Digitization of Pune Mahanagar Parivahan Mahamandal Ltd. (PMPML): DAMINI—A Real-time Bus Tracking App for the Commuters

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Abstract: Transportation is one of the basic needs like food, clothing and shelter. In upcoming metropolitan cities like Pune, the need of an efficient public transport system cannot be ignored. Such metropolitan cities face various problems related to road transport. This research paper presents a simple and effective solution for these problems, using the BRTS in Pune–Rainbow BRTS as an example. Digitization of information in real time for commuters can tremendously improve the reliability and expand the user-base thereby easing traffic congestion and provide all the associated benefits. The mobile app is named as 'Damini' which will give the real time information of the bus. The financial and technical aspects of the app were studied with the help of 'Mitroz Technologies' and Financial consultants MSL Corporate Advisory.

Keywords: Digitization of PMPML, Bus Tracking App for the Commuters

Introduction

Transportation is one of the basic necessities of life, just like food, clothing, shelter and education. We have come a long way from traditional means of surface transport like walking, palanquins, hand-pulled rickshaws, bullock carts and horse carriages, bicycles etc. to cars, buses, trains and metros.

While some of us are privileged enough to use our personal mode of transport for travel, a major fraction of our country uses the public transportation system to commute. Public transport is of utmost importance in a country like India, which is densely populated and with low per capita income.

Since commuter rail services are available only in the very few metropolitan cities of Mumbai, Delhi, Chennai, Kolkata, Bengaluru, Hyderabad and Pune, the public primarily uses road transport for commutation. Buses comprise over 90% of public transport in Indian cities, and serve as a cheap and convenient mode of transport for all classes of society. Services are mostly run by state or local government-owned transport corporations.

The growing population, and especially the exploding urban population, needs an ever-increasing fleet of vehicles to manage travel to work, school, shopping or elsewhere. The development of roadways while commendable, cannot keep up with the exponential growth as we will soon run out of space within the cities and towns to build additional roads. Moving in the right direction, government state transport corporations have introduced various facilities like low-floor buses for the disabled and air-conditioned buses to attract private car owners to help decongest roads. Mumbai introduced air conditioned buses in 1998. Bangalore was the first city in

India to introduce Volvo B7RLE intra-city buses in India in January 2005. Bengaluru is the first Indian city to have an air-conditioned bus stop, located near Cubbon Park. It was built by Airtel. The city of Chennai houses one of Asia's largest bus terminus, the Chennai Mofussil Bus Terminus.[1]

Bus Rapid Transit Systems (BRTS), although quite recent, exist in several cities including Pune, Ahmedabad, Jaipur, Rajkot, Surat, Bhopal and Indore.

Nevertheless, private mode of transport (cars and motorcycles) is still widely used by a considerable chunk of commuters. Everyone is aware of the nightmarish traffic blocks everywhere. A side-effect of such high volumes of vehicles on roads is the severe traffic congestions, pollution, health burden and lost productivity. If public transport is available, why is there a consistent increase in such private mode of transport? A key reason why people often prefer their own vehicle to commute is the poor reliability and lack of awareness of using public transport systems.

We will present in this research paper a simple and effective solution using the BRTS in Pune–Rainbow BRTS as an example. Digitization of information in real-time for commuters can tremendously improve the reliability and expand the user base thereby easing traffic congestion and provide all the associated benefits.

Scope of the Research Paper

The study is limited to the bus transport in Pune–PMPML.

Objectives of the Study

1. Study the public transport in Pune city and areas surrounding it, with special reference to PMPML.

2. Propose digitization of PMPML transport system (including the existing mobile apps of PMPML)

3. Development of a simple and highly efficient mobile app for commuters to track the real time movement of bus.

4. Characterize the benefits associated with the usage of real-time bus tracking app.

5. Providing financial viability of the development and application of the real-time mobile app for PMPML commuters and increased revenue for the PMPML

6. Expanding scope to additional utilities that can be added in the proposed app.

7. Learning from the digitization of bus transport in other countries which are comparable to PMPML.

8. Execution of such a proposal, hurdles and other considerations.

Research Methodology

The paper is primarily based on observation, primary data from commuters and secondary data collected from the various available resources like–websites, annual reports of PMPML, newspapers etc.

There has been an effort to meet up various technology firms which can get associated in implementation of this research project. Under a signed NDA (Non-Disclosure Agreement), Mitroz Technologies has agreed to develop the android application. The business consultant, MSL Corporate Advisory Services has agreed to oversee financial and marketing aspects of the research project.

The study was carried out with the help of these two entities ready to partner in the project with PMPML authorities for its implementation, if proposal is accepted. There is no objection if PMPML implements the project on its own in a timely manner with adequate consulting.

About PMPML

The company, PMPML (Pune Mahanagar Parivahan Mahamandal Ltd.) came into existence, on 19 October 2007 when the two transport undertakings, *viz*, PMT and PCMT were merged. PMPML caters its bus services to the Puneites and plays a vital role in providing affordable and convenient public transport service that help the people reach any nook and corner in and around PMC and PCMC area. It is useful for different groups of people like students, employed people, senior citizens, shoppers, people visiting Pune city etc. PMPML Bus Service has been serving the people on the same line of PMT, formerly known as Pune Municipal Transport, since for last 58 years. PMPML has a share in the city developments as people give priority to those areas where PMPML buses ply while selecting their houses to settle down.[2]

About BRTS: (Bus Rapid Transport System)

The world's first BRT system, the Rede Integrada de Transporte in Curitiba, Brazil, was opened in 1974.[3] Since then, many other countries have implemented BRTS.

Pune was the first city in India to experiment with a Bus Rapid Transit System.

Rainbow BRTS is a Bus Rapid Transit System in the twin cities of Pune and Pimpri-Chinchwad in Maharashtra, India which is operated by the Pune Mahanagar Parivahan Mahamandal Limited (PMPML). The infrastructure has been developed by the Pune Municipal Corporation (PMC), Pimpri-Chinchwad Municipal Corporation (PCMC). The project currently envisages 113 km of dedicated bus corridors along with buses, bus stations, terminals and intelligent transit management system.

PMPML started plying pilot routes in December 2006. The Hadapsar-Katraj pilot project consisted of 16.5 kilometres (10.3 mi) of bus lanes along the Pune-Satara Road using airconditioned, low-floor more than 500 Volvo B7RLE buses initially on Katraj-Swargate-Hadapsar. Most of these buses are not in service currently. The funding for the project came from the Government of India under the Jawaharlal Nehru National Urban Renewal Mission. A total of

112 kilometres (70 mi) route was proposed for Pune BRTS. Now regular PMPML buses ply on the Hadapsar-Katraj corridor of BRTS.

The Pimpri-Chinchwad BRTS was announced in December 2008, when eight routes covering 112 km were proposed. Construction of the first route was due to be completed within 18 months.[2] By January 2009, 90% of the construction work on an 11 km pilot route between Nigdi and Dapodi had been completed. However, a string of disputes between the Pimpri-Chinchwad Municipal Corporation (PCMC), civic administrators and corporators led to the project being delayed, with corporators citing funding difficulties and problems encountered on the similar Delhi BRTS and Pune BRTS projects as the causes.

In September 2009, it was announced to the press that, although most work had been completed, difficulties in procuring the 650 buses required to run on the system had led to the project being indefinitely postponed. It was also found that the proposed new bus shelters had been due to be installed on the wrong side of the road, leading to delays in their construction, while passenger information systems had yet to be installed. The PCMC stated that this was not a major issue as the shelters could be constructed quickly from prefabricated materials, and that the vehicles would be purchased by December 2009. A month later, it was revealed that the cost of the project had overrun by 230 crore, around 50% of the total project cost. By May 2010, funding for the completion of four BRT routes had been agreed, with the remaining four sanctioned by the national government but not yet funded. A number of high-rise buildings along the routes had also been approved for construction.

Both the systems were merged to form Rainbow BRTS which is currently under expansion.

Fig. 1

BRTS at Wakad

By April 2014, two of the routes were under construction, with the first station near to completion. The first two lines were expected to be operational by the end of March or the beginning of April 2015.[8] The Sangvi-Kiwale corridor (earlier named as Aundh-Ravet corridor) was thrown open to public on 5 September 2015.[4]

Rainbow BRT Description[5]

The features of Rainbow BRT include:

- *Buses*: Over 600 special Rainbow BRT buses with doors on both sides and more standing space, that ply smoothly and rapidly in reserved lanes.

- *Bus Stations in the BRT Lanes*: Covered and providing protection from rain and sun, well lit, have a ramp at the entrance and signage boards with information about the BRT corridors.

- *Tickets at Stations*: The ticket is to be bought at the ticket counter inside the station before boarding the bus. Smart Cards are proposed in the next phase Alternate option of buying from bus conductor is also available.

- *Level Boarding*: The height of the bus platform and the BRT station platform are all at the doors and bus interface level. Passengers do not have to climb steps to board the bus, a feature similar to metro rail.

- *Automatic Doors*: Automatic doors on BRT stations and bus doors open only when the bus is properly docked at the station.

- *Crossings*: The crossings from the footpath to the BRT stations have signals in many locations or have speed tables so that vehicles have to slow down to allow passengers to cross safely.

- *Bus Route Number, Bus Arrival and Station Information*: Information on bus arrivals is displayed on screens at the bus stations. Display screens and audio announcements in buses give information about the next stop. Route numbers appear on LED displays on the front, back and the left side of buses

- *Intelligent Transit Management System*: BRT buses have GPS and all bus and stations are linked with the BRTS Control Room at Swargate which tracks bus movement and gives feedback to drivers to improve service.

- *Security and Traffic Management*: Security personnel are present at each BRT bus station. Traffic wardens are present at signals and crossings to help in the management of other traffic and prevent entry into dedicated bus lanes.

Fig. 2

Fig. 3

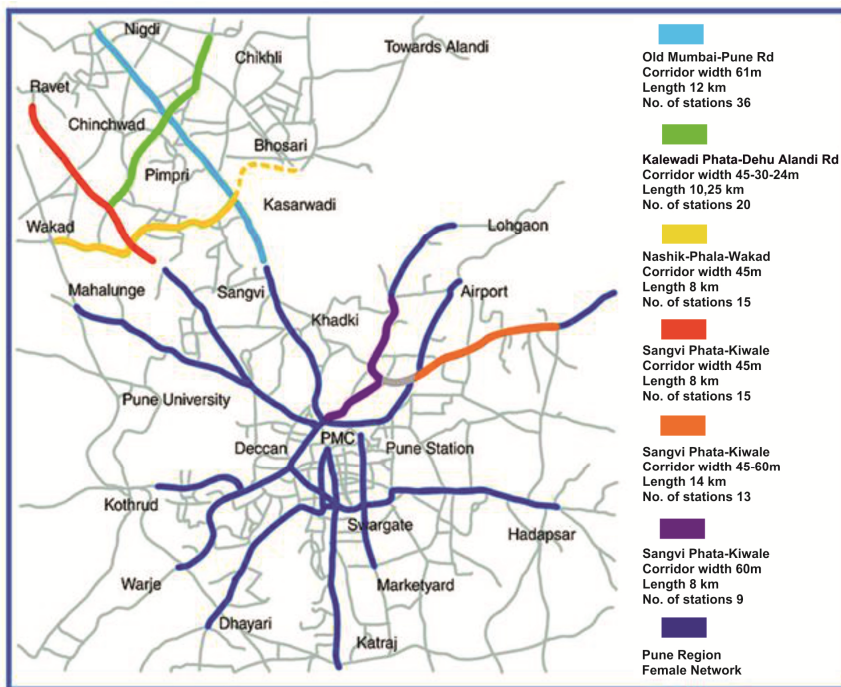## About BRT Prospects[6]

The special features of a BRT, combined with its higher carrying capacity automatically makes it the right choice for augmenting existing public transport by also enhancing its image.

Pune's Comprehensive Mobility Plan is a milestone in Pune's traffic and transport planning history and it recommends BRT as a highly effective solution for the forecasted traffic growth. While today the public transport share in Pune region is abysmally low at around 15%, it will further reduce to 10% in 2031 if no concrete steps are taken. Augmentation of PMPML service alone will only increase the share marginally, while a comprehensive BRT network which complements regular PMPML service will cater to 60% of the modal share in 2031, making Pune comparable with other model international cities.

Statistics of PMPML Buses[7,8,9,10]

1. 19th October 2007: The company, PMPML was formed by merging PMT and PCMT.

2. Currently PMPML has 1600 buses with it (including the approximately 1000 buses which are not operating in the BRTS, and approximately 600 new buses which are operating in the BRTS).

3. PMPML is in process of buying 1550 new buses for its BRTS routes.

4. Pune and Pimpri Chinchwad Municipal Corporations are giving Rs. 300 crore and 200 crore respectively to PMPML for buying new vehicles.

5. Rs. 1816 crores spent on BRTS.

6. BRTS in Pune was initiated in 2007.

7. In all, 6 BRTS routes are operational in the twin city of Pune and PCMC:

    - Katraj–Swargate–Hadapsar (Rs. 108 crores: 16 km)

    - Vishrantwadi–Wagholi (with the link route of newly constructed Sangamwadi– Deccan College Road) (Rs. 38 crores: 15.2 km)

    - Dapodi–Nigdi (not functional yet)(Rs. 286 crores: 12 km)

    - Aundh–Ravet (Rs. 238 crores: 14.5 km)

    - Nasik Phata–Wakad (Rs. 205 crores – 8 km)

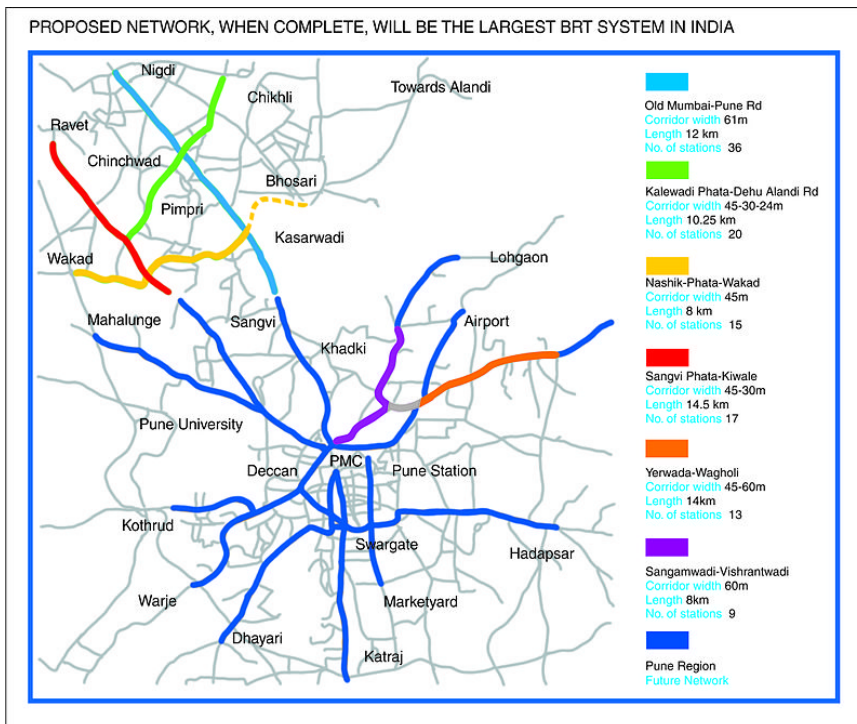   - Kalewadi Phata–Dehuroad(Rs. 45 crores spent, still not functional: 10.5 km)

Fig. 4

Mobile Applications (PMPML Routes) Available in Google Play Store Currently

All the apps in the list given just provide the information of bus timings related to the time-table as displayed on the PMPML website. The time-table is not updated on a regular basis to show the timing of the bus. There is one app, ridlr [11] which is also useful but no real-time tracking of the bus is possible since it operates without internet. It is very much useful in train tracking not only in Pune but also at other places. The app has low user-base in spite of its utility.
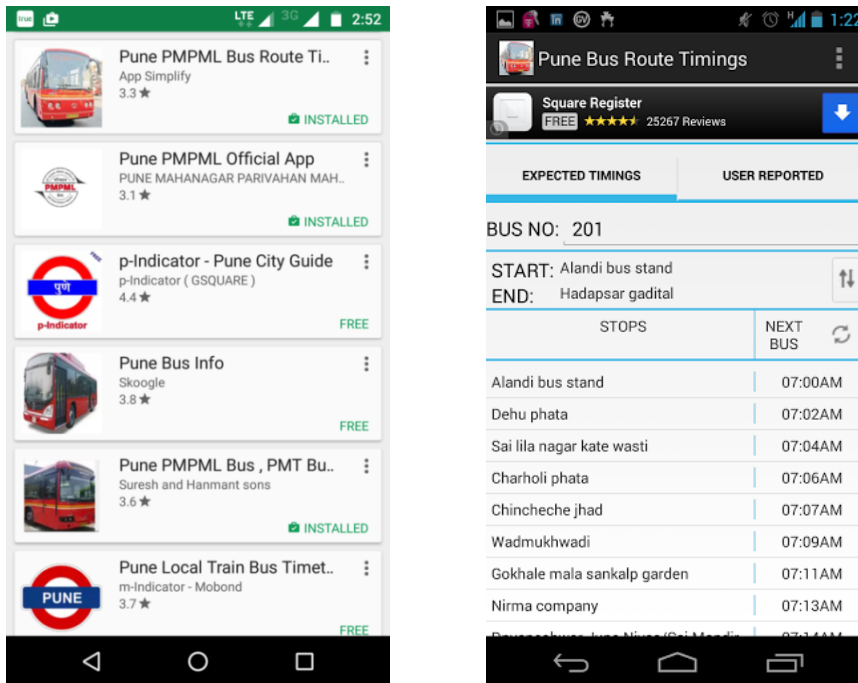

Fig. 5

Brief Reviews of Users of App[12,13]

Commuter-1(Dec 09, 2016): Waste of time–The app did not show information about any single route, even basic route such as bus to Shivajinagar. Every time the app shows a message that alternate route will be available soon.

Commuter-2 (Oct 30, 2016): WORST APP–Earlier the buses as well as their timings werethe worst part of this company; now ONE more thing is added and that is the APP which they are saying is for customer's help but it converts their hope into FRUSTRATION. Please, if you can't give better, then don't show it. 1. The app is not working properly. 2. Some bus routes are missing. 3. Please try to avoid the multiple stops. 4. Please make the proper TO & FROM stop

names so people could find the proper bus route. 4.ETA PART SHOULD WORK properly. 5.Please show bus time.

Commuter-3 (May 18, 2015): Good initiative, but timings are wrong. It is a good initiative, but timings displayed are incorrect. e.g. after 1:10 pm, timing for next stop is 11:57 am. This needs to be updated as timings are the important part of this app as said in the description. 'There are lots of apps that give Bus Routes, but this is the only app that also gives TIME'.

Commuter-4 (July 27, 2015): Good to start with. The app is good to atleast know the next bus timing. User reported module is good if used by many people. Although there are lot many things which can be included like 'from' and 'to' place, Range of timings within which user wants to know the buses, via stations, multiple options if available for the routes for the same journey. I hope the developer takes it into account during the next update. Thank you for making this app worthwhile at the least.

Commuter-5 (Feb 05, 2014): Good app but lacks a few features. When I am in the bus, it does not show my current location even though I am connected to GPS. Secondly, and most importantly, if I know the start and end point from where I have to board and where to get down but don't know the bus number, then this app is useless. Kindly add this, so people will come to know different bus numbers also going via the same route; thiswill be especially useful for newcomers in Pune.

Commuter-6 (Dec 24, 2016): What a shame! If most of the features are 'soon to be available' then why to release the app? Flow should be like enter 'from' and 'to' station and then it should show. All buses and options leaving on or after that time and then clicking on bus should show route.

Commuter-7(October 14, 2016): Very Good App. Thank You PMPML. PMPML is very good service by Pune and Pimpri-Chinchwad Corporation...but needs some improvements in buses and staff... It's very useful for outside students.

Problems Ahead if Bus Transport Issues are not Resolved on War Footing

1. Increase in shift to personal transport (two-wheeler/ four-wheeler) leading to traffic congestion, lost productivity and pollution.

2. Increased incidences of irresponsible driving, road rageleading to road accidents.

3. Higher fuel prices due to increased demand. This results in either higher subsidy (budget deficit) or higher prices (inflation).

4. Increase in the under-age student community driving two wheelers on road without license and decreased usage of buses.

5. Increased fare prices which will further erode user base or subsidies which will cause local government budget deficits leading to increased taxation.

6. The Pensioner's Paradise–Pune–no more a destination for elderly community, leading to decreased growth.

7. The BRTS purpose will be defeated while problem will still remain unsolved instead of spending crores of rupees

8. Tourism to eventually suffer due to dearth of good public transport (since many tourists cannot depend or may not prefer on OLA, UBER due to myriad reasons).

9. Pune's vision of being a SMART CITY almost impossible to achieve.

Observations

1. Though public transport is highly used by Puneites, many still prefer personal transport due to lack of timeliness and convenience in using public transport like PMPML Bus.

2. This has resulted in an increase in usage of two wheelers and four wheelers by people leading to more of traffic congestion on roads.

3. The usage of more of personal transport has led to more fuel consumption and increase in pollution; thus more of environmental hazards.

4. It was also observed that a major proportion of the student population in Pune uses two-wheeler for commutation between their residence and education centre. This has led to many fatal accidents on roads due to irresponsible driving by many of those students. Not to mention that many of them are riding the two wheelers without any license or formal training.

5. Bus Rapid Transit provides an integrated network of safer, faster, affordable and more efficient public transport. However, the pending status of the construction of the BRTS routes at most of the places has made it more of an inconvenience than comfort.

6. Commuters can experience high quality BRT stations, level boarding facility, real time bus arrival information and voice announcements on Rainbow BRT. Though this is available only at a few places where BRTS is functional (that too after almost 10 long years since 2007 since BRTS was initiated). The places where the facility are not existing, the commuters have to depend on the road maps or time table provided on the bus-stop which has very limited availability and most are outdated.

7. Dedicated lanes ensure that BRT buses are able to run efficiently and rapidly along their routes, helping passengers reach their destinations easily. However, if any bus fails in the process, or stuck in traffic, commuter cannot track its position. There is no system to track the real-time position of the bus. The commuter may end up waiting for hours.

8. The mobile applications available online are an application version of the data available on website www.pmpml.org. They have very limited use when it comes to real-time tracking.

9. The routes where BRTS is not available, the commuters do not have any option other than to wait endlessly for the bus to come, especially when lot of re-routing has taken place due to lot of civil work going on various roads in Pune.

10. When the bus breaks down (something very common with PMPML), the commuter in the broken bus cannot plan his next route or bus at the non-BRTS route.

11. When the bus breaks down, the commuter at the next bus stop (who has least idea of what has happened to the bus mid-way) is still waiting for the bus to come since the commuter does not have any LED panel to be looked for the arrival of the bus at the non-BRTS route.

12. The buses at non-BRTS routes sometimes do not even halt at the designated route, leaving the commuters in a lurch who have been waiting since long for the bus.

13. The buses often do not halt at designated bus stops due to various reasons. Sometimes, the bus is overfull and cannot take more passengers and many other times, when there is no other passenger to disembark from the bus at the designated route, the bus driver ignores halting at the designated route due to sheer lack of sense of duty. Poor commuter experience.

14. The bus drivers lack accountability because of no real-time monitoring on their travel path.

15. The Pune Smart City proposal, has not considered the real-time tracking of bus facility.[14]

'The public transport company's financial condition is very weak and is worsening rapidly. We are not able to carry out preventive maintenance of buses because there is no money to buy spares,' said Pravin Ashtikar, Joint Managing Director of PMPML.[15]

My Contribution to the Study

I strongly feel that there is a need of a real-time tracking app for PMPML bus system. Though there are many apps available with time and route details, still there is a dearth of a real time tracking system on the side of the commuter. The PMPML tracks the route of the buses operating in BRTS but what about the buses operating on other roads? Also, this tracking is on the terminal of PMPML. The commuter can see the actual approach time of the bus at the BRTS in the LED. However, if the commuter has to plan his/her journey for a route, he/she cannot do so because the time of arrival of the buses only at the current terminal can be known in the app. To plan a complete tour, it is very important to know the real-time position of the buses enroute. Accordingly, the commuter can decide whether to wait for a direct bus or complete his journey in breaks.

Another utility which can be very useful to the commuter is the capacity utilization of the bus. If the commuter knows that the bus is full beyond a particular capacity (which will generally happen in a populated city like Pune, especially during the peak hours); then he or she can decide to wait for the next bus which may be just few minutes away and comparatively empty. This will give a comfortable journey to the commuter. Commuters generally try to get into the first available

bus which is overfull thinking that the next bus would be much away or in same condition. As we can see in the app of UF, the bus capacity utilized is clearly visible in the app.

The development of such an application for PMPML was even discussed with technology experts from Mitroz Technologies.

A suitable name was also decided for the app 'DAMINI' ☺

'DAMINI' means lightning. So with the speed of lightning the information would be available to the commuters thus, making their journey safe, comfortable and rapid in real sense.

A similar app is available in US–NJ–New Jersey
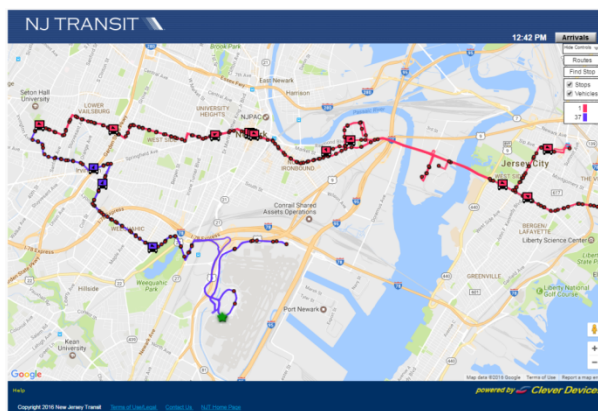(http://mybusnow.njtransit.com/bustime/home.jsp)

Bus map

Fig. 6

Close View of the Route: When the cursor is taken on the bus, it gives the exact information about the bus and its destination.
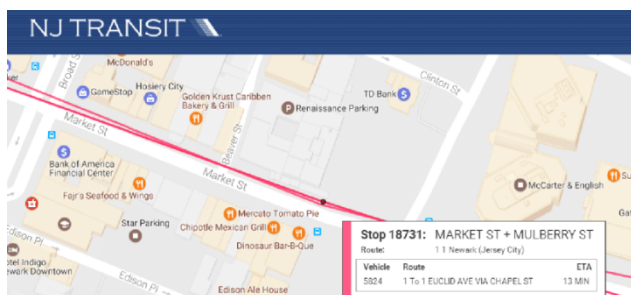

Fig. 7

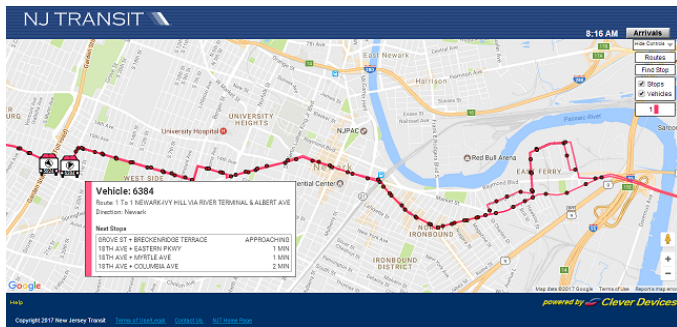Another screen shot of real-time tracking of bus in the NJ transit app

Fig. 8

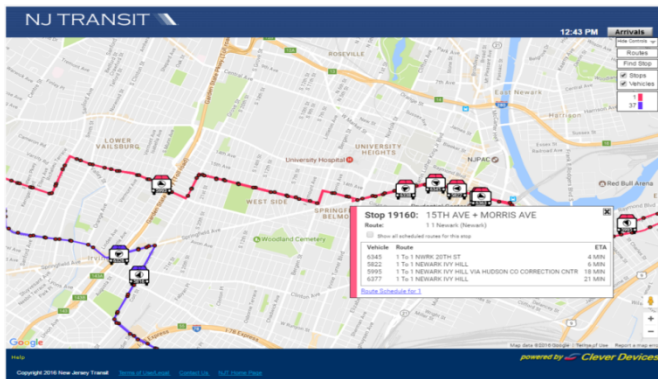Image of real-time tracking of bus

Fig. 9

This can also be used to provide any service alerts to public which is helpful to them for planning their travel.[16]

Announcements available at another app in University of Florida (Florida has a major percentage of student population using public transport).
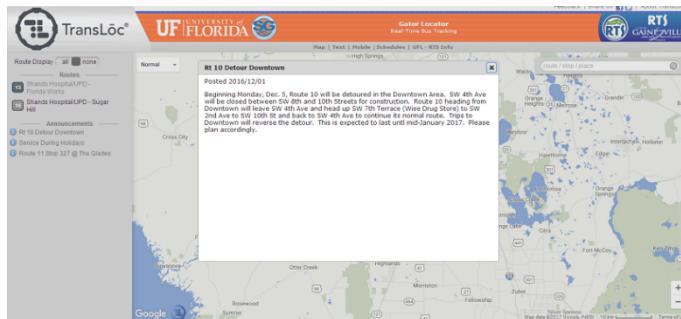

Fig. 10

Challenges in Development and Implementation of App Damini

Technical Challenges

1. The language to be used for the DAMINI app development: JAVA, HTML 5, etc.

2. Platform selection: Android, iOS, etc. Cloud based app development platforms.

3. Ability of the app to integrate and synchronize with different mobile devices with similar data and features.

4. Security issue of app.

5. Availability of Internet for the commuter.

6. App user experience has to be enhanced to make it usable.

7. Integration of vast information related to the bus routes and bus numbers.

8. Advertising within app: To make the DAMINI project financially viable, it will need to run the advertisement on the app. Integration of advertising in text, image or video form with the app.

Possible Solution: The technical challenges can be handled with ease with the help of efficient and talented technology partners, who have handled transportation related apps in the past. Such apps are commonly available in many big cities across the world and can serve as a role model to develop DAMINI.

Financial Challenges

1. The installation of GPS in all the buses of PMPML (approximately 1600 buses currently) would be an expensive affair. The GPS device will cost anything between Rs. 12,000 to Rs. 15,000 per device. So for 1600 buses it would be Rs. 192–240 lakh.

2. The software development will cost around Rs. 3 lakh (as discussed with technology partner Mitroz Technologies).

3. The app development will not be a one-time activity. It is going to require continuous upgradation and support which will involve hiring of a complete team of software and hardware technicians.

Financial Viability: The required investment of Rs. 2 crore–Rs. 3 crore in the project is miniscule compared to the Rs. 1800 crore already spent by PMPML on the BRTS project. If the PMPML authorities permit, MSL Corporate Advisory (Project Partner) is willing to partner and arrange for venture capital to implement the solution. The advertisements run on the app would be a good revenue generating source to keep the app financially viable. Commuters who do not need the advertisement can go for the paid versionwith a one-time nominal price of say Rs. 50.

System Challenges

1. The red-tapism and hierarchy in the PMPML is quite infamous. Though the PMPML is a separate entity from PMC and PCMC, it has the same work culture which existed in the old system. This restricts early implementation of many things.

2. There may be some resistance from the PMPML employees as the proposed solution makes the system efficient and accountable.

3. The app requires usage of smart phones.

Possible Solution: Partnering with an external firm could make the implementation more efficient rather than PMPML taking up the task. Of course PMPML support is needed but the relevant technical experts can be appropriately involved. Making it an open and transparent process could also speed up the task. A major portion of bus commuters are using smart phones which makes the implementation of the app easy. Additionally, PMPML is planning to introduce free Wi-Fi on the bus stops, which will further help the commuters. The profit generated from advertisement revenue could be another source of income for PMPML, which should help in coping with their losses. The proposal could be introduced in phases covering the most populous routes first and expanding to others eventually. This may also control the costs and allow to adopt, based on initial rollout.

> Jagtap told reporters that installation of GPS in buses would involve a cost of Rs 2.17 crore. 'The gadgets would be installed in the buses so that their movement can be tracked from the centralised control room, which is being set up at the PMPML headquarters in Swargate. In case of breakdowns, it would help PMPML to rush repair vehicles to the spot.'[17]

Future Plans of PMPML[18]

1. Introduction of mobility card and pre-paid cards for commuters.
2. Providing free Wi-Fi to commuters at 560 bus stops
3. Installation of GPS in all buses to track their movement and provide support in case of breakdown.
4. Timely completion of BRTS routes which are in process.

Conclusion

DAMINI would serve as a real-time tracking app for the commuters, which would be cost-efficient, easy to operate and helpful in planning travel to a great extent. I suppose with the wave of demonetization and digitization, more and more people in India have become tech-savvy helping in successful implementation of DAMINI. This is a vanilla proposition which will be improvised and flavoured with more utilities as the project development phase starts. It is high time, that we become responsible towards our environment and society. Less vehicles, less traffic,

less pollution, less accidents with more usage of a comfortable and convenient public transport. DAMINI would help us in achieving the objective of being a 'SMART PUNE'

Further Research Prospects

1. Track the financial progress of PMPML revenues.

2. Increase or decrease in the number of commuters of PMPML after implementation of 'DAMINI'.

3. Learning from the project and opportunities in other relevant public sector areas.

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