**Electric Cars Parking Management System**

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Functionality of the web application list:

- User registration
- Vehicle registration
- Locating nearest charging station (charging station characteristics)
- check availability
- checking the prices according to the charging speed
- booking the station
- Pay for reservation
- tracking usage history
- get notification about the reservation
- pay for charging
- access green energy data
- contact and chat support for questions
- Reviews and ratings

The registration of both the user and their vehicle within the system constitutes an integral aspect of the web application's core functionality. A primary feature of the web application entails the identification of the nearest charging station on the map, contingent upon the user's current location. Upon locating the nearest charging station, the user has the ability to access detailed information regarding its attributes and reviews. Should the user express a favorable interest in the selected station, they may proceed to ascertain its availability.

Once a charging station has been selected, the user is presented with the opportunity to examine the pricing structure relative to the charging speed, subsequently enabling them to initiate a reservation and make the requisite payment. Furthermore, users possess the capability to review their historical transaction records, thus facilitating an overview of their past usage.

Upon the successful completion of the aforementioned tasks, the user will receive notifications regarding the status and specifics of their reservation. It is worth noting that the payment for the charging service occurs in the midst of the charging process. Subsequent to the completion of the charging service, the user retains the ability to monitor their sustainable green energy usage, which can be leveraged to secure discount offers within the application.

To enhance user experience and provide timely assistance, customer support services and a dedicated chat space are readily available for issue resolution.

deals within the app. Customer support and Chat space are available to resolve issues.

Databases:
- User
- Vehicle
- Charging station
- Transaction

**Mappping Approach**

  In the rapidly evolving landscape of transportation, the emergence of Electric Car Parking Management Systems represents a pioneering stride toward a sustainable future.This advanced system is powered by a user-friendly web application designed exclusively for electric vehicle owners.

# 1. Users and Subtypes:

Within the Electrical Car  Management System, the central entity  **Users**, represents registered individuals. It includes the following attributes:
- UID (User ID): Primary key for unique user identification.
- Name: User's full name.
- Number: Contact number of the user.
- Password: User's password for authentication.
- Username: Unique username for login.

ISA subtypes delineating the users roles and access privileges:
**Guests** (Subtype of Users):
- GID (Guest ID): Primary key specific to guest users.
- Temp: Additional attribute for temporary guest identification.

**Registered** (Subtype of Users):
- RegisteredID:  Primary key to registered users, ensuring exclusive access and personalized services.

# 2. Vehicles and Subtypes:

The **Vehicles** entity represents user vehicles within the system. It includes attributes such as:
- VID (Vehicle ID): Primary key for unique vehicle identification.
- RegisteredID (Registered ID): Foreign key linking the vehicle to its registered owner. This attribute establishes a clear association between vehicles and registered users within the system.
- Brand: Vehicle brand or manufacturer.
- Model: Specific model of the vehicle.
- Year: Manufacturing year of the vehicle.

ISA Subtypes:
**Cars** (Subtype of Vehicles):
- CID (Car ID): Primary key specific to cars, ensuring uniqueness.
- VID Foreign Key: Links to the parent Vehicles entity.

**Bikes** (Subtype of Vehicles):
- BID (Bike ID): Primary key specific to bikes, ensuring distinct identity.
- VID Foreign Key: Links to the parent Vehicles entity.

# 3. Charging Station and Subtypes:

The **Charging Station** entity serves as a crucial infrastructure for electric vehicle charging. It includes attributes like:
- SID (Station ID): Primary key for unique charging station identification.
- Price: Cost associated with using the charging station.
- Location: Geographical coordinates or address of the charging station.
- Availability: Real-time status indicating station occupancy.
- SName: Unique identifier for the charging station.

ISA Subtypes:

**Basic** Charging Station (Subtype of Charging Station):
- BasicID: Primary key specific to basic charging stations.

**Fast** Charging Station (Subtype of Charging Station):
- FastID: Primary key specific to fast charging stations.
- ChargingSpeed: Attribute indicating rapid charging speed.

**Solar** Charging Station (Subtype of Charging Station):
- SolarStationID: Primary key specific to solar charging stations.
- SolarPanelCapacity: Attribute representing solar panel capacity.


# 4. Transaction and Subtypes:

The **Transaction** entity manages financial and operational data related to user interactions. It includes attributes such as:
- TID (Transaction ID): Primary key for unique transaction identification.
- Status: Current status of the transaction (ongoing, completed, or pending).
- StartTime: Timestamp when the transaction commenced.
- EndTime: Timestamp when the transaction concluded.
- AmountPaid: Financial value associated with the transaction.
- SID (Station ID): Foreign key linking the transaction to the specific charging station involved. This attribute establishes a connection to the Charging Station entity.
- VID (Vehicle ID): Foreign key indicating the vehicle associated with the transaction. This attribute establishes a connection to the Vehicles entity.
- UID (User ID): Foreign key referencing the user involved in the transaction. This attribute establishes a connection to the Users entity.

ISA Subtypes:

Reservations (Subtype of Transaction):
- RID (Reservation ID): Primary key specific to reservation transactions.

Regular Transactions (Subtype of Transaction):
- RegularID: Primary key specific to regular transactions

# 5. Handling Constraints:

In our database schema, we have implemented several constraints to maintain data integrity and enforce relationships between entities. These constraints are essential to ensure

that the data stored in the database remains accurate, consistent, and meaningful. Below are the key constraints applied in our schema, each designed to ensure meaningful associations and reliable transactions within the Electrical Car Management System.

# 1. Owns Relationship (One-to-Many):

The "**owns**" relationship establishes a fundamental one-to-many connection between users and vehicles, enabling a user to possess multiple vehicles while each vehicle is linked to a single owner.
Owns Table Structure:
- VID (Vehicle ID): This attribute ensures unique identification for each vehicle, facilitating precise differentiation.
- RegisteredID: This unique identifier connects each ownership record to a specific registered user, forming an unambiguous link.
- Composite Primary Key: The combination of VID and RegisteredID forms the composite primary key of the "owns" table, guaranteeing the uniqueness of each ownership record and preventing duplicates.
- VID Foreign Key: Links to the VID attribute in the "vehicles" table, ensuring that each vehicle in the "owns" table corresponds to a valid entry in the "vehicles" table, maintaining data consistency.
- RegisteredID Foreign Key: Connects to the RegisteredID attribute in the "registered" table, establishing the relationship between users and their owned vehicles, allowing efficient data retrieval and user-specific operations.

# 2. Has Relationship (Many-to-Many):

The "**has**" relationship signifies a complex many-to-many connection between vehicles and charging stations, allowing multiple vehicles to be associated with various charging stations and vice versa.
Has Table Structure:
- VID (Vehicle ID): Identifies each vehicle participating in the relationship.
- SID (Station ID): Uniquely identifies each charging station involved in the relationship.
- Primary Key (VID, SID): The combination of VID and SID forms the primary key of the "has" table, ensuring the uniqueness of each association between a vehicle and a charging station.
- VID Foreign Key: References the VID attribute in the "vehicles" table, establishing a connection between the entry in the "has" table and the specific vehicle.
- SID Foreign Key: References the SID attribute in the "charging_stations" table, linking the entry in the "has" table to the specific charging station.

# 3. Make Relationship (One-to-Many):

The "**make**" relationship signifies a one-to-many connection between users and transactions, enabling a user to initiate multiple transactions.
Make Table Structure:

- TID (Transaction ID), UID (User ID): Together, these attributes form the composite primary key of the "make" table, ensuring the distinctiveness of each transaction initiated by a user.
- TID Foreign Key: References the TID attribute in the "transactions" table, linking the entry in the "make" table to the specific transaction.
- UID Foreign Key: References the UID attribute in the "users" table, establishing the connection between the user initiating the transaction and the transaction record.

## 4. Use Relationship (One-to-Many):

The "**use**" relationship signifies a one-to-many connection between vehicles and transactions, allowing a single vehicle to be involved in multiple transactions.
Use Table Structure:
- VID (Vehicle ID), TID (Transaction ID): Together, these attributes form the composite primary key of the "use" table, ensuring the uniqueness of each transaction involving a specific vehicle.
- TID Foreign Key: References the TID attribute in the "transactions" table, establishing a connection between the entry in the "use" table and the specific transaction.
- VID Foreign Key: References the VID attribute in the "vehicles" table, linking the entry in the "use" table to the specific vehicle.

## 5. Associated Relationship (One-to-Many):

The "**associated**" relationship signifies a one-to-many connection between charging stations and transactions, allowing a charging station to be associated with multiple transactions.
Associated Table Structure:
- SID (Station ID), TID (Transaction ID): Together, these attributes form the composite primary key of the "associated" table, ensuring the uniqueness of each association between a charging station and a transaction.
- TID Foreign Key: References the TID attribute in the "transactions" table, establishing a connection between the entry in the "associated" table and the specific transaction.
- SID Foreign Key: References the SID attribute in the "charging_stations" table, linking the entry in the "associated" table to the specific charging station.