A citizen volunteered application for rural commuters to manage traffic congestion- Potentials for a GIS based mobile application

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Abstract:

Sri Lanka with a population density of 316/km^2 has a rural roads network almost closer to 140,000km, and more than 70 % of its population still live in rural areas. Even though this implies an overall road density of around 1.5km/square km, spatial variability of "ability to move" in other words, provisions for mobility are not uniform throughout the country. Beside above, throughout the last 2 to 3 decades, governments of developing countries in general and in particular in Sri Lanka had been investing colossal amounts of borrowed money to have high mobility networks, i.e., expressways constructed mainly for the benefits of urban population. Rural poor commuters still spend 1.5 to 2.0 hours to travel 20 km distance either to reach or to leave the capital city during peak periods using whatever the mode.

Today almost all urban commuters use smart phones, so they have access to reach real time status of traffic congestion, accordingly could plan their mobility plans. A rural commuter in average needs to travel 3.5 km to 10 km to reach a point on the national road network, and majority of them do not have smart phones either. Objective of this research study was to develop a citizen's volunteered based information system to provide status of traffic and that of other obstructions within the rural networks to rural commuters so that they could plan their mobility needs.

A pilot study was carried out by selecting volunteered village citizens covering a rural roads network, information collected by them about the status of rural networks, availability of bus services were reported to the unit that was established at the area police station. This real time validated information with spatial and temporal dimensions is uploaded to a GIS based server and then text messages are transmitted to all those registered village commuters.

Keywords: Real time, volunteered citizens, rural commuter, urban commuter, mobility, validation

1. Introduction – General

Sri Lanka is an Island, located within the Indian Ocean, (see Figure 2.0). Total area of the country is approximately 65,610sq.km. Since year 2016, growth of population remains at 1.1%. The country have 3.1% of poor households, estimated based on the official poverty line. Population density of the country is approximately 342 per sq.km, and the country still shoulder an unemployment rate of 4.2%.

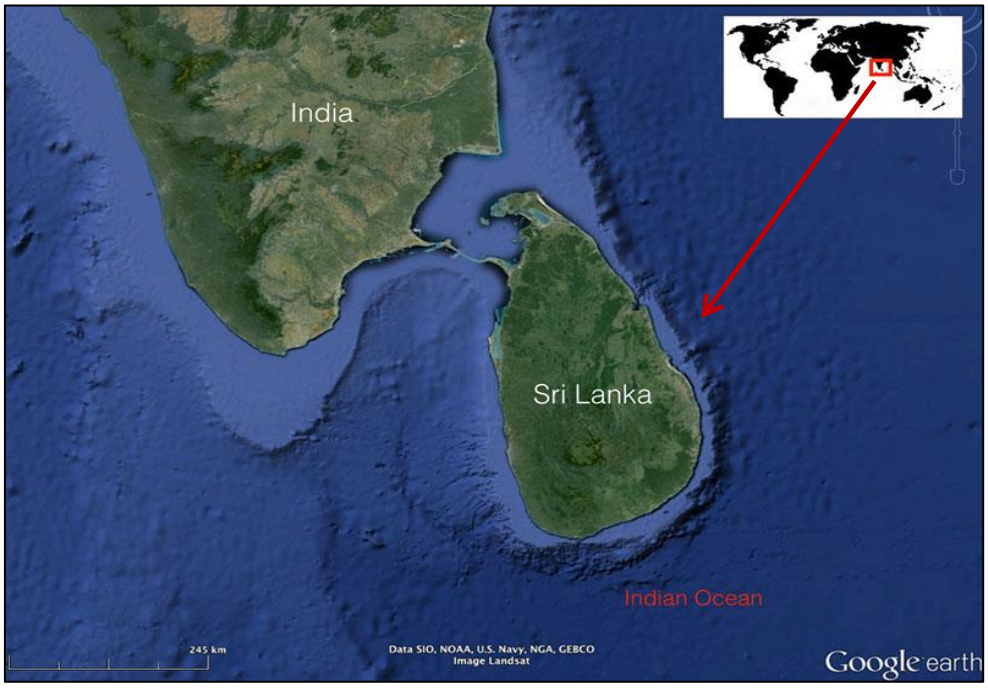


Figure 1.0: Spatial position in Sri Lanka

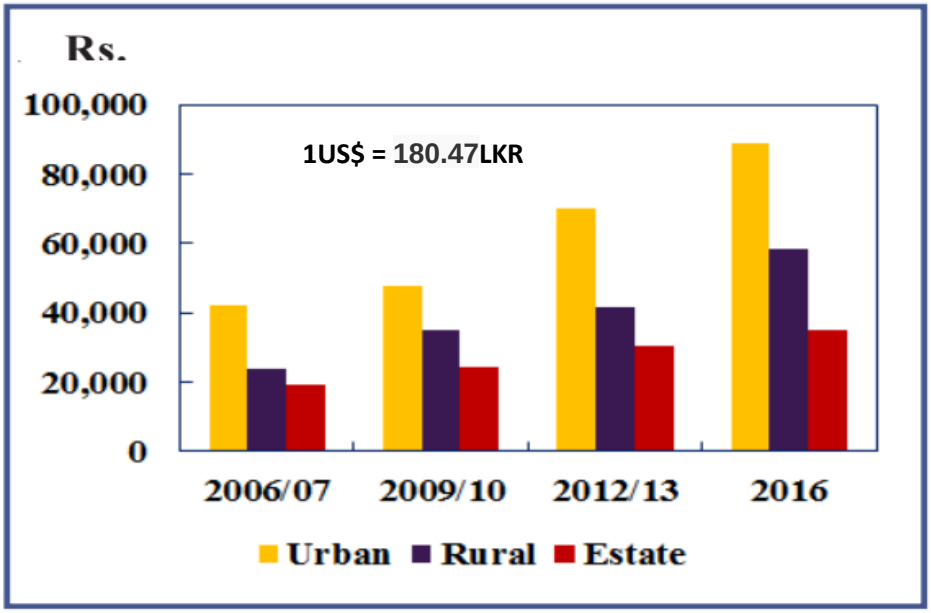


Figure 2.0: Average monthly household income by sector

2.0 Status of Transport

Almost 80% of the country's transport demand is met through surface modes that is by private cars, small vans, three wheelers, public transport busses and to some extend by the railways. The Figure 3.0 shows the growing trend of car ownership of the country. The Figure 4.0 shows the growing trend of total number of registered vehicles during the period 2013 to 2017.

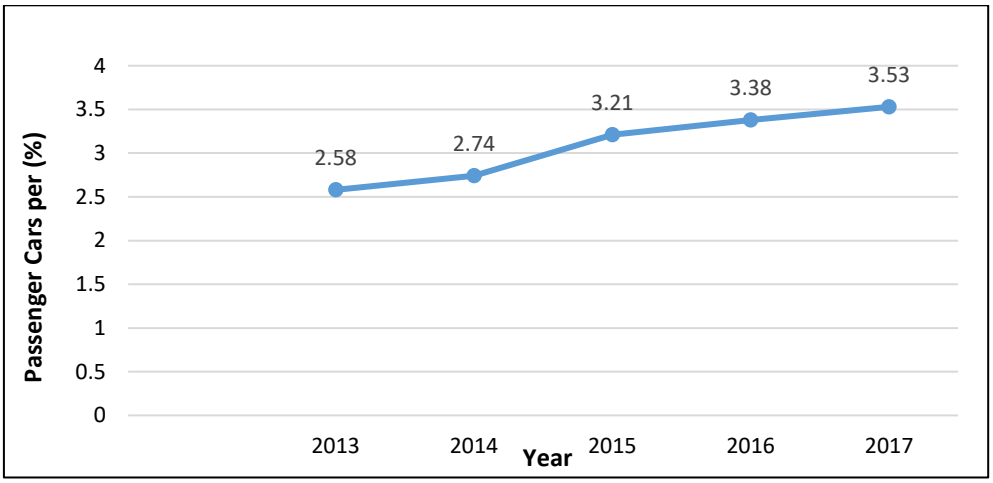


Figure 3.0: Growth trend of car ownership – cars per 100 people

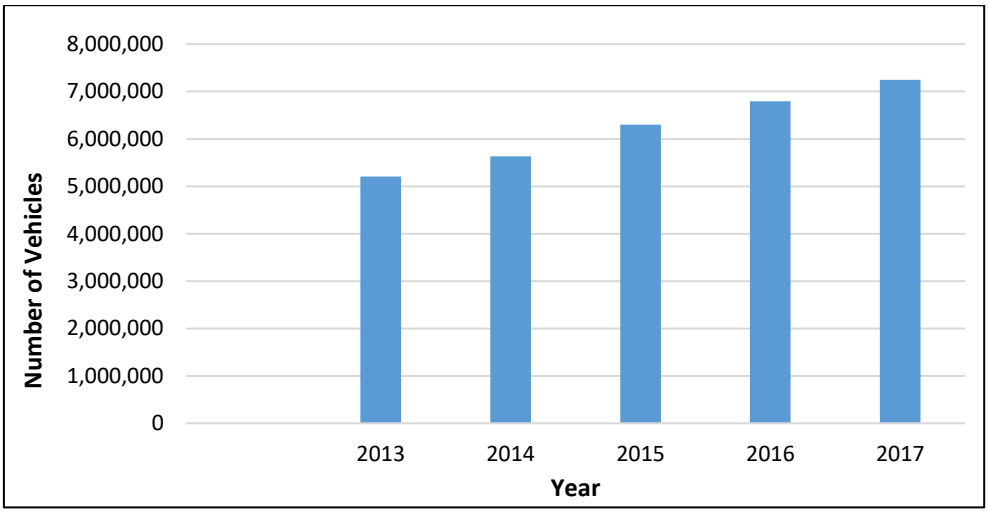


Figure 4.0: Growth trend of registered vehicles

2.1 Status of Rural Accessibility

The total road network of the country amounts to 10,442 km of national roads, 15,302 km of provincial roads, and over 65,000 km of rural roads and further 16,300 km of roads belong to specific agencies.

When the density of surface road network, is considered which is approximately 1.72 km/sqkm, Sri Lanka has a quite satisfactory road density. Yet the disparity over the status of mobility provision, despite having a high road density is significant. There are more than 2000 rural villages that do not have access to vital social service centers. Further there are about 200 villages which are only connected only by railway with no road access.

In the North and East there are villages that are connected only by causeways and inland waterways. Over all about 6% of villages in the country do not have usable access to reach points on national network where public mobility services are available.

2.2 Status of Rural Mobility provisions.

It is obvious that a full range of motorized and non-motorized vehicles are in use throughout rural areas. However, availability of the provision to a greater extend depends on many variables, such as, poor infrastructure, ever forgotten maintenance, weather, demand, status of economic activities etc.,

Still today, the main form of mobility provision is shouldered by the buses operated by both public and private sector. Today because of unreliability of the provision of both public and as well as private buses villagers are relying on three wheelers, motor cycles, foot bicycles and even on animals such as donkeys and oxen, and eventually many of them rely on walking by themselves. Figure 4.0 and Figure 5.0 illustrates, how commuters of unconnected villages, accomplish their mobility needs.

Figure 5.0: Situation that has been there for the last 20 or more years

Figure 6.0: Road infrastructure is mobility provision.

The objective of this study was not to provide solutions for the rural transport issues prevailing in Sri Lanka, but to develop an ICT based information system for rural commuters, so that they even could plan their mobility needs, considering congestion and other obstacles along national roads on weekdays during peak periods.

3.0 Current Practices and Future Trends

Today the use of Transport Demand Management strategies had significantly limited to provide interventions to urban areas. Urban traffic chaos are been created due to congestion, accidents, environment problems, urban concentration and sprawl. Many developed countries adopt ICT based approaches to develop corporative systems between vehicles and infrastructure (MAKINO, 1997).

In principal, system architecture of such a system could be presented as shown in Figure 7.0.

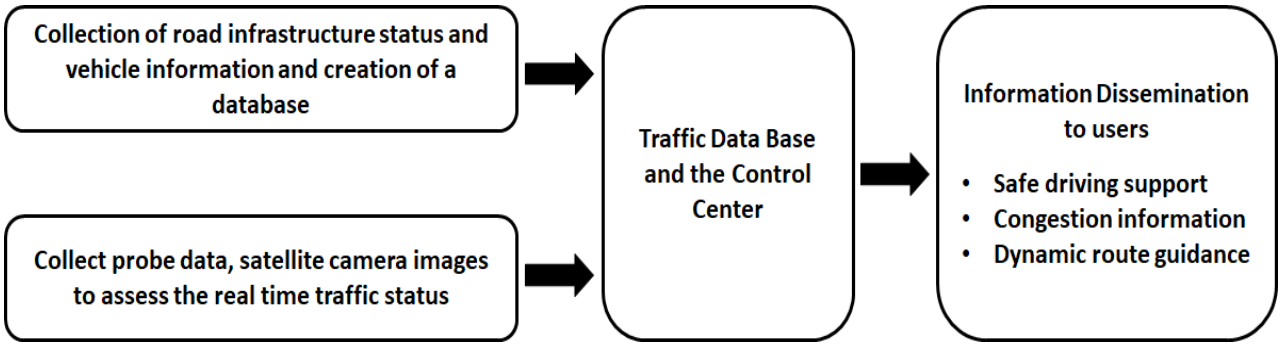


Figure 7.0: Geo-spatial based information system to provide real time information to commuters.

Further in many developed countries, particularly urban traffic is controlled by adopting Integrated Transport Interventions. Figure 8.0 shows the concept of such a system.

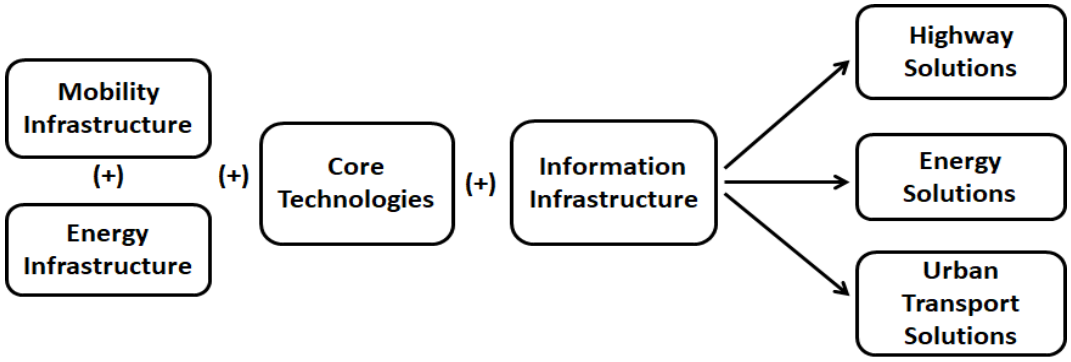
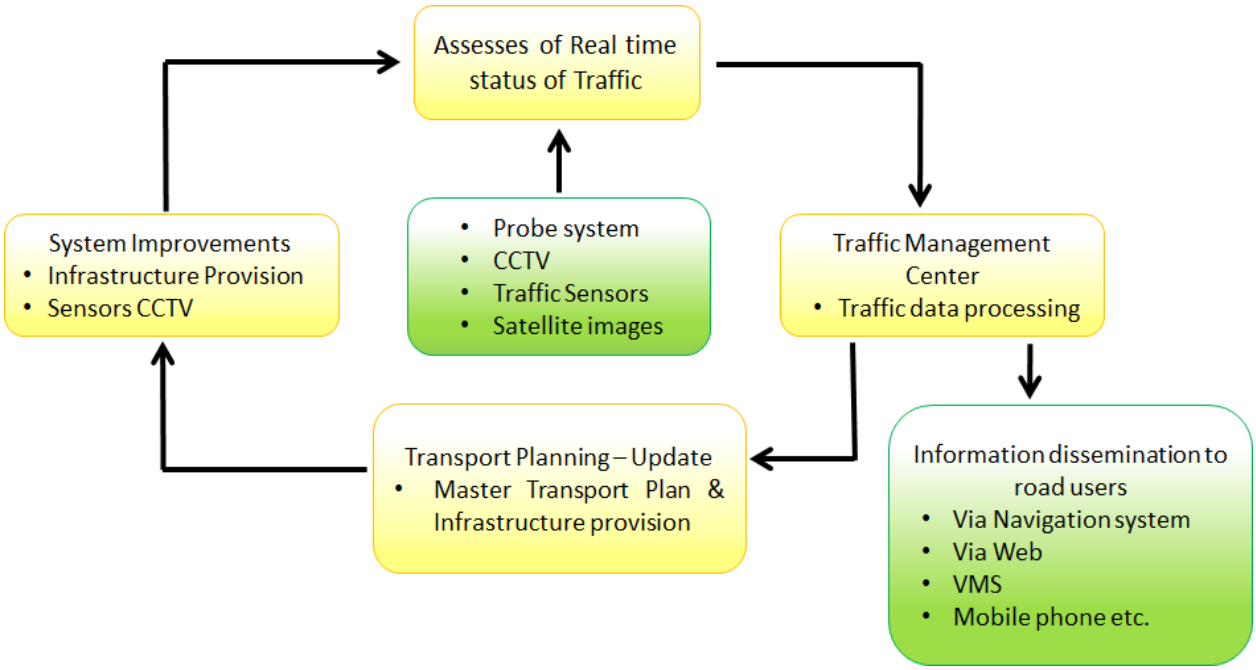


Figure 8.0: The concept of Integrated Transport Solutions.

4.0 Methodology

4.1 Current Approaches

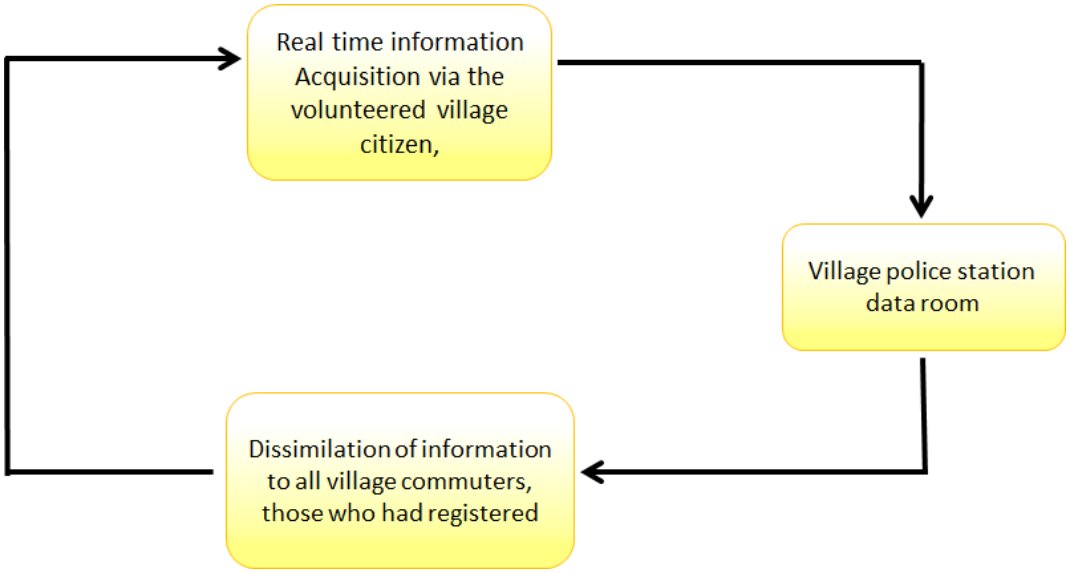
Geo- spatial technologies based, traffic management frame works in general could be represented as showing in Figure 9.0.



Figures 9.0: Commonly adopted default approach.

4.2 Citizen Volunteered Approach

Application of geo-spatial technologies based approach could not be adopted and could not even be financially viable for the provision of "real time information "to rural commuters. As such, authors carried a low cost, practically implementable system, i.e. a citizen volunteered approach for rural commuters to manage their mobility needs avoiding congestion and all possible other obstacles preventing smooth mobility. The Figure 10.0 illustrates the system architecture of the concept at a glance.



Figures 10.0: The System Architecture of citizen volunteered approach.

4.3 GNS Division selected for the pilot study

a) Sri Lanka is divided in to 25 Administrative Districts and under these 25 Administrative Divisions, there are 331 Divisional Secretaries (DS) and under there 331 Divisional Secretaries, there are 14021 Grama Niladari Divisions(GND). A GND is the smallest administrative division.

For this pilot study, authors selected the GN Division called "Ihalagama" that falls within the DS Division of Galgamuwa of the Kurunegala Administrative District. Figure 11.0 shows the GIS Map showing the main national roads and all the rural roads network, over laid with the rural household units.

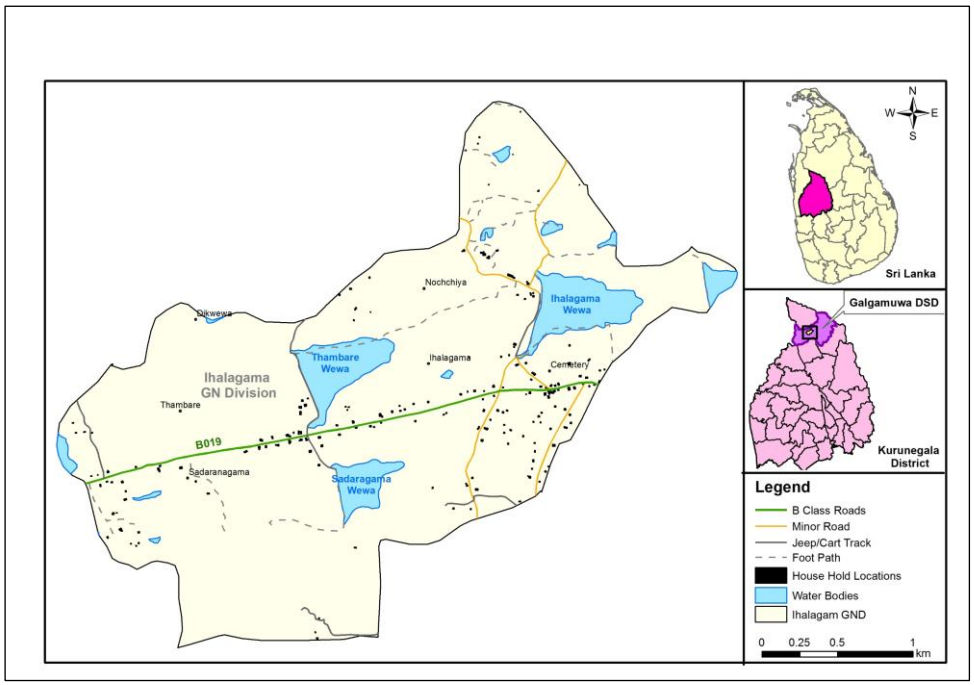


Figure 11.0: The GIS Map of the DSD with the road network overlaid with rural households.

b) Positioning of volunteers

An awareness session was held at the DS Division of Galgamuwa. GN helped to identify personal within the division, who had involved in similar efforts and eager to devote time for social works, both young and elderly persons showed interest to contribute to this project. Village volunteers were selected, so that each volunteer will get approximately equal road length to cover. All volunteers had motor bikes, so they could cover the respective length quota within a period of maximum 30 minutes.

The Figure 12.0 shows spatial positions of households where selected village volunteers are living and they were asked, to collect roadway status during 3 time slots, morning (5.00-5.30), mid time (12.30-13.00) and evening (17.30-18.00).

All volunteers had smart phones so that they could call the center and inform whether there is an issue. The issue could be, any obstruction preventing smooth mobility. Pilot

trial runs were conducted, to train all volunteers, how to use phone to collect an image and to use WhatsApp, Viber or Imo to convey them to the control room. Types of obstructions were normally of following nature.

i. A fallen tree, fallen electrical power line.

ii. Road sections, washed away, collapsed etc.,

iii. Vehicle breakdown.

iv. Weather status, raining, about to rain.

v. Details of accidents if any.

vi. Road construction works

vii. Street protests etc.,

viii. Status of congestion alone main roads.

c) Bus Service Availability and Arrival Information

Rural villagers normally have only one or maximum two buses operating particularly in early mornings, mid-day and again in evening. Service reliability of these buses are in general very poor due to so many reasons as such availability of these buses are so much vital for rural commuters to plan their mobility needs.

Under this study, one volunteer was appointed to check the availability of bus services and to assess whether there might be a delay in reaching the bus halts. This information too, is conveyed to the computer placed at the police station.

4.4. Dissemination of information as text messages

Upon receiving the information related to obstructions and availability of bus services the control room server will generate TEXT messages and will deliver to respective households those who had registered. In particular information about the availability of bus services is delivered to those who had intimate a text to 1126,

In general, all subscribers will automatically receive information during morning, mid-day and evening. Figures 12 shows the user interface with this information and figure 13 shows the user interface with details of bus availability.

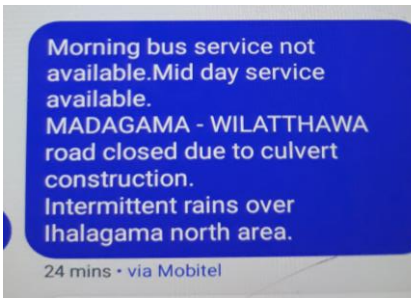


Figure 12: all commuters will receive this information during mooring, mid-day & evening

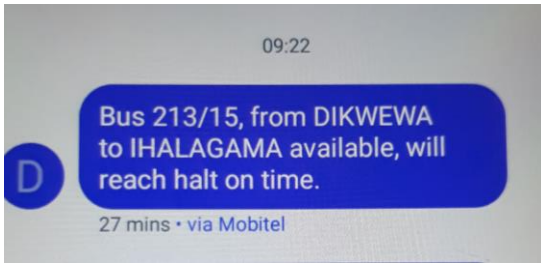


Figure 13: Bus availability & arrival information on request

5.0 Conclusion

Still more than 70% of the population lives in rural areas of the country, yet only the urban flocks are blessed with high quality transport provisions. Further, they enjoy all advantages of Transport Demand Management (TDM) tools, so that they could effectively plan their mobility plans.

Rural commuters waste their time significantly at bus halts, as they do not have access to real time information about the status of their bus services. Both politicians and relevant authorities too had been used to keep quiet, because rural people are mostly innocent and do not have any means to influence politicians.

Through this research, authors had been able to introduce low cost, practically executable system to provide decision supportive information for the rural commuters as text messages to even to their analog phones, so that they could plan their mobility plans.

6.0 Reference List

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