



Department of Computer Science
Faculty of Computing and Information
Technology (FCIT) University of the Punjab

**“LahoreLens: An AI-Driven Travel Companion
Using Topic Modeling”**

Final Year Project Proposal

Session 2025-2026
A project submitted in partial
fulfilment of the BS in Computer
Science
Fall 2025
08 September 2025

Project Registration

Project ID (for office use)						
Nature of project		[] Development		[X] R&D		
Area of specialisation		Text Processing & Web Development				
Project Group Members						
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This is to certify that, I am Muhammad Arham Nadeem Son of Muhammad Nadeem, group leader of FYP under registration no BCSCF22M047 at Computer Science Department, University of the Punjab, Lahore. I declare that my FYP proposal is checked by my supervisor and the similarity index is 4% that is less than 20%, an acceptable limit by HEC. Report is attached herewith as Appendix A.

Date: 16-September-2025

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Co-Supervisor (if any): _____

Designation: _____ Designation: _____

Signature: _____ Signature: _____

Project Abstract

Our project proposes the development of a sophisticated, web-based travel companion that generates recommendations by mining and analyzing public social media data related to Lahore. The core innovation lies in our system's ability to collect a dataset of unstructured, user-generated text from various sources and public comment histories. We will then apply natural language processing (NLP) techniques to extract valuable, real-time insights regarding local trends, popular venues, and public sentiment.

To achieve a deep level of personalization, the system will track user search behavior within the application. By applying social network analysis (SNA) to user search history, the system will identify user habits and create a filtering model. This data-driven approach moves beyond static recommendations to provide suggestions that are both trend-aware and socially validated.

An AI-powered chatbot will provide an intuitive conversational interface for user assistance. The backend is designed with a Microservices architecture and applies patterns like Facade to ensure the system is scalable and maintainable, capable of handling the distinct tasks of data collection, NLP processing, and user interaction. The final prototype will serve as a proof-of-concept towards this.

Our goal is to empower both residents and tourists of any type to grow the tourism industry of Lahore itself. We will empower our application for those who need help for navigation through images and sentiments to convert text into images. We use topic modelling to give concise information of found title as well as its image with an intelligent, interactive, and practical digital tool to explore Lahore. This app combines localized, culturally rich content with AI-driven insights and real-time updates in an accessible and modern interface, showcasing the city's culinary diversity and vibrant cultural landscape effectively.

1 Introduction

The digital tourism industry in Pakistan has experienced remarkable expansion, with estimates indicating that the market will exceed a value of \$1.2 billion by 2028. This growth is fueled by a rise in digital-centric travelers, with online reservations projected to rise by more than 25% within the next three years. The swift digital transformation of travel planning generates a distinct need for more advanced and tailored applications. The rise of digital-first travelers generates a notable market need for smarter and more customized travel applications. Although Lahore serves as a dynamic hub of culture and food, the significant, immediate insights from public social media discussions regarding the city are still a considerable and underutilized asset. Present travel tools offer fixed information but do not reflect the vibrant, genuine feel of what is currently favored, challenging, or trending among residents and visitors.

Our research and development initiative, the "Lahore Travel Companion," aims to fill this gap by creating a system that converts unstructured social media information into a structured knowledge repository for travel suggestions. The main objective of the project is to utilize data across different platforms and perform machine learning on it. This enables us to automatically gather essential insights, including location names, event patterns, and public opinions, establishing a recommendation system grounded in real-world input.

The project will be presented via a prototype web app that shows the feasibility of this data-driven method. The key research and development tasks are:

- **Data Collection & NLP Pipeline:** To build a module that collects unstructured text from public social media APIs to use their comment history and sentiments. This pipeline will then use NLP and machine learning to clean the data and extract structured insights, including place entities and sentiment scores.
- **System Architecture Design:** The system design is based on a Microservices architecture, which will handle the tasks of data collection, NLP processing, and serving user requests. We will also implement the Facade design pattern, to make a simplified API gateway for the frontend, hiding the internal communication between our various backend microservices.
- **Intelligent Recommendation Engine:** Using Topic Modeling, specifically applying the latent dirichlet allocation (LDA) algorithm, and its variants to the processed social media text. The purpose of this is to discover the hidden topics or themes within the public conversations. Using a graph-based model social network analysis (SNA) to show personalized suggestions based on similar user habits. This graph allows to show items that are popular among a user's peer group or locality.
- **AI Chatbot Integration:** To incorporate a chatbot assistant, specifically trained on Lahore's landmarks, cuisine, and events, to provide users with an intuitive, conversational method for their queries.
- **Testing and Evaluation:** To measure the accuracy of our models on a standard test set, and to perform cross-source validation by training our models on data from one API and testing them on data from another API to prove model generalization.

2 Success Criterion

Criterion	Success Condition
1. NLP Model Performance	The model must correctly identify and extract place/event names with a-score of over 70%. The model must classify the sentiment of a given text with an accuracy of over 70%.
2. Recommendation Quality	We will implement a text-to-text mapping model using the TF-IDF algorithm of LDA, to represent each location's textual description. The system must use Cosine Similarity to identify the top 3 most similar locations for a given input, based on our processed media data.
3. Data Pipeline Freshness	To ensure the application's recommendations remain current with public trends, the data pipeline will operate on a daily batch processing schedule. It must be able to automatically pull new data from external APIs. The entire batch of new text must then be successfully processed by our NLP pipeline and used to update in MongoDB, ensuring the system's insights are consistently refreshed.
4. Chatbot Performance	The AI chatbot must successfully and accurately answer a predefined list of 20 common user queries.
5. Feature Reliability	Core application features must be free of critical bugs during final user acceptance testing.
6. User Satisfaction	The final prototype must achieve an average user satisfaction of at least 3 out of 5 conducted with a group of at least 10 users.

3 Related work

3.1 Literature Review

Our research is grounded in three established academic fields: tourism recommender systems, natural language processing (NLP) for social media analysis, and sentiment analysis for personalization.

The foundational landscape of tourism recommender systems has been well-documented. Overviews by Xin [1] and Kazaz [2] categorize content-based, collaborative filtering, and highlight the industry-wide shift towards more personalized and context-aware systems. A key insight from this body of work, as noted by Berka and Plößnig [3], is that combining multiple filtering techniques is often necessary to handle the complexity of tourism data.

A critical evolution in this field is the ability to incorporate unstructured data from the web. The work of Li [4] is highly relevant, as it demonstrates the significant value of using sentiment analysis from online reviews to improve recommendation quality. This provides a strong academic precedent for our project's core hypothesis: that real-time public opinion contains valuable insights missing from static databases. Our project extends this principle from formal reviews to the noisier, more dynamic data stream of social media.

Recent studies in NLP provide the technical foundation for this analysis. Research by Kumar specifically on "Sentiment Analysis on Twitter Data for Tourism" proves that modern AI models can effectively classify public sentiment from short-form text [5]. Furthermore, work by Liu, Wang, and Sun on Entity Recognition [6] provides a methodology for automatically extracting place and event names from unstructured social media text. These two fields of research form the cornerstone of our data processing pipeline.

Finally, to achieve deep personalization, our project will employ social network analysis (SNA). As demonstrated by the research of Hassan [7] on clustering user behaviors collaborative filtering algorithms can model user habits to predict future interests. Our system will apply a similar technique to user search history, creating a layer of data-driven recommendations.

3.2 Existing Market Applications

To understand the current market landscape, we analyzed several leading and local travel applications. While many platforms offer robust booking and information services, they predominantly rely on curated, static databases and lack the real-time analysis that our project proposes.

- **TripAdvisor:** The global leader in user reviews and travel planning. TripAdvisor excels at providing a vast database of user-generated ratings and photos. However, its recommendations are based on a simple popularity ranking system and do not incorporate real-time data from social media, nor does it have a specific focus on Lahore.
- **Google Maps / Google Travel:** A powerful tool for navigation and discovering points of interest. Its strength lies in its vast location database and user reviews; however, it does not analyze social media to identify what is currently popular or problematic in a specific city.
- **Klook:** An international app focused on booking tours and attractions. It provides a curated marketplace for travel activities. Klook's model is based on partnerships with vendors and does not involve analyzing public social media conversations to discover activities or gauge user interest.
- **FindMyAdventure:** A leading Pakistani platform focused on booking pre-packaged tours and adventure travel across the country. Its primary strength is in offering a catalog of trips and experiences, especially for nature and adventure tourism. However, its model is vendor-based and does not extend to real-time analysis of urban trends or public sentiment within a specific city like Lahore.

Table 1 shows a comparison of existing market applications relevant to travel and tourism. These apps highlight the current landscape while also demonstrating the gaps our project addresses.

Table 1. Comparison of Existing Travel and Tourism Applications

Reference No	Application Name	Target area	Techniques used	Target culture
1	TripAdvisor	Global Tourism	User Reviews, Popularity Ranking	Broad/Global
2	Google Maps/Travel	Global Navigation & Discovery	Location Data, User Reviews, Basic Personalization	Broad/Global
3	Klook	Global Tour Booking	Curated Marketplace, Vendor Partnerships	Broad/Global
4	FindMyAdventure	Pakistan-Wide Tour Booking	Curated Trip Marketplace	Pakistan

As summarized in **Table 1**, existing platforms such as TripAdvisor, Google Maps, Klook, and FindMyAdventure provide useful services but primarily rely on static datasets or vendor-based models. None focus on real-time, preference-driven personalization specifically tailored for a city like Lahore.

4 Project Rationale

Lahore is a city steeped in history, culture, and renowned culinary heritage, attracting millions of visitors annually. Existing travel applications, while useful, are largely designed for a global audience and operate on a fundamentally different model than what we propose. Major platforms like TripAdvisor and Google Maps excel at user reviews and location data on a massive scale, but their recommendations are primarily driven by simple popularity rankings and broad, high-level personalization. Similarly, tour booking services like Klook and the Pakistan-based FindMyAdventure operate as marketplaces, connecting users to pre-packaged trips rather than offering dynamic, real-time guidance.

Their reliance on structured reviews and static listings means they miss the authentic, up-to-the-minute pulse of the city found in unstructured social media conversations. This results in a travel planning experience that, while providing broad information, can still feel fragmented and overwhelming, lacking the deep, trend-aware, and culturally nuanced assistance that modern travelers now expect.

While Lahore is a vibrant epicenter of culture and cuisine, the digital tools available to explore it fail to capture the city's dynamic, authentic pulse. Valuable, real-time insights from public social media conversations, reviews, and comments about the city remain a vast and untapped resource. Existing travel applications rely on static databases and curated lists, which often lag behind actual trends and fail to highlight the hidden gems or pressing issues that locals and tourists discuss online.

This project provides an invaluable learning pathway, enabling us to gain hands-on expertise in the end-to-end development of a data pipeline, from collecting raw data from social media APIs and giving it to models for analysis, to building a recommendation engine based on our findings.

4.1 Aims and Objectives

The primary goal of this project is to investigate the feasibility of using social media data for travel recommendations and to deliver a prototype application that demonstrates our findings.

To achieve this, the following objectives are established:

1. **To design and implement a Data Collection Pipeline** that gathers unstructured text data from public sources like the Twitter API and online comment histories.
2. **To develop a custom Natural Language Processing (NLP) module** that automatically performs two key tasks:
 - **Named Entity Recognition** to extract and categorize Lahore-specific places, events, and topics from the raw text.
 - **Sentiment Analysis** to classify the public opinion associated with these entities.
3. **To implement an SNA model** based on locality and display as graph to user based on certain key indexes in user preferences.
4. **To build an intelligent Recommendation Engine** that gathers all insights from model to generate trend-aware and personalized suggestions.
5. **To develop a functional prototype web application** that serves as a proof-of-concept, effectively presenting the data-driven recommendations and research findings to the user.

4.2 Scope of the Project

The scope of this project is defined to ensure the core research objectives are met and a high-quality prototype is delivered within the academic timeline.

1. **Project Deliverables:** A working prototype of the "Lahore Travel Companion" web application, and a comprehensive final report detailing our research methodology, data analysis, model evaluation, and conclusions.
2. **Features and Functions:** The prototype will include user authentication, a search interface, and a recommendation display. The core functionality will be the backend data pipeline, which is out of scope for the user to interact with directly but is the primary focus of the project's work.
3. **Key Tasks:** The major R&D tasks include: Data Collection, Data Preprocessing, NLP Model Development and all its subtasks, Backend API Development, and Prototype Frontend Development.
4. **Deadlines:** Completion is targeted within the academic year, as outlined in the project's Gantt Chart.
5. **Limitations:** The project's primary focus is on the research and viability of the data pipeline. As such, the frontend prototype may have limited features beyond displaying the core recommendations. The scope excludes the development of a native mobile app and offline functionalities.

5 Proposed Methodology and Architecture

Our project will follow a structured Research Methodology to rigorously investigate the feasibility of transforming unstructured social media data into actionable insights for travel recommendations. This methodology ensures our process is valid, repeatable, and directly addresses the core research objectives. The entire research workflow is systematically broken down into sequential phases, as shown in **Figure 1**.

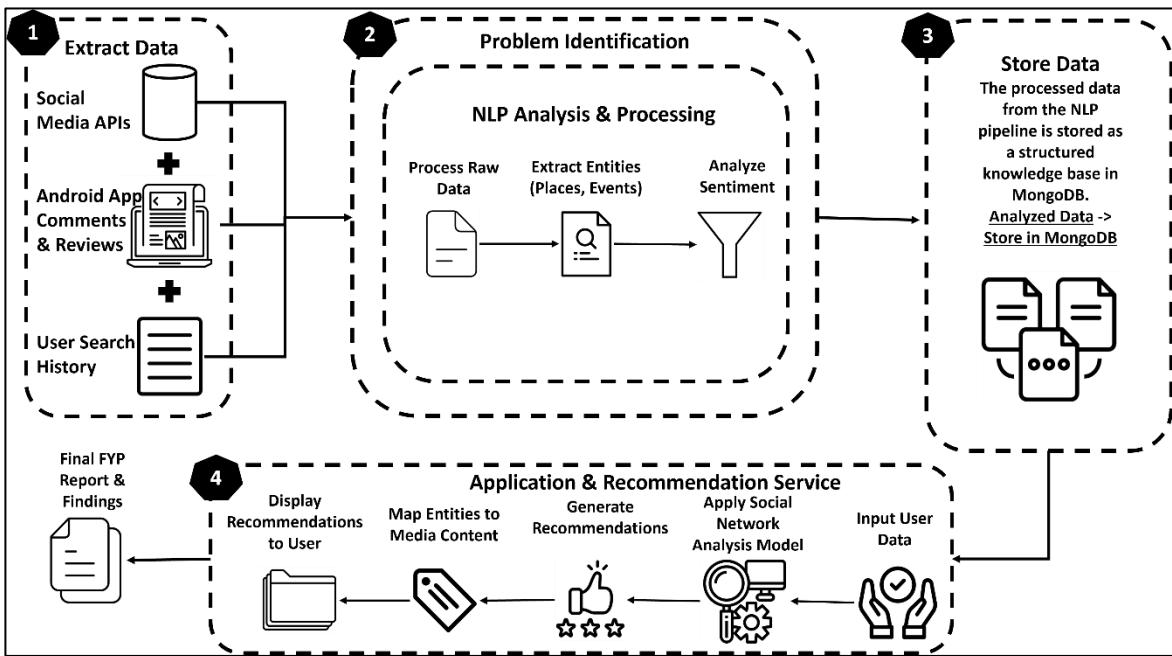


Fig. 1. Proposed Research Methodology

As illustrated in Figure 1, these phases collectively enable the transformation of raw data into structured insights and their integration into the proposed recommendation system.

The key phases of this methodology are:

1. **Data Collection:** This initial phase involves gathering raw, unstructured text data from diverse public sources relevant to Lahore tourism. Our primary input sources include real-time public posts and comments via social media APIs (e.g., Twitter Developer API) and publicly accessible user comment histories from platforms like Android app reviews and YouTube.
2. **NLP Analysis & Feature Extraction:** The collected raw data undergoes a critical processing phase using natural language processing (NLP) techniques. This involves several sub-steps:
 - o **Data Preprocessing:** Cleaning and normalizing the raw text (e.g., removing noise, stop words, special characters) to prepare it for robust AI analysis.
 - o **Entity Recognition:** Applying machine learning models to automatically identify and extract specific entities within the text, such as names of restaurants, cultural sites, events, and relevant keywords.
 - o **Sentiment Analysis:** Implementing further NLP models to classify the sentiment associated with the extracted entities, thus gauging public opinion and emotional responses.
3. **Structured Data Storage:** The insights derived from the NLP analysis are then converted into a structured, machine-readable format. This clean, actionable data, which now includes identified entities, sentiments, is stored in a MongoDB database. We will apply social network analysis (SNA) techniques to our collected user search history to identify patterns in the user's data across the multiple platforms, laying the groundwork for filtering recommendations.
4. **Application Layer & Recommendation Service:** The final phase integrates all research outputs into a functional web application prototype. The backend will utilize the structured data from MongoDB and the patterns identified through social network analysis (SNA) to generate dynamic, trend-aware, and personalized recommendations

5.2 System Architecture

To effectively implement and demonstrate our research methodology, the system will be built upon a robust Microservices Architecture. This architectural pattern is chosen for its inherent scalability, modularity, and resilience, which are critical for handling distinct data-intensive and computationally heavy tasks separately. This also allows for independent deployment and management of each research component.

The system's components are structured as follows:

- **Data Collection Service:** A dedicated microservice responsible for interacting with external social media APIs (e.g., Twitter API) and web-scraping public comment histories. It will be built primarily with Python for its robust data handling libraries.
- **NLP Processing Service:** Another distinct microservice, also Python-based, housing our NLP and machine learning. This service will receive raw text data from the Data Collection Service and return structured, analyzed insights.

- **Application Service (Backend):** This core backend microservice, built with Node.js and Express.js, will manage user authentication, interact with the MongoDB database, orchestrate calls to the NLP Processing Service, and implement the collaborative filtering logic from the social network analysis (SNA).
 - **Presentation Tier (Frontend):** A dynamic and responsive user interface developed using the React.js framework. This tier will handle all user interactions, visual display of recommendations, and communicate exclusively with the Backend Application Service via RESTful APIs.
 - **Data Store:** A central MongoDB database for persisting all application data, user profiles, processed social media insights, and search histories essential for the social network analysis (SNA).
 - **Conversational AI Integration:** An external, third-party NLP service (e.g., Google Dialogflow) will be integrated with the Application Service to power the AI chatbot functionality, providing intelligent conversational support to users.
 - **Images:** A process of text-to-image mapping will be developed. When a recommendation is generated, the extracted entity name will be used to search for a relevant image via a third-party API. Which will then be displayed with the recommendation generated.
 - **Video:** The project will not host or stream video. Instead, it will store and display direct URL links to videos on their native platforms (e.g., YouTube), avoiding streaming complexity.

The overall structure of the system is illustrated in **Figure 2**.

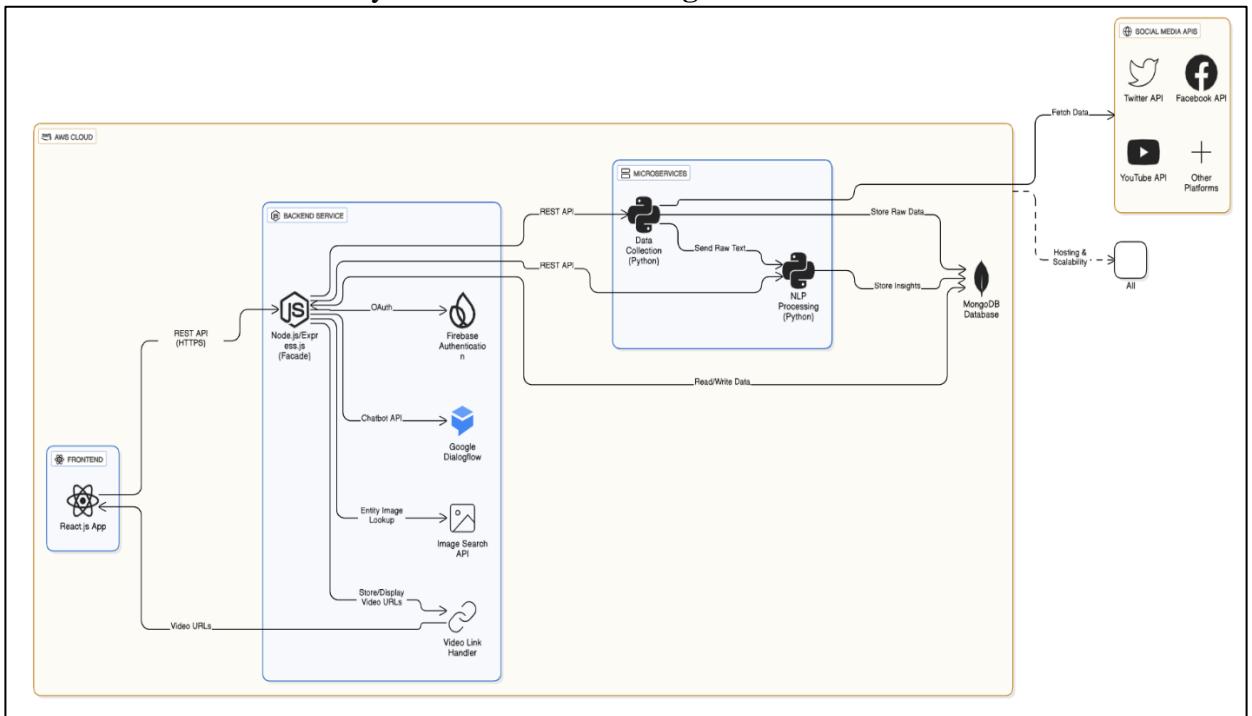


Fig. 2. Proposed System Architecture

As shown in Figure 2, the architecture separates data collection, NLP processing, backend logic, and frontend presentation into distinct services, all integrated with a central database and chatbot interface.

5.3 Step-by-Step Development Procedure

The development of the prototype application will follow an Agile, iterative process. This ensures we can build, test, and refine each component of our R&D pipeline before proceeding.

1. **Requirement Analysis & Research Design:** The initial phase will focus on defining the specific research questions, identifying data sources, and designing the architecture for the data pipeline and the final application. This includes a thorough literature review to inform our choice of NLP models.
2. **System Design:** This phase involves producing the detailed technical blueprints for the project, including the Research Methodology Diagram and the Microservices Architecture Diagram.
3. **Implementation & Development:** The core R&D work will be broken down into functional parts:
 - o **Data Collection Service:** Develop the Python service to connect to the Twitter API and gather the initial raw text dataset.
 - o **NLP Service (Initial Models):** Develop the Python service to clean the data and implement baseline models for Named Entity Recognition and Sentiment Analysis.
 - o **Backend & Application Service:** Develop the Node.js backend, user authentication, and the core API that will eventually serve the recommendations.
 - o **Social Network Analysis & Model Refinement:** Implement the collaborative filtering model and refine the accuracy of the NLP models based on testing.
4. **Integration and Testing:** As the microservices are developed, they will be integrated to form the complete data pipeline. We will apply unit testing based on the test cases as per the system requirement.
5. **Deployment:** In the final phase, the integrated system will be deployed to a cloud platform (AWS).

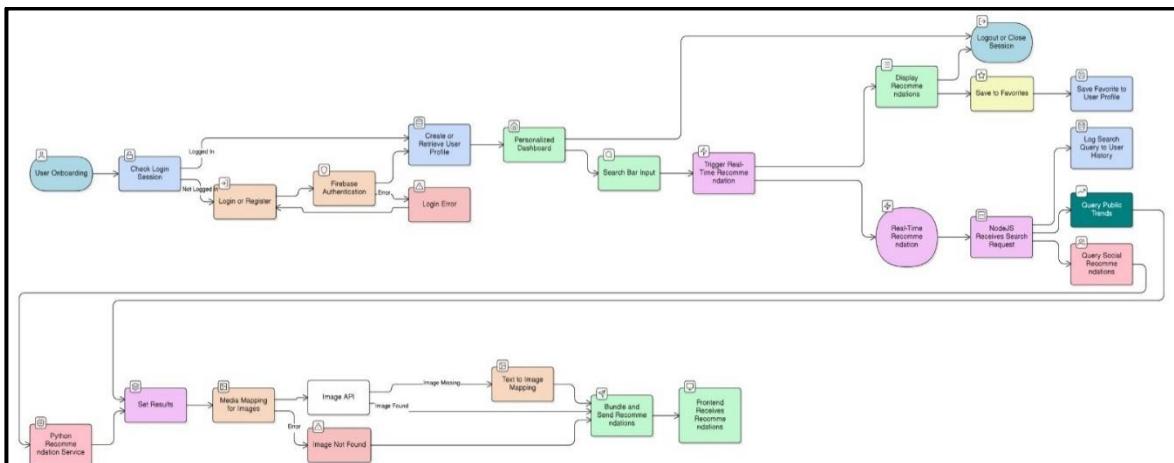


Fig. 3. Main Program Flow

Figure 3 displays programs main flow for interacting with user.

6 Individual Tasks

Team Member	Activity	Tentative Date
M. Arham Nadeem <i>(Project Lead & Backend)</i>	Lead overall project planning and handle the proposal and reports.	Sep - Oct 2025
	Build the main backend server using Node.js to manage the application.	Nov 2025 - Apr 2026
	Connect all the different parts of the project together.	May 2026
	Manage the final deployment of the project online.	May 2026
Kashif Ali <i>(Frontend Developer)</i>	Design the App's UI/UX.	Oct 2025
	Build Frontend Components.	Nov 2025 - May 2026
	Perform Component-Level Unit Testing.	Dec 2025 - Apr 2026
Ayesha Yaqoob <i>(Data & AI Specialist)</i>	Implement the Data Collection Pipeline	Nov 2025 - Jan 2026
	Develop the core NLP Module	Jan - Mar 2026
	Manage the Structured Data Pipeline	Jan - Feb 2026
	Implement the Media Handling Feature.	Apr 2026
Maaz Mughal <i>(AI & Recommendation Engineer)</i>	Work towards developing AI features.	Jan - Feb 2026
	Implement the Similarity Algorithm.	Mar - Apr 2026
	Conduct the Performance Evaluation for AI Models.	Apr - May 2026
	Document the Findings for Final Report.	May 2026

7 Gantt Chart



8 Tools and Technologies

Core Language & Data Handling

- **Python:** The primary programming language for all data collection, processing, and machine learning tasks due to its extensive ecosystem of scientific computing libraries.
- **Pandas:** The essential library for data manipulation. We will use it to load, clean, and structure our collected datasets before they are fed into our analysis models.

Natural Language Processing (NLP) Libraries

- **NLTK & spaCy:** These industry-standard libraries will be used for text preprocessing and, crucially, for implementing our custom Named Entity Recognition (NER) model to extract Lahore-specific place names from the raw text.
- **Transformers (Hugging Face):** To perform high-accuracy Sentiment Analysis, we will utilize a state-of-the-art, pre-trained model from the Hugging Face Hub. This allows us to classify public opinion without needing to train a sentiment model from scratch.

Recommendation & Evaluation Library

- **scikit-learn:** This foundational machine learning library will be used for two key tasks: implementing the social network analysis (SNA) model (a filtering algorithm) and for the formal evaluation of all our AI models.

Data Collection APIs

- **Twitter API:** The primary data source for collecting a real-time corpus of public posts and comments related to tourism and events in Lahore.

Backend Architecture

- **Node.js & Express.js:** The primary framework for our main Application Service. It will handle user authentication, serve the API for the frontend, and act as a gateway (using a Facade pattern) to the other microservices.
- **Python (with Flask/FastAPI):** The NLP Processing Service and Data Collection Service will be built as separate microservices using a lightweight Python framework like Flask or FastAPI, which is ideal for serving machine learning models.

Frontend Development

- **React.js:** A modern JavaScript library that will be used to build the responsive and dynamic user interface for the prototype application, allowing us to effectively visualize the research findings and recommendations.

Database

- **MongoDB:** A NoSQL, document-oriented database chosen for its flexibility in storing the structured data that results from our NLP analysis pipeline, as well as user profiles and search histories.

Conversational AI & Supporting Services

- **Google Dialogflow:** The AI chatbot will be powered by Google's NLP service, integrated with our Node.js backend to provide an intuitive conversational interface.
- **Firebase:** Utilized for core application services, including Firebase Authentication for secure user management.

Development and Deployment

- **Git & GitHub:** Standard tools for version control and collaborative development.
- **AWS (Amazon Web Services):** The entire microservices-based application will be deployed on AWS, which provides the necessary cloud infrastructure to host and scale our various services independently.

9 References

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Appendix A

Document Viewer

Turnitin Originality Report

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