MSc in Information Technology

Individual Research Project

Community Based Train Locating System (CBTLS)

Abstract

The main objective of this project is to develop a system named Community Based Train Locating System (CBTLS), for the benefit of train passengers and train transportation of Sri Lanka.

The proposed system would be consisting of a native Android mobile application and a Web application. Only the master data would be inserted into the system initially and the rest of the data required for system's functionality is supposed to be inserted by the train passengers.

The system would facilitate viewing current locations of selected trains, the availability of trains and the crowd density of compartments for passengers. Also the system would consist of a component to provide suggestions to passengers based on boarding and destination stations and time. There would be an analytical component available in web application, allowing a selected set of users to view the patterns of transportation.

A location based alarm could be included in the system for the use of passengers to indicate when their destination has been reached. The location-aware android mobile application would allow the system to gather information regarding train's location through passenger. The location would be gathered through GPS and the Network Location Provider of Android.

Project Details

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Background and Motivation

Rail transportation has been considered as a main mode of transportation in Sri Lanka. It is important to support and enhance railway transportation as an alternative method of transportation; this has been indicated in the annual report 2012 of Central Bank of Sri Lanka as below, (SLR - Sri Lanka Railway)

"SLR has the potential to improve its services for transportation of passengers and freight thereby helping to reduce city traffic congestion to a great extent."

"The limitations in the rail transport system, such as inadequate coverage, lack of carriages and inefficiency have compelled the general public to seek other modes of transportation. This has caused heavy traffic congestion, and thereby losses in terms of productive man-hours and energy utilisation." [1]

As mentioned above, the productive man hours, energy could be saved, and the heavy traffic congestion could be avoided to a certain extent by enhancing rail transportation service. The current issues mentioned above, inadequate coverage and lack of carriages could be addressed by providing required physical resources for the service.

The issue "inefficiency" could be considered as a main reason for general public to consider other modes of transportation in place of trains. The main objective of the system proposed here (CBTLS) would be to provide a means for the general public to use this "inefficient service" efficiently.

When considering the statistics provided by Ministry of Internal Transport - Sri Lanka, which is given in the table below, no. of passengers who has chosen train, increasing annually.

**Table 1:** Sri Lanka Railways - Operational Statistics[2]

	2010	2011	2012	2013
Total trips operated (Both passenger and Goods trains)	116,912	119,392	121,782	122,269
No.of Passengers Carried (in millions)	101.45	96.11	106.05	118.71
Length the passengers carried on (Km in million)	4,352.83	4,574.19	5,039.45	6,257.38

Considering data shown in Table 1 above, the important figure in this context would be the "No.of Passengers Carried". The variation of this figure is given below,

Figure 1. No.of Passengers Carried (in millions) over 2010 - 2013 period

[1] "economic and social infrastructure - Central Bank of Sri Lanka." 2013. 4 Feb. 2015 <http://www.cbsl.gov.lk/pics_n_docs/10_pub/_docs/efr/annual_report/AR2012/English/7_Chapter_03.pdf>

[2] "Statistics - Ministry of Transport." 2013. 4 Feb. 2015 <http://www.transport.gov.lk/web/index.php?option=com_content&view=article&id=141&Itemid=113&lang=en>
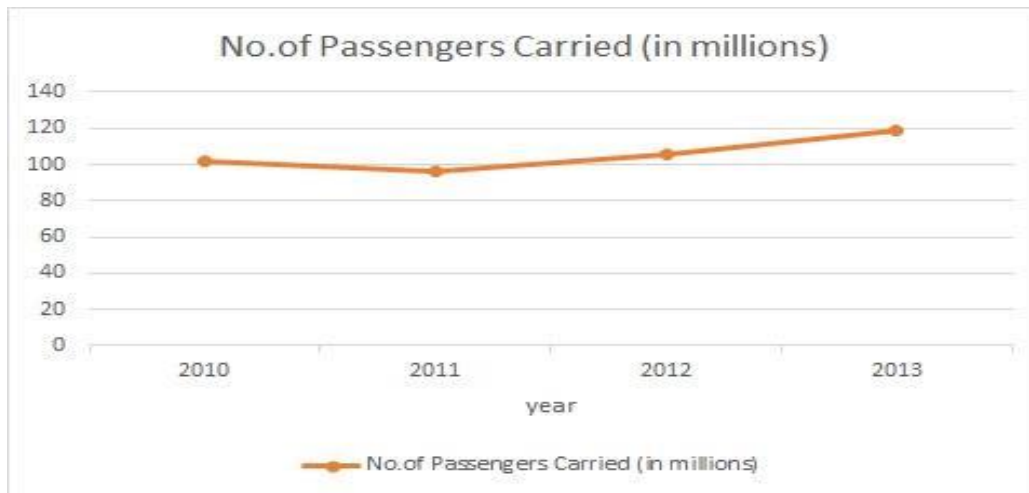
The increased number of passengers over the years indicates the increasing demand for the train as a mode of transportation.

This service has been popular among various types of passengers. Based on how frequently the train has been used, various types of passengers can be categorised roughly as below,

- Daily Users - train is used as the main method of transportation daily
  eg:-
    - Workers in both private and government sectors, travelling daily to the working places
    - School students,
    - University students
    .
- Weekly users - train is used as the main method of transportation weekly
  eg:-
    - Workers, of whom the working places are in Colombo, travelling from faraway places like Galle, Kandy, and Anuradhapura.

- Occasional users - train is used as the main method of transportation occasionally
- eg:-
    - Tourists

When the passenger type - daily users is considered, it can be observed most of the time their travelling pattern has been similar along time. The train, the compartment, sometimes even the seat row which is being used to travel has been the same. The system which is proposed here has mainly targeted this passenger type.

When the factors mentioned above, the importance of rail transportation, and the increasing demand and usage of rail transportation in Sri Lanka, are considered, any contribution to enhance it as a service for general public would be of great value. The system proposed here has been aimed to be a contribution for that.

For the passengers to use currently available railway transportation service efficiently, information available regarding the train schedules would be very crucial. Based on the information, the passengers would be able to make decisions on their travel plans.

When the currently available methods of information retrieval by passengers are considered, certain drawbacks could be seen in them. A list of such services that could be found online is shown below,

- eService by The Department of Railways
  - Accessed via - http://www.eservices.railway.gov.lk/schedule
  - Same service is used as a mobile application
  - Displays the train schedule
  - An enquiry can be placed by providing start position and destination stations
  - Drawbacks as observed,
    - no way of confirming if the train is available or not in real time
    - When selecting certain destinations, no trains are available although in reality there are. e.g.:- from Ja-Ela to Panadura
    - No way to locate the current or most recent location of the train in the system

- GPS based train movement tracking system by Sri Lanka Railway with University of Colombo
  - Accessed via - http://www.slrail.info/
  - The system is implemented only for Coastal Line
  - The current location of the train could be seen on a map
  - An enquiry can be placed by providing start position and destination stations
  - Drawbacks as observed,
    - implemented only for Coastal Line

- A proposed system - GPS based tracking system for trains in Sri Lanka, by Gunasekara, NS - http://dl.lib.mrt.ac.lk/handle/123/443
  - Aimed for Control center staff

Aim and Objectives

Aim

The expected outcome of this research is to provide a comprehensive software application - named as Community Based Train Locating System (CBTLS), for the train passengers in Sri Lanka, which would help them for an efficient usage of current train transportation service in Sri Lanka.

Objectives

CBTLS would be aiming at enhancing the usage of rail transportation service in Sri Lanka for passengers, by introducing new features for them which are not available in current systems like

- Searching and Locating trains in real time
- Providing information about the passenger density in each compartment of the selected train
- Predicting and suggesting most suitable train to take based on destination, and time of arrival at destination desired by the passenger.
- Location based alarm to indicate if the passenger has reached the destination.

The proposed system will also be an enhancement and combination over the features available in currently available systems for the same purpose.

Additionally, the CBTLS would facilitate the storage and analysis of historical data related with each train by storing them in a centralised database. With this facility, authorised users would be allowed analyse patterns of train travelling daily, hence the delays could be determined.

As a community based system, it would allow registered users to post their comments, criticisms and suggestions regarding a selected train. Those could be allowed to be flagged by other passengers as appropriate or inappropriate by using a thumbs up system. Authorised users would be allowed to view these comments, criticisms or suggestions by the passengers.

Research Plan

For the research purpose, only a single train route would be selected to initially implement the system. Of that train route, train schedules would be selected to cover both weekdays and weekends, for office times where the trains are mostly crowded, and to cover regularly crowded times.

Initial data of selected train schedules would be fed to system so the users would be able to look up schedules initially. But the proposed system is based on data provided by general public (the community of train passengers). The most challenging part of the system would be to validate the received data before it gets displayed for other users.

For this validation purposes, and for data analytical purposes, geo coordinations of train stations along the selected route, and the geo coordinates of the selected rail route would be have to be inserted into the system. To retrieve the exact geo coordinates of these and to confirm them would be a considerable part of the research.

The system would be consisted with a web application and a mobile application. Mobile application would be used to collect data about trains from passengers and the same is used to display data upon enquiries. The mobile application would be a native, location-aware application for Android which would support geo locating the user. Therefore this mobile system would only be available for android users.

The user location would be acquired through GPS and Android's Network Location Provider. Although GPS is most accurate, it only works outdoors, it quickly consumes battery power, and doesn't return the location as quickly as desired. Android's Network Location Provider determines user location using cell tower and Wi-Fi signals, providing location information in a way that works indoors and outdoors, responds faster, and uses less battery power. Therefore, to obtain the user location in this application, both GPS and the Network Location Provider are to be used.

The web application would also contain all the features of mobile application, except for the facility to provide the location of the train or the compartment details. The general public would be able to search for trains, get the estimation and predictions. At the same time they could provide feedback on each selected trains.

In the web application, there would be a part with restricted access for admin functionalities which would be described in detail in below sections.

Methodology

The proposed system would be consist of a web application and a mobile application. First the available train schedule details from Sri Lanka Railways would be inserted to the system as master data. This data would be considered as a base line through the rest of the application.
A proper database structure should be defined in order to store these kind of master data, the data received from passengers. Design of this data structure would be a key part of the system.

A location aware android mobile application consisting of a data retrieval and a data view part would be developed for the use of passengers.

- Considering data retrieval part for the system from passengers,
    - a simple user interface would be provided for them to indicate if a selected train has arrived or not at their location
        - The data inserted would be validated against the predefined geo coordinates of the selected rail route, before accepting into the system.
        - If any previous passenger data is available for the selected train, the new insertion would be validated against them also
    - a simple user interface would be provided for passengers to indicate the passenger density of their current compartment,
        - the density states would be predefined as levels,
        - the compartment number could be selected within a given range
        - this data would be validated against history data in prior to accepting to system
    - a user interface would be provided for passengers to enter their comments/suggestions/criticisms into the system regarding a selected train

- Considering data view part of the system for passengers,
    - A UI would be provided to search for a train, while listing all the recently used relevant trains for the used based on user's location and time.
    - After the desired destination and optionally desired reaching time of destination is inserted, the suggested trains would be listed to the user, with information about the closest station for the user.
    - The passengers would be able to view last known location of the train to the system (must have been reported by another passenger), for a selected train, together with the crowd density details reported for each compartment.
    - The scheduled time for the train to reach the user's station (or the nearest station for the user), and the general deviation of it along the time, and predicted reaching time would be displayed for the passenger.
    - When viewing details reported by other passengers, an indicator about the confidentiality would also be displayed for the passenger

A web application would be developed specifically for the admin functionalities like to maintain master data. It would also provide the analytical functions related with data mining for a restricted set of users, in order to analyse the patterns of transportation of a single train. This would allow the authenticated users to determine any delays at specific points of journey. The same set of users would be able to see the feedback from passengers regarding the selected trains.

Risk/Benefit Analysis

The party whom are mainly benefited by this system would be the passengers. With the currently available systems, they are only capable to see the train schedules. This new system will provide the following information to a passenger, regarding a selected train.
- Indication if the train is available or not (for current trains).
- The current position of the desired train.
- The crowd density in each compartment.
- Suggestions for trains based on destinations and time of reaching destinations together with user's location and the most nearby station of boarding the train
- Facility to provide the passenger's suggestions, comments and criticisms regarding a selected train
- A location aware alarm to indicate when the desired destination is reached

The above features would allow a passengers to save the waiting time at the stations for a train. It would also allow to select an alternative method of transportation, in case a train is not available for the desired time, or the train has been delayed or cancelled. This can save many productive man hours for the country. Through the facility to provide their feedback regarding the train, passengers would be able to convey their suggestions, comments and criticisms for other passengers, and possibly for some responsible authority.

A set of authorized users for the web application, would be able to analyse patterns of train transportation and to identify the points where delays occur. The past stored data could be also analysed and studied to provide a better train transportation service which will serve the need of passengers better.

The main risk for the system would be the possible inaccuracy and reliability issues of the data retrieved from the passengers. The inaccuracy could be reduced by through validation, but the reliability of data could only be determined through the amount of similar data retrieved from different sources. To enhance the reliability, a grading system for users could be introduced.

The location awareness of the mobile application for passengers would require GPS or Android's Network Location Provider activated in the mobile application. Also the application would require an active internet connection to use this application. These could be considered as limitations of the system, since some users would not be agreed with these terms.

Resource Requirements with plan

All the existing and proposed systems mentioned currently available, would require an involvement from Sri Lanka Railways (SLR), mainly for locating trains. It has been done by placing a GPS tracking device inside the train. In this CBTLS, there won't be a requirement for any involvement of SRL, since the data is expected to be fed by train passengers.

For the passengers, to use the mobile system, it would require an android mobile device with either GPS or Android's Network Location Provider activated, and an active internet connection.

For the web application, it would require a high performance server to host the application to handle the expected large amount of requests, since this is accessed by general public. At the same time, since the current locations of trains should be updated at regular intervals, requests for locations updates would be sent frequently to the server.

For the demonstration purposes for this research, a single rail route would be selected, and the geo locations along the route would be required to be inserted into the system as master data. The existing train schedules also would be inserted. A set of randomly generated mock data also would be inserted to the system to demonstrate the analytical part of the system. To demonstrate location-aware mobile application, a mock GPS client could be used.

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