

Review Paper on Performance Evaluation of Nut and Bolt Recognition System Using Artificial Neural Network

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Abstract

There is constant research going on in the field of recognition by means of artificial intelligence to enhance the productivity. The automotive industry requires an automated system to sort different sizes and shapes nut and bolt which are the mainly used component in the industry, to improve the overall productivity. This review paper deals with some feature extraction techniques and its performance impact on the artificial neural network efficiency for the recognition of nut and bolt. The main feature extraction techniques analysed for this review paper are stationary wavelet transform, principle component analysis and radius analysis. The aforementioned techniques are already tested and simulation is done on MATLAB. The results obtained varies depending on pre-processing techniques used for the nut and bolt recognition.

Keywords

Digital signature, MATLAB, recognition, wavelet transforms, principle component analysis, artificial neural network.

1. Introduction

The human perception of identifying an object is the natural logical thinking process by which humans recognise an object. But, machines are far behind the human recognition system of an object, so researchers are up-to increasing this efficiency of the machines. The computer vision is the branch of engineering which is working for the purpose of giving recognition logic to the machine by its machine visual system. In computer vision the visual system mimics the human biological system where camera performs the function of eye of a human where the targeted input images are taken,

these images are stored in the memory of computer which is further processed for recognition like the brain functions in humans. The nut and bolt recognition is useful phenomenon in the automotive industry where large number of various shape nut and bolts are used. In this paper we are reviewing the methodologies which are earlier used for the recognition of nut and bolts. Artificial neural network is the soft computing technique used for training the data set of nut and bolts. Artificial neural network is the evolutionary technique which mimics the human brain of retaining the data when it is first identified or trained. The main focus of this paper is on the various feature extraction techniques which can be used along with the artificial neural network. Three important techniques are been discussed here for the feature extraction i.e. radius variation detection from various shape nut or bolts, principle component analysis and stationary wavelet transform. These techniques are discussed in detail in software framework part. The paper is divided into 1.introduction, 2.software framework, 3. Methodology, 4.Performance evaluation and 5.references.

2. Software framework

The three processes which we are going to discuss in this paper are as below:

[1] Radius variation detection: The flowchart defined is as below:

The working of this algorithm requires edge detection of the acquired images from camera of nut and bolt, canny algorithm is used for detection of edges of nut and bolt (prewitt algorithm can also be used for the purpose).After detecting the edges centre of nut or bolt is then determined, from these centres the radius at every 20 degrees of an angle is taken. This gives unique 18 values for different shapes and sizes of nut and bolts which can be used as feature extraction data for the artificial neural network input.

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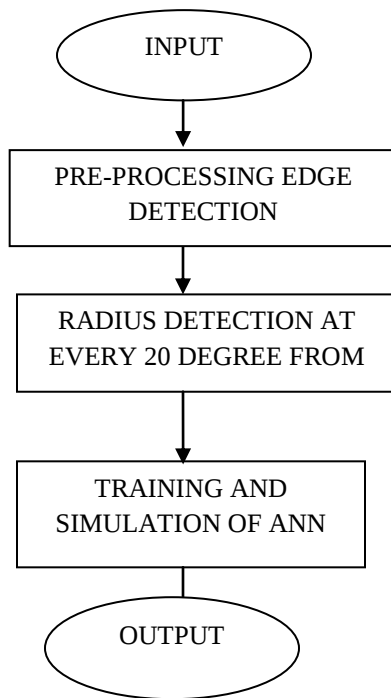


Fig.1 Flow Chart for recognition using radius variation detection technique

The feature extracted data of individual nut and bolts are given to the input of artificial neural network for training. The targets are set for recognition of nut and bolt for individual recognition parameters. After the performance parameters are meeting the network is saved for simulation. For simulation again above process is repeated for edge detection and radius detection, saved network is simulating the output. This method has an drawback of detection of edges as in real time application edge detection is not the suitable process as it reduces the accuracy and makes the process complex but for the advantage of the speed.

[2] Principle component analysis: The flowchart defined is as below:

The camera acquired images from like web camera of nut and bolt, image enhancements are done before applying principle component analysis as feature extraction tool for more accuracy of results.

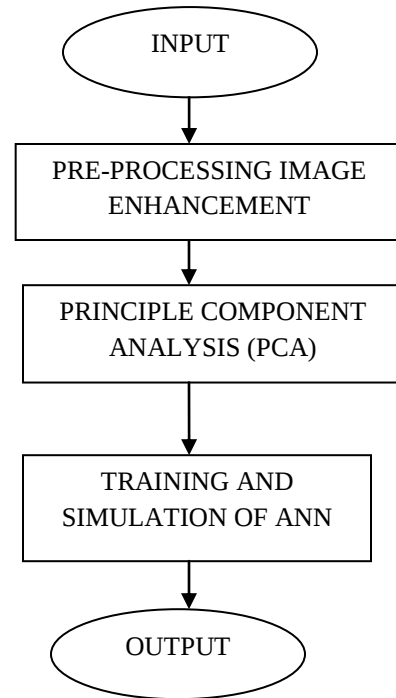


Fig.2 Flow chart for recognition using Principle component analysis method

The feature extracted data of individual nut and bolts are given to the input of artificial neural network for training. The targets are set for recognition of nut and bolt for individual recognition parameters. After the performance parameters are meeting the network is saved for simulation. For simulation again above process is repeated of principle component analysis and image enhancement, saved network is simulating the output

This method has a drawback of low convergence speed due to which the training takes more iterations than the radius variation detection but at the advantage the accuracy is more than the other two methods due to robust feature analysis of principle component analysis for any direction of nut or bolt.

[3] Stationary wavelet transform: The flowchart defined is as below:

The camera acquired images from like web camera of nut and bolt, image enhancements are done before applying stationary wavelet transform as feature extraction tool for more accuracy of results.

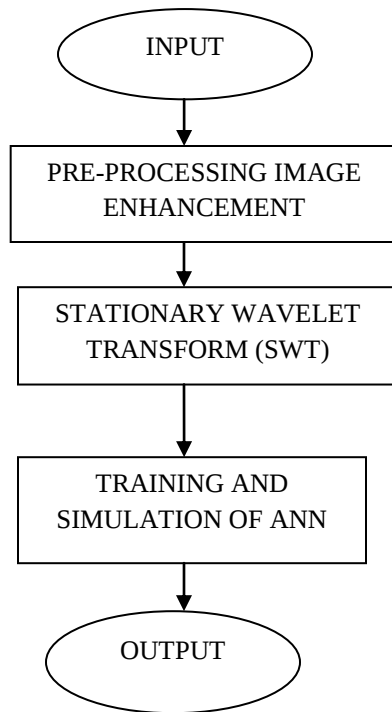


Fig. 3 Flow Chart for recognition using stationary wavelet transforms technique

The feature extracted data of individual nut and bolts are given to the input of artificial neural network for training. The targets are set for recognition of nut and bolt for individual recognition parameters. After the performance parameters are meeting the network is saved for simulation. For simulation again above process is repeated of image enhancement and stationary wavelet transform for feature extraction and the saved network is simulating the output. This method has a drawback of low convergence rate due to which the speed is lower than the other two methods also it has drawback of worst accuracy among other two methods. For better understanding of the feature extraction tools used refer the references given below.

3. Methodology

A software framework is designed using the MATLAB which is more suited for the image processing application due to its basic matrices. The process start with image acquisition where image will be capture using the high resolution camera, follow by pre-processing of the images captured to reduce the image for its unified size. Images are then

converted to gray scale and double precision image for the analyzing process. After the images have been pre-processed, the wavelet transforms analysis, radius analysis and principle component analysis is determined. Lastly according to the parameter of the wavelet transforms analysis, radius analysis and principle component analysis, the status of a TRAINING process can be determined by using neural network and action can be taken to follow up this result .

The algorithm for implementation of the work is as follows:

1. Image acquisition from digital camera or web camera of high resolution.
2. Pre-processing of the acquired image by image enhancement algorithms.
3. Image resize into 100x100 common resolutions for uniformity.
4. Stationary Wavelet decomposition using haar wavelet function or radius analysis or principle component analysis.
5. Different parameters are acquired for various feature extraction techniques.
6. Feature parameters are given input to the artificial neural network for training.
7. Trained artificial neural network is then simulating to obtain the results.

4. Performance Evaluation

In this paper, we have touched the topic of performance evaluation of three feature extraction techniques which is given to the artificial neural network for recognition of nut and bolt. We noticed that it becomes more and more urgent to correctly and appropriately evaluate computer vision algorithm performance. Therefore a generic evaluation system must be constructed for bench marking.

Current image processing system, such as Matlab, on the one hand, is too complicated for performance evaluation, and on the other hand, many aspects have not been covered, for example, for point set handling algorithm, for which we have to make special programs.

Some investigations must be done for understanding the overall requirements for evaluating computer vision algorithms and also other feature enhancement techniques also been implemented for improving efficiency as well as reducing the complexity. The analysis shows that the radius analysis method is fast

where we required less iteration in artificial neural network but edge detection and segmentation process are very much complicated on the other hand stationary wavelet analysis and the principle component analysis are less complex techniques but requires more epochs for training. So, when we speak of accuracy of result radius analysis is better but more complicated.

5. Conclusion

Oftenly the industrial application oriented images needs to be in exact manner without distorting information along with the enhanced, clear and distinct edges to pretend the information in the image very carefully so the proposed scheme can be able to evaluate all the parameters in an exact manner for the recognition of nut and bolt.

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