Implementation of DFS, BFS, and Dynamic Programming in Green GPS Navigation System

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Abstract—**GPS or Global Positioning System is common technology in navigation system nowadays. GPS Navigation System uses satellite to give information about location, time, and weather everywhere on or near Earth within satellite coverage and every time it can receive reception from satellite to guide users from one place to another. As time goes by, GPS technology in navigation system goes better and better every time. But, its growth is influenced by a lot of problems that people experience. One of those is environmental problem. How GPS navigation system can maintain its purpose, which is to guide users between places while helping them to save the Earth. In this paper, algorithm to help building suggestion path to reach destination places defined by users in normal GPS navigation system and green GPS navigation system are defined as comparison.**

Index Terms—**GPS navigation system, Breadth-first searching algorithm, depth-first searching algorithm, green GPS navigation system.**

I. INTRODUCTION

GPS technologies help us to locate position using satellite to give us information about location, time, weather, and such.

Picture 1 GPS is used in mobile device

Picture 2 GPS is used in vehicle as navigation system

Nowadays, GPS technologies have been implemented almost everywhere. From mobile device to vehicle has already been using these technologies. Mobile device are equipped with GPS mainly to support application that has been installed in it. Vehicles and automobiles use GPS to guide them between places with GPS navigation system. Some newer vehicles also have GPS installed in their machine to track and locate their position as an act of prevention against crime. And even Department of Defense uses GPS in their defense system, like controlling a cruise missile.

Picture 3 GPS is used to help defenses system.

The most practical use of GPS nowadays is as a navigation system that guides its user to a desired location.

Picture 4 Google GPS Navigation system

Picture 5 GPS Navigation System Design for Porsche

When travelling from one place to another whether it is far or near, there is a lot of problem comes to mind. How should we get there or what path should be taken. The farer it is, the more problem we could face, like being lost or being late. This is where GPS navigation system can be used to help people avoid those problems by giving them a suggestion path to take based on GPS's setting, whether user wants the system to give the fastest route, or the safest route.

The development of GPS as a navigational system is strongly depends on user's needs and has to be able to solve many problems, one of those is environment problems.

The most popular environment problem is to reduce oil and fuel usage. GPS navigation system has to bring solution to help people to save the Earth. And one of the solutions it can offer is to give people suggestion to take path that can save a lot of energy.

II. BREADTH-FIRST SEARCHING ALGORITHM

Breadth-first searching algorithm (BFS) is an algorithm for traversing a tree structure to find what it is desired.

BFS must have an array to determine its searching path. The type of array used is entirely depends on what user want to save as a member of the list. If user wants to save an object or a class, they can use an array list or a queue, if user wants to save an integer or a string, they can use a common array.
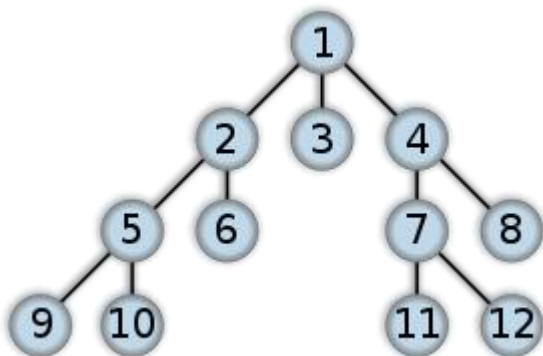
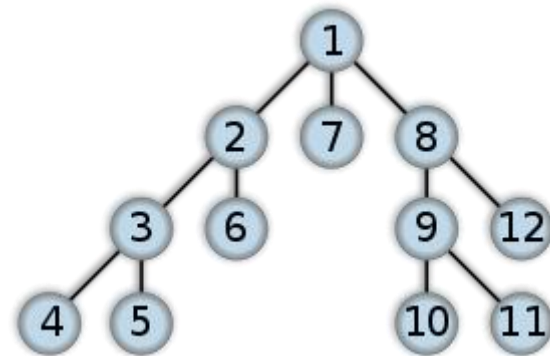*Picture 6 BFS algorithm searching method*

Searching process begins with adding root node to the array as its first element. Then searching process continues to identifying first element of the array. If the

searching process cannot find anything, every child from this root will be added to the array. Then searching process proceeds to process the next element of the array. While solution not found, child nodes of node which is being processed are added to the back of the list. This iteration continues until either all element of the tree have been processed or a solution has been found.

III. DEPTH-FIRST SEARCHING ALGORITHM

Depth-first searching algorithm (DFS) is also an algorithm for traversing a tree structure to find what it is desired as a solution.

For a second, DFS is just like BFS. The differences are located in the searching process.
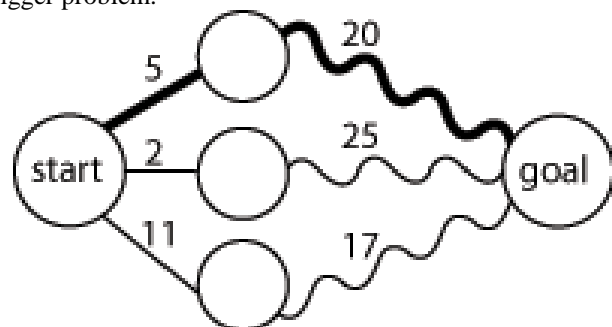

Picture 7 DFS algorithm searching method

For DFS, we could have a linked list for our array. Searching process begins with adding root node to the array as its first element. Then searching process continues to identifying first element of the array. If the searching process cannot find anything, build a new list, and start an iterative process that calls recursive process. Then searching process proceeds to process the first element of the new array. While solution not found, it keeps building a new array. This process continues until either all element of the tree have been processed or a solution has been found.

IV. DYNAMIC PROGRAMMING

Dynamic Programming is a method to solve complex problem by breaking them into several simpler sub problem. It solves every part of sub problem to solve the bigger problem.

Picture 8 Dynamic algorithm searching method

There are two methods of solving problem in dynamic programming, first is to check every sub problem from the first phase to the last phase, and second is to check every sub problem from the last phase to the first phase. Either way, dynamic programming will give an optimal solution in every sub problem.

Even though in theory it is right that if each one of sub problems gives an optimal solution, then if all of the solution are united into a solution for the problem, then the solution will also be an optimal solution, but reality doesn't work that way. The solution produced might be optimal, but dynamic programming could also produce solution that is not optimal.

IV. Green GPS Navigation System

Green GPS Navigation System is just like another GPS Navigation system. The difference is Green GPS provide user a choice to choose a suggestion path that can save energy big time.

How does it work?

Green GPS calculates route with either DFS or BFS or dynamic programming algorithm but the choice is mainly to go straight or to turn right. Suggestions of taking a right turn are handled in special cases that calculate time. This is because when you go left, you there is always a light and you have to cross the junction to get there. (This is based on transportation system that applied in Europe and America, where people drive on the right side of the road.)

Picture 9 No left turn sign

There are four benefits people can get by following this suggestion path.

1. safety

Picture 10 Safety

When you go left, you have to cross a cross route to get where you wanted to be. There is always a chance of accidents when you crossing a junction. In the other hand, by taking a right turn, you don't have to cross any junction. By taking a right turn, you reduce the chance of accidents, because taking a right turn are much safer than taking a left turn.

2. time

Picture 11Time

If there is a light in every junction when you have to wait about one minute every time you want to take a left turn and you don't have to wait to take a right turn. Consider there are twenty five junctions between starting point and destination point where you have to take left turns. If you choose to take three right turns instead of a left turn, you can actually save twenty five minutes. (If the lengths of path you have to take when taking three right turns are not considered.) Of course, it would be ridiculous if a GPS never give a left turn. Special cases are needed to handle left turn suggestions.

3. saving gas

Picture 12 Gas

When you save the time it needs to travel, you automatically save a lot of fuel.

4. saving money

Picture 13 Money

When you save gas consumption and travelling time, you automatically save a lot of money.

UPS, one of the biggest name in package delivery, has been using this navigation system in their system and say that they approximately ten percent of travel time and fuel. In their research, by taking the suggestion path, they have saved over twenty eight point five million miles of travelling and roughly three million gallon of gas in a year.

Picture 14 UPS

If Green GPS uses BFS, the searching process would be like this. First, create an array, and then add the location of GPS right now as source to the array. Then, using basic BFS algorithm defined in the previous chapter, search every possible path from source to destination, and select the suggestion path while considering to not taking a lot of left turn. While GPS location is still in the suggestion path, continue drawing map and the suggestion path. If GPS location isn't in the suggestion path, check whether GPS location has arrived in destination, or not. If GPS location has arrived in destination place, give users information that they have arrived, else (if GPS location isn't anywhere near the destination place, do another searching to find another path. This process continues until GPS location has arrived in destination place.

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And, if Green GPS uses Dynamic Programming, the searching process would be like this. First list each road junction as nodes. Count and take notes for each nodes distance. Then, check for an optimal route while considering Green GPS applied conditions, like not to take left turns unless it's more optimal solution than to take another way and other conditions mentioned above. While GPS location is still in the suggestion path, continue drawing map and the suggestion path. If GPS location isn't in the suggestion path, check whether GPS location has arrived in destination, or not. If GPS location has arrived in destination place, give users information that they have arrived, else (if GPS location isn't anywhere near the destination place, do another searching to find another path. This process continues until GPS location has arrived in destination place.

V. Conclusion

Green GPS Navigation System is one of many ways to help building a better world. It could help people to save the Earth by giving them a suggestion path that save a lot of energy, save travelling time, save a lot of money and the most important, safety.

Green GPS Navigation System can either use Depth-first searching algorithm (DFS) or Breadth-first searching algorithm (BFS) or maybe Dynamic Programming algorithm to help their path finding method. Each one of those algorithm has its own advantages and drawbacks. There is no perfect algorithm, which algorithm to use is entirely in the hand of developers to choose.

VI. Appendices

Table of Pictures

VII. ACKNOWLEDGMENT

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Signed,

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