UNIVERSITI TEKNOLOGI MARA

MICRO-DEFECTS DETECTION ON METAL SCREW SURFACES BASED ON ALGORITHM OF FASTER-REGION CONVOLUTIONAL NEURAL NETWORK OVER INTERNET OF THINGS

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ABSTRACT

It is significant for most of the production process to develop efficient techniques in order to control products outcome. This is to ensure that the quality assurance of the products is reliable. The detection of defects in a product is one of the major production processes for quality control. The quality control process of metal screws uses much manpower for manual inspection at the manufacturing line. Manually inspecting screws of various sizes manufactured in large quantities is time-consuming. Therefore, this research proposes deep learning by implementing of Faster Region-based Convolutional Neural Network (Faster R-CNN) model for the micro defect detection on metal screw surfaces. In the meanwhile, the Internet of Things (IoT) has been identified as a suitable instrument for connectivity that enhances industrial operations with real-time monitoring; capable to provide data processing to control production quality. In this project, the defects that are considered are surface damage screw, stripped screw, and surface dirty screw. Webcam on laptop provide image in real-time is used for image acquisition of the metal screws with different types of defects. Then, the image collected is employed to train the Faster R-CNN. This programming is employed to communicate with Node-RED; as a visual tool designed for the Internet of Things (IoT) Network. The results of the experiment show that the detection accuracy of the model is 98.8%. The model also shows the superiority of Faster Region based on Convolutional Neural Networks (Faster R-CNN) in detection methods when compared with traditional machine vision techniques and Single Shot Detector (SSD Detector) model. The success of this research project in classifying the micro defect on metal screw surfaces facilitates the implementation of Industrial Revolution 4.0 (IR4.0) by the government in the manufacturing industry.

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CHAPTER ONE

INTRODUCTION

1.1 Research Background

Quality control is one of the most important processes in the production industry to ensure the quality of the products. Inspection of the product was a necessary step in the process to identify any defects in order to ensure that product quality is protected or improved. In the modern age, the development of technologies in the production process especially in automation systems has been widely utilized around the globe. The rise of automation in the production process also required an intensive quality control system to stay competitive in the industry.

The manual inspection performed by humans seems to have many problems, especially for large production and small product such as metal screws. The process will require much manpower and is very time-consuming. The quality control is done by humans also has a high tendency for error in inspection due to human fatigue and psychological. Therefore, to meet the demand for high-quality products, much research has been done in the automated quality control system to minimal human intervention.

There are three main factors to take into account when developing an automated quality control systems in the production industry environment which are the system accuracy, the system cost, and the system processing time in performing the inspection. One way for an automated inspection system is by integrating computer vision with the inspection system.

Object detection is a deep learning and image processing achievement that identifies and detects objects in images. Object detection is a computer vision approach that allows a software system to recognize, locate, and trace an object in an image or video. The special feature of object detection is that it detects the type of object. Object detection became significantly more common in the current generation with the development of Convolutional Neural Networks (CNNs) and the adaptation of computer vision technology. The applied methods for the system include the traditional template matching method and the implementation of deep learning.