

PROG8060

High level design - architecture

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1. Purpose:

The purpose of this document is to provide a preliminary design and design overview for a chatbot intended for a car rental application.

1.1 Preliminary Design:

1.1.1 Purpose: In the preliminary stages of software development, this document aims to outline the scope and size of the project.

1.1.2 It identifies potential risks and time-consuming aspects of developing the chatbot for car rental.

1.1.3 The high-level design in this context will serve as an initial blueprint for the chatbot's architecture and functionality.

1.2 Design Overview:

1. As the project progresses, this document will offer an overview of how the various sub-systems and components of the chatbot system fit together.
2. It will break down the entire system into smaller parts for a better understanding of its structure.
3. The design overview will help stakeholders comprehend the integration of the chatbot within the car rental application.

2. High Level Design:

2.1 Database Architecture:

Database Management System: MySQL

Entities

1. Car Inventory:

- CarID (Primary Key)
- Car Make and Model
- Year

- Color
- Rental Price per Day
- Availability Status (available, reserved, rented)
- Additional Information (e.g., features, specifications)

2. Customers:

- CustomerID (Primary Key)
- First Name
- Last Name
- Contact Information (email, phone)
- Address
- Payment Information (credit card, PayPal, etc.)

3. Reservations:

- ReservationID (Primary Key)
- CustomerID (Foreign Key to Customers)
- CarID (Foreign Key to Car Inventory)
- Pickup Date and Time
- Return Date and Time
- Rental Duration
- Total Cost
- Status (pending, confirmed, completed, canceled)
- Additional Notes

4. Chatbot Conversations (Optional):

- ConversationID (Primary Key)
- CustomerID (Foreign Key to Customers)
- Chat Timestamp
- Messages (to store chat history)

5. Reviews and Ratings (Optional):

- ReviewID (Primary Key)
- CustomerID (Foreign Key to Customers)
- CarID (Foreign Key to Car Inventory)
- Rating (e.g., 1 to 5 stars)
- Review Text
- Timestamp

a. Application Architecture (Layers):

i. Presentation Layer:

The presentation layer for a car rental chatbot involves the user interface through which customers interact with the chatbot. The primary goal is to provide a user-friendly and efficient experience for users as they inquire about car rentals, make reservations, and perform various other tasks.

Chat Interface:

- **Chat Window:** Provide a chat window or interface where users can type their queries and receive responses from the chatbot.
- **Messaging Format:** Use a chat-style format for the conversation, where messages from the user and the chatbot are displayed sequentially.
- **Text and Multimedia:** Support text, images, and possibly other media formats for communication.

ii. Business Logic Layer:

1. **Feedback Handling:** Collect and process user feedback and reviews. Use feedback to enhance the chatbot's performance and user satisfaction.
2. **Conversation Management:** Keep track of the ongoing conversation, maintaining context and history of user interactions. Understand when a conversation starts, ends, or is in a middle state.

3. **Natural Language Understanding (NLU):** NLU components to analyze and understand user intents and entities from their input. Intent recognition: Identify what the user wants (e.g., book a car, get information about rentals).
4. **Multilingual Support:** Provide support for multiple languages if targeting a diverse user base. Recognize and respond in the user's preferred language.

2.2.3 Data Access Layer

1. **Car Rental Information:**
 - Provide information about available car models, pricing, and specifications.
2. **Reservation Handling:**
 - Allow users to make, modify, or cancel reservations.
3. **Availability Check:**
 - Check the availability of specific car models for given dates and locations.
4. **Payment Assistance:**
 - Assist users in making payments for reservations.
5. **Customer Support:**
 - Answer common customer queries and provide information about rental policies and procedures.
6. **Feedback and Reviews:**
 - Collect and process feedback and reviews from customers.
7. **Language Support:**
 - Offer multilingual support to cater to a diverse user base.

2.3 Security Architecture for the Car Rental Chatbot:

1. **Data Encryption:**
 - Ensure that all data transmissions between the chatbot and backend systems are encrypted using secure protocols such as HTTPS.
 - Encrypt sensitive data stored in the database to protect user information.

2. Authentication and Authorization:

- Implement user authentication to verify the identity of users interacting with the chatbot.
- Enforce access controls to limit access to sensitive data and functions based on user roles and permissions.
- Use industry-standard authentication mechanisms like OAuth for secure access to external services.

3. Secure User Input Handling:

- Sanitize and validate user inputs to prevent common security vulnerabilities, such as SQL injection and cross-site scripting (XSS).
- Implement security measures to block potentially malicious input.

4. Bot Identity Verification:

- Verify the identity of the chatbot to ensure that it is not impersonated or used for malicious purposes.
- Utilize API keys, tokens, or other mechanisms to authenticate the chatbot with external services.

This security architecture outlines measures to ensure the confidentiality, integrity, and availability of the chatbot system's data and operations, as well as regular assessments to maintain a high level of security.

3. Design Overview for the Car Rental Chatbot:

Functionality:

1. **Car Information:** Provide information about available car models, including details such as make, model, year, color, features, and pricing.
2. **Availability Check:** Allow users to check the availability of specific car models for their desired dates and locations.
3. **Customer Support:** Answer common customer queries and provide information about rental policies, terms, and conditions.
4. **Feedback and Reviews:** Collect feedback and reviews from customers, allowing them to rate and review their rental experiences.

Menu Options:

A typical menu structure for the chatbot might include the following options:

- **Browse Cars:** Access information about available car models, view pricing, and explore features.
- **Check Availability:** Check if a specific car is available for a particular date and location.
- **Customer Support:** Access information about rental policies, contact customer support, or escalate issues.
- **Feedback and Reviews:** Submit feedback or read reviews from other customers.

4. External Interfaces for the Car Rental Chatbot:

1. User Interfaces:

- **Mobile Applications:** The chatbot will have user interfaces within the mobile applications designed for passengers and drivers (iOS and Android). These interfaces will allow users to interact with the chatbot for services like booking, inquiries, and assistance.
- **Admin Web Dashboard:** An administrative web interface will be provided for administrators to manage the car rental service. The chatbot's integration with this dashboard allows administrators to oversee bookings, monitor driver activities, and address customer support issues.

2. Hardware Interfaces:

- **Smartphones:** The chatbot will be accessible via smartphones (iOS and Android) used by passengers and drivers. It will leverage the device's hardware for features like GPS for navigation and notifications for real-time updates.

3. Software Interfaces:

- **Database Management System:** The chatbot will interact with the MySQL database to access and update booking information, driver profiles, and user data.
- **NLP Engine:** To support natural language processing, the chatbot will interface with an NLP engine or library, which will aid in understanding and generating human-like responses.

4.Web Services

- RESTful APIs will be used for communication between the chatbot and the car rental application's backend systems, enabling data exchange for booking confirmations, payment processing, and other operations.

5. Communications Interfaces:

- **HTTPS:** Secure communication will be established between the web dashboard and the server, using the HTTPS protocol to ensure data privacy and protection.
- **In-App Messaging:** The chatbot will communicate with passengers and drivers through in-app messaging, allowing for real-time updates, assistance, and notifications.

These external interfaces are essential for the successful operation of the Car Rental Chatbot. They facilitate interactions between the chatbot and various user groups, the underlying database, external services, and hardware components, ensuring a seamless and efficient user experience.

5. User Interfaces

1. Home Screen:

- The Home Screen serves as the starting point for users when they interact with the chatbot.
- It may include a welcome message and a primary menu.

2. Browse Cars Screen:

- This screen provides information about available car models, their details, and pricing.

3. Customer Support Screen:

- This screen provides information about rental policies, terms, and conditions. Users can also access customer support.

5. Feedback and Reviews Screen:

- Users can submit feedback, read reviews from other customers, and rate their rental experience.

6. Exit Confirmation:

- When users want to exit the chatbot, they will receive an exit confirmation screen.

6. Database organization and Data Storage

Entities and Attributes:

1. Car Information:

Entity: Car

Attributes:

- Car ID (Unique identifier)
- Make (e.g., Toyota, Ford)
- Model (e.g., Camry, Explorer)
- Year (e.g., 2023)
- Color (e.g., Blue, Silver)
- Features (e.g., GPS, Sunroof)
- Price per day (e.g., \$50)
- Availability (e.g., yes, no)
- Description (e.g., car description)

2. Availability Check:

Entity: Availability Check

Attributes:

- Car ID (Unique identifier)
- Pickup Date
- Return Date
- Pickup Location
- Return Location

3. Customer Support:

Entity: CustomerSupport

Attributes:

- Support Ticket ID (Unique identifier)
- User ID (if logged in)
- Username
- User Email
- Subject (e.g., inquiry, issue, feedback)
- Message (User's inquiry or message)
- Status (e.g., open, in-progress, closed)
- Customer Support Agent (if assigned)
- Timestamp (date and time of the inquiry)

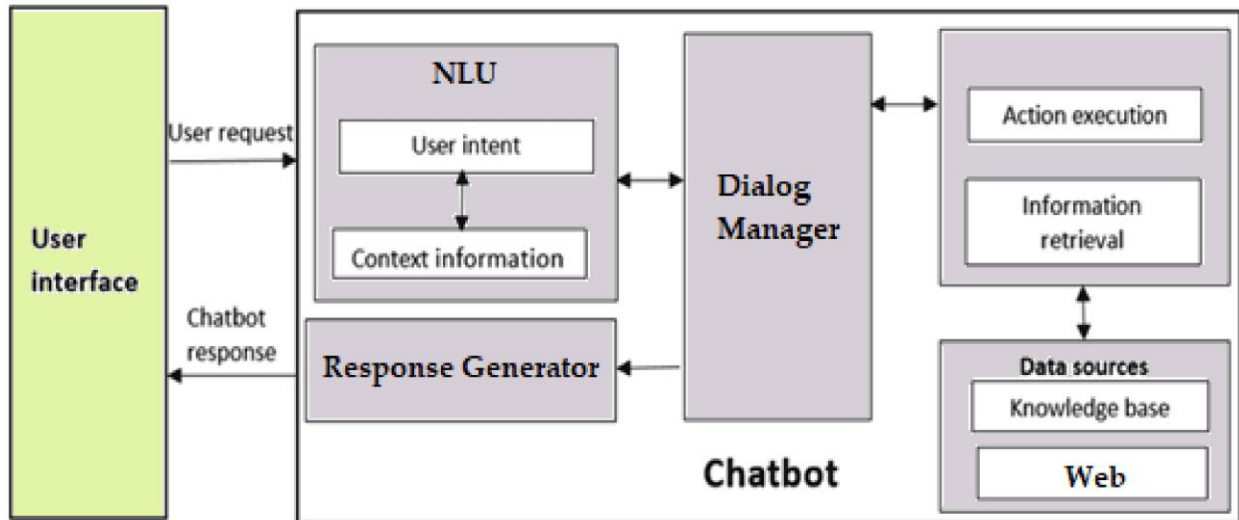
4. Feedback and Review:

Entity: FeedbackReview

Attributes:

- Review ID (Unique identifier)
- User ID (if provided)
- Username (if provided)
- Car ID (if associated with a specific car)
- Rating (e.g., 1-5 stars)
- Review Text (User's feedback or review)
- Timestamp (date and time of the review)
- Status (e.g., pending, published)

These entities and their attributes provide the necessary structure to manage data for car information, availability checks, customer support inquiries, and feedback and reviews within the chatbot's database. They can be used to store and retrieve relevant information for each of these functionalities.



a. Rationale for choosing the DBMS:

1. Data Structure and Requirements:

- Consider the structure and requirements of the data that the chatbot will manage. Does the data have a structured, tabular format, or does it involve complex relationships and hierarchies? Choose a DBMS that aligns with the data structure.

2. Scalability Needs:

- Assess the scalability requirements of the chatbot. Will the system experience a high volume of data and users in the future? Choose a DBMS that can scale horizontally or vertically to accommodate growth.

3. Data Integrity and Consistency:

- Ensure that the chosen DBMS provides strong data integrity and consistency mechanisms. This is critical for maintaining data accuracy and reliability, especially in applications like car rental where data consistency is vital.

4. Data Security:

- Data security is paramount, especially when handling user information, payment data, and sensitive customer data. Choose a DBMS with robust security features, including encryption, access controls, and auditing.

7. Other Design Considerations

Designing a car rental chatbot involves several considerations beyond the choice of the database management system (DBMS). Here are some additional design considerations:

1. User Experience (UX) Design:
 - Prioritize a user-friendly and intuitive interface. Ensure that the chatbot provides a smooth and enjoyable user experience, making it easy for users to interact and achieve their goals.
2. Multi-Platform Support:
 - Design the chatbot to work seamlessly on various platforms, such as web, mobile, messaging apps, and voice assistants. Adapt the user interface and features to suit each platform.
3. Natural Language Processing (NLP):
 - Implement advanced NLP capabilities to enable the chatbot to understand and respond to natural language queries and commands. Consider sentiment analysis for better user engagement.
4. Integration with External Systems:
 - Integrate the chatbot with external systems, including payment gateways, location services, and customer relationship management (CRM) systems to streamline processes and provide a holistic service.