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Electronic Circuit Assessment using Machine Learning (ML)

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Abstract : *Traditionally after installing all the electronics on the circuit board part, a worker make sure the circuits are working properly. Motive is to build machines that can replace the repetitive function of Human and Test Electronic Circuit Performance using Computer Vision which is one of the advancements using machine learning. Printed circuit board (PCB) testing has been a critical process in electrical production industry to ensure product quality and reliability, reduce production costs and increase production. PCB testing involves the detection of errors on a PCB and the segmentation of those errors to identify the roots of errors. The proposed algorithm is broadly divided into five categories, feature detection and feature classification. The algorithm is able to perform tests even if the image is captured rotating, measuring and translating according to a template that performs algorithm rotation, scale and translation they are different. The newness of the algorithm is still at the beginning of analyzing the feature with its unique appearance as well firmness. In addition to this, the algorithm only takes 2,528 s to scan a PCB image. Performance of the proposed algorithm is verified by performing experiments on various PCB images and shows that the proposed algorithms suitable for automatic PCB view testing*

Keywords – *Computer Vision, Defect Classifier, Machine Learning, Neural Network, Open CV, Printed Circuit Board, Python, Raspberry Pi, VGG16, YOLO.*

I. INTRODUCTION

PCB production is an important part of the electronics industry. The performance of a PCB depends largely on its quality and reliability. Defective PCB may result in unwanted circuit behavior and may have a defective product. As a result of this testing PCB is an important method in the electronics industry. The purpose of this testing program is to ensure 100% quality of all components, which is very expensive in production. Human operators are often involved in visual inspections of PCBs to detect and classify errors. This routine book review process is time-consuming, tedious, and flawed. Also, test results may vary from person to person due to personal incompatibility. The problem of quality control can be solved through advances in the field of computer vision. To make the PCB testing process faster and more reliable, automated testing (AVI) systems are very useful for industry.

II. LITERATURE SURVEY

II.I. Real-Time Image Processing Method Using Raspberry Pi for a Car Model

This paper outlines the design of a car model that can see the edge, line, and corner of a street image and also the model can see the red color of the robot image. The car model is equipped with a camera used for the purpose of detecting a computer. This photo is from a camera read using a Raspberry Pi single-board. Image processing algorithms are selected to detect the edge, line, angle, and color of traffic light traffic model. Algorithms are developed on the Simulink diagram block and embedded in the Raspberry Pi using the Rimberry Support Hardware Simulink Support Package. Embedded algorithms for finding line, edge, corner and red color of the robot will be tested. The test will be performed in real-time mode. Based on the test results, the embedded image processing algorithms can successfully detect line, edge, and corner of the road images, and detect the red color of traffic light image.

II.II. Implementation of Image Processing on Raspberry Pi

Today image processing is used in a variety of techniques, this paper offers the implementation of image processing in Raspberry Pi. The Raspberry Pi is a basic embedded and low cost single-board computer used to reduce the complexity of programs in real-time systems. This platform is based mainly on python. The raspberry pi contains Camera slot Interface (CSI) to connect the raspberry pi camera. Here, black and low contrast images taken using the Raspberry Pi camera module are enhanced to detect a specific image region. This concept is used in real-time MAV, MAVs are basically used to capture photos and videos with the Raspberry pi camera module. Because of its limited (small) credit card and low weight in construction. However, an image captured by MAVs will contain unwanted objects due to atmospheric conditions; which is why it is necessary to remove the noise present in MAVs images.

II.III. Raspberry pi based Intelligent Reader for Visually Impaired Persons

Human communication is based entirely on speech and text. So visually impaired people can collect information by voice. With the help of this project, visually impaired people can read the text in the captured image. In this Project we are using Raspberry Pi Camera and this help is taking pictures and that image is converted into a scanning image for further use using Image magic software. Magical image software extraction in the form of a scanned image this scanner provides as an application to Tesseract OCR (Optical Character Recognition) software to convert an image into text. Converting text into speech using the TTS (Text to Speech) engine. The test results show that the analysis of the various images taken and will be very helpful for blindness.

II.IV. Circuit Board Defect Detection based on Image Processing

Because the acquisition of a printed circuit board feature is slow, the base of the path is raised on the edge of the image, this method can quickly detect and detect an error on the circuit board. The algorithm incorporates the gradient correction features of the gray image on the edge of the image, the various defects different from the normal image and the feature image used to distinguish errors, and then identify the type of errors. Tests show that this method can detect short circuit, opening, burr, hole and other circuit board defects quickly.

II.V. Automatic Visual Inspection of Printed Circuit Board for Defect Detection and Classification

Printed circuit board (PCB) testing has been a critical process in the electrical production industry to ensure product quality and reliability, reduce production costs and increase productivity. PCB testing involves the detection of errors in the PCB and the separation of those errors in order to identify the roots of the defects. In this paper, all 14 types of disabilities are identified and classified into all classes that may be used using a different perspective. The proposed algorithm is broadly divided into five categories: Image registration, pre-processing, image classification, feature detection and feature classification. The algorithm is able to perform tests even if the captured image is rotated, measured and interpreted according to a template template that makes algorithm rotation, scale and translation vary. The newness of the algorithm is still in its infancy to analyze the feature in its unique appearance and durability. In addition to this, the algorithm only takes 2.528 s to scan a PCB image. The performance of the proposed algorithm is verified by performing tests on various PCB images and indicates that the proposed algorithms are suitable for automatic PCB viewing testing.

II.VI. Defects Detection in PCB Using Image Processing for Industrial Applications

Printed Circuit Board (PCB) is used to connect different electrical appliances placed on it using methods or tracks. Printed circuit board (PCB) testing is a method used to combat complications that may arise during human testing. In this way, we start by comparing a typical PCB image with a PCB image, using a simple removal algorithm that can highlight major problem areas. We also see the effect of noise on the PCB image of how satisfying this approach is to get the wrong image. Finally, segmentation is used to analyze the source of the four types of errors namely, missing hole, pin hole, short circuit, and open circuit.

II.VII. You Only Look Once: Unified, Real-Time Object Detection

We are introducing YOLO, a new discovery method. Pre-discovery function restores classifiers to perform detection. Instead, we detect object detection as a retraction problem in 8 separate bound boxes and corresponding phase possibilities. A single neural network predicts bounding boxes and class opportunities directly from full-blown images in a single test. Since the entire acquisition pipe is a single network, it may be configured to end at the end of the acquisition operation. Our combined construction is extremely fast. Our basic YOLO model processes real-time images at 45 frames per second. The smaller network type, Fast YOLO, processes 155 frames per second while accessing a duplicate map of other real-time machines. Compared to modern art acquisition programs, YOLO makes many local performance errors but very little chance of predicting false positives. Finally, YOLO reads the most common submissions of items. It surpasses other acquisition methods, including DPM and R-CNN, where it is made from natural images to other domains such as graphics.

II.VIII. High Level Computer Vision Using OpenCV

This paper outlines some of the most advanced topics in image processing and computer visualization, such as Principal Components Analysis, Matching Techniques, Mechanical Learning Methods, Tracking and Light Flow and Parallel Computer Vision using CUDA. These ideas will be presented using the open CV library, which is a free computerized C / C ++ program library available for Windows, Linux Mac OS and Android platforms. These topics will be discussed not only in terms of theoretical aspects but also practical examples will be presented to understand how and when to use each one.

II.IX. METHODOLOGY

Building a product that automates both reference and non-reference methods may not cut down on storage and computational requirements, but if the manual detection and classification errors are reduced we gain massively from the increased and reliable throughput.

III.I. Making Defect Classification Possible

While we can try to train our deep learning model to differentiate existing flaws across the board, this can be a challenge. Check the PCB test boards with the following templates: The board on the left is what our model needs to separate. We can identify each defect by comparing it to a template. But how likely is it that our model will be able to reliably distinguish a combination of errors? What will the class be called? How many different combinations of features are there?

To reduce the burden placed on our model we will start by removing each defect in the test image. This can be achieved by creating a different image and extracting different parts of the image. To reduce the burden placed on our model we will start by removing each defect in the test image. This can be achieved by creating different image and extracting different parts of the image.

Note that errors are highlighted in red. The picture does not show all the shortcomings because in this article we are concerned with extracting only 3 variants. Capturing some of the most flawless types of errors, and I'll discuss this later. Since we have a separate image that emphasizes errors in the test image we can also use image processing to extract the colored parts of the image:

This greatly reduces the burden placed on our in-deep learning classifier . By removing each defect, we are transforming the problem from a complex recognition problem into a digital identity (a problem that already works well with in-deep learning). This also means that we are more likely to be successful in using transfer learning, because there are more successful models in the OCR space.Since we have a differenced image that highlights the defects in the test image we can also use image processing to extract the colored parts of the image:

This dramatically lowers the burden placed on our deep learning classifier. By extracting individual defects, we convert the problem from a complex recognition problem into something akin to digit recognition (a problem that already works well with deep learning). This also means we are more likely to be successful using transfer learning, since there are numerous successful models in the OCR space. I will discuss transfer learning in more detail later on.

IV. Tools Used

IV.I. Hardware used in the project

IV.I.I. Raspberry Pi 4 Model B+

Raspberry Pi is a series of small single-board computers manufactured in the United Kingdom by the Raspberry Pi Foundation in partnership with Broadcom. Initially, the Raspberry Pi project focused on promoting the teaching of basic computer science in schools and developing countries. Later, the original model became much more popular than expected, selling out the target market for robotic applications. It is now widely used in many areas, such as climate monitoring, because of its low cost, orderliness, and open construction.

After the release of the second type of board, the Raspberry Pi Foundation established a new organization, called Raspberry Pi Trading, and appointed Eben Upton as CEO, with the task of developing technology. The foundation was rededicated as an educational grant to promote the teaching of basic computer science in schools and developing countries. Sold units of Rasperry Pi. The Raspberry Pi is one of Britain's best-selling computers. Since December 2019, more than 30 million boards have been sold. Most Pi's are made in the Sony factory in Pencoed, Wales, [23] and some are made in China and Japan.

IV.I. II. Raspberry Pi Camera

The Raspberry Pi Camera Module v2 replaced the original Camera Module in April 2016. The v2 Camera Module has a Sony IMX219 8-megapixel sensor (compared to the 5-megapixel OmniVision OV5647 sensor of the original camera) It attaches via a 15cm ribbon cable to the CSI port on the Raspberry Pi.

IV.I.III. CNC MACHINE (Computer Numerical Control)

CNC machining is the most commonly used word in manufacturing and industrial applications, but what exactly is the CNC abbreviation represented and what is a CNC machine.

The term CNC stands for 'computer numerical control', and the definition of CNC machining is that it is a complex manufacturing process that often uses computer controls and machine tools to remove layers of material from a stock - known as an empty object or object - and produces a custom component. The process is suitable for a wide range of materials, including metals, plastics, wood, glass, foam, and composites, and is widely used in various industries, such as large CNC machining systems and CNC parts for aerospace machinery. Speaking of machinery itself, the definition of a CNC machine is that it represents a real structured machine capable of performing CNC machining operations independently. Note the difference between the process (CNC machining definition) compared to the machine (CNC machine definition).

Attractive production processes, such as CNC machining, are often presented in contrast to complementary production processes, such as 3D printing, or creative production processes, such as shaping liquid injection. While the extraction processes remove the layers of an object from the work to create the shape and form, the addition processes incorporate the layers of material to produce the desired form and the building processes disable and remove the stock asset in the desired condition. The CNC machining automation environment enables the production of high precision and high precision, simple components and cost-effectiveness in achieving single and medium run runs However, while CNC machining shows certain advantages over other manufacturing processes, the level of complexity and complexity achieved in construction of part and the cost-effectiveness of producing complex parts is limited.

IV.I. IV. Conveyor Belt

Conveyor Belt is a carrying medium of conveyor belt system (usually shortened to a conveyor belt). The conveyor belt system is one of many types of transport systems. The belt conveyor system consists of two or more pulley (sometimes called drums), with a closed loop handle a moving belt around them. One or both pulleys are powered, moving the belt and the forward . The powered pulley is called a drive pulley while the weak pulley is called an idler pulley. There are two main categories of belt conveyor industries; Those who carry common equipment such as those boxes that move inside the factory and handle large quantities of goods such as those used to move large quantitie .

IV.II.Software used in the Project

IV.II.I Python

Python is a translated, high quality and common programming language. The Python architecture philosophy emphasizes the readability of the code with its remarkable use of the white space. Its creative language and goal-oriented approach aims to help editors write clear, logical code for small and large projects. [28] Python typed harder and collected garbage. It supports a wide range of editing paradigms, including structured (especially, process), object-focused, and efficient. Python is often described as a "battery-powered" language because of its standard library. [29]

Python was created in the late 1980s, and was first released in 1991, by Guido van Rossum as a language supporter of the ABC program. Python 2.0, released in 2000, introduces new features, such as inventory comprehension, and a trust-based garbage collection system, and has been broken down

2.7 by 2020. [30] Python 3.0, released in 2008, was a major revision of a completely incompatible language and many of Python 2's functional code could not be modified in Python 3.

IV.III Model Used

IV.III. I. YOLOv4

Most accurate modern models require multiple GPUs for training in large mini-batch sizes, and doing this with a single GPU makes training slow and inefficient. YOLO v4 addresses this issue by making an untrained object detector on a single GPU with a small mini-batch size. This makes it easy to train a very fast and accurate detector with a 1080 Ti single or 2080 Ti GPU.

YOLO v4 gains technical results at real-time speeds in the MS COCO database with 43.5% AP running at 65 FPS with the Tesla V100. Great results! To achieve these outcomes, they include other factors such as Weighted-Residual-Connections (WRC), Cross-Stage-Partial-connections (CSP), Cross mini-Batch Normalization (CmBN), Self-adversarial-training (SAT) and Mish performance, Mosaic data addition, DropBlock implementation, and CIoU losses. These are called global features because they should work independently in computer viewing functions, data sets and models.

IV.III. II. VGG16

The ImageNet Large Scale Visual Recognition Challenge (ILSVRC) is an annual computer viewing competition. Each year, teams compete for two jobs. The first is to find objects within the image from 200 classes, called object localization . The second is the image classification, each with a single label of 1000, called image classification. VGG 16 was nominated by Karen Simonyan and Andrew Zisserman of the Visual Geometry Group Lab of Oxford University in 2014 in the paper "VERY DEEP CONVOLUTIONAL NETWORKS FOR LARGE-SCALE IMAGE RANNNITION". This model won first and second place in the above categories in the 2014 ILSVRC challenge.

V. FIGURES AND TABLES

FIG I. Raspberry pi model4 b+

FIG II. Arduino uno development board

FIG III. Raspberyy camera module and lens

FIG IV.Center (plane and threaded shaft couplers)

FIG V. Plane shaft

FIG VI. Threaded shaft and movement couplers

FIG VII. Stepper motor driver with heat sink

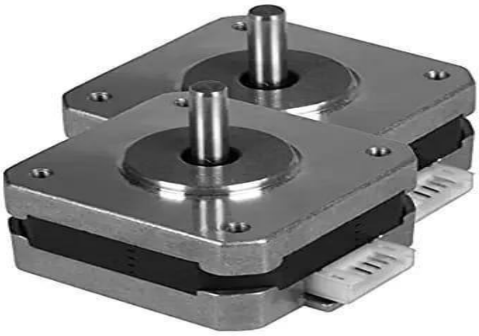

FIG VIII. Stepper motor (circular shaft and 2.5 kg torque)

VI. CONCLUSION

While checking any circuit by human it is possible to get an error ,since our device is completely work on AI the possibility of error is decreases and it can work precisely it can check product in bulk therefore the manpower and price of products also decreases.

It reduces the time with increases in accuracy and efficiency because of this the quality increases and reduce cost of worker.

Hence, because of this we can manufacture good quality in less time.

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