UNIVERSITAS BHAYANGKARA JAKARTA RAYA
FAKULTAS ILMU KOMPUTER
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Telepon: (021) 27808121 – 27808882
Kampus II: Jl. Raya Perjuangan, Marga Mulya, Bekasi Utara, Jawa Barat, 17142
Telepon: (021) 88955882, Fax.: (021) 88955871
Web: fasilkom.ubharajaya.ac.id, E-mail: fasilkom@ubharajaya.ac.id

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Nomor: ST/149/IX/2021/B-FASILKOM-UBJ

1. Dasar: Kalender Akademik Ubhara Jaya Tahun Akademik 2021/2022.

2. Dalam rangka mewujudkan Tri Dharma Perguruan Tinggi untuk Dosen di Universitas Bhayangkara Jakarta Raya maka dihimbau untuk melakukan Penelitian.

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2.	Prima Dina Atika, S.Kom., M.Kom.	0311037107	Dosen Tetap Prodi Informatika	Sebagai Penulis Kedua
3.	Ajif Yunizar Pratama Yusuf, S.Si., M.Eng.	0328068603	Dosen Tetap Prodi Informatika	Sebagai Penulis Ketiga
4.	Fata Nidaul Khasanah, S.Kom., M.Eng.	0327059202	Dosen Tetap Prodi Informatika	Sebagai Penulis Keempat

Membuat Artikel Ilmiah dengan judul **"*Android-Based Shortest Path Finding Using A-Star (A*) Algoritm in Bekasi City*"** dengan menerima LoA pada tanggal 23 September 2021 untuk dipublikasikan di media Jurnal Penelitian Ilmu Komputer, Sistem *Embedded and Logic*, Vol. 9, No. 2, September 2021, Hal. 197-210, p-ISSN: 2303-3304, e-ISSN: 2620-3553.

4. Demikian penugasan ini agar dapat dilaksanakan dengan penuh rasa tanggung jawab.

Bekasi, 23 September 2021
DEKAN FAKULTAS ILMU KOMPUTER

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p-ISSN: 2303-3304
e-ISSN: 2620-3553
Vol. 9 No. 2 September 2021

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Penelitian Ilmu Komputer
Sistem *Embedded and Logic*

Computer Science Research to Support Business, Education, and Management in Adapting to New Habits

Department of Computer Engineering
Universitas Islam "45" Bekasi

p-ISSN: 2303-3304
e-ISSN: 2620-3553

Vol. 9 No. 2 September 2021

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The Use of Location-Based Augmented Reality as Information Media in The Digital Map Application of Jakabaring Sport City
Siska Arifiani, Miranda Manurung, Raden Venantius Hari Ginardi ..... 103 - 118

Air Pollution Monitoring System Based on IoT with Cloud
Emny Harna Yossy, Arya Maulana, Ramadhani Prastyantoro ..... 119 - 134

Color Blind Test Using Ishihara Method for Mercu Buana University Prospective Students Selection
Sri Dianing Asri, Adhitya Dwiki Darmawan, Novianti Putri Wibowo, Dimas Riyanto Wibowo ..... 135 - 146

Evaluation of Web-Based Car Park Information System at PPPSRS Puri Casablanca Jakarta
Beno Aditya Sanusi, Herlawati, Prio Kustanto, Muhammad Harviansyah, Anisa Feby Yana, Ervan Dwi Kurniawan..... 147 - 160

Designing Motorcycle Security System Using E-KTP Sensor and SMS Gateway
Juani Khuswara Maulidin, Abrar Hiswara, Rafika Sari ..... 161 - 172

Fire Detection System Using Android-Based Microcontroller
Akbar Rafni Rafsan Jani, Dwipa Handayani, Achmad Noeman ..... 173 - 184

Computer-Based Test Application to Support E-Learning in Pandemic Situation
Imam Soleh Marifati, Joko Dwi Mulyanto, Chandra Kesuma, Ubaidillah, Suripah..... 185 - 196

Android-Based Shortest Path Finding Using A-Star (A*) Algorithm in Bekasi City
Herlawati, Prima Dina Atika, Ajif Yunizar Pratama Yusuf, Fata Nidaul Khasanah, Endang Retnoningsih, Beno Aditya Sanusi, Gedhe Hilman Wakhid ..... 197 - 210

Department of Computer Engineering
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p-ISSN: 2303-3304
e-ISSN: 2620-3553
Vol. 9 No. 2
September 2021

PIKSEL status is accredited by the directorate general of research strengthening and development no. 28/E/KPT/2019 with Indonesian Scientific Index (SINTA) journal-level of S5, starting from volume 6(1) 2018 to volume 10(1) 2022.

First publish in 2013.
Available online since 2018.

From Editor-in-Chief

Rahmadya, Ph.D.
Editor-in-Chief

Assalamu'alaikum
Warahmatullahi Wabarokatuh.

Best wishes to all the members of Editorial Board, Reviewers Panel, Authors and Readers of PIKSEL for a very happy, and stay healthy in adapting to new habits because of COVID-19.

The computer science researcher is facing many challenges after pandemic COVID-19 disaster, e.g. designing appropriate online applications, software evaluation, educating people for online activities, etc.

Augmented Reality (AR) that bring a reality to computer is still on demand for education and tourism. Testing using computer best test (CBT) should be prepared for every e-learning system. The ubiquitous app, such as color-blind test, can be used to help admission system in a school. Internet of things (IoT) are still in demand in this pandemic situation e.g. air pollution monitoring system, car park, vehicle security system, and fire detection system.

I hope this issue contribute to support nation in facing the pandemic, especially in adapting to new habits. And once again, thank you to members of Editorial Board, Reviewers Panel, Authors and Readers of PIKSEL.

Publisher: LPPM Universitas Islam 45
Office:
Fakultas Teknik Universitas Islam 45
Jl. Cut Meutia No. 83 Margahayu Kecamatan Bekasi Timur
Kota Bekasi Jawa Barat Indonesia 17113
Telp. (021) 8802015
e-mail: piksel.unisma@gmail.com
e-mail: piksel@unsimabekasi.ac.id
website: http://jurnal.unismabekasi.ac.id/index.php/piksel

p-ISSN: 2303-3304
e-ISSN: 2620-3553
Vol. 9 No. 2
September 2021

PIKSEL status is accredited by the directorate general of research strengthening and development no. 28/E/KPT/2019 with Indonesian Scientific Index (SINTA) journal-level of S5, starting from volume 6(1) 2018 to volume 10(1) 2022.

Editor Board Journal PIKSEL

p-ISSN: 2303-3304
e-ISSN: 2620-3553
Vol. 9 No. 2
September 2021

PIKSEL status is accredited by the directorate general of research strengthening and development no. 28/E/KPT/2019 with Indonesian Scientific Index (SINTA) journal-level of S5, starting from volume 6(1) 2018 to volume 10(1) 2022.

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Penelitian Ilmu Komputer, Sistem Embedded and Logic
p-ISSN: 2303-3304, e-ISSN: 2620-3553
Vol. 9 (2): 197 – 210 (September 2021)

Android-Based Shortest Path Finding Using A-Star (A*) Algorithm in Bekasi City

Herlawati [1], Prima Dina Atika [1], Ajif Yunizar Pratama Yusuf [1], Fata Nidaul Khasanah [1], Endang Retnoningsih [2,*], Beno Aditya Sanusi [1], Gedhe Hilman Wakhid [1]

[1] Informatics; Universitas Bhayangkara Jakarta Raya; Jl. Raya Perjuangan Bekasi Utara, Kota Bekasi, Jawa Barat; e-mail: herlawati@ubharajaya.ac.id, prima.dina@dsn.ubharajaya.ac.id, ajif.yunizar@dsn.ubharajaya.ac.id, fata.nidaul.khasanah@dsn.ubharajaya.ac.id, beno.aditya17@mhs.ubharajaya.ac.id, gedhe.hilman17@mhs.ubharajaya.ac.id.
[2] Informatics Engineering; Institut Bisnis Muhammadiyah Bekasi; Kampus A: Kavling 17A No. 16 Jalan Sersan Aswan RT 002/009 Margahayu Bekasi Timur; e-mail: endang.retnoningsih44@gmail.com

* Corespondence Author: e-mail: endang.retnoningsih44@gmail.com

Received: 20 August 2021; Revised: 28 August 2021; Accepted: 23 September 2021; Available online: 25 September 2021

Abstract

Getting information on routes can be he main problem for visitors. For example in determining the route to a proper place for eating and how to find the closest route to a mall. Based on the existing problems, this study proposes an application for finding information about places that visitors want to go based on the closest route. Algorithm A-Star (A) was implemented that uses the distance estimation by finding the closest path to the destination using a heuristic function as a basis to select from several alternatives effectively. The result showed that an android application can give the information about the location*

of places to visit for eating and malls by calculating the distance from the starting point to the end point.

Keyword : A-Star (A*) Algorithm, mall, nearest location, restaurant.

1. Introduction

According to data from (Statcounter, 2021) there are 91.42% of Android users in Indonesia, consists of 8.39% of iOS users and 0.04% of Windows Operating System users. In the technology era, there are many ways to get information based on geographic location with the help of technological devices (Marcelina & Yulianti, 2020). The development of information technology about locations and places makes everyone easy to obtain some locations, one of which is developing graphical data-based information that uses latitude and longitude as location coordinates (Mohamad et al., 2017).

A specific application is needed to find places to eat such as restaurants or cafes. In searching for malls from Pondok Ungu Permai, North Bekasi, to the 7 nearest malls in Bekasi, e.g. Summarecon Mall Bekasi, Grand Metropolitan Mall Bekasi, Grand Galaxy Park, Grand Mall Bekasi, Revo Town Bekasi, Bekasi Cyber Park, and Mega Bekasi Hypermall. Given the volume of vehicles in Bekasi which are increasingly difficult to control and traffic jams, finding the nearest route is the right solution for Mall visitors to arrive at their destination on time. With the problem of finding places to eat and malls, we need an information system facility that can be used to overcome this problem.

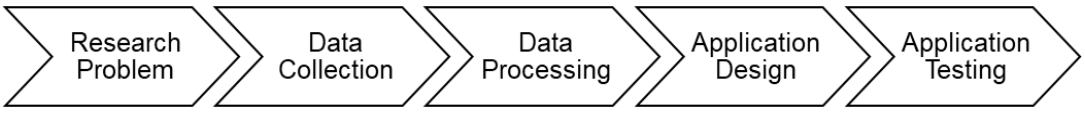
Determining the shortest path is how to get the graph path by minimizing the number of weights forming the path (Retnoningsih & Khasanah, 2018). There are several algorithms that can search for the shortest route, one of which is the A-Star (A*) algorithm. The A* algorithm is an improved algorithm from the Best First Search algorithm that combines Uniform Cost Search and Greedy Best First Search, with heuristic function modifications (Pramudhita & Muljono, 2018; Widodo & Ahmad, 2018). The A* algorithm has a heuristic function where the heuristic is an appraiser that can give a price to each node so that it can provide the desired solution (Nuryoso et al., 2020). The A*

algorithm is one of the best graph search algorithms that has optimal and complete capabilities in solving a problem related to finding or determining a route with the closest distance (Budiman et al., 2018; Purnama et al., 2018).

2. Research Method

The A-Star (A*)algorithm is one of the algorithms that uses the estimation of the closest distance to reach the goal and has a heuristic value that is used as a basis for consideration to determine the choice of a number of alternatives to achieve the target effectively (Nuryoso et al., 2020). In finding the route, we can use the A* algorithm calculation and the Heuristic method.

To make it easier for researchers in the process of making applications, a research flow is made as shown in Figure 1, with the following explanations. a) researching problems in the form of how to increase accuracy on travel routes and implement the A-Star (A*) algorithm in searching for several nearby locations ; b) collecting data by making direct observations of the object in question and recording important information such as coordinates, addresses, and place names; c) data processing, at this stage an A-Star Algorithm (A*) calculation will be carried out using the formula; d) application design, the researcher creates a user interface and performs coding by applying the data from the recorded data processing results; e) testing of applications using the A-Star Algorithm (A*) is carried out using the Black Box Testing method to get the expected results; f) after testing it produces an android application to search for the nearest route using the A-Star (A*) algorithm.



Source: Research Results (2021)

Figure 1. Research Flow

Research Problem

The shortest route finding is an attempt to find the shortest route from the initial location to the destination location with the fastest travel time compared to other routes. Therefore, in this study to solve the problems: a) how to get the

level of accuracy on the travel route to find the nearest location using the A-Star (A*) algorithm; b) how to implement A* algorithm for android application users.

Data Collection

To find the closest route to a place for eating, some area in Tambun Selatan sub-district in the form of: a) the coordinates of the location of the place to eat; b) the name of the place to eat; and c) the address of the place to eat. Meanwhile, data collection for the search for the closest route to the mall was carried out from the starting point of Pondok Ungu Permai Blok C15, Central Kaliabang sub-district, North Bekasi District to several malls in the city of Bekasi. The collection of data on eating places around Tambun Selatan is as shown in Table 1.

Table 1. Data Collection of Places to Eat in South Tambun

No	Location	Address	Coordinates
1	Steak Terrace	Perumahan Puri Cendana, Jl. Sumber Jaya Blok RPC No.142	-6.2345, 107.0677
2	Kopi Teknik	Sumber Jaya, Kec. Tambun Selatan	-6.2352, 107.0787
3	Asique Coffee Shop	Jl. Puri Cendana No.20, Sumber Jaya	-6.2398, 107.0674
4	The Madmoez	Jl. Buwek Jaya No.35 Rt. 001/002, Sumber Jaya	-6.2380, 107.0800
…	……	……..	…..

Source: Research Results (2021)

Data Processing

The A-Star (A*) algorithm is a revision of Dijkstra's Algorithm and forms the very first Best First Search (BFS) algorithm. The A-Star (A*) algorithm will work by adding up g(n), which is the number of movements from one node to another and h(n) which is the estimated cost from node n to the final destination. Therefore, an equation is (Setiawan et al., 2018).

$$f(n)=g(n)+h(n) \quad (1)$$

f(n) = total cost (distance) for one node to others.

h(n) = cost estimation from *node* n to the goal (using the heuristics).

g(n) = the number of movements from one node to another (graph).

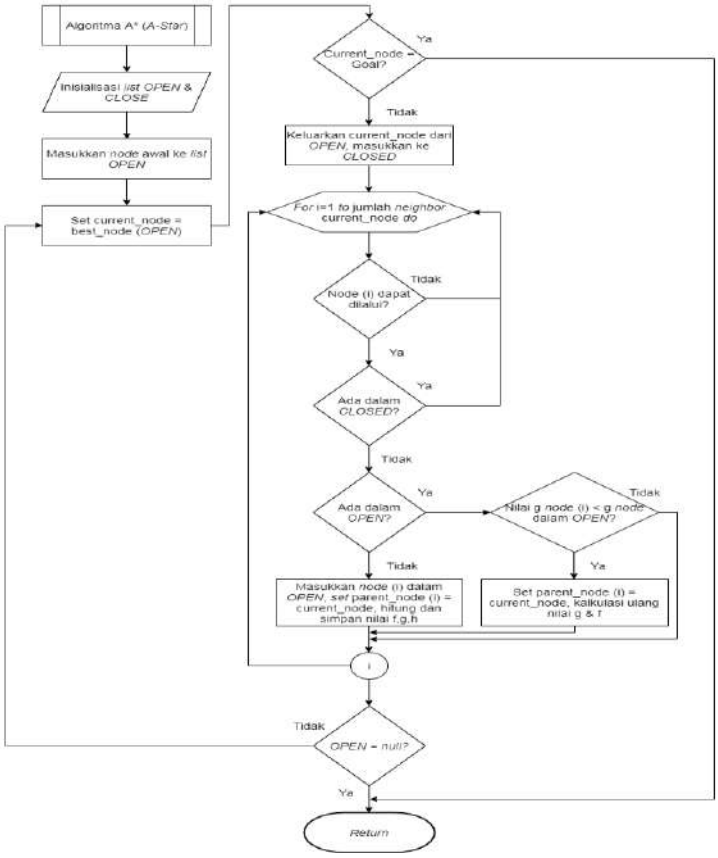
From equation 1, g(n) is the coordinate distance to the destination point, where the value of g(n) is obtained from the distance on the map multiplied by the map scale or written in formula 2 (Nuryoso et al., 2020).

$$g(n) = \text{distance on map x map scale} \quad (2)$$

Meanwhile, to determine the value of h(n), we can use the following equation.

$$h(x) = \sqrt{(x - x1)^2 + (y - y1)^2} \quad (3)$$

Based on the description above, it can be said that the A-Star (A*) algorithm has a good optimization in finding the shortest route because this method chooses the side with the minimum weight. The design of the A-Star (A*) algorithm in the application of finding places to eat and malls is as shown in Figure 2 which is a flowchart diagram.



Source: Research Results (2021)

Figure 2. A-Star (A*) Algorithm Flowchart

Figure 2 shows the flowchart of A*. First, Inserting the initial node into the open list; b) do a loop, the steps are first to find node (n) using the value f(n)

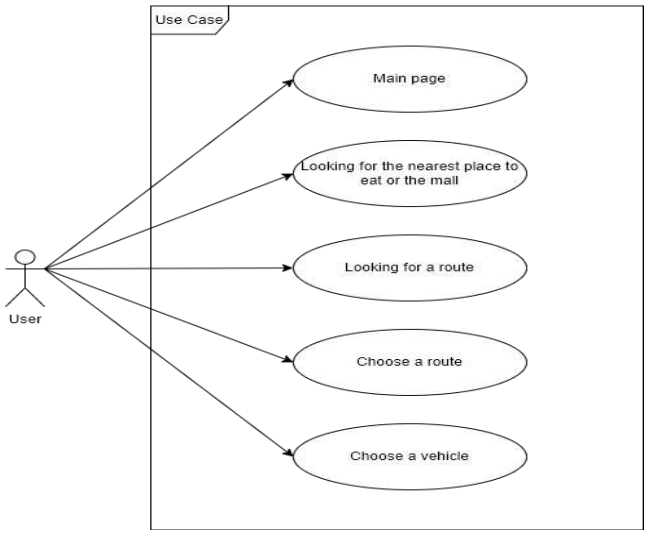
which has the lowest value in the open list, this node will become the current node. Second, we remove the current node from the open list, then insert it into the close list, thirdly for each neighbor of the current node, then if the route cannot be passed or is already in the close list and ignore it, if the route is not already in the open list, create the current node parent of the neighbor node and save the values of f, g, and h of the node this, if it is already in the open list, check if this neighbor node is faster, use the value of g as a measure, if the node is better, change the parent of the node in the open list to the current node, then recalculate the g and f values of this node, fourth stop looping if the destination node has been added to the open list, which means the route has been found, has not found the goal node, while the open list is still empty or there is no route; c) store the route backwards, sort it from the goal node to its parent to the start node while storing the nodes into an array.

3. Results and Analysis

In designing the application to search for several nearby locations using the A-Star (A*) Algorithm based on Android, the UML (Unified Model Language) system modeling is used.

Application Design

Figure 3 shows a use case that shows the interaction between actors and the system created.

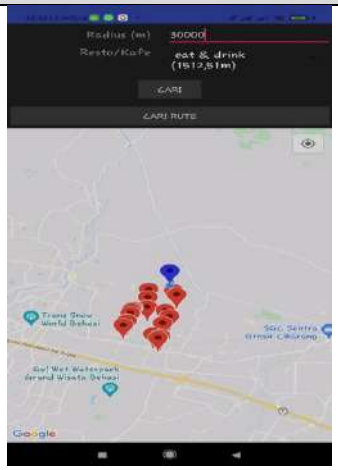
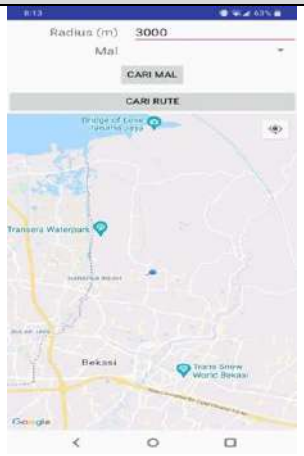
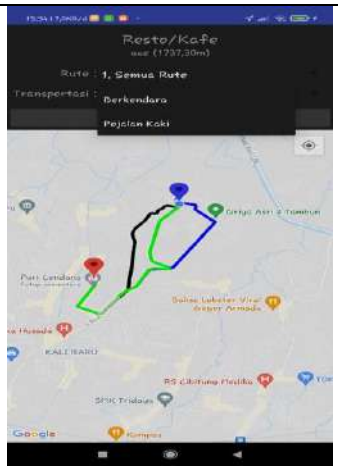


Source: Research Results (2021)

Figure 3. Use Case Diagram of Nearby Places Search Application

In table 2 is the application interface to find the nearest eating place and the nearest mall in Bekasi.

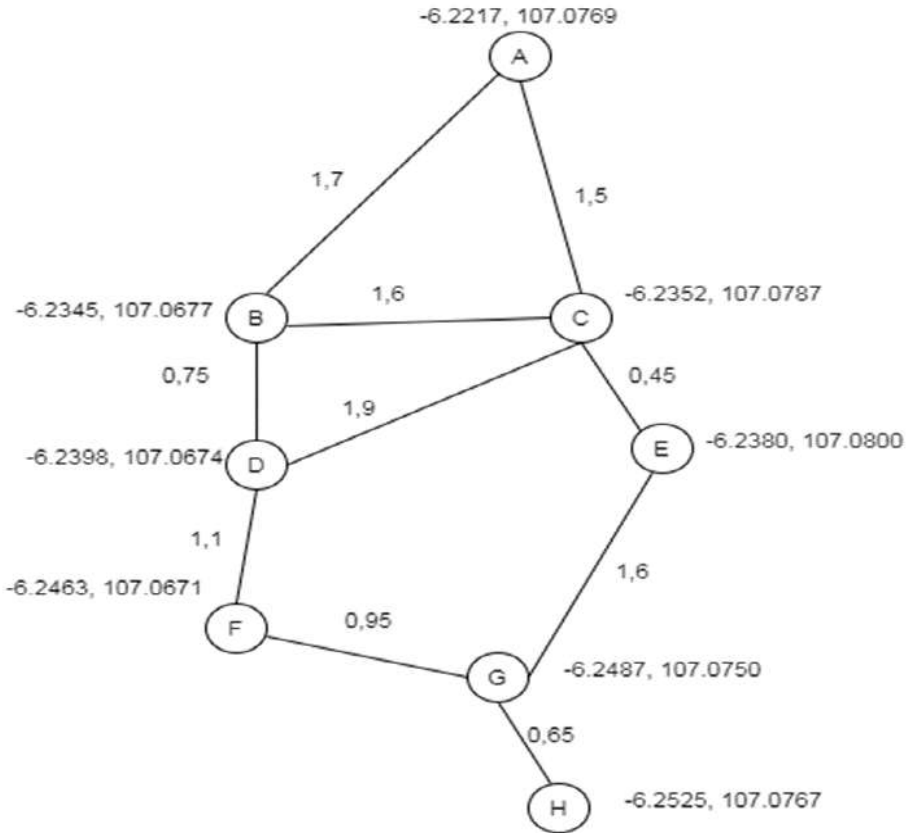
Table 2. Application Interface

Interface	Application usage	Search for Nearby Places to Eat	Search for Nearby Mall
Radius Input Display	The user inputs the radius in meters then presses the "CARI" button. This application radius limit is 1 to 43,100 m.		
Place Selection Display	The user selects an available place to eat, after selecting, the user presses the "CARI RUTE" button.		
Display the recommended route from the application to the preferred place	If User wants to change route, he/she needs to change “Semua Rute” to another route. Likewise with transportation or vehicles, according to the available options, namely driving or pedestrians.		

Source: Research Results (2021)

A-Star (A*) Algorithm Analysis

Figure 4 shows a graph for searching for the shortest route with the A-Star (A*) algorithm.



Source: Research Results (2021)

Figure 4. Nearby Places Search Graph

Based on Figure 4, the following is Table 3 an explanation of each point, coordinates and distance in Kilometers.

Table 3. Graph of Nearest Places to Eat

Node	Distance (Km)	Coordinates
A-B	1,7	A (-6.2217, 107.0769) B (-6.2345, 107.0677) C (-6.2352, 107.0787) D (-6.2398, 107.0674) E (-6.2380, 107.0800) F (-6.2463, 107.0671) G)-6.2487, 107.0750)
A-C	1,5	
B-C	1,6	
B-D	0,75	
C-D	1,9	
C-E	0,45	
D-F	1,1	
E-G	1,6	
F-G	0,95	
G-H	0,65	

Source: Research Results (2021)

Calculation of Heuristic Value

By applying formula 2 to find the Heuristic value, the results obtained are:

$a)\ Heuristis\ A\ (-6.2217, 107.0769) \rightarrow\ B\ (-6.2345, 107.0677)$

$H(x_2 - x_1) + (y_2 - y_1) = \big(-6.2345 - (-6.2217)\big) + (107.0677 - 107.0769)$

$H = -0.0128 + (-0.0092) = -0.022$

$b)\ Heuristis\ A\ (-6.2217, 107.0769)\ \rightarrow\ C\ (-6.2352, 107.0787)$

$H(x_2 - x_1) + (y_2 - y_1) = (-6.2352 - (-6.2217)) + (107.0787 - 107.0769)$

$H = -0.0135 + 0.0018 = -0{,}0117$

$c)\ Heuristis\ B\ (-6.2345, 107.0677)\ \rightarrow\ C\ (-6.2352, 107.0787)$

$H(x_2 - x_1) + (y_2 - y_1) = (-6.2352 - (-6.2345)) + (107.0787 - 107.0677)$

$H = -0.0007 + 0.011 = 0.0103$

$d)\ Heuristis\ B\ (-6.2345, 107.0677)\ \rightarrow\ D\ (-6.2398, 107.0674)$

$H(x_2 - x_1) + (y_2 - y_1) = (-6.2398 - (-6.2345)) + (107.0674 - 107.0677)$

$H = -0.0053 + (-0.0003) = -0.0056$

$e)\ Heuristis\ C\ (-6.2352, 107.0787)\ \rightarrow\ D\ (-6.2398, 107.0674)$

$H(x_2 - x_1) + (y_2 - y_1) = (-6.2398 - (-6.2352)) + (107.0674 - 107.0787)$

$H = -0.0046 + (-0.0113) = -0.0159$

$f)\ Heuristis\ C\ (-6.2352, 107.0787)\ \rightarrow\ E\ (-6.2380, 107.0800)$

$H(x_2 - x_1) + (y_2 - y_1) = (-6.2380 - (-6.2352)) + (107.0800 - 107.0787)$

$H = -0.0028 + 0.0013 = -0.0015$

$g)\ Heuristis\ D\ (-6.2398, 107.0674)\ \rightarrow\ F\ (-6.2463, 107.0671)$

$H(x_2 - x_1) + (y_2 - y_1) = (-6.2463 - (-6.2398)) + (107.0671 - 107.0674)$

$H = -0.0065 + (-0.0003) = -0.0068$

$h)\ Heuristis\ E\ (-6.2380, 107.0800)\ \rightarrow\ G\ (-6.2487, 107.0750)$

$H(x_2 - x_1) + (y_2 - y_1) = (-6.2487 - (-6.2380)) + (107.0750 - 107.0800)$

$$H = -0.0107 + (-0.005) = -0.0157$$

$$i)\ Heuristis\ F\ (-6.2463, 107.0671)\ \rightarrow\ G\ (-6.2487, 107.0750)$$

$$H(x_2 - x_1) + (y_2 - y_1) = (-6.2487 - (-6.2463)) + (107.0750 - 107.0671)$$

$$H = -0.0024 + 0.0079 = 0.0055$$

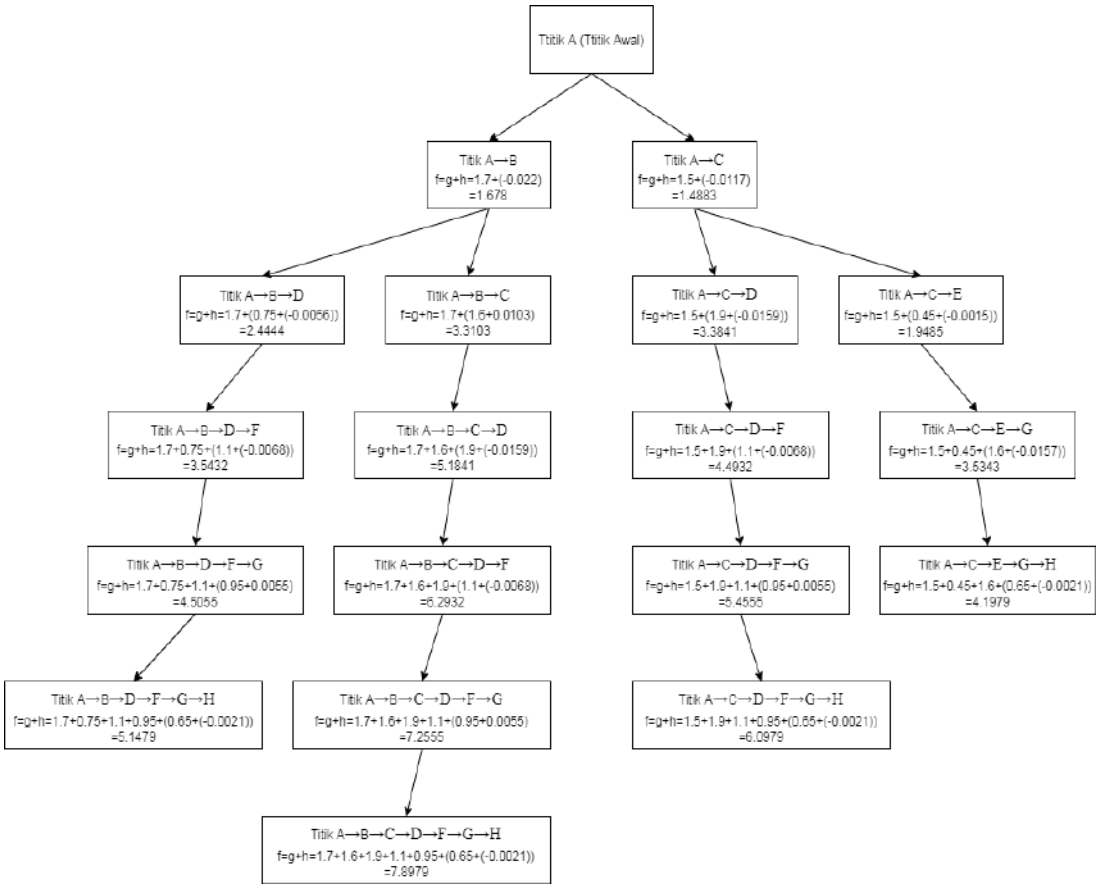
$$j)\ Heuristis\ G\ (-6.2487, 107.0750)\ \rightarrow\ H\ (-6.2525, 107.0767)$$

$$H(x_2 - x_1) + (y_2 - y_1) = (-6.2525 - (-6.2487)) + (107.0767 - 107.0750)$$

$$H = -0.0038 + 0.0017 = -0.0021$$

Shortest Distance Calculation

The process of calculating the shortest distance using the A-Star (A*) algorithm is carried out with formula 1, the calculation show in Figure 5.



Source: Research Results (2021)

Figure 5. Shortest Distance Calculation

In the calculation in Figure 5 the lowest value obtained through the A* Algorithm from the starting point (Point A) to the end point (Point H) is via the ACEGH route, namely 4.1979 and it can be concluded that the shortest distance from point A to point H using the A-Star (A*)Algorithm through ACEGH with AC=1.5 Km, CE=0.45 Km, EG=1.6 Km, and GH=0.65 Km. Then the total distance covered is 4.2 Kilometers.

The calculation starts from the starting point (node A) to the next point (node) (if any) according to the route on the graph, after that it is calculated using the A-Star (A*)Algorithm formula, do this repeatedly. The calculation must not jump to another point if there is no route in the graph. The calculation will be stopped if no further point (node) is found according to the route on the graph, in this case the calculation has reached the end point or destination (node H).

Application Testing

This test method is a functional test that is carried out after the system has been designed and tested to users. In this test, it is done by testing all existing navigations in order to produce applications that are in accordance with the desired design. At this stage the A-Star (A*) algorithm is implemented to search for the closest route between the starting point to the end point. This algorithm chooses the best solution from several points that are passed so that the closest distance will be obtained to get to the destination.

Testing to determine the functionality of the application has been built. In Table 4 are the results of black box testing on the closest route search application.

Table 3. Black Box Test Results

No	Testing Scenario	Testing Cases	Output	Testing Result
1	Opening User	*Applications Opening*	Applications Open Applications and Displaying the Appropriate Initial Display	Valid
2	Place Search User	*Place Search User inputs a radius of 5000 m and presses the "CARI" button.*	Displays a list of some nearby places.	Valid

No	Testing Scenario	Testing Cases	Output	Testing Result
3	Place Search	*User inputs a radius of 50 m and presses the "CARI" button*	Doesn't show a list of some nearby places.	
4	Track Search	*he user presses the "CARI RUTE" button.*	Displays the route provided by the application to the selected place.	Valid
5	Changing the Route	*User changes the route options provided by the application.*	Displays alternative routes in the application.	Valid
6	Changing Vehicles	*User changes the vehicle options provided by the application.*	Displays routes based on the selected vehicle.	Valid

Source: Research Results (2021)

4. Conclusion

Based on the description that has been submitted, it can be concluded that the application for searching several nearby places can be used to get information about locations such as restaurants, cafes or the nearest mall easily and efficiently. By displaying a list of selected places according to the radius entered, the application can also display the distance and route from the user's location (starting point) to the selected place (destination point). The A-Star (A*) algorithm can be applied as a computer algorithm that can search for the nearest route along with the distance traveled in location and route searches for android-based applications. Future study will develope further to get more attractive appearance, adding a directions menu so that users do not only see the route display, adding a history menu so that users can use this application in offline mode.

Author Contributions

Beno Aditya Sanusi and Gedhe Hilman Wakhid proposed the topic; Herlawati and Prima Dina Atika conceived models, Beno Aditya Sanusi and

Gedhe Hilman Wakhid designed the experiments; Herlawati and Prima Dina Atika conceived the algorithms; Ajif Yunizar Pratama Yusuf and Fata Nidaul Khasanah and Endang Retnoningsih analysed the result.

Conflicts of Interest

The author declare no conflict of interest.

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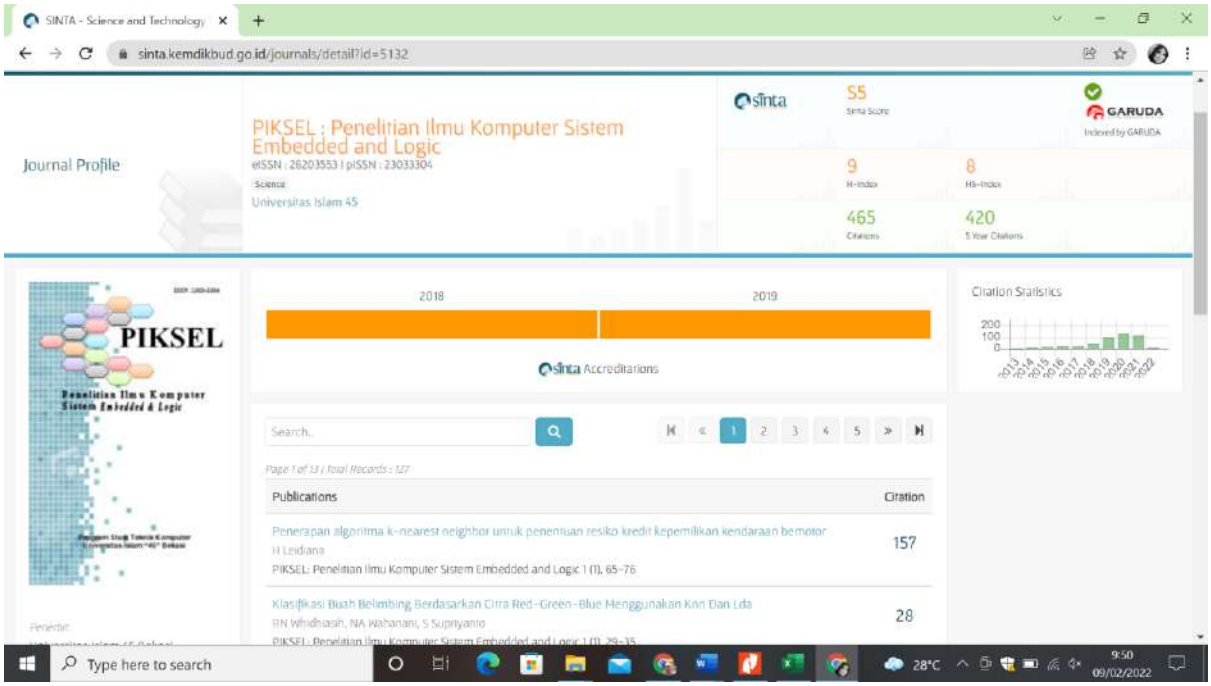
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Kutipan dari Keputusan Direktur Jenderal Penguatan Riset dan Pengembangan,
Kementerian Riset, Teknologi, dan Pendidikan Tinggi Republik Indonesia
Nomor: 28/E/KPT/2019
Tentang Hasil Akreditasi Jurnal Ilmiah Periode 5 Tahun 2019
PIKSEL (Penelitian Ilmu Komputer Sistem Embedded dan Logic)
E-ISSN: 26203553
Penerbit: LPPM Universitas Islam 45 Bekasi
Ditetapkan sebagai Jurnal Ilmiah
TERAKREDITASI PERINGKAT 5
Akreditasi berlaku selama 5 (lima) tahun, yaitu
Volume 6 Nomor 1 Tahun 2018 sampai Volume 10 Nomor 1 Tahun 2022
Jakarta, 26 September 2019
Direktur Jenderal Penguatan Riset dan Pengembangan
Dr. Muhammad Dimyati
NIP. 195912171984021001
TERAKREDITASI

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E-ISSN 2620-3553
ISSN 2303-3304