IsDB-BISEW: Islamic Development Bank Bangladesh Islamic Solidarity Educational Wakf

IT SCHOLARSHIP PROGRAMME

E-Toll Collection System

(ETCS)

Course Name: Web Application Development Using ASP.NET
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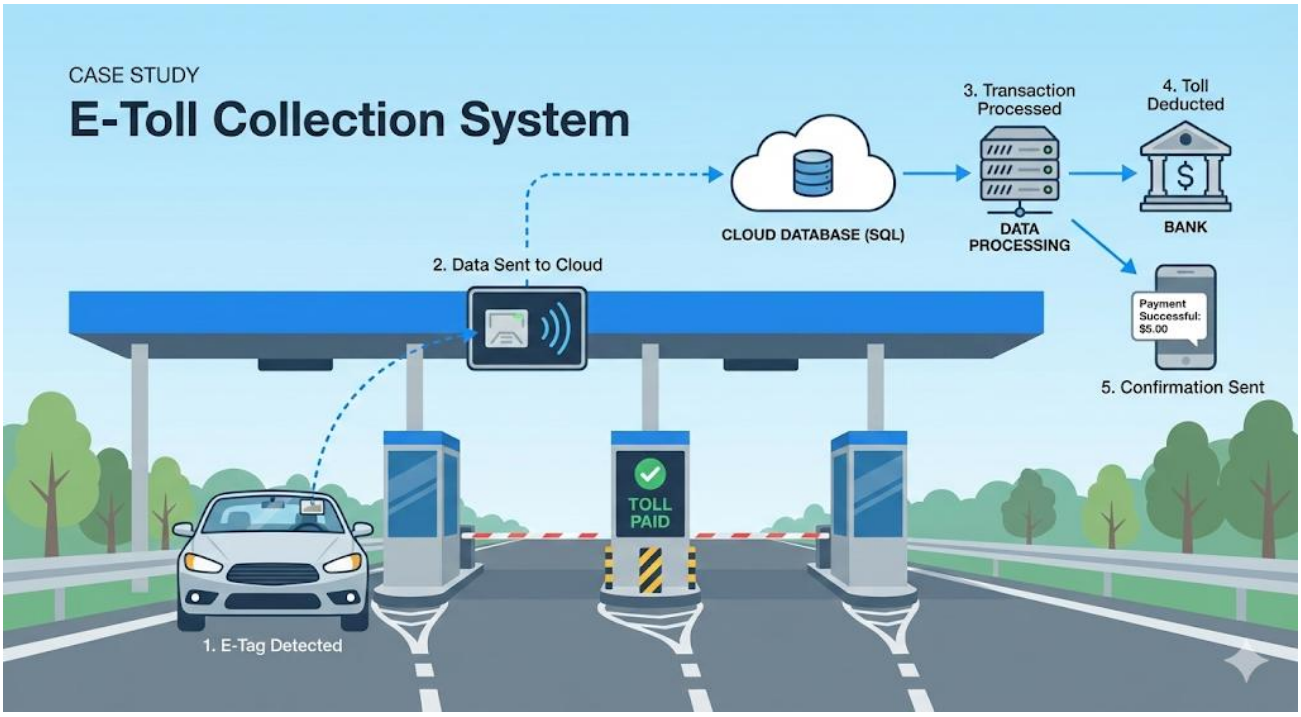


CASE STUDY

Nakibul Islam Fahim

E-Toll Collection System

Contents

Summary

The **E-Toll Collection System (ETCS)** is a digital platform designed to automate and streamline the collection of toll fees at various bridges and plazas. It integrates database management to handle high-volume traffic data, ensuring faster vehicle processing and accurate revenue tracking. The system helps plaza managers streamline operations, track vehicle entry/exit, optimize lane usage, and enhance financial transparency.

Introduction

ETCS is a comprehensive solution dedicated to modernizing highway infrastructure management. To improve operational efficiency and support the growing number of vehicles, the project implements a robust database system. This system provides real-time transaction data, automates fee calculation based on vehicle types, and facilitates informed decision-making for plaza administration.

Objectives

- **Efficiency:** To automate toll collection and reduce waiting times at plazas.
- **Data Accuracy:** To provide accurate, real-time data on revenue and vehicle counts for better decision-making.
- **Revenue Leakage Prevention:** To secure financial data through strict transaction logging and audit trails.
- **Traffic Management:** To monitor vehicle flow and categorize traffic by type (e.g., Heavy vs. Light vehicles).

Database Design

The database design of ETCS is structured to ensure data integrity, scalability, and efficient retrieval using Microsoft SQL Server.

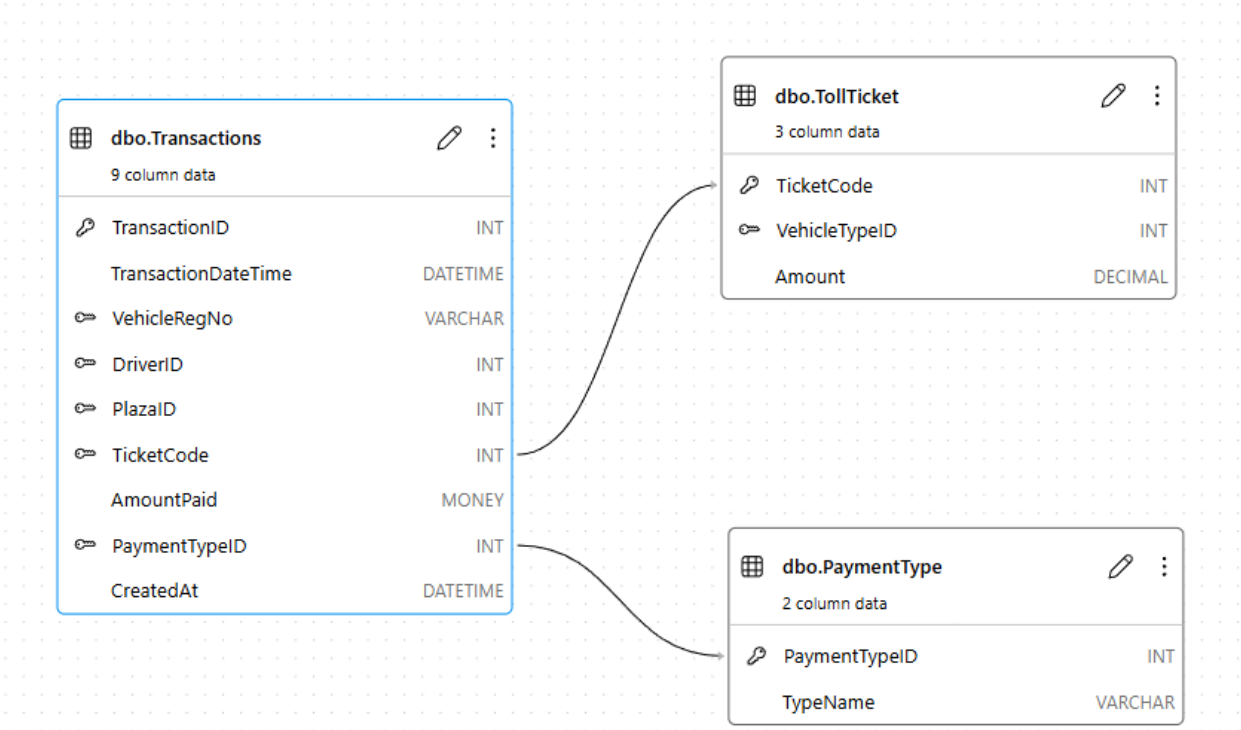
- **Entities:** Plaza, Location, Employees, Designation, Driver, Vehicles, VehicleType, TollTicket, Transactions, PaymentType, and Audit Logs.

- **Relationships:** Associations between entities such as Vehicles to Drivers, Plazas to Locations, Transactions to TollTickets, and Employees to Designations.
- **Normalization:** The schema uses lookup tables (e.g., VehicleType, PaymentType, Designation) to ensure minimal redundancy and optimal data organization.

Key Modules and Their Functionalities

1. Toll Transaction Management

This module handles the core function of the system: recording payments and vehicle passages. **Tables Involved:**



Functionality:

- **Automated Pricing:** Fetches the correct toll amount from TollTicket based on the vehicle type.

- **Revenue Logging:** records the exact amount, time, and payment method for every vehicle passing through.

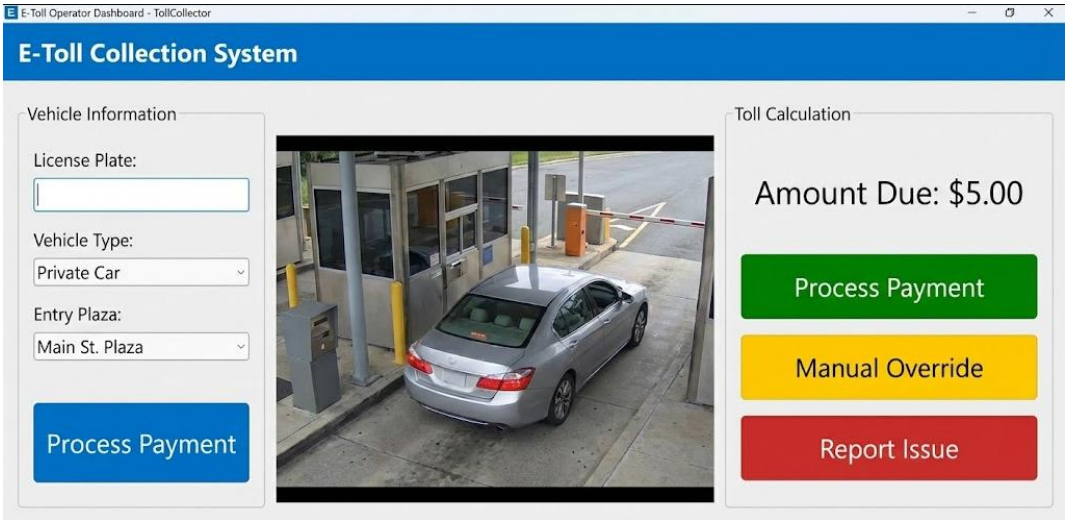
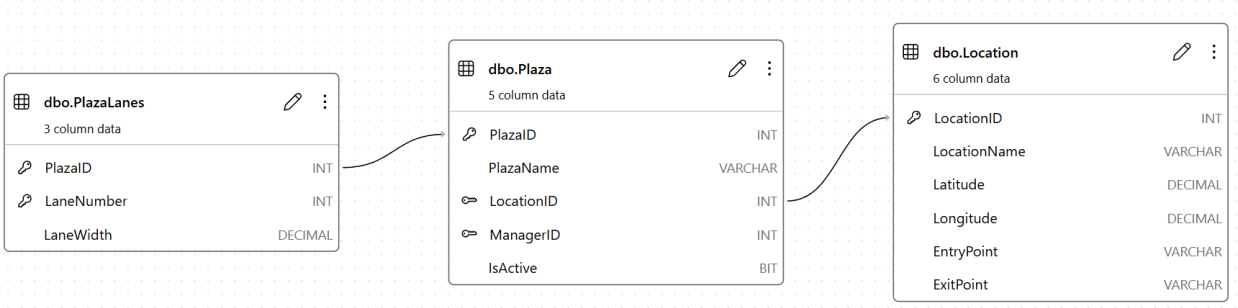


Figure: Collection User Interface for Toll Collector

2. Plaza & Infrastructure Management

Manages the physical locations and lane configurations. **Tables Involved:**

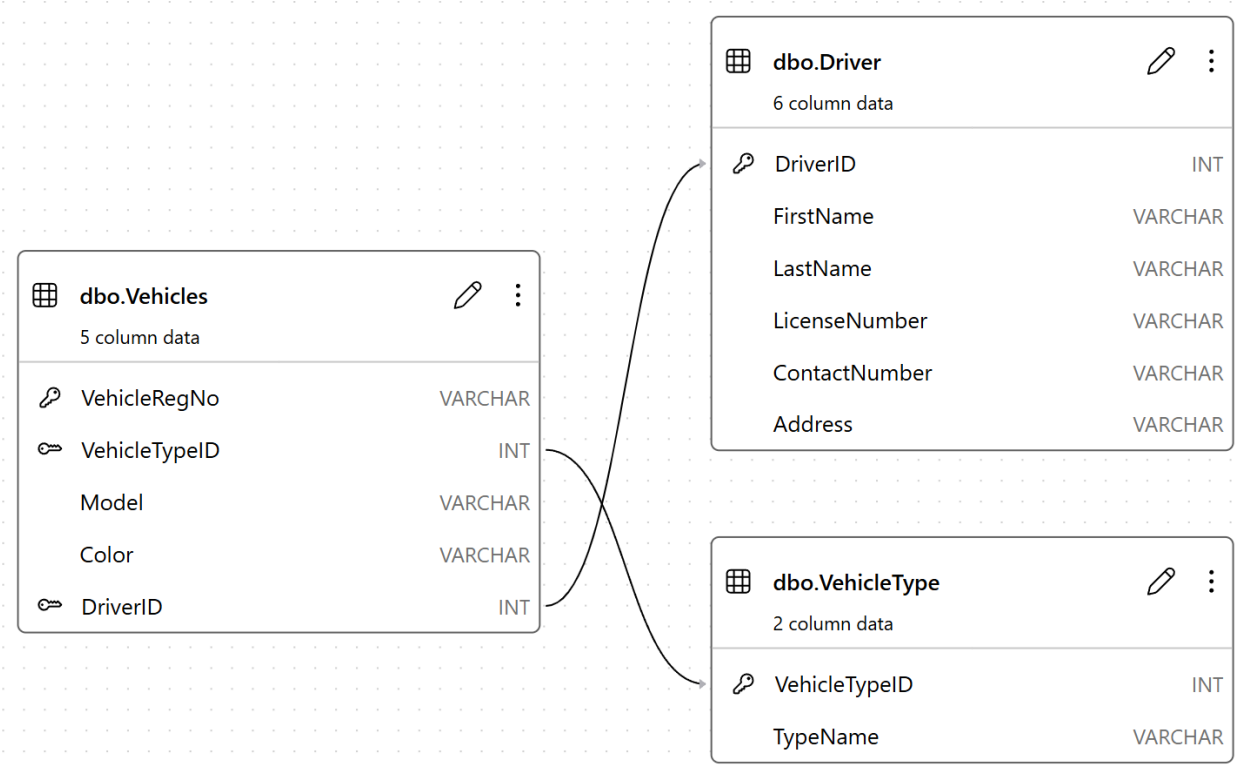


Functionality:

- **Infrastructure Tracking:** Monitors which plaza is located where (e.g., Meghna Bridge, Padma Bridge).
- **Lane Configuration:** Tracks specific lane details for maintenance and capacity planning.

3. Fleet & Driver Management

Maintains a registry of frequent users and their vehicles. **Tables Involved:**

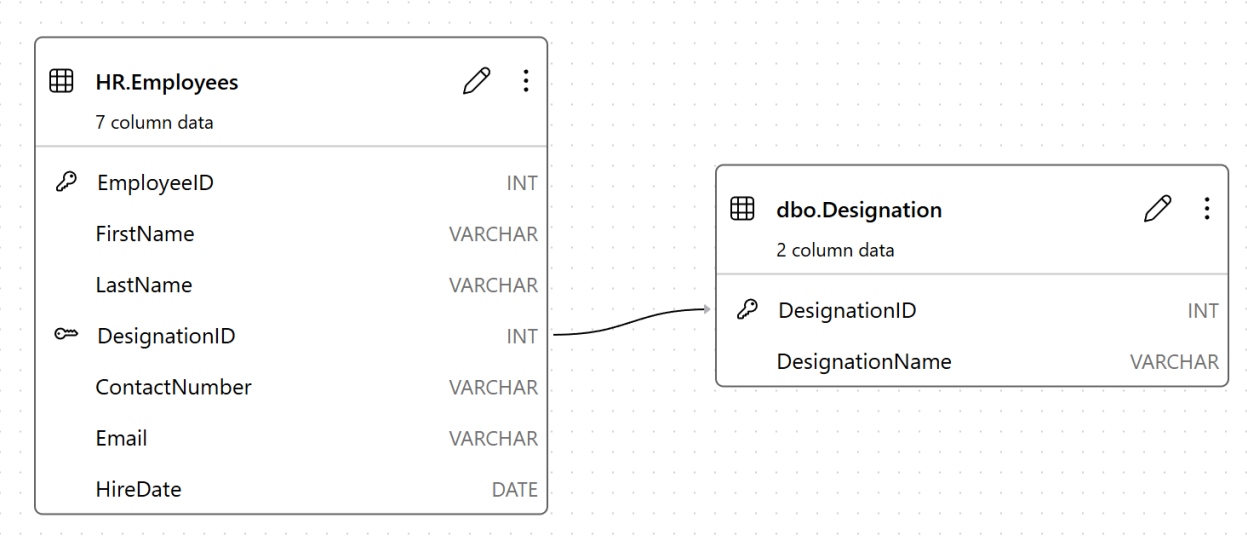


Functionality:

- **User Registry:** Stores driver license and contact info for security and identification.
- **Vehicle Classification:** Categorizes vehicles to apply correct toll rates (e.g., Heavy vs. Light).

4. HR & Administration

Manages the workforce operating the toll plazas. **Tables Involved:**



Functionality:

- **Staffing:** Assigns managers to specific plazas and tracks toll collectors.
- **Role Management:** clearly defines hierarchies (Admin vs. Collector) via the Designation table.

Business Requirements

The system meets the following critical business requirements:

1. **Vehicle Classification:** Automatically categorize vehicles (Motorcycle, Bus, Truck) to assign accurate toll fees.
2. **Audit Capabilities:** Track all changes to sensitive data (like Plaza definitions) using triggers to prevent fraud.
3. **Financial Reporting:** Generate views for total revenue and daily collection summaries.
4. **Operational Status:** Monitor which plazas are active and who is managing them.

Challenges and Solutions

1. **Data Integrity:**
    - *Challenge:* Ensuring valid data entry for vehicle types and amounts.
    - *Solution:* Implemented Check Constraints (e.g., Amount >= 0) and Foreign Keys to enforce referential integrity.
2. **Revenue Tracking:**
    - *Challenge:* Calculating tax and total revenue accurately across different plazas.
    - *Solution:* Created Scalar Functions (fn_CalculateTax) and Views (v_TotalRevenue) to automate calculations.
3. **Error Handling:**
    - *Challenge:* preventing duplicates or invalid insertions.
    - *Solution:* Used Stored Procedures with TRY...CATCH blocks to handle errors gracefully during data entry.

Reports and Analytics

ETCS generates comprehensive reports on various aspects of toll management:

- **Revenue Reports:** A view v_TotalRevenue provides a breakdown of total collection by Plaza.
- **Driver History:** The v_DriverTransactionHistory view compiles a detailed log of every transaction a specific driver has made, useful for frequent traveler programs or investigations.
- **Audit Logs:** The PlazaAudit table captures system changes, such as the addition of new toll plazas, ensuring administrative accountability.

Conclusion

The **E-Toll Collection System** provides a comprehensive solution for managing highway toll operations. By leveraging SQL Server features like Triggers, Stored Procedures, and Relational Views, it enables authorities to optimize revenue collection, reduce traffic congestion, and ensure transparent financial management.