Transport4You

An Intelligent Transportation System

Developed By

Kunal Sangwan
Sohil Arora
Shashank Srikant

Project Guide

Dr. Jitender Kumar Chhabra

Associate Professor
National Institute of Technology
Kurukshetra

Department of Computer Engineering
National Institute of Technology
Kurukshetra

Transport4You – An Intelligent Transportation System

- **Goals**
  - Helps improve existing metropolitan transportation systems
  - Commuter-centric services
  - High degree of automation

- **How IT shall help?**
  - Online registration portal for Users.
  - Automation of ticketing and fare calculation processes.
  - Makes use of instant messaging services to disseminate information to Users.

- **Why Intelligent?**
  - Makes use of data collected from the commuters in order to provide them with suggestion services.

Transport4You was a problem statement posed in Student Contest for Software Engineering 2011, a student Olympiad organized by the International Conference on Software Engineering 2011, Hawaii, USA.

Our team was one of the two B. Tech entries in the 18 teams shortlisted for the final evaluation.

Key Features

- **User Registration and Pre-Payment**
  - Web-based portal to allow users to register themselves.
  - Online payment gateways to help users pre-pay for trips

- **Automated User Detection**
  - Detection of users on-board buses through devices carried by them.
  - Wi-Fi and Bluetooth enabled devices used for detection.

- **Alternate-Path Suggestion**
  - Calculated in case of a path break-down.
  - Identifies users using such affected paths based on their travel habits.
  - Suggests alternate paths for such users.

- **Optimum Path Suggestion**
  - Calculates best (shortest and quickest) paths between the stops which a user has traveled.
  - These suggestions help users get to places quickly.

- **Automated Fare Calculation**
  - Data on user movement collected from every bus.
  - Fare calculation based on this data collected.

- **Messaging System**
  - Results of above features (Optimum path, Alternate Path, Fare Calculation) disseminated to users through SMS.

System Requirements

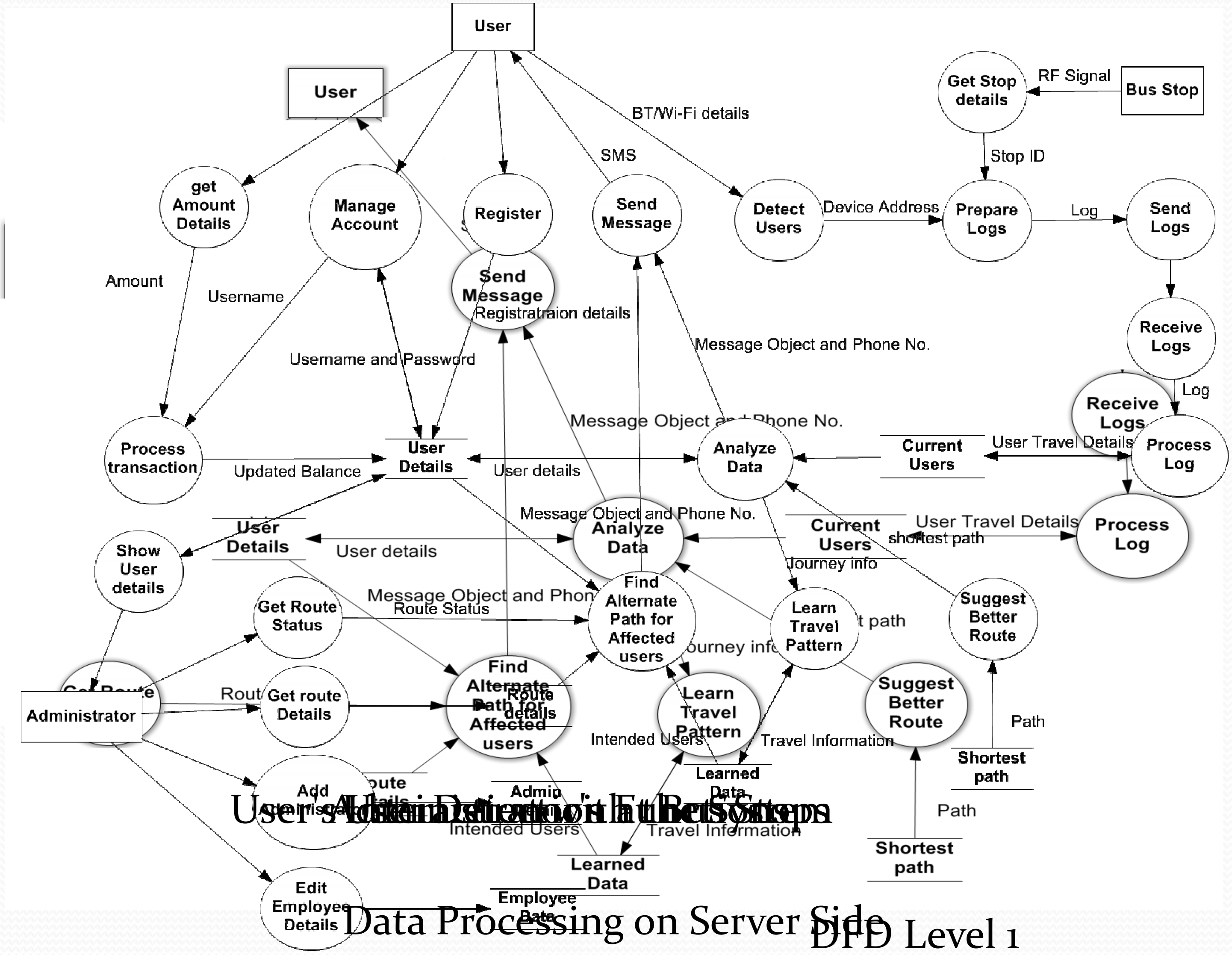
- **Users**
  - Bluetooth/Wi-Fi devices for their detection by system
  - Internet connection to register and pay for trips

- **Server**
  - Web-hosting Server
  - Messaging Server
  - Payment Gateway

- **Bus-Stops**
  - RF-radio emitting bus-stop ID

- **Buses**
  - Bluetooth/Wi-Fi detection system
  - GPRS communication for server-bound connection
  - RF-sensors to detect bus-stops

Overall Architecture



User's [illegible] with the System

Administrator's [illegible]

[illegible] at Bus Stops

Data Processing on Server Side

DFD Level 1

Design Issues and Assumptions

- **Design Guidelines**
  - Open Source Technologies
  - Scalable System
  - Software Engineering Principles

- **Design Issues**
  - Detect and track large crowds travelling in buses.
  - Very low user-initiated interaction with the system.
  - Keeping communication overheads to a bare minimum.

- **Assumptions**
  - Only registered users use the bus service.
  - Every passenger keeps his registered Bluetooth/Wi-Fi radio on at all the times.
  - A bus-stop is detected by a bus through a pre-implemented wireless system.
  - A passenger gets on to the bus and leaves a bus only at bus stops.
  - A fully implemented design of the on-board computer’s connectivity with the server through GPRS exists.

Registration and Messaging

- **User Registration**
  - Online Registration Portal supports 2 roles –*User* and *Admin*
  - Features on *User* portal
    - Register multiple devices for detection
    - Payment for trips
    - View past travel logs
    - Control degree of notification interaction from system
  - Features on *Admin* portal
    - Add bus-stop, route information of city
    - Inform broken down paths to trigger alternate path suggestions

- **Messaging Service**

  SMS notification by the system includes

  - User pre-paid balance updates
  - Alternate /Optimum path suggestions to users
  - Infraction notifications to law enforcement agencies

Ticketing System

- **Detection of Users**
  - Buses consist of Bluetooth/Wi-Fi detection systems.
  - On pulling out of any bus-stop, the vicinity of the bus is scanned by these systems to determine users who are in range.
  - 30 seconds after first scan, a second similar scan is performed.

- **Generation of Logs**
  - The users identified with each scan are logged in flat-files.
  - Logs from both scans are joined to retain common entries.
  - Other details such as time of scan, bus-stop ID are also logged.
  - Each bus' joined-logs are transmitted to server after every 2nd scan.

- **Fare Calculation from Logs**
  - Each log received by the server is parsed.
  - A user's movement is tracked based on this information.
  - The path traversed by the user is constantly updated.
  - Cost deducted based on number of T_VAL quanta utilized by user.
  - *T_VAL* is the maximum allowable time a user can travel for a given amount of money.

Robustness of Design

- **Avoiding False Detection of Users**
  - The joining of logs from the two-scan technique eliminates any passer-by who was detected just as the bus pulls out.

- **Failure in Communication of Logs**
  - The exact state of information on user movement is available at server by the logs provided by a previous bus-stop.
  - Discrepancies such as user detected to have boarded but not de-boarded or vice-versa may occur.
  - Such cases are handled such that no extra cost is borne by user.

- **Path Learning**
  - Intention of user travel based on time of day calculable.
  - Intention of user travel based on day of week calculable.

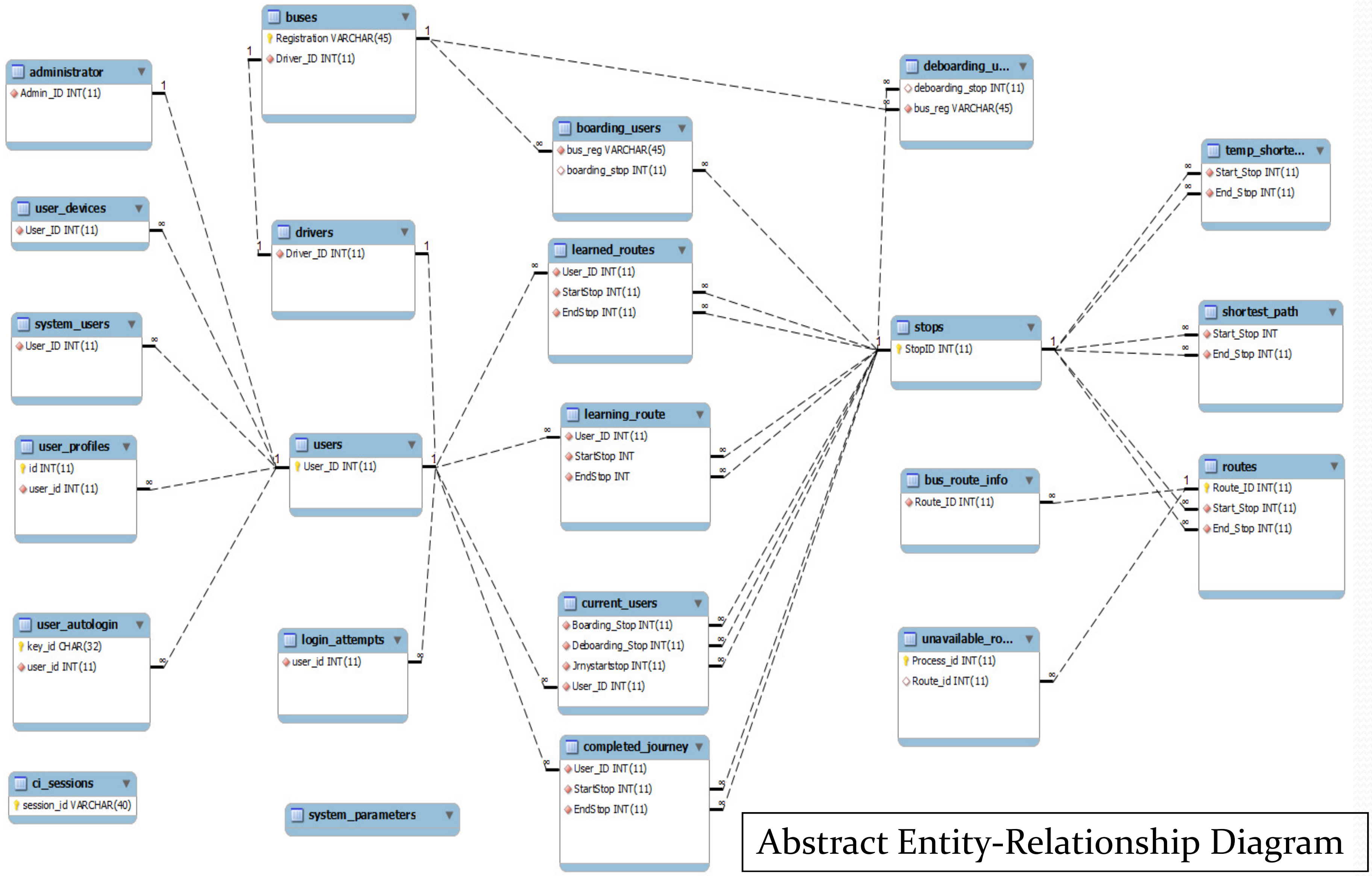
Suggestion System

- **Optimum Path Suggestion**
  - Pre-calculated optimum paths between every two bus-stops are stored.
  - Compare a user's path to these paths.
  - If pre-calculated path is shorter/quicker, message user.

- **Learning and Learned Users**
  - Learning Users – Those users for whom the system is trying to identify regularly traveled routes.
    - Time based movement learning
    - Path based movement learning
  - Learned Users – Those users for whom the system has identified a pattern in movement.
    - Threshold value for learning users parameters,

- **Alternate Path Suggestion**
  - Redraw city graph based on Admin. entered information.
  - Find intended users for affected path(s).
  - Inform learned user(s) through messaging system.

Database Design



Abstract Entity-Relationship Diagram

Test Plan Summary

Functionality	Test performed	Expected Result	Result
Onboard user detection	Some Bluetooth devices were kept in range of the system, while the device detection module was executed. Also some of the devices were kept temporarily in the range of the system Bluetooth to simulate users in the vicinity while the bus is moving.	The final log generated by the device detection system should have two lists of users, those who have boarded and those de-boarded, in the required format. The temporary user's devices should not be included in the final list.	The device detection module, modules to compare logs and the driver programs are working as expected.
Log processing and optimum path generation.	A sample log sequence from a bus was manually generated and fed to the loadTables.jar modules, to load the boarding_users and deboarding_users module. System was also tested for special cases like intermediate logs are missing.	The boarding_users and deboarding_users are loaded properly. The journey info of a user is recorded in the current_users table. The learning_routes or learned_routes tables are updated with the info available The messages regarding the completed journeys and optimum path as required are being generated.	LoadTables.java module is working properly. The BoardedBus, and DeboardedBus procedures working properly. processCompletedJourney and learnRoute procedures are working properly. prepareMessage.java and optimumPath procedures are working properly.
Alternative path	The unavailable path is informed through admin portal and message to be sent to the intended users are created.	The users selected to be informed satisfies the criteria of intended users. The final messages are generated.	alternativePath.java and prepareMessageType2.java modules are working properly.
User interface	Admin and user functionalities of the UI are tested. When unavailable path is submitted to the system the message regarding the alternative path are being generated.	The database is updated with the new information available from the admin or users. The alternative path functionality works as expected.	UI is working properly with the rest of the system

Future Scope

- **Machine Learning Algorithms**
  - Robust machine learning algorithms to effectively predict affected users.

- **Database Design Issues**
  - Current implementation not tested on scaled inputs.
  - Improvements in the form of clustering, indexing data better maybe introduced.

- **Practical Design Issues**
  - Possibility of Server receiving unordered log-files from Buses.
  - False detection of users in spite of implementing the two-scan technique.

Thank You