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作品編號 190018

參展科別 電腦科學與資訊工程

作品名稱 Convert pixel image into paths saves in
XYZ format to use in CNC machines using
innovative algorithms.

得獎獎項 三等獎

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Abstract:

CNC machines use vector graphics or vector image programs that take time and effort on hobbyists. Therefore, it is important to provide accurate techniques for converting ordinary images available on the Internet or can be designed with easy programs. In order to have precise drill paths read by CNC machines directly and produce a product that does not contain rattles at the edges. This depends on the accuracy of processing the extracted paths. The development of algorithms has been completed Transforms Pixel image into Paths with XYZ extension, which is used to drill material and cut it through CNC machines. And the algorithms are based on transfer images with low quality. And Its Advantage that it can create high Paths with as few points as possible.

The program can convert the pixel image into paths, and then converted into g-code, and use it in CNC machines directly.

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Introduction:

If there is one tool that everyone would like to acquire, the machines would be CNC. This high precision machine can produce many wonderful products.

And CNC machines are machines that can be controlled by computer to drill on materials, such as: wood, glass, and metals.

The power of CNC machines comes from its ability to handle different types of materials with high accuracy.

Unlike other machines, CNC machines have proved efficient in handling thick materials and can penetrate them easily. CNC machines can also handle fine detail, for example, the V-cut may not be easy on other machines. But it's different with CNC machines.

PROBLEM:

These machines rely on engineering drawing programs, but many of these programs developed into machines contain a lot of details. so, the work on these devices requires supervision by experts and specialists in the field of engineering drawing. This prevents many people from using simple home-made devices such as home-made CNC, Because of the difficulty of learning programs that produce files paths carried out by drilling machines. also, CNC machines use vector image that takes time and effort in design, so it's important to create a technique to convert low-quality images on the Internet or that can be designed from easy programs to paths for drilling.

CNC machines for children work on a scan on a picture and then drill on light materials such as plastic or plastic. These machines do not contain all the languages and are based on ready-made molds in the design.

Most engineers work on developing the engineering side and leaving the electronic side.

Tools:

1-Microsoft Visual Studio 2010:

This version was chosen for the lightness of its operating files, which speeds up the testing timeless to see the results of the algorithm work, because this type of project depends on a lot of calibration and resetting variables and checking the results of steps step by step.

2- Magnifier:

It is a Windows tool to magnify the screen.

And the program has been used because the program ensures the accuracy of the work and to monitor the changes that occur per pixel image To make appropriate adjustments to complete the task and keep edges on their own and to ensure the accuracy and effectiveness of cleaning operations that occur after the identification of external edges.

3- Library (GDI32):

To activate the functions GetPixel and SetPixel to analyze and recolour the image of any colour we specify in advance or by using any colour already exists within the image, Here we can call this method the easy part of the process of recolouring the image. The most difficult part is to select the appropriate points to set the edges in two stages to be red and the rest to be black, This is the main function in which the algorithm is in addition to the cleaning process.

```
Private Sub Picture1_MouseDown(Button As Integer, Shift As Integer, X  
As Single, Y As Single)
```

```
'Get the pixel color
```

```
PixCol = GetPixel(Picture2.hdc, X, Y)
```

```
Text1.Text = PixCol
```

```
'Convert to RGB
```

```
r = PixCol Mod 256
```

```
b = Int(PixCol / 65536)
```

```
g = (PixCol - (b * 65536) - r) / 256
```

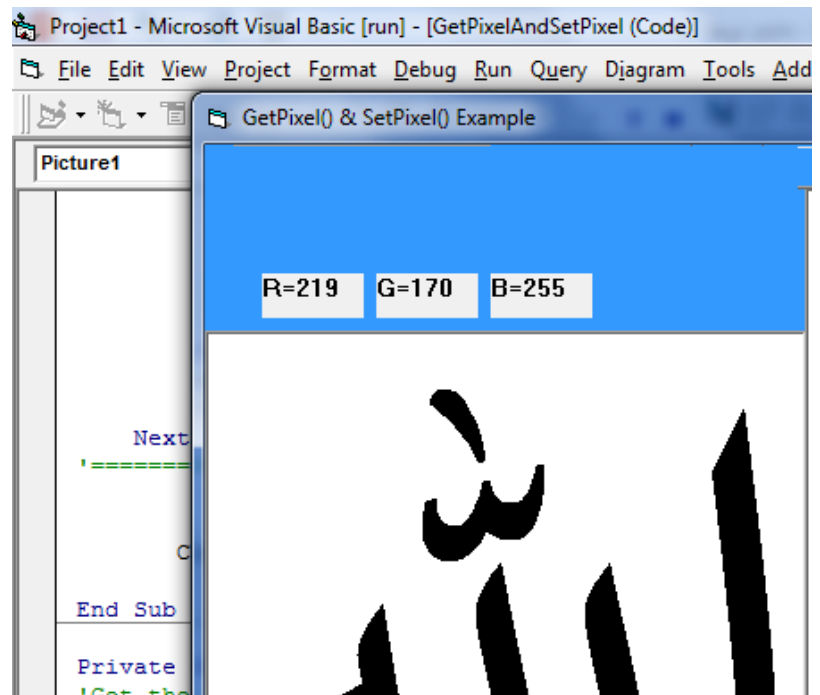
```
'Add to the labels
```

```
Label1.Caption = "R=" & X
```

```
Label2.Caption = "G=" & Y
```

```
Label3.Caption = "B=" & b
```

```
End Sub
```



```

For i = 0 To nSize
For j = 0 To nSize
    'Get the pixel color
PixCol = GetPixel(Picture2.hdc, i, j)
'Convert to RGB
r = PixCol Mod 256
b = Int(PixCol / 65536)
g = (PixCol - (b * 65536) - r) / 256
.....
PixCol = GetPixel(Picture2.hdc, i - 1, j - 1)
'Convert to RGB
r1 = PixCol Mod 256
b1 = Int(PixCol / 65536)
g1 = (PixCol - (b1 * 65536) - r1) / 256

' First level to convert point to Red color.
If r = 255 And g = 255 And b = 255 Then

    If sd2 >= 1 Then
        SetPixelV Picture3.hdc, i, j, 200
        numpoint = numpoint + 1
        Text3.Text = numpoint
        sd = 0: sd1 = 0: sd2 = 0
    End If

    End If

Next
sd = 0: sd1 = 0: sd2 = 0
Picture3.Refresh
Next

```

So, I develop a program that can transfer the pixel into paths in XYZ format by using an invention algorithm.

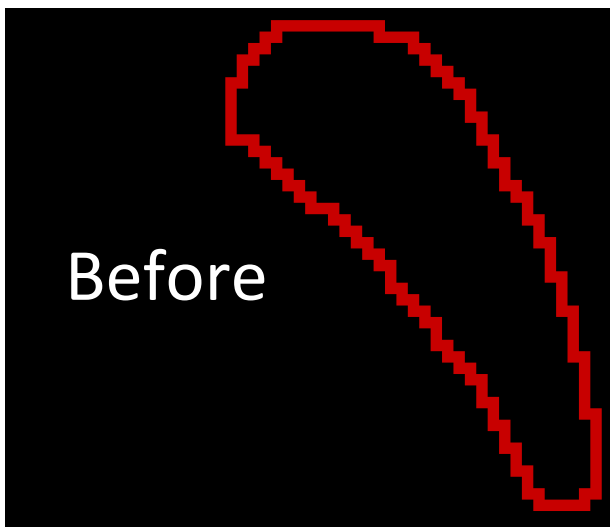
The algorithm works as follows:

1- Scan all points in Picture1 and leave all white and black dots and specify the gray dots where they are stored in a PixCol variable of type Long, Special conversion equations are used to determine the value of (RGB) for each pixel.

2-Study the eight pixels on the pixel and turn them to a red pixel if the number of points of proximity is at least two or more white pixels and 4 gray or black pixels. To do this, The SetPixel function sets the pixel at the specified coordinates to the specified color.

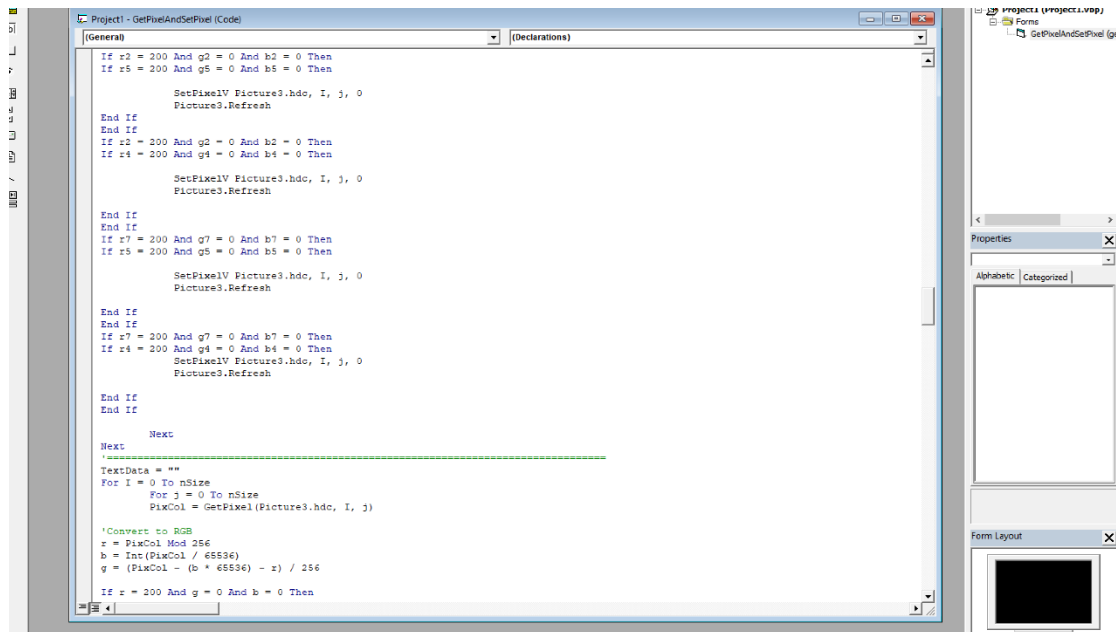
3-Move all the red dots to Picture3 to represent the edges of the shape and ignore the black and white dots for the third stage, And the transfer is done through two statements For statement During the transfer process, the number of pixels is stored in a standalone counter.

4- In the third stage is the cleaning process by reading all the pixels of proximity for all points and if the number of neighbors more than two pixels are identified pixels that should be deleted.



5- Point algorithms are used to arrange the path, which states the order of the points so that the difference between each point is 1 by using arrays and sentences for.

6-Conversion of points to G-CODE and use in CNC machines.



Measures:

Programs show code to process and clean bitmaps and store paths with XYZ extensions. This is done as follows:

1- The program specifies a window to add a regular bitmap.

Then the image is copied to bootable for conversion to white and black.



```
' Copy the image in Picture1 into Picture2
''
Private Sub cmdCopyImage_Click()
    cmdCopyImage.Enabled = False
    cmdCopyImage.Caption = "loading..."

    Dim i As Long, j As Long, k As Long, m As Long, ff As Long, gg As L

    Dim sd As Long
    Picture2.AutoRedraw = True

    '' Picture2 is a square, so width=height, so just cache one value
    ''
    nSize = Picture2.ScaleWidth
    Picture2.Cls

    Text2.Text = " "
    numpoint = 0

    For i = 0 To nSize
        '' for each pixel across
        ''
        For j = 0 To nSize
            'Get the pixel color
            PixCol = GetPixel(Picture1.hdc, i, j)
```

2- Images are converted into edges by Image Processing.

Visual Basic functions are most important: GetPixel, PixCol, SetPixelV.

```

General

'Convert to RGB
r = PixCol Mod 256
b = Int(PixCol / 65536)
g = (PixCol - (b * 65536) - r) / 256
.....
PixCol = GetPixel(Picture1.hdc, i - 1, j - 1)

'Convert to RGB
r1 = PixCol Mod 256
b1 = Int(PixCol / 65536)
g1 = (PixCol - (b1 * 65536) - r1) / 256
.....
PixCol = GetPixel(Picture1.hdc, i - 1, j)

'Convert to RGB
r2 = PixCol Mod 256
b2 = Int(PixCol / 65536)
g2 = (PixCol - (b2 * 65536) - r2) / 256
.....
PixCol = GetPixel(Picture1.hdc, i - 1, j + 1)

'Convert to RGB
r3 = PixCol Mod 256
b3 = Int(PixCol / 65536)
g3 = (PixCol - (b3 * 65536) - r3) / 256
.....
PixCol = GetPixel(Picture1.hdc, i, j - 1)

'Convert to RGB

```

```

General

If r1 > 100 And r1 <= 255 And g1 > 100 And g1 <= 255 And b1 > 100 And b1 <= 255 Then
    sd = sd + 1
End If
If r2 > 100 And r2 <= 255 And g2 > 100 And g2 <= 255 And b2 > 100 And b2 <= 255 Then
    sd = sd + 1
End If
If r3 > 100 And r3 <= 255 And g3 > 100 And g3 <= 255 And b3 > 100 And b3 <= 255 Then
    sd = sd + 1
End If
If r4 > 100 And r4 <= 255 And g4 > 100 And g4 <= 255 And b4 > 100 And b4 <= 255 Then
    sd = sd + 1
End If
If r5 > 100 And r5 <= 255 And g5 > 100 And g5 <= 255 And b5 > 100 And b5 <= 255 Then
    sd = sd + 1
End If
If r6 > 100 And r6 <= 255 And g6 > 100 And g6 <= 255 And b6 > 100 And b6 <= 255 Then
    sd = sd + 1
End If
If r7 > 100 And r7 <= 255 And g7 > 100 And g7 <= 255 And b7 > 100 And b7 <= 255 Then
    sd = sd + 1
End If
If r8 > 100 And r8 <= 255 And g8 > 100 And g8 <= 255 And b8 > 100 And b8 <= 255 Then
    sd = sd + 1
End If
If r >= 0 And r <= 100 And g >= 0 And g <= 100 And b >= 0 And b <= 100 Then
    If sd >= 3 Then
        SetPixelV Picture2.hdc, i, j, 200
    'Text3.Text = numpoint
    sd = 0
Else: SetPixelV Picture2.hdc, i, j, 0
End If

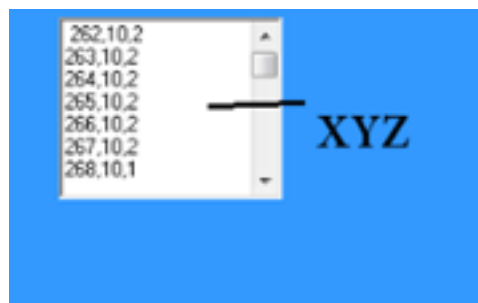
```

3-Excess points are processed through an innovative algorithm that uses mathematical coordinates to accurately distinguish excess pixels.

```
general
If r = 200 And g = 0 And b = 0 And finishh = 0 Then
  If r2 = 200 And g2 = 0 And b2 = 0 Then
    If r5 = 200 And g5 = 0 And b5 = 0 Then
      SetPixelV Picture3.hdc, i, j, 0
      finishh = 1
    End If
  End If
End If
If r = 200 And g = 0 And b = 0 And finishh = 0 Then
  If r2 = 200 And g2 = 0 And b2 = 0 Then
    If r4 = 200 And g4 = 0 And b4 = 0 Then
      SetPixelV Picture3.hdc, i, j, 0
      finishh = 1
    End If
  End If
End If
If r = 200 And g = 0 And b = 0 And finishh = 0 Then
  If r7 = 200 And g7 = 0 And b7 = 0 Then
    If r5 = 200 And g5 = 0 And b5 = 0 Then
      SetPixelV Picture3.hdc, i, j, 0
      finishh = 1
    End If
  End If
End If
If r = 200 And g = 0 And b = 0 And finishh = 0 Then
  If r4 = 200 And g4 = 0 And b4 = 0 Then
    If r7 = 200 And g7 = 0 And b7 = 0 Then
      SetPixelV Picture3.hdc, i, j, 0
      finishh = 1
    End If
  End If
End If
Next
sd = 0: sd1 = 0: sd2 = 0
Picture3.Refresh
```

4-The program converts the new edges into paths arranged in the form of XYZ coordinates in sequence that makes the engine move the drill head or shear according to the input.

5-These serial coordinates are saved in a XYZ text document that is used by CNC machines.



6-Working on the machines directly.

Test:

1- A sentence was written using AutoCAD and then converted into a specific design and then into G-code language and then drilled using the HDS CNC Router.

2- The sentence was redesigned using the Paint program and the program that was designed to be converted into paths was then converted to G-code and then drilled.

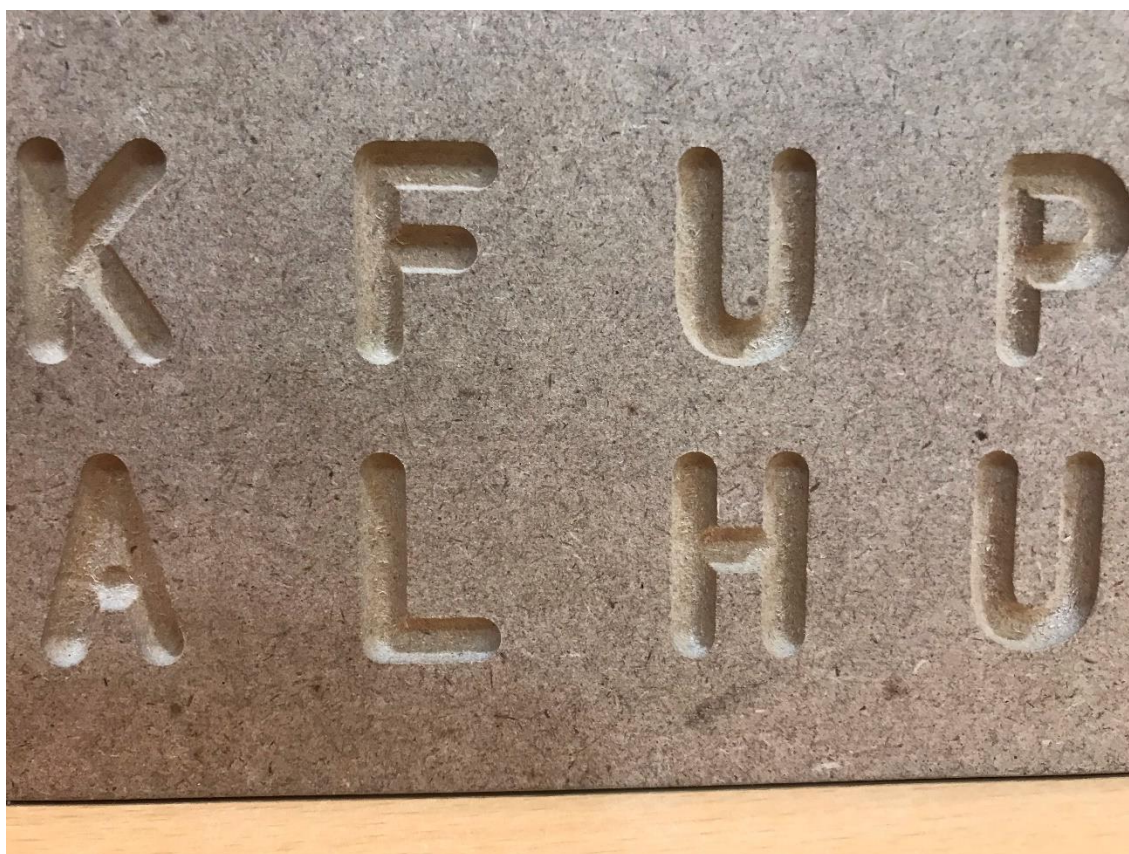
3- The producers scanned 15 identical regions ($20 * 20$ Pixel) in the producers to determine the amount of aliasing in the selected paths.

4- The images were enlarged 1600% compared to aliasing in selected areas.

5- The comparison of the image product processed by the program shows the image product designed by AutoCAD in 13 out of 20 regions

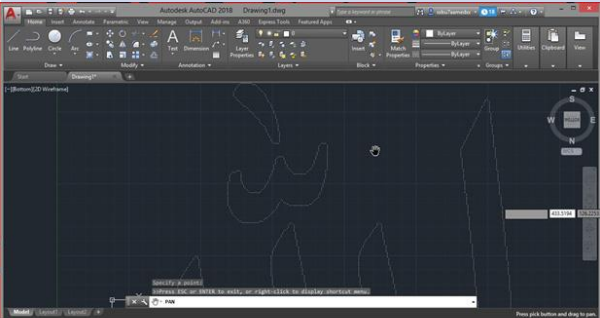
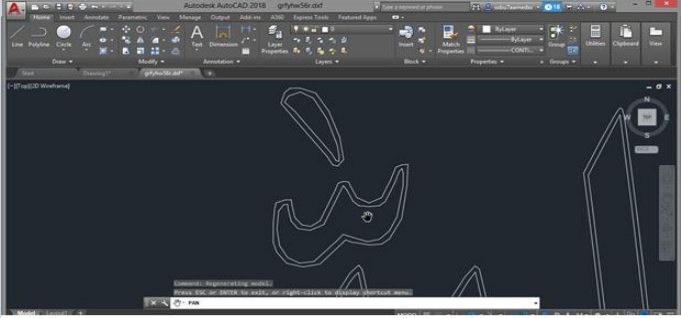
6-A sentence was designed using the Paint program and the program was able to convert it to the coordinates of the paths and then converted these coordinates into the G code language and then drilled them.

7- 20 students from the primary school were directed to design what they wanted using Paint and the program succeeded in converting them into tracks.



Comparison:

The results showed that the average speed of the proposed algorithm is 34.6 second, which is smaller than Inkscape that is 47.7 second. Moreover, the proposed algorithm has a higher precision (SE=6.8), which is small than Inkscape that is 8.7.

Comparison	Accurate g-code generator	Inkscape
Time	45.3 s	1 min
paths	Curves	Lines
Price	Free	Free
Number of point	9576	162
Pictures		

Results:

1-In the first phase, the program has succeeded in neutralizing the gray dots that hinder the precise determination of the edges. Where it turned to red points in preparation for the second phase.

2- The program was able to complete the edges accurately in the second stage even with low-resolution images and letters. By making all edges red and turning the rest of the dots to black.

3- The program clean all the extra points at the pixel level, which is centered at the corners of the curves, This was confirmed by comparing the number of points before, after and enlarging the image to monitor the effect of cleaning.

4- The program stored all the coordinates of the edges of the edges after the cleaning process, and is arranged in paths and saved in a text file to convert the file to XYZ extension and processing it to work on the CNC machine software.

5- The program sort all the point and create an accurate path that CNC machines can handle it with high quality.

Applications:

1-The program can be used in the field of sewing to save time and effort in the creation of designs requiring prior experience in the graphics engineering, So it is possible for anyone to draw what he/she wants through any program and convert these drawings into yarns on clothes to embroider them with the drawings that he/she wants.

2-School students and teachers have been able to use CNC machine tools, which contribute to their dissemination among schools, Thus raising the efficiency of students' scientific and technical projects and opening up new horizons for design without the need to learn engineering programs especially with the ability of many to buy homemade CNC low cost and spread in the markets.

3-Completion of students Projects that require digging or cutting a character or a set of characters in an open form without a specific line. This includes all languages because the program can unload characters such as shapes.

4-The design of fine finishes on the industrial products by digging or cutting accurately without the trimming or the need for sanding.

Future Work:

1- The algorithm can be developed to produce 3D tracks after reading points through a 3D scanner to develop 3D printers.

2-Integrates the algorithm with image analysis programs to develop their ability to determine the number of living organisms or stars and other images that require accuracy in the neutralization of objects.

3-Facilitate the work of robots that track tracks or draw forms stored in advance within, and to increase the efficiency of its work in carrying out the tasks.

4- Include the algorithm in the programs of drawing engineering and image editing programs and create a drawing where will develop the work of the Magic Wand tool.

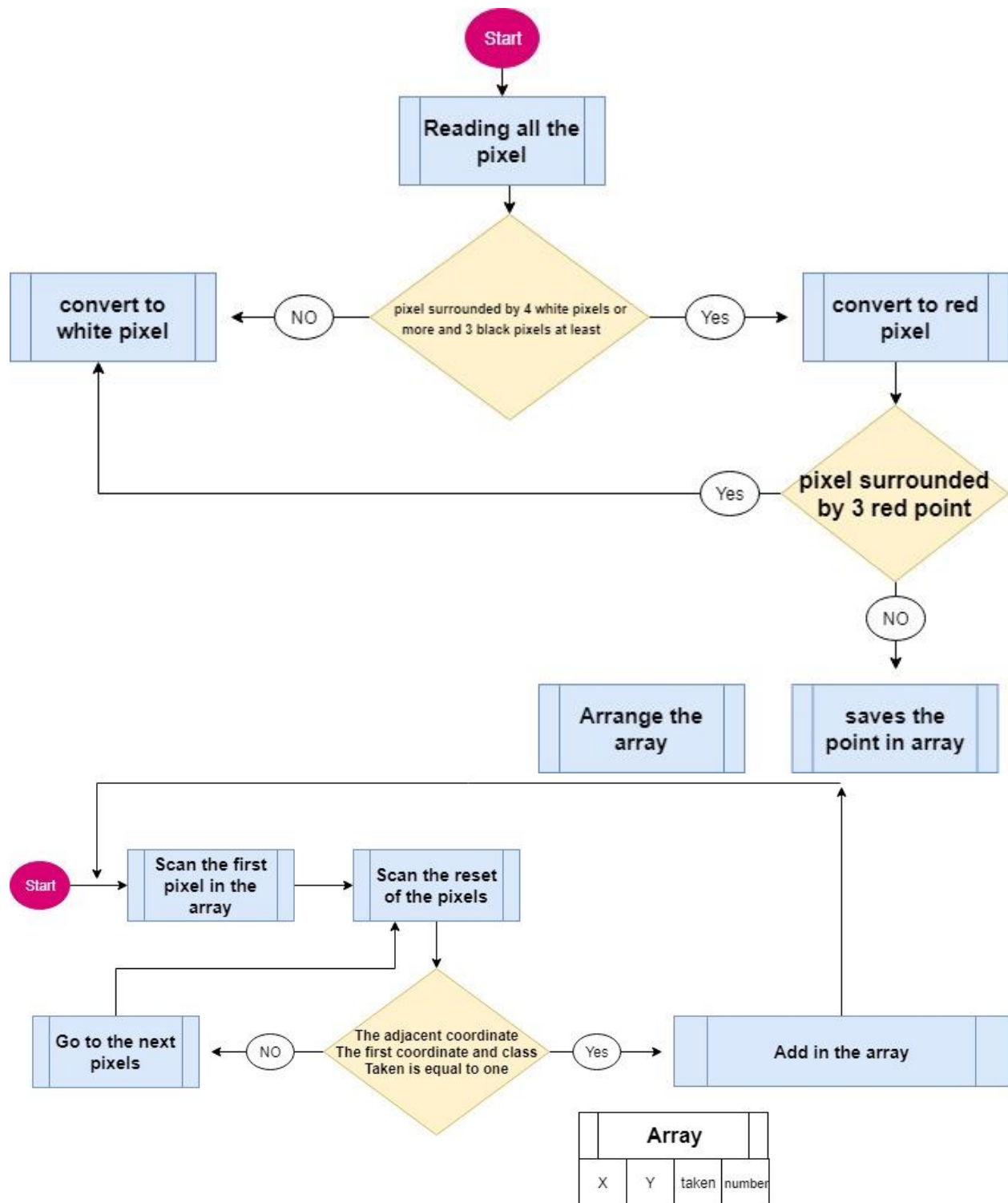
5- Increase the ability of fingerprint devices to accurately identify tracks and facilitate comparison with stored images.

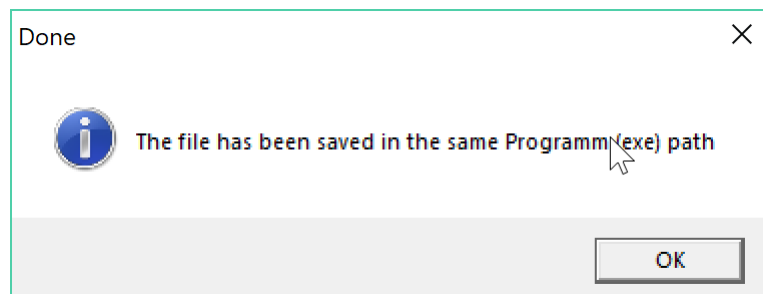
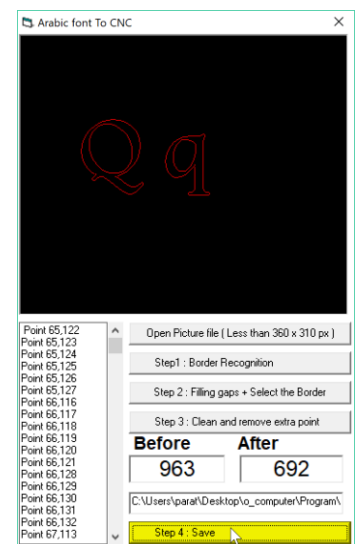
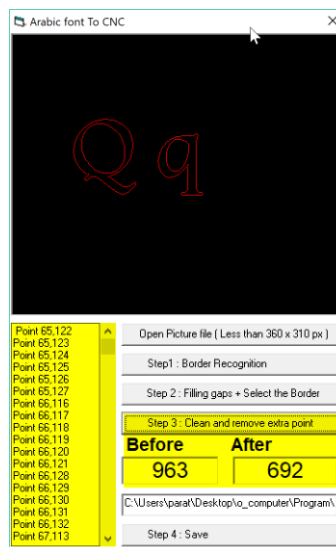
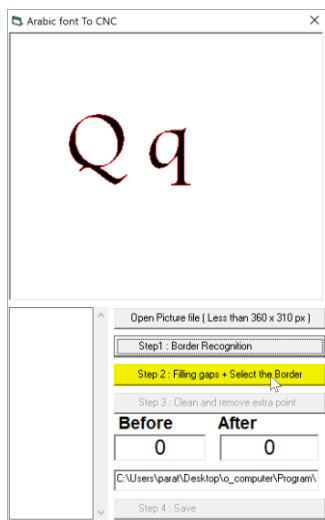
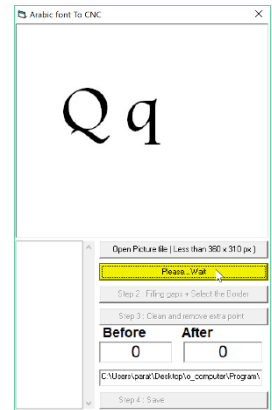
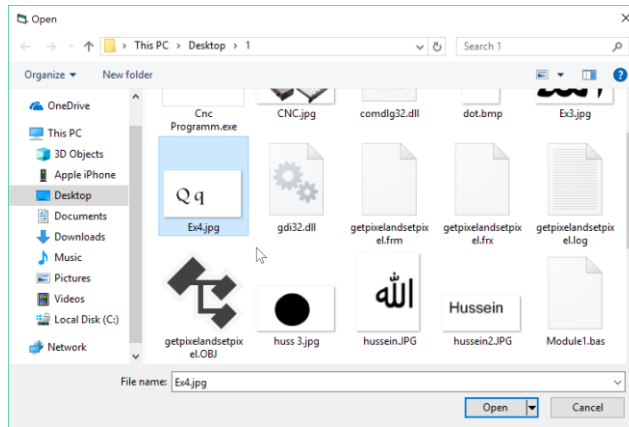
And this can Be Raising its success rate in fingerprint recognition.

Conclusion:

Without the use of engineering drawing software, the program can produce precise paths that match the Vector Image paths with the minimum number of points needed to form a path. Based on an innovative cleaning algorithm that can reduce the number of points through an invention algorithm, thus contributing to raising their economic value.

Appendices:





Reference:

1-More about CNC Machining- Thomas Publishing Company – 2016

<http://www.thomasnet.com/about/cnc-machining-45330503.html>

**2- Beginner's Guide: Make G-Code and CNC Coordinates Easy-
CNCCookbook's -2014**

<http://www.cnccookbook.com/CCCNCGCodeCoordinates.htm>

**3-CNC Coordinate System for G-Code and Machines - G-Code
Tutorial - 2017 www.cnccookbook.com**

**4-HIGH-Z S-1000/T CNC ROUTER - TECHNICAL DATA, ACCESSORY
AND PRICES – 2017 [https://www.cnc-step.com/cnc-router-
1000x600-s-1000t-ball-screw/](https://www.cnc-step.com/cnc-router-1000x600-s-1000t-ball-screw/)**

**5- New castle school of trades - High-Quality CNC Machine Training -
Experienced CNC Training in Pennsylvania –**

**[http://www.ncstrades.edu/cnc-machine-training-school-youngstown-
ohio-pa/](http://www.ncstrades.edu/cnc-machine-training-school-youngstown-ohio-pa/)**

【評語】 190018

This is a nice project that is both innovative and useful. Use of image processing to help guide the CNC is not new, and the path taken by the CNC machines certainly are not unique, but this project is able to use simple algorithm to determine a good path to speed up the whole process. It would be better if more experiments can be done to help understand the goodness of the path generated by the given algorithm. For example, is the generated path an optimal path?