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Dijkstra Algorithm Implementation in Determining the Shortest Route of Industrial Gas Distribution in PT Tira Austenite Tbk Cikarang with Python Programming Language

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Abstract

Mathematics is used in various fields of human life, one of them is in the industrial field. In the field of industrial mathematics can be used in finding the shortest route in distributing industrial gas. Finding the shortest route was done using Dijkstra's algorithm and developing the Python programming language. The purpose of this study is to determine the shortest route on industrial gas distribution at PT Tira Austenite Tbk Cikarang using the Python programming language. This type of research is applied research. The results obtained from this study are the Python programming language that can be used to find the shortest route of industrial gas distribution and users only enter the starting point and endpoint data on the program.

Keywords: shortest route, industrial gas distribution, Dijkstra algorithm, Python

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1 Introduction

Mathematics can be used in various areas of human life. The use of mathematics starts from simple things, such as home numbering, to complicated things, such as the application of mathematics to other sciences. One of the areas that use mathematics is the industrial field. Based on Law No. 5 of 1994 on industry, industry is an economic activity that manages raw materials, semi-finished goods, and finished goods into high-value goods of their use. Over time, the industrial field in Indonesia also began to develop. Industrial gases are one form of industrial development and the main gases available are Oxygen (O_2), Nitrogen (N_2), Carbon Dioxide (CO_2), Argon (Ar), Hydrogen (H_2), Helium (He), and Acetylene (C_2H_2)[1].

Industrial gas is widely used by various fields such as hospitals, universities, or other companies providing goods resulting in an increasing need for industrial gas. Therefore, there are various companies that offer industrial gas and one of them is PT Tira Austenite Tbk Cikarang. PT Tira Austenite Tbk Cikarang sells, produces, and distributes industrial gas. The company certainly expects all activities to run efficiently. Activities that are usually carried out by the company in distributing its products by delivering products to 4 to 5 consumers based on the same direction in one trip. Distribution activities can run more efficiently by searching for the shortest route to 5 consumers. The process of finding the shortest route can indicate that mathematical science is applied in human life. Finding the shortest route on PT Tira Austenite Tbk Cikarang which includes open companies can help in auditing the company's finances to estimate the fuel costs incurred.

The process of finding the shortest route can be done with a graph that will represent the travel map. The graph consists of 2 infinite sets, namely a blank set of dots (V(G)) and a set of lines (E(G)) [2]. Based on the type of line, the graph is divided into directional graphs and undirected graphs. Directional graph is a graph whose side has a direction while an undirected graph is a graph whose side has no direction [3]. In the representation of the graph of PT Tira Austenite Tbk Cikarang with consumers will be

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used directional graphs. Directional graphs are used because on the map there is a one-way path. It will also use labeled graphs. A labeled graph is a graph whose lines are each line assigned a value or label [4].

When the representation of the travel map graph from PT Tira Austenite Tbk Cikarang with consumers has been formed, finding the shortest route can be done with various algorithms and one of them Dijkstra algorithm. Dijkstra's algorithm is an algorithm that uses the greedy principle that each step in choosing a minimum weight line then inserts it in the solution set [5]. The selection of this algorithm is based on its advantages, which are simple and have a good level of accuracy and produce the shortest route that is quite accurate [6]. During this time, the process of finding the shortest route is usually done manually without utilizing technology. However, over time technology is used to facilitate human life.

Python programming language can be used as one of the alternatives to help the process of finding the shortest route. In Python there are keywords, data types, and operators that can help keep programs running as commanded. Some keywords contained in Python such as and, def, break, return, and global. Then the data types contained in Python are integers, floating points, complexes, strings, lists, and tuples [7]. There are several operators in Python. The operators that assist in the process of mathematical calculations are arithmetic operators e.g. + which are useful for addition and * which are useful for multiplication [8]. Assignment operators are useful for placing data into variables, such as = to assign values in the right operand to left operands. Then the comparison operator is useful for comparing the left pass with the right pass. Comparison operators include ==, !=, >, <, >=, and <=. While logic operators are useful for determining the true value of a value. Logical operators consist of and, or, and not [9]. The Python programming language was chosen because in addition to being free and easy to learn, the calculation results have a high level of accuracy so as to provide valid results on the program [10].

Based on the background that has been presented, the purpose of this study is to determine the shortest route in the distribution of industrial gases from PT Tira

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Austenite Tbk Cikarang to 5 consumers with the most purchases of industrial gas in the most types of industrial gas sold in January 2020 to June 2021, namely PT Annisa Mitra Husada, PT Indocement Tunggal Prakarsa, Jiangxi Thermal Power Construction, PT Solusi Bangun Indonesia Tbk, and Universitas Kristen Indonesia with Python programming language.

2 Research Methodology

The type of research used is applied research. Applied research is conducted with the aim of applying, testing, and evaluating the ability of a theory applied to solve practical problems[11]. The study will apply Dijkstra's algorithm to determine the shortest route of industrial gas distribution to 5 consumers. The subject of this study is google maps which is useful in knowing the distance between PT Tira Austenite Tbk Cikarang and 5 consumers. Meanwhile, the object of this study is the route that connects every consumer in the distribution of industrial gas. This research method is a literature study to gather accurate information related to Dijkstra's algorithm and its application in determining the shortest route. The libraries used are reference books and scientific journals.

3 Results and Discussion

The process of distributing industrial gases from PT Tira Austenite Tbk Cikarang to PT Annisa Mitra Husada, PT Indocement Tunggal Prakarsa, Jiangxi Thermal Power Construction, PT Solusi Bangun Indonesia Tbk, and Universitas Kristen Indonesia there is a possibility not to be done every day. Therefore, 1 day is chosen which is the frequency of days most often distributed products to each consumer. Based on sales data from January 2020 to June 2021, the companies that most often distributed products on Mondays are PT Annisa Mitra Husada, PT Solusi Bangun Indonesia Tbk, and Universitas Kristen Indonesia. Meanwhile, for Wednesday is PT Indocement Tunggal Prakarsa and Jiangxi Thermal Power Construction and Friday is Jiangxi Thermal Power Construction.

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Use of Python programming language in finding the shortest route of industrial gas distribution at PT Tira Austenite Tbk Cikarang using a GUI (Graphical User Interface) window. The use of a GUI can make it easier for users in the process to find the shortest route. The syntaxes used in creating the GUI window use the data types, keywords, and operators available in Python. The developed Python program will display a GUI window then it needs a tkinter module in its syntax.

The view that will be seen first by the user after the program in the run is a GUI window that has been created. In the GUI window contains several components that can help users in finding the shortest route. The components that will appear are like buttons. There are 3 buttons that users will see in the initial display, namely the 'Hari Senin', 'Hari Rabu', and 'Hari Jumat' buttons. The button corresponds to the day in the distribution of industrial gases. In addition, there is also a box for users to enter the starting point and endpoint and information for the user regarding the starting point and endpoint that can be entered in the box. Here's the initial view that the user will see.

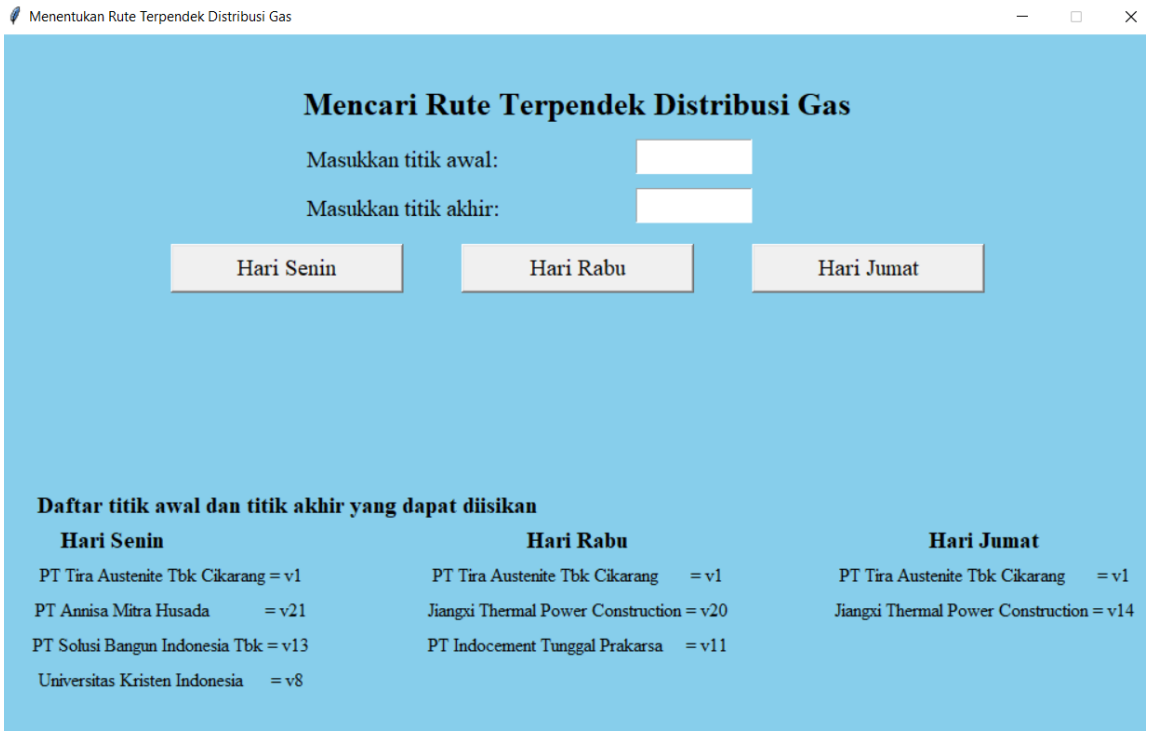


Figure 1. Program Start View

The user can enter the starting point and endpoint according to the information that has been provided. On the available information the starting point and the end point of

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Monday, Wednesday, and Friday are different. This is due to the difference in the company that the distribution process does on each day. After the user fills in the starting point and endpoint, the user can press the ‘Hari Senin’, ‘Hari Rabu’, and ‘Hari Jumat’ buttons based on the shortest route to search. When one of the day buttons is pressed, the user will see results in the form of the length of the track and the route to be traversed. Here is one example when a user confuses v11 as the starting point and v20 as the endpoint and presses the ‘Hari Rabu’ button on the program.

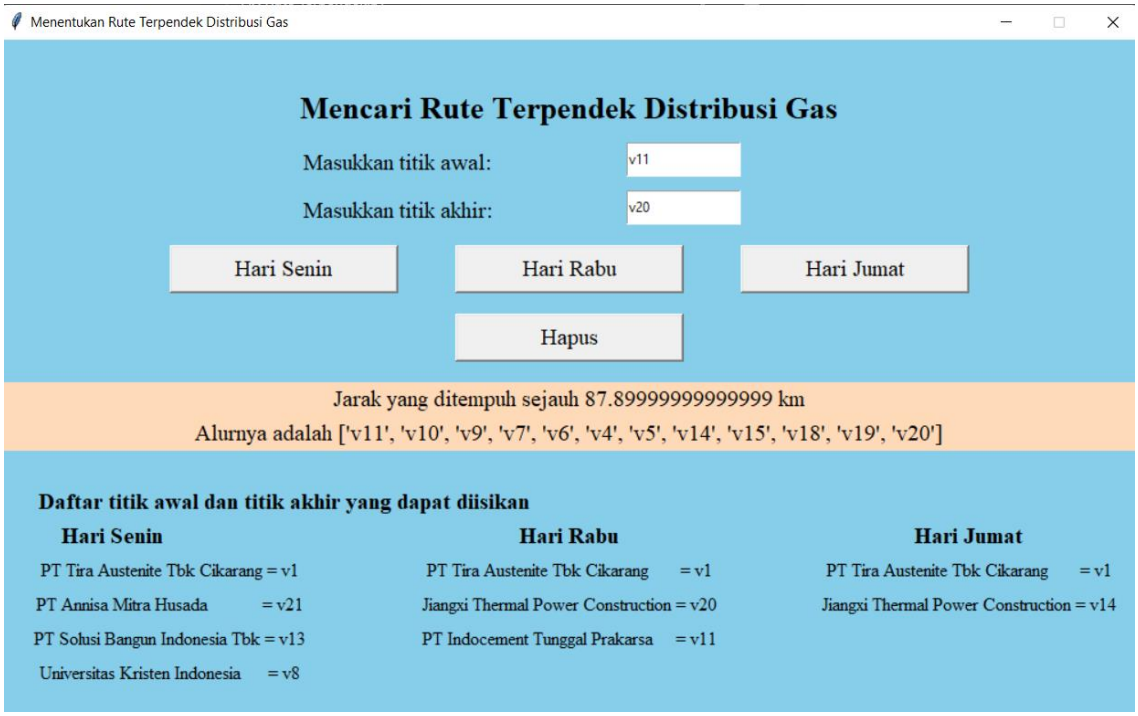


Figure 2. Program Running

This program was created to help and make it easier for users to find the shortest route. Therefore, users will be able to search for the other shortest routes with this program. Users can press the delete button when they want to delete the previous data and perform another shortest route search process. Here is the view that the user will see when pressing the ‘Hapus’ button.

The Python GUI program that has been created is proven to help users in finding the shortest route, especially in distributing industrial gases at PT Tira Austenite Tbk Cikarang. The results displayed are also in accordance with the results of manual calculations.

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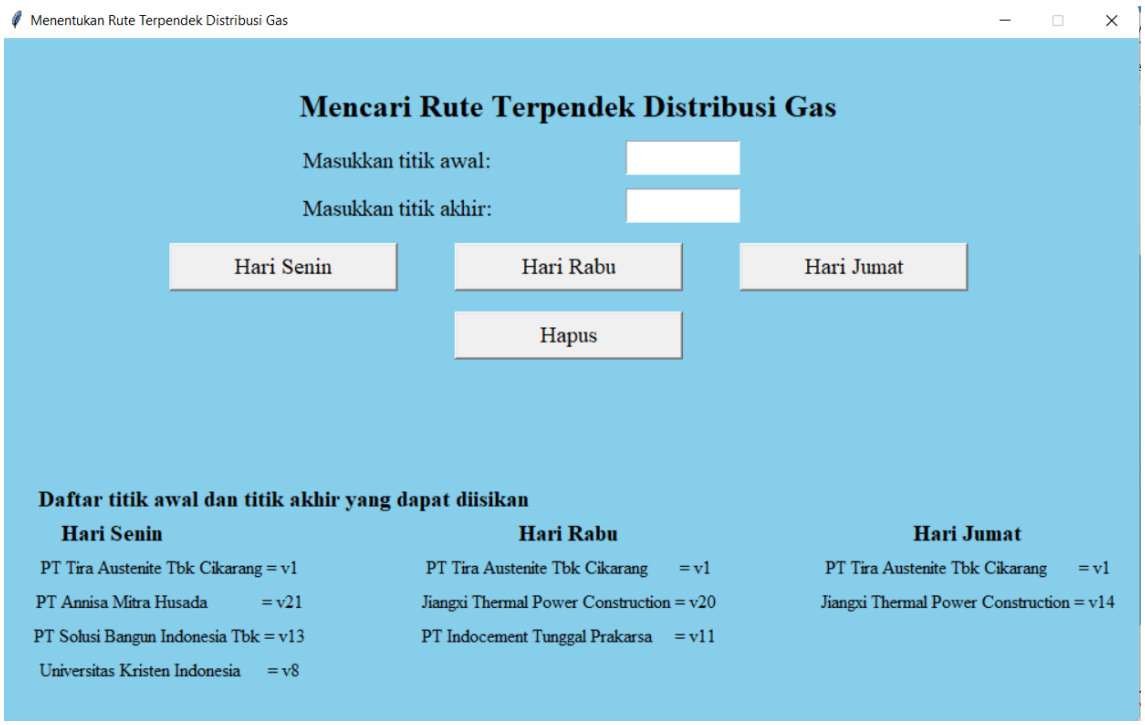


Figure 3. After Pressing the Delete Button

4 Conclusion

The Python programming language is utilized in the process of finding the shortest route of industrial gas distribution at PT Tira Austenite Tbk Cikarang with Dijkstra algorithm by developing GUI windows. GUI window development can make it easier for users to use programs and make the look more attractive. When the user will search for the shortest route can enter the starting point and endpoint on the program. Results will appear when the user presses the Day button which corresponds to the frequency of the day most often distributed to each consumer. Users can also search for other shortest routes without closing the GUI window by pressing the Delete button then all data will be deleted.

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