SCHOOL OF COMPUTER SCIENCES

CPT344: COMPUTER VISION AND IMAGE PROCESSING

ACADEMIC SESSION SEMESTER 1 2021/2022

ASSIGNMENT 2

DETECTION OF INCOMPLETE SOLDERING PROCESS

Group C

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Introduction

In this assignment, we are required to detect the incomplete soldering process on the PCB. We choose to use image processing method to detect the incomplete soldering process.

Problem statement and Solution

The sample reference image shown in *Figure 1* below can be used as reference to differentiate between undercooked and fully cooked solder by converting it to grayscale first then to a binary image as shown in *Figure 2* below. Hence, the test images can be compared with the binary image of the sample reference image to detect the incomplete soldering process. We can see that; a good soldering will come out mostly rectangle shape in the binary image while a bad soldering will not be seem clearly with broken shape. From that, we use closing morphology to make the shape more clearly in the binary image.

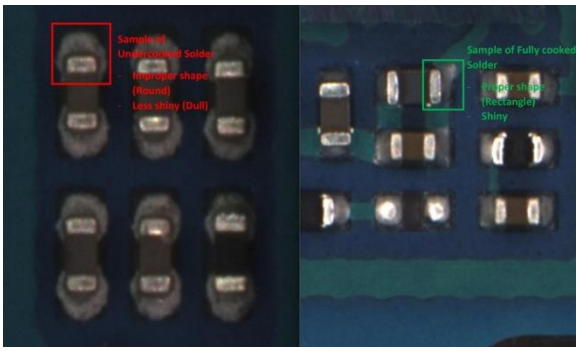


Figure 1 Original image of 'Sample Image (Reference)_page-0002.jpg'

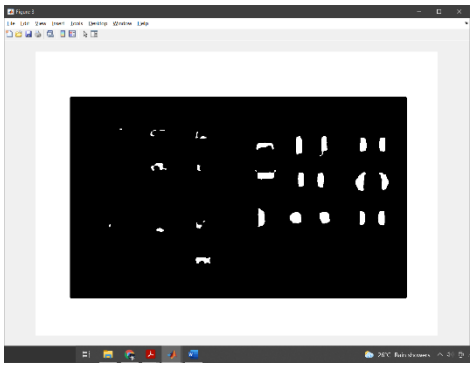


Figure 2 Binary image of 'Sample Image (Reference)_page-0002.jpg'

In this assignment, we were given 5 different images of PCB. The first problem that we met is that these pictures' size are too big leads to the object is too small in the background. To solve this, we crop the image before we start the image processing image. We use "imcrop" to crop the image.

Figure 3 Example of PCB image given before crop

As the given image is colour image, hence we convert the image into grayscale image as the first step of image processing. We use Otsu's method, which is a method that chooses the threshold value to minimize the intraclass variance of the thresholded black and white pixels to create a binary image. This step makes us to separate the components on the PCB clearly. In addition, we use erosion morphology to remove the small lines between the components. To ensure the components are shown clearly, we remove the noise in the image and fill the holes within those components. [1] [2]

After we processed the images, we can justify the soldering process based on the result image we had.

Results

The image shown the original test image that we want to test.

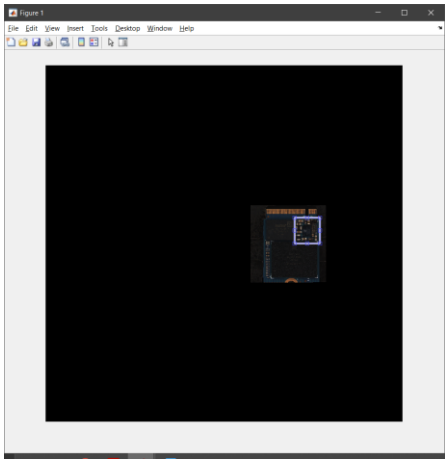


Figure 4 Test Image 1 with the crop section

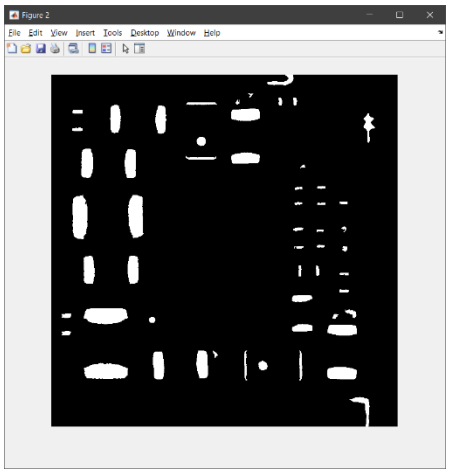


Figure 5 Crop section of test Image 1

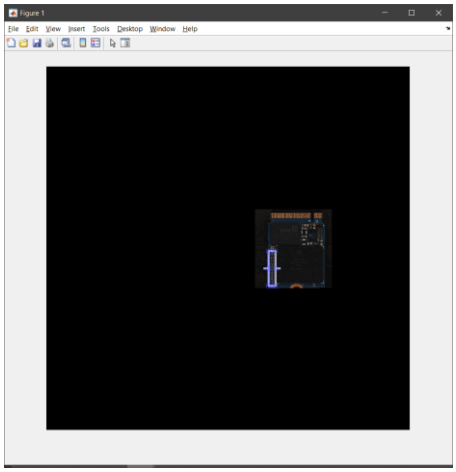


Figure 6 Test Image 1 with crop section 2

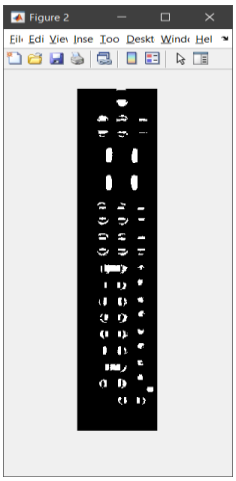


Figure 7 Crop section 2 of test image 1

We choose to crop a small region to closely check the soldering process of the PCB. From *Figure 5*, we can see that the soldering is quite complete and in proper shape. While in *Figure 7*, we can see that there are many improper shapes and round ended lead to the results of undercooked.

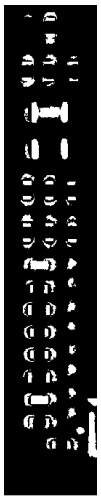


Figure 8 Test Image 2 with crop section 1

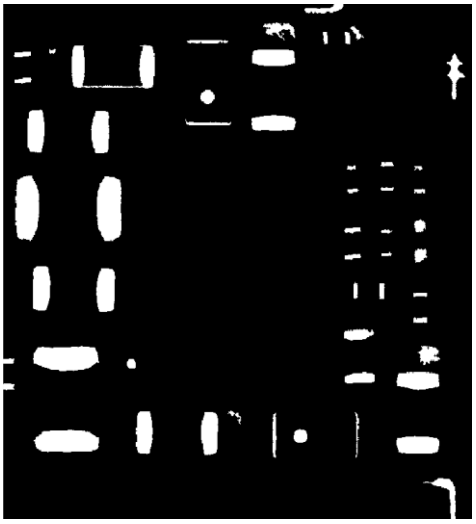


Figure 9 Test Image 2 with crop section 2

Figure 10 Test Image 3 with crop section 1

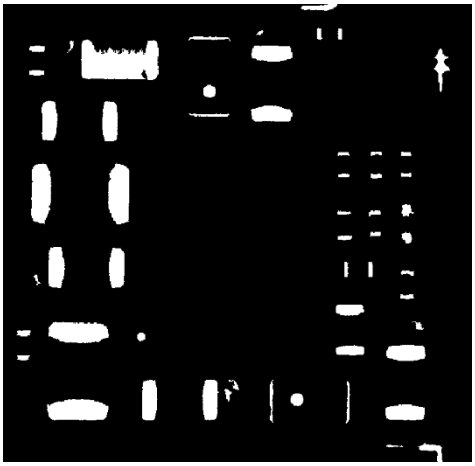
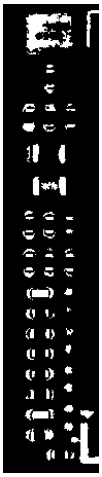


Figure 11 Test Image 3 with crop section 2

In *Figure 9* and *Figure 11*, the soldering is in rectangular (proper) shape which considered as fully cooked solder. In *Figure 8* and *Figure 10*, the soldering shape is round ended (improper) which is considered as undercooked and incomplete soldering.



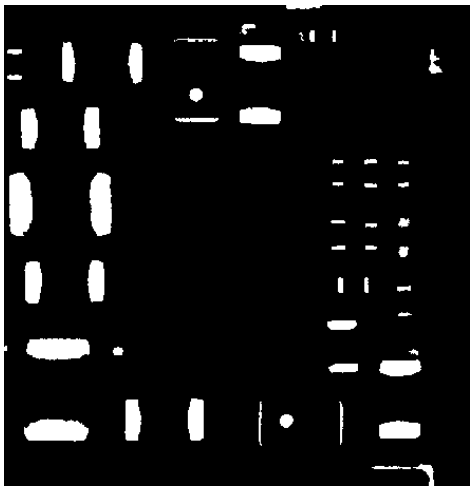


Figure 12 Test image 4 with crop section 1

Figure 13 Test image 4 with crop section 2

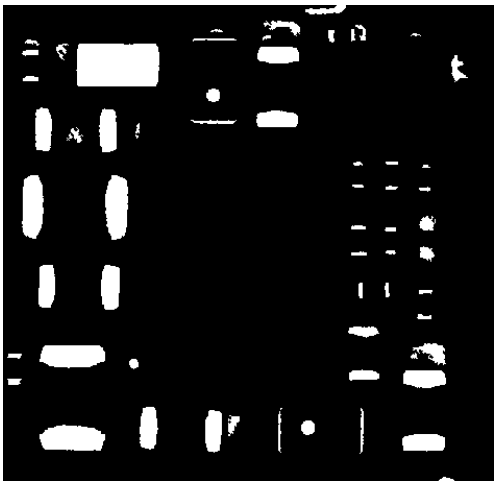


Figure 14 Test image 5 with crop section 1

Figure 15 Test image 5 with crop section 2

In *Figure 12* and *Figure 13*, the soldering point is complete and there is no redundant part, which is considered as good soldering. In *Figure 14* and *Figure 15*, some parts of the soldering points are missing or inappropriate soldering methods, which are considered as incomplete soldering.

Conclusion

From these images, we can say that the soldering is more difficult for small parts in the PCB which most of the soldering in small parts are undercooked and not in proper rectangular shape. We turned the images into binary image to see the soldering part clearly. While in the process, erosion morphology helped us to beautify the shape while we remove the small noises in the image to get a clear result. Image processing does help us to detect the incomplete soldering process of the PCB.

Source code (For reference image)

```
%read test image
I = imread('Sample Image (Reference)_page-0002.jpg');
i = im2gray(I);
j = imbinarize(i);

%closing
se = strel('disk',10);
closeBW = imclose(j,se);
%remove noise
rn = bwareaopen(closeBW,30);

%show image
figure
imshow(rn);
```

Source code (For test image)

```
%read test image
I = imread('test2_20211221155633.jpg');
[J,rect] = imcrop(I);

%crop image
I2 = imcrop(I,rect);
i = im2gray(I2);
j = imbinarize(i);

%figure
%imshow(j);

%erosion
se = strel('disk',1);
erodedi = imerode(j,se);
%remove noise
rn = bwareaopen(erodedi,30);
%fill holes
fh = imfill(rn,'holes');
%show image
figure
imshow(fh);
```

References

[1] J. Ye, "Two-stage Soldering Defect Detection with Deep Learning," 2019.

[2] N. S. S. Mar, "Vision-based classification of solder joint defects," 2010.