Intelligent Reasoning Systems Project Proposal

MyTrail App

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1. Introduction

MyTrails is a mobile application designed for newcomers and residents in Singapore who enjoy running, hiking, or brisk walking but may not be familiar with the city's diverse outdoor trails. Unlike traditional navigation apps that focus on optimal or predefined paths, MyTrails emphasizes exploration and variety. The system automatically generates randomized yet safe and feasible routes from the user's current location, tailored to distance and duration preferences.

The generated routes are then ranked according to personalized filters such as terrain type, slope intensity, crowd density, and environment (urban streets vs. parks). By encouraging users to explore unfamiliar yet accessible areas, MyTrails aims to combine fitness, adventure, and urban discovery in one experience.

The project's primary goal is to provide users with a novel way to engage with their environment while exercising, supporting both fitness goals and the intrinsic motivation of exploration.

2. Project Background & Market Context

2.1. Background

Outdoor running and walking apps have gained immense popularity worldwide as health awareness increases and urban residents seek convenient exercise solutions. In Singapore, where urban and natural landscapes coexist closely, runners and walkers often look for new routes to keep their routines engaging. However, current tools mainly optimize for shortest or fastest travel paths, or rely on user-generated content without system-level personalization.

2.2. Problem / Challenge Addressed

Mainstream fitness and navigation apps (e.g., Strava, Keep, Google Maps) only partially address the needs of users who seek exploration-oriented experiences. Current gaps include:

- **No randomized or exploratory route generation** – existing apps typically provide optimal routes or showcase fixed community routes but lack the ability to generate diverse, randomized loops aligned with user-defined distance or time constraints.

- **Lack of intelligent ranking across multiple alternatives** – most tools suggest one route or show unorganized options without personalized ranking based on filters like scenery, congestion, or safety.

- **Limited support for slope or elevation awareness** – important for users who either prefer challenging uphill workouts or beginner-friendly flat terrains.

MyTrails addresses these gaps by:

- Generating several candidate routes from user input and randomized exploration algorithms.

- Ranking them using multi-criteria reasoning (e.g., environment, slope, safety) that is explainable to the user.

- Encouraging a spirit of discovery rather than mere utility, making exercise more enjoyable.

2.3.   Market Landscape & Research

The global fitness app market is highly competitive and saturated with performance-tracking tools (e.g., Strava, Runkeeper, Nike Run Club). However, few focus on exploration and novelty in route planning. In Singapore, the demand for unique outdoor experiences is growing, particularly among expatriates, fitness enthusiasts, and wellness-conscious residents. MyTrails differentiates itself by combining AI-driven exploration with personalized fitness route recommendation.

The current market for fitness and navigation applications shows dominance by major platforms like Strava, Nike Run Club, Keep, and MapMyRun. These apps emphasize:

- **Performance tracking** (pace, calories, heart rate).

- **Community features** (leaderboards, shared routes).

- **Predefined or crowd-sourced routes** (heatmaps, challenges).

Gaps & Opportunities:

- Few apps allow automatic **randomized route generation**.

- Lack of **customizable filters** for terrain, slope, and environment.

- Demand for **exploration-based fitness** is rising, especially in urban regions where runners seek variety and motivation beyond repetition.

Key Trends:

- Personalization in digital fitness through AI and recommender systems.

- Growth of **experiential fitness** — users valuing fun and novelty as much as performance.

- Integration of **geospatial data** and environmental awareness into lifestyle apps.

Market Potential:

- Singapore serves as an ideal testbed with a mix of parks, waterfronts, and urban neighborhoods.

- Initial target users include:
    - Expats and newcomers unfamiliar with routes.

    - Fitness enthusiasts who want diverse challenges.

    - Wellness-focused users seeking engaging outdoor activities.

3. Project Target & Features

3.1. Target:

We hope to combine intelligent reasoning and optimization algorithms to develop an application that can meet user needs. This application can accurately solve the current pain points and cater to market needs.

3.2. Features:

- **Randomized Route Generation**

    - Automatically generates multiple randomized yet feasible and safe routes based on the user's current location and preferred distance or duration.

    - Encourages exploration of unfamiliar areas instead of always taking the shortest or fastest path.

- **Personalized Filtering and Ranking**

    - Users can set filtering conditions (e.g., preferred waypoints), such as terrain type (urban streets/parks), slope intensity, crowd density, and safety.

    - The system evaluates and ranks candidate routes across multiple criteria and provides explainable recommendations.

- **Combination of Exploration and Fitness**

    - Supports not only exercise but also the discovery of new environments, enhancing the sense of novelty and fun.

    - Integrates fitness, adventure, and urban exploration into one experience.

- **Support for Diverse Scenarios**

- ○ Suitable for running, brisk walking, and hiking.

- ○ Covers both urban and natural trails.

4. Project Scope

4.1. Market Scope

MyTrail aims to provide intelligent, personalized route generation for urban outdoor activities such as walking and running. The system is designed to integrate with consumer fitness, travel, and smart city applications, delivering intelligent route generation that leverages rich and dynamic POI (Point of Interest) data for users in cities worldwide.

4.2. Intelligent Systems Focus:

- Intelligent Query Analysis:
  - ○ Uses NLP to extract user preferences such as activity type, distance, duration, and points of interest from input query.
  - ○ Integrates user history and contextual factors (e.g., time, weather, fitness goals) to produce structured constraints for route generation. (future plan)
- Dynamic Route Generation:
  - ○ Generates candidate routes based on real-time user constraints (location, time, preferences) and live POI data.
  - ○ Utilizes advanced multi-criteria scoring algorithms, considering distance, duration, category relevance, and user preferences.
  - ○ Applies diversity optimization and novelty detection to ensure recommendations are varied and engaging.
  - ○ Incorporates user feedback and behavioral data for continuous personalization and learning. (future plan)
- Scalable Architecture:
  - ○ Integrates with global mapping APIs (e.g., Google Maps, OpenStreetMap) for up-to-date data and directions.
  - ○ Supports real-time data pipelines for POI updates and traffic conditions.

4.3. Limitations & Constraints:

- Data Access:
  - ○ Requires reliable access to third-party mapping and POI APIs.
  - ○ Data timeliness issue: Some location data may be outdated.
- Personalization Depth:
  - ○ Effectiveness depends on the availability and quality of user preference and behavioral data.
  - ○ Some specific conditions entered by the user cannot be fully met.

5. Data Collection and Preparation
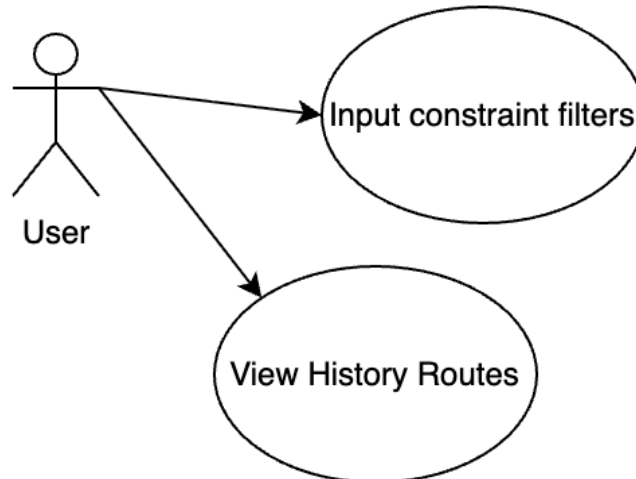
5.1. Data Sources:

- Global Mapping APIs:
  - Real-time POI (Point of Interest) and route data sourced from providers such as Google Maps, OpenStreetMap, and other commercial mapping platforms.
- User-Related Data:
  - User preferences, activity history, and feedback collected through integrated mobile/web applications. (future plan)
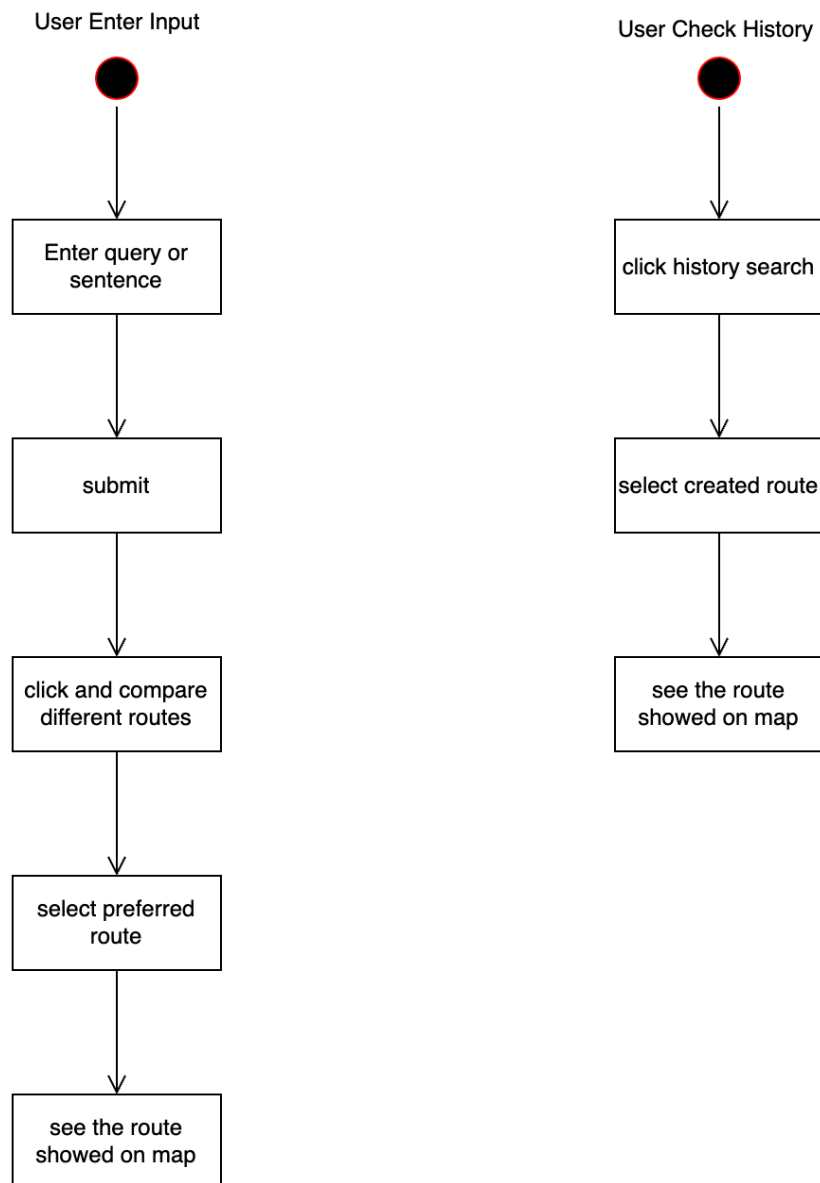
6. System Design

6.1. Architecture Overview:

The MyTrail intelligent route generation system is designed for scalable, real-time urban route recommendations. It integrates external mapping APIs, user data, and advanced reasoning modules to deliver personalized and diverse route suggestions.

6.2. Use Case:

6.3. Activity Diagram:

User Enter Input

Enter query or sentence

submit

click and compare different routes

select preferred route

see the route showed on map

User Check History

click history search

select created route

see the route showed on map

6.4.   Architecture Flowchart:

6.5.   Key Components:

Frontend (Mobile App):

- User Interface:
    - Allows users to input queries (natural language or structured forms), view recommended routes, and provide feedback.

- Query Composer:
    - Guides users to specify preferences (distance, POI types, time, pet-friendliness, etc.).

- Visualization:
    - Displays routes on interactive maps, highlights POIs, and shows route details.

- Feedback Module:

○ Collects user ratings, preferences, and behavioral data for personalization.

Backend:

- API Gateway:
  - Receives requests from frontend, returns formatted responses.

- Query Parser:
  - Interprets user input and extracts structured preferences.

- Data Integration Layer:
  - Connects to mapping APIs for live POI and route data.

- Reasoning Core:
  - Route Generation, Scoring & Ranking, Diversity Reranking.

- Monitoring & Analytics:
  - Tracks system performance and user engagement.

6.6.   Reasoning Techniques:

- Query Parsing & Preference Extraction
  - NLP & Rule-Based Extraction: Parse user queries into structured preferences (distance, route type, POI categories, time window, pet-friendliness).

- Route Generation
  - A* and Dijkstra Algorithms: Efficiently generate candidate routes that satisfy user constraints using graph-based pathfinding.

- Multi-Criteria Scoring & Ranking
  - Weighted Feature Scoring: Rank candidate routes by combining distance, duration, POI relevance, and environmental features.

- Diversity Optimization
  - Greedy Diversity Selection / Maximal Marginal Relevance (MMR): Rerank results to ensure variety in geography and POI types.

- Personalization (Future plan)
  - Collaborative Filtering & Reinforcement Learning: Adapt recommendations based on user preferences and behavior for personalized route suggestions.