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Application of Convolution Neural Network in Defect Detection of 3C Products

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Abstract: *Some uncontrollable defects will occur on the surface of metal work pieces during processing. The existence of surface defects not only affects the appearance of the finished product, but also affects the quality to a certain extent. Surface defect detection of metal work pieces can effectively improve product quality and production efficiency, and is an important link in the process of product quality control. Although there are many different types of surface defect detection methods, in the actual production process, due to the characteristics of multiple types and irregular distribution of the surface defects of metal work pieces, in most cases, manual inspection or simple machine inspection is still used to detect the surface of metal work pieces*.

Keywords: Defect.

I. INTRODUCTION

With the continuous improvement of science and technology, the intelligent, automated, and unmanned manufacturing industry will be an inevitable trend in the future.

[1]. As an important form of metal materials, metal workpieces are widely used in daily life and industrial production by virtue of their excellent mechanical and physical properties. In the production process of the product, due to the influence of equipment and technology, different kinds of defects often appear on the surface of the product, such as scratches, holes, and cracks in the metal workpiece.

[2]. The surface quality of metal workpieces not only affects the appearance and image of the product, but may also affect the functional characteristics of the product and cause significant losses to the enterprise

[3]. Therefore, it isvery necessary to detect the surface defects of the product, and it is particularly important to design a real-time and effective surface defect detection method for metal workpieces.

Machine vision inspection technology is constantly being used in inspections in various fields. Machine vision inspection mainly uses high-resolution industrial cameras to obtain images of specimens to be inspected, and uses digital image processing inspection algorithms to complete the inspection of defect

II. LITERATURE SURVEY

Zhang et al. (2020), a CNN model was developed for detecting defects in mobile phone screens. The model was trained using a dataset of 1,500 images, including 750 defect-free images and 750 images with different types of defects. The model achieved an accuracy of 98.75% in detecting defects, outperforming other traditional defect detection methods.

Similarly, Zhang et al. (2019), a CNN model was developed for defect detection in printed circuit boards (PCBs). The model was trained using a dataset of 1,600 images, including 800 defect-free images and 800 images with various defects. The model achieved an accuracy of 96.6% in detecting defects, demonstrating its effectiveness in PCB defect detection.

Wang et al. (2018), a CNN-based method was proposed for defect detection in LCD panels. The proposed method used a combination of two CNN models, one for defect detection and another for defect classification. The model was trained using a dataset of 13,584 images, including 3,024 defective images and 10,560 normal images. The proposed method achieved an overall accuracy of 97.8% in defect detection and classification.

Li et al. (2021), a CNN model was developed for defect detection in smartphone camera modules. The model was trained using a dataset of 8,290 images, including 4,145 defective images and 4,145 normal images. The model achieved an accuracy of 98.5% in detecting defects, outperforming other traditional defect detection methods.

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2.1 Objectives

The aim of this doctoral work is to develop image processing algorithms for product identification, defect detection and grading. For the purpose, it is also proposed to develop a specially designed product image acquisition setup. This aim is proposed to be achieved in the study by the following objectives

- Design and develop a robust machine learning algorithm for product classification.
- Design and develop a lab prototype system to acquire images of surface defects over the entire area of the product.
- Develop texture feature descriptors to discriminate defective and non-defective regions of the product
- Evaluate and validate the performance of the feature extraction algorithm and classifier results for unseen test data sets.
- Develop grading rules based on computation of effective cutting value of the product for objective product grading

III. METHODOLOGY

A pre-processing procedure is performed to enable more accurate classification as well as ensuring the image resolution corresponds to the expected size of input images in the network. Image Processing for a more detailed description of the implemented image processing algorithm. Once processed, the image is transferred to a classification network which attempts to determine if the product is defective or not.

3.2 SYSTEM ARCHITECTURE

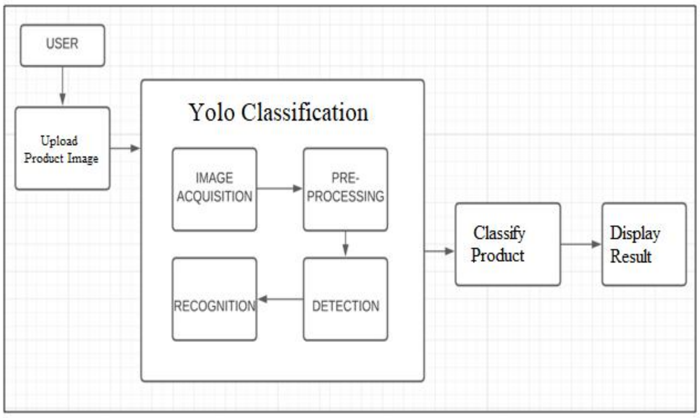

Fig 1.2 System Architecture

The system consists of 3 main stages:

Stage1: Acquiring the image of the product

It involves the capturing of the images of the product using camera. In this system we collected the number of database of product images that is good and bad quality images. These product image databases are helpful for more accurate result. So in this system we collected the camera as database and these images used as input i this system.

Stage 2: Detection process:

Choose an input image from collected database images. Product is detected by feature extraction process. The proposed methodology in this paper, to perform the analysis for image features extracts using following steps

1. Capture input images using camera and collect number of images as a database images. It includes good as well as bad quality images.

2. RGB image is converted to HSV color space. Then lower and upper ranges are defined. Then ranges of binary image are defined. Then convert single channel mask back into 3 channels.

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3. For extracts a colored object to detect the color, here we use HSV colorthresholder script to determine the lower/upper thresholds. HSV color space is also give the information about the image that is, it either present or not in this system.
4. Using by this input image we obtain the mask images. In mask image we get black and white colored image.

Stage 3: Detection of defective product:
Find out defective product is one of the most important preprocessing steps. The defective skin is calculated. A color image of the product was used for the analysis. If the pixel value is less than the selected threshold value then it is considered as a part of defective i.e. bad quality product. Any pixel value greater than the selected threshold value is a part of pure skin i.e. good quality product. The image is mask then pure part of the image indicated by black while the damaged ones white. Then the total number of white pixels are calculated which will be equal to the total number of pixels corresponding to damaged part

3.3 USE CASE DIAGRAM

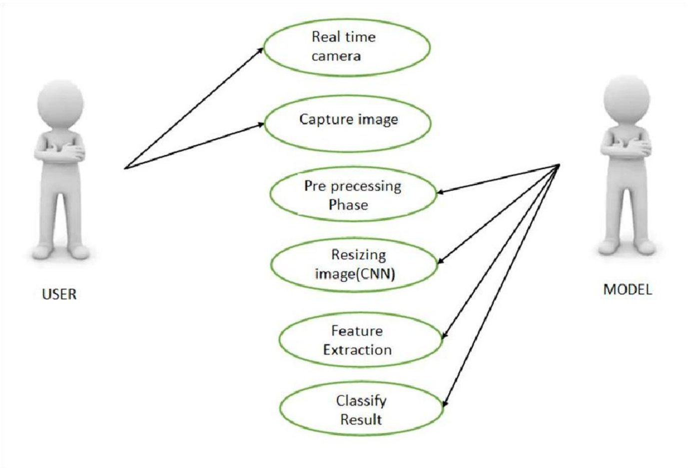

Fig.2.2 Use case diagram

IV. PROBLEM STATEMENTS

The suitability of deep learning models will be investigated for steel surface defect detection. The main challenge of this task is to establish a robust system with a limited number of samples In this project, we will analyze the performance of different neural network architectures and data augmentation strategies in order to classify and compare their performance when solving the main challenges previously exposed
To implement a deep learning model using CNN for defect detection on products
Input :Defective and non defective products images
Output : Device screen to display the results of defective products

V. CONCLUSION

In this project,a method to detect defect in products has been presents using image processing techniques.The method replaces manual inspection of the product section ,by automatic inspection.
A video camera can be installed in separate sections of the track to take images of the product section and then it can be input to the suggested system to defect any defect in the product section
This will help to detect defects immediately and reduce the possibilities of any mis happening.Since the system would be automatic and will require less intervension,the utmost efficiency of the system can be ensured.

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VI. GRAPHS

In summary, unsupervised learning can extract patternsand structures from raw data without additional information.The introduction of GAN, a defect detection species, solvesthe problem of lack of actual defect samples. There has alsobeen a major breakthrough in detection accuracy, which canreach . But while introducing GAN, the real-time performance of the model is not very ideal, therefore the real-time performance of the model needs to be improved

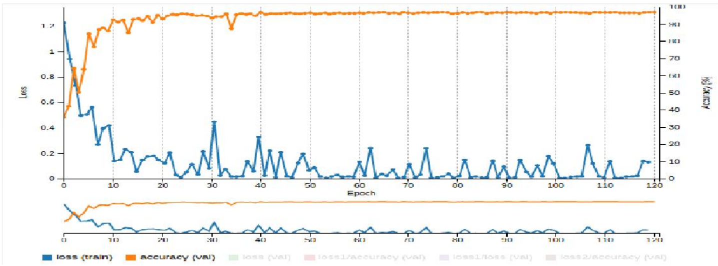

Fig.3 defect detection on phone screen

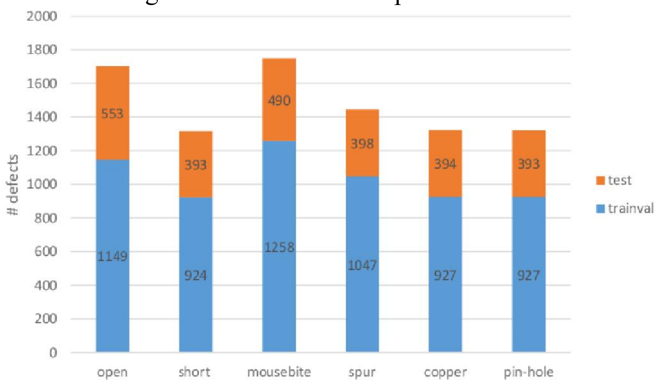

Fig.4 defect detection on PCB

VII. RESULTS

These results indicate that the CNN models can significantly improve the quality control process of 3C products, leading to higher customer satisfaction and reduced costs for manufacturers. Furthermore, the use of CNN in defect detection can reduce the time required for inspection and improve the reliability of defect detection, which can result in increased efficiency and productivity in the manufacturing process.

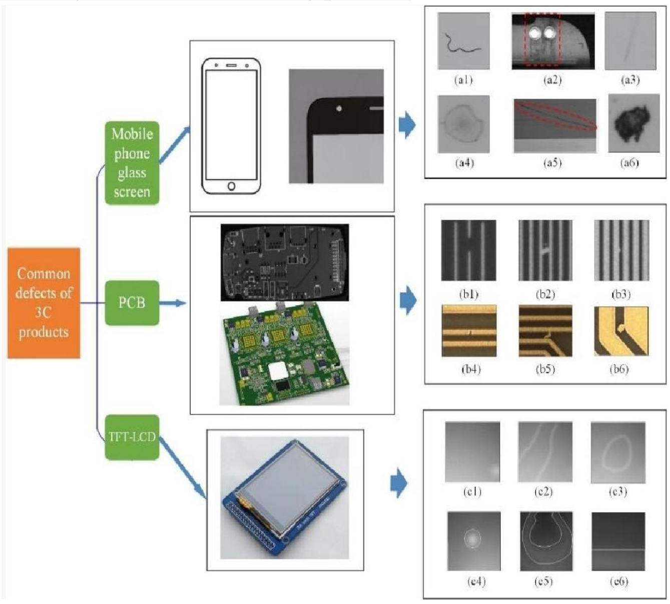

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Fig.5 Product defect samples :(a1) - (a6) are common defects of glass display screens, including cracks, floaters and point defects [11, 22]; (b1) - (b6) are common defects of PCB, including circuit break, connection, projection and crack [19, 23]; (c1) - (c6) are common defects of TFT-LCD, including dot color difference, uneven ring and uneven gravity [21,24]

VIII. FUTURE SCOPE

We hope that in the future, this model will be implemented with a much more efficient dataset for a specific piece of product or object that contains various information, and so on. So that no product or object is wasted by quality inspection and this system is more productive. We want this model to be used all over the world to help the growth of the Industrial sector. Both researchers and entrepreneurs may be interested in this field. In the future, we hope to create a cloud platform for all of the industries that will be using this model to share information all over the industries. This will let various industries in one country know about the prospect of product or object detection in another part of the world; down to a specific geographical unit.

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