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DETECTION OF SURFACE DEFECTS ON HOT ROLLED STEEL

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ABSTRACT

Automatic defect detection on hot-rolled steel surface is challenging owing to its localization on a large surface, variation in appearance, and their rare occurrences. It is difficult to detect these defects either by physics-based models or by small-sample statistics using a single threshold. Also the identification of surface defects like hole, scratches, water bubble, ris, misc, blister, roll mark etc., helps in improving steel quality. The main objective of our work is to extract the metal surface features like mean, entropy, energy, standard deviation, kurtosis, skewness using wavelet transform and identifying the defect using neural network. The experimental results show that the proposed method can detect the defects effectively and has better correct detection rates than the thresholding method.

KEYWORDS- wavelet transform-haar transform, neural network..

1.0 Introduction

T Machine Vision is the application of computer vision to industry and manufacturing. Whereas computer vision is mainly focused on machine based image processing, Machine vision most often requires digital input/output devices and computer networks to control other manufacturing equipment.
One of the most common applications of machine vision is the inspection. Just as human inspectors working on assembly lines visually inspect parts to judge the quality, so machine vision system use digital cameras and smart cameras to perform similar inspection.

Machine vision systems are programmed to perform narrowly defined task such as counting objects on a conveyor, reading serial numbers, and searching for surface defects. Manufactures favors machine vision system for visual inspection that require high speed, high magnification, 24-hour operation and repeatability of measurements. Frequently these tasks extend roles traditionally occupied may human being whose degree failure is classically high through distraction, illness and circumstances. However, humans may display finer perception over the short period and greater flexibility in classification and adaptation to new defects and quality assurance policies.

Computers do not see in the same way that human beings are able to. Cameras are not equivalent to human optics and while people can rely on inference system and assumption, computing devices must see by

examining Individual pixels of image, processing them and attempting to develop conclusion with the assistance of knowledge bases and features. Although some machine algorithm have been developed to minimize human visual perception, a number of unique processing methods have been developed to process the images and identified relevant image feature in an effective an consistent manure. Machine vision an computer vision systems are capable of processing images consistently but computer based image processing systems are typically designed to perform single, repetitive task and despite significant improvement in the fields.

II. LITERATURE SURVEY

Surface defect detection:

Steel strip is an essential industry raw material, and its surface quality is an important evaluation indicator. It is probably several kinds of surface detects (such as scratch, inclusion, scale, hole and pimple) when manufacturing steel strip because of billet, rolling equipment, techniques and so on. These flaws not only affect the appearance of the product, even more serious reduces the corrosion resistance, wear resistance and fatigue properties and so on. Simple surface defects like pits, bumps, scratches and hole create obvious problems for finishing operations, but more problematic is the fact that many times these defects do not become visibly noticeable until the operation is complete. Steel surface quality problems have been caused more and more concerned by the iron and steel enterprises.

Automatic metal surface inspection is a well known problem and is being considered for more than two decades. The steel quality control is currently done mainly by human visual inspection. Human inspectors classify the defects according to their cause and origin because the inspection results are used as feedback to correct the manufacturing process. The experience of the inspectors is essential, because there are no fixed defect criteria. The inspectors pass/reject decisions seem to be based on the types of defects and their extent, the maximum number of defects per unit of surface area and the total number of defects on the entire inspected strip. In addition the inspector's knowledge of the customer and the use of the strip have a great impact on the decisions. As the human visual inspection can provide a reliable quality control system for steel manufacturers. We are aiming through this research to detect steel defects by the image processing algorithm. Recently automatic visual inspection is popularly being used in that neural networks have taken major part for classification of defects according to image processing.

Existing system:

Traditionally steel sheets are inspected manually which is time extensive and labor intensive. Labor shortages and lack of overall consistency in the process resulted in a search for automated solutions; the development of machine vision system shows an improvement in efficiency. Recently automatic visual inspection is popularly being used. In order to find defects on steel surface edge preserving filter has been used. The image has been analyzed on separate x and y axis using laplacian filter. To analyze the horizontal coefficients double threshold was used and for vertical coefficient single threshold was used. But in thresholding method defect detection rate is less.[1][2]

Proposed System:

The image after acquisition has to be segmented where the regions of interest are isolated from the rest of the image. Image processing support higher accuracy, reliability, speed, reduces man power and can handle job that are not possible with human inspection and in hazardous environment. This project deals with the new method for defect detection. It can make the performance of defect detection rate higher than the existing one and can reduce the total computational time.

In our project we are using wavelet transform to extract the features like mean, standard deviation, entropy, skewness, kurtosis and analyzing the defect using neural network.

Step 1: Performing some image preprocessing operations.
Step 2: Applying the proposed defect detection process.
Step 3: Classifying the defect using all proposed algorithms.

III.BLOCK DIAGRAM

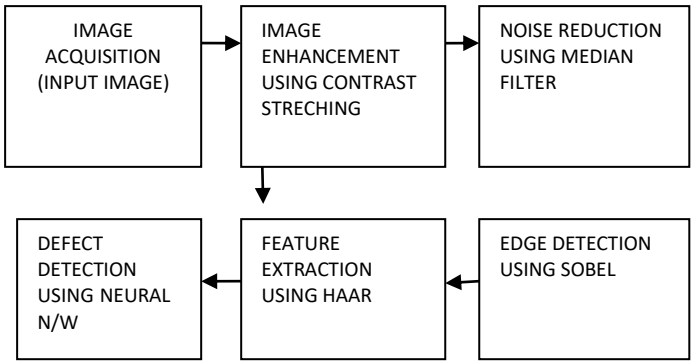

Figure 1: detection of defect

- Image acquisition: Image acquisition is the process of obtaining a digitized image from a real world source. Each step in the acquisition process may introduce random changes into the values of pixels in the image which is referred to as noise. An image is captured and stored into the computer for further processing.
- Image enhancement: Image enhancement technique is to make the image clearer so that various operations can be performed easily on the image. For this, at first the captured RGB image is converted to the gray level image. Contrast stretching (often called normalization) is a simple image enhancement technique that attempts to improve the contrast in an image by stretching' the range of intensity values it contains to span a desired range of values, e.g. the full range of pixel values that the image type concerned allows. Low contrast images can be found due to the poor illumination, lack of dynamic range in the imaging sensor, or due to the wrong setting of the lens. The idea behind the contrast stretching is to increase the dynamic range of intensity level in the processed image.

- Noise reduction: Noise reduction is a process of removing noise from a captured image. To remove noise some filtering techniques can be used. Median filter technique is good at removing salt and pepper noise from an image, and also causes relatively little blurring of edges, and hence is often used in computer vision applications.

- Edge detection: we detect edge using sobel edge detection method upon the resulting image. Actually there are many kinds of edge detectors. We use first derivative edge detector (sobel) to detect edges of the image.

- Feature extraction and defect detection: Different features are calculated from the image. These features can be for example mean, energy, entropy, skewness, kurtosis and standard deviation. Typically a couple of dozen features is used, but there is no limit to the number of features used in the classification. Adding more features after a certain level does not contribute classification of the defects. When the features are calculated a feature vector can be put together. Defects with about similar feature vectors are classified in the same class by the neural network.

Neural Network

Neural networks are composed of simple elements operating in parallel. These elements are inspired by biological nervous systems. As in nature, the connections between elements largely determine the network function. You can train a neural network to perform a particular function by adjusting the values of the connections (weights) between elements.

Typically, neural networks are adjusted, or trained, so that a particular input leads to a specific target output. The next figure illustrates such a situation. There, the network is adjusted, based on a comparison of the output

and the target, until the network output matches the target. Typically, many such input/target pairs are needed to train a network.

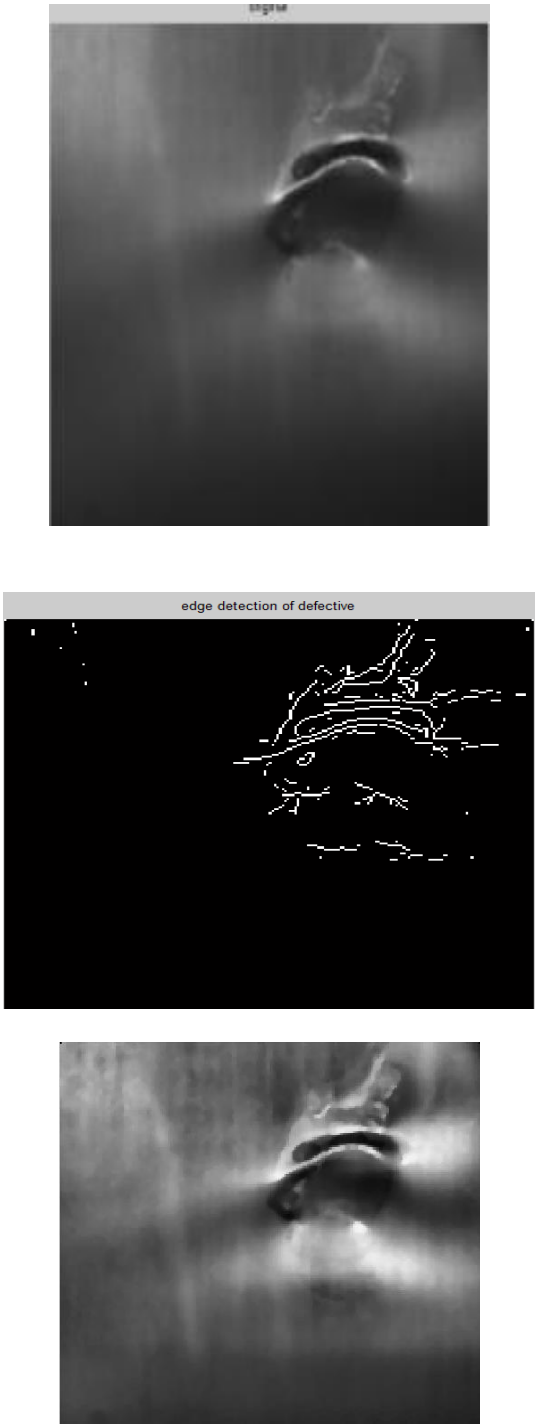

FIGURE 2: WORKING OF NEURAL NETWORK

Neural networks have been trained to perform complex functions in various fields, including pattern recognition, identification, classification, speech, vision, and control systems. Neural networks can also be trained to solve problems that are difficult for conventional computers or human beings. The toolbox emphasizes the use of neural network paradigms that build up to--or are themselves used in-- engineering, financial, and other practical applications.

	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	mean	mean	std dev	std dev	std dev	entropy	entropy	entropy	skewness	skewness	skewness	kurtosis	kurtosis	kurtosis	class
2	0.002917	0.00014	0.012019	0.024105	0.007231	10.01564	8.156847	0.910589	0.840615	-0.29614	-0.05849	15.47315	10.90149	26.49821	def
3	0.011979	0.000318	0.022738	0.032243	0.016275	5.046263	3.054868	0.6094	0.447669	0.257671	0.313743	4.162441	3.566255	3.538147	nodef
4	-0.00188	0.000353	0.051462	0.069395	0.035746	18.65689	25.55591	9.737268	-0.23257	-1.20427	0.396361	64.45581	32.32295	47.53928	def
5	0.002605	-2.84E-05	0.021607	0.035637	0.007921	9.277431	13.45118	1.072486	-3.05122	-0.582	0.079833	28.37625	14.33783	8.386728	def
6	-0.00022	0.000104	0.018306	0.020477	0.015067	8.028091	3.669685	2.487578	0.63164	0.855125	0.030931	19.57573	25.31358	4.168833	def
7	0.00168	-4.94E-05	0.011545	0.014485	0.006588	7.9874	3.886971	0.790516	-0.41731	0.601614	-0.00657	5.405919	7.407054	5.470009	nodef
8	0.003582	8.45E-05	0.018581	0.021351	0.014258	12.90182	6.719967	1.368434	2.356763	2.598859	16.90347	150.5646	94.65273	939.8646	def
9	0.003135	0.000127	0.013474	0.020032	0.005966	11.99896	6.898942	0.68138	1.183895	1.124525	0.31743	8.502315	13.36115	11.27918	nodef
10	0.002628	-0.0005	0.048787	0.052776	0.026711	4.607412	6.672401	2.430223	1.817986	0.561873	0.695154	41.40824	26.38545	15.42393	def
11	0.000635	-0.00059	0.014725	0.018111	0.01503	6.5995	3.147356	2.033892	0.29275	-0.05584	-0.15152	5.520227	3.788883	4.051243	def
12	0.000427	0.00014	0.012681	0.025389	0.005982	2.873554	8.047211	0.700991	-0.62606	-0.18989	0.177366	5.507243	7.380255	8.702537	def
13	0.001976	7.25E-05	0.04328	0.01247	0.003458	6.555152	3.077538	0.261641	-5.76571	1.166147	0.179993	37.92587	13.13914	6.377383	nodef
14	0.002823	6.12E-05	0.044789	0.013273	0.003588	6.988304	3.766163	0.27291	-5.76494	0.858208	-0.07952	37.94058	9.069916	6.474485	nodef
15	0.002517	-3.72E-05	0.009097	0.015328	0.004844	6.650067	4.501058	0.445899	0.490986	1.422836	0.056899	9.45874	14.61448	9.462858	nodef
16	0.001645	-0.00026	0.014164	0.019987	0.014451	5.329318	4.301032	2.237541	-0.54341	-0.01547	-0.06942	10.52712	8.518524	3.691862	def
17	0.003473	0.000128	0.010805	0.023717	0.006754	9.090966	8.846023	0.814234	-0.2831	1.338381	-0.59418	11.52066	15.6986	32.00258	def
18	0.002453	-0.00015	0.010139	0.017298	0.005299	7.670393	5.302728	0.490262	0.227181	1.259904	0.069365	9.170241	13.4908	10.13861	nodef
19	-0.00069	0.000344	0.068089	0.080416	0.052205	37.70192	47.80327	25.0329	-0.25046	-0.12121	0.012946	7.285264	7.419251	7.761279	def
20	0.003135	0.000127	0.013474	0.020032	0.005966	11.99896	6.898942	0.68138	1.183895	1.124525	0.31743	8.502315	13.36115	11.27918	nodef
21	0.00226	0.000191	0.010622	0.018803	0.005109	8.711224	5.314727	0.533396	0.757527	0.119605	0.201273	7.708488	18.51113	8.193982	nodef
22	0.003212	0.000389	0.020279	0.023512	0.014232	13.58242	7.301195	2.02947	1.030106	0.957243	7.277332	141.6605	66.55401	267.0464	def
23	0.002798	5.76E-05	0.017984	0.016703	0.006135	13.02487	5.283695	0.70996	0.197297	0.617784	-0.05975	2.743674	7.657552	5.213268	nodef
24	0.004693	-9.26E-05	0.017567	0.0252	0.011516	9.880913	10.58535	1.845238	-1.04424	0.567628	-0.21071	12.59359	9.201467	22.95418	def
25	0.005157	-1.68E-06	0.01275	0.023012	0.009167	8.096058	10.01411	1.280454	-1.04983	0.864826	-0.73969	12.89068	7.742264	18.2051	def

Table 1
DIFFERENT TYPES OF SURFACE DEFECT IMAGES USING DIFFERENT SETS OF FEATURES

Conclusion :

Solving the problem of quality grading and sorting steel surfaces is a complex one involving research and study in a lot of related areas such as Image processing and Artificial Intelligence.The work we have done is a preliminary study of defective steel surfaces. With the help of literature study on the fundamentals of wavelet and neural network, we have extracted the features of defects and identified the defect using neural network which was trained. Apart from the features that we have extracted, this project can further be improvised to

extract features like area, depth of defect etc. The central outcome of this project is that the wavelet feature sets are better suitable for steel surface defect detection application compared to texture-based segmentation or thresholding techniques. Further, three-level Haar feature set is more promising compared to the Daubechies, Bior, and multi-wavelet wavelet features.he survey did contain some cheer for the export sector, saying that green shoots have started to appear on the trade horizon with world trade growth projected at 3.8% and 3.9% in 2017 and 2018, respectively, and India's trade growth also picking up.

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