Department of Electrical and Computer Engineering
North South University

Senior Design Project

Project Proposal

A Multi-Agent RAG system for Legal Information Retrieval in Bangladesh

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1. Introduction and Background

Access to reliable and understandable legal information remains a significant challenge for the general population in Bangladesh. Many individuals lack legal literacy and affordable access to legal professionals, which often leads to misinformation or legal missteps. Although recent advancements in Large Language Models (LLMs) have demonstrated remarkable capabilities in various domains, including law, their tendency to generate hallucinated or outdated responses makes them unsuitable for critical legal use without additional safeguards.

To address this, this project proposes a Multi-Agent Retrieval-Augmented Generation (RAG) system designed specifically for Bangladeshi legal information retrieval. The system aims to ensure factual accuracy, contextual relevance, and accessibility for users with little to no legal background. By combining localized legal datasets with multi-agent AI workflows, the project seeks to democratize access to legal information in a low-resource setting like Bangladesh.

2. Objectives

The primary objectives of this project are as follows:

1. Develop a specialized AI-driven legal assistant based on a Multi-Agent RAG architecture tailored for Bangladeshi legal data.
2. Design and implement two cooperative agents — a Clarification Agent for refining user queries and a RAG Agent for retrieving and generating accurate legal responses.
3. Curate and preprocess localized datasets including Bangladesh's penal codes, laws, and judgments from the Supreme Court and High Court.
4. Integrate the agents into a user-friendly conversational interface to assist individuals in understanding their legal queries in real time.
5. Evaluate system performance using standard RAG metrics such as Faithfulness, Answer Relevancy, and Contextual Recall through the Deepeval framework.

6. Provide a scalable and affordable solution for expanding access to legal information in low-resource contexts.

3. Methodology

3.1 System Design Overview

The system follows a multi-agent architecture using LangChain and LangGraph frameworks. It is designed around two main agents:

- Clarification Agent: Interacts with the user to understand and refine vague or incomplete legal questions using LLM-driven dynamic questioning.
- RAG Agent: Retrieves contextually relevant legal documents using a vector database (ChromaDB) and generates grounded responses based on retrieved texts.

3.2 Data Collection and Processing

- Sources: Supreme Court of Bangladesh judgments, *Laws of Bangladesh* (Ministry of Law website), BD Law Post, and LawHelpBD.
- Processing: Text extracted via PyMuPDF and processed with LangChain's RecursiveCharacterTextSplitter.
- Embeddings: Generated using OpenAI embeddings API, stored in ChromaDB for similarity-based retrieval.

3.3 Implementation Tools

- Programming Language: Python
- Frameworks: LangChain, LangGraph, Streamlit, ChromaDB
- Model: GPT-4o mini (through LangChain ChatOpenAI interface)
- Web Search Integration: Tavily Search for conditional retrieval of recent or missing information.

3.4 Evaluation

- Test Suite: 10 representative legal questions based on Bangladeshi law.
- Metrics: Faithfulness, Answer Relevancy, Contextual Recall, Contextual Precision, and GEval Correctness.
- Evaluation Framework: Deepeval (LLM-as-a-judge evaluation).
- Performance Analysis: Quantitative assessment supported by qualitative inspection of generated outputs.

4. Expected Outcomes

The project aims to deliver:

1. A functional prototype of a multi-agent RAG chatbot capable of understanding and responding to Bangladeshi legal queries.
2. A curated and structured local legal dataset, optimized for retrieval-augmented generation.
3. Improved access to justice and legal awareness by providing reliable, factual, and easy-to-understand legal information.
4. Demonstrated evaluation results showing high faithfulness and answer relevancy metrics (>90%).

Through this system, citizens will be empowered with accurate knowledge of their rights, legal procedures, and recourses, minimizing dependency on expensive legal consultations.

5. Project Timeline

The estimated project duration is January to August 2025. The following table outlines the major phases and their expected timeframes.

Phase	Duration	Timeline
Topic Selection & Proposal	2 months	Jan – Feb 2025
Literature Review	1 month	Feb – Mar 2025
Data Collection	3 months	Feb – May 2025
Model Design & Implementation	4 months	Mar – Jun 2025
Testing & Evaluation	3 months	May – Jul 2025
Report Writing & Submission	2 months	Jul – Aug 2025

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