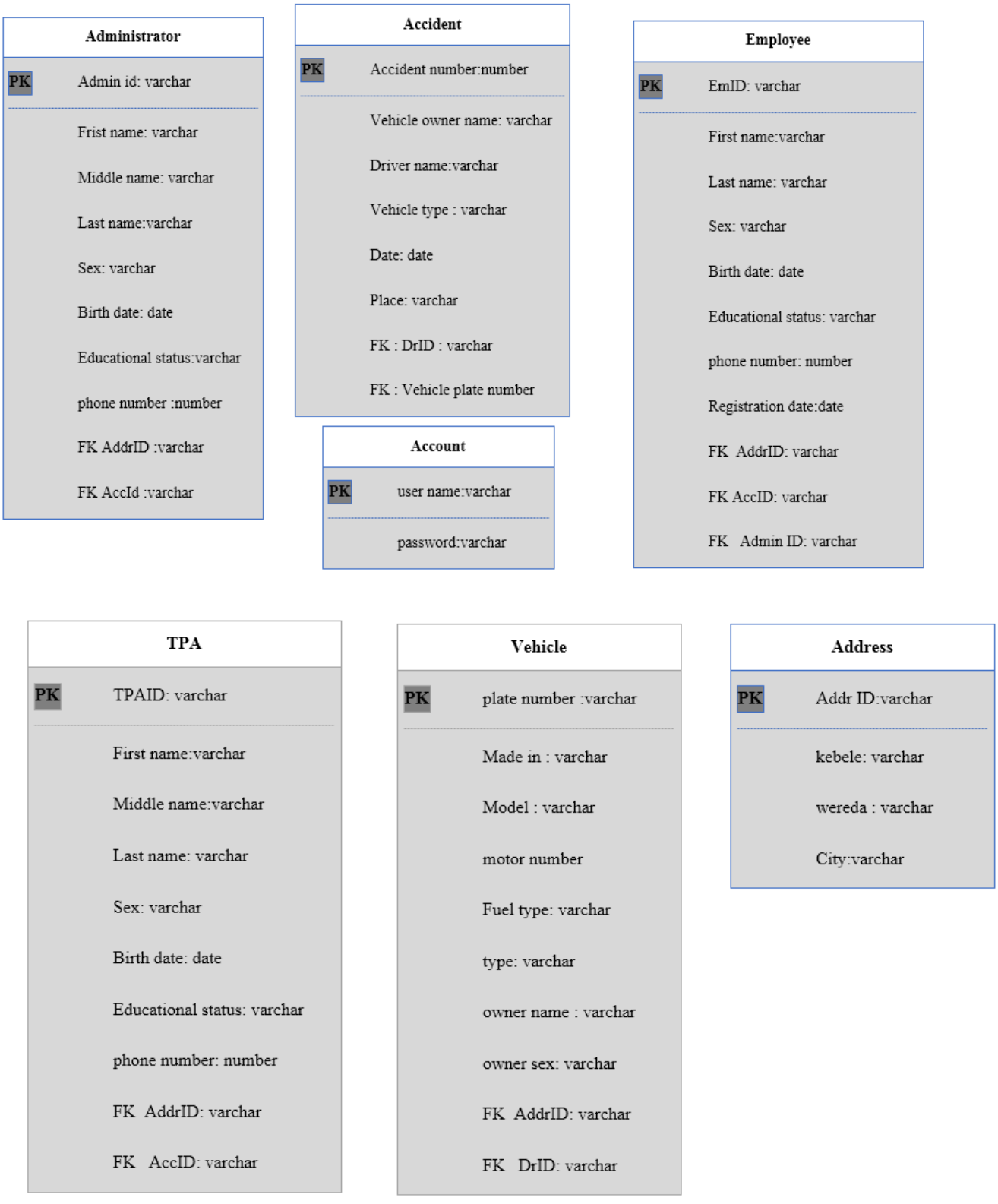
Administrator
PK
Admin id: varchar
Frist name: varchar
Middle name: varchar
Last name:varchar
Sex: varchar
Birth date: date
Educational status:varchar
phone number :number
FK AddrID :varchar
FK AccId :varchar
Accident
PK
Accident number:number
Vehicle owner name: varchar
Driver name:varchar
Vehicle type : varchar
Date: date
Place: varchar
FK : DrID : varchar
FK : Vehicle plate number
Account
PK
user name:varchar
password:varchar
Employee
PK
EmID: varchar
First name:varchar
Last name: varchar
Sex: varchar
Birth date: date
Educational status: varchar
phone number: number
Registration date:date
FK AddrID: varchar
FK AccID: varchar
FK Admin ID: varchar
TPA
PK
TPAID: varchar
First name:varchar
Middle name:varchar
Last name: varchar
Sex: varchar
Birth date: date
Educational status: varchar
phone number: number
FK AddrID: varchar
FK AccID: varchar
Vehicle
PK
plate number :varchar
Made in : varchar
Model : varchar
motor number
Fuel type: varchar
type: varchar
owner name : varchar
owner sex: varchar
FK AddrID: varchar
FK DrID: varchar
Address
PK
Addr ID:varchar
kebele: varchar
wereda : varchar
City:varchar

Normalization and Schema Design

Normalization

Normalization is the process of organizing data into tables in such a way that the results of using the database are always unambiguous and as intended. Normalization may have the effect of duplicating data within the database and often results in the creation of additional tables. (While normalization tends to increase the duplication of data, it does not introduce redundancy, which is unnecessary duplication.) Normalization is typically a refinement process after the initial exercise of identifying the data objects that should be in the database, identifying their relationships, and defining the tables required and the columns within each table.

First Normal Form (1NF)

First normal form (1NF) sets the very basic rules for an organized database:

- ✓ Eliminate duplicative columns from the same table.
- ✓ Create separate tables for each group of related data and identify each row with a unique column or set of columns (the primary key).

Second Normal Form (2NF)

Second normal form (2NF) further addresses the concept of removing duplicative data:

- ✓ Meet all the requirements of the first normal form.
- ✓ Remove subsets of data that apply to multiple rows of a table and place them in separate tables.
- ✓ Create relationships between these new tables and their predecessors through the use of foreign keys.

Third Normal Form (3NF)

Third normal form (3NF) goes one large step further:

- ✓ Meet all the requirements of the second normal form.
- ✓ Remove columns that are not dependent upon the primary key.

1. **Mapping Administrator entity**

AdID	First name	Middle name	Last name	Sex	Birth date	Educational status	Phone number	AddrID	AccID

- ❖ **AccID**: foreign key references the primary key of Account entity
- ❖ **AddrID**: foreign key references the primary key of Address entity
- ❖ Full fill First, Second and Third normalization

2. **Mapping Address Entity**

AddrID	Kebele	wereda	city

- ❖ Full fill first, second and third normalization

3. **Mapping Account entity**

User name	password

- Full fill First, Second and Third normalization.

4. Mapping Employee entity

EmId	First name	Last name	Age	Sex	Birth date	Educational status	Registration date	AdID	AccID	AddrID

- **AdID**: foreign key references the primary key of Administrator entity
- **AddrID**: foreign key references the primary key of Address Entity
- **AccID**: foreign key references the primary key of Account entity
- Full fill First, Second and Third normalization.

5. Mapping Vehicle entity

plate number	Model	Made in	Motor number	Fuel type	Type	Owner name	Owner sex	Owner address	EmpID	DrID

- **EmpID:** foreign key references the primary key of Employee entity
- **DrID:** foreign key references the primary key of Driver entity
- Full fill First, second and third normalization.

6. Mapping Driver entity

Driver License number	First name	Last Name	sex	Region	Level	Registration date	Phone number	AddrID	EmpID	AccID

- **EmpID:** foreign key references the primary key of Employee entity
- **AddrID:** foreign key references the primary key of Address entity
- **AccID**: foreign key references the primary key of Account entity
- Full fill First, Second and Third normalization.

7. Mapping TPA entity

TPAID	First Name	Last Name	Sex	Birth date	Phone number	Educational status	Phone number	AddrID	AccID

- **AccID**: foreign key references the primary key of Account entity
- **AddrID**: foreign key references the primary key of Address entity
- Full fill First, Second and Third normalization.

8. Traffic police entity

TpID	First name	Last name	Age	Sex	Birth date	Address	TPAID	AccID	AddrID

- **AccID**: foreign key references the primary key of Account entity
- **AddrID**: foreign key references the primary key of Address entity
- **TPAID:** foreign key references the primary key of TPA
- Full fill First, Second and Third normalization.

9. Mapping Punishment relation ship

TpID	DLnumber	Date

- **TpID**: foreign key references the primary key of Traffic Police.
- **DLnumber**: foreign key references the primary key of Driver entity.
- Full fill First, Second and Third normalization

10. Mapping Report entity

ReID	Report date	Report type

- Full fill First, Second and Third normal form

11. Mapping Administrator-Report Relation ship

AdminID	ReID

- **AdminID**: foreign key references the primary key of administrator
- **ReID**: foreign key references the primary key of Report entity
- Full fill First, Second and Third normal form

12. Mapping TPA-Report relation ship

TPAID	ReID

- **TPAID**: foreign key references the primary key of TPA
- **ReID**: foreign key references the primary key of Report entity
- Full fill First, Second and Third normal form

13. Mapping Employee-Report Relation ship

EmID	ReID

- **EmID**: foreign key references the primary key of Employee
- **ReID**: foreign key references the primary key of Report entity
- Full fill First, Second and Third normal form

14. Mapping Accident/Crime entity

Accident number	Vehicle owner name	Driver name	From	To	Vehicle type	Date	Place	DrID	Vehicle Plate Number

- **DrID:** foreign key references the primary key of Driver entity
- **Vehicle Plate number:** foreign key references the primary key of Vehicle
- Full fill First Normal Form
- Requires Second Normal Form because they do not fully functional dependent

2NF

14. 1 Mapping Accident/Crime entity

DrID	Vehicle Plate number	From	To	Date	Place

14.2 Mapping Accident/Crime entity

Vehicle plate number	Vehicle owner name	Vehicle type

14.3 **Mapping Accident/Crime entity**

DrID	Driver Name

- Full fill Third normal form.

1.1.1. Access control and security Access control

Here we will describe the privileges or authorities of actors over the functionalities. In this system there are three actors Administrator, Employee, Traffic Police, Traffic police Administrator and Driver. Each has their own privileges to gain access of the system.

Below is the description of access control using access control matrix.

	Administrator	Employee	Driver	TPA	Traffic police
Login	✓	✓	✓	✓	✓
Register Employee	✓				
Register Driver		✓			
Register Traffic police				✓	
Register Vehicle		✓			
View self-profile	✓	✓	✓	✓	✓
View Employee profile	✓				
View Driver profile	✓	✓		✓	✓
View Vehicle Profile	✓	✓		✓	
View Traffic police profile				✓	
Change password	✓	✓	✓	✓	✓

Enable/Disable Account	✓			✓	
Generate report	✓	✓		✓	
Punish Driver					✓
Logout	✓	✓	✓	✓	✓

Table 1: Access control table

Security

Here are some security issues taken in the system

- All users of the system must first login to perform operation and get services.
- When Employee, Driver and Traffic Police Registered, the will get user name and password.
- The user name and password of the users are encrypted and store in the database.