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Performance Increase of Mechanical nut and bolt Detection using Back-Propagation Artificial neural Network and Wavelet Energy Decomposition.

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Abstract— Humans are better in various aspects like in the field of the recognition. But as automation is increasing day by day there is need of the efficient machine recognition system. So, there are lot of research going on to machine recognition. In this paper we are dealing with the unique method to sort the mechanical objects in automation industry. In this paper we sort various mechanical components in order to attain very high efficiency. Wavelet transform is used for feature extraction of the input object. Artificial neural network the popular artificial intelligence technique is used for recognising the wavelet component object. There is also a special error function for increasing the efficiency of the system. Matlab 7.10 is used for the simulation of the object.

Keywords— Digital signature, MATLAB 7.10, recognition, wavelet transform, ANN-artificial neural network.

I. INTRODUCTION

There are things at which humans are still way ahead of the machines in terms of efficiency one of such thing is the recognition especially pattern recognition. There are several methods which are tested for giving the machines the intelligence in a efficient way for pattern recognition purpose. The artificial neural network is one of the most optimization techniques used for training the networks for efficient recognition. Computer vision is the science and technology of machines that can see. The machine is made by integration of many parts to extract information from an image in order to solve some task. As a scientific discipline, computer vision is concerned with the theory behind artificial systems that extract information from images. Each of the application areas described above employ a range of computer vision tasks; with more or less well defined measurement or processing problems, which can be solved using a variety of methods. Some examples of typical computer vision tasks are presented below. Recognition is the classical problem in computer vision, image processing, and machine vision. It is related to the determination of whether or not the image data contains some specific object, feature, or activity. This task can normally be solved robustly and without effort by a human, but is still not satisfactorily solved in computer vision for the general case, involving arbitrary objects in arbitrary situations. The existing methods for dealing with this problem can at best solve it only for specific objects, such as simple geometric objects, human faces, printed or handwritten characters, or vehicles, and in specific situations, typically described in terms of well-defined illumination, background, and pose of the object relative to the camera ([1]–[6], [8], [11],[17]).

The bolt and nut is a sample of a automobile fixer that mechanically joins or affixes two or more objects together. Fixers can also be used to close a container such as a box, or a tyre etc. Principle component analysis is a technique that will be suitably used for the application purpose for sorting of nuts and bolts. MATLAB is the abbreviation of matrix laboratory, which has several hundred in built function packages and thirty kinds of tool kits. In this paper, we use the MATLAB and implement the wavelet transform analysis and artificial neural network for image processing and detection. The optimization algorithm has less iteration than implementation with Artificial Neural Network process for the same task and other improved algorithms while the convergence rate is faster and the precision is higher [7,17].Curve figures in terms of perimeter radius are used as feature extraction ([6], [10], [12]) for recognizing objects. This method is efficient and more suitable for real time recognition systems compared with previous research [5, 7, and 17], because we can get better iteration time, speed of belt conveyor and accuracy. This paper is organized as follows; software implementation is proposed in the section 2. Methodology and hardware details are presented in section 3. The result and discussion are presented in section 4. Finally, section 5 presents the conclusion on the findings.

II. SOFTWARE FRAMEWORK DEVELOPMENT

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 principle component analysis is determined. Lastly according to the parameter of wavelet transform, the status of a TRAINING process can be determined by using neural network and action can be taken to follow up this result [15].

2.1 Configuration database

This configuration is used for configuring the information such as image size and image resolution. In this case, image size is fixed i.e. 100 x 100 pixels, and the image input format is in gray scale.

2.2. Image processing feature extraction

Image processing feature extraction consists of wavelet transform analysis methodology for getting the unique feature vector.

2.3. Artificial neural network

Artificial neural network is the soft computing optimisation technique which is used to give the train result in an efficient way depending on the training set of data. So, it is essential to give artificial neural network proper training input vectors which is nothing but the wavelet transform parameters viz. approximate, horizontal, vertical and diagonal. These values are different and unique for the input datasets. An artificial neural network gives an promising outcomes with improved results over an uncertainty of the input parameters which can be changes with respect to any circumstances such as environmental conditions, human efforts errors etc.

III. METHODOLOGY

An algorithm is designed using the MATLAB which oftenly is preferred for the image processing application due to its basic matrices techniques. The process start with image acquisition where image will be capture using the high resolution camera, followed by pre-processing of the images captured to reduce the image for its unified size which basically includes cropping and enhancement of images and are then converted to gray scale and double precision image for the analyzing process. After the images have been pre-processed, the wavelet transform analysis is determined. Lastly according to the parameter of wavelet transform, the status of a TRAINING process can be determined by using neural network and by means of various training algorithm respected networks are get trained with the aid of multiple of information and finally action can be taken to follow up this result.

The flowchart for discussed algorithm is shown:

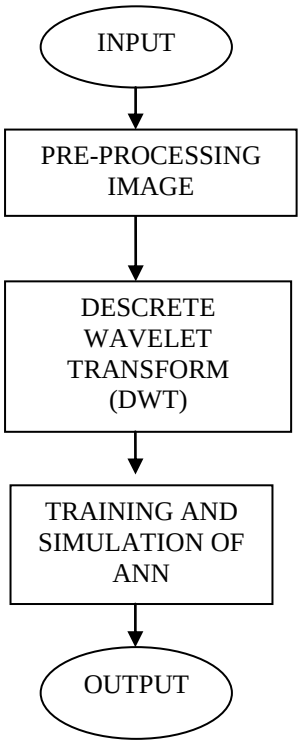

Fig.1 Flow chart of proposed algorithm

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. Wavelet decomposition using haar wavelet function.
5. Wavelet energy detection and get parameters like approximate coefficient, horizontal coefficient, vertical coefficient and diagonal coefficients.

6. Wavelet coefficients are given input to the artificial neural network for training.
7. Trained artificial neural network is then simulating to obtain the desired results.

IV RESULT & DISCUSSION

Fig.2 Artificial neural network training parameters

The desired and improved output found shows the promising results when tested with 11 sample test nut and bolts.The obtained results gives idea regarding the wavelet energy decomposition as a feature extraction technique for any position of nut or bolt on the conveyor belt without the pre-processing techniques like edge detection and segmentation process. The avoidance of pre-processing makes this process less complex and robust. The artificial neural network applied with log sigmoid activation function with four inputs and one output with four hidden layer gives around 96% accuracy.

Part of the code which shows the artificial neural network build for the problem.

```
S1 = 4;
S2 = 1;
net = newff(minmax(annINPUTpattern),[S S1 S2],{'logsig','purelin'},'trainlm');
% net = newff(minmax(annINPUTpattern),[S1 S2],{'logsig' 'logsig'},'trainlm');


%    TRAINING THE NETWORK
   ================================

net.performFcn = 'sse';        % Mean-Squared Error performance function
net.trainParam.goal = 0.1;     % Sum-squared error goal.
net.trainParam.show = 20;      % Frequency of progress displays (in epochs).
net.trainParam.epochs = 4000;  % Maximum number of epochs to train.
net.trainParam.mc = 0.95;      % Momentum constant.
```


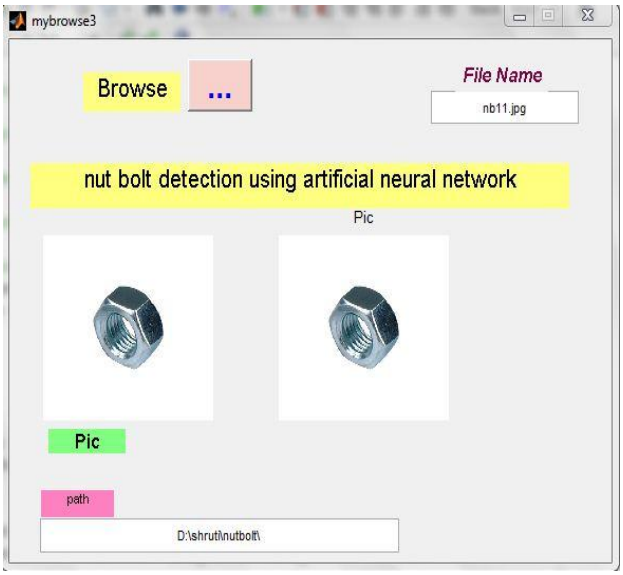

Fig.3 Artificial neural network nut detection

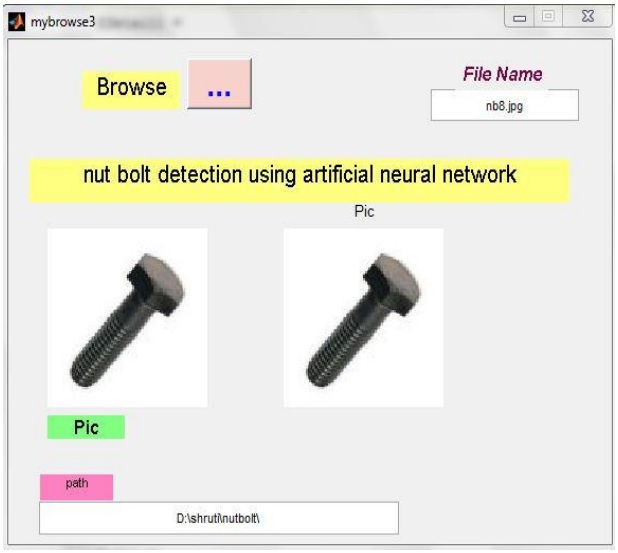

Fig.4 Artificial neural network bolt detection

The results of wavelet transform analysis of testing can be seen in the Fig. 3 and Fig. 4.

V. CONCLUSIONS

The wavelet transform decomposition analysis is the simple yet powerful descriptors of object detection. We tested on the basis of theoretical concepts that this descriptor can be used to approximate the spatial location of a sparse foreground hidden in a spectrally sparse background, which is also continuous in nature. Provided experimental data to show that the approximate foreground location highlighted by wavelet energy was perfectly notable, predicting them better than other algorithm at a very high speed and accuracy. The result is then when given to the artificial neural network the result accuracy is very high compared to some traditional methods.

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