CHAPTER V

IMPLEMENTATION AND TESTING

5.1. Implementation

This program will process the annual rings image in trunk which has been inputted by user. The process will change the image into grayscale, apply median filter, edge detection continue with edge linking, thresholding, and in the final stage is calculation of the yearly circle using chain code. And the final result will show us the sum of the yearly circle from image.

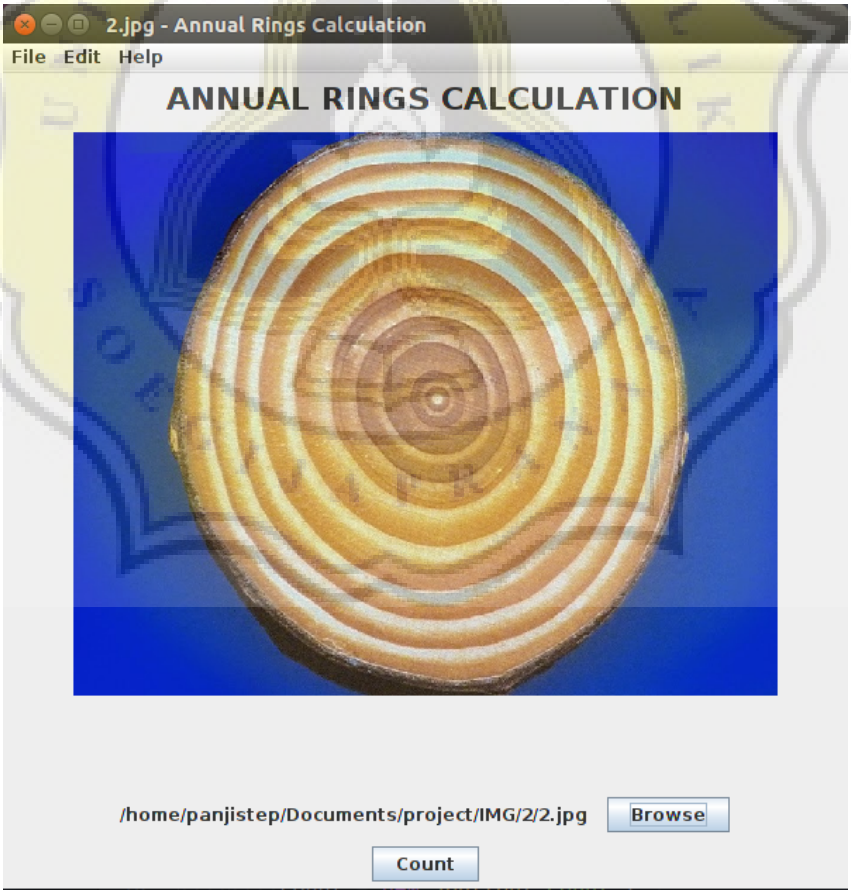


Figure 13. Main GUI

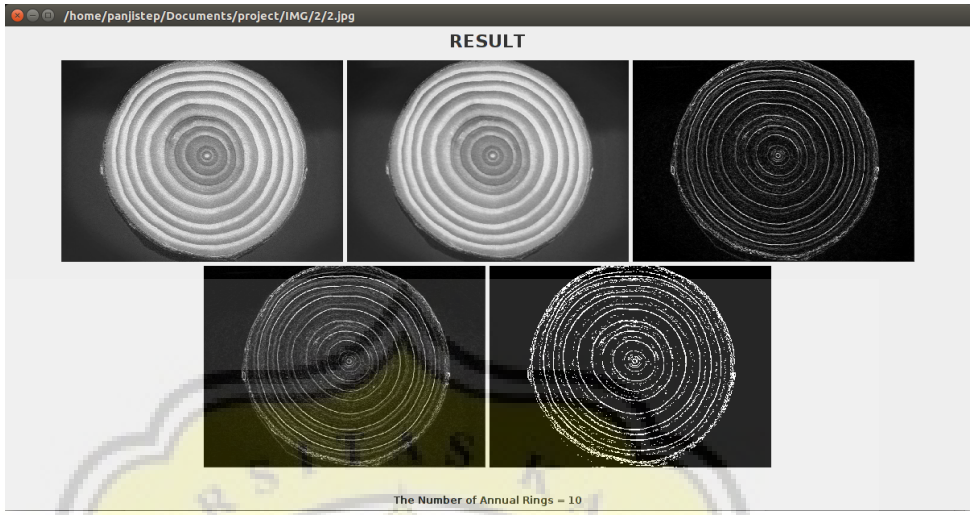


Figure 14. Result GUI

5.1.1. Grayscale

The first process that do by the program is convert the image into grayscale, with luminosity algorithm that have been explained before. Value of each layer pixels is taken and multiplied using the formula, then produce a new value pixel and placed in all layers. After all the layers have the same value, so we have a new grayscale image.

```
Color c = new Color(image.getRGB(j,i));
total = (int) ((0.21*c.getRed()) + (0.72*c.getGreen()) + (0.07*c.getBlue()));
Color newColor = new Color(total,total,total);
image.setRGB(j,i,newColor.getRGB());
```

Figure 15. Grayscale Code

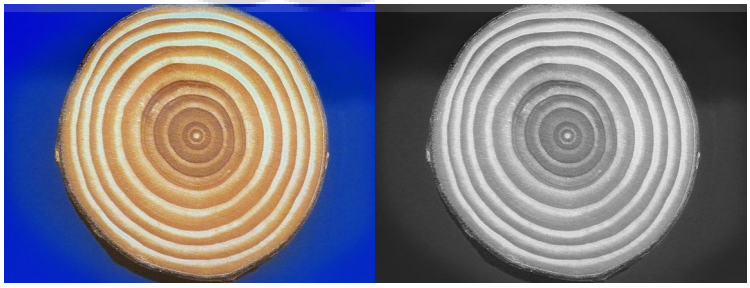


Figure 16. Grayscale Result

5.1.2. Median Filtering

After grayscale process, the image will be process using median filtering. The writer using median filtering because this method is quite optimal to remove the noise and the image detail still looks very clear. Due to this method gathering all of the neighbor pixel in 3x3 way then sort them from the smallest in the biggest and take its median value, so it will not produce new pixel value.

```
for(int i=1 ; i<height-1 ; i++)
{
    for(int j=1; j<width-1 ; j++)
    {
        med[0] = (pixel[i-1][j-1];
        med[1] = (pixel[i-1][j];
        med[2] = (pixel[i-1][j+1];
        med[3] = (pixel[i][j-1];
        med[4] = (pixel[i][j];
        med[5] = (pixel[i][j+1];
        med[6] = (pixel[i+1][j-1];
        med[7] = (pixel[i+1][j];
        med[8] = (pixel[i+1][j+1];

        for(int a=0;a<9-1;a++)
        {
            for(int b=1;b<9-a;b++)
            {
                if(red[b-1] > red[b])
                {
                    temp=red[b-1];
                    red[b-1]=red[b];
                    red[b]=temp;
                }
            }
        }

        temp=(red.length/2);
        hasilred=red[temp];
```

Figure 17. Median Filtering

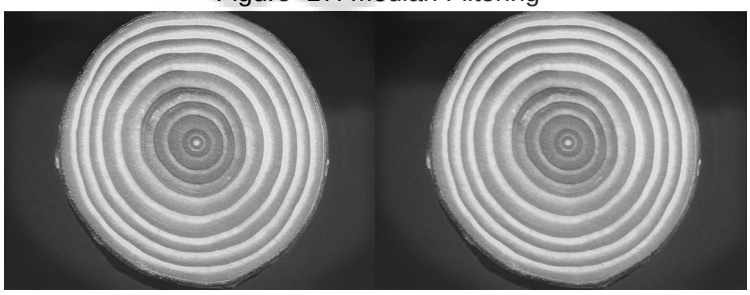


Figure 18. Median Filtering Result

5.1.4. Edge Detection

Edge detection is done by taking pixel value from early coordinate (0,0) until the end. Each pixel value are multiplied with kernel prewitt x (px) and y (py), create edge detection image in X axis and Y axis. Both summed and create edge detection value image.

```
{
    /*Perkalian Matrix Kernel*/
    temp[0] = (pixel[i-1][j-1] * py[0][0]);
    temp[1] = (pixel[i-1][j+1] * py[0][2]);
    temp[2] = (pixel[i][j-1] * py[1][0]);
    temp[3] = (pixel[i][j+1] * py[1][2]);
    temp[4] = (pixel[i+1][j-1] * py[2][0]);
    temp[5] = (pixel[i+1][j+1] * py[2][2]);

    tpy = Math.abs(temp[0]+temp[1]+temp[2]+temp[3]+temp[4]+temp[5]);

    temp2[0] = (pixel[i-1][j-1] * px[0][0]);
    temp2[1] = (pixel[i-1][j] * px[0][1]);
    temp2[2] = (pixel[i-1][j+1] * px[0][2]);
    temp2[3] = (pixel[i+1][j-1] * px[2][0]);
    temp2[4] = (pixel[i+1][j] * px[2][1]);
    temp2[5] = (pixel[i+1][j+1] * px[2][2]);

    tpx = Math.abs(temp2[0]+temp2[1]+temp2[2]+temp2[3]+temp2[4]+temp2[5]);

}
```

Figure 19. Edge Detection Code

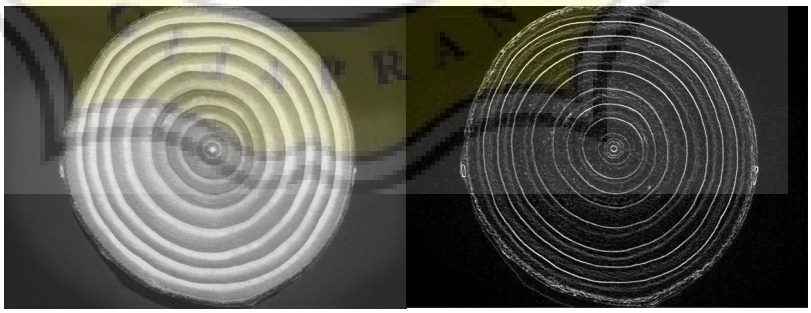


Figure 20. Edge Detection Result

5.1.5. Edge Linking

After Edge Detection, continue with edge linking. Actually there are two option for edge linking, 3x3 or 5x5 but the applied Edge Linking for this program is 3x3 because if the comparison is too wide, such as 5x5 will be harm the annual rings image. Because some of annual rings have a close space one to another, so if the comparison is too wide will make 2 close circle connected.

With quite short distance it's become less effective, because if there a big noise which made a breaking edge it will still not connected. Therefore it can be said that the edge linking not so helpful. In this program use threshold for pixel value is <=20 and for pixel angle direction <5.

```
for(int i=0; i<height-2 ; i++)
{
    for(int j=0 ; j<width-2 ; j++)
    {
        /*Neighborhood 3x3*/
        if(pixel[i][j]>=128)
        {
            temp[0] = Math.abs(pixel[i][j] - pixel[i][j+2]);
            temp2[0] = Math.abs(pixela[i][j] - pixela[i][j+2]);
            temp[1] = Math.abs(pixel[i][j] - pixel[i+2][j]);
            temp2[1] = Math.abs(pixela[i][j] - pixela[i+2][j]);
            temp[2] = Math.abs(pixel[i][j] - pixel[i+2][j+2]);
            temp2[2] = Math.abs(pixela[i][j] - pixela[i+2][j+2]);
```

Figure 21. Compare With the Neighborhood

```
if(temp[0]<=20 && temp2[0]<5)
{
    baru = Math.max(pixel[i][j],pixel[i][j+2]);
    Color newColor = new Color(baru,baru,baru);
    if(pixel[i][j+1]<127)
    {
        image.setRGB(j+1,i,newColor.getRGB());
        pixel[i][j+1]=baru;
    }
}

if(temp[1]<=20 && temp2[1]<5)
{
    baru = Math.max(pixel[i][j],pixel[i+2][j]);
    Color newColor = new Color(baru,baru,baru);
    if(pixel[i+2][j]<127)
    {
        image.setRGB(j,i+1,newColor.getRGB());
        pixel[i+1][j]=baru;
    }
}

if(temp[2]<=20 && temp2[2]<5)
{
    baru = Math.max(pixel[i][j],pixel[i+2][j+2]);
    Color newColor = new Color(baru,baru,baru);
    if(pixel[i+2][j+2]<127)
    {
        image.setRGB(j+1,i+1,newColor.getRGB());
        pixel[i+1][j+1]=baru;
    }
}
```

Figure 22. Connect the Edge

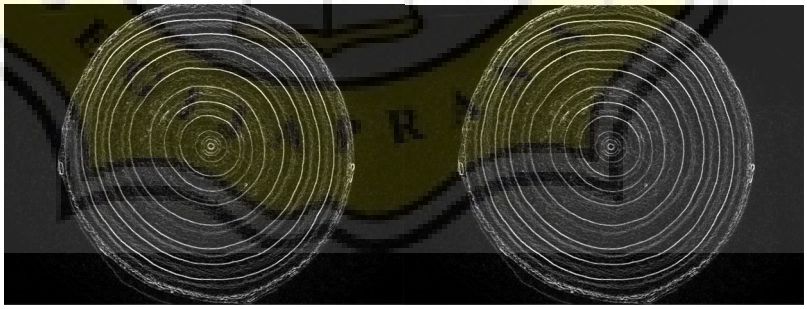


Figure 23. Edge Linking Result

5.1.7. Thresholding

After edge detection and edge linking process, the image will be threshold. Thresholding is necessary to separate the edge from edge detection result with the existing background. So, in the picture no other object. As already said before the thresholding requires a boundary to change the pixel value to a certain value.

In this program, the boundary is 50. Value pixel under 50 will be converted to 0 and above 50 will be changed to 255. So that later the image has only two pixel values, 0 and 255 (2 bit).

```
Color c = new Color(image.getRGB(j,i));
total = c.getRed();
if(total<50)
    total=0;
else
    total=255;
```

Figure 24. Thresholding Code

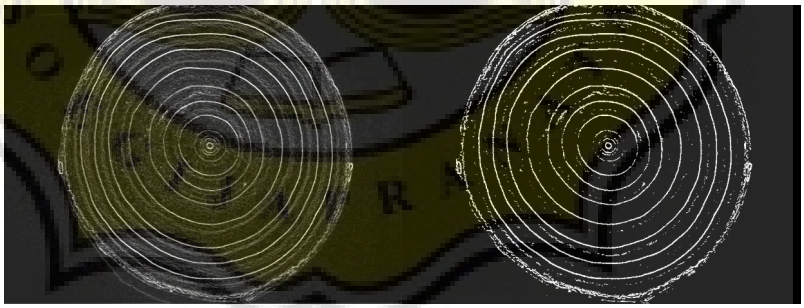


Figure 25. Thresholding Result

5.1.7. Count with Chain Code

This is the last process to find out how many annual rings on the image who has inputted by user. In this process, first finding the first point and the last point of the annual rings, either vertically and horizontally.

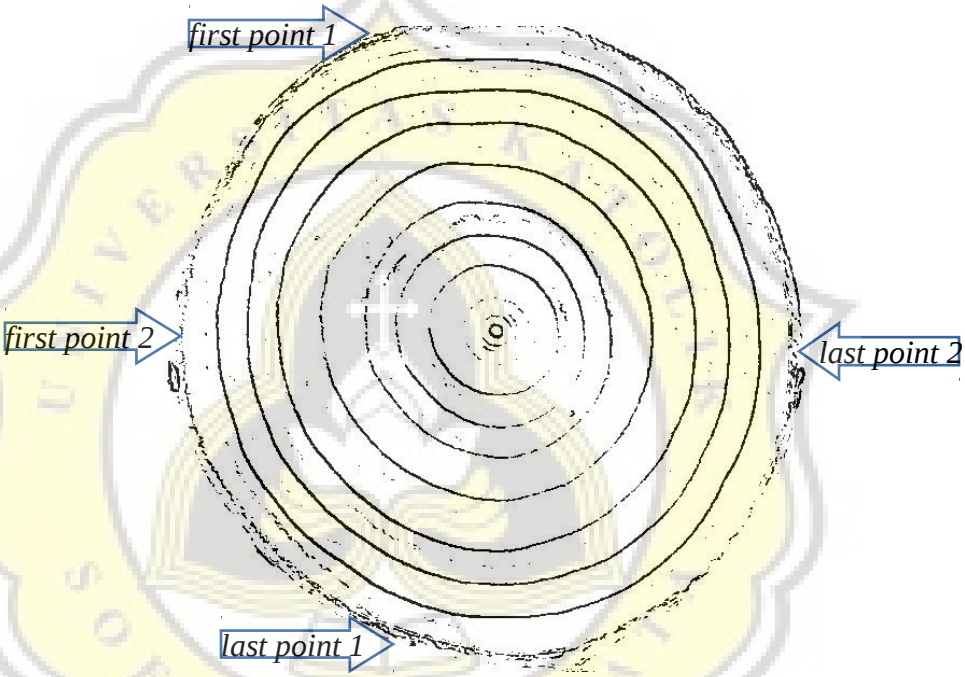


Figure 26. First Point and Last Point of Annual Rings

```
for(y=0;y<height;y++)
{
    for(x=0 ; x<width; x++)
    {
        if(pixel[y][x]==255)
        {
            atasx = x;
            atasy = y;
            break;
        }
    }
    if(atasx!=0 || atasy!=0)
    {
        break;
    }
}
```

Figure 27. Find the First Point of Annual Rings Code.

```
for(y=height-1;y>=0;y--)
{
    for(x=0 ; x<width; x++)
    {
        if(pixel[y][x]==255)
        {
            bawahx = x;
            bawahy = y;
            break;
        }
    }
    if(bawahx!=0 || bawahy!=0)
    {
        break;
    }
}
```

Figure 28. Find the Last Point of Annual Rings Code.

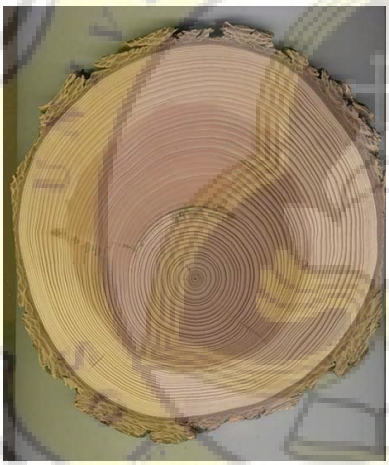
After the “first point 1” and “last point 1” of annual rings are obtained, the rings are examined by scanning each row horizontally or by X axis, until the first value of 255 is found. Then the process of the chain code is executed by exploring several pixel above and below the particular point, it will assume as edge of ring if the result is reached 25 pixels.

This process will be repeated for “first point 2” and “last point 2”. In order to get the best result is by using the maximum value from 2 process above and then the result will be divided by 2 and minus 2.

5.2 Testing

Table 1. Testing

No.	Original Image	Program Calculation	Visual Calculation	Difference
1	 Source : http://geoberry.ru/zhivem %20po%20pravilam %20poholodanija_clip_image001.jpg	36	48	12
2	 Source : http://2.bp.blogspot.com/-cHQqsQfHgf8/U1m0TfGvrQI/AAAAAAAAAeA/LlmDs4KevBA/s1600/1323698628-4045-3.jpg	14	9	5
3	 Source : http://www.aucoeurdelarbre.ca/upload/images/1.2.1g_ls0001665_1_1.jpg	11	13	2

No.	Original Image	Program Calculation	Visual Calculation	Difference
4	 Source : http://www.daviddarling.info/images/annual_rings.jpg	16	19	3
5	 Source : http://www.kgs.ku.edu/Publications/PIC/35gifs/fig3.jpg	29	51	22
6	 Source : https://upload.wikimedia.org/wikipedia/commons/thumb/f/f6/Robinia_sezione.jpg/220px-Robinia_sezione.jpg	13	20	7

No.	Original Image	Program Calculation	Visual Calculation	Difference
7	 Source : http://www.baannatura.com/public/images/real_wood/small_red_pine.jpg	23	22	1
8	 Source : https://i.stack.imgur.com/aaUUM.jpg	10	12	2
9	 Source : http://biomesblog.typepad.com/photos/uncategorized/treerings.jpg	11	20	9

No.	Original Image	Program Calculation	Visual Calculation	Difference
10	 Source : http://www.mezistromy.cz/userdata/fotografie/vlastnosti_dreva/borovice_4.jpg	24	22	2
11	 Source : https://s3.amazonaws.com/test.classconnection/304/flashcards/401304/jpg/small_red_oak.jpg	26	27	1
12	 Source : http://www.benateckyctyrlistek.eu/wp-content/uploads/2014/10/akat_23.jpg	39	35	4

No.	Original Image	Program Calculation	Visual Calculation	Difference
13	 Source : http://www.dhresource.com/200x200s/f2-albu-g2-M01-8A-F0-rBVaG1YLJIqAS3AyAAKd3rBGyiE438.jpg/wholesale-tree-bark-growth-ring-pattern-wood.jpg	3	15	12
14	 Source : https://2.bp.blogspot.com/-hL6jXTIO6H8/VyUW1RUT7tI/AAAAAAAAzIM/Ctz1YVsamGs5sjHKIIzlPbA6b7CYdnmlgCLcB/s1600/kambium%2Blingkaran%2Btahun.jpg	15	22	7
15	 Source : http://amazingpict.com/hd-wallpapers-background-images/tree-annual-rings/	11	31	20

From above testing result, the best result came from 2, 3, 4, 7, 8, 10, 11, and 12. Which have differences between calculation on the program and manual calculation below 5. Because the annual rings line looks thick and clear.

While the bad result came from 1, 5, 13, and 15 have quite significant differences. Because annual rings line looks very thin and the light was not equally and it make the annual rings line dotted and incalculable. But on the 13, and 15 due to the the annual rings didn't seen too clear like 1 and 5, but the differences are not quite far because there are another object in the background so it makes those objects are countable also.

From this testing, the success rate is 53%. The writer can resume that the best result came from the object that have clear annual rings, equal lighting and non background object.