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Determine The Best Location of Disaster Emergency Response Command Post Using Hill Climbing and Ant Colony Algorithms

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Abstract

Indonesian region, geographically and geologically, has great potential of natural disasters. When a natural disaster occurs, many things are done spontaneously that raises a lot of mistakes in the distribution of aid. Errors that commonly occur is the uneven distribution of aid, where there are disaster emergency response command post that have so many aids, while the other posts that lack of support.This study was done to overcome the aid distribution problems by finding the best algorithms for determining the best location of command post. The algorithms tested are Simple Hill Climbing, Steepest Ascent Hill Climbing, and Ant Colony.

Keyword: Natural Disaster, Recovery Post, Simple Hill Climbing, Stepest Ascent Hill Climbing, Ant Colony

1. Introduction

Computer technology, both hardware and software, is growing very fast. Computer technology has become a necessity of human life, ranging from household appliances to robots for expedition in outer space. The development of the Internet and multimedia technologies are growing exponentially, resulting in the huge amount of data managed by the computer. The use of technology in post-disaster management is still very little, most of the technology used for the recovery process after the natural disaster occurred is communication technology.

Indonesian region, geographically and geologically, has great potential of natural disasters. When a natural disaster occurs, many things are done spontaneously that raises a lot of mistakes in the distribution of aid. Errors that commonly occur is the uneven distribution of aid, where there are disaster emergency response command post that have so many aids, while the other posts that lack of support.

When a natural disaster occurs, as recovery actions,disaster emergency response command post usually established to be used as a place to get medical help, as well as primary supports such as getting food, clothing, and shelter. The determination of the post location is still done

without careful planning. This raises the accumulation of aid in one post which may not reach the victim. From this incident, it is clear that the positioning of the post determine the ease of distribution of aid.

This study was done to overcome the aid distribution problems by finding the best algorithms for determining the best location of disaster emergency response command post. The location determination is based on the location of the other posts that exist around the scene of the disaster.

2. Literature Review

2.1 Hill Climbing Algorithm

In computer science, hill climbing is a mathematical optimization technique which belongs to the family of local search. It is an iterative algorithm that starts with an arbitrary solution to a problem, then attempts to find a better solution by incrementally changing a single element of the solution. If the change produces a better solution, an incremental change is made to the new solution, repeating until no further improvements can be found.

For example, hill climbing can be applied to the travelling salesman problem. It is easy to find an initial solution that visits all the cities but will be very poor compared to the optimal solution. The algorithm starts with such a solution and makes small improvements to it, such as switching the order in which two cities are visited. Eventually, a much shorter route is likely to be obtained.

Hill climbing is good for finding a local optimum (a solution that cannot be improved by considering a neighbouring configuration) but it is not necessarily guaranteed to find the best possible solution (the global optimum) out of all possible solutions (the search space). In convex problems, hill-climbing is optimal. Examples of algorithms that solve convex problems by hill-climbing include the simplex algorithm for linear programming and binary search [1].

The characteristic that only local optima are guaranteed can be cured by using restarts (repeated local search), or more complex schemes based on iterations, like iterated local search, on memory, like reactive search optimization and tabu search, or memory-less stochastic modifications, like simulated annealing.

The relative simplicity of the algorithm makes it a popular first choice amongst optimizing algorithms. It is used widely in artificial intelligence, for reaching a goal state from a starting node. Choice of next node and starting node can be varied to give a list of related algorithms. Although more advanced algorithms such as simulated annealing or tabu search may give better results, in some situations hill climbing works just as well. Hill climbing can often produce a better result than other algorithms when the amount of time available to perform a search is limited, such as with real-time systems. It is an anytime algorithm: it can return a valid solution even if it's interrupted at any time before it ends.

In simple hill climbing, the first closer node is chosen, whereas in steepest ascent hill climbing all successors are compared and the closest to the solution is chosen. Both forms fail if there is no closer node, which may happen if there are local maxima in the search space which are not solutions. Steepest ascent hill climbing is similar to best-first search, which tries all possible extensions of the current path instead of only one.

2.2.Ant Colony Optimization Algorithm

In computer science and operations research, the ant colony optimization algorithm (ACO) is a probabilistic technique for solving computational problems which can be reduced to finding good paths through graphs.

This algorithm is a member of the ant colony algorithms family, in swarm intelligence methods, and it constitutes some metaheuristic optimizations. Initially proposed by Marco Dorigo in 1992 in his PhD thesis [2][3], the first algorithm was aiming to search for an optimal path in a graph, based on the behavior of ants seeking a path between their colony and a source of food. The original idea has since diversified to solve a wider class of numerical problems, and as a result, several problems have emerged, drawing on various aspects of the behavior of ants.

2.3. Satellite Imagery

Satellite imagery consists of images of Earth or other planets collected by satellites. Imaging satellites are operated by governments and businesses around the world. Satellite imaging companies sell images under license. Images are licensed to governments and businesses such as Google Maps.

Satellite images have many applications in meteorology, oceanography, fishing, agriculture, biodiversity conservation, forestry, landscape, geology, cartography, regional planning, education, intelligence and warfare. Images can be in visible colors and in other spectra. There are also elevation maps, usually made by radar images. Interpretation and analysis of satellite imagery is conducted using specialized remote sensing applications.

3.Research Methods

3.1. Research Input

Image used as research material is satellite imagery, which is a hybrid image that has been combined with road map. The sample is shown in Figure 1.

Figure 1. Satellite Imagery (example)

3.2. Research Process

This study is done by performing these following steps:

1. Generate the posts locations coordinates.
2. Calculate the distance between each coordinate.
3. Test three methods: Simple Hill Climbing, Steepest Ascent Hill Climbing and Ant Colony Algorithm

4. Result and Discussion

The posts locations coordinatesused in this experiment is shown in Table 1, the distance between each coordinate is shown in Table 2, and the test results is shown in Table 3.

Table 1. Posts Locations Coordinates

Location	x	y
1	15.275	5.275
2	35.75	5.75
3	20.93	25.93
4	30.78	25.78
5	15.81	35.81
6	35.87	35.87

Table 2. Distance between each coordinate

	1	2	3	4	5	6
1	0	20.48051	21.41514	25.7072	30.53969	36.881
2	20.48051	0	25.03727	20.63739	36.07225	30.12024
3	21.41514	25.03727	0	9.851142	11.12784	17.94456
4	25.7072	20.63739	9.851142	0	18.01948	11.30116
5	30.53969	36.07225	11.12784	18.01948	0	20.06009
6	36.881	30.12024	17.94456	11.30116	20.06009	0

Table 3. Test Results

Method	Order	Best Cost
Simple Hill Climbing	4-2-1-3-5-6	105.0221
Stepest Ascent Hill Climbing	1-2-4-6-5-3	105.0221
Ant Colony	1-2-4-6-5-3	105.0221

From table 3, it appears that all methods give the same cost, Stepest Ascent Hill Climbing gives the leasts number of iterations. While the order for Stepest Ascent Hill Climbing and Ant colony are same, but simple hill climbing is different.

5. Conclusion

From the experiment, all methods give the same cost, Stepest Ascent Hill Climbing gives the leasts number of iterations.

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