IDENTIFYING DEFECTS IN GEAR SYSTEM USING NEURAL NETWORK

Amuthalakshmi.S[1],Sivagayathri.A[2],Sukanyadevi.J[3], Usha.G[4]

Final year, Department of ECE, Narasu'sSarathy Institute of Technology, Salem, Tamilnadu, India.

Dr.M.Poonguzhali.Ph.D[5]

Head of the Department of ECE, Narasu'sSarathy Institute of Technology, Salem, Tamilnadu, India.

[1]amuthalakshmiece@gmail.com, [2]asivagayathriece@gmail.com, [3]jsukanyadevi@gmail.com, [4]ushaecensit@gmail.com

ABSTRACT

Rotating machinery plays an important role in industrial applications. When these machines recently are getting more complicated, fault diagnosis techniques have become more and more significant. In order to keep the machine performing at its best, one of the principal tools for the diagnosis of rotating machinery problems is the vibration analysis, which can be used to extract the fault features and then identify the fault patterns. Artificial intelligent techniques have been successfully applied to automated detection and diagnosis of machine conditions. The computer vision method have focalized mainly on gears or on bearings alone whereas the Neural network is to generate answers that give the combined state of gears and bearings simultaneously.The proposed method is based on the Neural Networks to identify one defect or several combinations of mechanical defects. The Advantage of using Neural network methodology is to identify combined mechanical defects.

Key words: Defect Detection, Image Processing, Neural Network.

I.INTRODUCTION

Quality control is an important factor in industrial production which is increasing day by day. Gear industry is not an exception in this regard. Inspection of Gear defects plays an important role in the quality control. Human visioninspection is not enough accurate due to fatigue and tediousness. Also, it is time consuming and high quality cannot be maintained. So the solution to this problem is automated i.e. machine vision based Gear inspection system. Automated Gear inspection involves two challenging problem, namely, defect detection and defect classification. Classification process is composed of several steps. One of the important steps is scene analysis and feature selection. The complexity of the subsequent steps increases and the classification task becomes hard by selecting Inappropriate feature set. In the highly competitive global market to increase the performance industry should increase productivity as well as quality. Quality is affected due to defects that occur in Gear. So accurate detection of defect is an important factor to improve the quality. Defect analysis is a very important part of our approach to automated Gear defect inspection problem, which has been done earlier than all other parts. Defect analysis helps understand the defects properly, and give clues to appropriate feature. Automated Gear inspection systems are real-time applications. So they require real-time computation, which exceeds the capability of traditional computing. Neural Networks (NNs) are suitable enough for real-time systems because of their parallel-processing capability. Moreover, NNs have strong capability to handle classification problems. The classification accuracy of an appropriate NN, which handles multiclass problems, is good enough. There is a number of performance metrics of NN models. Classification accuracy, model complexity and training time are three of the most important performance.

II.RELATED WORK

J. Caron , L. Duvieubourg[i] described the defect detection by using recursive filters in packaging industry. This paper addressed the task of automating the visual inspection of strip of plastic by a vision system based on a line scan camera. The defects on the strip are characterized by a local variation in reflectance properties of the surface to be inspected. In this paper they proposed to take advantage of a new method which had been developed in our laboratory and which optimized the edge detection of defect in any case.

All Rights Reserved © 2016 IJARMATE

E. Deutschl, C. Gasser, A. Niel, J. Werschonig[ii] proposed an approach to Defect Detection on Rail Surfaces by a Computer Vision based System. A new vision based inspection technique for rail surface defects is presented. It replaced visual checks with an automatic inspection system. Color line-scan cameras and a special image acquisition method - the so called Spectral Image Differencing Procedure (SIDP) –allow the automatic detection of defects on rail surfaces, like flakes, cracks, groovesor break-offs by means of image processing.
Qingxiang Wang1,2 , Di Li1 , Wujie Zhang1[iii]used Optimal Gabor Filters for Detecting Defects in Golden Surfaces of Flexible Printed Circuits This paper studied the application of advanced computer image processing techniques for solving the problem of automated defect detection for golden surfaces of flexible printed circuits (FPC).
Alisha Tremaine et.al [iv] were able to understand how mould and die when not working properly, might give rise to the surface defects in plastic product. This paper basically discuss defects developed due to shrinkage, due to overheating and variation in temperature. To identify these kinds of defects, this paper suggests using SEM (Scanning Electron Microscope) technique.
S. Kamaruddin et.al. [v] paper presented a study in which an attempt has been made to improve the quality characteristic(shrinkage) of an injection molding product (plastic tray) made from blends plastic (75% polypropylene (PP) and 25% low density polyethylene (LDPE)) by optimizing the injection molding parameters using the Taguchi method.

III. Neural Network

A computing system made up of a number of simple, highly interconnected processing elements, which process information by their dynamic state response to external input. Our basic computational element (model neuron) Is often called a **node** or **unit**. It receives input from some other units, or perhaps from an external source. Each input has an associated **weight** w, which can be modified so as to model synaptic learning. The unit computes some function f of the weighted sum of its inputs:

$$y = (w\, y)$$

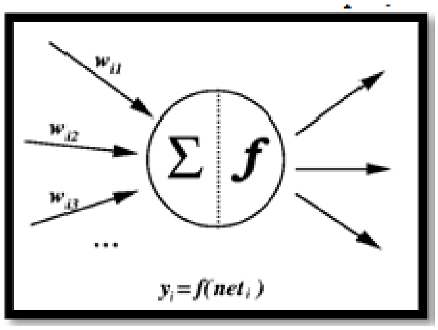

Figure.1.

To the second layer of neurons, and then via more synapses to the third layer of output neurons. More complex systems will have more layers of neurons with some having increased layers of input neurons and output neurons. The synapses store parameters called "weights" that manipulate the data in the calculations.

.

IV. Model Presentation

The proposed system can be a competitive model for recognizing gear defects in real world. Base on the research, the proposed system design is separated into two parts. The first part of our research processes the images to calculate the thresholding values of different gears. The second part calculates the number of gears and third part checks whether the gear is defective or non-defective.

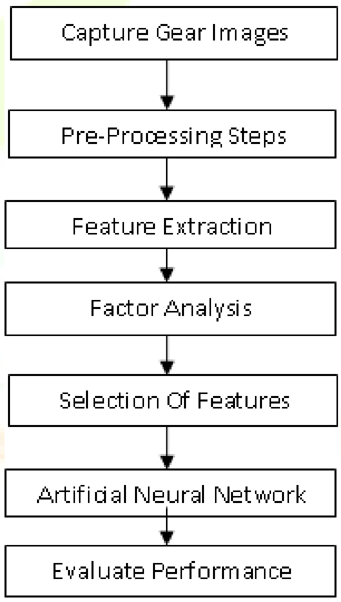

Fig:Flow diagram for Neural Network

All Rights Reserved © 2016 IJARMATE

After conducting a systematic review and after reading all other possible resources we are proposing a methodology that covers up the limitation of previous work done and it can be summarized into the following steps:

(**1) Capturing of gear images*:***Images of the object understudy are to be captured using a digital camera. These captured images are then being processed for the detection of plastic gear surface defects.

(**2) Pre-processing steps** :Since, the images are exposed to multiple kind of noise and other interferences during image acquisition phase. The images may require some pre-processing steps for it to work with the algorithm and results in good level of accuracy. Pre-processing involves the following: Resizing means change the size of the image or to make the image size more appropriate for faster processing. The gear images captured from the camera are very big in size i.e., about 5MB. Since we have to process lots of gear images in faster speed, the size of images should be compressed. Sometimes, when we capture these images from the camera ,noiseencounter the gear images. The noise in images is because of variation of brightness or color information in images ,unwanted signals, electrical fluctuations etc. during acquisition various types of noises may arise including Gaussian noise caused by poor illumination or high temperature during capturing, salt and pepper noise occurs because of analog to digital converter errors and bit errors in transmission, film grain is usually regarded as a nearly isotropic noise source. Its effect is made worse by the distribution of silver halide grains in the film also being random. Anisotropic noise occurs when the image sensors subject to row noise or column noise. In order to make the gear image smoother or to suppress the noise blurring is applied on the images. Sometimes flash is used during image capturing which is the instantaneous illumination of bright light but this intensity of light may cause problems in images like some portion of image illuminate with light intensity is not clearly visible hence, cannot be observed properly. Sometimes ,because of noise and flash either a part of gear image is destroyed or whole part is eliminated or only half part of the gear image is captured. Therefore, keeping in mind all these steps we have to consider only those gear images which represent whole part of gear. Finally we go for the Contrast enhancement that helps in improving the perceptibility of gears in the seen by enhancing the brightness difference between gears and their backgrounds.

(3) Feature selection and extraction: When the input data to an algorithm is too large to be processed and it is suspected to be redundant then the input data will be transformed into a reduced representation set of features (also named features vector).Transforming the input data into the set of features is called feature extraction.[xi] Therefore, multiple features are then extracted on the basis of descriptive statistics of coherence and spectral density of the gear image signals. Coherence: The spectral coherence is then used to examine the relation between two signals or data sets and is commonly used to estimate the power transfer between input and output. Spectral Density: In statistical signal processing, statistics, and physics the spectrum of a time-series or signal is a positive real function of a frequency variable associated with a stationary stochastic process, or a deterministic function of time, which has dimensions of power per hertz (Hz), or energy per hertz. The spectrum decomposes the content of a stochastic process into different frequencies present in the process, and helps identify periodicities. The spectral density of „f(t)" and the autocorrelation of „f(t)" form a Fourier transform pair .Descriptive statistics measures the following: Mean, Variance, Standard Deviation, Minimum and maximum etc.

(4) Factor analysis: Here we have to find out the features which are more significant that than the other analysis. i.e., we choose different factors which then help to select the best feature out of no. of features. Therefore, for this we employed step up/grow up method.

(**5) Selection of features:** We have selected spectrogram of the image signal and the coherence and finally calculate their descriptive statistics. We are then trying to analyze the statistic features which are more significant for identification of defect and non-defect. We can view feature selection as a method for replacing a complex classifier (using all features) with a simpler one.

(**6) Artificial Neural Network**: The real challenge in designing a neural network based solution is to design the I-H-O architecture. The idea is to build an learning classifier that can adapt, as well as remain stable for large data set variations with lowest possible computational overhead. We need to find the best possible combination of input features which can yield the most significant factors from which defects can be identified mathematically in easiest possible way. The number of hidden layers must be optimal so that large memory and computational resources are not wasted .In hidden layer there has to be some correlation between the input and output layer. Therefore, it is always suggested to design multiple I-H-O architecture and out of these we have to find out the most optimal one.

(7) Evaluate performance: After processing the data on the neural network we will then evaluate performance of the system .i.e., how accurately the system is operating.

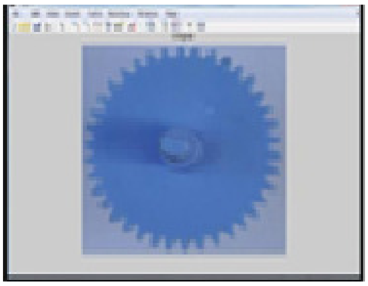

Fig2: Original image

RGB image of a plastic Gear which is used as input

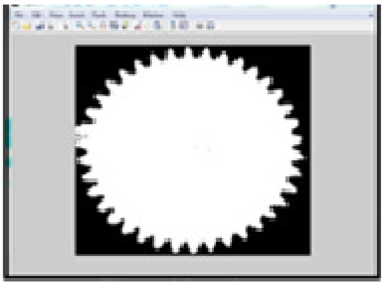

Fig3:Input Image

This is the binarized image of Gear passing through teeth counting algorithm

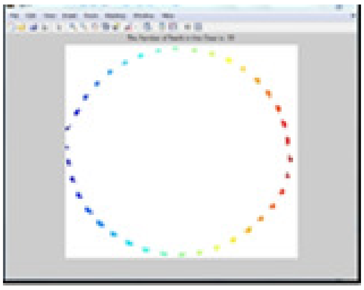

Fig4:Count the number of tooth

The above image count the number of teeth's of the gear image for checking whether the number of teeth's are same as that of the subscribe number. If the number of teeth matches with the subscribe number then the gear in non- defective otherwise it is defected.

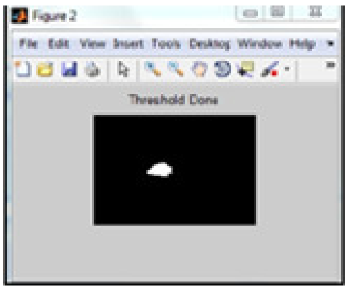

Fig5:Defected Gear

V.Result

The technique used here in this research work is better in accuracy, cost and time consumption. In this paper we are using the advantages of neural networks that other researchers did not used. Secondly, we have been able to identify some surface defects by using range bound thresholding which can work on both color and grey scale images of the gears.

VI.Reference

[1]. J. Caron , l. Duvieubourg proposed" Defect detection by recursive filters in packaging Industry" and published in international conference on Information, communications and signal processing ICICS Singapore, 9-12 September 1997.

[2]. Qingxiang Wang1,2 , Di Li1 , Wujie Zhang1proposed " Detecting Defects in Golden Surfaces of Flexible Printed Circuits Using Optimal Gabor Filters" and is published in Second International Symposium on Intelligent Information Technology Application.

[3]. E. Deutschl, C. Gasser, A. Niel J. Werschonig proposed" Defect Detection on Rail Surfaces by a Vision based System'' and published in 2004 IEEE Intelligent Vehicles Symposium University of Parma, Italy June 14-17 2004

[4]. Alisha Tremaine (2005), "Characterization of Internal Defects in Open Die Forgings" FIERF Grant Project for Undergraduate ResearchNovember 17, 2005

[5]. S. Kamaruddin, Zahid A. Khan and S. H. Foong(2010) " Applicationof Taguchi Method in the Optimization of Injection Moulding Parameters for Manufacturing

All Rights Reserved © 2016 IJARMATE