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Development of PCB Defect Detection System Using Image Processing With YOLO CNN Method

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ABSTRACT

Abstract– Inside the equipment there are many electronic components such as resistors, transistors, capacitors and so on. When used in the production of electronic equipment, PCBs are very influential in the manufacture of these electronic devices, for example, when there are only a few broken or damaged PCB paths, the electronic device cannot be operated properly. So it is very important in the PCB Quality Check process to check whether there is damage to the PCB or not. Usually in PCB inspection only direct checking is used in the conventional way. Therefore, in this study, the author tries to create and analyze a PCB flaw checking tool with the help of a camera that has a high revolution to replace human vision to make it easier and save costs. The application of this PCB checking tool uses a technology called a laptop and a camera. With these two technologies, Image Processing can be used to detect objects using the OpenCv and Tensorflow libraries. PCB flaw detection tool with the help of Image Processing with the YOLO Convolutional Neural Network method to help determine broken paths and drill holes on the PCB

I. Introduction

PCB is a board used to connect electronic components with a layer of conductor paths usually using copper. The conventional PCB manufacturing process is carried out with several basic stages, namely the copper line design stage and the PCB etching stage. The matching stage is the process of removing unwanted copper from the PCB board (Pradhana, et.al, 2008). According to (Nurmala, 2020), entitled "Printed Circuit Board (Printed Circuit Board) Defect Detection Design Based on Image Processing" said that PCB defect detection is only based on broken paths, while PCB defects can be caused by overlapping paths or pods/vias that not drilled yet.

Therefore the author will conduct research to make a PCB flaw detection tool with the help of Image Processing with the YOLO Convolutional Neural Network method to help determine the broken path and drill holes on the PCB.

II. Methods

The problem identification stage is the initial stage in the implementation of research so that it can be identified problems and objectives to be achieved. The contents of the initial identification stage consist of several steps, namely:

A. Problem Identification

In making this research, it was taken from the needs of PCB companies about the latest innovations to be able to carry out PCB inspections.

B. Determination of Problem Formulation and Research Objectives

The formulation of the research problem is how the system works to detect broken PCBs. Based on the formulation of the problem, the purpose of this research is to be able to make a suitable PCB defect detector.

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C. Literature Study

This Research is collected and studied from various relevant and reliable sources in order to produce more complete, directed, and accountable information.

D. System Concept

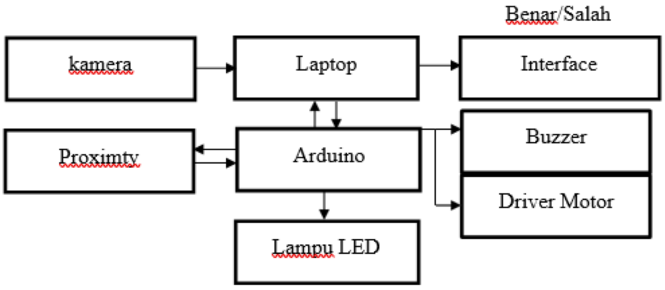

Figure 1 Diagram System

The system is designed using a camera as an image input, then the PCB is placed on a running conveyor, when the PCB enters the detection zone, the conveyor will stop and then continue to take pictures by the camera. The input image is processed on a computer using the yolo cnn method, the output results in the form of detection of damage to the PCB path which will be displayed on the interface.

E. Image Processing

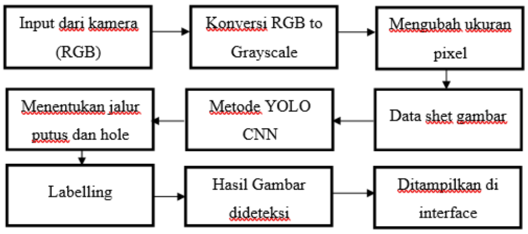

Figure 2 Channel Image Processing

The input image is processed and prepared on a computer using the yolo cnn method, the output results in the form of detection of damage to the PCB and hole drill break lines that will be displayed on the interface

F. Mechanical Design

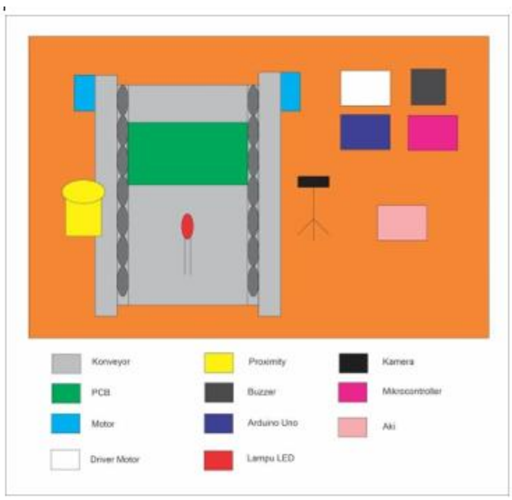

Figure 3 Mechanical Design

In Figure 3 is an overview of the mechanical design in this study, with details of the PCB being in the middle and there are clamps on the right and left. Conveyor 2 pieces placed right and left. The buzzer is on the left, the proximity is on the right and the LED light is in the middle. At the bottom of the conveyor there is a motor driver to drive the conveyor.

Figure 4 Hardware Design

III. Result and Discussion

A. Hardware Design

The following are the results of testing the level of accuracy and error on each component used in this research.

B. Camera Test

In this research, the author uses a webcam as the main sensor that is able to detect PCB defects and retrieve images to be processed on a laptop using the YOLO CNN method. The type of webcam used is the Logitech 922 pro.

C. Hardware Design (Real)

The hardware in this research is arranged in such a way as to maximize PCB detection. In Figure 4.3 the webcam will be placed as far as 0.5 meters from the conveyor so that the PCB can be seen and can be taken pictures. For the background, a plain color is chosen in order to reduce the level of noise detected and also to balance the lighting contrast with the detected object.

D. Software Test Result

The software testing phase includes testing the performance of the YOLO CNN method, real-time detection testing, and interface testing. In each test using a laptop with the following specifications.

1) Result of CNN YOLO Method Perfomance Test

In performing the performance test, it takes a dataset that has been annotated but hasnever been used as training data. In the training stage, there are several images that have been labeled according to the object name. As for the training model used is YOLO CNN with the model using the same configuration that can be seen.

2) Real-Time Detection Test Result

There are 30 broken and nondrill PCB pictures, explained how the number of broken PCBsis a total of 35 broken lines with the lowest error result of 5.71% and the highest error result is 22.85%, then further explains about non-drilled PCB pictures, namely a total of 27non-drilled with the result the lowest error is 0% and the highest error result is 11.11% First Try.

There are 30 broken and nondrill PCB pictures, explained how the number of broken PCBsis a total of 35 broken lines with the lowest error result of 0% and the highest error result is 2.85%. the lowest and highest error is 3.7% Second Try.

IV. Conclusion

A. Conclusion

Based on the results of the tests that have been carried out in this Research which were obtained from the system testing that has been made, it can be concluded that;

1 The results of detection using the You Only Look Once (YOLO) method have maximum results. From the detection results PCB break it was detected that the highest error data was 22.85% with a success percentage of 77.15%, then Non- drill PCBs were detected that the highest error data was 11.11% with a success percentage of 88.89%.

2 Detection results using the You Only Look Once (YOLO) method have maximum results. From the detection results of PCB break it was detected that the highest error data was 2.85% with a success percentage of 97.15%, then Non-drill PCBs were detected that the highest error data was 3.7% with a success percentage of 96.3%.

3 In running the You Only Look Once (YOLO) program by providing an output in the form of an image, when it detects a broken or non-drilled PCB.

B. Sugesstion

Based on the experiments that have been carried out, there are several suggestions to continue and improve the shortcomings that exist in this Research, namely;

1. Increase data in each class to increase the level of accuracy in each class to be more responsive when detecting PCBs.

To increase the success of the system, it is very important to pay attention to the placement of the tool, especially the distance and angle position of the tool

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