Data Structures and Algorithms

EFFICIENT POWER SUPPLY SYSTEM

Course Project Report

School of Computer Science and Engineering

2023-24

Contents

1. Course and Team Details

1.1 Course details

Course Name	Data Structures and Algorithms
Course Code	23ECAC203
Semester	III
Division	F
Year	2023-24
Instructor	K.M.M.Rajashekaraiah

1.2 Team Details

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2. Introduction

The implementation of data structures and algorithms plays a pivotal role in addressing the pervasive issue of insufficient power supply, a challenge that has far-reaching implications for modern societies. In the realm of power distribution and management, efficient utilization of available resources is paramount to ensure a reliable and sustainable energy infrastructure. By leveraging data structures, such as graphs and matrices, intricate power distribution networks within cities can be effectively modeled, allowing for a granular understanding of connectivity and energy flow.

Algorithms, ranging from classic approaches like Dijkstra's algorithm to more contemporary solutions, enable the optimization of electricity routes, minimizing energy losses, and alleviating the impact of insufficient power supply. These algorithms provide a systematic means to analyze , plan, and enhance the distribution grid's efficiency. Additionally, data structures like arrays and linked lists prove invaluable in managing vast datasets related to electricity consumption, production, and user complaints.

The fusion of data structures and algorithms empowers engineers and policymakers to make informed decisions, proactively address power shortages, and enhance the resilience of energy systems. Whether it's optimizing routes for electricity distribution or handling user complaints through efficient search algorithms, the implementation of these foundational concepts is instrumental in paving the way for a robust and responsive power supply infrastructure, crucial for the sustainable development of communities worldwide

3. Problem Statement :

Our course project, titled "Efficient Power Supply System," focuses on creating a smart and effective solution for managing electricity. The main aim is to make sure that people receive reliable and sustainable power in an organized way. We're implementing a computer program that automates different important tasks related to electricity. This includes efficiently managing information about electricity companies, optimizing how power flows through cities using smart algorithms, and making sure that billing for electricity is clear and fair. By doing all this, our project aims to contribute to building a power supply system that is not only reliable but also smart and well-organized, making sure everyone gets the electricity they need in the best possible way.

3.1 Domain

Our project endeavors to revolutionize the power supply ecosystem by developing a comprehensive program that automates various critical aspects. The overarching goal is to create an efficient power supply system that seamlessly integrates electricity company management, city power distribution, graph algorithms for optimized routes, and transparent billing for localities.

The program will facilitate streamlined electricity company management, providing a centralized platform for administrators to handle diverse information related to different electricity providers, including types, production capacities, and overall management. Simultaneously, it focuses on the intricate power distribution networks within cities, employing graph algorithms like Depth-First Search (DFS) and Dijkstra's algorithm to optimize connectivity and determine efficient paths for electricity flow. These algorithms ensure a resilient and adaptive power grid, minimizing energy losses and congestion.

Additionally, the program automates the billing process, generating accurate and transparent bills for localities. Integration with relevant data, such as electricity consumption patterns and tariff structures, streamlines billing operations, enhancing financial management and ensuring fairness.

In essence, our project aims to automate and optimize key components of the power supply system, contributing to the development of an efficient, sustainable, and responsive infrastructure. By seamlessly integrating these functionalities, the program aspires to address the challenges of insufficient power supply, fostering reliability, transparency, and overall effectiveness in energy distribution.

3.2 Module Description

I am currently engaged in developing a module dedicated to optimizing energy paths for cities and localities, utilizing advanced algorithms. Additionally, the module addresses user complaints, ensuring efficient handling and resolution. This dual-purpose module aims to enhance the overall efficiency and responsiveness of our power supply system.

Graph Algorithms for Route Finding:

The code incorporates graph algorithms to facilitate efficient route finding within cities. The createGraph function initializes a graph structure, and the addEdge function populates the adjacency matrix, representing connections between nodes (transformers) in a city. The Depth-First Search (DFS) traversal, implemented through the dfsTraversal function, starts from a specified vertex and explores adjacent nodes, aiding in understanding the connectivity and structure of the power distribution network. Additionally, the code employs Dijkstra's algorithm for each city, implemented in the Dijkstra function, to find the shortest paths between localities. This algorithm optimally determines the most efficient routes for electricity distribution, considering the weights of the edges (connections) in the adjacency matrix.

Complaint Handling:

The complaint handling module is integrated into the code to address user concerns and contribute to the overall system's reliability. The handleComplaints function interacts with

users, allowing them to register complaints related to electricity companies. The Knuth-Morris-Pratt (KMP) algorithm, implemented in the kmpSearchCompany function, efficiently searches for the specified electricity company name in the complaints. This enhances the system's responsiveness by associating each complaint with the respective electricity company. The code also monitors the frequency of complaints against each company, and if the number surpasses a predefined threshold (MAX_COMPLAINTS), it triggers actions such as canceling the company's license.

4. Functionality Selection

Si. No.	Functionality Name	Known	Unknown	Principles applicable	Algorithms	Data Structures
	Name the functionality within the module	What information do you already know about the module? What kind of data you already have? How much of process information is known?	What are the pain points? What information needs to be explored and understood? What are challenges?	What are the supporting principles and design techniques?	List all the algorithms you will use	What are the supporting data structures?
1	Read City Tower Connections	Information about how city towers are connected.	Specifics of data representation, source.	Hierarchical Data and Trees	Insertion	Adjacency matrix/Graph
2	Display path.	City tower connections.	Specifics of DFS implementation, efficiency criteria.	Brave and cautious travel.	Depth-first search (DFS) to find the most efficient path between towers	Stack
3	Read_Locality	Information about how the localities are connected	Specifics of data representation, source.	Hierarchical Data and Trees	Insertion	Adjacency matrix
4	Shortest_path	Locality connections.	Specifics of shortest path algorithms to use. So we selected Dijkstra's algorithm	Greedy approach	Dijkstra's Algorithm	Minimum priority queue
5	Read customer Complaints	Customer information	Specifics of data representation.	-	Array Insertion	Array
6	Store the complaints	Complaints details	Specifics with storing	-	Array store	Array
7	Search whether the company mentioned by the customer is present in the company database.	Company details against whom the complaint is registered	Specifics with searching techniques	Brute Force	Knuth-Morris-Pratt Algorithm	Array
8	Display the result	Number of complaints	To decide the action taken	Decision making.	-	Array

		against the company	against the company.			

5. Functionality Analysis

1) Read City Tower Connections

A graph is used to insert the values:
The Space efficiency of the Graph is O(V).
The time efficiency of the Graph is O(V+E).

2)Display path.

Stack is used by the DFS Algorithm to find the path:
The space efficiency of the stack is O(n)
The time efficiency of the stack is O(n)

3) Read_Locality

A graph is used to insert the values:
The Space efficiency of the Graph is O(V).
The time efficiency of the Graph is O(V+E).

4) Shortest_path

Dijkstra's algorithm is used to compute the shortest path:
The space complexity of Dijkstra's algorithm is O(V).
The time complexity of Dijkstra's algorithm is O(V^2).

5) Read customer Complaints

Arrays to insert the values:
The Space efficiency of Arrays is O(n).
The time efficiency of Arrays is O(n).

6) Store the complaints

Arrays to store the values:
The Space efficiency of Arrays is O(n).
The time efficiency of Arrays is O(n).

7)Search for companies with complaints

Knuth-Morris-Pratt Algorithm is used to search the company
The Space efficiency of Knuth-Morris-Pratt Algorithm is O(m+n)
The Time efficiency of Knuth-Morris-Pratt Algorithm is O(m+n)

8) Display the result

Here, the decision-making design principle is used and the result is based on the comparison of the predefined condition and the number of complaints against the company. So here the comparison is the basic operation but it is compared only once hence the efficiency of this function is O(1).

6. Conclusion:

In conclusion, the development of our course project, titled "Efficient Power Supply System," marks a significant stride towards addressing the multifaceted challenges in the realm of energy management. Through the amalgamation of automation and sophisticated algorithms, our program encapsulates the essence of a resilient and responsive power supply infrastructure. The integration of electricity company management, city power distribution, graph algorithms for optimized routes, and transparent billing for localities provides a holistic solution to the persistent issues surrounding insufficient power supply.

By streamlining tasks related to electricity companies, our project aims to enhance administrative efficiency, contributing to well-informed decision-making. The utilization of graph algorithms for city power distribution ensures that the energy grid is not only interconnected but also optimized, reducing energy losses and improving overall efficiency. Furthermore, the automated billing system adds a layer of transparency and fairness, ensuring that consumers are billed accurately.

As we navigate the complexities of modern power supply challenges, our project stands as a testament to the potential of technology to reshape and elevate essential infrastructures. Through this endeavor, we aspire to contribute to the realization of a more sustainable, reliable, and efficient power supply system that meets the growing demands of contemporary societies.

7. References

www.geeksforgeeks.com[1].

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