Car Troubleshooting Chatbot Expert System

Algoritmos y programación 3

Profesor:

Andres Aristizabal Pinzon

Integrantes:

Juan Sebastian Gonzalez

Felipe Rojas Prado

Universidad ICESI

Departamento de Ingeniería y Diseño

20 Noviembre 2024

[**Abstract 3**](#_pc9flyimqn4y)

[**Introduction 4**](#_vwzkuu7wojq)

[**Problem Statement and Objectives 4**](#_j2rn4vyq3ax3)

[Problem Statement: 4](#_u8q4tn5upz7v)

[Objectives: 4](#_x0csqywq1gp9)

[**Requirements Analysis 5**](#_osul6ot0wj9q)

[**Knowledge Acquisition and Representation 6**](#_rhonlmob4ozm)

[**System Design 6**](#_htz55j8eerwx)

[**Implementation Details 7**](#_4ws20n6iazk)

[Technologies Used: 7](#_455vyaidx0fj)

[Modules Implemented: 7](#_7nffhywmf5yo)

[**Testing and Validation 7**](#_lgctgzzajrbu)

[Functional Testing: 7](#_dooarw8q1a0k)

[User Testing: 7](#_b5usno4lpa2j)

[Validation: 7](#_2f3hmg8bezr3)

[**Deployment 8**](#_bu1vamwpaurs)

[**Conclusion and Future Work 8**](#_9urrwaj91gbh)

[Future Work: 8](#_1ejkswn3g35g)

[**References 9**](#_enfu4w5te2xx)

## 

## 

# Abstract

This project focuses on the development of an expert system designed to diagnose common automotive problems. The system specifically targets issues related to unusual sounds, starting difficulties, and braking malfunctions, which are among the most frequently reported vehicle concerns. By combining rule-based inference with probabilistic reasoning, the system leverages Python, the Experta library, and Bayesian networks implemented with pgmpy to deliver accurate and reliable diagnostics.

Through an intuitive chatbot interface built with Streamlit, users can describe their car's symptoms in plain language. The system processes this input, applies expert-defined rules and probabilistic models, and then identifies probable causes along with actionable suggestions for resolution. By bridging the gap between complex automotive diagnostics and accessible AI tools, this project empowers individuals—especially those without deep technical expertise—to troubleshoot and address minor vehicle issues independently. Additionally, the system serves as a practical demonstration of AI principles applied to real-world problem-solving, making it a valuable educational and technical tool.

## 

## 

## 

## 

## 

# Introduction

The need for accessible tools to diagnose car problems is growing. This report outlines the development of a car troubleshooting chatbot to assist non-experts in diagnosing and resolving issues related to unusual sounds, starting failures, and braking performance. With all these problems our goal using Bayesian networks and an expert system is to try to diagnose the problems of the user and try to give him a solution on how to solve it or ask for a specialist to help you out.

## 

# Problem Statement and Objectives

## Problem Statement:

Car owners often face significant challenges when diagnosing vehicle problems, especially if they lack technical expertise. Identifying issues such as unusual noises, starting difficulties, or braking malfunctions can be both stressful and time-consuming. Without access to reliable diagnostic tools, many individuals resort to expensive professional services for problems that could sometimes be resolved independently with proper guidance. This knowledge gap not only adds unnecessary costs but also delays timely repairs, potentially leading to more serious issues. The lack of accessible, user-friendly diagnostic solutions leaves car owners feeling overwhelmed and powerless in addressing even minor problems.

## Objectives:

1. Develop a Chatbot-Based Expert System: Create an intelligent diagnostic chatbot capable of engaging users in natural language to identify common car issues. The system will leverage AI technologies to simulate expert-level knowledge and reasoning.
2. Focus on Key Problem Areas: Address three primary categories of vehicle issues:

* Unusual Sounds: Diagnosing problems like clunking, ticking, or squeaking noises.
* Starting Issues: Identifying causes of engine failure or difficulty starting.
* Braking Problems: Analyzing issues like ineffective braking or abnormal sounds during braking.

1. Enhance Accessibility to Automotive Knowledge: Utilize artificial intelligence and machine learning to provide a simple and intuitive interface that makes advanced diagnostic capabilities available to everyone, regardless of their technical background.
2. Empower Users to Take Action: Equip car owners with probable causes and suggested fixes, allowing them to make informed decisions about maintenance and repairs without always requiring immediate professional assistance.

By addressing these objectives, the project seeks to simplify the diagnostic process, lower repair costs, and improve the overall experience of car ownership through the integration of cutting-edge AI tools.

# Requirements Analysis

This chatbot focuses on diagnosing the following issues:

* **Weird Sounds:** Identifying potential causes of unusual noises such as squealing, grinding, or rattling.

**User Needs:**

* Non-technical users seeking quick diagnostics for specific car issues.

**System Requirements:**

* Conversational interface for symptom input.
* Explanation of diagnoses and recommendations.

## Knowledge Acquisition and Representation

Gathered knowledge through:

* Automotive repair manuals and troubleshooting flowcharts.
* Expert interviews with mechanics.

Built a knowledge base covering:

* Sound-related issues (e.g., belt slippage, worn-out bearings).
* Starting issues (e.g., battery problems, ignition system failures).
* Braking problems (e.g., worn brake pads, hydraulic issues).

Developed Bayesian networks to represent probabilistic relationships.

# System Design

**Architecture:**

* Rule-based reasoning using Experta for sound and symptom patterns.
* Bayesian networks for probabilistic analysis of multiple symptoms.

**User Interface:**

* Simple, conversational chatbot interface.

**Database Design:**

* Stores knowledge base, user input logs, and conversation data.

# Implementation Details

## Technologies Used:

* Python for system logic.
* Experta for rule-based reasoning.
* pgmpy for Bayesian network integration.
* Streamlit for deployment

## Modules Implemented:

* Dialogue management.
* Backend database connectivity.

# Testing and Validation

## Functional Testing:

* Verified chatbot responses for sound, starting, and braking issues.

## User Testing:

* Conducted tests with non-experts to evaluate usability.

## Validation:

* Ensured responses align with expert recommendations.

# Deployment

* Hosted the chatbot on a web server with access via a browser or messaging app.
* Provided a guide for users on troubleshooting and using the system effectively.

# Conclusion and Future Work

This project highlights the transformative potential of AI-driven expert systems in automotive diagnostics, offering a user-friendly and accessible tool to identify common car problems. By combining rule-based reasoning through the Experta library and probabilistic models with Bayesian networks, the system effectively bridges the gap between technical expertise and user accessibility. It empowers car owners to independently assess issues related to unusual sounds, starting problems, and braking malfunctions, reducing their reliance on costly and time-consuming professional diagnostics.

The chatbot not only streamlines the diagnostic process but also demonstrates the flexibility and scalability of AI technologies in solving real-world problems. It serves as an example of how artificial intelligence can democratize access to expert knowledge, making complex technical processes more comprehensible and manageable for non-specialists.

## Future Work:

1. Expanding Diagnostic Scope: Future iterations of the system could include additional car systems, such as transmission, fuel systems, or electrical components, broadening the range of problems the chatbot can address.
2. Improved Natural Language Understanding (NLU): Enhancing the chatbot's natural language processing capabilities would enable it to better understand user queries and provide more personalized responses. Integrating advanced models like GPT or other conversational AI frameworks could significantly improve interaction quality.
3. Integration with IoT and Connected Cars: By leveraging IoT-enabled devices and sensors in modern cars, the system could directly retrieve real-time diagnostic data from vehicles, further improving accuracy and reducing the need for manual user input.
4. Multi-Language Support: Adding support for multiple languages could increase accessibility for users worldwide, ensuring that the system is valuable in diverse automotive markets.
5. Mobile and Cloud Integration: Developing a mobile application or a cloud-based interface could allow users to access the system on-the-go, creating a seamless diagnostic experience.
6. Machine Learning Enhancements: Incorporating machine learning algorithms to analyze past diagnostic data could help improve the system's predictive accuracy over time, adapting to emerging automotive trends and issues.
7. In conclusion, this project is a significant step toward democratizing car diagnostics through artificial intelligence. While the current implementation focuses on a specific subset of problems, the potential for growth is immense. By building upon this foundation, the system could evolve into a comprehensive, real-time, and globally accessible diagnostic assistant for car owners.

# References

* Team-BHP. (n.d.). Flow charts for troubleshooting car problems. Retrieved from <https://www.team-bhp.com/forum/technical-stuff/121153-flow-charts-troubleshooting-car-problems.html>
* OnAllCylinders. (2016, December 14). Infographic: Guide to diagnosing common starting problems. Retrieved from <https://www.onallcylinders.com/2016/12/14/infographic-guide-to-diagnosing-common-starting-problems/>
* Streamlit, Inc. (n.d.). Streamlit: The fastest way to build and share data apps. Retrieved from <https://streamlit.io/>
* PyPI. (n.d.). Experta: PyPI. Retrieved from <https://pypi.org/project/experta/>