

CIRCUMFERENCE DETERMINATION AND DATA EXTRACTION OF TWO-DIMENSIONAL CIRCLE

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ABSTRACT

Shape is a space enclosed by an outline. For the purpose of this study, a circle shape is chosen. The objectives of this study are to determine the circumference and extract the data of circle's circumference using the methods in Computer Aided Geometric Design (CAGD). This technique of circumference determination and data extraction can help the researchers for other processes involving the curve fitting and surface fitting in CAGD. In the first technique, the noise of the image was reduced by using Adobe Photoshop CS5. Next, the boundary image of circumference is extracted to determine the circumference of a circle. Then, the coordinate of the circumference was extracted using WebPlotDigitizer software. The solution from this study is a circumference of a circle and the data of a circle. This is a proposed alternative that can help researchers to proceed with another technique in CAGD such as corner points detection, control points determination, shape analysis and reconstruction of the curves and surfaces.

Keywords: Circumference Determination; Data Extraction; Circumference of a Circle; Data of a Circle; Webplotdigitizer.

1. INTRODUCTION

The circle is a unique shape because it has no vertex and it has the same radius from the center to any part of its circumference. The circumference of a circle is the boundary around the circle. Boundary image is the outline of the curved geometric shape. In this study, the boundary image is the circumference of a circle. Thus, boundary extraction is the process of finding the outline of a circle. The data of two-dimensional image is from the two numbers that can locate any points on a grid chart that have two perpendicular axes. These perpendicular axes consist of the horizontal line called the x-axis, while the vertical line is known as the y-axis. Extraction is the process of taking out something. Thus, data extraction of a circle means the process of taking out a set of coordinate x and coordinate y from the boundary of the circle.

In this study, the image is undergoing the process of boundary extraction and data extraction. This study proposed to extract the boundary of circle's image by using an algorithm to determine the circumference of the circle. Next, the data of circle is extracted by using WebPlotDigitizer.

The circumference and data obtained from the process of boundary extraction can be used for the researchers in order to reconstruct the curves and surfaces in their research in CAGD. According to [1], CAGD is about using mathematical description for shape as well as utilizing it in computer graphics, analysis or manufacturing.

2. LITERATURE REVIEW

There are many previous papers and researcher articles about determining the important points. [2] introduced about capturing outlines of planar images. This study provides a comparative study of results and various benefits of proposed algorithm are highlighted. The process of capturing outlines includes boundary extraction, corner point detection, piecewise curve approximation and segment subdivision. In order to find the corner point, the algorithm is determined based on computation of the highest curvature at each contour point. The algorithm used in this study to detect corner point is introduced by [3]. Another algorithm proposed by [2] is about the sliding rectangles along planar curves. This technique is used to detect the corner points. The corner detection process is divided into two parts. First part is the determination of corner points from the grayscale image and boundary-based corner detection for the second part. This proposed algorithm is different from traditional approach because it does not have the calculation of cosine angle and

incorporates scales of given object and curvature. A comparative study of different algorithms is conducted. As a conclusion, the proposed algorithm has various advantages over previous techniques, namely: RJ, RW, FD, BT and CS algorithms.

Next, another further enhancement by [4] is about the comparison of two techniques using linear and conic interpolations. In order to vectorize the image outline, the first step is pre-processing. Pre-processing includes boundary extraction and corner point detection. Corner points in digital images gives important clue for shape analysis. The researcher used the strategy from [2].

Other study used are from [5] entitled “Model-Based Recognition and Extraction of Information from Chart Images”. Charts are usually used as a representation of quantitative data. They present a model-based-method to extract data automatically and convert it in XML format. The procedure includes several steps: chart detection, model-based classification by chart type, extraction of graphical components, detection and recognition of textual components and extraction of semantic relations between graphics and text. Examples of data extraction software would include VistaMetrix (skillcrest.com), Dagra (BlueLeafSoftware.com), Plot Digitizer (plotdigitizer.sourceforge.net), qplot (qplot.com), Engauge Digitizer (digitizer.sourceforge.net) and Data Thief (datathief.org).

In addition, this paper also refers to a study from [6] on WebPlotDigitizer, created by Ankit Rohatgi. WebPlotDigitizer is a free software developed to extract data from various plot types. The three languages selection in this software are English, French or Deutsch. This software will help the users to extract data from figures. Firstly, the users need to upload image, then select the plot types. Then, axis calibration to determine minimum and maximum value of both the x and y axes. The point selection uses the manual or automatic mode. As a conclusion, this study has shown the ability of WebPlotDigitizer digitizing graphical images efficiently.

Lastly, a reference is made to a study by [7] on digitization process. During digitization process, Engauge Digitizer is used to vectorise the curves on digital images. The process involved two steps which are the determination of coordinate system on each image by specifying the actual coordinates of three references, then the points of the curve is traced with a digitizing tablet using either the semi-automatic or the manual mode. The result of this process is in text files containing information about the vectorised curves in a tabular form. This study explained about the technique of WebPlotDigitizer in order to extract the circumference of circle as an alternative approach for further research in CAGD.

3. METHODOLOGY

3.1 Image Sampling

The first process involved is selecting an image of a circle. Then the noise in the image is reduced in order to obtain an accurate image for the circumference determination process.

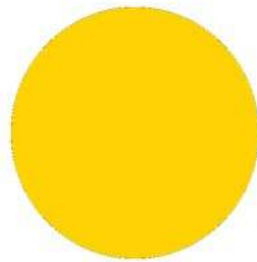


Fig.1. A sample of two-dimensional image

3.2 Circumference Determination

In the second step, the circumference of the image is finding by extracted the boundary of the circle. This technique is implemented by applying the algorithm from [8]. This circumference image is very important for the next process, data extraction. Figure two shows the result for boundary extraction of circle's circumference.



Fig.2. The circumference of the circle.

3.1 Data Extraction

The data is extracted by using a software name as WebPlotDigitizer. In this process, the set of data in coordinate are listed in a table with two columns to represent the respective x and y coordinates. The process of boundary image of circle's circumference is uploaded as shown in Figure 3.



Fig.3. The process of loading the image file

After the image is uploaded, the user must choose the type of plot they want to determine in “Choose Plot” type section as shown in Figure 4.



Fig.4. Plot determination

Based on the image uploaded, click on X1, X2, Y1 and Y2 such as in Figure 5. The values selected are labelled with variables X1, X2, Y1 and Y2. These variables are selected in order to set the minimum and maximum values for x-axis and y-axis.

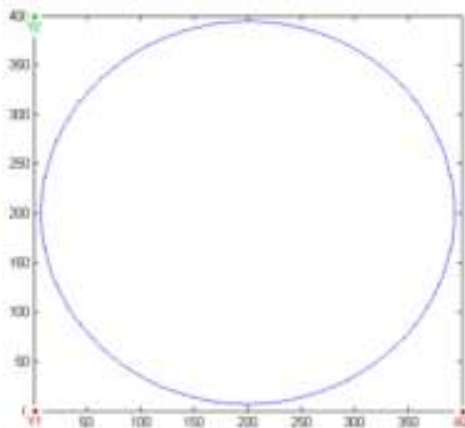


Fig.5. X1, X2, Y1 and Y2 point selection

In the next process, the minimum and maximum values on x and y axis are inserted such in Figure 6 below



Fig.6. The process of setting the minimum and maximum value of x and y axis

By using automatic mode in the software, select pen to highlight the circumference of the circle as shown in Figure 8.

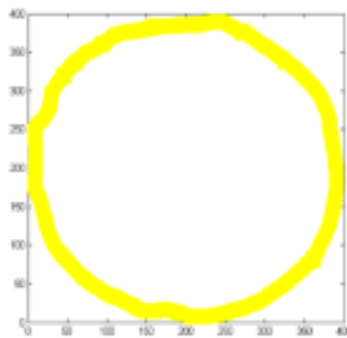


Fig.8. Highlighted circumference

Next, the point selected from the process of highlighted circumference will appear as a result of circle's circumference as shown in Figure 9 and viewed by using WebPlotDigitizer.

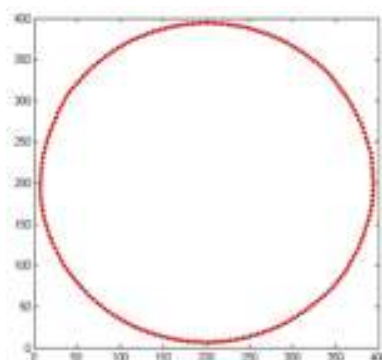


Fig.9. The points selection

3. RESULT AND FINDINGS

This section illustrated the process of proposed technique. The result from this technique is the coordinates around a circle. This also can be called the data for circumference of a circle. Figure 10 displays the coordinate of the circle's circumference. The result is presented in X and Y coordinates for an image of two dimensional circle. The extracted data can be download and saved by the user.

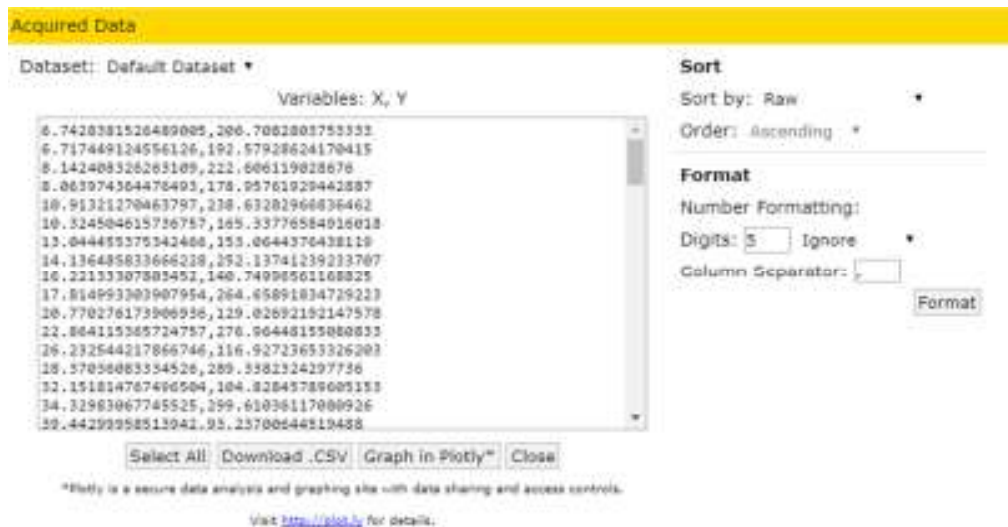


Fig.10. List of coordinates from the data extraction process

4. CONCLUSION

This paper proposed an alternative technique for the data extraction of two-dimensional image. It can be concluded that WebPlotDigitizer is an alternative for a better solution in order to extract the data as it can extract a lot of coordinates. These coordinates are very important for the researchers to proceed with their project in curve fitting, surface fitting and shape analysis.

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