Design and Development of Automatic Surface Defect Detection in Hot Rolled Steel Strip

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Abstract **- In the steel industry Automatic detection of steel surface defects is very important for product quality control. However, the traditional method cannot be well applied in the production line, because of slow running speed and its low accuracy. The current, popular algorithm (based on deep learning) also has the problem of low accuracy, and there is still a lot of room for improvement. This paper proposes a method combining improved and enhanced faster region convolutional neural networks (faster R-CNN) to improve the accuracy reduce the average running time. Firstly, the image input into the improved model, which add the deformable revolution network (DCN) and improved cutout to classify the sample with defects and without defects. If the probability of having a defect is less, the algorithm directly outputs the sample without defects. Otherwise, the samples are further input into the improved faster CNN. The output is the classification and location of the defect in the sample or without defect in the sample. By analyzing the data set which is obtained in the real factory environment, the accuracy of this method can reach 98%. At the same time, the average running time is faster than other models. Here, the NEU database, used for improve efficiency of model, which having six kinds of typical surface defects of hot-rolled steel strip. The results show that in all kinds of defects in database, the proposed model can perform defect segmentation, in this process there is no need of skilled learning with no labeling and small training procedure, so it is easy to give required application. also, this defect detection shall improve the reliability and productivity of steel strip's production process.**

Index Terms **- steel surface defect detection; Convocutional neural network, python deep learning, classification.**

I.INTRODUCTION

The main aim of this project is surface defects detection of different types of classes of hot rolled Steel strip Using images which are captured by CCD camera and after achieving images that images are used for the detection processes for grabbing 20 frames per second line scan camera is used. After getting the images defects are classified in different types when detection process is carried out. In production line it is essential to study the algorithm of automatic real-time detection. Performance of steel is depend on the defects on surface of that Steel. In traditional method by human eye the detection is done. So it is not proper detection because of that result is get imperfect and it causes the major economic loss. So now a days the automatic defect detection is a need and the improved online defect detection system is coming up. By using automatic detection defect is easily found out. The image processing detection has advantages of the non-contact efficiency, visual inspection and intelligence. The main idea is acquiring the images from steel production industries and Do the detection on that images and hand of the all the effects on that Steel which is help for Minimize that defect.

The organizational structure of this paper is as follows: firstly introduces the structure of our algorithm, including the overall classification model, object detection model, etc. Then analyzes the dataset and improvement of the algorithm. After that use the experiment to prove the efficiency and accuracy of the algorithm and compare our results with other methods. Finally, summarizes the paper and conclusion.

II. EXPERIMENT WORK

We evaluated our model with different numbers of training samples, different sizes of image, different batch sizes, different epochs, different filter kernels

and different activation functions on the aforementioned dataset.

Design & Analysis-
Selection-

1. Programming Language-Python
2. Machine learning->Categorical data type->supervised learning->classification algorithm
3. Deep learning-> CNN neural network
   Design calculations-
4. Size of Dataset-1800 images classified into 6 defect into 300 images
5. # Rescaling all Images using Image Data Generator library
   rescale=1. / 255,
   shear_range=0.2,
   zoom_range=0.2,
   horizontal_flip=True
6. 6.Training data set used-80% I.e=1656 images
   Testing Data set used-10%=72
   Validation data set used-10%=72
7. 7.Activation function-relu
   Optimizer-'rmsprop

Epoch-20
Batch size-32(By default)

To evaluate the robustness against the failure of the image, additive Gaussian noise was added to the image, which simulated the failure behavior of the image. We corrupted 10 % of the random test samples from each class, every chosen image was added to Gaussian noise with three different values. All experiments were conducted using the open source ConvNet libraryTraining was done on a standard desktop with a NVIDIA GTX 970 GPU card with 8GB memory. To deal with random influence, we did every experiment 10 times. The filter kernels of the first convolutional layer were initialed with learned filter kernels by the sparse auto-encoder, the other filter kernels were all initialized by sampling from a standard normal distribution and the biases of the feature map were all initialized to zero. The model was optimized using mini-batch stochastic gradient descent over the whole training dataset with the following settings: a learning rate was initialized at 0.001 and decreased by 50 % every 20

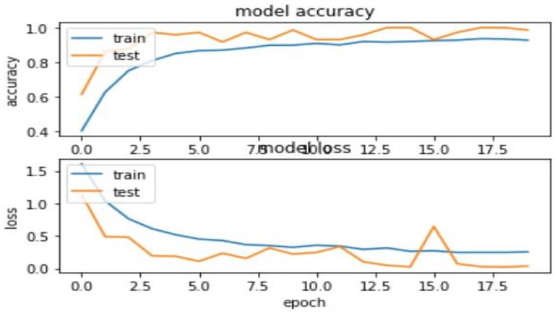
III FEATURE EXTRACTION AND REDUCTION

In general, feature extraction and reduction is applied to the high dimensional feature vector in order to remove not necessary and does not work very well information. Large number of features that present a single image may increases the complications of the classifier which in turn may slow down the training process and affected the final classification perfection. In this work, the feature reduction is performed by make use of PCA to minimize the size of the combined input vector at the feature of removal level. PCA is a conclusive statistical analysis technique for constructing a lower dimensional presentation of larger dataset. The main idea in PCA is based on a mathematical procedure that uses an orthogonal alteration to transform a set of observations of possible correlated variables known as principal components. Normally, the n of principal component is lower than or equal to number of original variables. This modification is defined in a such way that first principal component has the largest possible variation, and each succeeding component in turn has the highest variation possible under the restrictions that it be orthogonal the preceding component.

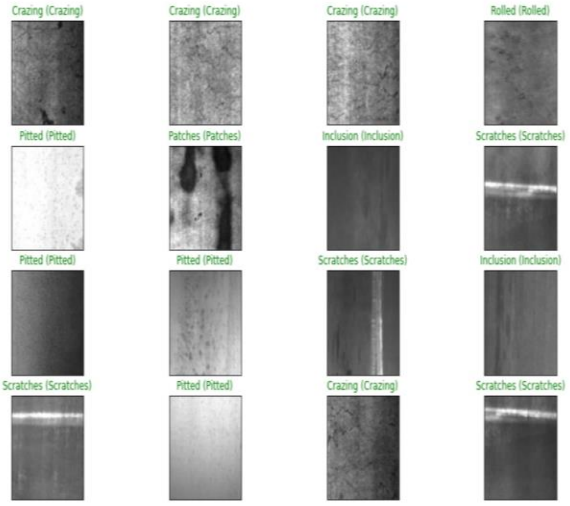
In this stage, the focus is to decrease the dimensional size which permit superior discrimination between distinct classes and produce the highest classification accuracy rates. The PCA is applied respective times on the reserved number of features than the original for every image.

IV RESULTS AND DISCUSSION

The classification of the proposed framework is represented in given paper showing the training-testing splits in 80-20%. The results can be clearly shows that the highest classification accuracy rate was achieved by using the evaluation set (80-20%). As presented in this paper, the highest classification accuracy rate was 98.9% and it is achieved by using this method with 80-20% set.



The summary of the overall results is represented in fig. The classes (PA), (In), (SC) have achieved higher classification rate than the other classes that using six classes. And this is because of large difference in appearance that exist in the intra-class samples.



VII. CONCLUSION AND FUTURE WORK

In the traditional method of defect detection there are the many problems in detection like slow detection Speed low detection accuracy and dependency of parameter setting for solving a such a problem there is a automatic surface defect detection in hot rolled Steel strip using the CNN network. For this we studied the convolution neural network and also improved this network off for the higher Optimisation training accuracy. The major advantages of this method is, shorter training time, faster convergence speed, and more accurate with parameters. By this method we are not going to detect only intraclass defect but also the inter class defect.

In future we can study for the two condition first one is, there we can collect an update library also we can argue for the better libraries which gives the better performance for the defect detection and second one is where we can go for the improved algorithm which make classification very easily. And having the excellent classification also we can get the new idea for the classification on steel strip. In future we can go for the details of classification performance and last but not least but speed of the setup.

ACKNOWLEDGMENT

We are especially thankful to our institute, Adarsh Institute of Technology and Research Centre, Vita for the Conviction bestowed on us and give responsibility for our project “Design and Development of Automatic Surface Defect Detection In Hot Rolled Steel Strip.” At this moment, we feel deeply respected in expressing our genuinely gratitude to our internal guide Prof. U. Y. Siddha Sir, Mechanical Engineering Department, Adarsh Institute of Technology and Research Centre, Vita for Providing Valuable explaination leading to our project and helping us whenever we needed support.

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