SUPERIOR UNIVERSITY

Programming for Artificial Intelligence (lab)

Project Documentation

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Automotive Fault Diagnosis Assistant

Project Overview:

This project is a web-based tool designed to help car owners and mechanics diagnose vehicle problems. It allows users to describe the symptoms of their car in plain language and receive step-by-step guidance on what could be wrong and what checks to perform.

The system combines Natural Language Processing (NLP) and Generative AI (GenAI) to understand the user's input and generate accurate, easy-to-follow responses.

Project Category:

This project falls into the NLP and Generative AI domain:

- ***NLP:*** To understand and process the user's input and find relevant past cases using sentence embeddings.
- ***Generative AI:*** To create a human-readable diagnostic explanation and step-by-step instructions using Google's Gemini AI model.

Key Features:

1. User-Friendly Interface:
    - Users can type in their car issues in plain English.
    - A clean web interface guides the user through submitting their query.
2. Semantic Understanding with NLP:
    - The system uses sentence embeddings to understand the meaning of the user's input.
    - It searches a database of known automotive issues to find the most similar cases.
3. Step-by-Step Diagnostic:
    - After finding relevant cases, the system uses Generative AI to generate clear recommendations.
    - The response includes the most likely cause and step-by-step checks the user can perform.

4. Fallback for Unknown Queries:
    - If the user enters a problem that is not in the database, the system advises consulting a professional mechanic.
5. Accessibility Features:
    - The results page is keyboard-friendly.
    - Users can navigate easily and read the response clearly.

Project Architecture:

1. Frontend:
    - Allows users to submit queries and displays the AI-generated diagnosis.
    - Loader animation shows while the system processes the input.
2. Backend:
    - Handles form submissions.
    - Passes user queries to the NLP module to find similar cases.
    - Sends the retrieved information to Generative AI for a human-readable answer.
    - Returns the final result to the frontend.
3. NLP Module:
    - Uses sentence-transformers to convert text into embeddings.
    - Uses FAISS for fast similarity search among past automotive cases.
4. Generative AI Module:
    - Uses Google Gemini API to produce detailed and natural language diagnostic responses.
    - Ensures output is easy to understand, formatted in step-by-step instructions.
5. Data:
    - Contains a dataset of automotive faults, symptoms, and diagnosis steps.
    - Preprocessed into “chunks” suitable for vector search and AI generation.

Technologies Used:

- *Backend:* Python, Flask
- *NLP & Vector Search:* pandas, numpy, sentence-transformers, FAISS
- *Generative AI:* Google Gemini API
- *Frontend:* HTML, CSS, JavaScript
- *Environment Management:* python-dotenv for API keys
- *Data:* CSV files with automotive faults and diagnostic steps

Workflow:

1. User types a description of the car problem.
2. The system cleans and embeds the input.
3. FAISS retrieves the top 3 most similar automotive cases.
4. These cases are sent along with the user query to Gemini AI.
5. Gemini AI generates a human-readable, step-by-step diagnostic guide.
6. Result is displayed in the browser with a clear, accessible format.

Challenges and Solutions:

- Handling unknown queries:
    - Implemented a fallback message advising professional help.
- Ensuring reliable AI output:
    - Used structured prompts and verified Gemini API responses.
- Fast and accurate retrieval:
    - Pre-processed data and embeddings, used FAISS for efficient similarity search.
- User experience:
    - Added loader animations and removed unnecessary focus borders for better UI.

Conclusion:

The Automotive Fault Diagnosis Assistant successfully combines NLP and Generative AI to provide users with understandable, actionable insights about vehicle problems. It demonstrates how AI can help automate diagnostic processes while remaining accessible and easy to use.