Implementing of Road Map by using A* Searching Algorithm

May Su Hlaing Oo, Moe Ohmar
University of Computer Studies, Kyaing Tong
primerose08@gmail.com, khaingaa@gmail.com

Abstract

Artificial Intelligence is the science and engineering of making intelligent machines, especially intelligent computer programs. It is related to the similar task of using computers to understand human intelligence, but AI does not have to confine itself to methods that are biologically observable. Shortest path problem is a classical AI topic and is based on search method. Each search method has a different approach to solve the problem. In this paper we intended to present Optimal Route finding system for Eastern Shan State by using A search algorithm . A* search is one kind of heuristically informed search strategy and is very suitable for finding shortest path. The experimental result of this system is also discussed in this paper.*

1. Introduction

Computer Science is the systematic study of the feasibility, structure, expression, and mechanization of the methodical processes (or algorithms) that underlie the acquisition, representation, processing, storage, communication of, and access to information. As computer science and technology has progressed, computer is used in various fields like medicine, research, space, etc.

For an increasingly large number of applications, there are many problems that can decide for them what they need to do in order to satisfy their design objectives. The application of evolutionary computation techniques for the solution of optimization problems is now the major area of research. Optimization problems reveal the fact that the formulation of engineering design problems involves linear terms for constraints and objective function but certain other problems involve nonlinear terms for them. In some problem, the terms are not explicit functions of the design variables. Unfortunately, there does not exit a single optimization algorithm which will work in all optimization problems equally efficiently. Some algorithms perform better on one problem, but may perform poorly on other problems. That is why the optimization literature contains a large number of algorithms, each suitable to solve a particular type of problem [3].

Algorithms are very useful in real life applications. The real-world performance of any software system depends on only two things: (1) the algorithms chosen and (2) the suitability and efficiency of the various layers of implementation. The choice of a suitable algorithm for an optimization problem is, to a large extent, dependent on the user's experience in solving similar problems. An important part of computing is the ability to select algorithms appropriate to particular purposes and to apply them, recognizing the possibility that no suitable algorithm may exist. This facility relies on understanding the range of algorithms that address an important set of well-defined problems, recognizing their strengths and weaknesses, and their suitability in particular contexts. Efficiency is a pervasive theme throughout this area.

2. Related Work

Shortest path problem is a classical AI topic. It is based on search method. Search methods aren't the perfect solution for every problem, but with creative applications it can solve many. If search is an appropriate solution, then choose the one which is guaranteed to find the solution. It divides the methods into two kinds. There are Blind Search (Basic Search) and Heuristically Informed Methods [5].

Blind search are done when there is no information about a preferred search path. A* search is one kind of heuristically informed search strategy. A* search maintains the set open of so-called open nodes that have been generated but not yet expanded. This method always selects a node from open with minimum estimated cost, one of those it considers "best" [1]. In this paper, we intended to present optimal route finding system for Eastern Shan State by using A* search algorithm.

3. Background Theory

Heuristics (rules of thumb) are included as a key element of AI. Artificial intelligence is the branch of computer science that deals with ways of representing knowledge using symbols rather than numbers and with rules-of-thumb, or heuristics ,methods for processing information. By using heuristics one does not have to rethink completely what to do every time a similar problem is encountered.

3.1. Problem Solving and Decision Making

Problem solving is often associated with the performance output of thinking creatures. It is a mental activity of finding a solution to problem means dealing with trouble or distress. Although this is true in some cases, it is not true in all situations. The term problem solving was introduced by mathematicians. In the world of business, the term decision making is routinely used as equivalent to problem solving [3].

3.2 Searching

Searches are broken into two main categories: uninformed searches (brute-force, blind) and informed searches (heuristic, directed). Uninformed searches are done when there is no information about a preferred search path. Informed searches have some information to help pick search paths; usually a rule of thumb is used to reduce the search area.

3.3 Informed (Heuristic) Search Strategies

Informed search is the one that uses problem-specific knowledge beyond the problem definition. It can finds solution more efficiently than the uninformed search. The informed search methods include best-first search, memory bounded search and iterated improvement algorithms (generate-and-test approaches). The general approach is called best-first search. Best-first search is an instance of the general TREE-SEARCH or GRAPH-SEARCH algorithm in which a node is selected for expansion based on an evaluation function ,f(n). The special cases of best-first search are greedy best-first search and A* search [6].

3.4 A* search

The most widely-known form of best-first search is called A* search. The step by step procedure of the A* search algorithm is shown as follow:

1. Create a search graph, G, consisting solely of the start node, n0. Put n0 on a list called OPEN.
2. Create a list called CLOSED
3. If OPEN is empty, exit with failure
4. Select the first node on OPEN, remove it from OPEN, and put it on CLOSED. Call this node n.
5. If n is a goal node, exit successfully
6. Expand node n, generating the set, M, of its successors
7. Establish a pointer to n from each of those members of M that were not already in G (i..e, not already on either OPEN or CLOSED). Add these members of M to OPEN. For each member, m, of M that was already on OPEN or CLOSED, redirect its pointer to n if the best path to m found so far is through n. For each member of M already on CLOSED, redirect the pointers of each of its descendants in G so that they point backward along the best paths found so far to these descendants.
8. Reorder the lost OPEN in order of increasing f values. (Ties among minimal f values are resolved in favor of the deepest node in the search tree.)
9. Go to step 3.

4. Proposed System

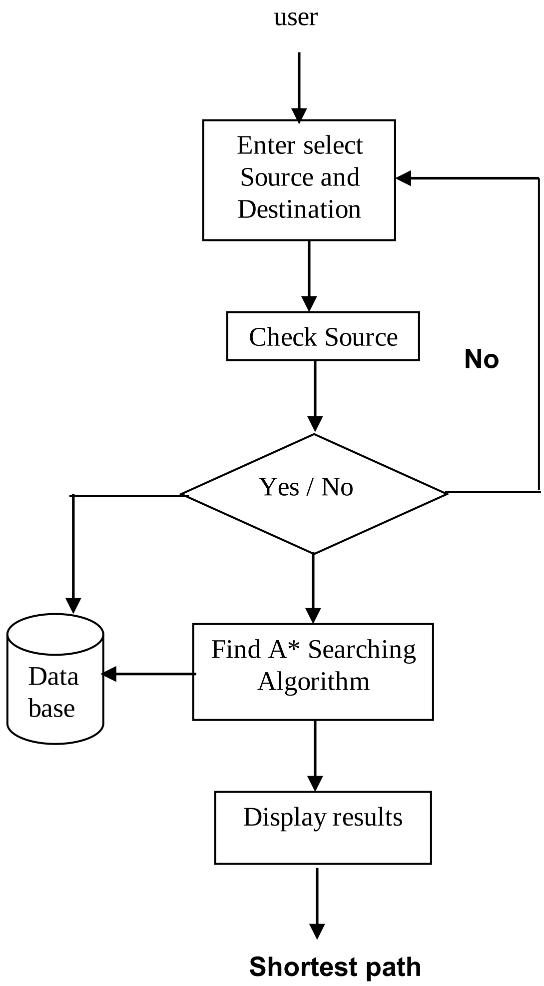


Figure 1. System Overview Diagram

This system is a computer system capable of capturing, analyzing, and displaying geographically referenced information of interesting places in Eastern Shan State; that is, data identified according to location. This technology integrates common database operations such as query and statistical analysis with the unique visualization and geographic analysis benefits offered by Eastern Shan State Map. In this system, user can select source and destination of place on the Eastern Shan State Map. So, the system drawn the shortest route on the Eastern Shan State Map and evaluates distance.

5. System Implementation

There are two main processes in the system. The user can modify the Map. The user can choose source and destination of places in the system. The system searched shortest path by using A* algorithm, along the track with the possible ways, the waypoints and heuristics straight line distance of destination point. User can also view the information of interesting places in Eastern Shan State in this system.

In A* search, the nodes expand closest to the goal. f (n)=g(n)+h(n). g(n) is the cost to reach the node and h(n) is the estimated cost to the goal from n. f(n) is estimated total cost of path through n to the goal.

Table 1. Heuristics Straight-Line Distance from တာချီလိတ်

Eastern shan state		
No	Position	hsld
1	Kyainge Tong	229.88
2	Tarchilate	0
3	Mainn Phyat	120.3
4	Mainn pyinn	299.16
5	Mainn lar	326.63
6	Tar lay	86.59
7	Mainn khoke	106.36
8	Mainn sat	326.63
9	Mainn Tong	205.56
10	Mainn Yu	273.78

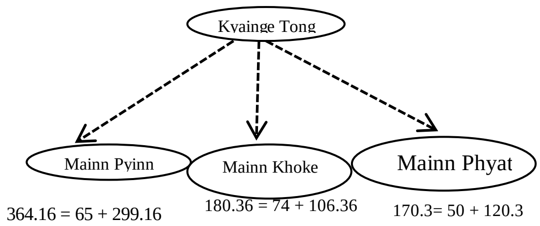
Before finding the shortest path ကျိုင်းတုံ to တာချီလိတ်, must be calculate Heuristics Straight-Line distance (hSLD) values to တာချီလိတ်. hSLD is straight line distance value between target node to other nodes. As shown in Table is Heuristics Straight-Line distance table from တာချီလိတ် to other waypoints. A* algorithm replace this values as h(n) into the equation.

5.1 Example

1. The initial state

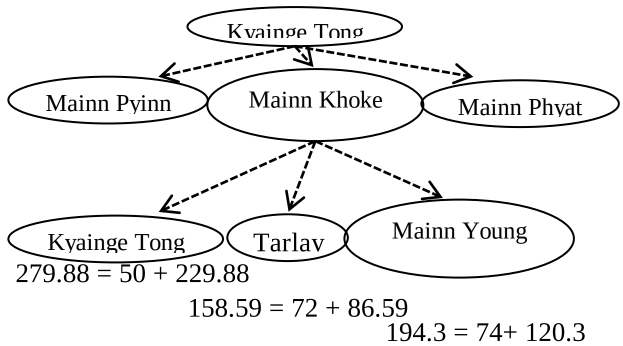
229.88= 229.88 + 0

2. After expanding Kyainge Tong



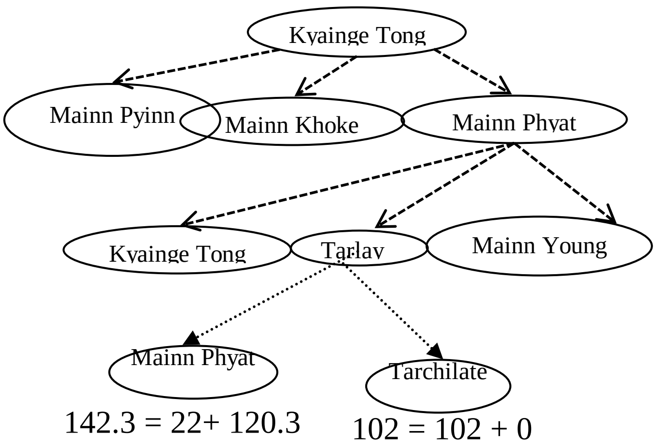
In this initial state, start expands from the source node as shown in Figure. f(n) of Kyainge Tong is 229.88, g(n) is 0 and h(n) is 229.88. After the initial state, must choose minimum distance waypoints. Kyainge Tong to Mainn Pyinn; 364.16 nautical miles. Kyainge Tong to Mainn Khoke is 180.36 nautical miles. Kyainge Tong to Mainn Phyat is 170.3 nautical miles. In all waypoints Mainn Phyat is minimum distance. So algorithm expands from Mainn Phyat to the other nodes.

3. After expanding Mainn Phyat



After expanding Mainn Phyat, A* algorithm get from Mainn Phyat to Kyainge Tong is 279.88 nautical miles. Kyainge Tong to Tarlay is 158.59 nautical miles. Mainn Phyat to Mainn Young is 194.3 nautical miles. In all ways points Tarlay is minimum distance. So algorithm expands from Tarlay to the other nodes as shown in figure.

4. After expanding Tarlay



After expending Tarlay, A* algorithm get from Tarlay to Main Phyat is 142.3 nautical miles. Tarlay to Tarchilate is 102 nautical miles. A* algorithm reach Tarchilate as shown in figure.

6. Experimental Result

In this system, the users or user can choose existing chart. After choosing the chart, the user can choose source or start waypoint and destination or target waypoint. A* search on possible track and can view the value of straight line distance to target waypoint and shortest path on the chart respectively.

Table2. Duration time of the traveling

Source	Destination	Time(seconds(s))
Kyainge Tong	Tarchilate	0.2s
Mainn lar	Tarchilate	0.28s
Mainn Young	Mainn lar	0.12s
Mainn Phyat	Tarchilate	0.1s
Kyainge Tong	Mainn Lar	0.11s

7. Conclusion

The goal of this system was to explore different design issues associated with map-based itinerary-planning tools. In this way, a prototype was demonstrated to use and modify existing tools and software to create map-based finding shortest path system for Eastern Shan State. This system is based on search methods. These methods can use to solve path-finding problem. Path-finding problem need to search a path or away from the start point to the goal point. Each method has a different approach to solve the problem. It divides the methods into two kinds. There are uniformed methods and informed methods. Uniformed methods are done when there is no information about a preferred search path. Informed methods haves some information to help pick search paths, usually a rule of thumb is used to reduce the search area. Informed search uses problem-specific knowledge the definition of the problem itself. It can find solutions more efficiently than a uniform search. This system use A* algorithm in the informed methods is the cost to reach the node and h(n), estimated cost to the goal from n and f(n), estimated total cost of path through n to the goal. This search algorithm is both complete and optimal. So A* algorithm is very suitable for this system. We're presented a road map system for Kyainge Tong Map by using A* search algorithm. Our proposed system intends to solve path-finding problem. It can find solutions more efficiently than other searching methods. Moreover, it can give the exact shortest path to user, the user can reduce their time and cost in path finding. In future, we have planned to test with more state and divisions and compare result with other searching methods.

8. References

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