UNIVERSITY OF PETROLEUM AND ENERGY STUDIES, DEHRADUN

Map Navigator For Campus Routes

Synopsis Report of the (Minor Project - 1) in Semester V

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INDEX

Title of the project - Map Navigator For Campus Routes

Abstract

Dijkstra Algorithm is one of the most famous algorithms in computer science. There might be several possible routes to reach a destination point. If someone doesn't travel through optimal path, it will consume more time and energy. This project aims to determine locations of the node that reflect all the nodes in the list, build the route by connecting nodes and evaluate the optimal path by using Dijkstra algorithm. Dijkstra's Algorithm is also known as a single source shortest path algorithm which is used to find the shortest distance/path from one node to another node in a graph. This algorithm can be used only for positive distances from one location to another.

Introduction

In everyday life, people often struggle to figure out which path to take. They try different ways to find the best route, like when moving around a campus, but not all methods give the most efficient path. The "shortest path problem" is about finding the quickest or shortest way between points, usually on a map or diagram (called a graph). In "Campus Navigation," this means helping users get from one place to another by finding the best route based on their starting location. Each direction or road has a certain "cost," like time or distance, and the goal is to find the path with the lowest total cost.The shortest path problem can be solved using Dijkstra's algorithm, which helps find the best route between points in a graph. There are different versions of this problem: finding the shortest path between two points, between all possible points, or from one starting point to all other points.

Literature Review

1- **Reference [2]** Dijkstra is the backbone of every navigation system. Google maps is a typical application of the algorithm. This navigation system is very prevalent but the problem is how can people find a travelling route within a private area such as university campus used to find the location. Finding the shortest path from origin to destination in these private areas cannot be performed by only relying to services provided by google maps application or google geocoder API.

2- **Reference [3]** proposed Djkstra's algorithm to optimize the routes in a railway system so as to present the user with the shortest route. The proposed system provides users with regular and reliable information on rail system and serves as a framework for the development of future 'smart cities'.

3- **Reference [5]** proposed Vehicles Route Planning (VRP) for finding an optimal route from a car starting point to its destination. In this work, comparative analysis of Bellman-Ford and Dijkstra shortest path algorithms were conducted. Results from the simulation experiment confirmed that Dijkstra's algorithm perform best in terms of delay time and shortest travel path.

Motivation

- **Campus navigation** is a digital guide that helps you find your way around a large campus.
- It works by finding the best route between your starting point and your destination.
- **Think of it like solving a puzzle:** the campus is a puzzle with many pieces (buildings and paths), and the navigation system finds the best way to connect them.
- **It's like playing connect the dots:** the system finds the shortest line between the "dots" (buildings) to show you the quickest route.
- **Next time you're lost on campus, use campus navigation to guide you to your destination.**

Problem Statement

There exist many advanced navigation systems but most of them are unable to provide routes precisely as well as information of building within a region such as campus, shopping mall, hospital and etc.Nowadays, as people are getting more and more connected to technology, they lost their human touch. Also, people feel more convenient to search for the problem themselves rather than asking someone for help. An informative, reliable and precise guidance system is very important in this technological era. It should be able to navigate the user no matter the user is under the indoor or outdoor environment. The guidance system must be user-friendly and able to process data efficiently.Since the size of any college/university campus can vary from 30 acres to anywhere around 200 acres, students spend majority of their time in travelling between different buildings. New students feel inconvenient to search their way inside the campus.Therefore, a navigation system is required to find the optimal path within the campus and for the aforementioned problem.

Objectives

To provide a navigation system/map for a campus.

- To determine the nodes (significant infrastructure points) inside the campus
- To determine the estimated distance among all the nodes.
- To find the shortest optimal path from one location to another.

Methodology

Dijkstra's algorithm is for minimum spanning tree. In Dijkstra's we generate a *SPT (shortest path tree)* with given source as root. We maintain two sets, one set contains vertices included in shortest path tree, and other set includes vertices not yet included in shortest path tree. At every step of the algorithm, we find a vertex which is in the other set (set of not yet included) and has a minimum distance from the source.

The steps to be followed for completing the proposed project are as follows:

1. Identification of key locations in campus infrastructure- Key Structural points in the campus are to be identified, which work as the node points for the Dijkstra's Algorithm
2. Distance Estimation -Estimated distance is calculated which works as the weight between two adjustment nodes, hence a weighted directed graph is generated.
3. Proposing the shortest Path to the User- Using the Dijkstra's Algorithm the program will suggest the shortest optimal path.

Example illustration

Imagine you are in a city and you want to find the fastest way to get from your home to the nearest grocery store. The city has roads connecting different places (like parks, schools, and markets). In this example, each place is like a "node," and the roads connecting them are the "edges."

In a map navigation project:

1. Nodes- are the important places (e.g., home, grocery store, parks).

2. Edges- are the roads between these places, each with a distance (like 2 km or 5 km).

3. Goal- You want to find the shortest road (path) from your home to the grocery store.

Working-

Step 1- The computer will look at all the places (nodes) and all the roads (edges) connecting them.

Step 2- It will figure out all possible routes from your home to the grocery store.

Step 3- Using Dijkstra's algorithm, it will compare the distances of all routes and find the one with the shortest distance.

Result - The computer tells you which route to take to get to the grocery store in the shortest time.

This is how map navigation works in simple terms, using nodes, edges, and an algorithm to find the best route.

Work have been done until now

1-Set Up our (Development Environment)

Install a C++ Compiler On Windows, we use tools like MinGW or Visual Studio.

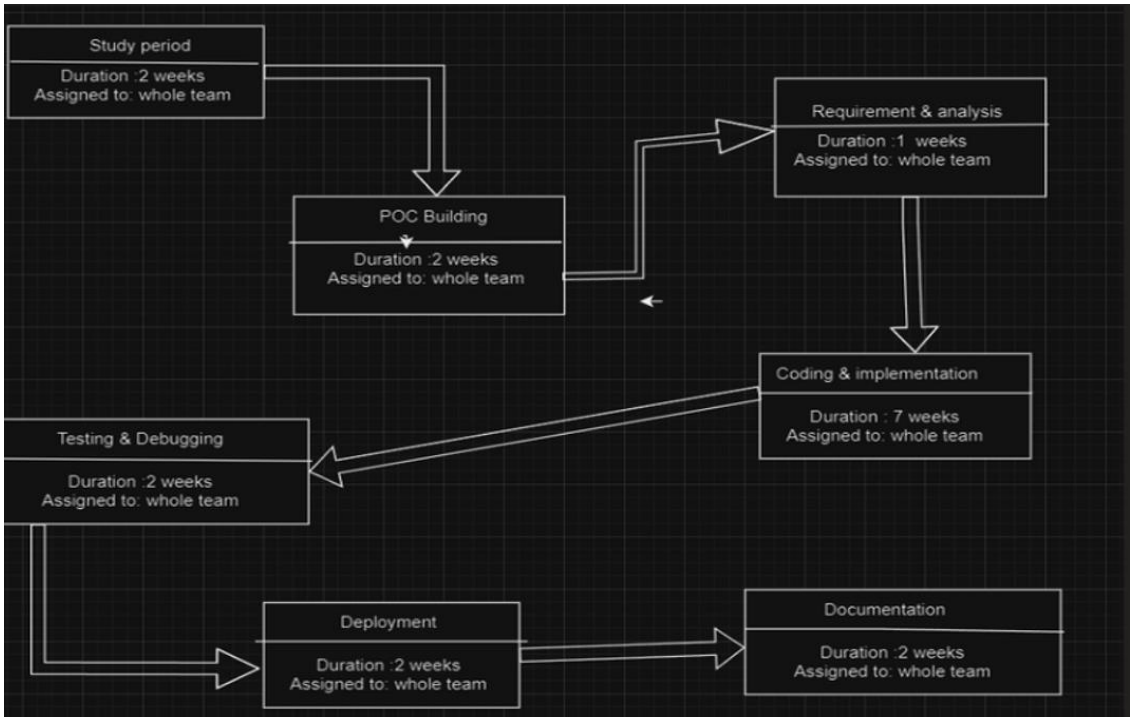
Install an IDE or Text Editor: we use Visual Studio Code, Code::Blocks and C++ IDE.

Libraries for Graph Representation If needed, we will install additional libraries like Boost for graph operations, but for basic Dijkstra's algorithm, you can write your own.

2- Documentation

Documented our clear comments to explain the logic.

PERT Chart


Study period
Duration :2 weeks
Assigned to: whole team
POC Building
Duration :2 weeks
Assigned to: whole team
Requirement & analysis
Duration :1 weeks
Assigned to: whole team
Coding & implementation
Duration : 7 weeks
Assigned to: whole team
Testing & Debugging
Duration :2 weeks
Assigned to: whole team
Deployment
Duration :2 weeks
Assigned to: whole team
Documentation
Duration :2 weeks
Assigned to: whole team

Requirement

1. Software Requirements

Operating System	:	Windows 10/8/7 (32-bit or 64-bit)/ Linux
Software	:	Text Editor/Turbo C/DevC
Compiler	:	GCC

1. Hardware Requirements

Processor	:	Dual Core 2.7 GHz or better
RAM	:	512 MB or higher

References

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3 P. Pramod and D. Sunanda Railway Route Optimization System using Dijkstra's Method. International Journal on Recent and Innovation Trends in Computing and Communication, 2(3), 2014, 3435-3440.

4 A.K. Sangaiah, M. Han, and S. Zhang, An Investigation of Dijkstra and Floyd Algorithms in National City Traffic Advisory Procedures. International Journal of Computer Science and Mobile Computing, 3(2), 2014, 124-138.

5 Research on Google map algorithm and implementation ,Article in Journal of Information and Computational Science 5(3):1191-1200, May 2008.

Approved By

(Mentor)