Software Design for Depiction and Calculation of Curves Area on Cartesian Coordinates

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Abstract. The area which is limited by the curve can be calculated using certain integral function. The process of calculating integral functions is quitely complex and extensive because it is requires to control several rules of integration. In addition, the process of calculating a definite integral function for several equations such as a circle equation requires an example and substitution. This learning software performs various completion processes. This process begin with the process of reading and checking input data. The process is continued by describe the function of the input curve. The process is ended by calculate the area using the certain integral function. This learning software will display an image of the function curve which is inputted and the results of the calculation of the area using the certain integral function. The software also provides facilities for storing input and image data from curve functions in the *.bmp image format.

1. Introduction

Integral function is one of the most widely used on calculus calculation sciences. Various fields of science use this concept. Calculation area of a region, the contents of a rotating object, determining the weight of an object, calculating the moment of inertia, and measuring the surface area of a ball can be solved using the integral function [1][2].

The concept of integral is the opposite of derivative functions. In general, integral functions can be divided into indeterminate integral functions and definite integral functions. This integral function is used to calculate the area of the curve [3]. In calculus, curves can be described in the Cartesian coordinates form. In Cartesian coordinates, the x-axis and y-axis are scaled in the numbers form.

In mathematics, the Cartesian coordinate system is used to determine each point in an area using two numbers commonly called the x coordinates and y coordinates of the point [4][5]. To define coordinates, two directional lines are required perpendicular to each other (the x axis and y axis), and the length of the unit, which is made on the two axes.

Cartesian coordinate systems can also be used on higher dimensions, such as 3 dimensions, using three axes (x, y, and z axes). Using the Cartesian coordinate system, geometric shapes such as curves can be expressed with algebraic equations. This work was very influential in the development of analytical geometry, calculus, and cartography[6].
2. Related Works
The progress of science and technology, which was achieved at this time, especially progress in the last centuries, is basically not separated from the results of the progress of mathematics as a very important tool. Various subdivision of mathematics such as Differential Calculus, or Integral are the appropriate and very powerful weapons to work on various problems that arise in physics, chemistry, biology and various other subdivision of science both exact and non-exact [7], [8][9][10][11].

3. Research Methodology

3.1. Collecting Data Method
To obtain the data or information in this study, the authors collects data through one research method only, namely the Research Methodology Library (Library Research). The author selects data through books, as well as other reference materials related to the program to be designed. Meanwhile, the methodology used to design a new system is the Waterfall model [12][13].

![Figure 1. Life cycle with waterfall model](image)

The Waterfall Model offers a way to make software more real [14]. The important steps in this model are:

1. Determination and analysis of specifications.
   Services, constraints and objectives are generated from consultation with system users. Then everything was created in a form that can be understood by the user and the developer staff.

2. System design and software.
   The system design process divides requirements into software or hardware systems. The process produces the overall system architecture. Software design includes producing a soft warfare system function in a form that might be transformed into one or more programs that can be run.

3. System implementation and trial.
   During this stage a software design was recognized as a complete program or program unit. The test unit includes testing that each unit is according to specifications.

4. Integration and system testing.
   The program unit were integrated and tested into a complete system to ensure that software requirements are met. After testing, the system is delivered to customer.

5. Operation and maintenance.
Normally, this phase is the longest. The system is installed and used. Management includes error correction was not found in the previous step. Improved the system unit implementation and improved system services as new needs which can discover.

3.2. Flow Chart
Flowcharts are a diagram with graphic symbols that state the different types of program operations [15]. As a representation of a program, flowchart and algorithm can be a tool to facilitate the design of the flow sequence of a program’s logic, facilitate tracking of sources of program errors, and tools to explain the logic of program[16].

3.3. Algoritma
Software design algorithms applying limited integral functions to calculate the area in the cartesius coordinates are divided into 3 (three) parts, namely:

1. Depiction of Curve and Trigonometry Charts, divided into 3 (three) parts, namely:
   a. The depiction algorithm of the x and y coordinate axis.
   b. Graphical equation drawing algorithm.
   c. The area shading algorithm is limited by the graph of the Algorithm equation
2. Calculation of Area, consisting of:
   a. Algorithm for calculating the area with integral functions.
   b. Algorithm for displaying calculation steps.
3. Algorithm Capture Screen and Save Graph Image to Format Bitmap (* .bmp). Indentification of the model is made to see the significance.

4. Result and Discussion
4.1. Analysis
a. Functional Requirements
The area calculation software that is limited by the curve using the integral function certainly has the following requirements:
1. The software is able to describe graphs of the curve and the results of the shading of the area formed.
2. The software is able to store graphs of curves produced in * .bmp format.
3. The software is able to display the process and results of extensive calculations using certainly integrals.
4. Inputable curve functions include a three-order maximum polynomial equation and a one-order trigonometric function.
5. Curve graphs are illustrated using a scale that serves to enlarge or reduce the graphic image.
6. The area of shading area is the integral result of the reduction between the upper curve function and the lower curve function with the integral boundary, namely the lower and upper limits.

b. Area Calculation
The process of calculating the area that is limited by a curve using the integral function can certainly be divided into 2 major parts, namely:
1. The process of drawing curves.
2. The process of calculating the area which is limited by the curve.
3. To be clearer about the processes that occur, examples can be made:
4. Suppose that a curve function is known: 4x2 + 2x + 1, the curve is limited by the x axis and the line x = 0 and x = 8, then the image of the resulting curve is:
Figure 2. Area which are limited by y curve = 4x^2 + 2x + 1, x axis and x line = 0 dan x = 8

Calculation Result Area:

\[ \text{Area} = \int_{0}^{8} (4x^2 + 2x + 1) \, dx \]
\[ = \left[ \frac{1.3333}{3} x^3 + \frac{1}{2} x^2 + x \right]_{0}^{8} \]
\[ = \text{ABS}(754.6667 - 0) \]
\[ = 754.6667 \text{ unit area} \]

4.2. Display Design
The Use Case diagram can be seen in figure 1[17].
The application of definite integral software to calculate the area in Cartesian coordinates is designed using the Microsoft Visual Basic 6.0 programming language. This software is designed by using several object components (tools) from Microsoft Visual Basic 6.0, including:
1. Label, which serves to display information.
2. Rich Textbox, which serves to display the results of calculations.
3. Picture box, which functions as a curve drawing.
4. The command button, which functions as the execution button.
5. Option button, which functions to choose one of the desired options.
6. Check box, which functions to select the desired choices.

While this software has several form designs, including:
1. Main Form (Primary)
2. Input Form
3. Calculation Result Form

In addition, the software also provides several facilities such as storing graphic images into the image file format *.bmp, load facilities and save for curve functions [18]

5. Conclusion
After completing the software design the implementation of the integral function is certainly to calculate the area bounded by the curve in Cartesian coordinates, the author describes the following conclusions: [3] [19]
1. Software that has been designed can increase speed and accuracy both in calculating integral functions or drawing graphics compared to manually.
2. The graph of the curve that has been described and the calculation steps can be saved and reloaded.
3. The graphic image can be saved into a Bitmap (*.bmp) file.

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