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MISMATCH OF BOTTLE DETECTION BY VIDEO PROCESSING

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Abstract

Many Industries adopt manual sorting for the classification of the defected bottle as they travel along the conveyor belt. Manual sorting may not be a suitable option for identifying the defected bottle in high throughput. It has also been noted that there is a lot of difficulties in achieving consistency in the bottle separation process. Therefore, an Intelligent system for automated sorting is needed to replace the manual sorting system. The main component used for the Intelligent sorting system is recognition of image. As a result, in this work, combination of Top-hat and histogram equalization and the segmentation scheme is implemented to extract the ROI from the frames of bottle images. After extracting the ROI from the frames, the classification of defected bottle is identified by the SVM (Support Vector Machine) with FKM (Fuzzy K-means). This experimental result confirms that, the proposed approaches is efficient in extracting the ROI from the considered frames of images. In future, this methodology can be used in industries to classify the defected bottles.

Keywords—SVM (Support Vector Machine) with FKM (Fuzzy K-means), OCR, Top-hat, Histogram Equalization, ROI (Region Of Interest)

I. INTRODUCTION

Industries play an important part in the global economy and also in daily experience. At present, for companies, the purpose of automation has shifted from growing productivity and reducing costs to broader issues. The defected bottles in the conveyor belt is identified manually in the industries which recovers more man power. To overcome this problem, SVM method is implemented for the detection of defected bottles by a highly intelligent system.

This work will only focus on classification of defected bottles from the non-defected bottles while moving in the conveyor belt. The classification of defected bottles is based on the liquid level, label placement, detection of cap and shape of the bottle. Before analyzing the bottle, a video sample is converted into the number of frames and then the following procedures has been taken.

Many classifiers have been employed to classify the shape of the bottle. For example, neural networks can be trained on ideal shapes that take into account the possible intensity changes at the edges of the structures and edge detection algorithms [6]. In [7], the SVM classifier is used to recognize the extracted edge-based structural features and color moment features. These two sources of information are incorporated into a recognition system in order to provide complimentary information for robust image orientation detection. However, the detailed measurement of classifying the defected bottles and the use of SVM are not described in detailed. Thus, in this work, input sample video is get through the uigetfile and converted into number of frames.

In the proposed tool, the pre-processing of images is carried out by the Top-hat/Histogram Equalization, the segmentation is executed by the extraction of ROI and the classification of defected bottle is identified by SVM with Fuzzy K-means.

The experimental result of this work confirms that, proposed approach is efficient in extracting the ROI efficiently from the frames of the images and mismatch of bottle is accurately found by SVM with FKM. Hence in future, this approach can be considered in industries to classify the defected bottles.

II. METHODOLOGY

This division presents the methods adopted in this paper to implement the proposed computerized image analysing procedure.

A. Video Input

Sample of input video used here are obtained from the mobile camera. With the help of FKM, Video sample is trained and this sample input is gets through the uigetfile function and converted into number of frames. These images are gray scale images of size 256 × 256 pixels.

B. Top-hat

In mathematical morphology and digital image processing, top-hat transform is an operation that extracts small elements and details from given images. Top-hat transforms are used for various image processing tasks, such as feature extraction, background equalization, image enhancement etc., Top-hat contains subsequent mathematical definitions:

Let $f : E \rightarrow R$ be a grayscale image, mapping points from a Euclidean space or discrete grid E (such as R^2 or Z^2) into the real line. Let b(x) be a structuring element of grayscale.

Then, the white top-hat transform of f is given by:

$$T_w(f) = f - f \circ b, \qquad (1)$$

where $\circ$ denotes the opening operation.

The black top-hat transform of f (sometimes called the *bottom-hat* transform[1]) is given by:

$$T_b(f) = f \bullet b - f \qquad (2)$$

where $\bullet$ is the closing operation.

C. Histrogram Equalization

Image enhancement is the process of adjusting digital images so that the results are more suitable for display or further image analysis. Histogram equalization is used to improve the contrast in images.

D. Region Of Interest (ROI)

A region of interest (ROI) is a portion of an image that you want to filter or perform some other operation on. ROI by creating a binary mask, which is a binary image that is the same size as the image you want to process with pixels that define the ROI set to 1 and all other pixels set to 0. The concept of a ROI is commonly used in many application areas. ROI defines the border of an object under consideration.

E. Support Vector Machine(SVM)

Support Vector Machines(SVM) is one of the successful supervised learning methods for this problem. They have strong theoretical foundations and have shown excellent empirical success in various fields. Support Vector Machines are trained so that the decision function would classify the unseen example data accurately. This ability to classify unseen example data accurately is referred to as *generalization*. High generalization capability is one of the main reasons for the success of SVMs.

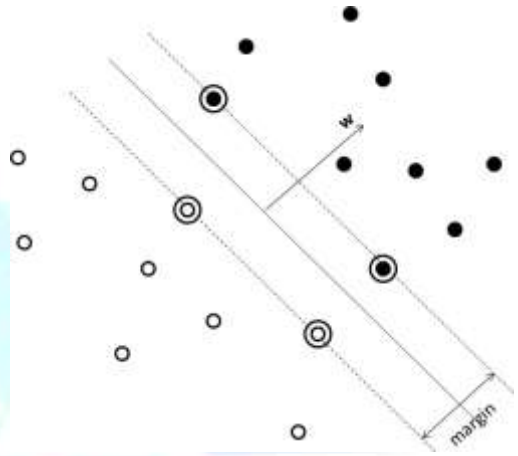

Fig 1. A Linear separation with a hyperplane

From now on, we would be looking at a two-class case(+ve class and -ve class) unless specified. Let see the basic idea behind the SVMs at first. Given a set of a *d*- dimensional vectors, a linear classifier tries to separate them with a (*d*-1)-dimensional hyperplane. There are many hyperplanes that might classify the data. If we define "margin" as the distance between the nearest samples on both sides of the hyperplane, SVMs are designed to choose the hyperplane that has the largest margin between the two classes. If such a hyperplane exists, it is known as the maximum-margin hyperplane and the linear classifier it defines is known as a maximum margin classifier. We shall review the basic theory of SVMs for different cases in the following sections.

Notations: To describe the task in mathematical terms, we introduce the following notations

- an example data point is denoted by
  $x \in R^d, \qquad (3)$
- class membership for a data point is denoted by
  $y \in \{-1, +1\}, \qquad (4)$
- the set of training examples is denoted by
  $X = \{x_1, \ldots, x_n\}, \qquad (5)$
- class labels for the training set is denoted by
  $Y = \{y_1, \ldots, y_n\} \qquad (6)$

F. Fuzzy K-means

Fuzzy K-Means (also called Fuzzy C-Means) is an extension of K-Means , the popular simple clustering technique. While K-Means discovers hard clusters (a point

belong to only one cluster), Fuzzy K-Means is a more statistically formalized method and discovers soft clusters where a particular point can belong to more than one cluster with certain probability.

1) Centroid

With fuzzy *c*-means, the centroid of a cluster is the mean of all points, weighted by their degree of belonging to the cluster. The higher it is, the fuzzier the cluster will be in the end.

2) Image Analysis

Fuzzy K-means has been a very important tool for image processing in clustering objects in an image[8]. FKM algorithm is used to improve the accuracy of clustering under noise. FKM algorithms have been used to distinguish between different activities using image-based features.

3) Image Processing

Image segmentation using FKM has been used for pattern recognition, object detection and medical imaging[9].However due to the limitations such as noise, shadowing traditional hard clustering method is not applicable for this kind of tasks. Fuzzy clustering proposed more applicable algorithm which is best suited for this kind of tasks.

G. Implementation

The execution of projected technique is presented in Fig 2. This involves the Pre-Processing of images and the Extraction of ROI. The pre-processing phase implements the Top-hat and histogram equalization to extract the small elements and to enhance the gray scale images. Segmentation of ROI is extracted with the Fuzzy K-means algorithm, which is used to eliminate the noise from the images. Finally, the support vector machine algorithm is used to classify the defected bottle from the non-defected.

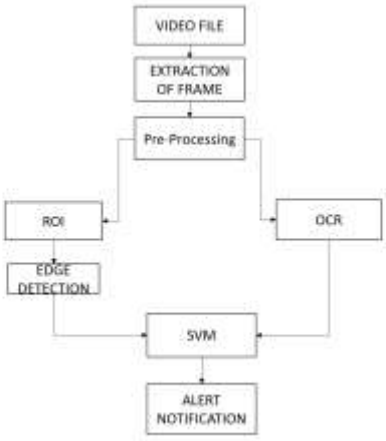

Fig 2. Stages in proposed video processing technique

III. RESULT AND DISCUSSIONS

This section illustrates the experimental outcomes and deliberations. The main aim of this paper is to classify the defected bottle from the non-defected while moving along the conveyor.

In this paper, MATLAB is implemented to do the image processing techniques like pre-processing, edge detection, image enhancement and image segmentation. This work gives effective and efficient classification of defected bottles by the SVM algorithm.

The proposed approach is implemented on the sample video and later, the similar procedure is executed with the live video for many industries. The sample video is taken for two sample bottles in the mobile camera. This sample video is in avi format. Fig 3. Represent the sample video which is uploaded through the uigetfile function.

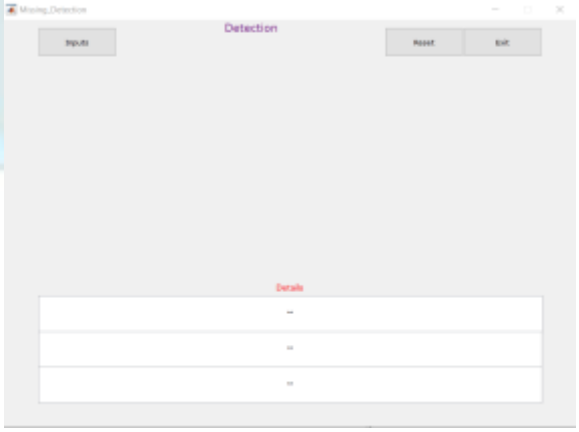

Fig 3. Uploading of sample video by the uigetfile function

After the video file is uploaded, it is converted into number of frames. The frames are 256 × 256 pixels of gray scale images.Fig 4. Represent number of frames. Where the sample video is converted into n number of frames.

Fig 4. Converted frames of sample bottle

Pre-processing phase is done by the Top-hat and histogram equalization algorithm for image enhancement. Image segmentation is carried out for the extraction of feature points by the edge detection mechanism. ROI is also used for the segmentation process for extracting the required features by the varying pixel values. Fig 5. Represents the extraction of feature points from the sample bottle.

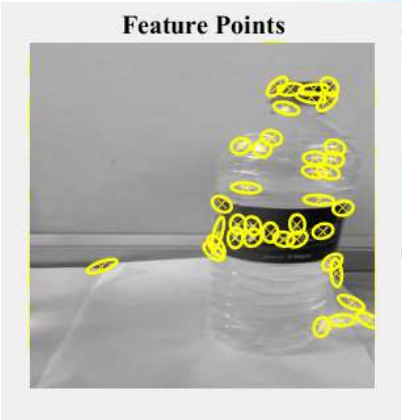

Fig 5. Feature points extraction

After extracting the ROI, the image classification algorithm known as the SVM is implemented with the FKM algorithm. Based on the SVM algorithm, images are classified with respect to the level of water, label position and cap placement of the bottle. Later on, the mismatched bottle is identified with the alert notification. Fig 6. Represents the mismatched bottle which is not filled properly.

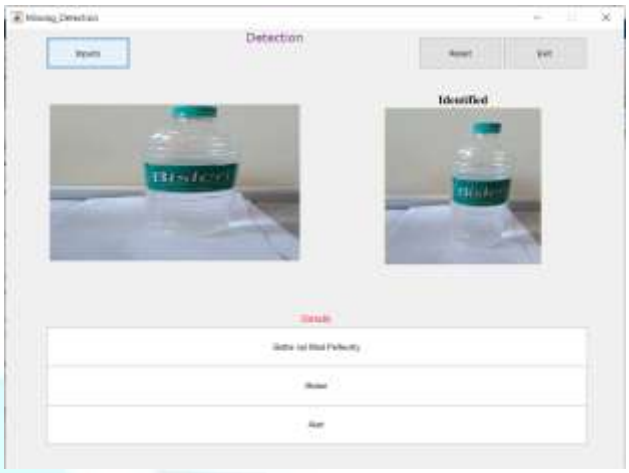

Fig 6. Mismatch of bottle is identified.

IV. Conclusion

This paper presented an approach to extract and evaluate the ROI from the frames of bottle images. In this paper, initially FKM is implemented to remove the unwanted region from the test images. The pre-processing approach based on Top-hat and histogram equalization is used to enhance the quality of the ROI. This procedure further removes the unwanted section of test image by implementing the thresholding procedure. Finally, evaluation of sample bottle is carried out by the SVM algorithm. Result of this paper confirms that, proposed approach is very proficient in extracting the ROI in classification of defected bottles. Future work involves the design and construction of a pick-and-place robot capable of classifying the defective bottle without alerting the operators.

References

[1] S. Shahbudin A. Hussain S. A Samad N. M. Tahir "Training and Analysis of Support Vector Machine using Sequential Minimal Optimization" The IEEE System Man and Cybernatic SMC 2008.

[2] Edgar Scavino Dzuraidah Abdul Wahab Aini Hussain Hassan Basri Mohd Marzuki Mustafa "Application of automated image analysis to the identification and extraction of recyclable plastic bottles" Journal of Zhejiang University SCIENCE A vol. 10 no. 6 pp. 794-799 2009.

[3] "Support Vector Machines for automated classification of plastic bottles," 2010 6th International Colloquium on Signal Processing & its Applications, Mallaca City, 2010, pp. 1-5.

[4] Varshal shah, Dr.Kirit Bhatt “Image processing based bottle filling and label checking using embedded systems” IEEE Explore 2009.

[5] Pruthvi Kumar S1 , Dr H.V Ramakrishna2“Automated Bottle Cap Inspection using machine vision system” July 2015 IJIRT.

[6] A. Bosch, A. Zisserman, and X. Munoz. Scene classification via pLSA. In *ECCV*, 2006

[7] A. Bosch, A. Zisserman, and X. Munoz. Representing shape with a spatial pyramid kernel. In *ICCV*, 2007.

[8] Ahmed, Mohamed N.; Yamany, Sameh M.; Mohamed, Nevin; Farag, Aly A.; Moriarty, Thomas (2002). "A Modified Fuzzy C-Means Algorithm for Bias Field Estimation and Segmentation of MRI Data" (PDF). IEEE Transactions on Medical Imaging. doi:10.1109/42.996338.

[9] Yang, Yong(2009), "Image segmentation based on fuzzy clustering with neighborhood information".

[10] Hadyan Arifianto,Catur Edi Widodo,Kuswaro Adi"Design of Automatic Bottle Filling Using Raspberry Pi" December 2018.

[11] vinit . A.Dave, S.K.Hadia "Automatic Bottle filling Inspection System using Image Processing" IJSRD 2015

[12] Ramli Suzaimah Mustafa Mohd Marzuki Hussain Aini Wahab Dzuraidah Abdul "Histogram of Intensity Feature Extraction for Automatic Plastic Bottle Recycling System Using Machine Vision" American Journal of Environmental Sciences vol. 4 no. 6 pp. 583-588 2008

[13] Suzaimah Ramli Mohd Marzuki Mustafa Aini Hussain "A Morphological-based Approach for Plastic Bottle Shape Classification" Proceedings of the International Conference on Electrical Engineering and Informaticsinstitut Teknologi Bandung 2007.

[14] "Enhanced water-level detection by image processing" 10th International Conference on Hydro informatics HIC 2012, Hamburg, Germany.

[15] Huasheng Zhu"New Algorithm of Liquid Level of Infusion Bottle Based on Image Processing" IEEE Explore 2018.

[16] Shasha Wang,Weina Guo,Wu Wen,Ruihan Chen,Ting Li, Fang Fang "Belt Conveyor Monitoring and Control System" ICICA 2010.

[17] Huanjan liu"Empty glass bottle inspection method based on fuzzy support vector machine neural network and machine vision" Published on 12th October 2010.