International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 06 Issue: 11 | November - 2022 Impact Factor: 7.185 ISSN: 2582-3930

MACHINE VISION AND IMAGE PROCESSING BASED DEFECT DETECTING USING RASPBERRY PI

Prof. Pradeep. S. Togarikar [1], Vishal T Pardeshi[2], Vaibhav B Kavade[3], Swapnil B Gajare[4], Harshada S Kawade[5],

[1,2,3,4,5] SB patil college,indapur E& TC

Abstract: -

The manufacture of printed circuit boards involves various steps such as structuring, etching, drilling , masking and printing labels. Shorts between traces and pads, open circuits, and various defects can occur during the manufacture of PCB hardware. This white paper resents his unique technique for identifying defects in PCBs using image processing and image processing techniques. The system reduces PCB inspection time and improves accuracy even when the image scale is different with respect to the reference image. The proposed automated PCB inspection system significantly reduces the time taken to detect defects. Accurate results speed up the inspection process and help improve productivity. Easily identify opens and shorts, as well as detect wire gaps, voids, flaws and defects. This automatic inspection system can be introduced at low cost. Smaller industries can adopt this system to reduce inspection time and minimize errors.
Keywords — Circuit Boards, Fault Detection, Vision, Raspberry Pi, Machine Vision, Sensors, Cameras, etc.

1.Introduction:

A printed circuit board (PCB) is a printed circuit board used prior to the component assembly and soldering process. Used with other components to manufacture electronic products. During the manufacture of printed circuit boards, manufacturing defects such as dust, over-etching, under-etching, and false metal can cause variations in the width of insulators and conductors. Etching is the process of subjecting a copper circuit board to a "stripping" process to wash away the remaining copper background while preserving the circuit layout. To minimize scrap due to PCB etch mistakes, inspection should be done early. To reduce manufacturing costs associated with defective bare PCBs, bare PCB inspection is required as the most critical step in the manufacturing process.

This project is primarily motivated by the need for more efficient techniques for PCB board inspection in the PCB manufacturing process. Typically, several operators are stationed at each station to manually inspect the PCB panels. This technique is not economical in the long run as it requires a lot of man-hours. Additionally, people are more prone to errors, especially when they are tired.

Also, it is impossible to inspect the entire board panel everywhere without delay. Instead, printed laminates are scanned at specific quantity intervals for manual inspection. As electronic circuit technology advances, PCB patterns become denser and more complex, enabling smaller end products. This eliminates the need for manual control. On the other hand, image processing devices are becoming more sophisticated and cheaper due to faster computers, larger capacities, and lower costs.

2. LITRATURE REVIEW

Manasa HR [1] All introduces the detection of missing components on a PCB, verifies the physical dimensions of the components, and extracts detailed control sheets. In this current work LabVIEW NI Vision software was used to implement PCB inspection. Namita,Kalyan, Shindeetal.

[2] introduce an image subtraction algorithm to the PCB template image and his PCB image under inspection to detect PCB defects. Extract structural features based on regional properties such as perimeter, area, and orientation to obtain defect details. S.Sridevi et al.

[3] devised a new technique to identify such defects using image processing and image processing techniques. The system reduces inspection time and improves accuracy even if the image scale changes with respect to the reference image. There is no need to maintain a constant distance between the camera and the circuit board. The result of applying this technique to the PCB layout and the actual image are shown. Subhashini A, et al. [4] is typically implemented on reference and test PCB images to detect defects on

bare her PCBs before the etching process, as etching contributes to the most destructive defects on her PCBs. We present a survey of different approaches. First, a standard PCB image is compared to a test PCB image using a simple subtraction algorithm that can highlight key problem areas.
Observable defects include over etching (openings), under etching (shorts) and holes. Malge P.S. et al. [5] Automated visual inspection of printed circuit boards (PCBs) is an approach used to address the difficulty of manual inspection by humans, eliminating the subjective aspects and providing rapid, quantitative We can provide a dimensional evaluation. A printed circuit board (PCB) is a fundamental part of many electronic devices. The quality of printed circuit boards has a great impact on the performance of many electronic products. Much research is currently focused on the detection and classification of defects in printed circuit boards. Over the past two decades, numerous approaches to automated visual inspection of printed circuit boards have been reported. This study explores different algorithms and techniques. An overview of commercially available PCB inspection systems is also provided. Mohit Borthakur etal. [7] examines all error detection algorithms developed to date and
analyzes their shortcomings, thereby providing the optimal approach for detecting the largest error with greater accuracy and speed. announced. This approach uses morphological image segmentation algorithms and simple image processing theory.
The specified algorithm can overcome any PCB defects such as missing components, broken traces, and misplaced components. Fenglin Guo, et al. [9] The development of a board defect inspection system by image processing aims to meet the need for high speed and high precision in the board manufacturing industry, which is a combination of software and hardware. This document first introduces the structure of the overall system and the principles of vision detection, describes the relevant key technologies used in PCB defect inspection, and finally presents a series of techniques using the key technologies mentioned. Implemented a test system. Experimental results show that defects in circuit boards can be effectively inspected, located, and detected by leading technologies. Professor Ruchir V. Nandanwar et al. [8] planned to develop a PCB verification system based on automated visual inspection (PCB). In this system, a camera autonomously scans the circuit board under test and uses image processing algorithms to classify faults as catastrophic faults (such as conductors). Quality defects, also called critical defects and latent defects (e.g. wrong size hole). Because it is a non-contact testing technology, it can be used during the manufacturing process and implemented at multiple tages of the manufacturing process, including bare board inspection, post component placement, and other stages.

3.Problem Statement

- Mainly focused on the industrial application
- It is estimated that 15 percentage production in the industry is defective dueto various reasons according to the Harvard business report. It will impact the company-customer relation, and if such products are delivered to the customer. So, it is essential to sort out these products .
- Industry needs a system that can categorise the defective products separatelyin the production line and can give the efficiency of the production.

4.Block Diagram

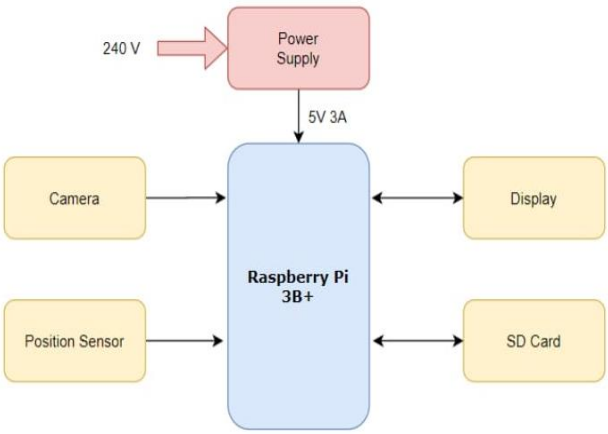


Fig.: - block diagram

The raspberry pi is the main block diagram as shown in the block diagram. The Raspberry Pi is the main control unit for the entire system.
The system shown in System is a position sensor that is also connected to the controller. The camera is also one of the main parts of the system and is connected to the control unit. This is the camera used to capture the image of the PCB at the location of the control unit

throughout the system detected by the PCB. As shown in the system, this system has one of the main parts of the system, the camera, connected to the control unit. This camera is used to capture an image of the PCB at the board position. Detected PCB

Circuit diagram

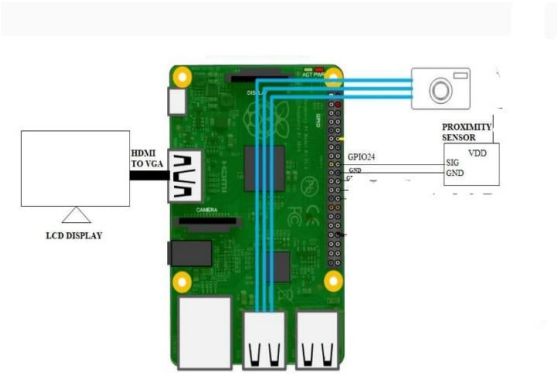


Fig.:-Circuit diagram

The circuit of this PCB defect detection system is very simple. Here we use an LCD monitor to view the defective areas on the PCB. The display is connected to the Raspberry Pi via an HDMI to VGA converter cable. The Pi Camera Module plugs into the Raspberry Pi's camera slot. The proximity sensor is connected to GPIO pin 24 on the Raspberry Pi.

⎫ To detect boards on the conveyor, bind a proximity sensor connected to the Pi's GPIO 24 pin.

⎫Connect a camera to the Raspberry Pi's USB port to capture an image of the PCB.

⎫ Connect the display to the Raspberry Pi's HDMI port

4.WORKING OF SYSTEM

There are several steps to using image processing to detect defects in bare PCBs. First, when a position sensor detects her PCB under the camera, it sends a signal to the control unit, which is Raspberry Pi. a This control unit then sends it to the system to collect an image of her PCB via a camera. The collected images are enhanced by image processing and binaries. After a special image recognition and analysis process, the image should be compared with the original image. This allows you to accurately find common defects such as shorts, open circuits, burrs, scratches, voids, and other defects. Finally, recognition results are collected and reported. If no defects are found on the circuit board, the control unit sends a start signal to the DC motor. If the system detects a defect, the display will indicate the defective circuit board area with a message.

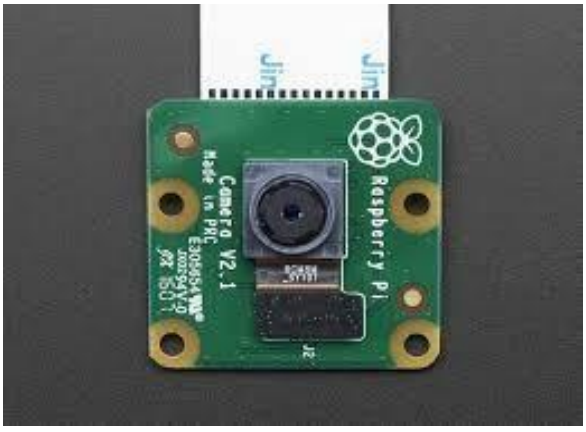
Component specification:

Raspberry pi image

1.Processor/Controller: Raspberry Pi is an ARM cortex based popular development board designed for Electronic Engineers and Hobbyists. With the processing speed and memory, Raspberry Pi can be used for performing different functions at a time, like a normal PC, and hence it is called Mini Computer in your palm.

Camera image

2.Camera: The camera used in this system is capture the Product image and send it to the Raspberry pi for processing, from this camera we first capture the reference image of Product and store it into Raspberry. Camera capture the images of PCBs and Raspberry compare this image with stored reference image and generates the result whether the Products is faulty or not.



Position sensor image

3.Position Sensor: In this proposed system used photoelectric sensor for detecting the position of product , this sensor emits a light beam from its light-emitting element. A reflective-type photoelectric sensor is used to detect the light beam reflected from target. Which gives us the position OF Product.

Algorithm:

- ✓ Start
- ✓ Detect Position of products
- ✓ Capture the PCB image with camera.
- ✓ Separate the foreground and background images from capture image.
- ✓ Compare capture image with preloaded images in database.
- ✓ If defect detected then show defected region on display.
- ✓ Separate defected Parts.
- ✓ If PCB is correct the show message on display “No defect detected”.

F. **Flowchart**:

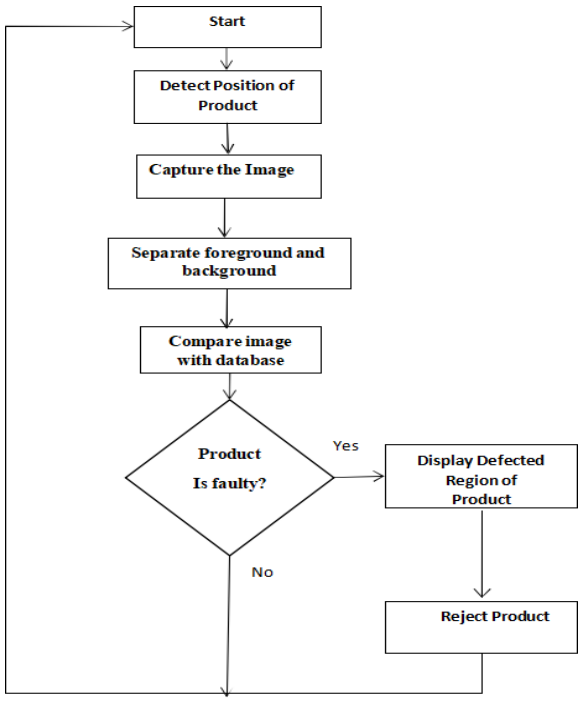


Fig.: -Flowchart

Conclusion:

In the proposed Automatic Product inspection system will reduce the time taken to detect the defects significantly. It helps in increasing the production by speeding up the inspection process with accurate results. Easily identify the Damaged Products and Paints scratch, but also can detect gaps, voids, scratches defects etc. This automated inspection system can be implemented in low cost. Small scale industries can adopt this system to reduce the time of inspection and minimize the errors.

International Journal of Engineering Research & Technology (IJERT) 2, 1-5 1 2013

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