquired by the camera undergoes pre-processing such as gray scale conversion, adaptive thresholding for binarization, erosion and dilation. Optical character recognition is used for the recognition of text in the printed labels. Several experiments were conducted on real images to verify the effectiveness of the proposed algorithm.

Keywords: Gray scale conversion, Adaptive thresholding, Erosion, Dilation, Optical Character Recognition.

Introduction

Nowadays each and every type of food materials are available in packaged form. Hence the packaging is considered as an essential component of our modern lifestyle. In every industry automatic inspection of printed labels is of great concern. The label printed on the food packets contains characters and numericals. Failure of these prints occasionally occurs. In many industries, these printed labels are inspected by professional staffs, but this is time consuming and inaccurate.

The manufacture date printed on the food packets indicates the date on which the food material becomes the product. The problems related to health and diseases are rapidly increasing. In order to retain the consumers faith about the industry and to avoid the faulty packets reaching the consumers, it is very essential to inspect the label printed on food packets. Several Types of defects would occur in the labels printed on food packets. Therefore, depending on the characteristics of printed label images, these defects are commonly classified as,

- Missing Line
- Missing character
- Improper printing
- Patch
- Different pattern

Figure 1(a) shows the image of proper printed label, In the case of missing line and missing character some of the lines and characters are missing from the printed label as shown in Figure 1(b) and 1(c), in improper printing case all the lines and characters are present but they are not properly printed as shown in Figure 1(d), In the case of patch the overlapping of characters or lines may occurs as shown in Figure 1(e), and in different pattern case the target character or a target line are replaced by some other line or character as shown in Figure 1(f).

The main objective of the proposed work is to automatically detect the defects present in the printed label using image processing techniques.

This paper is organized as follows: Section II provides a review of existing printed label inspection methods, the methodology of proposed work is described in Section III and in section IV the experimental results of the proposed method are presented, and the conclusion in section V.

Literature Review

This section provides a brief review about the past work related to printed label inspection system.

The authors in [1] developed an automatic system for inspecting the printed labels. First, binarization is used for the separation of printed part from the background part in the images acquired from the web-camera. The binarized images with proper printed labels are registered with the developed inspection system. The methods like pattern matching or character recognition

(a) Proper print (b) Missing line (c) Missing character

(d) Improper printing (e) Patch (f) Different pattern

Figure 1. Some of the common defects occur in the labels printed on the food packets

is used for comparing the shape and position of blobs presented on the defective printed label with the proper printed label. By analyzing the results obtained by comparing proper print with defective print they can able to detect the patchiness of length 0.3 mm and the stain with size larger than or equal to 0.1 by 0.1 mm.

A method for an automatic identification of labels printed on fast moving consumer goods products is developed in [2]. Cigarette packets are used as fast moving consumer goods. The enhancement techniques like thresholding, filtering, erosion and dilation are used as pre-processing steps. The region of interest is extracted using ROI descriptor, pattern matching methods are used to detect the defect in the labels printed on the cigarette packets.

In [3], the authors provide various techniques for identification of printing technologies. Various image processing approaches are used based on textures, HSV color model, spatial variation, spatial correlation, and pattern recognition methods like roughness of the text, gray level co-occurrence matrix. Gaussian variogram model is used for printer classification.

A real-time system to read the names and address on the tax forms is presented in [4]. The two major steps document recognition and document analysis is used. For document analysis methods like address block extraction, label detection and connected component analysis are used. For document recognition, the methods like character recognition, word recognition are used.

The authors in [5] used correlation based techniques to exploit the presence of constant character strings and their topology for detection of seals. Optical character recognition was employed to read the contextual information present in the seal.

Methodology

The main objective of the printed label inspection system using image processing is to detect the defects in the label printed on the food packets. Figure 2 shows the methodology of proposed printed label inspection system.

Input to the system is an image of the food packet captured using a camera. The captured image is subjected to pre-processing where actually the image is eroded and dilated to ensure that no adjacent pixels are connected as a single object during text matching. The pre-processed image is segmented using adaptive thresholding. The optical character recognition is used for printed text recognition. The recognized text is compared with the text stored in the database.

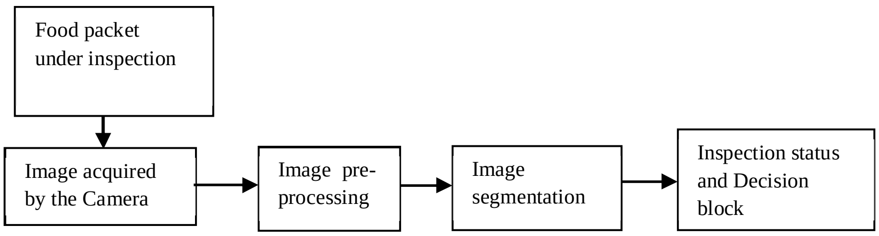


Figure 2. Printed label inspection system

Image Acquisition

The packet under inspection is captured using a camera. Figure 3 shows an image of food packet captured by the camera.

Figure 3. Printed label on the food packet

Pre-processing

The Printed portion of the image is extracted from the captured image by auto-cropping. The extracted portion is converted to gray scale and the gray scale image is segmented to get a binary image.

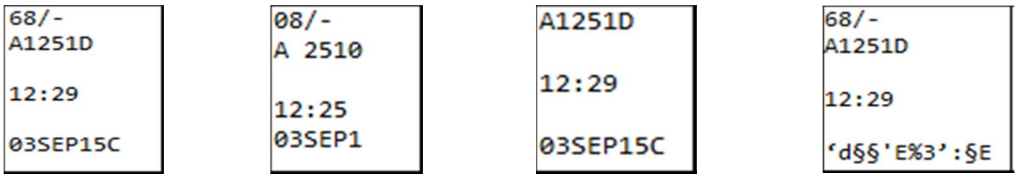
Image Segmentation

Pre-processed image is segmented by using adaptive thresholding. Adaptive thresholding takes gray scale image as input and produces a binary image as output. Adaptive thresholding divides the image into sub-images and each sub-image is set with a threshold.

After adaptive thresholding, erosion and dilation are employed on the binary image. Dilation enlarges the boundary regions of foreground pixels whereas erosion shrinks the boundary regions of foreground pixels. Both erosion and dilation takes two data as input, first one is the image which is to be dilated or eroded and the second one is the structuring element. Here dilation and erosion are employed to ensure that no adjacent pixels are connected as a single object during text matching. Also makes the features more prominent.

Optical Character recognition (OCR)

The optical character recognition is the electronic conversion of an image of printed, typed or handwritten text into a machine encoded text, from a photo of a document or from a scanned document. In this method OCR is used to recognize the printed on the labels of the food packet. Figure 4 shows the text recognized from the both proper and defective printed labels.



(a) original print (b) Print with missing line (c) Print with missing character (d) Print with patch

Figure 4: Results of the text recognized by the OCR

Experimental results

Experimental results of the proposed algorithm are shown in Figure 6-10. These results are obtained by comparing the food packet having proper printed label with the food packets having defects like line missing, character missing, improper print and the patchiness in their printed labels.

Two conditions uniques and duplicates are checked by comparing the stored file of the proper printed label with the character recognized by the OCR from the defect images. Where uniques represents the differences and the duplicates represents the similarity between the stored file of the proper printed label and the character recognized by the OCR from the defected images.

Figure 5 represents the result obtained by comparing the text in Figure 5(a) with the stored text of a proper printed label shown in figure 1(a). In this case the uniques are zero and hence the food packet is valid with no defects.

(a) (b) (c) (d)

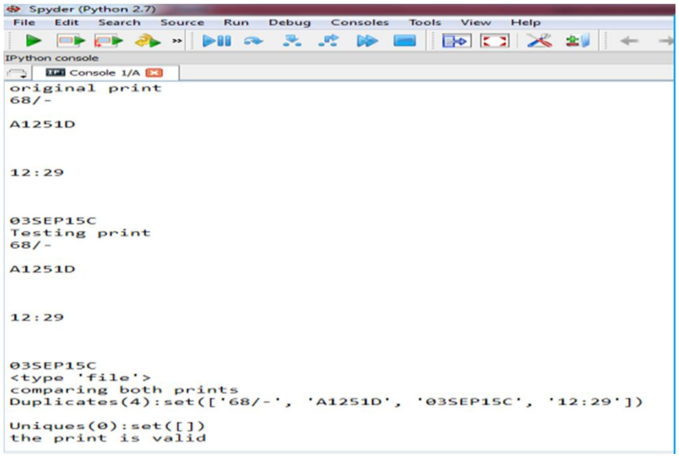
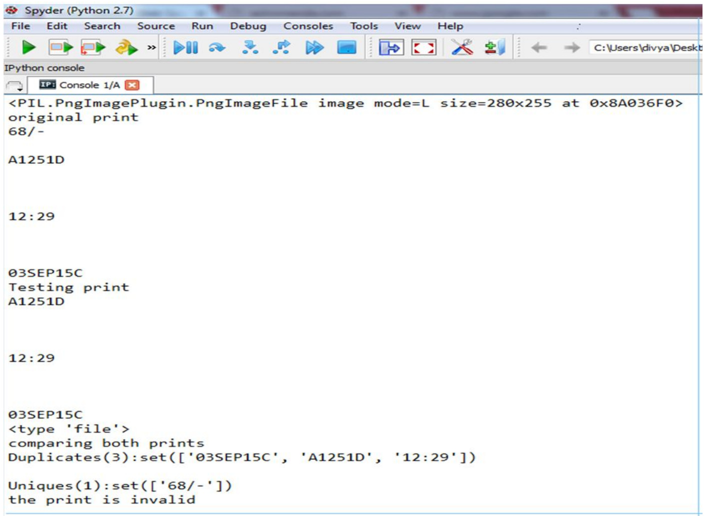


Figure 5. Result of food packet with no printed label defect. (a) Captured image (b) Region of interest, (c) Gray scale image, (d) Results of adaptive thresholding and (e) Snapshot of a console representing the status of the print

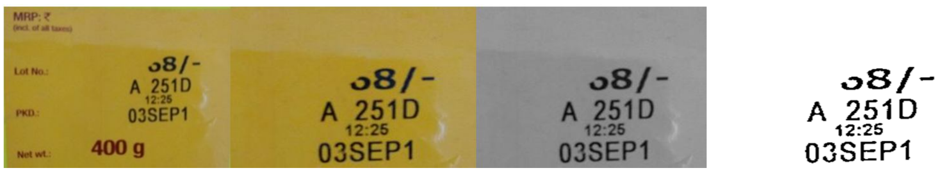
(a) (b) (c) (d)



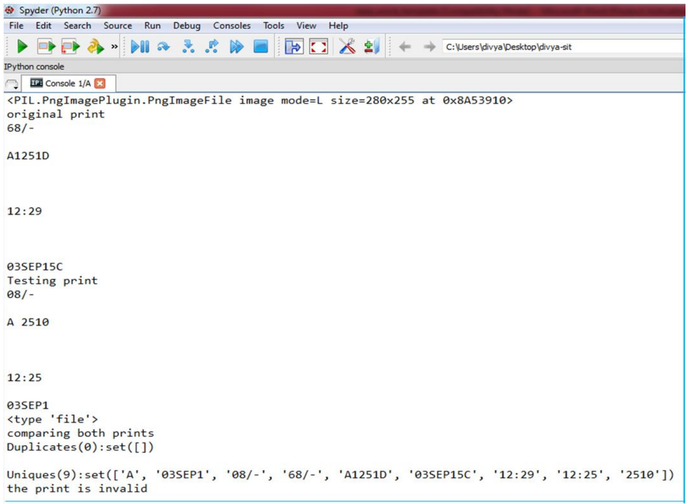
(e)

Figure 6. Result of food packet with missing line defect. (a) Captured image (b) Region of interest, (c) Gray scale image, (d) Results of adaptive thresholding and (e) Snapshot of a console representing the status of the print

Figure 6 represents the result obtained by comparing text tin Figure 6.(a) with the stored text of a proper printed label shown in figure 1.1 (a). In this case the uniques are present and hence the food packet is invalid with missing line defects.

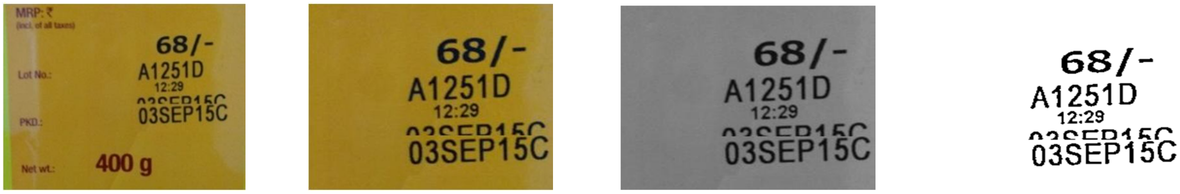


(a) (b) (c) (d)

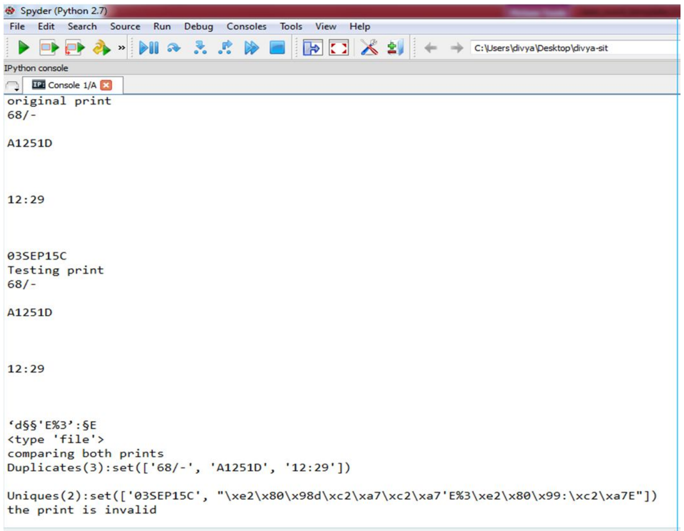


(e)

Figure 7. Result of food packet with missing character defect. (a) Captured image (b) Region of interest, (c) Gray scale image, (d) Results of adaptive thresholding and (e) Snapshot of a console representing the status of the print



(a) (b) (c) (d)

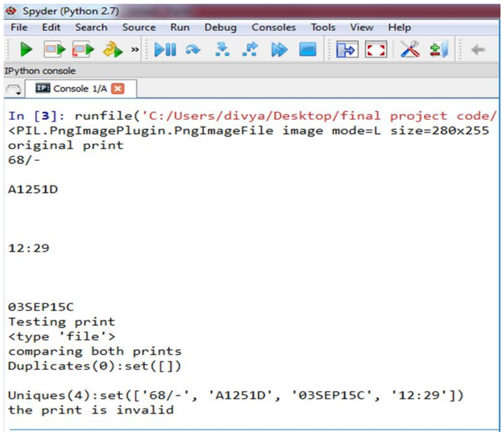


(e)

Figure 8. Result of food packet with patch defect. (a) Captured image (b) Region of interest, (c) Gray scale image, (d) Results of adaptive thresholding and (e) Snapshot of a console representing the status of the print.

Figure 7 represents the result obtained by comparing text tin Figure 7.(a) with the stored text of a proper printed label shown in figure 1.1 (a). In this case the uniques are present and hence the food packet is invalid with missing character defects. Figure 8 represents the result obtained by comparing text tin Figure 8.(a) with the stored text of a proper printed label shown in figure 1.1 (a). In this case the uniques are present and hence the food packet is invalid with patch defects.

(a) (b) (c) (d)



(e)

Figure 9. Result of food packet with improper printing defect. (a) Captured image (b) Region of interest, (c) Gray scale image, (d) Results of adaptive thresholding and (e) Snapshot of a console representing the status of the print

Figure 9 represents the result obtained by comparing text tin Figure 9.(a) with the stored text of a proper printed label shown in figure 1.1 (a). In this case the uniques are present and hence the food packet is invalid with patch defects.

Conclusion

In this paper, an automatic printed label inspection system for food packets is discussed. The proposed algorithm uses adaptive thresholding technique to binarize the image captured from a camera. The character recognized from the OCR is compared with the stored file with proper print to find the defects. Experimental results shows that, the proposed algorithm can detect the missing characters, missing line, improper print, and the patchiness defects present in the labels printed on food packets effectively.

References

[1] Yuhki Shiraishi and Fumiaki Takeda, “ Development of a Portable Automatic Inspection System for Printed Labels Using a Web Camera”, Eighth International Conference on Intelligent Systems Design and Applications, pp. 381-385, Nov 2008.

[2] Abahan Sarkar, Sourav Chakraborty and B K Roy, “Image Processing Based Product Label Quality Control on FMCG Products”, International Conference on Energy, Power & Environment: Towards Sustainable Growth (ICEPE), pp. 1-5, June 2015.

[3] M. Uma Devi, C. Raghavendra Rao and Arun Agarwal,” A Survey of Image Processing Techniques for Identification of Printing Technology in Document Forensic Perspective”, Recent Trends in Image Processing and Pattern Recognition RTIPPR, pp. 9-15, 2010.

[4] Sargur N. Srihari, Yong-Chul Shin, Vemulapati Ramanaprasad, and Dar-Shyang Lee, “A System Read Names and addresses on Tax Forms”, Proceedings of the IEEE, pp. 1038-1049, Jul 1996.

[5] Farshad Nourbakhsh, Peeta Basa Pati and A G Ramakrishnan, “automatic Seal information reader”, International Conference on computing: Theory and Applications , pp. 502-505, March 2007.

[6] Jesper B. Pedersen, Kamal Nasrollahi, and Thomas B. Moeslund, “Quality Inspection of Printed Texts” 23rd international conference on systems signals and image processing, pp. 1-4, May 2016.