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Analysis of Sales Distribution Strategy Gallon Water at Harmoni Water Using Monte Carlo Method

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ABSTRACT

Distribution problems currently have an important role in the distribution of goods from producers to consumers because the main function of distribution is the distribution of goods. Currently, Harmoni Water has problems in distribution, the large demand for gallon water causes Harmoni Water to experience problems in distributing water to consumers, so the problems that occur cause Harmoni Water to need a method that is able to find the shortest route for water distribution. so that to solve the problem in Harmoni Water, a monte carlo method is needed to generate random random numbers which can determine the shortest path in the distribution of gallon water in Harmoni Water.

1. Introduction

Technological advances in distribution are closely related to transportation which can facilitate the delivery of goods or services to consumers. for that various businesses, businesses compete, especially in making information systems in order to help the development of business processes or businesses to be more efficient and effective, the rapid development of technology can enable businesses to develop from local businesses to regional businesses, national businesses to multinational businesses according to[1]distribution is distribution is one of the important things in a business field. Every effort is made to ensure that the goods reach consumers quickly and are well received. One of the places of business studied is "Harmoni Water" Harmoni Water currently has problems in distributing gallon water to consumers, many obstacles or problems that often become obstacles, one of which is the delay in sending gallon water to customers, due to different locations, this problem. which often leads to a decrease in gallon water buyers at Harmoni Water,[2]. While in other research related to distribution (Fahmi 2020), the Ant Colony algorithm is applied to solve problems in distribution and get better accuracy and distance values. According to[3]Monte Carlo simulation is a very practical method used to solve problems related to uncertainty. according to (Manurung and Santony 2019) Monte Carlo is a method that has a statistical test category. According to[4] The unified modeling language (UML) is a "language" that has become an industry standard for visualizing, designing and documenting software systems.[5] The monte carlo method is a numerical analysis method that involves random number experimental sampling. the montecarlo method can be applied in various fields, in a way its application is different from other fields. According to [6]The basis of the monte carlo simulais is a probability element experiment using a random sample. According to[7] Use case diagrams are diagrams that must be made first when modeling object-oriented software [8]Monte Carlo is a type of probability simulation that approaches the solution of a problem by sampling from a random process. Monte Carlo involves determining the probability distribution of a studied variable and then taking a random sample of the distribution to generate the data.[9] distribution is an activity in which a business is carried out to move a product from the producer to the consumer.

2. Method

2.1 Research Framework

The following is a research framework carried out by researchers in solving problems, namely as follows:

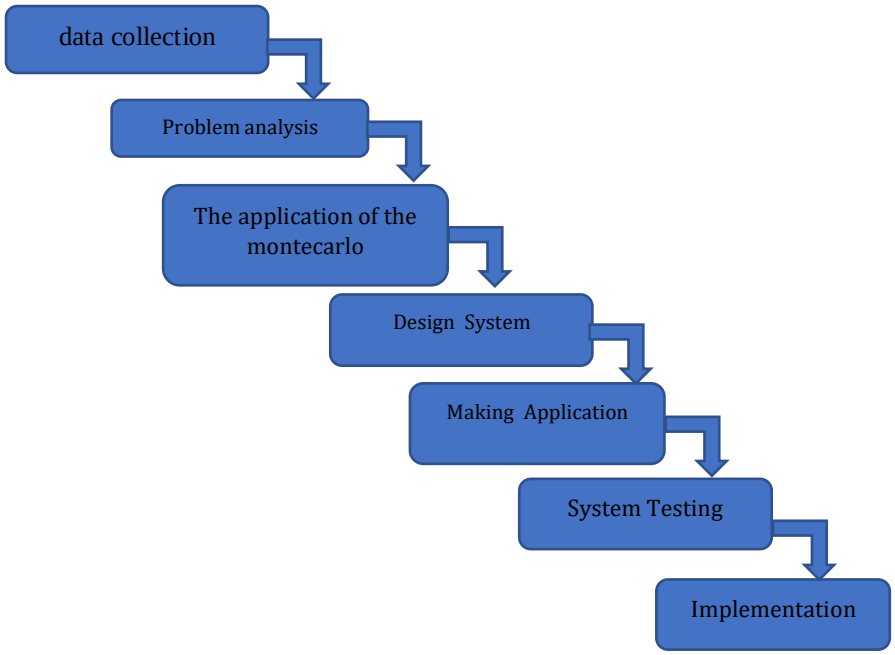

Figure 1. Research methodology with the Waterfall Model

2.2 Data collection

In obtaining data, several methods have been used to obtain data in accordance with the research needs. The method referred to in research.

Table 1.
The name of the distribution line

NO	Point of Location of Harmoni Water Business (x)	Distribution Location Name Gallon water made in the form (BLOCK)
1	X	Harmony = Block A.
2	X	Mesjid I Cemara = Blok B
3	X	Earth twinkling = Block C
5	X	Mosque I teak fence = Block D
6	X	Jln.pembangungan = Blok E
7	X	Pumpkin pantsi = Block F
8	X	jln. siantar = Block G.

2.3 Application of the Monte Carlo Method

In this simulation, there are several steps taken, both from the initialization of the graph and the determination of the random variable in the monte carlo.
Step 1: Initialize the number of vertices (n).
Step 2: From the number of vertices we will be able to calculate the number of edges (e).

$$e = n\frac{(n-1)}{2}$$

Step 3: Initialize the weights of all edges (w). If we use v = 5, then the sum of e (w) = (e1, e2,..., e10), for each edge has e1 = weight value, e2 = weight value,...., E10 = weight value, the weight value is initialized according to the value conditions weight.

Step 4: Determine the distribution of random values on the edges. If we are going to go through all the points on the graph then at one point we will stop. For this reason, all the edges on the graph have a chance to be selected with a random value distribution. Let r be a random value with an interval of 0≤r≤1, with a distribution

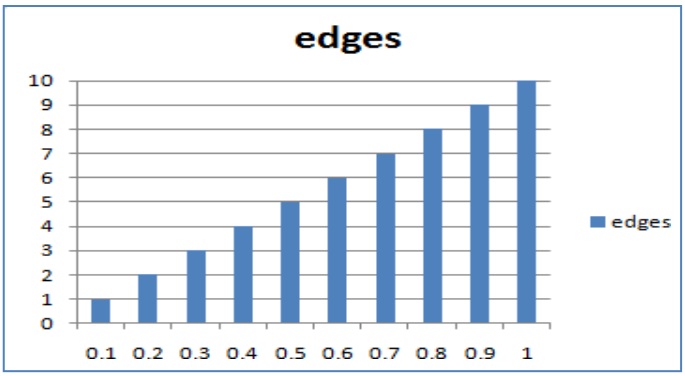

Figure 2. Distribution of random values to edgeSumber [6]

Table 2
Random table

Edge	Random
e1	≤ 0.1
e2	≤ 0.2
e3	≤ 0.3
e4	≤ 0.4
e5	≤ 0.5
e6	≤ 0.6
e7	≤ 0.7
e8	≤ 0.8
e9	≤ 0.9
e10	≤ 1

Step 5: Determine the number of edges needed in the shortest path. Each edge only connects 2 vertices, so the number of edges required is

$$P = n - 1$$

P = number *edge* that taken in random.

n = number of vertices.

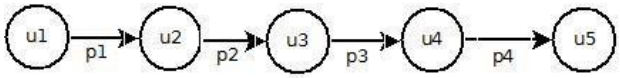

Figure 3. U (H) = V (H), P (H) ⍰E (H)

Source [6]

U (H) = {u1, u2, u3, u4, u5}, is the order in which the vertices appear from the random distribution.

P (H) = {p1, p2, p3, p4}. If in a random distribution, the history of the emerging edges will be stored in P (H) if the same edge appears then random will be repeated.

Step 6: Selection, One generation is the order of vertices based on the random distribution and the sum of all edges that appear.

$$fi \sum_{i=1}^{n-1} pi$$

Where i = 1,2,3,... f = the path results in generations. The best generation is the generation with the shortest path. The generation that appears depends on the number of epochs that are done, the more epochs that are done the more generations that can be selected and the greater the chance to get the shortest path.

3. Results and Discussion

3.1 Analysis and Application of Methods

Analysis is a problem-solving technique by breaking the system into components with the aim of studying these components work and interacting to complete their goals. System design is a complement to system analysis into a complete system with the aim of getting a better system.

Analysis is a step in understanding the problem to be solved before taking action or design decisions system to be created. While the system design stage is a stage carried out after the analysis phase that defines needs functional and prepare the design and build implementation to be describes how the system will be formed.

The Monte Carlo method in analyzing the distribution strategy of water sales is a system that can help water harmony efforts in finding the shortest route in distributing gallon water to consumers.

Data analysis is an effort or way to process data into information so that the characteristics of the data can be understood and are useful for solving problems, especially problems related to research. In analyzing data, data is necessaryprepared in analyzing the distribution strategy of the sale of gallon water with the search for the shortest route the Monte Carlo method.

Table 3.
Is a table of the names of distribution places in harmoni water which is made in the form of blocks.

No	Point of Location of Harmoni Water Business (x)	Distribution Location Name Gallon water made in the form (BLOCK)
1	X	Harmony = Block A.
2	X	Mesjid I Cemara = Blok B
3	X	Earth twinkling = Block C
5	X	Mosque I teak fence = Block D
6	X	Jln.pembangungan = Blok E
7	X	Pumpkin pantsi = Block F
8	X	jln. siantar = Block G.

a) Block (A)

Table 4.
The distance in each block to the block visited

No.	Starting point (x)	(Block A)	Visited blocks	Distance traveled (km)
1	X	A	B	1 km
2	X	A	C	4 km
3	X	A	D	6 km

b) Block (B)

Table 5.
The distance in each block to the block visited

No.	Starting point (x)	(Block B)	Visited blocks	Distance traveled (km)
1	X	B	C	4 Km
2	X	B	E	6 km
3	X	B	G.	5 km

c) Block (C)

Table 6.
The distance in each block to the block visited

No.	Starting point (x)	(Block C)	Visited blocks	Distance traveled (km)
1	X	C	D	2 Km
2	X	C	E	3 km
3	X	C	G.	4 km

d) Block (D)

Table 7.
The distance in each block to the block visited

No.	Starting point (x)	(Block D)	Visited blocks	Distance traveled (km)
1	X	D	E	2 Km
2	X	D	F	3 km
3	X	D	H	1 km

e) Block (E)

Table 8.
The distance in each block to the block visited

No.		(Block E)	Visited blocks	Distance traveled (km)
1	X	E	F	5 Km
2	X	E	G.	5 km

f) Block (F)

Table 9.
The distance in each block to the block visited

No.	Titik starting location (x)	(Block F)	Visited blocks	Distance traveled (km)
1	X	F	G.	6 Km

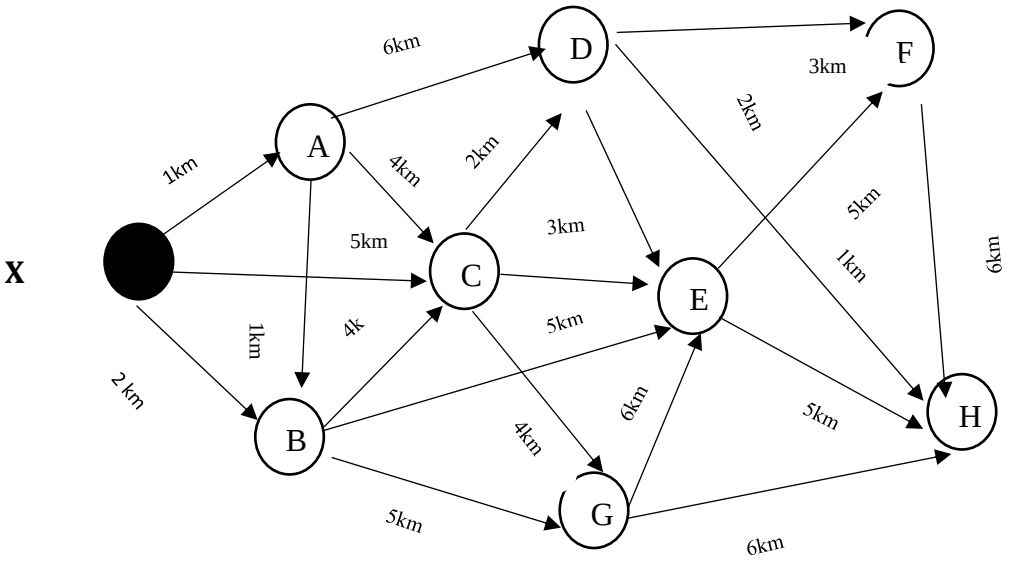

Figure 4. Distribution line graph

In accordance with the table above, for the search for the shortest route, the steps taken by making a distribution line graph in each distribution block in Figure 4 are determined.

3.2 Analysis of the Application of the Monte Carlo Method

This method is divided into 5 stages, namely :

1. Distribution line

The following figure 5. is the distribution route for gallon water in water harmony where each place or block has a different distance.

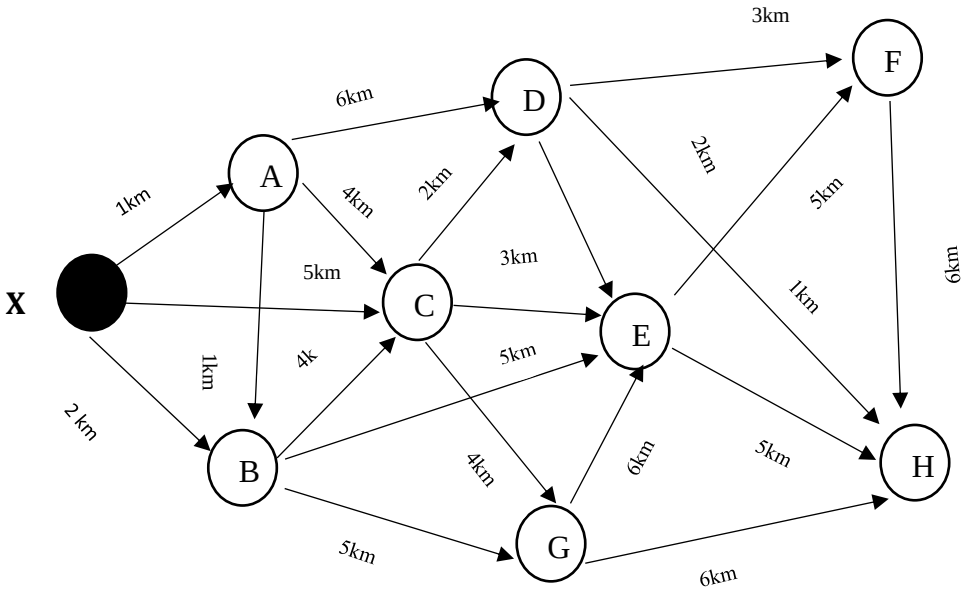

Figure 5. Distribution line graph

2. Build a cumulative likelihood distribution for each variable in the first stage.

To determine the shortest route, the distance that must be covered on each route is determined in order to facilitate water harmony efforts in the search for the shortest route. Following are some of the paths in finding the shortest route in water harmony in graph form.

a) The first pass:

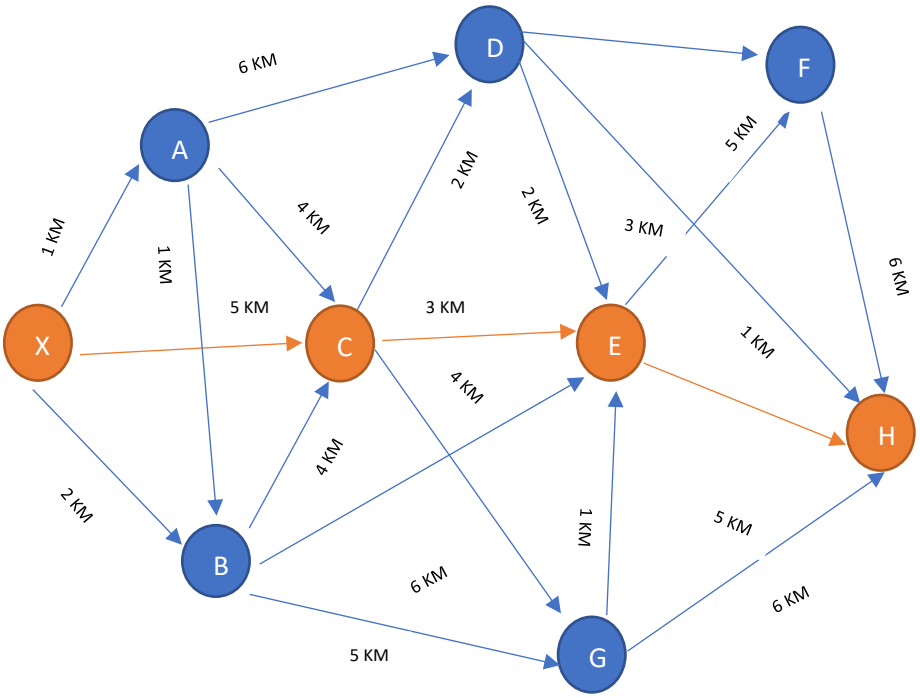

Figure 6. Distribution line graph

Table 8.
The first pass

No.	Block code	Distance
1	X- C	5 km
2	CE	3 KM
3	EH	5 KM

(xc) = 5 km (ce) = 3 km (eh) = 5 km
5 + 3 + 5 = 13
H = 13 km

b) The second pass:

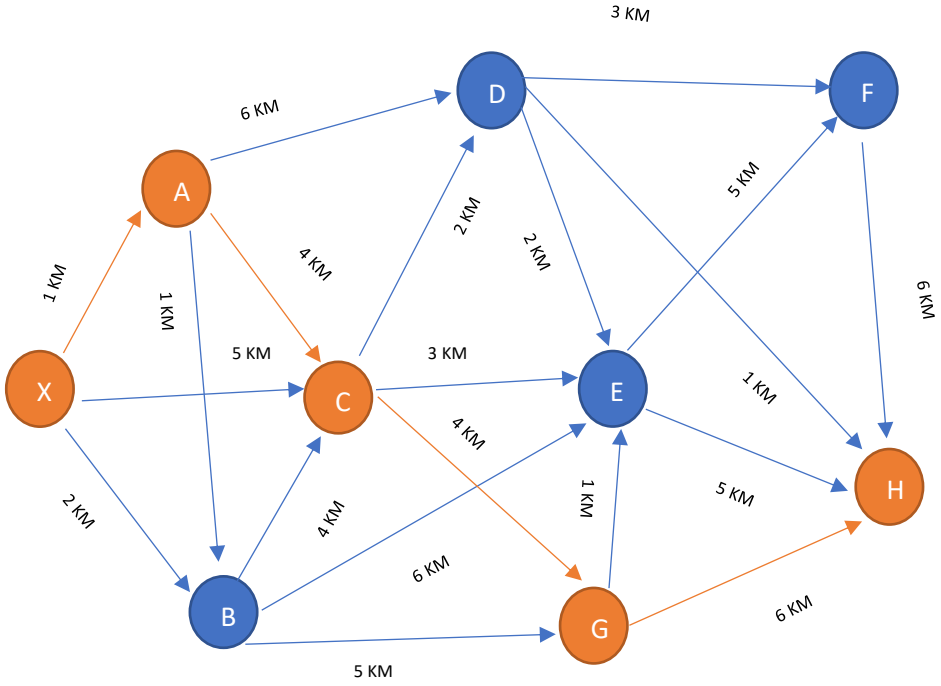

Figure 7. Distribution line graph

Table 9.
Second track

No.	Block code	Distance
1	X- A	1 KM
2	air conditioning	4 KM
3	CG	4 KM
4	GH	6 KM

(xa) = 1 km (ac) = 4 km (cg) = 4 km (gh) = 6 km
1 + 4 + 4 + 6 = 15
H = 15 k

c) The third pass:

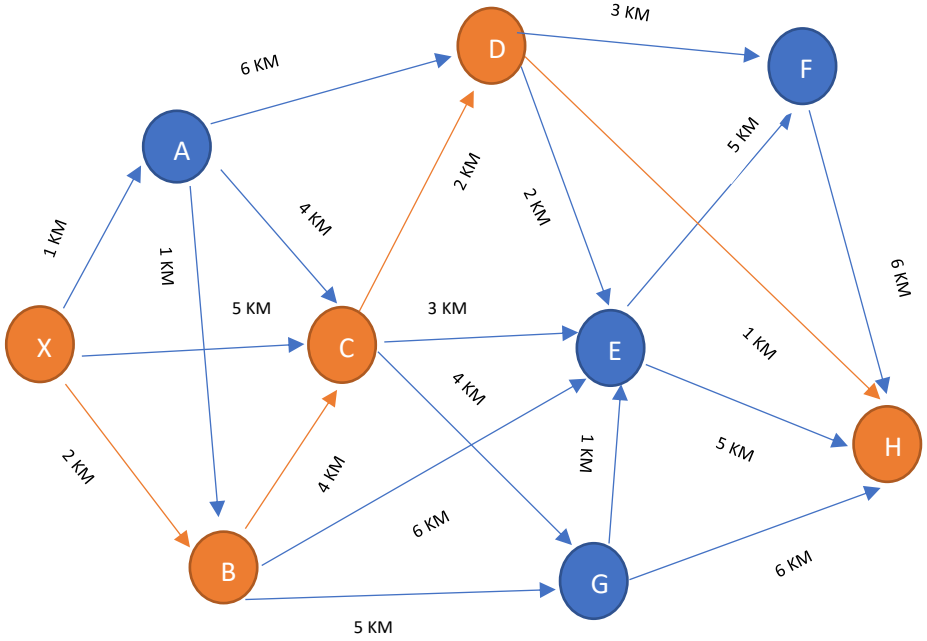

Figure 8. Distribution line graph

Table 10.
Passage three

No.	Block code	Distance
1	X- B	2 km
2	B-C	4 KM
3	C-D	2 KM
4	D-H	1 KM

(xb) = 2 km (bc) = 4 km (cd) = 2 km (dh) = 1
2 + 4 + 2 + 1 = 9 km
H = 9 km

d) The fourth pass:

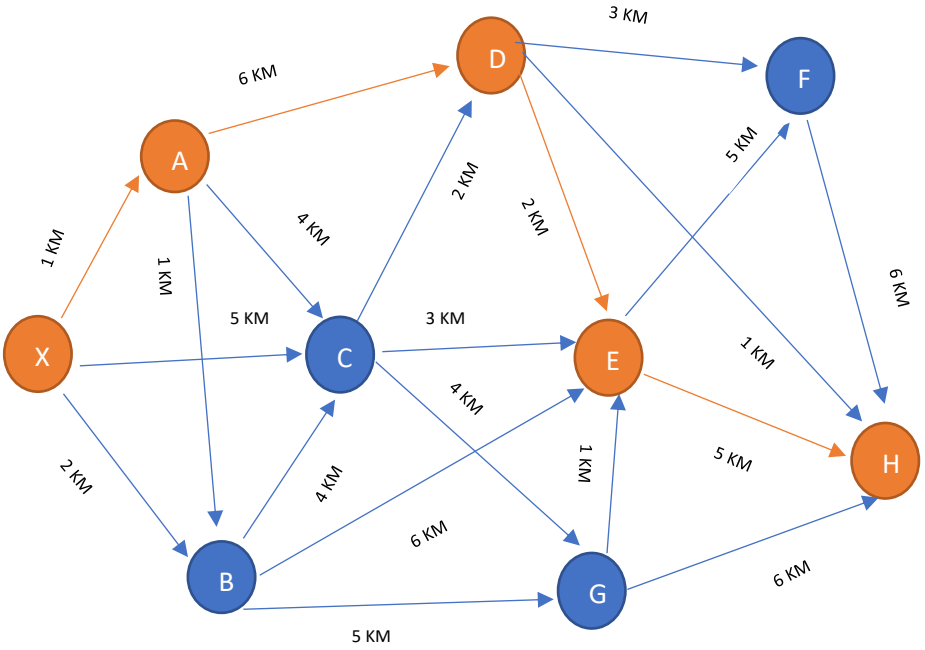

Figure 9. Distribution line graph

Table 11.
The fourth pass

No.	Block code	Distance
1	X- A	1 km
2	A-D	6 KM
3	D-E	2 KM
4	E-H	5 KM

(xa) = 1 km (ad) = 6 km (df) = 3 km (fh) = 6
1 + 6 + 3 + 6 = 16 km
H = 16 km

e) The fifth pass:

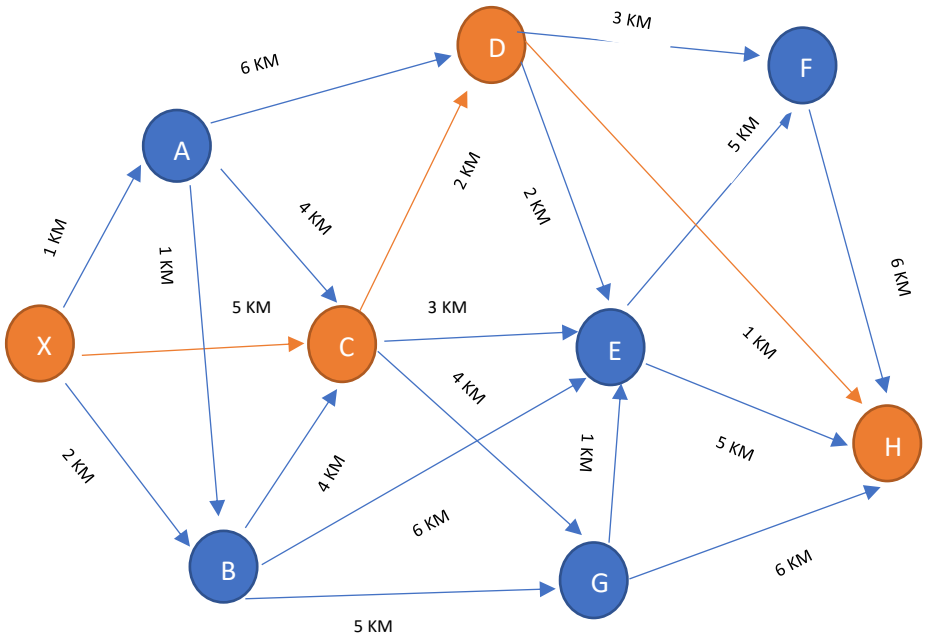

Figure 10. Distribution line graph

Table 12.
The first pass

No.	Block code	Distance
1	X- C	5 km
2	C-D	2 KM
3	D-H	1 KM

(xc) = 5 km (cd) = 2 km (dh) = 1
5 + 2 + 1 = 8 km
H = 8 km

f) The sixth pass:

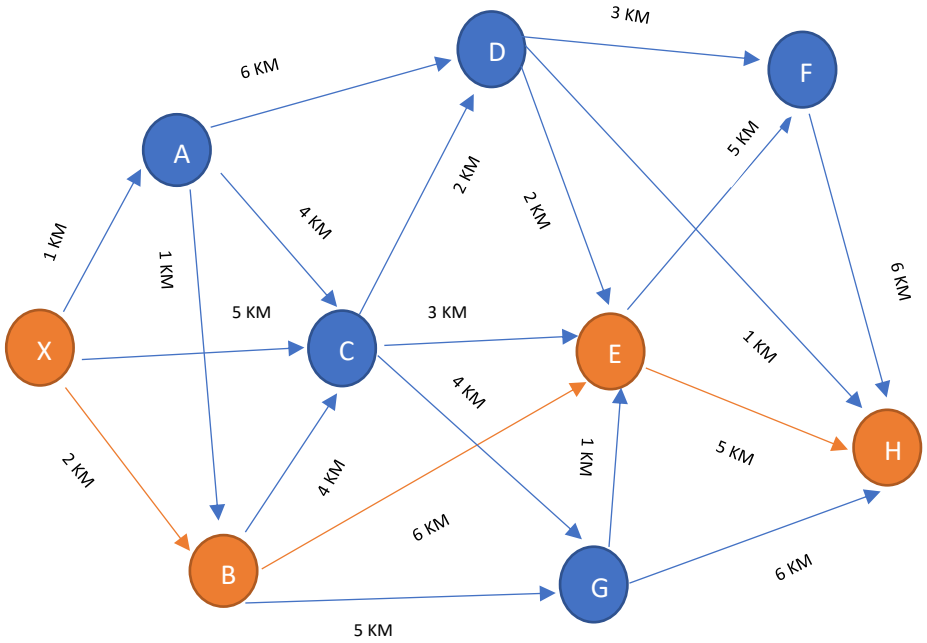

Figure 11. Distribution line graph

Table 13.
The sixth line

No.	Block code	Distance
1	X- B	2 km
2	B-E	6 KM
3	E-H	5 KM

(xb) = 2 km (be) = 6 km (eh) = 5
2 + 6 + 5 = 13 km
H = 13 km

g) The seventh track:

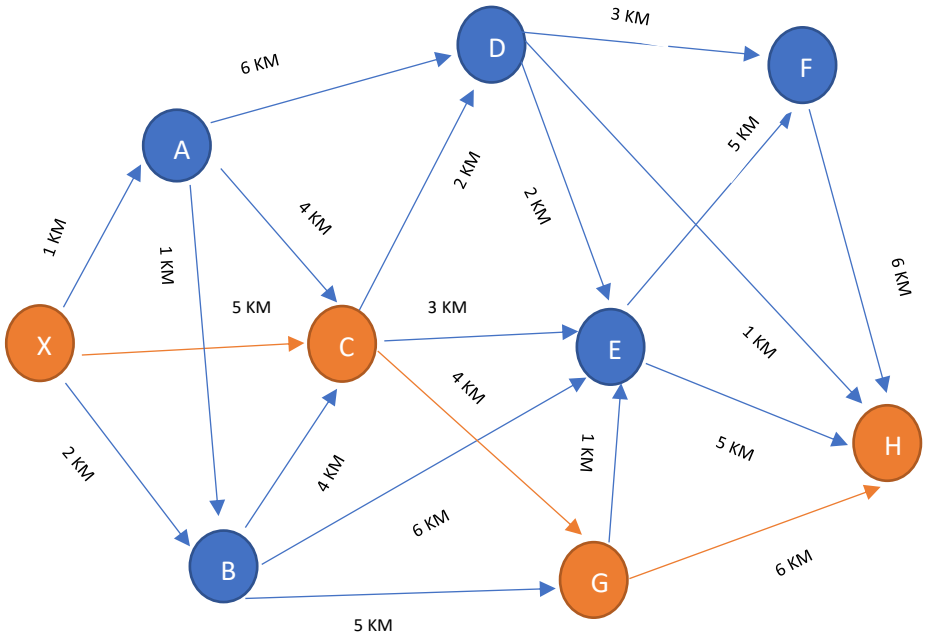

Figure 12. Distribution line graph

Table 14.
The first pass

No.	Block code	Distance
1	X- C	5 km
2	CG	4 KM
3	GH	6 KM

(xc) = 5 km (cg) = 4 km (gh) = 6
5 + 4 + 6 = 15 km
H = 15 km

3. Determine the random number interval for each variable.

So from some of the routes above, which have different distances, it can be concluded that the results of the lowest path distance are the shortest paths in the distribution of gallon water in water harmoni along with the results of the distance traveled on each path.

L1 = 13 km
L2 = 15 km
L3 = 9 km
L4 = 16 km
L5 = 8 km
L6 = 13 km
L7 = 15 km

Then the shortest path is low
L5 = 8 km

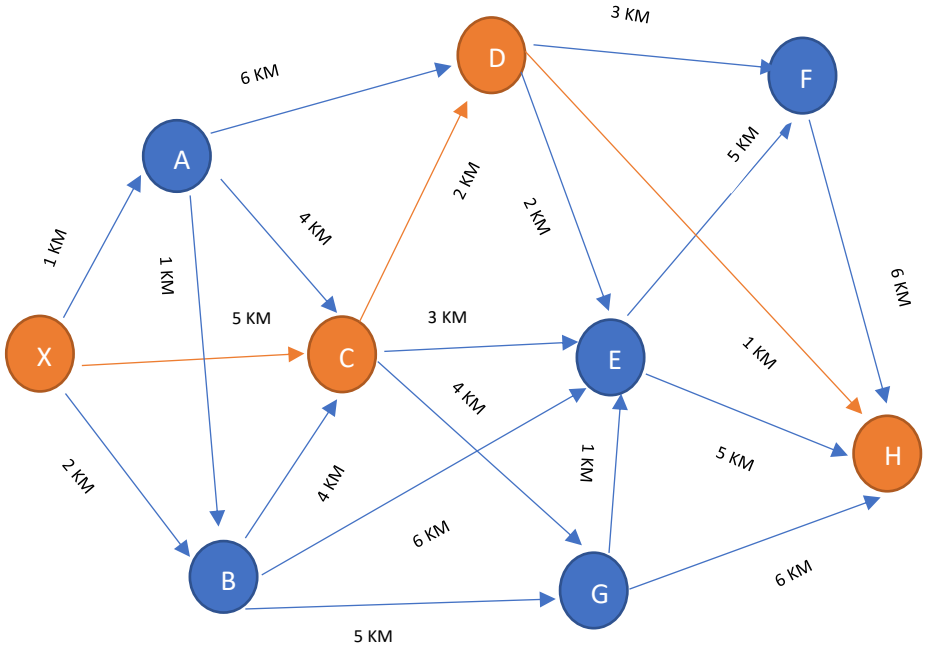

Figure 13. The shortest distributed path graph

Table 15.
The shortest path

No.	Block code	Distance
1	X- C	5 km
2	CD	2 KM
3	DH	1 KM

(xc) = 5 km (cd) = 2 km (dh) = 1
5 + 2 + 1 = 8 km
H = 8 km

So from some of the trajectories above, it can be concluded that the fifth line is the shortest line of 8 km.

4. Determination of the distribution of random values on the edges

Let r be a random value with an interval of 0≤r≤1, with a distribution.

Table 16.
Random value

Edged	Random
L1	≤ 0.8
L2	≤ 1
L3	≤ 0.5
L4	≤ 0.8
L5	≤ 0.5
L6	≤ 0.8
L7	≤ 1

5. Make a simulation experiment

Is a table of results from generating random random numbers in the search for the shortest route so that you get a random value in each edged.

From the results of the random random number generator, the result of the search for the shortest route is

L5 = with distance = 8 km and random value = 0.5
L3 = with a distance = 9 km and a random value = 0.5

3.3 System Implementation

a. Use Case Diagram

*Use Case Diagram*describe the system requirements functionally by identifying the actors involved and interacting with the basic functions of the system. Use Case Diagrams will explain what functions the system performs. The use case diagram of the system is described as follows:

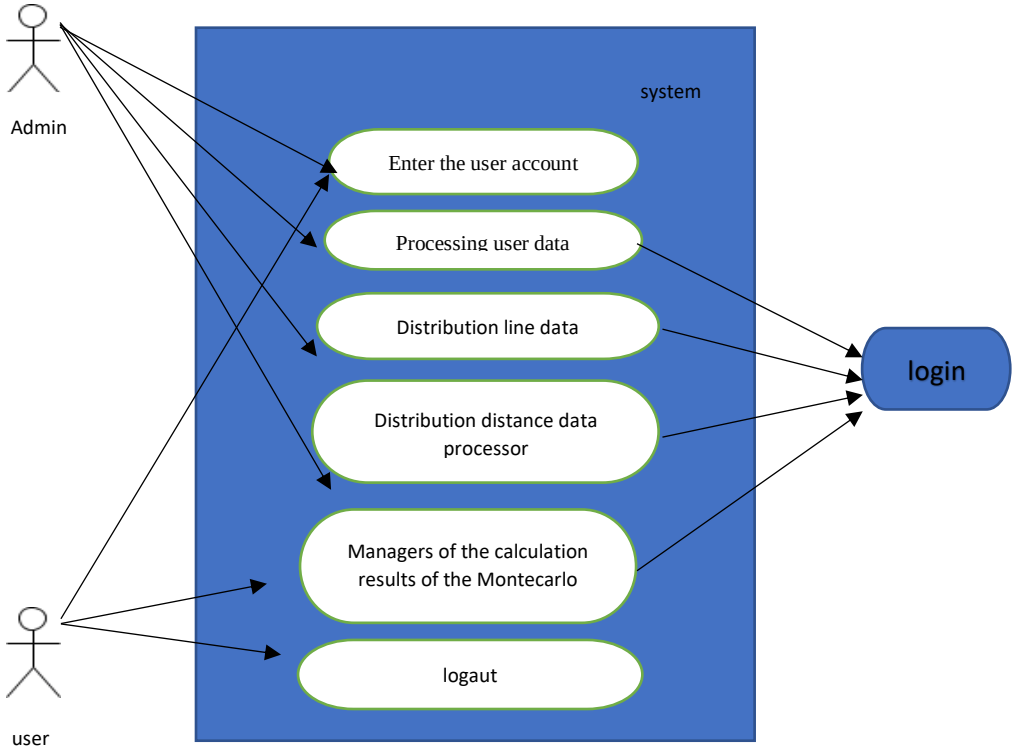

Figure 14. Use case diagram

b. Result Display

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No.	Id.Jalur	Nama Lintasan	Kode Blok	Hasil	Perhitungan Nilai Random Jarak
1	J05	Lintasan 5	5	8	0.5
2	J03	Lintasan 3	3	9	0.57142857142857
3	J06	Lintasan 6	6	13	0.85714285714286
4	J01	Lintasan 1	1	13	0.85714285714286
5	J02	Lintasan 2	2	15	1
6	J07	Lintasan 7	7	15	1
7	J04	Lintasan 4	4	16	1.0714285714286

Figure 15. Display The result of the search for the shortest route

4. Conclusion

With the completion of all system analysis research activities, program design, to implementation and discussion, the researcher can draw the following conclusions.

a. Based on the research discussion, "analysis of the distribution strategy of gallon water sales at Harmoni Water using the monte carlo method" can facilitate water harmony efforts in optimizing the gallon water distribution system to consumers.
b. The search for the shortest route for distributing gallon water in harmony water using the monte carlo method can be resolved.
c. With this research, it can increase sales of gallon water at Harmoni Water.

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