Slide 1

Assalamualaikum wr wb, good morning everyone lets me introduce my self. My name is Heri Nur Alim. Now let me present my paper result with me Heri Nur Alim the first author, Niam tamami the second author, and ali husein alasiry the third author and we from Electrical Engineering Department Politeknik Elektronika Negeri Surabaya, Surabaya, Indonesia. And My paper title is Automated Library System Mobile Robot using A-Star Algorithms.

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And the next slide is the background from my paper, *Currently, libraries have realized many aspects of information technology such as book purchases, book collections, RFID, databases and other technologies that improve library management and service levels. One of the technologies used is library robots. Library robots are the integration of automation and information in daily library applications, which can increase the level of library automation*

One of the automation systems that need to be applied in the library management system is a robotics system that can arrange books into bookshelf automatically in order to facilitate an automatic and structured book return.

Slide 3

An example is in a library where books must be arranged according to category or title, so that readers can easily find books. But if someone has finished reading a book, sometimes someone forget to put the book back in its place. Placing books in the wrong place can make it difficult for someone to find the book, this will also increase the work of the librarian.

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For this reason, library management system need an automated mobile robot system to solve the above problem using RFID to recognize book title and A-Star Algorithm to mobile robot move. The a-star algorithm will be used to calculate the closest path for the mobile robot when finding the location of the bookshelf to place books, so that it will shorten the time the mobile robot returns book to the bookshelf. Based on the results of the A-Star algorithm calculation in the case of finding the closest route in the library area, get accurate results and get the closest path from start to finish by considering the final result of the calculation f(n) = g(n) + h(n).

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And the next is final product from mechanic design, This final product consists of three parts, the first the mobile robot, up-down mechanic, and pusher mechanic to push the book. and next the two parts are combined into one system.

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And the next is the hardware design for my system, The hardware system consists of two main systems, the first is hardware systems for mobile robots and the second is hardware systems for up and down mechanics. For the first hardware system is the hardware of the mobile robot which contains an Arduino nano microcontroller, six infrared sensors, two BTS motor drivers, and two Mitsubishi DC motor and the hardware system of the up and down mechanic which contains an Arduino nano microcontroller, stepper motor, dc motor, and RFID reader.

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And this slide is block diagram system for my robot, the first Robot stand by in the initial position, if someone puts a book in the robot, the robot system will detect the book from the RFID, and the robot system will get the location of the book from RFID, next the system Calculate the close route to a bookshelf with A-Star Method, next the robot move to a bookshelf and place the book in the bookshelf, and the last the robot back to start position.

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The next is A-Star algorithm explanation, The A* (A-star) algorithm is one of the algorithms included in the category of an informed search method. This algorithm is very good as a solution for the pathfinding process. This algorithm looks for the shortest route distance that will be taken by an initial point (starting point) to the destination object.

The notation of the a-star algorithm is:

$f(n) = g(n) + h(n)$

where n is the next node on the path and g(n) is the cost of the path from the start node to n, and h(n) is a heuristic function that estimates the cost of the cheapest path from n to the goal.

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And this slide is A-Star algorithm implementation for my systems. This Picture show a design for the library, Based on this design, we can determine the library design to a diagram and given the coordinate value to each points line.

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This image is the result of a library design that has been converted into a coordinate and assigned a value according to its position from the starting line. Where the green colour is start position, red colour is bookshelf or the movement in not allowed, and the white colour is the line or the movement is allowed. From this coordinate we can calculate the f value to get a closest line from start to finish.

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This slide is the example case pathfinding with A-star Algorithm to calculate the closets line from start in green colour and finish in purple colour. The step of this calculate is :

From this diagram, there are four moves (left, right, up, and down) from a robot position provided a valid step is available. In red square positions, no movement is allowed (like in start position only down motion is available since up). One important aspect of A-Star is f = g + h. The f, g, and h variables are in our Node class and get calculated every time we create a new node, F is the total cost of the node, G is the distance between the current node and the start node, and H is the heuristic or estimated distance from the current node to the end node.

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From the start and finish coordinates we can calculate the value of f, and we get several possible f path values. The possible line from start to finish is in red, green, yellow, and purple arrow. There we try to calculate the yellow arrow, The coordinate path passed by the yellow arrow is: {(0,0), (1,0), (2,0), (3,0), (4,0), (5,0), (5,1), (5,2), (5,3)}. From this coordinate we can calculate the f value. The f value is

f = 0 + 1 +2 + 3 + 4 + 5 + 1 + 2 + 3 = 21 And the result for f value the yellow line is 21

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And we calculated the other possible line is with the same way, and the result f values from the all possible is in this table, From the Table , we can see the smallest **f** value is the yellow path with value 21, from this smallest value it can be concluded that the fastest and best path from start to finish is the yellow path.

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the next is testing the movement of the mobile robot for each calculated f values. The goal of this test is to prove that the smallest f values achieves the fastest time from start to finish. The following table shows the execution time for each possible values of f.

From the Result Mobile Robot with f possible values in Table 4, it can be seen that the fastest time for the movement of the mobile robot from start to finish in the yellow line with f value is 21 with a time 12 seconds. from this result we can conclude that the calculation of the smallest f value is the best and closest path from start to finish.

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And the next is conclusion :

1. This library robot system can help in the automation system in the library system which can improve the quality of service.
2. In the A-star method, it is possible to get the same f value but on a different path.
3. A-Star does not always produce the best pathfinding, because it all depends on the heuristic when calculating the value of h (heuristic function that estimates the cost of the cheapest path from n to the goal).

Penutup

I sincerely appreciate your attention today. I would like to thank you for your time and attention.