Automated Classification System for Square Washer with Fixed Size using SVM Classifiers

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Abstract— The main problem in the Automobile industry is quality classification of square washer with human is difficult and also the experts need more training. Due to human error the dimensions of square washer are not correctly identify and practically that will affect the overall performance of the system produced, that reduces the overall efficiency. This problem can be rectified using automated system for the purpose to separate defected washer. Today there are various automated systems with different algorithms have been developed for fault detection. In this paper a method is proposed to separate the improper square washer in dimensions of length of fixed size using image processing approach. In proposed algorithm the images are taken and can be used SVM classifier which can be implemented for automated system. Square Washer quality is controlled through the dimensions such as length of the sides and diameter of the hole. The results obtained through this method are more accurate and proper defect detection can be done.

Key words: SVM (Support Vector Machine), Defect detection, Square washer

I. INTRODUCTION

Quality requirements for industrial product are very important factor. Visual inspection or monitor in industry is a difficult task and the accuracy is also not so good. In the manual monitor of the product a lot of time will take to identify the defect and also the accuracy factor of the product will also degrade. Quality control is basically is to avoid the defects in the product. Traditionally, visual inspection and quality control are performed by the human experts in the industry, but they also require proper training and skills to identify the defect in the product [1]. Human expert cannot do the better job than machines. Quality is basically fulfilling the specification or customer requirement, without any defect. A product is said to be high in quality if it is functioning as expected and reliable. Quality control refers to ensure the produced items with highest possible quality. In some countries they already have implemented automatic systems to identify the defect in the product to increase quality of their product. To increase productivity of any product in the market the Customer first check the quality of the product and then depending on the quality of product, the product are sold. So the machine vision control is better to increase the quality of the product and also the productivity in the market.

Today, in the industry defective products detection by visual control is a very difficult task and it should be monitor through machine vision control which will be more accurate and efficient then vision control [1]. Image processing is one of the important techniques which is used widely now-a-days. The digital image can be used in machine vision in many applications. There are many algorithms to extract the various features from the digital by computers automatically. One of the most important application on digital image is detection and classification various types of defects in image. In industrial products the inspection after production is needed for each product. So it is important task is to classify the products on the packaging line based on the type of defects and selecting the defected product depend on criteria for the manufacturer. The defect detection systems are carried out in many kinds of surfaces for example defect detection in Textile Fabricant, crack beams and Radiograhic weldment images [2]. Thresholding or edge detection method is occupied to detect defects in non-textured surfaces such as glass planels, sheet steel and uniform web materials.

In ceramic tile defect detection it automatically detects the defected one and helps to monitor the defects in the tiles. The different types of defects in the ceramic tiles can be cracks, scratches, spots and blobs which detected through the defect classification algorithm [3]. In Diwan P. Arian showed a new method to detect the defect in whole pickles, using hyper spectral imaging. The first step in image pre-processing was to split each images. Principal component analysis (PCA) was performed on the masked image to aid in visualizing the hyper spectral image data, surface colour is not useful for detecting bloater damage pickles, [10].

II. METHODOLOGY

To identify the defects in any of the industry products visual inspection is very difficult task then machine vision. The machine vision inspection identifies the exact defects in the product on the production line within less time. The machine vision offers accuracy, consistency and low cost solution to the problem of subjectivity, fatigue and the high cost associated with the human inspectors. The objective of this research is to develop a system as specific countermeasures which will separate the improper square washer from the proper ones of fixed size by using the image processing approach. If its length of sides of the square washer differs from the specified dimension (in length) then it will be considered as a 'defective'. The proposed algorithm identifies whether the square washer is defective (in dimensions) or not. This algorithm is implemented for real time application and the count of defective square washer will be displayed on the screen.

This proposed algorithm presents a analysis for continuously monitoring of square washer size and separate the improper square washer from proper ones. Among several vision-based activities, object recognition and classification are basic and immediate acts. Proposed method uses image processing steps to classify the square washer which consist of pre-processing, feature extraction and classification. In the object classification process, the first step is the extraction of features or key properties of objects (i.e. mapping from the real world to the feature

space). The next step is classification of objects according to their features (i.e. mapping from feature space to the classification space). The proposed algorithm is based on using camera for continuous monitoring the square washer in appropriate light intensity. The proposed scheme finds in real time the size of square washer captured by the camera. The proposed method compares the original image and the test image to make a decision whether the square washer is defective or not. The proposed approach considers the size of all the sides and diameter of the hole of the square washer.

The flowchart shows the basic steps involved in the system of defect detection of square washer:-

A. Image Acquisition

The image acquisition process is obtaining a digitized image from real world source. A camera lens to focus the part of square washer. Two of the most important parameters of a lens are its magnifying power and light gathering capacity image for further processing.

B. Pre-Processing

Pre-processing operations such as image acquisition and image enhancements can be used for better quality of image and to obtain the digitized image from original image. Image enhancement process is applied for better quality and high efficiency. It is the process that use to improve quality of image for further operations. The main goals of image enhancement

1) To improve the subjective quality of an image for human viewing.
2) To modify the image in such way as make it more suitable for further an analysis.

The first step in image enhancement is to convert the captured RGB image into gray level image. The lowest level is 0 and the highest level is 255.

Median filtering is the average of the pixel values in the neighbourhood of the corresponding input pixel. Median filter of 3x3is used in this proposed system. The median value is less sensitive than the mean. The Median Filter block can remove salt-and-pepper noise from an image without significantly reducing the sharpness of the image. The output image BW replaces all pixels in the input image with luminance greater than level with the value 1 (white) and replaces all other pixels with the value 0 (black).

$$y[m,n] = median\{x(i.j),(i,j) \in w\} \quad (1.1)$$

Where w represents a neighbourhood centered on location (m,n) in the image.

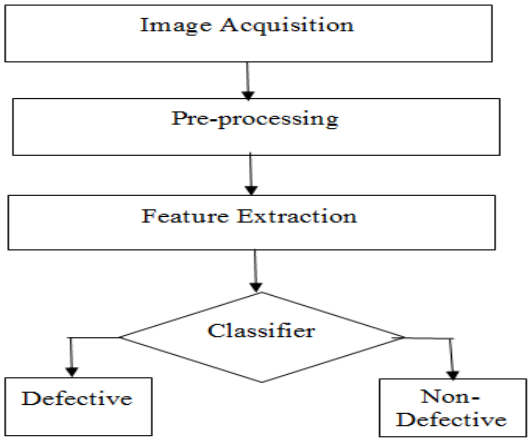
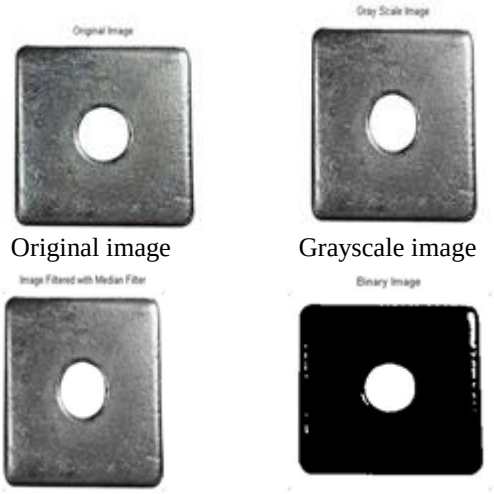


Fig. 1: Flowchart



Original image Grayscale image

Filtered image Binary image

Fig. 2: Pre-processing output images

III. FEATURE EXTRACTION

Key features of square washer must be extracted from the image captured by the web camera. Four parameters of square washer as a features are calculated Height, Length, Area and diameter of hole. The height and length are denoted as H1, H2, L1 and L2 respectively. While calculating the height and length of all sides some of the pixels of image are not considered so that the diameter of hole can be measured. Then the total area of square washer is measured by the number of pixel to cm.

IV. SVM

SVMs are based on the statistical learning technique and can be used for pattern classification and inference of nonlinear relationships between variables. This method has been successfully applied to the detection, verification and recognition of faces, objects, handwritten characters and digits, text, speech and speakers and the retrieval of information and images. An SVM classifier which is trained with the features length and height of all sides and diameter of the hole.

SVM provides several salient properties, such as maximization of margin nonlinear transformation of the input space to the feature space using kernel methods. A binary (two) classification problem can be described as follows: given a set of labelled points (xi; yi), 1≤i≤l, where xi∈Xpa p dimensional input space containing vectors of features and yi ∈ {-1, +1} are class labels, construct a rule that correctly assigns a new point x to one of the classes. The vectors xi in this formulation corresponds to objects, and the dimensions of the features or characteristics of these objects. Using labels {0,…, K-1} instead of {-1, +1} we can describe a multiclass problem with K classes. A classification method or algorithm is a particular way of constructing a rule, also called classifier, from the labelled data and applying it to the new data. SVMs can be thought of as a method for constructing a special kind of rule called a linear classifier, in a way that produces classifiers with theoretical guarantees of good predictive performance.

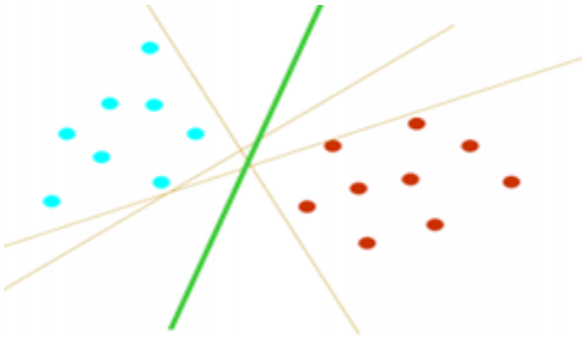


Fig. 3: Optimal Separating hyper plane.

Here there are many possible linear classifiers that can separate the data, but there is only one that maximises the margin (maximises the distance between it and the nearest data point of each class). This linear classifier is termed the optimal separating hyperplane. Consider the problem of separating the set of training vectors belonging to two separate classes.

$$D = \{(x1, y1), \dots, (x1, y1)\}, x \in Rn, y \in \{-1,1\} \quad (2.1)$$

With a hyper plane,

$$(w, x) + b = 0 \quad (2.2)$$

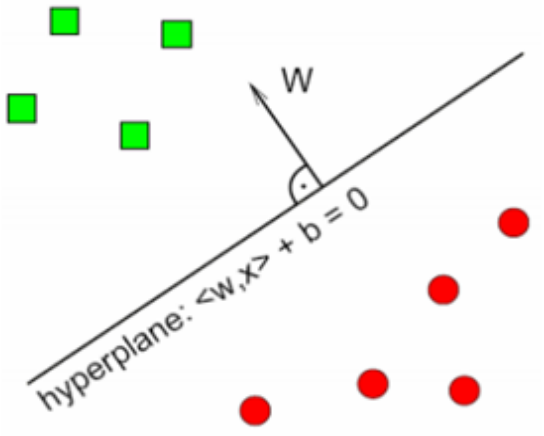
The set of vectors is said to be optimally separated by the hyperplane if it is separated without error and the distance between the closest vectors to the hyperplane is maximal.

A. Linear Classifiers

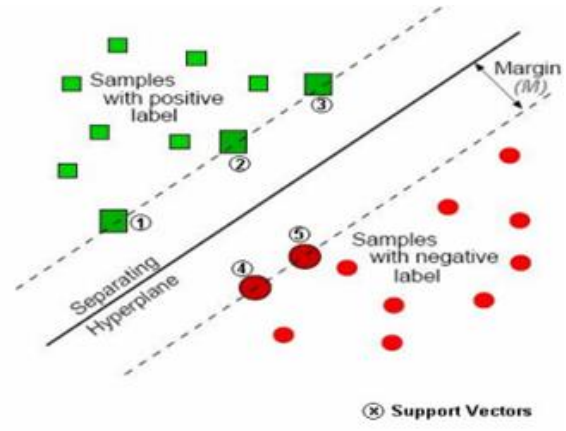
Consider SVM its simplest form, a linear SVM. A linear SVM is a hyperplane that separates a set of positive data from a set of negative data with maximum margin in the feature space. It is defined by the normal vector w and the offset b.

$$\text{Hyperplane} = \{x| < w, x > +b = 0\} \quad (2.3)$$

Figure 4(a) shows a separating hyperplane with a normal vector w. Figure 4(b) shows an example of a simple two dimensional problem that is linearly separable. Each feature corresponds to one dimension in the feature space. The distance from the hyper plane to a data point is determined by the strength of each feature of the data. The SVM computes the hyper plane that maximizes the distances to support vectors for a given parameter setting.



(a)



(b)

Fig. 4: SVM linear classifiers

V. Conclusion

This paper presents to separate the improper square washer in dimensions (in length) of fixed size for the defect detection in the square washer, by using a web camera continuous monitoring on the square washer. This proposed method extracts the features such size of all sides and diameter of hole of the square washer. This algorithm will test the dimensions of the washer due to observation under the vision control mechanism and helps to minimize manufacturing defects of square washer. Hence, the reliability of the square washer will increase without manual work.

VI. Acknowledgments

We would like to take this opportunity to thank one and all who have provided their valuable advice, without their guidance this work would not have been a success, we have to thank who have helped us directly or indirectly since they have given us more than just guidance. Our profound thanks to Dr. S. R Gengaje, Head of the Department ,Department of Electronics Engineering, Walchand Institute of Technology, Solapur. for his invaluable advice and constant encouragement to complete this work in a successful manner. I would like to convey our sincere thanks to management and supportive staff of Walchand Institute of Technology, Solapur, for encouraging us to come up with this paper work.

VII. References

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