REPORT

Submitted By

Miss. Chandanshive Pallavi Shashikant

Miss. Chavan Aarti Haribhau

Miss. Kale Pushpa Dnyaneshwar

Miss. Sutar Pradnya Dilip

In Partial Fulfillment of degree of

B. Tech (Mechanical Engineering)

DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE

DEPARTMENT OF MECHANICAL ENGINEERING

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1. **NAME OF COLLEGE :** Adarsh Institute of Technology and research Center, Vita
2. **NAMEOF COURSE :** B. Tech (Mechanical Engineering)
3. **NAME OF STUDENT : 1. Chandanshive Pallavi Shashikant**

   2.Chavan Aarti Haribhau

   3.Kale Pushpa Dyaneshwar

   4.Sutar Pradnya Dilip

4. **DATE OF REGISTRATION :** October 2020
5. **NAME OF GUIDE :** Mr.U.Y. Siddha
   Mechanical engineering Department
   AITRC, Vita
6. **TITLE OF PROJECT : " Design and Development of Automatic Surface Defect Detection in Hot rolled Steel Strip".**

CHAPTER -1

INTRODUCTION

INRODUCTION:

The target to be achieved through this thesis was primarily aimed at detecting the surface defects belonging to different classes of hot rolled steel strips. This was achieved through grabbing the images from the CCD camera. Here line scan camera is used which grabs 20 frames per second. Then carrying out defect detection on these images and later classifying the defect types. Surface defect is one of the most crucial causes which affect the performance of hot-roll steel sheets. The traditional visual detection by human eyes is not an easy way to deal with the massive production of hot rolled steel coils . Besides, the testing results tend to be misled by observers. As a consequence, new detection methods need to be come up with improved online defect detection system. Defects can easily escape from being found out since image processing detection has the advantages of noncontact efficiency, visual intuition and intelligence, home and foreign scholars have deeply researched image detecting methods applying to the steel industry. By using automatic detection, defect is easily found out. The idea is that by acquiring images of steel production samples on the production line, the quality of steel productions can be controlled fairly, which takes the place of visual detecting by human. The output is the classification and location of the defect in the sample. By analyzing the dataset 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 dataset is used for improve efficiency of model.

CHAPTER-2

RELEVANCE,PROBLEM STATEMENT,SCOPE,OBJECTIVES.

RELEVANCE:

- It is totally non-contact detection which is going for error-free results.
- Automatic recognition method for hot-rolled steel strip surface defects is extremely important to the steel surface inspection system.
- In order to improve the tolerance ability of local deformations .
- Surface defect detection is an important part of industrial production, and has significant impact upon the quality of industrial products on the market.
- The traditional manual detection method is time-consuming, and its detection accuracy is easily affected by the subjectivity, energy and experience of the inspector.
- It need only input which is in image form.
- It not needed huge setup and data.
- There is no limitations of numbers of input images .
- Easy to transfer data from one setup to another.
- No need of special maintenance.

PROBLEM STATEMENT:

The earliest defect detection method of steel strip is totally dependent on manual visual inspection method which cannot meet the requirement of real-time. In addition, manual

visual inspection also has the disadvantages of labor intensity, missed inspection, mis - inspection, poor working environment and easy to cause injuries to quality inspectors.

With the increase in production speed, it is difficult to achieve complete detection by manual visual inspection. Therefore, it gradually evolved into random inspection, i.e., randomly select a certain percentage of completed production of steel coils, and then open a few meters on the un coiler to check whether there are defects. Since the sampling inspection method cannot achieve a comprehensive inspection of steel coils, it has been largely replaced by machine vision inspection systems. And in automatic detection there is a low accuracy factor that mean gives low accuracy. And having the automatic programming which is short time solution which not can be used for other applications. And it can find out intra - class differences but there also is difficulties to find out inter- class differences.

SCOPE :

The industrial world is in a constant state of change. Machine learning will change mechanical engineering and thus many user industries. Implementation has already begun now the focus is on concrete application scenarios and their implementation. The efficiency, flexibility and quality of the systems can be significantly improved with the help of the available data. New business models for customers are developed. Machine Learning ensures that software and information technology are increasingly becoming the key drivers of innovation in mechanical engineering. A defect classification method based on deep learning is proposed to detect defects on the surface of hot-rolled steel strip. Compared with the traditional machine vision method, this method improves the accuracy and efficiency of hot strip surface defect detection. At the same time, this method has a strong ability of defect recognition .

OBJECTIVES :

- To detect surface quality of steel.
- To evaluate the models, accuracy metrics used.
- To detect and classify steel surface defects using machine and deep learning

- To improve the algorithm by localizating and classifying surfaces defects on sheet metal
- To give better accuracy .
- To bring forward an appropriate method to find out the surface defects of the hot-rolled round steel under the help of software.

CHAPTER-3

FACILITIES REQUIRED & AVAILABLE, METHODOLOGY

FACILITIES REQUIRED:

- **Network Analysis**:

Network Analysis is used to store the project plan with the large number of activities with their features as per data base input. The system analyses the plan to determine, start, finish, floats, critical activities etc. and produce reports accordingly.

- **Resource Scheduling:**

These packages have ability to allocate resources to activities with or without reference to the available resource levels. When resource levels are specified, the activities (with the help of the system) can be scheduled in such a way that the levels are not exceeded. The success planned referred to earlier can produce several reports on obtained resources .

METHODOLOGY :

The proposed work will be carried out with following steps:

1.Study of literature.

2.Selection and study of topic.

3.ldentification of Project.

4.Development of flow chart.

5.Study of to detect the defect on the surface of hot rolled steel strips,

Defects, Parameters.

6.Software analysis .

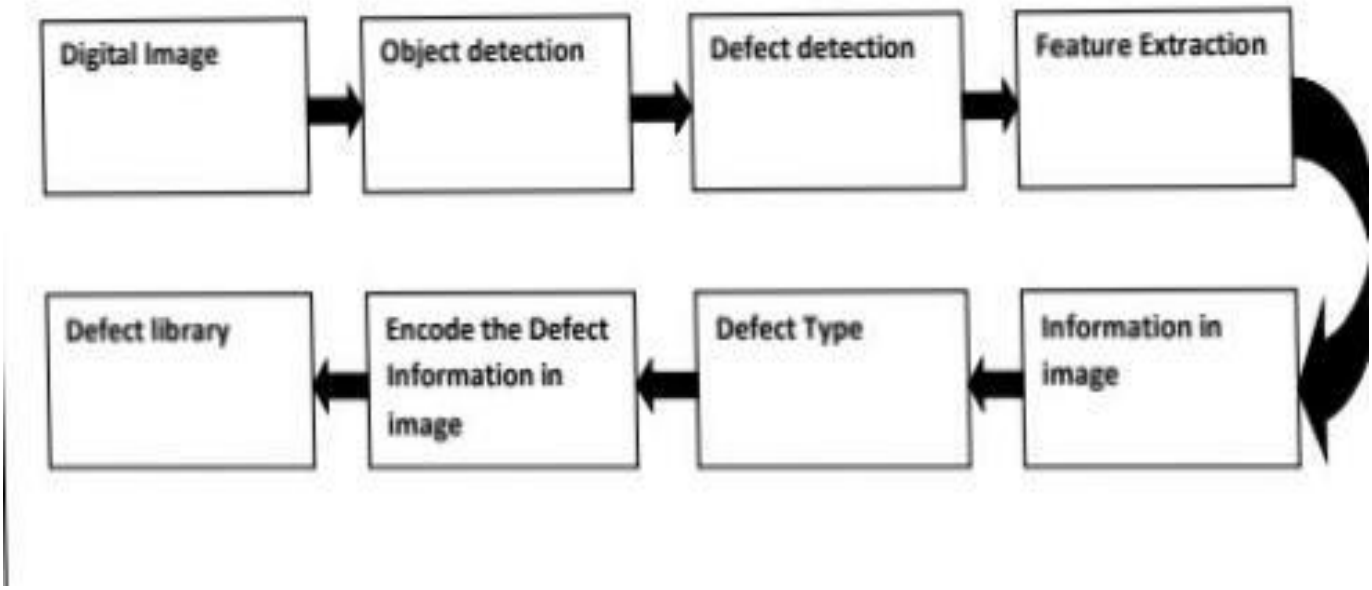
7.Setup and data importing .

8.Data preprocessing.

9.Build a Algorithm.

10.Training and Testing.

11.Comparison of results .



CHAPTER-4
LITERATURE REVIEW

LITERATURE REVIEW:

The automation and intellectualization of the manufacturing processes in the iron and steel industry needs the strong support of inspection technologies, which play an important role in the field of quality control. At present, visual inspection technology based on image processing has an absolute advantage because of its intuitive nature, convenience, and efficiency. A major breakthrough in this field can be achieved if sufficient research regarding visual inspection technologies is undertaken.Therefore, several different hypotheses have been reported to describe the detection ,analysis and result on hot rolled steel stip.

Hai liang yu et al.[1] published a paper that titled, " Occurrence of surface defects on strips during hot rolling process" . initiation and growth of surface defects on strips during the hot rolling process. Strip deformation process where simulated for various rolling reduction ratios and friction coefficient between the roll and the strip. The risk of occurrence surface defects on strip increases as the friction between roll and strip increases for the same reduction ratio.

T. Koinov(University of chemical technology and metallurgy ,Bulgaria) et al. [2] published a paper that titled, "Quality control system for a hot-rolled metal surface". presence of surface defect of steel rolling origin is peculiar to the production of hot rolling mill. the whole assortment of the mill 2000 was divided for the five groups by the outward appearance of the surface. The works on the identification of defects of hotrolled metal and widening of data base of knowledge of ASIS (automatic surface infection system)were continued after the carrying out of guaranty tests more than 10 thousands images of defects were added to the data base during the year.

Xiaohong sun et al. [3] published a paper that titled, " Research progress of visual inspection technology of steel products". latest developments in steel inspection relating to the detected object, system hardware ,system software and existing problems of current inspection technology. The network framework based on deep learning provide space for development of end to end mode inspect ion technology, which would greatly promote the implementation of intelligent manufacturing

Didarul Amin (university of business agriculture and technolody Dhaka, Bangladesh), et al. [4] published a paper that titled, "deep learning based on defect detection system in steel surface" .the proposed work anchorages computer vision techniques to localize steel surface defect .Caleb and Steure used the artificial neural networks(ANN)to detect the defects in Hot rolled steel strip.In this method for recognition of defect strong ability is their. the data can be realize by setting of parameters. In this design a new machine learning model and used to trace the accuracy by selected machine learning models.

A. Jiangyun Li,et al. [5] published a paper that titled, "Real time detection of steel strip surface". Deep learning is a data-driven learning method, and the amount of dataset directly affects the learning results. If a larger number and variety of strip surface defects images are available to train our network, the network will have better performance and higher accuracy. Meanwhile, the location and scale of the defects will be more accurate .also in this case of obtaining more types of strip surface defects deep learning method is further improved in detection accuracy.

Mohammed Waleed Ashour et al.[6] published a paper that titled, "Surface defects classification of hot rolled steel strips using multidirectional shearlet features" . a high discriminative feature extraction method called DST–GLCM was presented for accurate defects classification of teel strip surfaces. Our technique has shown an improvement in classification accuracy compared to other methods. Overall accuracy rate of 96.00% was reported using the proposed method, while accuracy rates of 92.88, 89.55 and
84.22% were achieved, respectively.

Shiyang Zhou (Huazhong university of science of technology) et al.[7] published a paper that titled, "Classification of surface defects on steel using CNN ". present an efficient tool combination, to categorize the surface defects of hot rolled steel products. Although the results

have been demonstrated in hot-rolled steel sheet, it may be suitable for other textured material such as wood, paper, plastic and fabric.

Zoheir mentouri et al.[8] published a paper that titled, "Steel strip surface defect identification baesd on statistical features ".the identification of surface steel defects reported different performance level.The obtained results demonstrate the applicability of the used descriptor in this field and show the efficiency and reliability of the proposed solution, what confirms its suitability for industrial application.

Yang Liu et al.[9] published a paper that titled, "A light weight deep learning model with multi scale features for steel surface defect classification". a light-weighted defect inspection method, named ConCNN, is proposed. ConCNN leverages the advantages of various image scales and a fusion strategy, for example, the images with a large scale improve the performance of small defect classification. ConCNN can be employed in both offline and online stages. In the online stage, ConCNN learns new incoming defect types in parallel, which further help to detect more defect types. Besides, it detects multiple types of defects accurately in real-time using a small number of training samples, which lessens the storage and labeling cost significantly.

Chao wang et al.[10] published a paper that titled, "Reasearch and classification of surface defects of hot rolled steel strip based on deep learning" . new combination of tools, where the recent BSIF descriptor, used, to date, in some biometric applications, is introduced and assessed in the description of the surface defect of hot rolled products. Further, data are processed by a combined reduction method to present an optimal features space that eases the classification task. This latter is performed with KNN classifier assuring an efficient defect identification with a low computational cost. Applied to a defect database which contains enough defects and defect variabilities, this tool combination outperforms the methods that dealt with similar defects , and even the one that used the same database as in our application.

M.graf and R. kawala [11] published a paper that titled, "Scale development on steel during hot strip rolling". a method for the identification of single scale properties independent of the raw material. So it is possible to describe these material parameters with suitable models. Additionally, the determined scale properties could validated with strip rolling experiments under industrial relations.The experimental results show that the scale keeps resisting to deformation without cracks dependent on temperature.

CONCLUDING REMARKS :

1. It gives higher defect detection rate than manual inspection.
2. It shows defect with classification.
3. It saves manpower and time.
4. Gives accurate and quick ressult
5. This inspection were generate to meet the customer demands and minimize the economical losses.
6. It detect not only pre-defects of strip but also the detect the defect which appear in actual rolling process.

CHAPTER-5

THEORY

THEORY:

Python is the most widely used programming language today. Python is an easy-to-learn, easy-to-debug, widely used, object-oriented, open-source, high-performance language, and there are many more benefits to Python programming. Python has been built with extraordinary Python libraries for data science that are used by programmers every day in solving problems.

Here's the libraries used for this project :

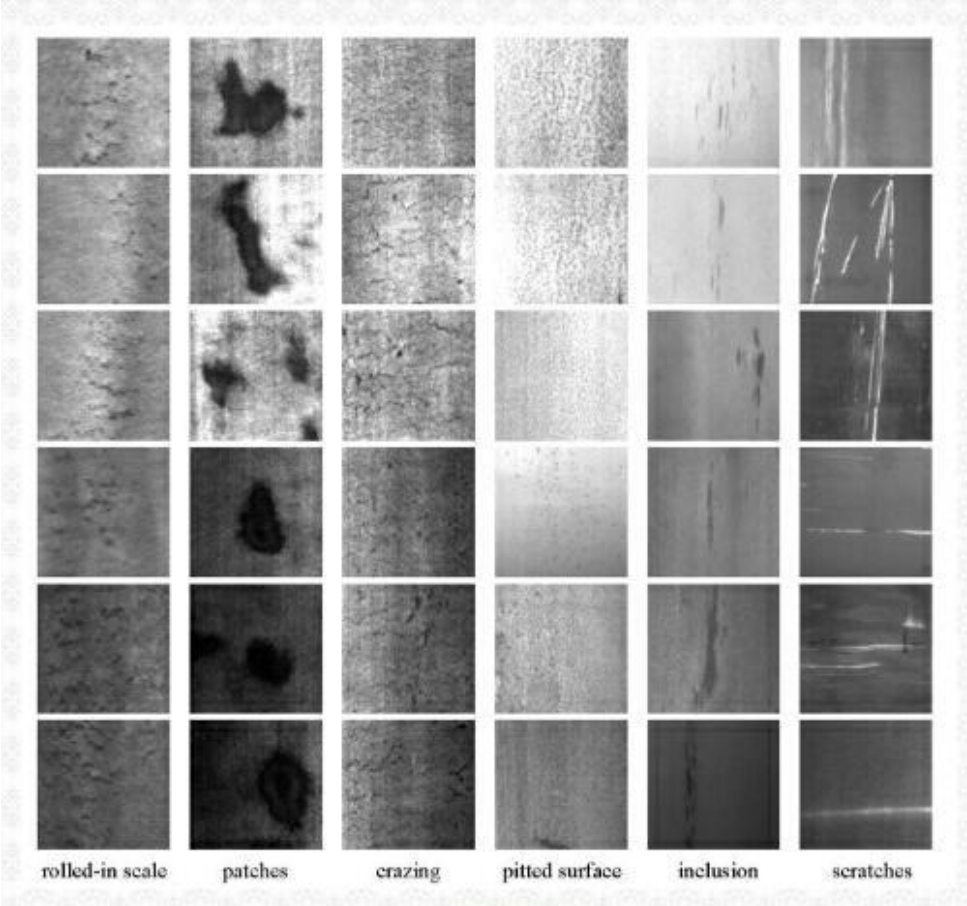
1. OS - The OS module in Python provides functions for interacting with the operating system. This module provides a portable way of using operating system dependent functionality. This modules include many functions to interact with the file system.
2. Numpy - It is the fundamental package for numerical computation in Python; it contains a powerful N-dimensional array object. It's a general-purpose array-processing package that provides high-performance multidimensional objects called arrays and tools for working with them. It Supports an object-oriented approach.
3. Pandas - It Contains high-level data structures and manipulation tools. It ETL (extract, transform, load) jobs for data transformation and data storage, as it has excellent support for loading CSV files into its data frame format.

4. Tensor Flow - Tensor Flow is a library for high-performance numerical computations. And it Reduces error by 50 to 60 percent in neural machine learning. It's used for image recognition.
5. Matplotlib - Matplotlib has powerful yet beautiful visualizations. It Visualize the distribution of data to gain instant insights. Low memory consumption and better runtime behavior.
6. Keras - Keras is another popular library that is used extensively for deep learning and neural network modules. It contains various implemented layers and parameters that can be used for construction, configuration, training, and evaluation of neural networks.

About Dataset

NEU Surface Defect DatabaseIn order to demonstrate the effectiveness of the feature extraction methods for defect recognition,a surface defect database named the Northeastern University (NEU) surface defect database is constructed. In this database, six kinds of typical surface defects of the hot-rolled steel strip are collected,Currently, the NEU surface defect database is a common dataset for steel strip defect classification. Many high-level studies have been conducted based on this dataset. Although NEU meets the needs of scholars to a certain extent; the effectiveness of the algorithm can be better verified with the complement of other datasets, and the experimental results on multiple datasets will be more convincing.
In addition, NEU contains a total of six types of defects and each type is balanced, all containing 300 images. i.e., rolled-in scale (RS), patches (Pa), crazing (Cr), pitted surface (PS), inclusion(In) and scratches (Sc). The database includes 1,800 grayscale images: 300 samples each of six different kinds of typical surface defects. Fig shows the sample images of six kinds of typical surface defects, the original resolution of each image is 200×200 pixels. From Fig. we can clearly observe that the intra-class defects existing large differences in appearance, for instance,the scratches (the last column) may be horizontal scratch, vertical scratch, and slanting scratch,etc. Meanwhile the inter-class defects have similar aspects, e.g., rolled-in scale, crazing, and pitted surface. In addition, due to the of the illumination and

material changes, the grayscale of the intra-class defect images is varied. In short, the NEU surface defect database includes two difficult challenges, i.e., the intra-class defects existing large differences in appearance while the inter-class defects have similar aspects, the defect images suffer from the influence of illuminationand material changes. It is verified and standard dataset. This dataset is approved by the manufacturing global-digital manufacturing platform and smart manufacturing community Mesa international.



CHAPTER -6

OBSERVATION AND RESULT

OBSERVATION:

The training of a CNN model from scratch requires a lot of data to get a good predictive model. However, often insufficient data is available, which requires complex techniques that can produce acceptable prediction results with less data.

RESULT:

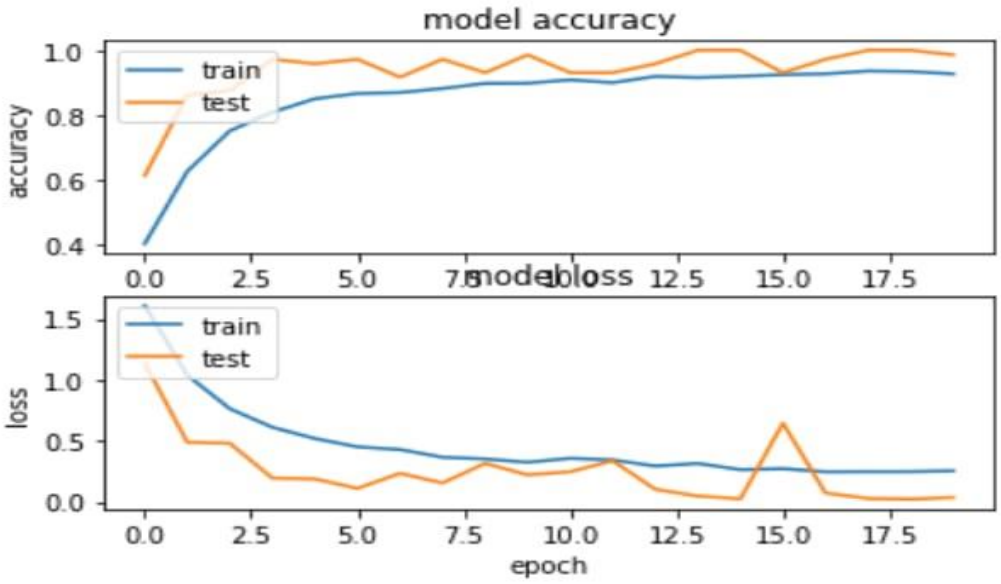

model accuracy
accuracy
train
test
model loss
loss
train
test
epoch

Fig.1

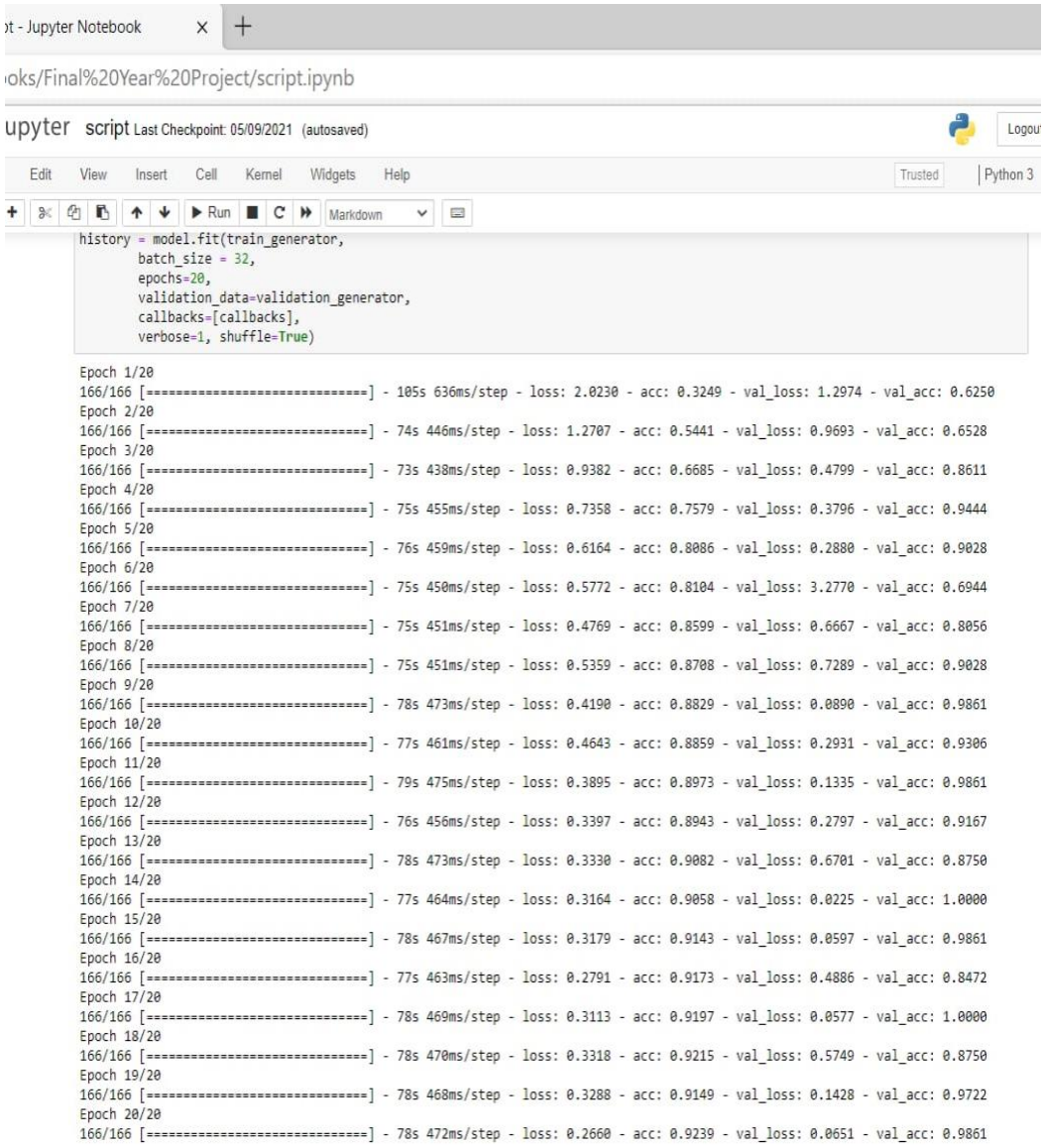
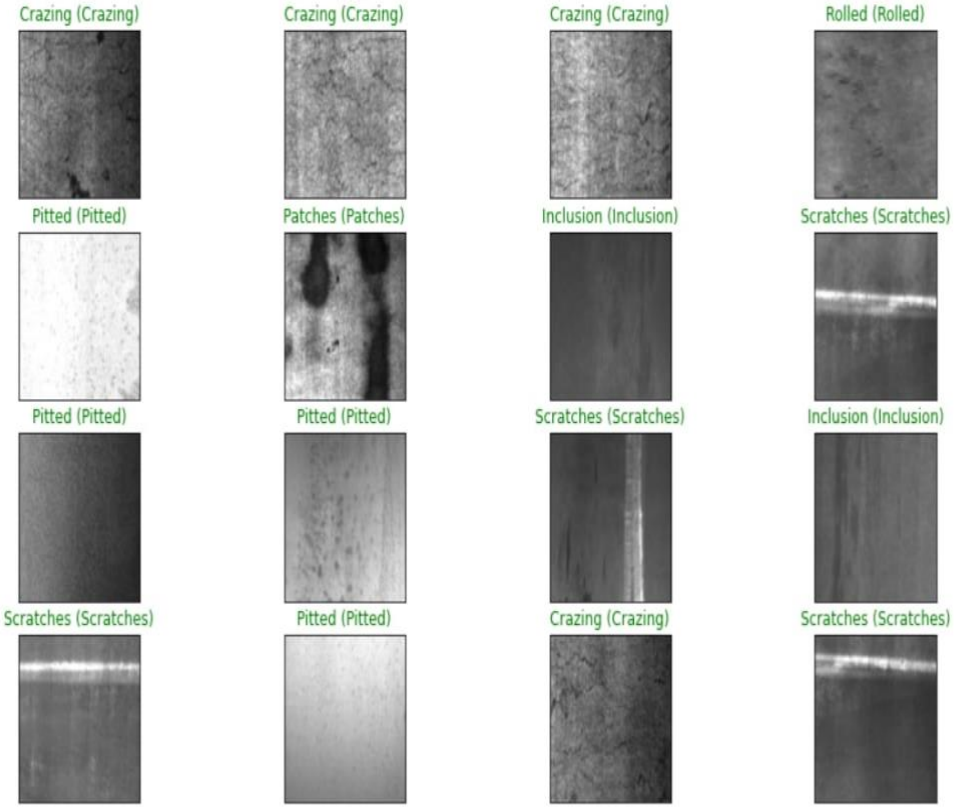

t - Jupyter Notebook
oks/Final%20Year%20Project/script.ipynb
upyter script Last Checkpoint: 05/09/2021 (autosaved)
Logou
Edit View Insert Cell Kernel Widgets Help
Trusted
Python 3
Run
Markdown
history = model.fit(train_generator,
batch_size = 32,
epochs=20,
validation_data=validation_generator,
callbacks=[callbacks],
verbose=1, shuffle=True)
Epoch 1/20
166/166 [==========] - 105s 636ms/step - loss: 2.0230 - acc: 0.3249 - val_loss: 1.2974 - val_acc: 0.6250
Epoch 2/20
166/166 [==========] - 74s 446ms/step - loss: 1.2707 - acc: 0.5441 - val_loss: 0.9693 - val_acc: 0.6528
Epoch 3/20
166/166 [==========] - 73s 438ms/step - loss: 0.9382 - acc: 0.6685 - val_loss: 0.4799 - val_acc: 0.8611
Epoch 4/20
166/166 [==========] - 75s 455ms/step - loss: 0.7358 - acc: 0.7579 - val_loss: 0.3796 - val_acc: 0.9444
Epoch 5/20
166/166 [==========] - 76s 459ms/step - loss: 0.6164 - acc: 0.8086 - val_loss: 0.2880 - val_acc: 0.9028
Epoch 6/20
166/166 [==========] - 75s 450ms/step - loss: 0.5772 - acc: 0.8104 - val_loss: 3.2770 - val_acc: 0.6944
Epoch 7/20
166/166 [==========] - 75s 451ms/step - loss: 0.4769 - acc: 0.8599 - val_loss: 0.6667 - val_acc: 0.8056
Epoch 8/20
166/166 [==========] - 75s 451ms/step - loss: 0.5359 - acc: 0.8708 - val_loss: 0.7289 - val_acc: 0.9028
Epoch 9/20
166/166 [==========] - 78s 473ms/step - loss: 0.4190 - acc: 0.8829 - val_loss: 0.0890 - val_acc: 0.9861
Epoch 10/20
166/166 [==========] - 77s 461ms/step - loss: 0.4643 - acc: 0.8859 - val_loss: 0.2931 - val_acc: 0.9306
Epoch 11/20
166/166 [==========] - 79s 475ms/step - loss: 0.3895 - acc: 0.8973 - val_loss: 0.1335 - val_acc: 0.9861
Epoch 12/20
166/166 [==========] - 76s 456ms/step - loss: 0.3397 - acc: 0.8943 - val_loss: 0.2797 - val_acc: 0.9167
Epoch 13/20
166/166 [==========] - 78s 473ms/step - loss: 0.3330 - acc: 0.9082 - val_loss: 0.6701 - val_acc: 0.8750
Epoch 14/20
166/166 [==========] - 77s 464ms/step - loss: 0.3164 - acc: 0.9058 - val_loss: 0.0225 - val_acc: 1.0000
Epoch 15/20
166/166 [==========] - 78s 467ms/step - loss: 0.3179 - acc: 0.9143 - val_loss: 0.0597 - val_acc: 0.9861
Epoch 16/20
166/166 [==========] - 77s 463ms/step - loss: 0.2791 - acc: 0.9173 - val_loss: 0.4886 - val_acc: 0.8472
Epoch 17/20
166/166 [==========] - 78s 469ms/step - loss: 0.3113 - acc: 0.9197 - val_loss: 0.0577 - val_acc: 1.0000
Epoch 18/20
166/166 [==========] - 78s 470ms/step - loss: 0.3318 - acc: 0.9215 - val_loss: 0.5749 - val_acc: 0.8750
Epoch 19/20
166/166 [==========] - 78s 468ms/step - loss: 0.3288 - acc: 0.9149 - val_loss: 0.1428 - val_acc: 0.9722
Epoch 20/20
166/166 [==========] - 78s 472ms/step - loss: 0.2660 - acc: 0.9239 - val_loss: 0.0651 - val_acc: 0.9861

Fig.2


Crazing (Crazing)
Crazing (Crazing)
Crazing (Crazing)
Rolled (Rolled)
Pitted (Pitted)
Patches (Patches)
Inclusion (Inclusion)
Scratches (Scratches)
Pitted (Pitted)
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Scratches (Scratches)
Inclusion (Inclusion)
Scratches (Scratches)
Pitted (Pitted)
Crazing (Crazing)
Scratches (Scratches)

Fig.3

CHAPTER -7

CONCLUSIONS

In the paper we present a simple model of CNNs to familiar task for the classification of surface defects of steel strip. Unlike existing methods, our approach achieves the dual goal of extracting features and designing the classifier simultaneously. Our study also encourages that no one technique can be classified as being the perfect machine learning technique. With experiments on the dataset of surface defects of steel strip, we demonstrate our approach. The experimental results show that with a small dataset and a small model, our approach is able to achieve moderate accuracy in the classification of surface defects of steel sheet, the average classification accuracy can be up to 98.9 %. can select some parameters, such as the number of layers, the size of the image and so on, depending on the trade-off between classification performance and computational load.

CHAPTER-8

REFERANCES

[1] Hai- Liang Yu,Kiet Tieu,Cheng lu,Guan-yu deng, Xiang-hua Liu, " Occurrence of surface defects on strips during hot rolling process" .Receivd 13 july 2012/Accepted :3 october 2012

[2] T.Koinov (University of chemical yechnology and metallurgy,Sofia, Bulgaria),I.mazur

(Lipestsk state technical university, Russia), "Quality control system for a hot-rolled metal surface". 2016.

[3]Xiaohong Sun,Jinan Gu, Shixi Tang and Jing Li, Research progress of visual inspection technology of steel products".received:15 september 2018, Accepted: 2 november 2018, Published : 8November 2018.

[4]Didarul Amin,Shamin Akhter (University of business agriculture and technology

Dhaka, Bangladesh), "deep learning based on defect detection system in steel surface",didardul38@gmail.com,7 june 2020.

[5] A. Jiangyun Li, B. Zhenfeng Siu,C. Jiahui geng,Yixin Yin, Real time detection of steel strip surface".2018,IFAC(International Federattion of automatic control)hosting by Elesevier ltd. All right reserved.

[6] Mohammed waleed ashour, k. Fatimah,Alfian abdul Halin,Lili N.abdullah, "Surface defects classification of hot rolled steel strips using multidirectional shearlet features" .
Arabian Journal for Science and Engineering ,Received :1 August 2017;Accepted :17 May 2018

[7]Shiyang Zhou ,Dailin Zhang(Huazhong university of science and technology),

"Classification "Classification of surface defects on steel using CNN ".

Wuhan,430074.Received :2015-11-30;accepted for publication :2016-01-07

[8]Zoheir mentouri ,Abdelkrim Mossaoui, Djalit boudjehem, Hakim donhmane,"Steel Strip Surface Defect Identification Based On Statistical Features",U.P.B.Sci.Bull.,Series B,Vol.80,Iss.4,2018

[9] Yang Liu ,Yachao,cristhian balta and Jing Liu."A Light-Weight Deep-learning Model with Multi-Scale Features for Steel surface Defect Classification ",Bremen Institute for Mechanical Engineering -bime,University of Bremen ,28359 Bremen,Germany;Institute of Computer Science ,University of Goettingen ,37077 Goettingen ,Germany.Received :7 sept 2020; Accepted:13 oct 2020;Published :16 oct 2020.

[10] Chao Wang,Yu ting liu,Ya-ning yang,xiang yu and Tao Zhang."Research on Classification of Surface Defects of Hot-Rolled Steel Strip Based on Deep Learning". College of Electromechanical Engineering ,Dalian Liaoning 116605,China. Control and Automation (ICA 2019).

[11] M.Graf,R.Kawalla,"Scale development on steel during hot strip rolling",La Metallurgia Italiana-n.2/2014

UNDERTAKING BY GUIDE:

Information given by student is correct and said facilities are available in this institute.

Miss .Chandanshive Pallavi Shashikant
(**Student)**
B.Tech (Mechanical Engineering)
AITRC VITA

Miss. Chavan Aarti Haribhau
(**Student)**
B.Tech (Mechanical Engineering)
AITRC VITA

Miss. Kale Pushpa Dnyaneshwar
(**Student)**
B.Tech (Mechanical Engineering)
AITRC VITA

Miss . Sutar Pradnya Dilip
(**Student)**
B.Tech (Mechanical Engineering)
AITRC VITA

Mr. U. Y. Siddha
(Guide)
Mechanical Engineering Department
AITRC VITA

(**HOD)** **(Principal)**

Date: / /2021

Place: Vita