Improving the DTC Bus System of New Delhi.

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Team Name: Digits

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Abstract and Problem Description

New Delhi has witnessed tremendous growth due to the development of a world class metro system by the government and the associated authorities. It is, by far, the most reliable means of transportation. However, smaller distance routes call in for buses and autos at our disposal. Even though buses have been there for quite sometime, there is neither an efficient way of tracking them in real time, nor a proper time schedule for the passengers to be assured of its arrival and departure. Owing to the ever increasing congestion on the roads, a really complex bus travel system, and no proper parallel lanes for buses to assure reliable networks, we propose a way to tackle this problem by mapping buses in real time for reliability. We also add in a routing algorithm and a recommendation system for robust path finding. Our data would be displayed directly on mobile phones and on bus stands via display boards. Designing and prototyping a state-of-the-art system that integrates all of the mentioned points is what we take up as a challenge in this proposal.

Goals

Making the bus transportation system convenient will encourage people to shift from private vehicles to the buses. We plan to do this by implementing the following:

1. Dynamic bus tracking system via GPS on mobile applications.
2. Bus routing algorithm to provide a complete or approximate route from point A to point B only by buses.
3. Display boards on bus stands which will highlight the status of the buses, how far they are, their current locations along with their ETA.
4. A robust recommendation system based on various parameters like late arrivals, general congestion, average number of passengers, current traffic etc. to provide the end user with a better alternative in case of certain situations.
5. Card payment for buses via an online wallet system, which ensures easy payment for quick travelling and congestion reduction.
6. Integration of payment system with participating Auto/Taxi owners. This would provide more flexibility to passengers, and further simplify payment.
7. Range of security options, such as:
   - One tap, informs the nearest police station about an emergency onboard, and provides along with the bus number, and its gps coordinates, for easy tracking.
We also think technology can help in identifying aggressive drivers and inform the concerned authorities thereby making our roads safer.

**Proposed Solution**

1. **Dynamic bus tracking system via GPS**

We propose to track buses in real time through a central application which would be on a passenger’s mobile phone. The idea, inspired by radio taxi services would provide real time tracking of all the buses on a single application. Efficient tracking requires a good GPS system in the buses, which has been taken up recently by the Delhi Government on a trial basis. A newspaper article link is shared below depicting the plans by the government for installing GPS and Wi-Fi in DTC buses.


We plan to effectively utilize the existing schemes taken up by the government and use it as a foundation to our mobile application for tracking. A central cluster of servers would be logging in, giving the details and locations of all the public buses which the end user mobile applications can track. A dynamic map will always be displayed on this mobile application.

**Added Feature**: The dynamic real time monitoring requires an active Internet connection on the mobile phones. We realize that not everyone has a smartphone, therefore we propose for the inclusion of 24x7 toll-free number wherein passengers can text their queries regarding the current bus locations and can get the same data from the server via a text message directly.

Comparing with the current services, neither of them provide an offline option for tracking.

2. **Bus Routing Algorithm**

The Delhi Metro has provided an easy way to understand how to travel from place A to place B via metro maps. An image from [www.mapsofindia.com](http://www.mapsofindia.com) gives us the map attached below.
It is fairly easy to figure out the path from one location to the other using the above map. This is not only because there are fewer metro lines as of now but also because of intermediate stations are limited. Hence a simple map is able to convey the idea effectively.

In case of bus system, the map projection would be huge and highly complex, owing to a large number of buses, and the various paths and stops they have. A natural intuition is to search for a few services that can provide indirect bus routes. The highest rated website on Google for this is www.delhitravelhelp.in. However, when we tried to find
routes from Jahangirpuri to Hauz Khas as an example, this service failed, as it only provides direct routes.

However we would adopt a much more user-friendly approach. Our mobile application would provide not only accurate direct routes but also indirect routes by using concepts of graph theory in our implementation to find the shortest routes and use the static data that we will collect from bus routes across the capital. This would provide users with a complete automated system for finding shortest paths to their destinations, thereby greatly reducing travel time.

3. Display Boards on Bus Stands

All Metro stations have electronic displays, which show the expected time of arrival (ETA) for the next metro car and metro map for that line. This provides a very convenient way for people to plan effectively by giving an accurate idea of how long they have to wait for the next car and where they will have to change next. Such a system for DTC buses would save time tremendously. Even though our mobile application and the offline text message service would provide all the necessary data for the buses, the boards would give the information for the people who do not possess phones. These boards will download the data directly from our servers, which track the buses through the GPS installed on them.

Our idea for this has been inspired by a service called NextBus. A link about this service in the United States is shared below. There is also an image of the Chapel Hill Transit in California having these boards.

https://en.wikipedia.org/wiki/NextBus
4. **Recommendation Systems**

Even after a lot of planning and tracking to ensure our timely arrival at our destination, there are many factors that still can work out against our planning. Our final add-on to the application is to provide a recommendation system for the users to provide other essential details. This system would consider various parameters that is collected directly from traffic congestion, current location of buses, apparently the number of passengers and other statistics to deliver the following as notifications:

- If the bus is far away, or is stuck in traffic jam for a very long time, then the system would suggest an alternative bus route or nearby station, so the user can decide accordingly.
- A rough approximate of the number of passengers in the bus can stipulate a suggestion for the user whether to board or not that bus. The user can then wait for a following bus with lesser congestion.
5. **Mobile Payment for Buses and Taxis**

Providing a fast and efficient way of making payments is a top priority for us. This functionality, if provided within the app itself, will save both time and paper, which is a great step towards building a smarter city. When the source and destination has been entered, along with providing the shortest route, the app will also provide them with the journey cost and an option to pay online using a secure payment method. On successful payment, money will be credited to your account. When the passenger plans to travel, he just chooses the bus number and the destination. A price for his travel will be mentioned on the app and a QR code will be generated. Next, when he boards the bus, the conductor will detect the QR code, and he can board the bus. That QR code will be removed from the database of tickets which have been generated, so it cannot be used again.

As an alternative a prepaid system similar to the one used in the metro, is under consideration: After charging an amount into a account, the passenger can travel available bus routes. Based on the location where the bus is entered or deboarded, the sum for the entire journey is automatically deducted from the account. The app will generate a QR code which functions as a validity check for a ticket checking conductor.

Direct advantages for implementing this system of payment is:

- Less paper ticket use, which ensures reduction in tree cutting.
- Using phone sensors, namely camera, which is available in all phones currently.
  We base our idea on the fact that there are more mobile phones than humans. This provides an easy base case for us to assume that the conductors and the users can afford a normal phone with internet connectivity. We also extract our dependency on the recent plans of implementing WiFi all over the city by the Delhi Government.
- Another alternative would rely on NFC cards. However this would increase the costs involved in deploying such a system.
- All of this is integrated in a single app: Locate a bus, check the timings, get routes and pay for your tickets on the app.
- The app also proposes to extend the online payment section of the app for taxi services like Ola, Uber etc. Hence, a person can pay directly to the Ola(or any other service) central account using his online wallet.

6. **Feedback system**

We also add a real time feedback system for all the buses. Using this feedback system, a passenger can report multiple issues like driver behaviour, delays in the bus, bus conditions etc. If a passenger notices an aggressive behaviour from the the driver and
thinks that it is effecting his driving, that person can inform this behaviour on the feedback.

All these feedbacks would be stored in a central server, thus reporting about the buses which have bad conditions or bad drivers. The central bus department can therefore take necessary actions to fix the problems.

**Key Implementation Challenges**

Implementation of a bus routing algorithm.

**TimeLine**

We will work as a team of 12 students, assuming that our project is selected and given a proposed time period of 6 months will foster with the complete working system. A rough approximate timeline distribution has been shared below, though it can change according to the timelines requested by our mentors/Delhi Govt for the project.

I. **1st and 2nd Month**
   - Data Collection, which we propose to collect from the Delhi Government, other state bodies and online sources. A lot of databases have been compiled and can be used after particular license approvals, if proprietary data is used.
   - Creation of cluster of servers, which will manage all the databases for the tickets and the bus data.
   - GPS installation in buses by Delhi Government.
   - Bus tracking feature completion using all the GPS calibrations with our apps and the databases.

II. **3rd Month**
   - Routing Algorithm along with further data collection, which will be based on the understanding of various
   - Display board installation by Delhi Government. We suppose that boards can be kept as an add-on. The main focus is on the application.

III. **4th and 5th Month**
    - Recommendation system development along with integration of display boards and mobile application with central servers.
    - GPS detail logging in central servers to track them.
    - Payment module integration with modular testing on small subject groups
IV. 6th Month

- Testing phase for individual systems and complete integrated systems on the roads of Delhi with a test set of around 500 people,
- Further modifications will be made from their input.

Expected Benefits

We conclude our proposal with the benefits that we believe can be provided to the people of Delhi as well as the Delhi Government. There will not be much use of hardware or human resources as everything is automated. Such benefits would save tremendous amount of money and time. And since our proposal builds upon already proposed schemes by the Delhi Government, no drastic amount of expenditure or change of policies would be required for implementation. The passengers would no longer gain confidence in the bus system. This would also decrease the traffic congestion. We can safely guarantee that this system, if deployed effectively, will bring a revolution in the transport sector of Delhi.