

CSE / EEE / ETE 499A (Section 02)

Project Proposal (CO1)

Project Title: Tollkeeper.ai, automated toll payment system

Submitted To

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Group No: G-8

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Introduction

In Bangladesh, the toll payment industry has remained entrenched in manual, cash-based practices. Unlike many other nations that have transitioned to digital and automated toll collection systems, Bangladesh still heavily relies on physical cash transactions at toll plazas, even as neighboring countries such as India have successfully implemented comprehensive digital systems like FASTag for their bridges and expressways.

The core issue this project aims to address is the archaic manual toll collection process used for vehicles entering expressways and bridges. Typically, vehicles arriving at a toll plaza are required to pay a specific toll amount based on their category and are provided with a printed receipt. This procedure is conducted by toll booth operators who depend on paperwork for calculations. Consequently, this manual process often leads to traffic congestion at bridge entrances, diminishing overall operational efficiency. Moreover, the absence of proper records makes the system vulnerable to corruption, as there is no transparent means of tracking toll collections.

The primary objective of this project, known as TollKeeper.ai, is to digitally transform the entire toll payment process. This entails eliminating the need for printed receipts and physical cash transactions. Instead, digital payment methods such as credit cards, debit cards, and mobile financial services (MFS) will be employed. Furthermore, this innovation can greatly benefit transportation and courier service companies like Pathao, Shohag Paribahan, TruckLagbe, and SA Paribahan, allowing them to pay tolls directly from their offices as their vehicles traverse multiple toll points. This integration significantly enhances transparency throughout the toll collection process. Initially, we plan to launch TollKeeper.ai as a web-based platform, with plans for an Android app.

Upon logging in, registered users will have the capability to enter their vehicle information, select their starting point and destination, and receive guidance through a map highlighting all toll points along their route. They will then encounter a list of toll plazas with detailed information, enabling them to

choose the tolls they wish to pay, adding them to their virtual cart, and completing the payment process. Users will receive confirmation via SMS on their registered mobile numbers. On the administrative side, authorities can access a dashboard displaying payment details alongside vehicle information, offering insights into the number of vehicles passing through and total toll collections. Currently, such comprehensive toll payment platforms are non-existent in Bangladesh, making this project a pioneering step towards establishing a digitally smart nation. TollKeeper.ai's ultimate objective is the complete automation and digitization of the toll collection system.

To realize our vision, we are adopting a two-pronged approach: the creation of a web-based platform, TollKeeper.ai, and the development of a dedicated mobile app for toll payers. Through these platforms, users will have the convenience of making all toll payments via their mobile devices, revolutionizing the toll collection process in Bangladesh.

Discussion

Presently, within Bangladesh, the inauguration of the Dhaka-Mawa smart expressway has introduced an Intelligent Transport System under the supervision of the Road and Highways Department. This system incorporates various data collection mechanisms, including vehicle detection systems, surveillance cameras, automated number plate recognition cameras, speed detection devices, and variable messaging signs. However, this advanced system does not encompass automated toll payment capabilities. An article by New Age Bangladesh, emphasizes on slow pace of traffic in the toll booths.



Here we can see that the slow pace at expressway toll booths causes congestion while the road ahead is empty. Thus, it proves that it is high time that Bangladesh automates its toll payment system. [4]

Real World System related to our project

FASTag is an electronic toll collection system introduced in India to facilitate cashless transactions at toll plazas on national highways. Operated by the National Highway Authority of India (NHAI), this technology employs Radio Frequency Identification (RFID) to enable swift and hassle-free toll payment processes. It aims to reduce traffic congestion, minimize the use of cash, and enhance the overall efficiency of the toll collection system. Some of the key Features of FASTag are:

Radio Frequency Identification (RFID) Technology: FASTag employs RFID technology, allowing for contactless communication between the tag and the toll booth's equipment. This enables seamless and quick transactions.

Prepaid or Linked Account: Users need to link their FASTag to a prepaid account or a savings bank account. Toll charges are automatically deducted from this account, eliminating the need for cash transactions.

Sticker-Based Tag: FASTag is available as a sticker that is affixed to the vehicle's windshield, ensuring ease of use and durability.

Interoperability: FASTag is interoperable across all toll plazas on national highways in India, irrespective of the issuing bank or agency. This ensures a consistent and convenient experience for users.

Online Recharge: Users can easily recharge their FASTag accounts online through various methods, such as mobile apps, websites, and bank portals.

SMS and Email Alerts: FASTag users receive instant alerts through SMS and email for toll transactions, balance updates, and low-balance warnings.

Validity: FASTag has a validity of five years from the date of issuance, providing long-term convenience to users.

Vehicle-Specific: Each FASTag is specific to a particular vehicle and cannot be transferred to another vehicle. This enhances security and accountability.

Dedicated Lanes: Toll plazas have dedicated lanes for FASTag users, ensuring faster passage and reduced waiting times.

Cash Recharge Option: Users can also recharge their FASTag accounts with cash at designated recharge points or authorized banks.

Emergency Services: In case of emergencies or technical issues, FASTag users have access to a 24x7 helpline for assistance.

Promotion of Digital Payments: FASTag is part of India's efforts to promote digital payments and reduce the dependence on cash transactions.

FASTag is a pioneering technology in India that has revolutionized toll collection by introducing a convenient and efficient cashless payment system for toll plazas on national highways. Its interoperability, ease of use, and

various features have made it an essential tool for commuters and transporters, significantly enhancing the country's transportation infrastructure.

Literature Review

[1] The research paper titled "Design and Implementation of an Automated Toll Collection System" by Zhiwei Yang, Yangxiang Zhang, and Qiyuan Peng, presented at the 2012 CECNet conference, explores the development and deployment of an automated toll collection system. It addresses the limitations of manual toll collection, emphasizing the role of Radio-Frequency Identification (RFID) technology in enhancing efficiency and accuracy. The paper details the system's architecture, integration with existing infrastructure, and performance evaluation. It acknowledges challenges and proposes future enhancements. This research contributes significantly to the advancement of automated toll collection, offering a comprehensive blueprint for more efficient and reliable transportation infrastructure management.

[2] The paper titled "Evaluation of an Automatic Toll Collection System Using RFID Technology" by Manoj M Nair, Anandakumar Haldorai, and Ganesh Kumar C., published in the International Journal of Emerging Technology and Advanced Engineering, assesses the efficiency and accuracy of an RFID-based automatic toll collection system. It examines the system's real-time performance, reliability in adverse conditions, and potential challenges. This research offers insights into improving toll collection processes and enhancing transportation infrastructure.

[3] The paper titled "Intelligent Transportation Systems in India: Challenges and Opportunities in Electronic Toll Collection" by Gaurav Raheja and Ajay Kumar, published in the Proceedings of the 2nd International Conference on Intelligent Transportation, sheds light on the complexities of introducing electronic toll collection systems within India's burgeoning intelligent transportation framework. It delves into the multifaceted challenges, including issues related to technology adoption, interoperability, and cybersecurity, while also emphasizing the significant prospects for enhancing efficiency,

reducing congestion, and optimizing revenue collection. This comprehensive review serves as a valuable resource for policymakers, researchers, and industry professionals aiming to navigate the intricate landscape of electronic toll collection in the Indian context.

Business Viability of the Project

- a. **Novelty of the Proposed Project:** The TollKeeper.ai project introduces a groundbreaking approach to the age-old manual toll collection system in Bangladesh by leveraging digital technology, including mobile payment methods. This novel initiative sets it apart from conventional toll collection practices and is a pioneering step towards modernizing the country's transportation infrastructure.
- b. **Market Segments:** TollKeeper.ai addresses a broad market segment encompassing Bridge and expressway authorities, individual vehicle owners, and transportation/courier service companies. This diverse market potential signifies a substantial user base for the platform.
- c. **Competitor Analysis:** In Bangladesh, there is a lack of direct competitors offering a comprehensive digital toll-collection platform like TollKeeper.ai. While there are some fragmented digital payment solutions, none offer the end-to-end toll payment and tracking capabilities envisioned in this project.
- d. **Competitive Advantages of the Project:** TollKeeper.ai's competitive advantages lie in its ability to eliminate congestion at toll plazas, enhance transparency, and provide a seamless and secure digital payment experience. These advantages position it as a game-changer in the toll collection industry.
- e. **Success Factors:** Successful implementation of TollKeeper.ai necessitates the establishment of a secure, user-friendly web platform, followed by the development of a mobile app. Furthermore, securing partnerships with transportation companies is essential to facilitate widespread adoption. Expanding the platform's reach to include additional modes of transportation and integrating with government agencies for regulatory compliance would be advantageous. Success will be measured by the percentage reduction in toll booth congestion, the

number of registered users, and the volume of toll payments processed digitally.

f. Risk Factors:

- **Security Concerns:** Safeguarding user data and financial transactions will be a paramount concern. Any data breaches or security lapses could harm the project's reputation.
- **Regulatory Challenges:** Adhering to existing regulatory frameworks and ensuring compliance with evolving government policies may pose challenges.
- **Public Perception:** Building trust in digital payment systems and overcoming skepticism about new technologies will be crucial for user adoption.
- **Operational Issues:** System failures or downtime could disrupt toll collection operations, leading to user dissatisfaction.

However, navigating these risk factors while achieving the outlined success factors will be critical to TollKeeper.ai's viability and impact on the toll collection industry of Bangladesh.

Project Analysis

Major components of our project will be a web application and also a mobile phone application. The major functional components of the project are given:

1. User Account Information Management

a. Priority – High

b. **Description-** Users can make an account and input information including, but not limited to personal information (name, contact details, etc.), vehicle information (number, color, model, category), and billing information, etc. The user can only log in through a mobile number.

c. Functional Requirements:

i. R1, Login Screen – There must be a panel or window or page with fields for users to enter an identifier (username or mobile number) and a verifying password.

ii. R2, Registration Screen – There must be a panel or window with fields for users to enter their desired identifier, password, and other details, to create an account with our system

iii. R3, Account Info Management Screen – There must be a panel, window, or page with fields for users to, once they have logged in, modify or add any of the details mentioned above in section b.

2. Location Input

a. Priority – High

b. Description – Users have to input their starting location and destination and details of the toll payments will be shown.

c. Functional Requirements –

i. R1, Displaying Toll Points – A panel that displays Toll points with some details.

ii. R2, More Info – Additional Panel displaying the details of the Toll Points.

3. Billing Option

a. Priority – High

b. Description – Users can see the total cost of passing through the Toll plaza.

c. Functional Requirements –

i. R1, Display Costs – List the different costs involved and the weekly/monthly/yearly total.

ii. R2, Payment Information – Let users choose from various way of online payment options.

4. Text Messaging

a. Priority – High

b. Description - Users can receive confirmation & authentication text messages.

6. Pre-payment of Multiple Vehicles

a. Priority – Medium

b. Description - Users can pre-pay for multiple vehicles in advance

c. Functional Requirements:

i. R1, display a calendar – A calendar will be shown and the user will be able to choose the dates they will travel through the point.

ii. R2, finalizing screen – The user will be asked to choose from the virtual cart and confirm the payment.

8. Administrative Dashboard

a. Priority – High

b. Description - Authorities can access a dashboard displaying payment details alongside vehicle information, offering insights into the number of vehicles passing through and total toll collections.

c. Functional Requirements:

i. R1, Login Screen – There must be a panel or window or page with fields for authorities to enter an identifier (username or business email) and a verifying password.

ii. R2, Account Open Request Screen – There must be a panel or window with fields for the authority/concerned person to enter their name, contact details, degree, experience, and other details, to submit a request to create an account with our system.

iii. R3, Account Info Management Screen – There must be a panel, window, or page with fields for authorities to, once they have logged in, modify or add any of the details mentioned above in section B.

User Story

User Story	Acceptance Criteria	Confirmation
As a Customer, I should be able to sign up on the website	<ul style="list-style-type: none">• The user will be required to enter a name, NID, mobile number, and password• The user will confirm their password by entering their desired password again• The user must enter a mobile number that has not been added to the system before• Password must be at least 6 numbers• Information from the form is stored in the registration database• Protection against spam is working	<ul style="list-style-type: none">• A confirmation text will be sent to the mobile number of the user if the submission is valid• A user cannot submit a form without filling out all the mandatory fields. If so, an error message will be shown.

As a Customer, I should be able to log in to the website	<ul style="list-style-type: none"> • The user must enter login details correctly to get logged in to the system 	<ul style="list-style-type: none"> • Successful login will ask the user to save their password • Unsuccessful login will give error messages and ask if they have forgotten their password
As a customer, I should be able to search locations & input my vehicle details	<ul style="list-style-type: none"> • The user must provide vehicle details and check everything is all right • The user must input the location details of the journey 	<ul style="list-style-type: none"> • Upon successful input of details, a map will show the toll point locations and their prices • Unsuccessful input will ask them to re-input the details
As a customer, I should be able to see the toll points in my journey	<ul style="list-style-type: none"> • After advancing, the toll points will be displayed as a list • User can select from the toll points and add them to the virtual cart 	<ul style="list-style-type: none"> • For successful choosing, it will advance to the payment option.
As a customer, I should be able to pay for the tolls	<ul style="list-style-type: none"> • After authentication, the customer will 	<ul style="list-style-type: none"> • Successful payment will display a bill, after checkout

	be asked to pay for the selected tolls through a payment gateway	<ul style="list-style-type: none"> • Unsuccessful payment will take you back to the previous page and display an error message
As an Administrator, I should have a panel window or page to enter an identifier (username or business email) and a verifying password.	<ul style="list-style-type: none"> • The admin will be required to enter a name, NID, business mail, and password • The admin will confirm their password by entering their desired password again • The admin must enter their business mail that has not been added to the system before • Password must be at least 6 numbers • Information from the form is stored in the registration database • Protection against spam is working 	<ul style="list-style-type: none"> • A confirmation mail will be sent to the mail of the user if the submission is valid • A verification process will be done through clicking the link in the mail • A user cannot submit a form without filling out all the mandatory fields. If so, an error message will be shown

As an Administrator, I want a dashboard displaying payment details alongside vehicle information, offering other insights too.	<ul style="list-style-type: none"> • Log in as an Administrator • Administrator will see a dashboard displaying payment details alongside vehicle information, offering other insights 	<ul style="list-style-type: none"> • Admin will see a dashboard
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Target for 499A and 499B

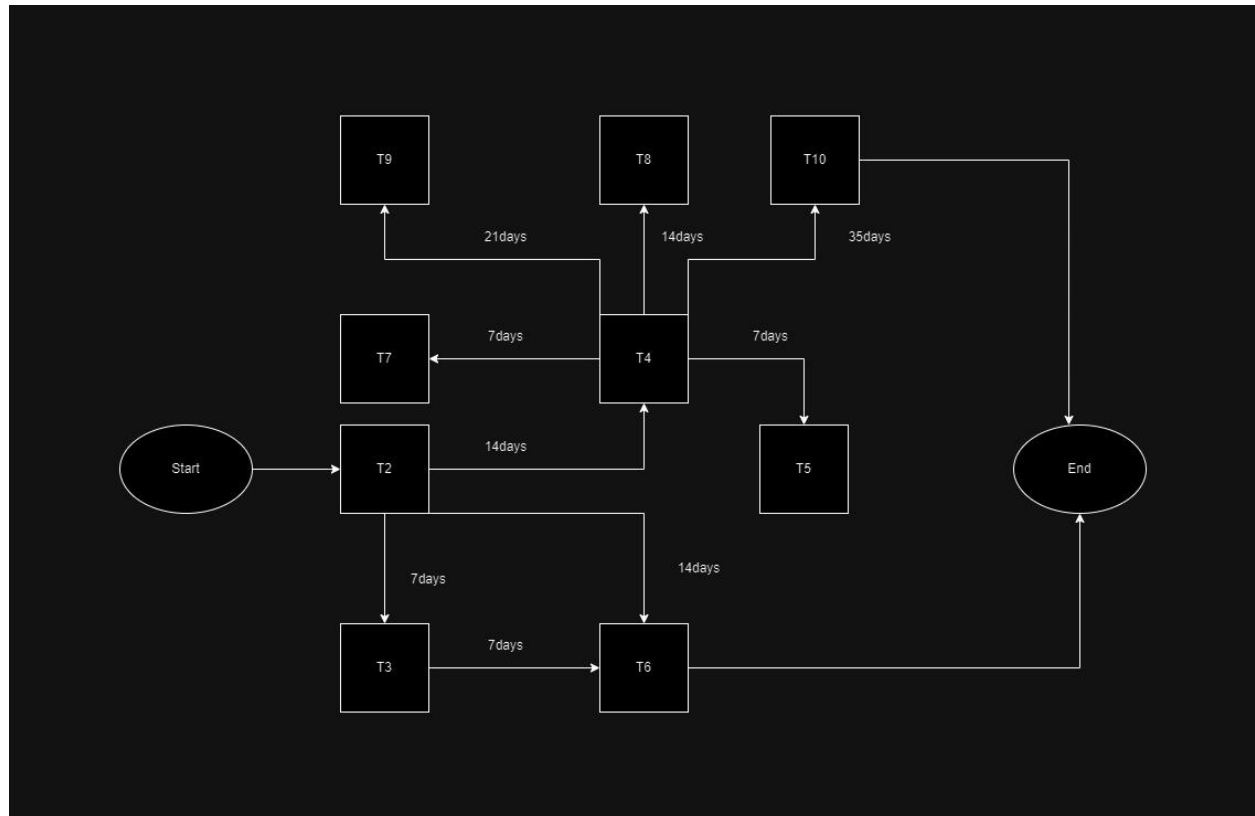
Our Target is to complete a web-based platform in 499A and an application for mobile in 499B

Task Analysis (499A)

Task No.	Task Description	Start Date	End Date
T1	Start CSE499A	30/07/23	29/10/23
T2	Project Proposal	03/09/23	10/09/23
T3	Design Report	10/09/23	17/09/23
T4	Frontend, Database	03/09/23	24/09/23
T5	Signup, Login	03/09/23	17/09/23
T6	Impact Report	17/09/23	24/09/23
T7	Map Integration,	24/09/23	01/10/23
T8	Payment	01/10/23	08/10/23

T9	Admin Dashboard	08/10/23	15/10/23
T10	Final Report	22/10/23	29/10/23

Activity Diagram (499A)

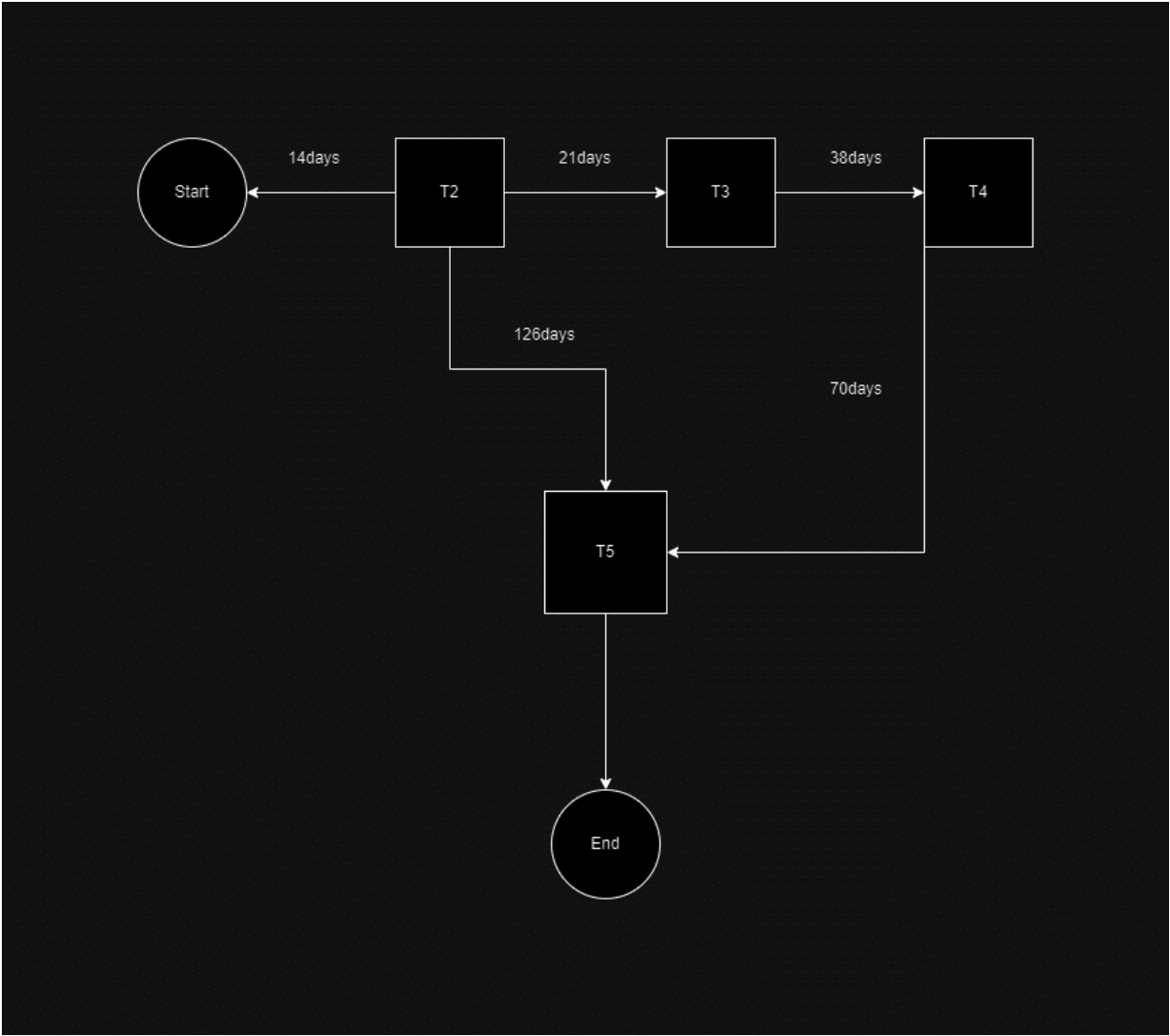


Task Analysis (499B)

Task No.	Task Description	Start Date	End Date
T1	Start CSE499B	11/02/24	30/06/24
T2	Android Frontend	11/02/24	25/02/24
T3	Android Backend Database	25/02/24	17/03/24
T4	Android Backend	17/03/24	21/04/24

	Features		
T5	Hosting, Final Paper	21/04/24	30/06/24

Activity Diagram (499B)



Cost Analysis

Sl.	Deliverable	Expense	Comment
1	Map API	\$15	Barikoi, Google Map
2	Hosting (AWS or Free)	\$20	AWS or Free

3	Google Play store	\$25	Developer Fee
4	UI, Design	\$10	
5	Others	\$30	
TOTAL		\$100	

Reference

[1] Zhiwei Yang, Yangxiang Zhang, and Qiyuan Peng, "Design and Implementation of an Automated Toll Collection System" 2012, 2nd International Conference on Consumer Electronics, Communications and Networks (CECNet)

[2] Manoj M Nair, Anandakumar Haldorai, and Ganesh Kumar C., "Evaluation of an Automatic Toll Collection System Using RFID Technology", International Journal of Emerging Technology and Advanced Engineering

[3] Gaurav Raheja and Ajay Kumar, "Intelligent Transportation Systems in India: Challenges and Opportunities in Electronic Toll Collection"

[4] <https://www.newagebd.net/article/174816/slow-pace-at-expressway-toll-booths-causes-congestion>