Title: Eco-Friendly Transportation

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Project Description

The Eco-Friendly Transportation Database Project is driven by a strong commitment to addressing key challenges in urban transportation and promoting sustainability. It seeks to tackle issues associated with traditional transportation systems, such as excessive greenhouse gas (GHG) emissions, air pollution, traffic congestion, and limited eco-friendly transportation choices. The primary motivation behind this project is to transform the urban transportation landscape and encourage sustainable travel practices.

At its core, the database system represents a revolutionary approach to urban mobility. It seamlessly integrates into users' daily lives, providing them with sustainable and efficient options for navigating cities. The system excels in delivering real-time information, offering personalized recommendations, and fostering community engagement to promote eco-friendly transportation choices.

One of the standout features of the system is its unwavering commitment to sustainability. It not only offers a wide range of eco-friendly transportation alternatives but also empowers users to track their individual carbon footprints. This functionality enables users to make informed decisions and select greener transportation options. For instance, users can plan journeys that incorporate electric vehicles, public transit, cycling, and walking, contributing to a more eco-conscious urban ecosystem. Moreover, the system encourages community participation by allowing users to share experiences, collaborate on shared trips, and collectively work towards sustainability goals. In line with the Sustainable Urban Transport initiative, this project strives to improve air quality, reduce congestion, and enhance the overall quality of life in urban areas.

The project's motivation aligns seamlessly with the functional requirements established for the database system. These requirements encompass user-friendly interfaces, real-time data retrieval, carbon footprint tracking, and support for multiple transportation modes, all of which are central to our mission of promoting sustainability and eco-friendly travel practices. By addressing these requirements, we aim to contribute significantly to the Sustainable Urban Transport vision of creating cleaner, more efficient, and more environmentally responsible urban transportation systems.

Use Cases:

Use Case: Eco-Conscious Registration

Actor: New User

Description: A new user, passionate about eco-friendly transportation, initiates the registration process. They access the registration page and provide the required information, including their name, email address, and password. The system verifies the provided information and sends a confirmation email. Once the user confirms their email, they gain access to the platform.

Use Case: Sustainable Travel Planning

Actor: Eco-Conscious Traveler

Description: An eco-conscious traveler wants to plan an upcoming trip with minimal environmental impact. They log in to the platform and access the route planning feature. The system allows them to enter the trip's details, including the destination and preferred mode of transportation. Based on this information, the system suggests eco-friendly routes and transportation options, taking into account the traveler's sustainability preferences.

Use Case: Emissions Tracking and Reduction

Actor: User Setting Emissions Reduction Goals

Description: A user is committed to reducing their carbon footprint and wants to set emissions reduction goals within the platform. They navigate to their profile settings and select the emissions reduction section. Within this feature, they can set specific goals, such as reducing emissions by a certain percentage within a specified timeframe. The system tracks their progress and provides recommendations on how to achieve these goals.

Use Case: Collaborative Trip Sharing

Actor: Eco-Conscious Commuters

Description: A group of eco-conscious commuters who work together decides to organize a shared trip to reduce emissions. They log in to the platform and access the trip sharing feature. Each member adds their vehicle to the trip, and the system calculates the combined emissions reduction. The system facilitates communication among group members and allows them to coordinate the trip details, such as meeting points and departure times.

Use Case: Eco-Score Competition

Actor: Eco-Aware Users

Description: Several eco-aware users on the platform decide to engage in a friendly competition to see who can achieve the highest eco score. They access the eco score leaderboard, which displays the eco scores of their friends and connections within the platform. Users receive incentives, rewards, or recognition for achieving high eco scores,

motivating them to make sustainable transportation choices and participate in the competition.

Functional Requirements:

1.User Entity:

1.1 A user shall be able to register an account.

1.2 A user shall be able to log in with their credentials.

1.3 A user shall have a profile page displaying their information.

1.4 A user shall be able to reset their password.

1.5 A user shall be able to update their contact information.

1.6 A user shall be able to view their eco-friendly transportation history.

1.7 A user shall receive email notifications for account-related activities.

1.8 A user shall have the option to set sustainability preferences in their profile.

1.9 Users shall be able to invite friends to join the eco-friendly transportation network.

1.10 A user shall access a dashboard displaying their sustainability progress.

1.11 Users shall receive personalized eco-friendly travel tips based on their usage patterns.

1.12 The system shall provide a forum for users to discuss sustainable travel practices.

1.13 Users can be friends with other users.

2. Vehicle Entity:

2.1 A user shall be able to add a new vehicle to their profile.

2.2 A user shall provide vehicle details such as make, model, and year.

2.3 A user shall track maintenance records for their vehicles.

2.4 A user shall set maintenance reminders based on mileage or time intervals.

2.5 A user shall view a summary of their vehicle's environmental impact.

2.6 Users shall schedule and receive automated maintenance alerts.

2.7 The system shall recommend vehicle upgrades for improved eco-friendliness.

2.8 Users shall compare the carbon footprint of different vehicle options.

2.9 A user shall access real-time data on available electric vehicle charging stations.

3. Route Entity:

3.1 A user shall plan eco-friendly routes based on their vehicle and preferences.

3.2 A user shall receive route suggestions with lower emissions options.

3.3 A user shall save favorite routes for quick access.

3.4 A user shall receive real-time traffic updates for their selected route.

3.5 A user shall view historical data on their past routes.

4.Emissions Tracking Entity:

4.1 The system shall automatically calculate emissions based on vehicle data.

4.2 A user shall receive emissions reports for each trip.

4.3 Emissions data shall be categorized by trip type (e.g., commuting, leisure).

4.4 Users shall compare emissions data with others in their network.

4.5 A user shall set emissions reduction goals.

5. Environmental Impact Entity:

5.1 A user shall view the environmental impact of their eco-friendly choices.

5.2 The system shall provide recommendations for reducing carbon footprint.

5.3 Users shall earn eco-friendly badges or rewards for sustainable actions.

5.4 A user shall share their achievements on social media.

6. Trip Sharing Entity:

6.1 A user shall be able to share trip details with other users.

6.2 Shared trips shall include route information, emissions data, and comments.

6.3 Users shall collaborate on group trips and split emissions data.

6.4 A user shall comment and rate shared trips.

7. Community and Social Features Entity:

7.1 Users shall join eco-friendly transportation communities.

7.2 A user shall post updates, photos, and articles related to eco-friendly transportation.

7.3 Users shall comment on and like community posts.

7.4 A user shall connect with other users to form eco-friendly travel groups.

8. Data Analytics and Reporting Entity:

8.1 The system shall provide analytics on eco-friendly transportation trends.

8.2 Users shall generate custom reports on their transportation habits.

8.3 The system shall offer insights and suggestions for improving eco-friendliness.

8.4 A user shall export their data for external analysis.

9. Integration with Eco-Friendly Services Entity:

9.1 The system shall integrate with public transportation schedules.

9.2 Users shall access real-time data for electric vehicle charging stations.

9.3 The system shall provide information on nearby bicycle-sharing services.

9.4 A user shall link their account with eco-friendly service providers.

10. Notification Management:

10.1 A user shall customize their notification preferences for various activities (e.g., new messages, shared trip requests).

10.2 Users shall receive real-time traffic updates and route recommendations based on current conditions.

10.3 The system shall send notifications for upcoming maintenance based on vehicle data.

10.4 Users shall be alerted about nearby eco-friendly transportation events or initiatives.

11.Emergency Assistance:

11.1 A user shall have access to emergency contact information in case of accidents or breakdowns during trips.

11.2 The system shall provide a direct link to roadside assistance services for users facing vehicle issues.

11.3 Users shall share their real-time location with trusted contacts for safety purposes.

12. Gamification and Challenges:

12.1 Users shall have eco scores representing their sustainability achievements.

12.2 Users shall view the eco scores of their friends and connections within the platform.

12.3 Users shall receive incentives, rewards, or recognition for achieving high eco scores.

13.Accessibility and Inclusivity:

13.1 The database system shall store user accessibility preferences, including font size and color scheme settings.

13.2 User profiles shall include language preferences, enabling the system to deliver content in the user's chosen language.

13.3 The database shall maintain a list of accessible transportation options, including wheelchair-accessible vehicles and routes.

13.4 he system shall store user-specific accessibility requirements, such as screen reader compatibility and keyboard navigation preferences.

14.Contract Entity:

14.1 Contract shall have a contract id, contract name

14.2 Contract shall be signed by employees of the company

14.3 Contract shall have start and end date

15. Company Entity:

15.1 Company shall be able to list its vehicles on the database

15.2 Company shall be able to participate in campaigns to promote eco-friendly transport

15.3 Company shall have company id , company name and email

15.4 Company shall pay for maintenance for its vehicles

16. Maintenance Entity:

16.1 Maintenance shall have a maintenance id and maintence name

16.2 Every maintenance shall have a vehicle id and payment id so keep track

16.3 Maintenance shall be paid by any payment method

16.4 Maintenance shall be paid by user or company

17. Mailing List Info Entity:

17.1 A user shall recieve mails monthly

17.2 A user shall receive mail on thier given address

17.3 Every user shall be on the mailing list

17.3 Mailing list shall have mailing id and mail name

18. Weather Entity:

18.1 A user shall outlook weather to make vehicle choice

18.2 Weather shall have a weather id.

18.3 Weather shall have measure of wind speed, temperature and humidity

18.4 Weather shall have a pollution index to track which weather

19. Stations Entity

19.1 A user shall be able to charge or fuel up a car at a station

19.2 A public vehicle shall have access to stations

19.3 A station shall have payment methods to pay for service

19.4 A station shall have a station id, station name and station location

20. Account :

20.1 Users shall be able to create and manage their accounts.

20.2 Each account shall have a phone number, which can be multivalued and numeric.

20.3 Each account shall have an email address, which is simple and alphanumeric.

20.4 Accounts shall be associated with an account ID, which is a foreign key and numeric.

20.5 Users shall provide an account name, which is simple and alphanumeric.

21. Payment Method :

21.1 Users shall have the option to add and manage payment methods.

21.2 Each payment method shall have a unique payment ID, which is numeric and serves as a key.

21.3 Users can choose from multiple payment types, which can be multivalued and alphanumeric.

21.4 Payment timestamps, which are multivalued and alphanumeric, shall be recorded for each transaction.

22. Bank Account :

22.1 Users can link bank accounts to their profiles.

22.2 Bank account numbers, which can be multivalued and numeric, shall be associated with each user.

22.3 Users shall provide the bank's name, which is simple and numeric.

22.4 Area codes, which can be multivalued and alphanumeric, shall be linked to bank accounts.

23. Paypal account:

23.1 Users can link PayPal accounts for payment.

23.2 PayPal account numbers, which can be multivalued and numeric, shall be associated with each user.

23.3 Users shall provide PayPal usernames, which are multivalued and alphanumeric.

23.4 Timestamps for PayPal transactions shall be recorded, and they are simple and alphanumeric.

24. Crypto wallets:

24.1 Users can manage cryptocurrency wallets.

24.2 Wallet addresses, which can be multivalued and alphanumeric, shall be associated with each user.

24.3 Users shall specify the amount of cryptocurrency they hold, which is simple and numeric.

24.4 Users can choose from various cryptocurrency types, which can be multivalued and alphanumeric.

25. Credit card :

25.1 Users can add and manage credit card information for payments.

25.2 Credit card numbers, which can be multivalued and numeric, shall be associated with each user.

25.3 Users shall provide the cardholder's name, which is simple and numeric.

25.4 Users can specify the bank's name for each credit card, which can be multivalued and numeric.

25.5 Each credit card shall be linked to a payment method using the payment ID, which is a foreign key and numeric.

26. Debit card :

26.1 Users can add and manage debit card information for payments.

26.2 Debit card numbers, which can be multivalued and numeric, shall be associated with each user.

26.3 Users shall provide the cardholder's name, which is simple and numeric.

26.4 Users can specify the bank's name for each debit card, which can be multivalued and numeric.

26.5 Each debit card shall be linked to a payment method using the payment ID, which is a foreign key and numeric.

Beneficiary Software Tools / Products

The Eco-Friendly Transportation Database System (DBSEM) offers significant benefits to existing software tools and products in the market. One such tool is Google Maps, a widely-used navigation and mapping application. By integrating DBSEM with Google Maps, users can access real-time information about eco-friendly transportation options, including electric vehicle charging stations, sustainable transit routes, and emissions data. This integration empowers users to make informed choices that align with their sustainability preferences, ultimately contributing to more eco-conscious travel practices.

 Additionally, EV Charging Station Apps like ChargePoint can leverage DBSEM's data to provide users with not only charging station locations but also information on nearby sustainable transit options such as bike-sharing services and public transportation. This holistic approach helps electric vehicle drivers plan eco-friendly routes and reduce their environmental impact. By enhancing these existing tools with DBSEM's insights, users can play an active role in promoting sustainable mobility and reducing their carbon footprint during their journeys.

Non-Functional Requirements

Performance

1.1 The database system shall provide response times for user queries within 2 seconds under normal load conditions.

1.2 The system should be capable of handling a minimum of 1000 simultaneous user connections without significant performance degradation.

Scalability

2.1 The database system should be designed to scale horizontally to accommodate an increasing volume of data and users.

2.2 The system shall support the addition of new servers or nodes without affecting ongoing operations.

Reliability

3.1 The system shall have a minimum uptime of 99.9% to ensure uninterrupted access for users.

3.2 In the event of a server or hardware failure, the database system should automatically switch to a backup server without data loss.

Data Integrity

4.1 Data integrity checks shall be performed regularly to identify and correct any inconsistencies or errors in the database.

4.2 The system shall maintain data consistency by enforcing referential integrity constraints.

Security

5.1 Access to the database system shall be controlled through user authentication and authorization mechanisms.

5.2 Data transmission between the user's device and the database shall be encrypted using industry-standard protocols.

5.3 The system shall maintain an audit trail of all database activities, including login attempts and modifications to sensitive data.

Compliance

6.1 The database system shall comply with relevant data protection regulations, such as GDPR, to ensure user data privacy.

6.2 The system shall adhere to eco-friendly data center practices to minimize its carbon footprint.

Backup and Recovery

7.1 Regular automated backups shall be performed to ensure data recoverability in case of data loss or system failure.

7.2 Backup data shall be stored securely and retained for a minimum of 90 days.

Usability

8.1 The user interface of the database system shall be intuitive and user-friendly to facilitate ease of use for both technical and non-technical users.

8.2 The system shall provide online documentation and user support resources for users to resolve common issues.

Compliance with Industry Standards

9.1 The database system shall adhere to industry-standard database management system (DBMS) practices and protocols.

9.2 It shall support SQL (Structured Query Language) standards to ensure compatibility with existing database tools and applications.

ERD Diagram:
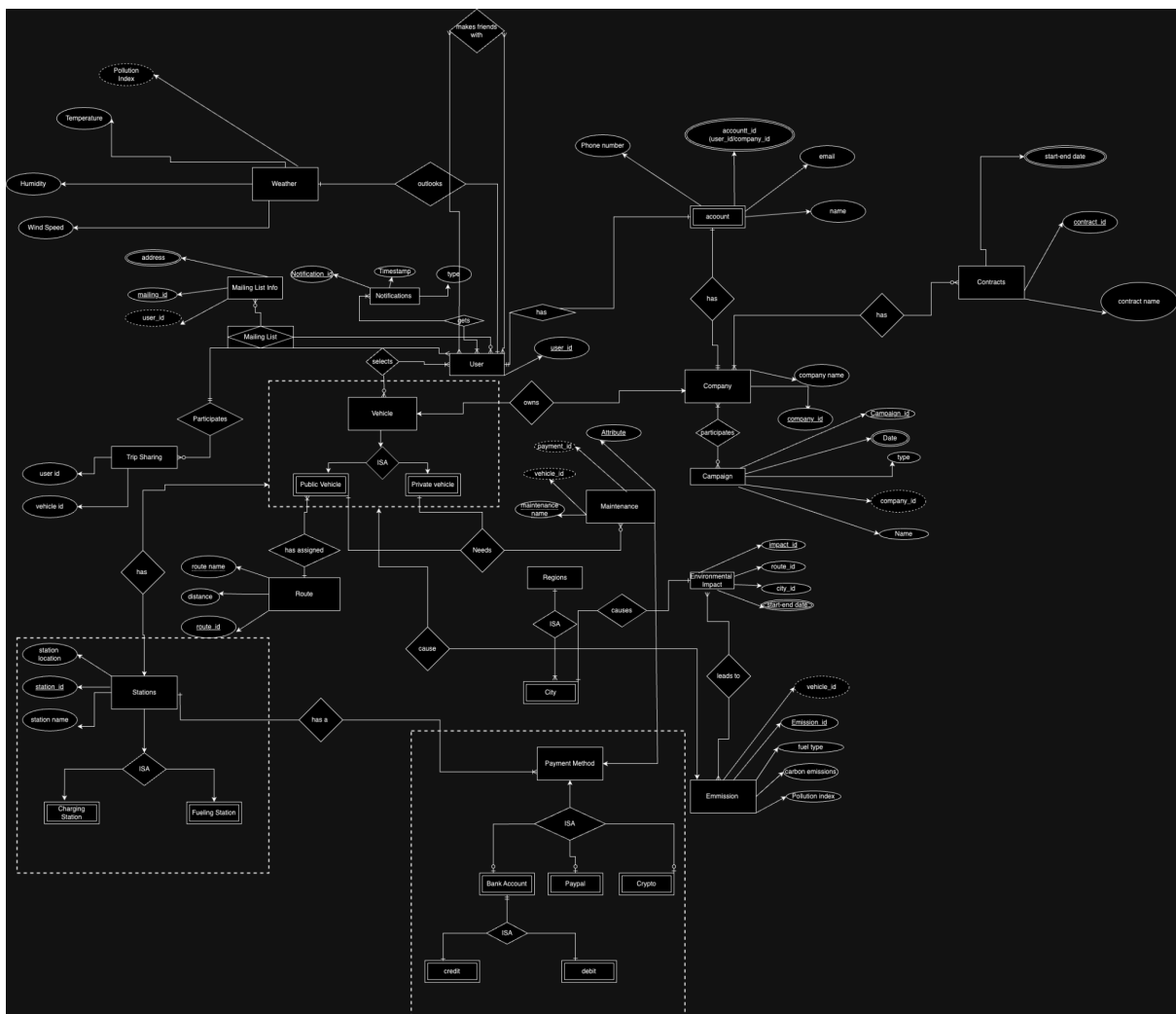
Entity Description

1.User (Strong)
- User_id: key, numeric
- Username: composite, alphanumeric
- Email: simple, alphanumeric

2. Vehicle (Strong)
- Vehicle_id: key, numeric
- Vehicle_type: simple, alphanumeric
- vehicle _company: multivalue, alphanumeric

3. Notifications (Strong)
- Notification_id: key, numeric
- Timestamp: composite, alphanumeric
- Type: simple, alphabet

4. Mailing List Info (Strong)
- Address: multivalue, alphanumeric
- mailing_id : key, numeric
- User_id: foreign key, numeric

5. Route (Strong)
- route_id : key, numeric
- Distance: simple, numeric
- Route_name: simple, alphabet

6. Trip Sharing (Strong)
- User_id: key, numeric
- vehicle _id: foreign key, numeric
- route_id : foreign key, numeric

7.Stations (Strong)
- Station_id: key , numeric
- station_name : simple, alphabet
- Station_location: simple, alphabet
- Station type: multivalue, alphabet

8.Charging Station (Strong)
- station _id: foreign key, numeric
- station_name : simple, alphabet
- station _location: multivalue, alphabet

- Charging_units: multivalue, numeric

9.Fueling Stations (Strong)
- Station_id: foreign key, numeric
- station_name : simple, alphabet
- station_location : composite, alphanumeric

10. Regions (Strong)
- Region_id: key, numeric
- region_radius : atomic, numeric
- coordinates : simple, alphanumeric

11. City (weak)
- Region_id: foreign key, numeric
- City_name: simple, alphabet
- City_area: atomic, numeric

12. Emission (Strong)
- emission_id : key, numeric
- vehicle_id : foreign key, numeric
- Fuel_type: simple, alphanumeric
- Carbon_emisison: simple, numeric
- pollution_index : simple, numeric

13. Environmental Impact (Strong)
- Impact_id: key, numeric
- city_id : foreign, numeric
- Date: multivalue, alphanumeric

14.Campaign (Strong)
- Campaign_id: key, numeric
- Date: composite, alphanumeric
- Campaign_type: composite, alphanumeric
- campaign_name : simple, alphanumeric
-

15. Company (Strong)
- Company_id: key, numeric
- Company_name: simple, alphanumeric
- Vehicle_count: multivalued, numeric
- Marketcap: multivalued, numeric

16. Contracts (Strong)
- contract_id : key, numeric
- Date: composite, alphanumeric
- Contract_name: simple, alphanumeric

- contract _type: multivalued, alphanumeric

17. Weather (Strong)
    - Weather_id: key, numeric
    - Humidity: multivalued, numeric
    - Temperature: multivalued, numeric
    - pollution _index: foreign key, numeric
    - Wind_speed: multivalued, numeric

18. Maintenance (Strong)
    - maintenance_id : key, numeric
    - maintenance_name : simple, alphanumeric
    - Vehicle_id: foreign key, numeric
    - Payment_id: foreign key, numeric

19. Account (weak)
    - phone_number : multivalued, numeric
    - Email: simple, alphanumeric
    - account_id : foreign key, numeric
    - Account_name: simple, alphanumeric

20. Payment Method (Strong)
    - Payment_id: key, numeric
    - Payment_type: multivalue, alphanumeric
    - Payment_timestamp: multivalue, alphanumeric

21. Bank Account (weak)
    - Account_number: multivalue, numeric
    - Bank_name: simple, numeric
    - Area_code: multivalue, alphanumeric

22. Paypal (weak)
    - Paypal_account: multivalue, numeric
    - Paypal_username: multivalue, alphanumeric
    - Timestamp: simple, alphanumeric

23. Crypto (weak)
    - Wallet_address: multivalue, alphanumeric
   - Amount: simple, numeric
    - Crypto_type: multivalue, alphanumeric

24. Credit (weak)
    - Card_number: multivalue, numeric
    - Card_name: simple, numeric
    - Bank_name: multivalue, numeric
    - payment_id : foreign key, numeric

25. Debit (weak)
   - Card_number: multivalue, numeric
   - Card_name: simple, numeric
   - Bank_name: multivalue, numeric
   - payment_id : foreign key, numeric

Entity Establishment Relationship Diagram
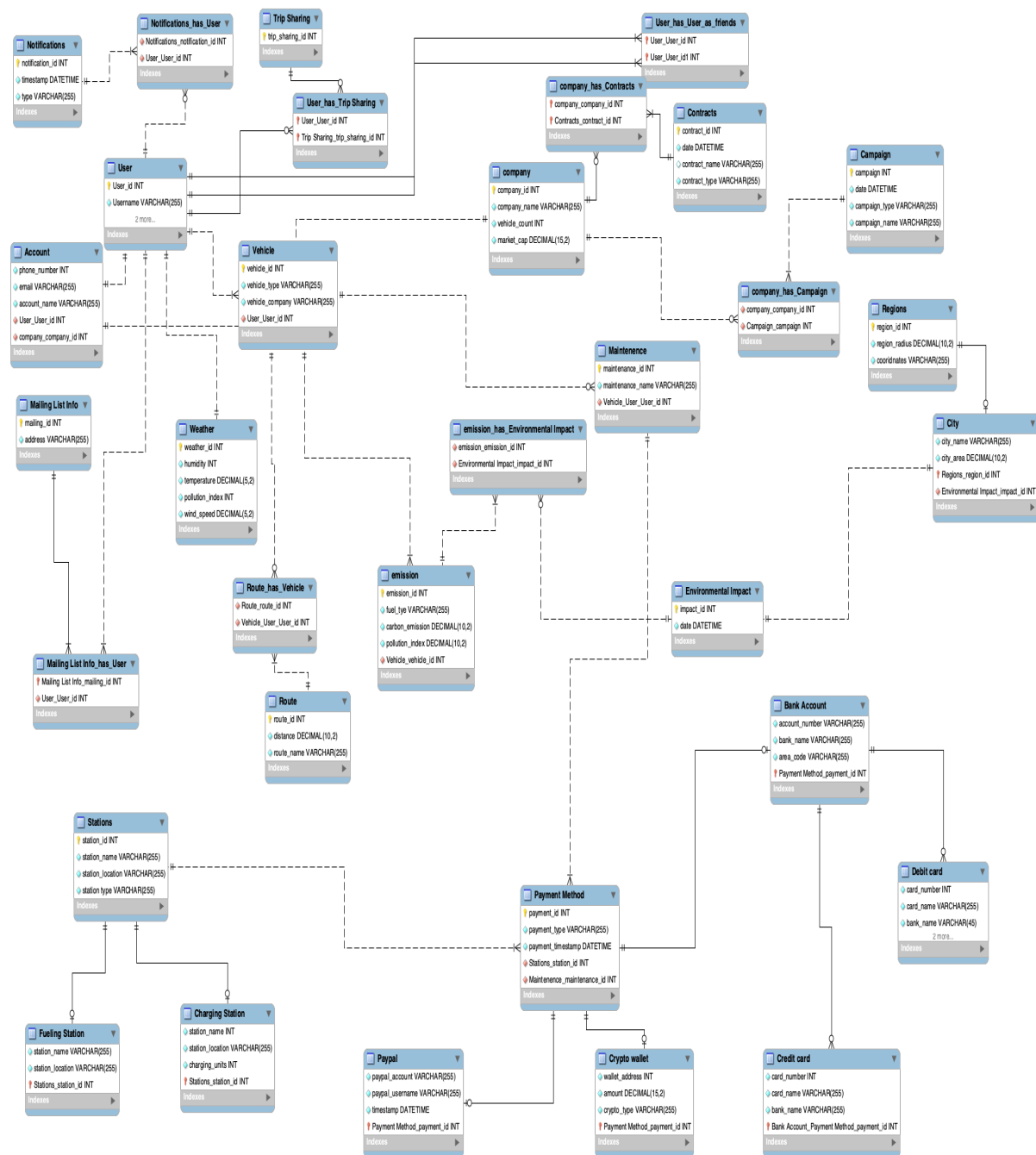
Constraints Table

TABLE	FK	ON DELETE	ON UPDATE	COMMENT
Account	user	ON CASCADE	ON CASCADE	When a user is deleted, their associated account should also be deleted.
User	role	SET NULL	ON CASCADE	If a role is removed from a user, the user should retain their account but have no role.
Mailing List Info	user_id	ON CASCADE	ON CASCADE	If a user is deleted, their associated mailing list info should be deleted.
Trip Sharing	user_id	ON CASCADE	ON CASCADE	If a user is deleted, their trip sharing records should be deleted.
Trip Sharing	vehicle _id	ON CASCADE	ON CASCADE	If a vehicle is deleted, trip sharing records associated with that vehicle should be deleted.
Trip Sharing	route_id	ON CASCADE	ON CASCADE	If a route is deleted, trip sharing records associated with that route should be deleted.
Charging Station	station_id	ON CASCADE	ON CASCADE	If a station is deleted, charging station records associated with

				that station should be deleted.
Fueling Station	station_id	ON CASCADE	ON CASCADE	If a station is deleted, fueling station records associated with that station should be deleted.
City	region_id	SET NULL	ON CASCADE	If a region is removed from a city, the city should retain its reference to the region, but it may become orphaned.
Emission	vehicle_id	ON CASCADE	ON CASCADE	If a vehicle is deleted, the associated emission records should be deleted.
Environmental Impact	city_id	ON CASCADE	ON CASCADE	If a city is deleted, the environmental impact records associated with that city should be deleted.
Maintenance	vehicle_id	ON CASCCADE	ON CASCADE	If a vehicle is deleted, the associated maintenance records should be deleted.
Maintenance	payment_id	SET NULL	ON CASCADE	If a payment method is removed, the associated maintenance records may no longer have a valid payment reference.