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"Implementation of Bus Rapid Transit System in Nagpur City"

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Abstract: *Transport in Nagpur is important due to Nagpur's strategic location in central India. It is a fast growing metropolis and is the third most populous city in Maharashtra after Mumbai and Pune, also one of the country's most industrialized cities. Due to increase in population as well as transportation NMPL company formed which gives the contract to Vansh Nimay Infraprojects (VNIL) to run city buses but due to increase in transportation and increase in population in Nagpur city it found that there is a numerous problem face by city buses to gave safe and efficient facility to public. Due to these, public in Nagpur city were diverting towards the private transportation. so there is extremely need to improve public transportation which can improve by bus rapid transit system which is new transportation system provide safety and mobility to road users.In these paper we shows the difference between existing public transportation system and bus rapid transit system and how the BRT is superior than other public transportation system and also providing the knowledge about automated vehicle location system which can give the exact location of the bus and other ITS (intilligent transportation system) and there benefits .For implementation purpose to know is there is need of BRT or not, various data of the existing public transportation (star bus) is collected such as accident data, Interview of people and driver for what problem they face, traffic data collection for how star bus face the problem and extra time taken to reach destination point.*

Key words: *BRT (Bus Rapid Transit system),ITS (Intelligent Transportation system).*

I. Introduction

Nagpur is one of 11 administrative districts in the Vidarbha region of Maharashtra state. Nagpur district lies between 20.35 deg – 21.44 deg North latitude and 78.15 deg-79.40 deg East longitudes. It is well-nigh triangular in shape.

Nagpur district stretches over an area of 9892 sq.kms. Area under 364.66 sq.kms is urban sector while area under 9527.34 sq.kms is rural sector. In terms of area Nagpur district constitutes 3.21% of total area of State of Maharashtra.

The population of the district according to the 1991 census were found to 3287139. The urban population were found 2031000 and rural population were found 1256139 which constituted 61.79% and 30.21% respectively of total population of district.

Whereas the figures of the 2001 census reveal that total population of district has raise upto 4068 thousand persons. The urban population 2614 thousands and rural population 1454 thousands which constitutes of 64.35% and 35.64% respectively of total population of the district. The male and female populations are 2105 thousands and 1962 thousands respectively.

Transport in Nagpur is important due to Nagpur's strategic location in central India. It is a fast growing metropolis and is the third most populous city in Maharashtra after Mumbai and Pune, also one of the country's most industrialized cities**.**

Due to increase in population as well as transportation NMPL company formed which gives the contract to Vansh Nimay Infraprojects (VNIL) to run city buses but due to increase in transportation and increase in population in Nagpur city it found that there is a numerous problem face by city buses to gave safe and efficient facility to public due to these they were diverting towards the private transportation. so there is extremely need to improve public transportation which can improve by bus rapid transit system which is new transportation system provide safety and mobility to road users.

In these paper we shows the difference between existing public transportation system and bus rapid transit system and how the BRT is superior than other public transportation system and also providing the knowledge about automated vehicle location system which can give the exact location of the bus and other ITS (intelligent transportation system) and there benefits .

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Public Transport is a mass transportation of people from one place to another place through Bus, Rail, and metro, LRT, BRT with efficient speed, punctuality, frequency, facilities, comfort, convenience, and reliability. Public transport or public transit is a shared passenger transport service which is available for use by the general public, as distinct from modes such as hired buses, metro rails, local trains which are not shared by strangers without private preparatory measures. Most of the public transport runs to a scheduled timetable with the most frequent services running to headway.

Private vehicle usage and vehicle ownership's are more in the Nagpur. Commuters are habituated to use Para-transit vehicles.

To ensure accessibility and live ability of our cities for future generations however, the substantial quality leap in public transport is necessary. This will facilitate the desired modal shift from car traffic towards public transport which is safe, cleaner and produces less congestion.

II. Methodology

Collecting information about existing public transportation system

1. Accident Data collection
2. People review towards existing public transportation
3. Finding out the congestion with HCS2000 software

The above data is collecting to know need of implementation of BRT in Nagpur city.
From los (level of service) we can know the position of congestion on selected road network.
Different ITS Parameter for Implementation of Effective BRT.

III. Study Area:

Road network selected from Nagpur city which is situated in Maharashtra, India.
Road network:-

1. sitabuldi to Ravinagar
2. sitabuldi to chatrapati sq.

The map of road network as shown in Fig1.

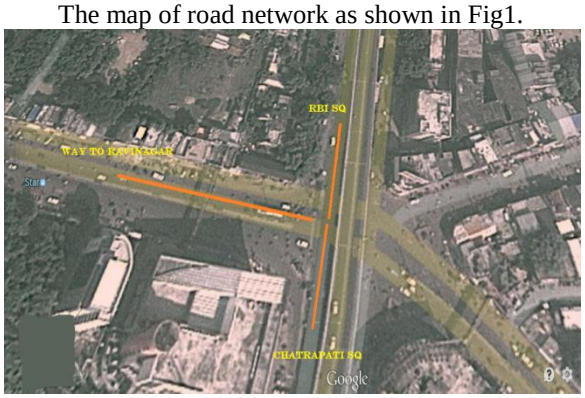

Figure 1.

Distance of selected road network

Road network	Distance
Sitabuldi - Ravinagar	3.4 Km
Sitabuldi-Chatrapati sq	4.0 Km

IV. Existing Public Transportation System :

The Nagpur city consistently becomes most congested .The Growth of city is expected to continue in Nagpur city as it is the biggest city in central India and winter capital of the state of Maharashtra. It is fast growing metropolis and It is third large populous city in Maharashtra after Pune and Mumbai .

Due to increase in population as well as transportation NMPL company formed which gives the contract to the Vansh Nimay Infraprojects (VNIL) to run the city buses but due to increase in transportation and increase in population in Nagpur city it found that there is a numerous problem face by city buses to gave safe and efficient facility to public due to these they were diverting towards the private transportation.

Figure 2. Existing public transportation (Star bus)

Fig.5 is the picture of star bus which started by Vansh Nimay Infraproject(VNIL)
Fig.3 & Fig.4 are Some of the photo shoot were taken from the Nagpur today news paper, Published On: Tue, Apr 2nd, 2013 which shows the massive traffic jam face by the star bus due to the heterogeneous traffic .

Figure 3..Other mode of transportation

Fig 4. Traffic Congestion Face by Star bus

V. Collection Of Accident Data Of Star Bus (Existing Public Transportation) :

the accident data were collected to find out how much accident are takes place per year due to heterogeneous traffic by Existing public transportation (star bus).This were found out to know is there is urgent need to implementation of BRT.

The Accident Data Collect from DSP office, Nagpur.

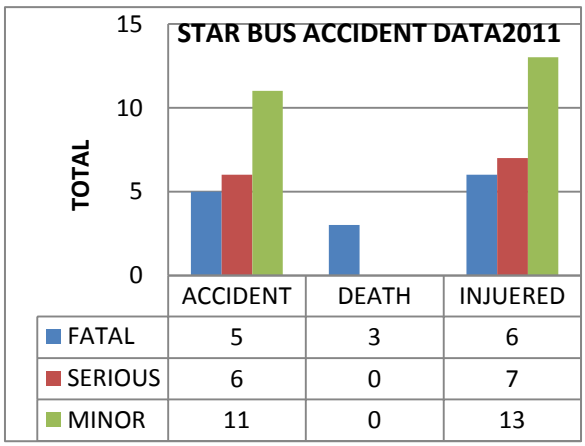

Fig 5.

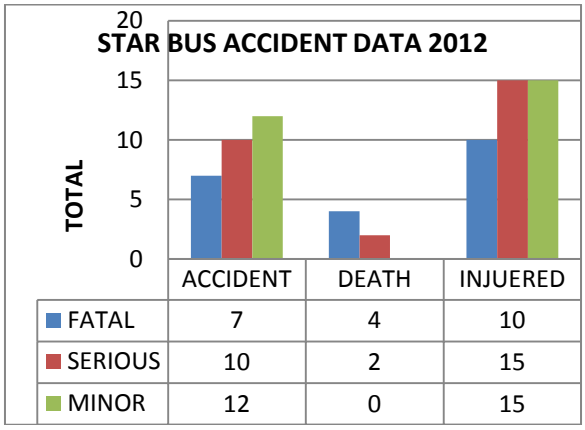

Fig.6.

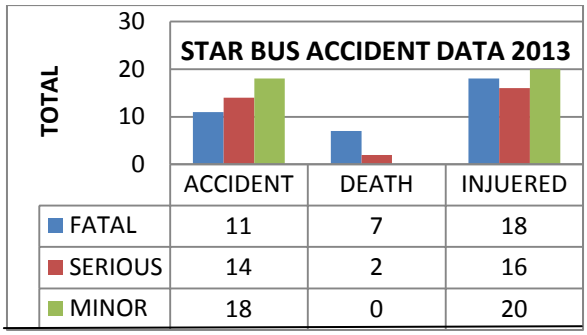

Fig 7.

from above observation ,The accident are categorized according as fatal ,serious , Minor. In 2011 fatal accident are 5 in it 3 people were dead and 6 were injured ,In serious and minor 6 and 11 accidents took place respectively. In it 2 people died and 36 people were injured. The total number of accidents takes place are 43.similarly in 2012 and 2013 the total number of accident were 29 and 43.The above figure shows that the accidents rates are increased per year by bus due to heterogeneous traffic.

VI. Public And Driver Opinion Towards Existing System :

Regards to existing system of public transportation ,the opinion and view toward the existing system conducted by NMPL company formed which gives the contract to Vansh Nimay Infraprojects (VNIL) to run city buses, is necessary. Because if the view of public and Driver towards the existing system is good, The peoples will automatically diverted on public transportation the growth of public transportation is increase and The use of private transportation facility will be reduce which directly puts good impacts on Indian economy.
for getting review or public and Driver opinion-
strategy plan-

A. Survey of 50 peoples which uses the public transportation Facility

- Collecting information ,For what purpose they are using Public Transportation Facility
- Problem Facing

B. Driver's opinion about Existing system

- Collecting Information From the driver and
- There point of view

The survey of 100 peoples which uses public transportation facility (city bus) and Drivers of city bus were conducted .

The most of the people are from Nagpur which uses the city bus for going to school, colleges , and their respective works when the survey were conducted it was found that the most of were unhappy by using the existing public transportation system. there review was not satisfactory because the time taken to reach their destination point for example school, colleges, office and their respective works is more .The people have fear in their mind of accidents because the traffic on the road are highly congested and the bike drivers ,rickshaws

and pedestrians not follows the rules and regulation ,not driving their respective vehicle properly and there is more chances of accident happening.
According to driver point of view due to heterogeneous traffic they face many problem due to improper driving of the vehicle user they suffer from accident. Drivers of the city bus face the congestion problem due to this the time required to reach the respective destination point is more. Drivers are mentally harassed by improper behavior of road users .They do not fill safe while Driving the star bus in heterogeneous traffic.

VII. Finding out LOS (LEVEL OF SERVICE) by HCS 2000

Level of service (LOS) is a qualitative measure used to relate quality of traffic service. LOS is used to analyze the highways by categorizing traffic flow and assigning qualitative levels of traffic based on performance measure like the density, speed etc.

7.1Finding out the Level of service with HCS 2000 Software:

- Level of service with HCS 2000 software requires the traffic data of peak hour of selected route network.
- Input the peak hour traffic data of seven days selected route network in HCS 2000 software.
- HCS 2000 software gives level of service as output.

The Data of selected route network from (sitabuldi sq, ravinagar sq and chatrapati sq) from morning 9.00 am to 10.00am and evining data from 5.00 pm to 6.00 pm peak hour at every 15 min. interval were collected and the data is converted into pcu (passenger car unit factor) as per(IRC64:1990).

Table1. Sitabuldi Sq.

NETWORK	Left turning (Vehicle in pcu)	Through sraight going (Vehicle in pcu)	RIGHT Turning(Vehicle in pcu)
SITABULDI West bound (9.00 am to 10.00am)	1822	2071	1598
5.00pm To 6.00 pm	1606	1644	1881
SITABULDI East bound (9.00 am to 10.00am)	1417	1450	1353
5.00pm To 6.00 pm	1367	1541	1446
SITABULDI North bound (9.00 am to 10.00am)	1079	1193	822
5.00pm To 6.00pm	1111	1149	860
SITABULDI South bound (9.00 am to 10.00am)	1117	1156	843
5.00pm To 6.00 pm	1046	1200	974

Table2.Chatrapati Sq.

NETWORK	LEFT (Vehicle in pcu)	Through(Vehicle in pcu)	RIGHT (Vehicle in pcu)
Chatrapati sq West bound (9.00 am to 10.00am)	957	1251	737
5.00pm To 6.00 pm	910	1346	845
Chatrapati sq East bound (9.00 am to 10.00am)	1760	1974	1571

5.00pm To 6.00 pm	1527	1734	1426
Chatrapati sq North bound (9.00 am to 10.00am)	1478	1931	1447
5.00pm To 6.00pm	1595	1531	1439
Chatrapati sq South bound (9.00 am to 10.00am)	1692	1996	1402
5.00pm To 6.00 pm	1306	1734	1432

Table3. RaviNagar Sq.

NETWORK	LEFT (Vehicle in pcu)	Through(Vehicle in pcu)	RIGHT (Vehicle in pcu)
Ravinagar sq West bound (9.00 am to 10.00am)	1708	1997	1583
5.00pm To 6.00 pm	1760	1974	1571
Ravinagar sq East bound (9.00 am to 10.00am)	1323	1408	1259
5.00pm To 6.00 pm	1334	1404	1376
Ravinagar sq North bound (9.00 am to 10.00am)	944	1251	711
5.00pm To 6.00pm	831	1193	822
Ravinagar sq South bound (9.00 am to 10.00am)	948	1115	740
5.00pm To 6.00 pm	991	1209	860

This Data were input in HCS 2000 and finding out the result:

A.Input Traffic Data of Sitabuldi inetersection-

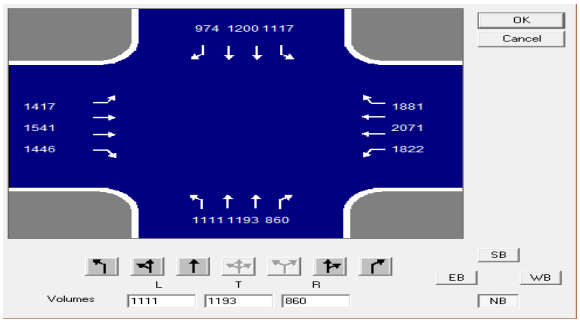

Fig.8.

Result output for sitabuldi Intersection:

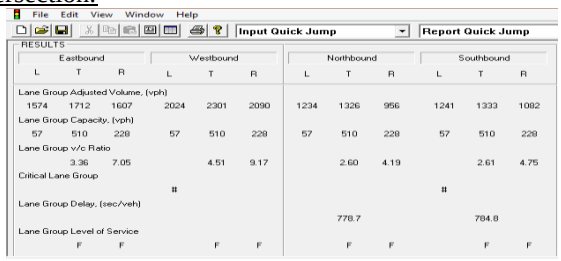

Fig.9.

B. Input Traffic Data for Chatrapati Intersection:

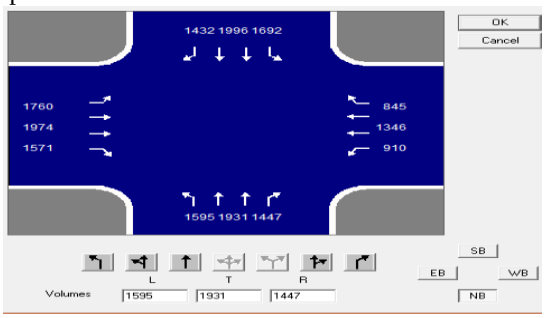

Fig.10.

Result output for Chatrapati Intersection:

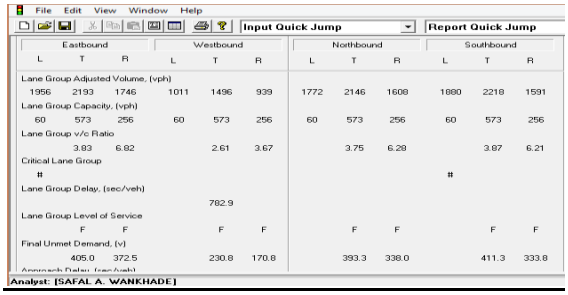

Fig11.

C. Input Traffic Data for Ravinagar Intersection:

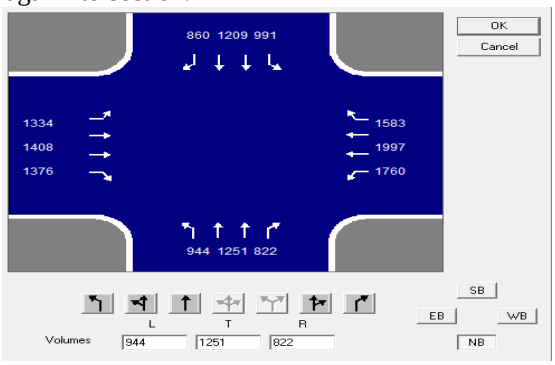

Fig.12.

Result output for Ravinagar Intersection:

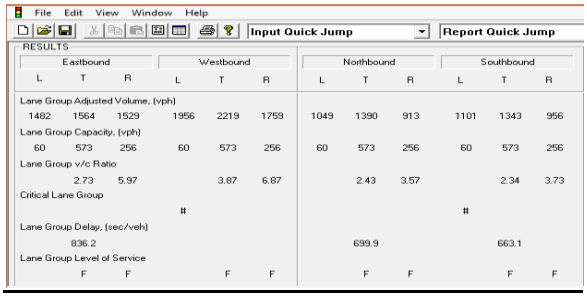

Fig.13.

7.2.Results of Level Of service for selected Route network :

- Sitabuldi sq
- Chatrapati sq
- Ravinagar sq

Is found to be F : This describes a forced flow operation at a low speed, where volumes are below the capacity. In extreme, both volume and speed can drop to zero. these condition result from queues of vehicles backing up for restriction downstream. Section under study will be serving as the storage area during parts or all of peak hour. Speeds are reduced substantially and stoppages may occur for short or the long periods of time because of downstream congestion. So there is urgent need for implementation of Bus rapid Transit System.

VIII. Bus Rapid Transit System (Brt) :-

8.1. Historical development of BRT in the world: The first broad scale development of BRT started in a Curitiba (Brazil) in 1974, there were several smaller-scale projects leading to its development. Since then, Curitiba's experience has motivated other cities to develop the similar systems . In the 1970s,evolution of BRT systems was limited to North and South American continent. In late 1990s, the replication of the BRT concept boosted and BRT systems were opened in Quito,Equador (1996), Los Angeles, USA (1999) and Bogotá, Columbia (2000). Especially, the TransMilenio project in Bogotá started operation in 2000 and its success drew concentration from the world community as an example of the state of the art in BRT systems. As of 2030, there are many BRT systems around the world, depending on one's definition of BRT (Levinson et al. 2003; Ernst 2005.

The mission of Bus Rapid Transit (BRT) is to combine the flexibility and low implementation cost of bus service with the flexible, efficiency, cost-potential, land use influence and versatility of light rail transit (LRT). Various projects around the world have indicated that BRT is an effective alternative for congested cities at a relatively low construction and operation cost. Cities in developing countries have struggled with the problem of how to ascent and improve existing transit services at a low cost . Developing countries with high transit-dependent populations and limited financial resources has increasingly attempted the use of BRT systems because of their low costs and relatively fast implementation times. BRT has demonstrate that it allows low fares and reduced travel times for low income users . BRT systems such as Curitiba in Brazil and Transmilenio in Colombia are best examples of the success that the BRT system has had in Latin American countries.

8.2. Definition Of BRT: In past decades, BRT systems is an innovative, lower cost, high capacity public transit result. There is no delicate definition of BRT. Wright defines it as a "bus-based mass transit system which delivers fast, flexible, and a cost effective urban mobility".According to the Levinson et al.2003 It defined as "a flexible and rubber tired rapid transit mode that combines stations, vehicles, running ways, services and Intelligent Transportation System (ITS) elements into an integrated system with a strong positive identity that raise a idiomatic image". Lloyd Wright ITDP (2002), "It is a high quality public transport system, Oriented to user that offers fast, comfortable and low cost urban mobality".

Diaz et al.(2004) "BRT has the potential to provide a Higher quality experience than possible with traditional bus operations due to reduce travel and waiting time, increased the service reliability and improved usability".Wright and Hook (2007) "BRTS is a Rubber-tired mode of public Transport that enables efficient travel". PNUMA (2010) "BRTS is also capable of improving local and Global Environmental conditions. BRT is a public transit mode that uses buses to provide a light rail quality of service. BRT merge the flexibility and low cost of bus service with the flexible, efficiency, cost effectiveness.

For Implementation of BRT knowing the exact condition of the Nagpur city so the survey of the selected road network is done.

9.3 BRT Runway Width

There are no hard rules regarding the necessary road width. Successful BRT system have been built in areas where the entire road width is only 3 meters (e.g., portion of the Quito historical centre). In an ideal situation, the roadway width will support a median station, one or two BRT runways, two mixed traffic lanes, and adequate space for pedestrians and cyclist.

A standard vehicle lane is typically 3.5 meters in width. However, lanes can be narrow as 3.0 meters and a narrow lane will tend to reduce speed and the risks of serious accidents. A BRT vehicle and many trucks are typically 2.6 meters in width while a standard car is approximately 2.2 meters in width. So the BRT lane is consider as 3.5 meters as per ITDP manual.

Considering parameter for implementing BRT:-

Minimum width required for BRT road:

3.5m (for BRT) + 7.0(for mix traffic) on both side+3.5m footpath+1.2m divider =29.2m

- If the road is already widen then there is no need of laying extra lane for BRT purpose.
- For NAGPUR—
- Network selection

- Sitabuldi-ravinagar sq = 29.2m wide road
- Sitabuldi –chatrapati sq = 29.2 m wide road
- Sitabuldi-RBI sq = 29.2m wide road

selected road network have required width for implementing BRT.

IX. Considering Effective Parameter To Enhance Brt .

9.1Automatic vehicle location Automatic vehicle location (AVL) technology is applied to monitor the location of transit vehicles in real time by the use of GPS devices or other location-monitoring methods. Information about the vehicle location is transmitted to a centralized control center in either raw data format or as processed data.

9.1.1Benefits

There are several benefits associated with application of an AVL system on BRT vehicles:

9.1.2Improved system control. The system can be calibrated with greater ease to distribute service times and coverage adequately through the application of signal priority and control centre and on-street supervision.

9.1.3Improved bus safety. In an emergency, the transit control center can relay vehicle location immediately to emergency response agencies.

9.1.3Improved quality of service. Passengers can be notified in real time of the location of the next bus and its expected arrival time.

9.1.4Improved system integration. Bus transfers can be better scheduled and controlled by knowing the location of each vehicle

9.2Transit signal priority: Transit signal priority (TSP) is the process of altering traffic signal timing at intersections to give a priority to transit operations.

9.2.1Benefits

Benefits from TSP to BRT operations can be found in three areas:

9.2.2Reduced bus travel time: Travel time savings associated with TSP in North America and Europe have ranged from 2 to 18 percent, depending on length of corridor, particular traffic conditions, bus operations, and the TSP strategy implemented. The reduction in bus delay at signals has ranged from 6 to 80 percent, again variable based on particular local conditions and strategies.

9.2.3Improved service reliability: Schedule adherence as measured by the variability in BRT travel times and arrival times at stops can enhance significantly with TSP application. In Seattle and Vancouver, bus travel time variability with TSP application was minimized by 35 to 40 percent. In Portland, Tri-Met avoided adding a bus to a corridor by using TSP and experienced up to
19 percent minimization in bus travel time variability.

9.2.4Reduced bus operating costs: By reducing bus travel time and delay and the variability in travel time and delay, transit agencies experienced both capital cost savings (by saving one or more buses during day on a route) and operating cost savings (due to more efficient bus operation). For the first two BRT corridors implemented in Los Angeles (along Wilshire/Whittier and Ventura boulevards), the transit agency realized an estimated cost savings of $110 per bus per day or $3.3 million per year.

X. Conclusion

BRT systems can attract new riders to transit and induce transit-oriented land use and economic development in a broad variety of environments. BRT systems is an innovative, high capacity, lower cost public transit solution. Integrated BRT with ITS improves the flow of transit system and extracts the efficiency from existing system.

Reference

[1]. Vincent, William; Jerram, Lisa Callaghan. The Potential for Bus Rapid Transit to Reduce
[2]. Transportation-Related CO2 Emissions. Journal of Public Transportation, Volume 9, Issue 3, 2006, pp 219-238
[3]. Guey-Shii Lin, Ping Liang, Paul Schonfeld, Robert Larson, "Adaptive Control of Transit Operations", Final Report for Project MD-26-7002, Transportation Studies Center University of Maryland, 1995, pp6-10.
[4]. Furth, P.G. and T.H.J. Muller. Conditional Bus Priority at Signalized Intersections: Better Service Quality with Less Traffic Disruption Transportation Research Record 1731, 2001, pp. 23-30.
[5]. IRC 64:1990 AND M.O.R.T.H(Ministry of road transport and highway)
[6]. ITS service manual: T1919A Metrocom II 150.8-174 MHz Vehicle Location Receiver, (Schaumburg, Illinois: Motorola Communications and Electronics, 1979).
[7]. Itdp International devlopment policy manual 2007.
[8]. Transit Cooperative Research Program (2000). TCRP Report 63: Enhancing the Visibility and Image of Transit in the United States and Canada. Washington, D.C.: National Academy Press. Cited in Diaz, R.B. (editor) (2009). Characteristics of Bus Rapid Transit for Decision-Making, Federal Transit Administration (FTA), United States Department of Transportation (U.S. DOT), Washington, DC..
[9]. Vuchic, Vukan R. Light Rail and BRT: Competitive or Complementary?. Public Transport International, Issue 5, 2005, pp 10-13