International Journal of Advance Research in Science and Engineering
Volume No. 12, Issue No. 01, January 2023
www.ijarse.com
IJARSE
ISSN 2319 - 8354

MECHANICAL DEFECT DETECTION USING DEEP LEARNING

Ashutosh Chandrakant Patil, Vinay Anil Bhole, Rishikesh Sunil Mane, Chetan Ravindra Patil, Mr. Satyajit Diliprao Ghorpade

ashupatil1101@gmail.com vinayrajbhole@gmail.com rishikeshmane2020@gmail.com
chetanpatil8668@gmail.com satyajitghorpade@gmail.com
Department of Mechanical Engineering
NANASAHEB MAHADIK COLLEGE OF ENGINEERING,
Peth, Tal: Walwa, Dist: Sangli. 415 407

ABSTRACT

The detection of product defects is essential in quality control in manufacturing. This study surveys state of the art deep-learning methods in defect detection. First, we classify the defects of products, such as electronic components, pipes, welded parts, and textile materials, into categories.

Second, recent mainstream techniques and deep-learning methods for defects are reviewed with their characteristics, strengths, and shortcomings described.

The core ideas of study is related to high precision, high positioning, rapid detection, small object, complex background, occluded object detection and object association, are summarized.

In this work, we suggest a machine vision system for automating the inspection process for gears with defects. The implemented inspection system uses a faster R-CNN network to identify the defects, and combines sector knowledge to reduce the manual inspection of non-defective gears.

Keywords: Quality control in manufacturing, deep-learning, R-CNN network, rapid detection

1. INTRODUCTION

This study focuses on the detection of small objects in radiographs, specifically manufacturing defects. There are few studies available that directly compare various object detectors (e.g., SSD, YOLO, Faster R-CNN) against each other when tasked with defect detection in images. In addition to highlighting works related to tire defect detection, additional studies involving object detection within radiographs, and small object detection studies will be reviewed.

Current analysis of manufacturing defects in the production of Gears and inspection at an industry partner’s manufacturing plant requires that a quality control specialist visually inspect radiographic images for defects of varying sizes. For each sample, twelve radiographs are taken within 35 seconds. Some defects are very small in

International Journal of Advance Research in Science and Engineering
Volume No. 12, Issue No. 01, January 2023
www.ijarse.com
IJARSE
ISSN 2319 - 8354

size and difficult to see (e.g.cracks) whereas others are large and easily identifiable. Implementing this quality control practice across all products in its human-effort driven state is not feasible given the time constraint present for analysis.

2. DESIGN AND PROPOSED SETUP-

The conceptual framework adopted for the development, assessment, and iteration cycles of the deep learning models in this study is based off of the IBM® (2017) machine-learning 2 model creation workflow. The portions of this workflow in Figure 1 related to data acquisition have been omitted as Old Dominion University was provided the raw ground truth data.

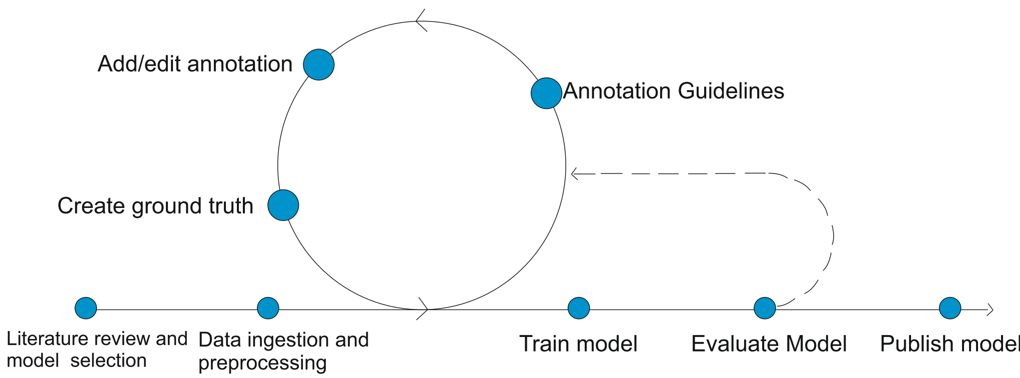

Figure-1

The general methodology used in the data preparation, data preprocessing, model configuration and performance evaluation of the Mobilenet SSD object detectors has been adopted from MathWorks (2022). A summary of this methodology is provided in Figure 2 The metrics utilized to assess model performance are further discussed in this chapter along with metrics improvement workflows and techniques.

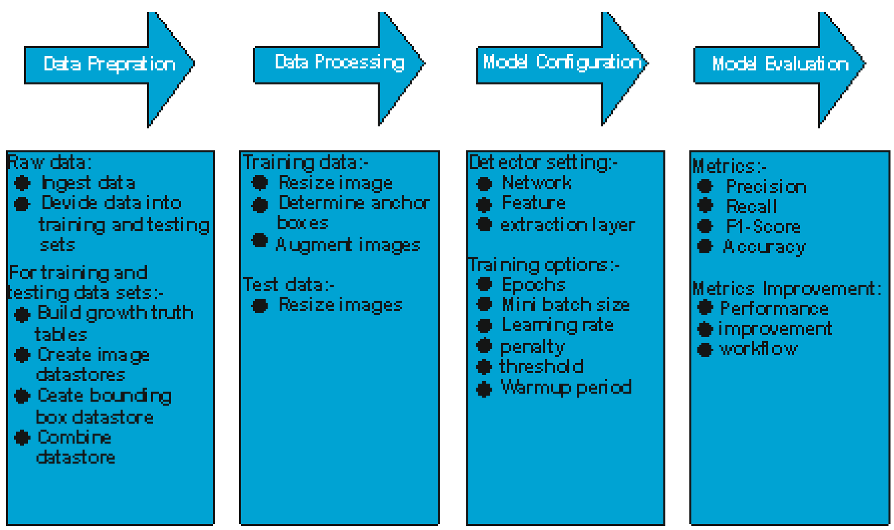

Figure-2

3. OBJECTIVES AND DISCUSSIONS-

The proposed work consists of following objectives

1. To reduce the human effort required for Quality check.
2. To show how to take out defects during this test.
3. To determine and expel damaged product in manufacturing strategy and survey of the product failure rate.

A existing literature on object detectors in a defect detection setting was conducted to aid in the selection process of the detector algorithm. Of focus were studies related to the inspection of radiographs in real-time. Additional consideration was given to studies where the performance of small object detection was characterized. Following the literature review, defect detection models were trained and assessed for performance. The object detector utilized in this study is Tensorflow with a Mobilenet SSD architecture.

4. CONCLUSION-

This study focuses on the detection of small objects in radiographs, specifically manufacturing defects. There are few studies available that directly compare various object detectors (e.g., SSD, YOLO, Faster R-CNN) against each other when tasked with defect detection in images. In addition to highlighting works related to tire defect detection, additional studies involving object detection within radiographs, and small object detection studies will be reviewed.

5. REFERENCES-

1. Anderson, J. (1995). An Introduction to Neural Networks. MIT Press, Cambridge, UK.
2. Bishop, C. (1995). Neural Networks for Pattern Recognition. Clarendon Press, Oxford, Birmingham, UK.
3. DLM (2002). Defect library manual, (Private communication).
4. Gonzalez, R.C., and Woods, R.E. (1992). Digital Image Processing. Addison-Wesley Publishing Company.
5. Gose, E., Johnsonbaugh, R., and Jost, S. (1997). Pattern Recognition and Image Analysis. Prentice Hall of India.
6. Haykin, S. (1999). Neural Networks. Pearson Education Asia.
7. IMPT (2002), Image Processing Toolbox, User's Guide (version 2), www.mathworks.com.
8. NNET (2002). Neural Network Toolbox User's Guide (version 3), www.mathworks.com.
9. MATLAB (2002). MATLAB 60 User's Guide, www.mathworks.com.
10. Rinn, R., Lorbach, N., and Lucking, F. (2002) First automatic surface inspection for hot strip mills. Parsytec Inc and Parsytec Computer GmbH. USA and Germany, www.parsytec.de.
11. Reich, Y., and Barai, S. V. (1999). Evaluating machine learning models for engineering problems. Artificial Intelligence in Engineering, Vol. 13, No. 3, pp: 257-272.