Capstone 400B Project Report

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“TOUR PLANNING: A Time-Conscious Tourist Places Recommendation System”

1. Introduction:

Tourism is a significant industry worldwide, with travelers often seeking personalized experiences according to their preferences. For planning purposes, they depend on many sources like guidebooks, word of mouth recommendations or online search engines and travel agencies, but those sources often fail in delivering proper suggestions according to traveler's preferences and are also very time consuming. So, a tourist recommendation system can help travelers solve those problems. It can help travelers by providing personalized tour plans based on traveler’s preferences and needs. Generally, those systems use information like user’s like or dislike, current location of traveler, the distance to potential destinations, and the travel cost, to recommend destinations, activities, accommodations, and restaurants that match the user's interests. This system helps travelers find the best places to visit and choose the ones that go well with their preferences. However, these systems could improve recommendations by including routes with multiple destinations and available time. By those improvements, travel experience can be even more enjoyable and effectively planned.

2. Literature review:

Prof. Sharikant et al. [1] proposed a personalized recommendation system which recommends places based on user interest,current location and range of distance. It uses content based filters to find similar interest among user profiles. Also, calculate euclidean distance and use KNN algorithm to recommend the places. Here, the apriori algorithm is used for classification. This system also filters out visited places, providing information like reviews and seasonal recommendations.

Sutomo, R., & Kaisha Pratama, D. [2] present an innovative approach to enhance tourism experiences in the City of Semarang , Indonesia. They develop an advanced recommendation system which integrates content-based and collaborative filtering techniques to offer personalized tourist suggestions. The paper also demonstrates the system's efficacy in simplifying travel decisions and uncovering Semarang's hidden treasures. Overall, it fills a research gap and also contributes to the field of tourism recommendation systems.

Mishal et al.[3] introduced a personalized and budget friendly tour spot recommendation system based on content-based filtering, which helps to enhance the tourist experience by recommending the best picnic spots according to all user's preferences, including budgets, interests, destination country, type of places, safety, transportation and climate. This system compares the features of different spots and takes into account the user's previous history to recommend similar tour spots by using content based filtering methods and predict the user's preferences accurately and suggest the best picnic spots.

Yanmei Zhang et. al.[4] proposed a route planning method which gives travel route with multiple places considering multiple factors (that is, the distance between sites, initial travel position, initial departure time, time duration of tour, total cost, scores and popularities of sites) comprehensively, and routes were rated by a comprehensive attractiveness index. They used simulated annealing, greedy algorithm, and genetic algorithm where genetic algorithm performed best on run time.

Title	Activity	Algorithm	Limitations
Traveler's Recommendation System Using Data Mining	Recommend considering user's interest,current location and range of distance.Filter out visited places.	Content Based Filtering, KNN Algorithm and Apriori algorithm	1. Uses Euclidean distance, which may not accurately reflect real-world distances. 2. Does not account for travel time constraints. 3. Recommends only one place from the suggested spots 4. Does not provide travel routes or sequences for visiting multiple places within a specific timeframe.
Measuring Tourist Experience in Semarang City through an Advanced Recommendation System	Enhances tourism in Semarang, Indonesia, by simplifying travel decisions, uncovering hidden treasures, and highlighting top-rated destinations and local favorites based on user ratings.	content-based and collaborative filtering	1. Does not account for travel time constraints. 2. Recommend only one place to visit from their list of suggested spots. 3. Does not provide travel routes and sequences for visiting multiple places within a specific time.

Tour Spot Recommendation System via Content-Based Filtering	Enhance the tourist experience by recommending the best picnic spots according to all users preferences, including budgets, interests, destination country, type of places, safety, transportation and climate.	Content Based Filtering	1. Does not consider traveler's travel time constraints. 2. Does not consider current location, travel routes and sequences for visiting multiple places.
A Tourism Route-Planning Approach Based on Comprehensive Attractiveness	Recommends travel route with multiple places considering multiple factors including the distance between sites, initial travel position, initial departure time, time duration of tour, total cost, scores and popularities of sites.	Genetic Algorithm	1. Conducts on a small dataset. If the dataset becomes larger, then time complexity increases exponentially that affects the real time recommendation.

Note:None of those papers considered the endpoint while recommending the tour plans.

3. Motivation

The motivation of this project is to overcome the limitations of the traditional recommendation system for travels. Traditional travel recommendation systems often overlook how many sets of places travelers can visit within their time constraints.Therefore, we need a recommendation system that suggests the best sequential route within these constraints.

- ➢ Recommending the most suitable places considering the endpoint destination to ensure a fulfilling travel experience within the available time.
- ➢ Providing travel routes and sequences for visiting multiple places within the given time constraints.
- ➢ Suggesting an optimal sequence of places to visit based on the user's starting point, ending point, and available time.

This project addresses the limitations of traditional travel recommendation systems by offering a time-aware, route-optimized solution. It ensures travelers can visit the most suitable places efficiently, maximizing their experience within limited time constraints.

4. Objectives

- **Collecting Tourist Spots Dataset**
    - o To build an optimal route recommendation system, the first step is to gather relevant data on tourist spots including details like location coordinates, types of attractions, popularity, and ratings.
- **Constructing Routes Between Tourist Spots**
    - o The collected tourist spots are represented as nodes within a graph.
    - o Possible routes between these spots are modeled as edges connecting the nodes,creating a network of potential paths.
- **Representing Weight of Nodes and Edges**
    - o Nodes can be weighted based on factors like the attraction's popularity, and edges can be weighted based on the distance between the spots and other user-defined criteria.
- **Evaluating Distances Between Spots**
    - o Use the Haversine formula to calculate the geodesic distance between each

pair of tourist spots.

- **Selecting Candidate Spots**

  o Implement a mechanism to filter and select candidate tourist spots based on user preferences, considering the start and end points.

- **Measuring the Weighted Cost of a Route**

  o Find an efficient cost function to evaluate the scores for the candidate considering the weight of nodes and edges.

5. Problem Statement

1. Collecting Tourist Spots Dataset

- ❖ How can we gather accurate and comprehensive data on tourist spots in Bangladesh?
- ❖ What is the best way to organize and store this data for easy access and use?

2. Graph Construction

- ❖ How can we create routes that connect different tourist spots?
- ❖ How can we calculate the distances between each spot?
- ❖ How can we represent the weight of each spot and the connections between them?

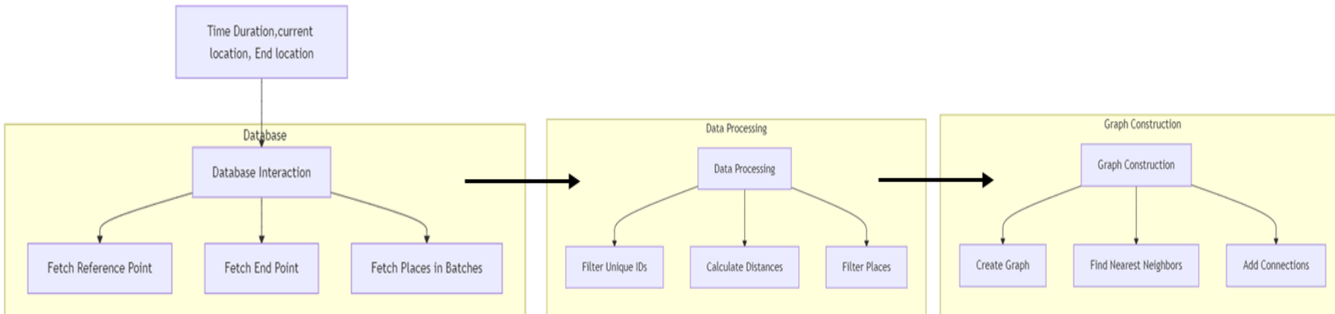
3. Recommendation

- ❖ How can we choose the best tourist spots to visit based on a starting and ending point?
- ❖ How can we determine the total cost of traveling along a specific route?

4. User Interaction

- ❖ How can we design a website and mobile app that are user-friendly, intuitive, and effective for tourists?
- ❖ What features should be included to enhance user experience and engagement?

6. Design and Implementation



Data Warehouse: The system begins by collecting essential input from the user, including:

- Current Location: The starting point of the journey.
- Destination: The end point or the final place of interest.
- Constraints: Maximum travel time, average speed, and other user preferences that might influence the route selection.

Data Prepossessing:

- **Retrieve Start Point Details:** The system establishes a connection with the database. to retrieve the geographical coordinates (latitude and longitude) and other relevant information for the user's current location.
- **Retrieve Endpoint Details:** Similarly, the system fetches the coordinates and relevant information for the destination specified by the user.
- **Filter Out Duplicate Places:** Once the data is fetched, the system processes it to eliminate duplicate entries based on the titles of places.
- **Filtering Mechanism:**Unique IDs are preserved by using dictionaries and sets, ensuring that only one instance of each place is retained.

Graph Construction:

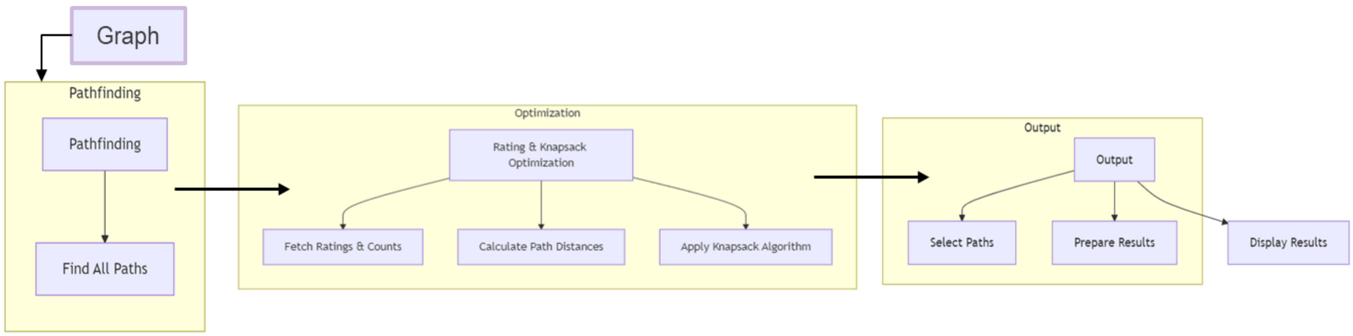
- **Create a Graph with Nodes and Edges:** A graph is constructed where each place is represented as a node, and the edges between them represent the calculated distances.
- **Distance Calculation**: The Haversine formula is employed to calculate the shortest distance between two geographical points, ensuring accurate representation of distances on a spherical surface.

$$a = \sin^2\left(\frac{\Delta\mathrm{lat}}{2}\right) + \cos(\mathrm{lat}_1)\cdot\cos(\mathrm{lat}_2)\cdot\sin^2\left(\frac{\Delta\mathrm{lon}}{2}\right)$$

$$c = 2\cdot\mathrm{atan2}\left(\sqrt{a}, \sqrt{1-a}\right)$$

$$d = R\cdot c$$

- **Identify Nearby Places:** The system identifies places within a predefined maximum distance from both the start and end points.
- **Dijkstra's Algorithm:** Used to find the nearest neighbors and ensure that the graph reflects realistic travel possibilities within the given distance constraints.
- **Explore All Possible Paths Using BFS:** The Breadth-First Search (BFS) algorithm is utilized to explore all feasible paths from the start to the end point.



Recommendation and Optimization:

- **Retrieve Ratings and Visit Counts:** The system fetches user ratings and visit counts for each place along the identified paths from the database.
- **Knapsack Problem (0/1 Knapsack:** The Knapsack problem is solved to maximize the total value of selected paths while adhering to the user's time constraints.

  dp[i][t] = max(dp[i-1][t],dp[i-1][t-segment_times[i-1]+segment_profits[i-1])

  Where:

  dp[i][t] is the maximum profit achievable with the first i segments and t minutes of time,

  dp[i-1][t] represents the profit achievable without including the i-th segment,

  dp[i-1][t - segment_times[i-1] + segment_profits[i-1] represents the profit achievable by including the i-th segment, if the remaining time (i.e, t-segment_times[i - 1]) allows it.

- **Select Optimal Paths:** Based on the results from the Knapsack algorithm, the system selects the optimal paths that offer the highest rating and value within the allowed time.

7. Experimental Result:

User Input:
Maximum travel time in hours: 4
Current location: Damudya Upazila Pond
End location: Dhanbari Nawab Palace

Runtime: 24.74 seconds.

System Output:

1. **Route 5**:
- **Path**: Damudya Upazila Pond -> Lakarta Sikdar Bari -> Namar Hati -> Dhanbari Nawab Palace
- **Score**: 992.01
- **Travel Time**: 3.56 hours

2. **Route 13**:
- **Path**: Damudya Upazila Pond -> Puran thanar ghat -> আরব নগর -> Konai bridge/কনাই ব্রিজ -> Dhanbari Nawab Palace
- **Score**: 962.41
- **Travel Time**: 3.56 hours

3. **Route 15**:
- **Path**: Damudya Upazila Pond -> Puran thanar ghat -> Namar Hati -> Dhanbari Nawab Palace
- **Score**: 961.41
- **Travel Time**: 3.56 hours

4. **Route 12**:
- **Path**: Damudya Upazila Pond -> Puran thanar ghat -> আরব নগর -> বাঁধ বাজারের মাথা -> উপরা চাঁদ -> Dhanbari Nawab Palace
- **Score**: 960.41
- **Travel Time**: 3.56 hours

5. **Route 10**:
- **Path**: Damudya Upazila Pond -> দাউল পাড়া -> Namar Hati -> Dhanbari Nawab Palace
- **Score**: 959.21
- **Travel Time**: 3.56 hours

6. **Route 1**:

- **Path**: Damudya Upazila Pond -> Puran thanar ghat -> আরব নগর -> Dhanbari Nawab Palace
- **Score**: 954.41
- **Travel Time**: 3.56 hours

7. **Route 11**:

- **Path**: Damudya Upazila Pond -> Number 1 -> Namar Hati -> Dhanbari Nawab Palace
- **Score**: 952.71
- **Travel Time**: 3.56 hours

8. **Route 2**:

- **Path**: Damudya Upazila Pond -> Puran thanar ghat -> Namar Hati -> Dhanbari Nawab Palace
- **Score**: 951.41
- **Travel Time**: 3.56 hours

9. **Route 9**:

- **Path**: Damudya Upazila Pond -> বড়শি শীতল বটতলা -> Namar Hati -> Dhanbari Nawab Palace
- **Score**: 950.71
- **Travel Time**: 3.56 hours

10. **Route 6**:

- **Path**: Damudya Upazila Pond -> Summertime Edge -> Namar Hati -> Dhanbari Nawab Palace
- **Score**: 950.71
- **Travel Time**: 3.56 hours

11. **Route 3**:

- **Path**: Damudya Upazila Pond -> পদ্মা ভিউ -> Namar Hati -> Dhanbari Nawab Palace
- **Score**: 949.71
- **Travel Time**: 3.56 hours

12. **Route 7**:

- **Path**: Damudya Upazila Pond -> Xmz Ashik -> Namar Hati -> Dhanbari Nawab Palace
- **Score**: 946.71
- **Travel Time**: 3.56 hours

13. **Route 8**:

- **Path**: Damudya Upazila Pond -> Abdul Hakim turn -> Namar Hati -> Dhanbari Nawab Palace
- **Score**: 945.71
- **Travel Time**: 3.56 hours

14. **Route 4**:

- **Path**: Damudya Upazila Pond -> Hiwlader Bari -> Namar Hati -> Dhanbari Nawab Palace
- **Score**: 936.99
- **Travel Time**: 3.56 hours

8. Conclusion:

The project will produce a reliable and user-friendly recommendation system that improves the tourist experience in Bangladesh by providing personalized and data-driven suggestions for top tourist destinations in each Upazila. The system will use advanced data processing techniques, geospatial calculations, and normalization methods to procedures accurate, relevant, and high-quality recommendations. There are many key benefits we gain by this system such as personalized travel itineraries, optimized route planning, enhanced decision-making, efficient time management. This recommendation system represents a significant advancement in how tourists experience Bangladesh, offering a blend of technology, data, and local insights to create a more enriching and personalized travel experience.

Appendix:

Addressing of COs, Knowledge Profile (K), and Complex Engineering Problem (EP):

CO	CO Descriptions	K	EP
CO3	**We have achieved:** ❑ Data Processing ❑ Distance Calculation ❑ Filtering Places ❑ Graph Construction ❑ Pathfinding ❑ Knapsack Optimization ❑ User Interaction ❑ Database Management ❑ Output Visualization	**(i)Problem Analysis[K1, K2, K3, K4]** **Distance Calculation:** Uses Haversine formula to calculate distances between coordinates. **Filtering Places**: Removes duplicates and selects places based on proximity to the route and start/end points. **Graph Construction:** Creates a graph representing connections between places. **Pathfinding:** Finds possible routes between start and end points.	**(i) Problem Analysis [EP1, EP2, EP3, EP6, EP7]** **Distance Accuracy:** Ensures accurate distance calculations and route filtering. **Unique Identification:** Filters out duplicate places to ensure relevance. **Efficient Graph Building:** Constructs a graph to analyze connections and paths. **Path Evaluation:** Evaluates different routes for feasibility and relevance.
CO4	❑ User Safety ❑ Environmental Consideration	**(i) Design and Implementation [K5]** **Public Health Considerations:** Ensured the project promotes user safety and data privacy. **Environmental Considerations :** helps reduce environmental impact by minimizing resource usage and lowering carbon emissions	**(i) Design and Implementation [EP1, EP2, EP4, EP5, EP6, EP7]** **Safety and Accuracy:** Ensures safe and accurate route recommendations by filtering and evaluating paths. **Cultural and Societal Considerations:** Incorporates user-defined locations and preferences in the design.
CO5	❑ Geospatial Tools ❑ Data Processing	**Materials and Devices [K6]**	**Materials and Devices [EP1, EP2, EP4, EP5]**

	❑ Libraries ❑ Graph Algorithms Optimization Techniques	**Modern Tools:** Uses Python and libraries (e.g., mysql.connector, math, heapq) for data processing and analysis.	**Data Handling:** Manages large datasets with batch processing. **Graph Algorithms:** Applies graph-based algorithms for pathfinding and distance calculations.
CO6	❑ Societal Impact ❑ Safety Consideration	**Social and Environmental Impact of Engineering [K7]** **Societal Impact:** Provides tools for personalized route planning based on user preferences. **Safety Considerations:** Ensures safe travel recommendations by filtering places and paths.	**Social and Environmental Impact of Engineering [EP2, EP5, EP6]** **User-Centric Design:** Considers user input and preferences in route planning. **Safety and Relevance:** Ensures routes are safe and relevant to user-defined criteria.

References:

1. Shrikant Kokate et. al. “Traveler’s recommendation system using data mining techniques”. (2018) ICCUBEA’2018.

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