Implementation of Computer Vision Algorithms For Position Correction of Chip-Mounter Machine

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Abstract- *Chip mounter is a machine in SMT Line that has the assignment of picking and putting SMD segments onto a PCB that has been covered with bind glue. To have the capacity to put SMD Segments precisely and quickly onto PCB, it is important to have a description on the area the chip to be set on the PCB, the present position of the chip, and the present position of the chip impression on the board. This paper depicts the means that have been structured and executed to meet the 3 prerequisites referenced by utilizing a computerized magnifying lens camera as a descending vision and the utilization of picture preparing calculations as the PC vision highlight of the chip-mounter. In the picture handling calculations utilized here, shading thresholding in HSV shading model for item determination is joined. Centroid location of the selected object can subsequently be calculated. As shown during the test, the computer vision method implemented in this work is capable of producing data required by the chip-mounter to do position correction if there is non-uniformity errors of the pattern on the PCB panel.*

Keywords- Chip Mounter, SMT Line, SMD, PCB, Downward Vision, Computer Vision, Image Processing, Thresholding, HSV Color Model, Morphological Opening, Morphological Closing, Canny Edge Detection, Centroid.

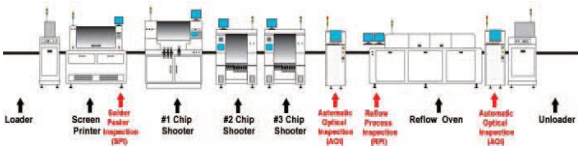
I. INTRODUCTION

Right now, Indonesia as of now has enough nearby organizations that produce electronic gear. As the occasions advanced, the size of the circuit and the electronic segments utilized were too getting littler. The circumstance is joined by the expanding interest for electronic hardware generation because of the requirements of the populace is expanding. So as to react to these challenges, numerous nearby organizations are swinging to utilize SMD part get together machines.

SMT is a technique used to deliver electronic circuits by setting segments on the PCB surface. SMT machines are generally utilized by gadgets

Organizations in light of the fact that the utilization of this machine has a dimension of computerization and better exactness contrasted with manual establishment of parts.

The working request of this machine is known as SMT Line. The perfect SMT Line exhibit comprises of Loader, Screen Printer, SPI (Patch Paste Inspection).



Be that as it may, there are different obstructions for nearby hardware organizations regarding the economy, that is, there are as yet few nearby organizations equipped for creating SMD part gathering machines with the goal that nearby assembling organizations purchase the machines by bringing in from abroad. Accordingly, generation costs are getting to be higher, and nearby hardware fabricating organizations are ending up progressively hard to become and less focused with universal assembling organizations in Indonesia.

II. SOFTWARE DESIGN AND IMPLEMENTATION

A. GUI Design

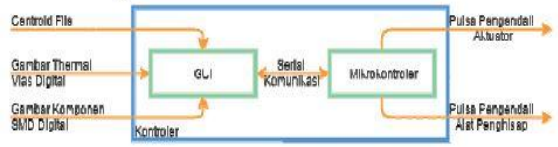


Figure 2 GUI Flowchart

GUI (Graphical User Interface) is an interface between user and CNC machine hardware. Its function is to give commands to be run by the machine. The user's command was designed in the form of buttons that will send data to the microcontroller in the form of characters or strings via serial communication port. Here is the first version of GUI design.

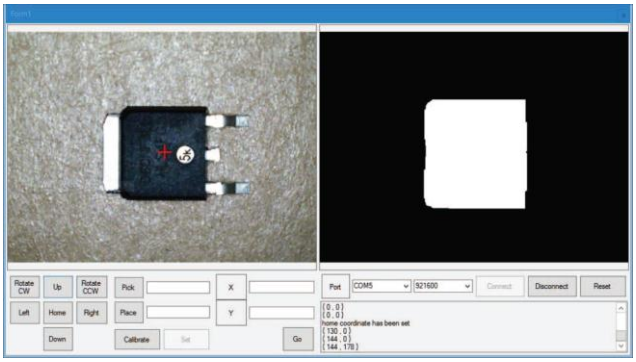


Figure 3 GUI Design

According to its function, the GUI design above can be divided into 5 sections as follows:

1) Communication Section. There are COM port box, baud rate box, and connect or disconnect button.
2) Machine Activity log Section. Displays the activity of the machine sent by the microcontroller.
3) Downward Vision Section. Displays the captured images and the results of component detection algorithms by computer vision.

B. **Computer Vision Algorithm**

The computer vision algorithm was performed in real-time on the downward vision of the GUI. The centroid of the component was searched by using image processing with OpenCV library within EmguCV wrapper.

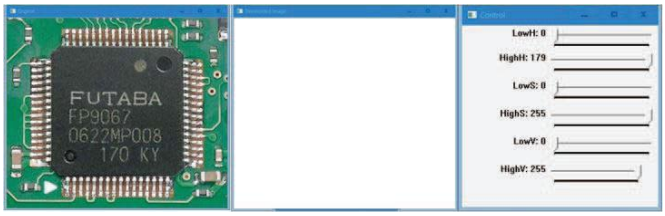


Figure 4 Before Color Detection

The first step is to get a rough selection of the desired object. This is done by color selection. Original images in RGB color model (Red, Green, Blue) were converted to the HSV color model (Hue, Saturation, Value). It then displays the original image, the color thresholding result in the HSV model, and the HSV control variable. Color selection was done by changing the value of the SV variable until the thresholded image shows the desired object. After color selection is done, morphological opening and closing is done to get the desired object intact. Next is the edge detection process to get the contour of the desired object. Canny operator is used to detect the edge of the desired object. After ward, the contour is drawn from the edge detected and then a bounding rectangle is drawn from the contour. Bounding rectangle is used to detect the centroid of the selected object.

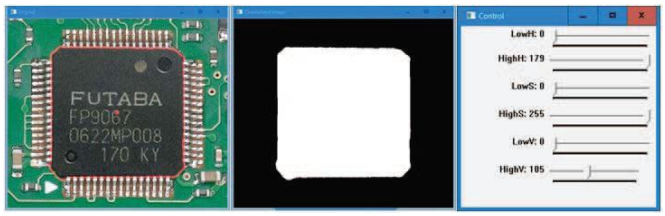


Figure 5 After Color Detection

C. **Integrating Computer Vision to GUI**

The previously designed computer vision algorithm is then integrated into the GUI and tested for moving images (using the camera). However, in the actual picture there is a problem when detecting small components type such as SOIC8 because of the distance between adjacent components on trays so that the downward vision will detect more than one component. Therefore, the image to be processed will be masked first at the top and bottom without changing the position of the original image. The size of the masking image will be adjusted to the size of the largest component to be processed, i.e.TQFP44. The purpose of masking the image is to narrow the viewpoint of the downward vision so that in one frame only 1 component is captured and to reduce the contour size of the components around. Next, the centroid is determined by selecting the largest contour size and then a bounding rectangle is drawn to determine the centroid of the component.

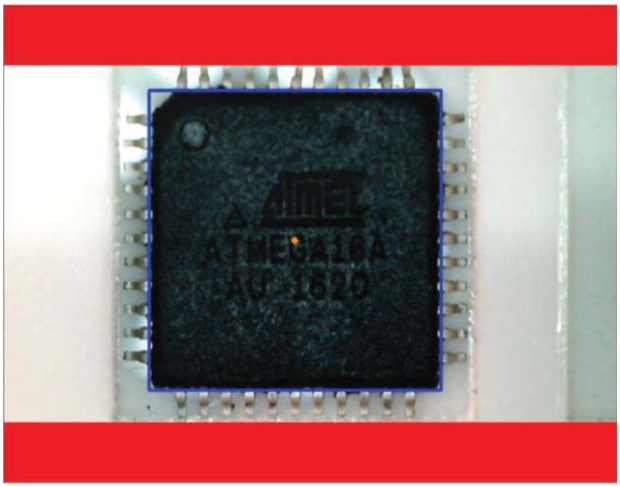


Figure 6 Component Centroid Test Result

In addition, downward vision is also used to detect thermal pad on PCB panels. The thermal pad image processing algorithm is similar to the component image processing algorithm, the difference between the two is only

in the size of the masking and the threshold value to distinguish the thermal pad from the surrounding object.

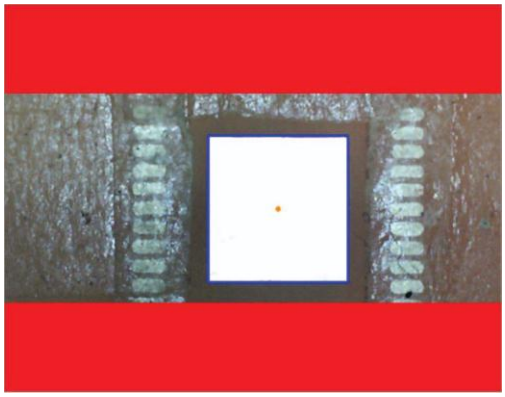


Figure 7 Thermal Pad Centroid Test Result

III. TESTING AND ANALYSIS

A. Downward Vision Test Result

Here is a picture of the downward vision test results.

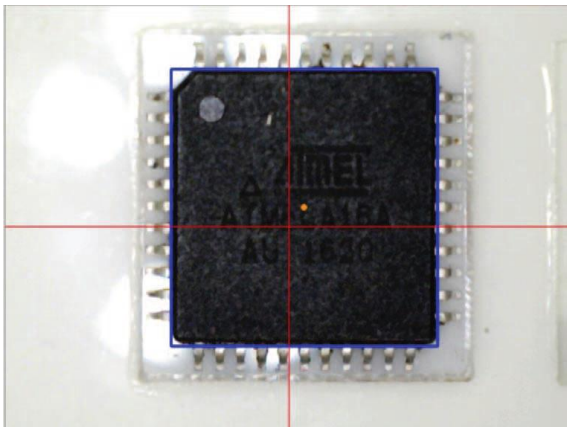


Figure 8 Downward Vision TQFP-44 Test Result

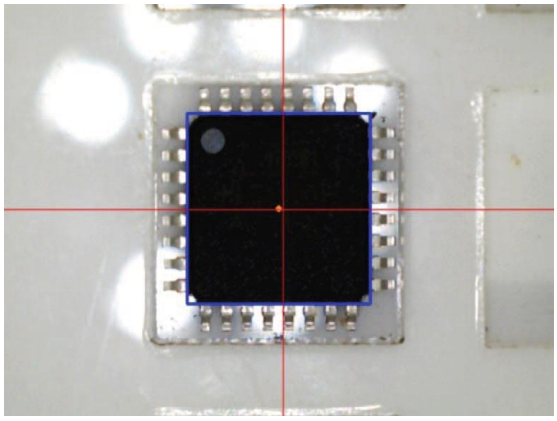


Figure 9 Downward Vision TQFP-32 Test Result

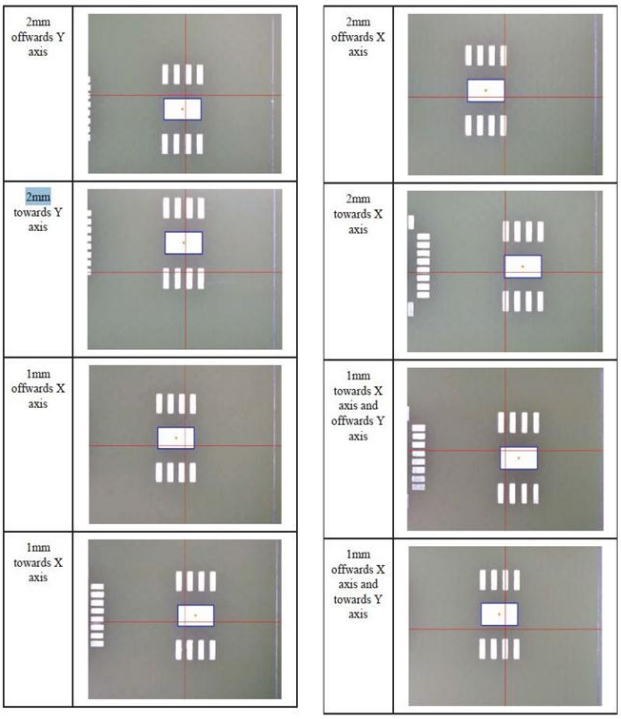
Based on the test results of the three images above, it can be concluded that downward vision is able to detect the centroid of each component type; TQFP-44, TQFP-32, andSOIC-8. The centroid of the component is obtained from the square that surrounds the outer portion of the component. The downward vision has not been able to detect the angle of the component. However, this is not a problem, given the specifications do not include the accuracy in rotational placement.

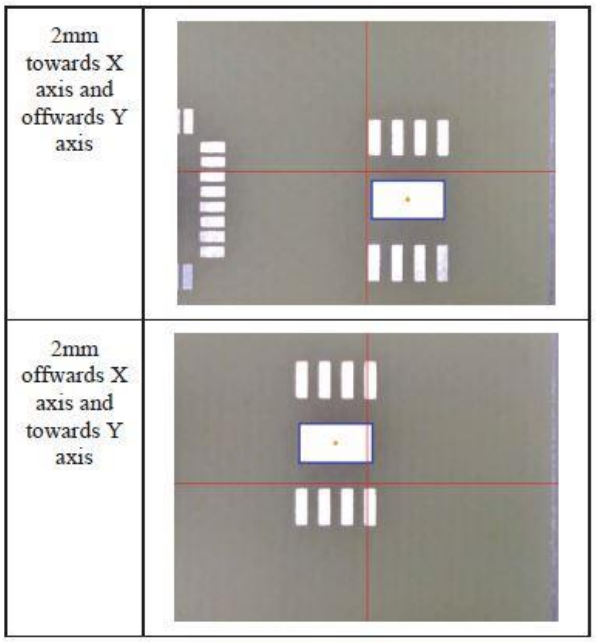
B. PCB Panel Error Tolerance Result

The following table shows the results of the PCB panel error tolerance test. **PCB Panel Error Tolerance Result**

The following table shows the results of the PCB panel error tolerance test.

Table 1 PCB Panel error tolerance





Based on the above test result table, it can be concluded that downward vision is able to detect thermal pad on PCB with error tolerance up to 2mm. Since the tests with SOIC 8 were successful, it can be concluded that downward vision is able to detect PCB panel errors on TQFP-44 and TQFP-32component type that have larger thermal pad sizes than SOIC-8. Thus, thermal pad detection becomes essential to improve the accuracy of component placement in the automation process.

IV. CONCLUSION

Computer vision can be used to improve the accuracy of the pick and place process of the chip mounter machine. The algorithm used for computer vision is taken from the basic of image processing. Selection of objects in an image can bed one through the color selection of the image. Basic morphological processes such as opening and closing in image processing can be used to sharpen the results of object selection.

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