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Using A* algorithm to find shortest path in Indoor positioning system

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Abstract - *Now a days, deducing position and route has become crucial because it helps user to get the destination more quickly and easier. Due to complex structure of buildings and infrastructure like areas, to get the exact location of any entity has become difficult. Therefore, Indoor positioning and navigation system, plays vital role for obtaining position (location) for indoor areas. In order to reach to the destination, knowing only position is not enough because there are a lots of rooms inside building, for example, hotels and malls. Thus knowing the route to the destination is also very important so that user can reach the destination in lesser time easily. This paper is divided into two section, the first section consists the general working of A* algorithm and second section shows that how A* is better than Dijkstra's algorithm.*

***Key Words*: A* algorithm, indoor positioning ,GPS, WIFI, Dijkstra's algorithm**

1.INTRODUCTION

Recently, many studies of indoor positioning system using wireless medium like WiFi, Bluetooth, have been researched actively. There are three types of approaches for indoor positioning system, triangulation method, fingerprinting technique and Cell-ID technique[1].Today, people take advantage to obtain location from Location-based service, which is also known as Location Base Service (LBS) [2][3][4][5]. LBS covers all wireless medium services that provide appropriate information based on users location. To find the required location, these services require location determination (path finding) technologies in indoor environment. For outdoor positioning, Global Positioning System (GPS) is commonly used. However, GPS has limitation in using indoor settings because it relies on signal from satellite [6][7].

In order to cover these challenges, indoor positioning system using wireless signal such as WiFi and Bluetooth - which are commonly used in indoor setting - is growing interest [8][9][10][11]. However, most of indoor positioning systems lack accuracy due to complex structure of areas, mobility of people and indoor obstacles. In order to increase the accuracy of positioning system using wireless communications, this paper suggests an A* algorithm to be implemented for finding the route due to its performance and accuracy.

2. PROPOSED ALGORITHM

A* is one of the shortest path finding algorithm, or a "best-first search", meaning that it searches minimum optimal route by finding among all possible paths to the target node for the one that has the smallest cost (least distance travelled, shortest time, etc.), and among these paths it first considers the ones that appear to lead most quickly to the target node. It is an extension of Dijkstra's algorithm.

2.1 WORKING OF A* ALGORITHM

The algorithm is designed in terms of weighted graphs: starting from a source node in the graph, it constructs a tree of routes which is initiated from that node and expands routes one step at a time, until one of its routes reach to the target node.
At each step of it's main loop, A* needs to determine which of its partial routes should be expanded into one or more longer routes. It does so based on an estimate of the cost (total weight) still to go to the target node. Specifically, A* selects the route that minimizes

$$G(n)=a(n)+h(n)$$

Where,
n is the last node on the path, a(n) is the cost of the path from the start node to n, and h(n) is a heuristic that estimates the cost of the cheapest route from n to the goal. For the algorithm to find the actual shortest path, the heuristic function must be admissible, meaning that it never overestimates the actual cost to get to the nearest target node also it means that the real cost to reach the destination from node n should be greater than or equal to h(n) [12]. Figure 1 is the flowchart of A* algorithm which gives the general idea how it works.

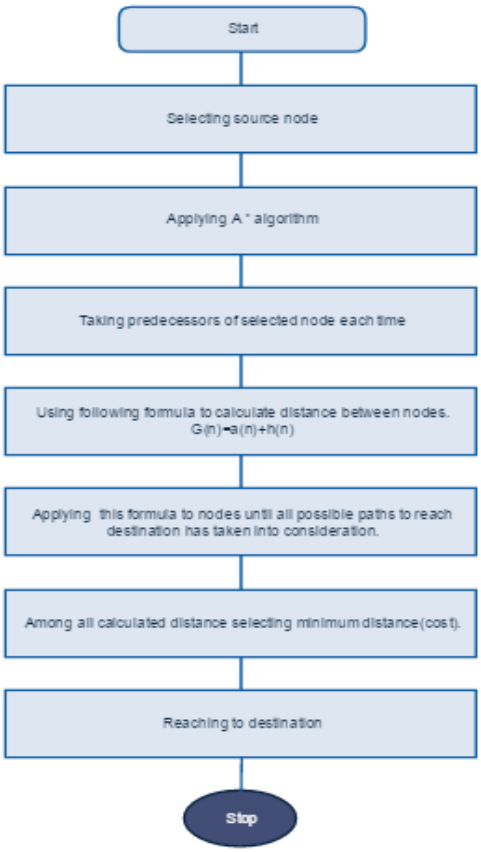

Fig -1: Flowchart of A* algorithm

3.HOW A* IS BETTER THAN DIJKSTRA'S ALGORITHM ?

As stated earlier an A* search algorithm is an extension of the Dijkstra's algorithm. A* algorithm is Dijksta's algorithm without heuristic . Both the algorithm gives the shortest path but the A* gives more faster and efficient result. Dijkstra's algorithm is slower as compared to A* because Dijksta's repeatedly attempts to improve an initial approximation (cost) of each node. Due to this it takes more time to reach the target node. Figure 2 and Figure 3 are the examples solved by both of the approaches. In both of the examples, we are finding shortest path from **S (source node) to T (target node).** Considering figure 2, there are total 4 routes from **S to T** that are :

1) S->A ->B->C->G = 8, 2) S->A ->C->G =9, 3) S->B->C->G= 9, 4) S->A->G =13.

Among all these four paths , we are selecting **S->A ->B->C->G = 8** route as it has the lowest cost among all the other routes.

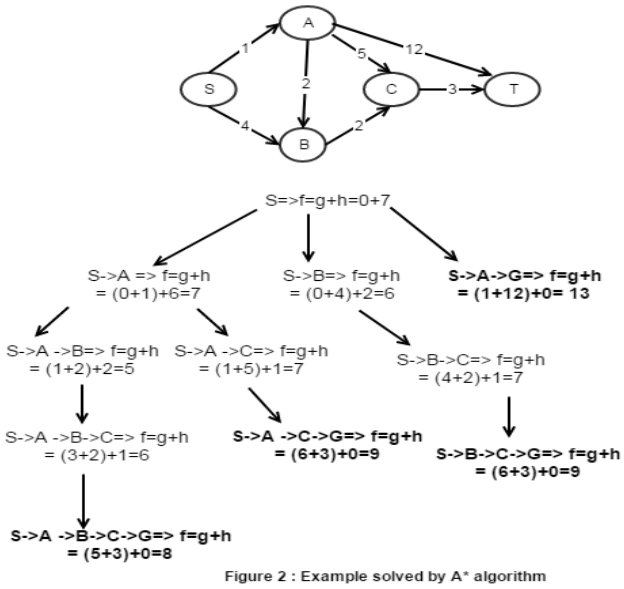

Fig -2: Example solved by of A* algorithm

Now consider figure 3, to reach **S to T** there are also four as stated same earlier. Out of these we are selecting the same route **S->A ->B->C->G = 8** . But in figure 3 it has been seen clearly that it has modified cost of node B, C, and T are modified once. Here Dijkstra's lacks in performance with A* algorithm. The same has been proved in the following examples.

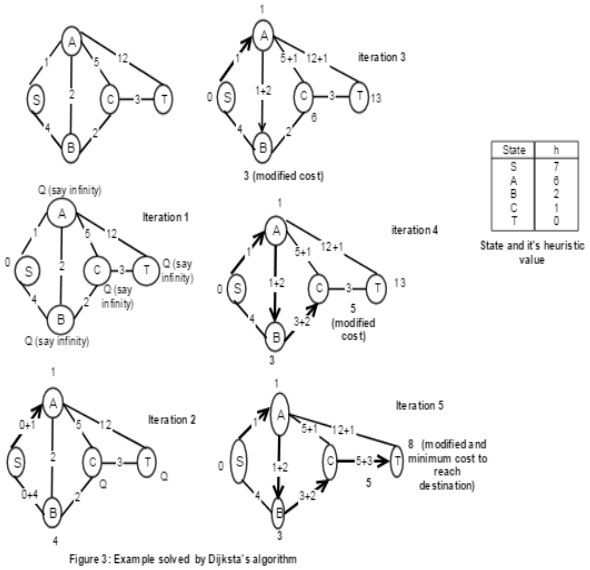

Fig -3: Example solved by of Dijkstra's algorithm

Moreover, to support the difference between these two algorithms, **figure 4** and **figure 5** can be considered[13].

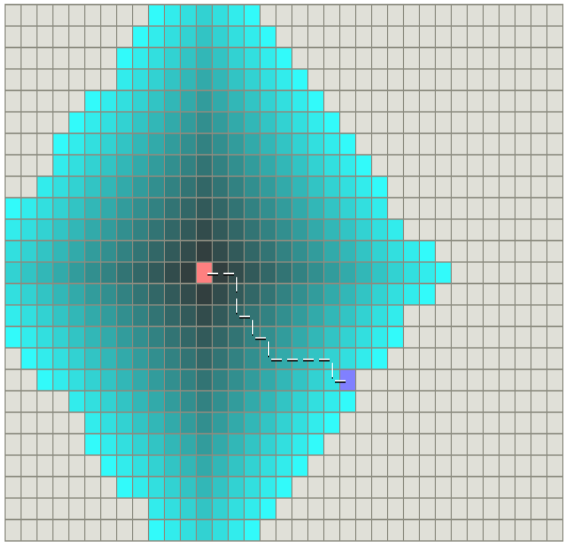

figure 4: Route find through Dijksta's algorithm

Fig -4: Route find through Dijkstra's algorithm

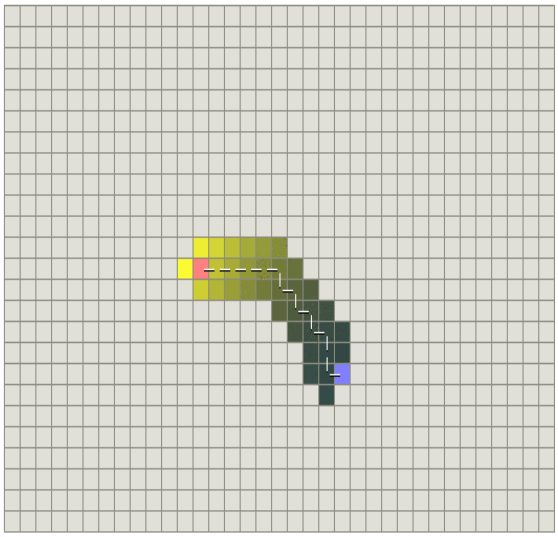

figure 5: Route find through A* algorithm

Fig -5: Route find through A* algorithm

4.CONCLUSION

In this way, we have studied how A* algorithm works and also we have determined the shortest path from source to destination. In addition to this, we have seen the difference between both the algorithms. **A*** behaves much more similar to **Dijkstra's**, the only difference between both the algorithm is that A* gives to a better path by using a **heuristic function** while Dijkstra's just explore all possible paths. A* accomplish better performance by using heuristics to guide its search and gives the optimal result much faster.

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