QUESTION 4

Using any RDBMS that has spatial capabilities, model a database for an emergency response system application. Explain your relationships and model using a flow chart.

SOLUTION

Vehicle
VIN (PK)
MAKE
MODEL
YEAR
DESCRIPTION

Vehicle Position
ID (PK)
VEHICLE_VIN (FK)
LINK_ID (FK)
STATUS
GPS_POSITION
MATCHED_POSITION

Emergency
ID (PK)
ALLOCATED_ VEHICLE_VIN (FK)
DESCRIPTION
ADDRESS
UPDATE_TIME
USER_ID
STATUS
RESPONSE_TIME
LOCATION

Road Node
NODE_ID (PK)
NODE_NAME
NODE_GEOM

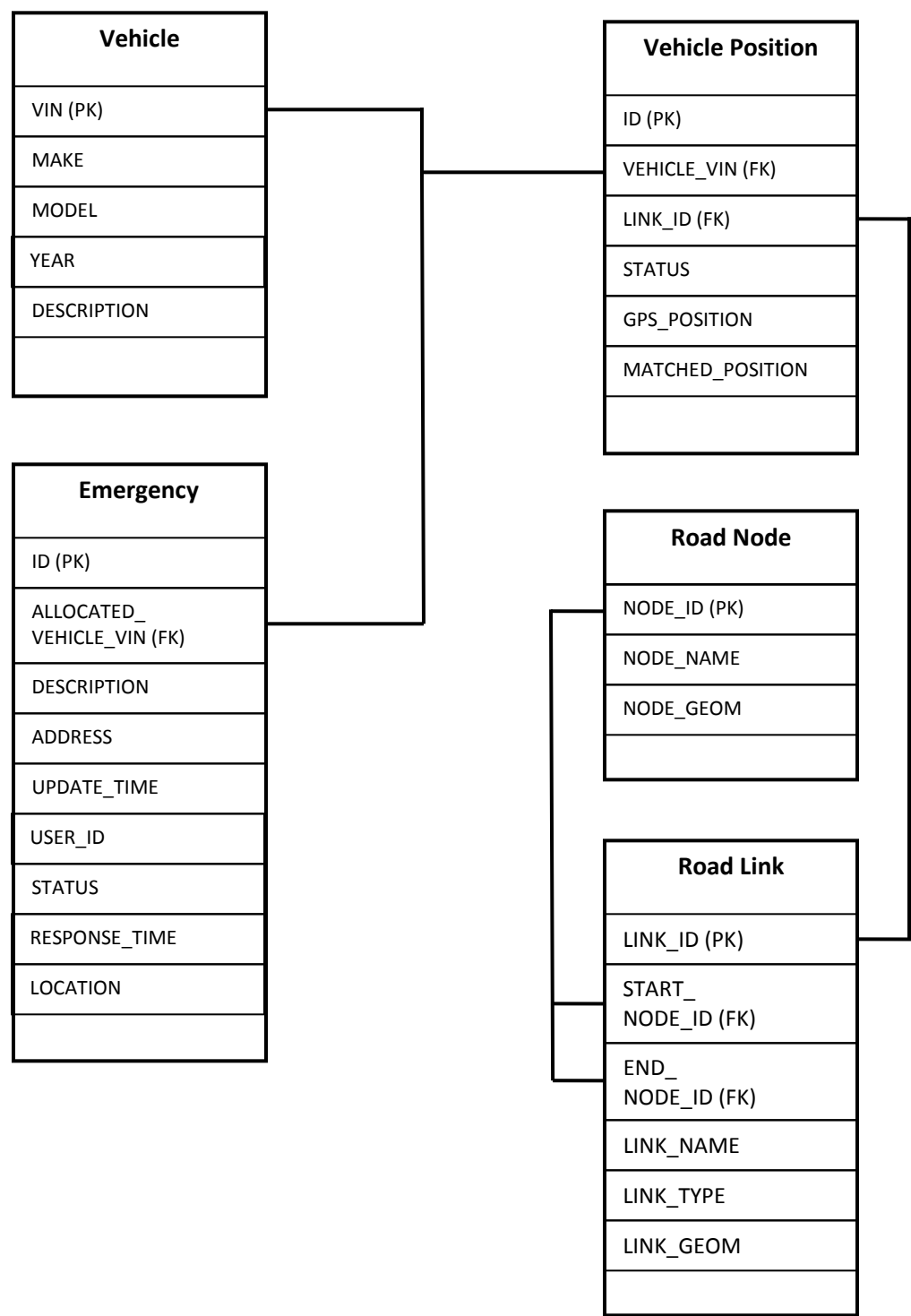| Road Link |
| --- |
| LINK_ID (PK) |
| START_ NODE_ID (FK) |
| END_ NODE_ID (FK) |
| LINK_NAME |
| LINK_TYPE |
| LINK_GEOM |
| |

Figure 1: Database Model for an Emergency Response System

The model in Figure 1 is based on an Oracle (spatial) database. However, this model could be used for a similar structured spatial database such as PostGIS. It should be noted that the authentication aspect of the system is not included in the model in order to keep the design simple.

4.1 Entities

The following entities are utilized in the system:

- **Vehicle:** This represents an emergency vehicle and contains attributes such as the vehicle identification number (VIN), make, model, and year.

- **Vehicle Position:** This represents the position of each emergency vehicle on the road network. It contains attributes such as the vehicle's VIN, GPS position, matched position, and update time.

- **Road Link:** This represents a segment of the road and contains attribute such as the link name, link type, start node, end node, link length, speed limit, and link geometry.

- **Road Node:** This is the intersection between two or more road links and contains attributes such as the node name and node geometry.

- **Emergency:** This represents the occurrence of an emergency and contains attributes such as the address, description, geocoded location, update time, and response time.

4.2 Relationships

The following relationships exist between the entities:

One-to-One Relationship

A One-to-One relationship exists between the *Vehicle* and *Vehicle Position* entities. This means that each vehicle *transmits* its position and only one record exists for the position of each vehicle. This relationship is sufficient in a situation where the system would only require the current position of each vehicle i.e. when the history of the vehicles movement is not needed.

One-to-Many Relationship

A One-to-Many relationship exists between the *Vehicle Position*/*Road Link* entities, the *Vehicle*/*Emergency* entities, and the *Road Link*/*Road Node* entities. This means that each road link is *associated* with one or more vehicle positions and each road node *belongs to* one or more road links. Also, each vehicle is *allocated* one or more emergencies after the *geocoding* of the address of the emergency to determine the closest vehicle.

4.3 Model Flowchart

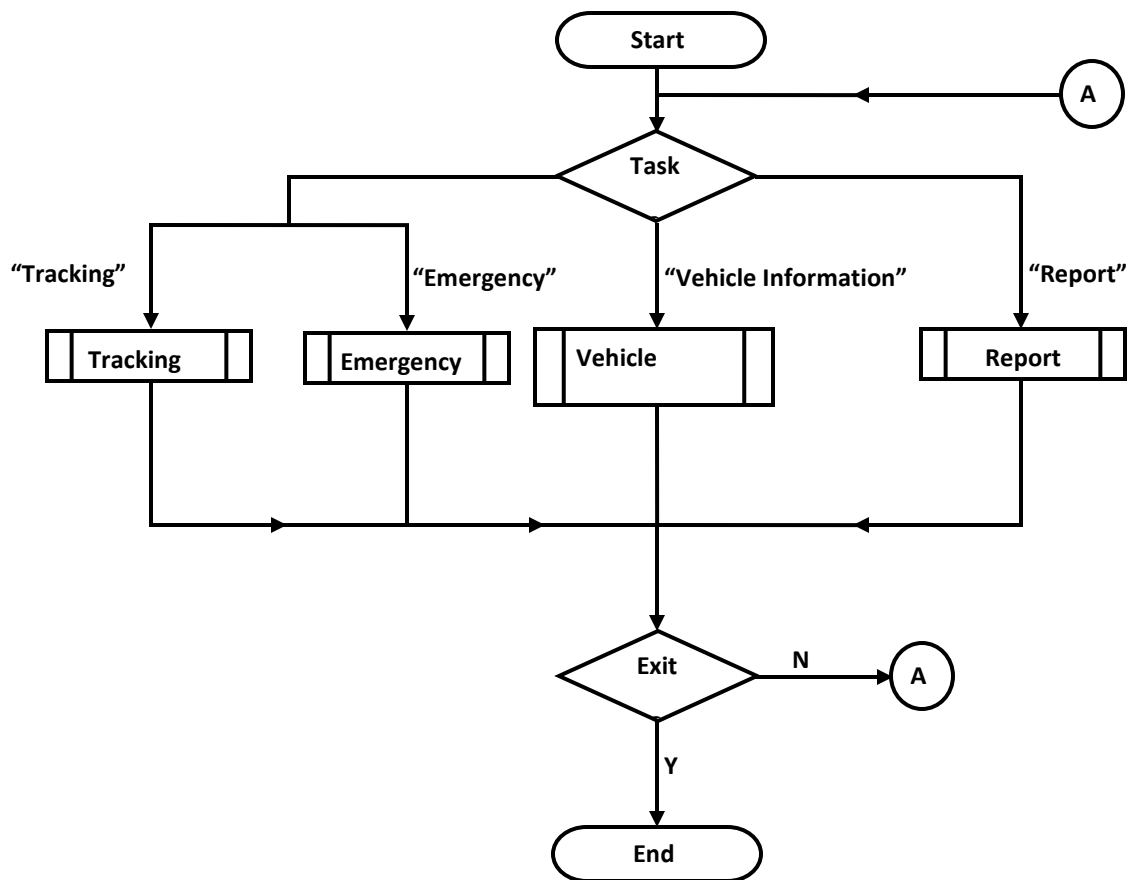The mode of operation of the system/model is explained with the following flowcharts:

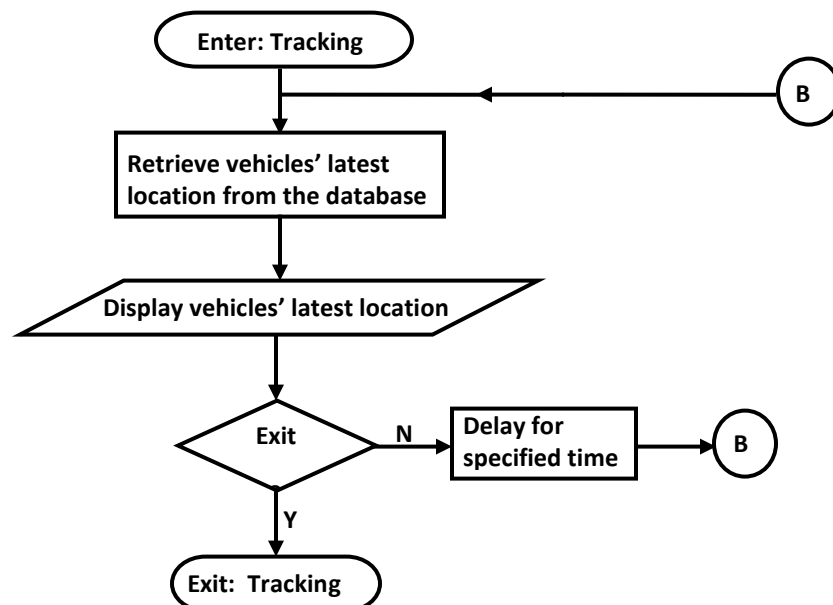Figure 2: Overview of the operation of the system/model

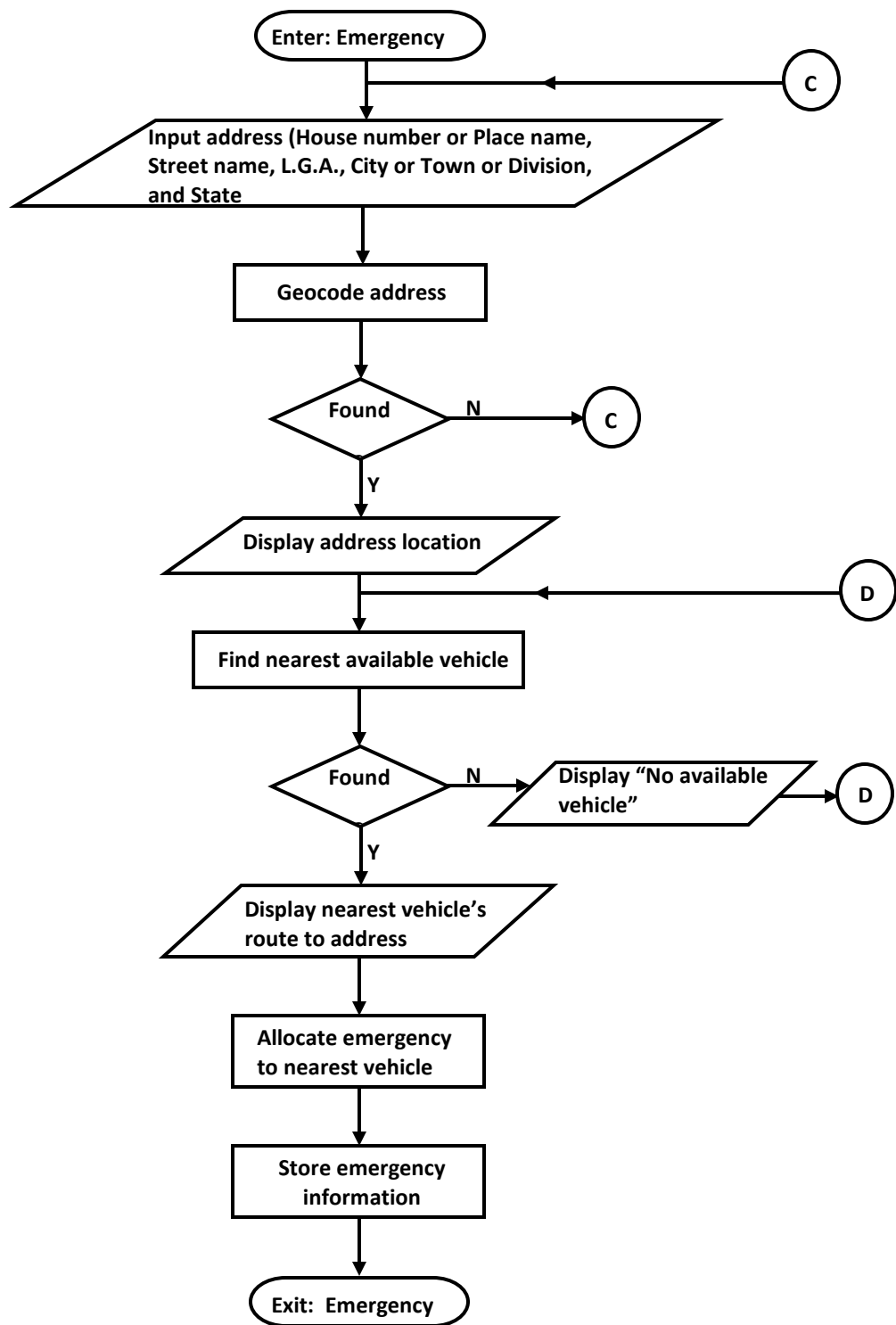Figure 3: The Tracking Procedure

Enter: Emergency

C

Input address (House number or Place name, Street name, L.G.A., City or Town or Division, and State

Geocode address

Found — N → C

Y

Display address location

D

Find nearest available vehicle

Found — N → Display "No available vehicle" → D

Y

Display nearest vehicle's route to address

Allocate emergency to nearest vehicle

Store emergency information

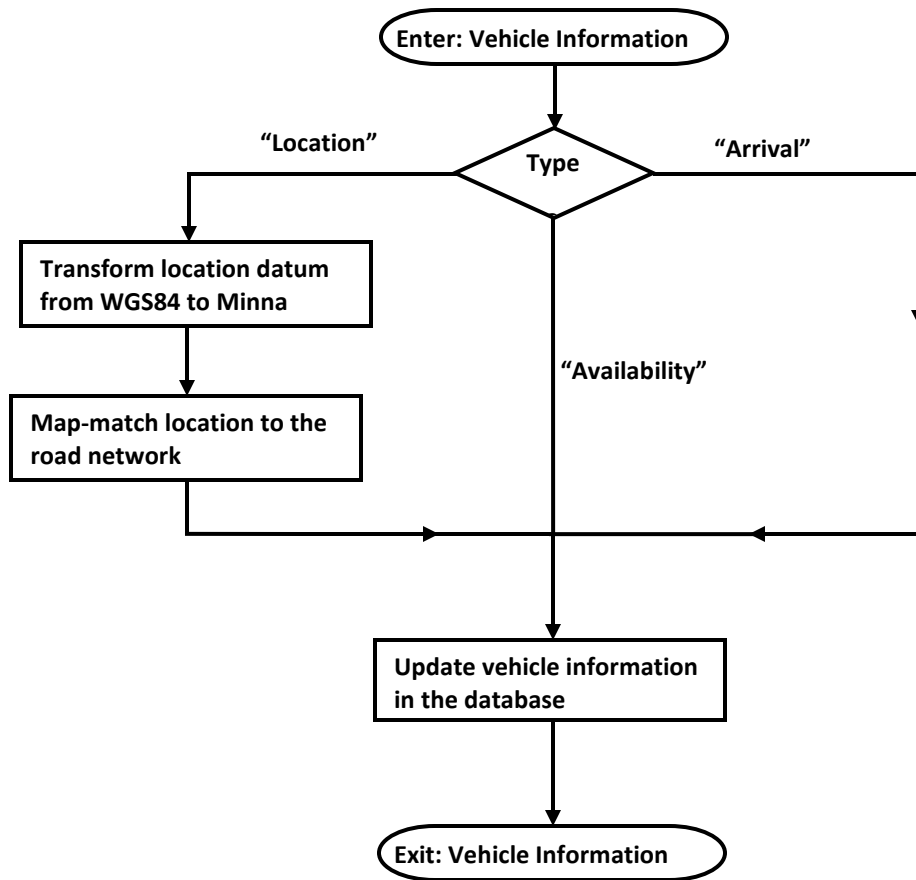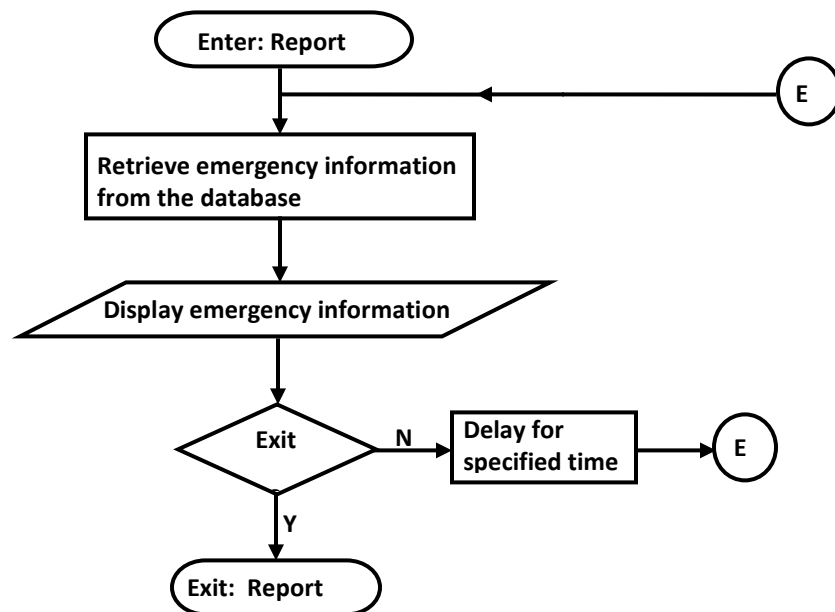Exit: Emergency

Figure 4: The emergency procedure

Figure 5: The Vehicle Position Procedure

Figure 6: The Emergency Report Procedure