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Prediction of Real Time Bus Arrival

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ABSTRACT

This system is possible by the use of GPS traces gathered from the prediction of real time bus arrival system implemented vehicles to determine routes, locate stops. This system determines the route served by a given vehicle at a given time and predicts its arrival time at upcoming stops. We evaluate this system on real datasets from two existing transit services. We showed from this system has the ability to accurately reconstruct routes and schedules, and compare our system's arrival time prediction with the current "state of the art" for smaller transit operators: the official schedule. Finally, we discuss our current prototype implementation and the steps required to take it from a research prototype to a real system.

Key word: GSM, GPS, Real Time, server

1. INTRODUCTION

In this busy world no one wants to be in trouble in traffic or in any difficulties. So he will search smart way to escape from that trouble. Some people don't know exactly at what time buses will come and all. To escape from traffic etc this project will be useful to come out from that (K. Takao, et al. 2005). Our bus arrival time prediction system comprises three major components: (1) Sharing users (2) Querying users (3) Backend server Implementing such a participatory sensing based system, substantial challenges. (1) Bus detection. (2) Bus classification (3) Information assembling. In this, there is a practical solution to cope with such challenges (K. Takao and K. Sugahara, 2007).

2. THREE MODULES

2.1 Bus Module

The bus module is made by GPS and GSM module. GPS module is used to track the bus and transfer the bus position information through SMS, to the head office. The passenger can send an SMS to get information about the present status of the bus.

2.2 Bus Stand
Bus stand module consists of a GSM module with a 20x4 line LCD display. The GSM module gives information about the route bus arrival time. The LCD displays the bus number, route information with time required to arrive.

2.3. Head Office
A GSM module is attached to the computer to receive SMS from each bus. Passenger can get the bus information through SMS to the head office. The software is developed using DOTNET (Joshua S. Greenfeld, et al. 2002)

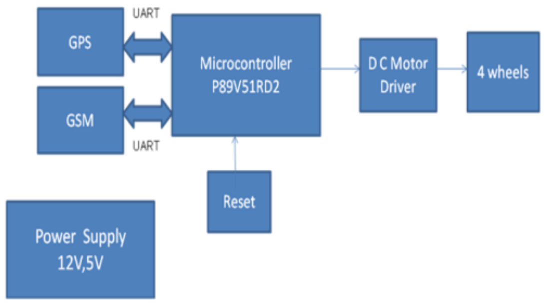
2.4. Block Diagram


Fig 1:- Bus Module

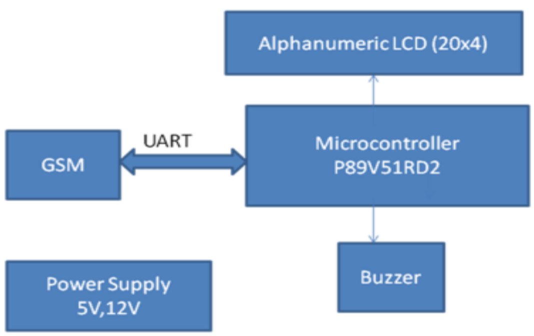


Fig 2:- Bus Stand

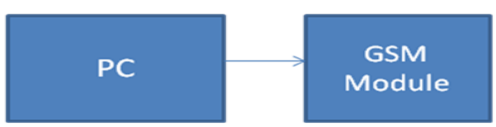


Fig 3:- Head Office

3. REAL-TIME INFORMATION DISTRIBUTION
Medium through which information about bus arrival is spread by is the electronic sign, also known as a dynamic message sign located at a bus stop. There were a total of 98 signs located at bus stops in the United States and 1,981 signs located at bus stops among the non-U.S. respondents. Of all the types of electronic signs available, the light-emitting diode (LED) sign and liquid crystal display (LCD) signs being used.

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Fig 4:- Portland, Oregon, Tri-Met Transit tracker sign.

3.1. Cell tower sequence matching

Sharing passenger on the bus at location A. The backend server will receive a cell tower sequence of _7,5,8,3_ when the sharing user reaches location B. Say that the cell tower sequence of the bus route stored in the database is _1, 2, 4, 7,5,8,3, 9, 6_, then the sequence_7, 5, 8, 3_ matches the particular bus route as a sub segment .

Fig 5:- Los Angeles Department of Transportation/Los Angeles County Metropolitan Transportation Authority Metro Rapid Bus stop shelter sign.

Fig 6:- London Buses Countdown sign**.**

Fig 7:- Bus arrival sign in Rome, Italy.

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Figure 8 show a unique system used by City Bus in Williamsport, Pennsylvania, provides the real-time location of each bus within the transit center.

Fig 8:- City Bus Transit Centre sign.

Figure 9. The current vehicle location and the direction of travel are displayed. Another example combines the real-time vehicle location display with predicted arrival time, as shown in Figure 11. This system, called Ride Finder.

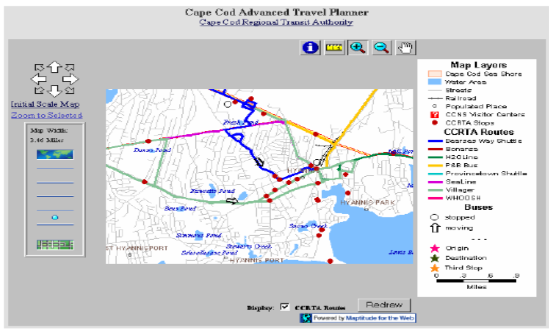

Fig 9:- Cape Cod Regional Transit Authority (CCRTA) real-time bus location map.

Fig 10:- Ride Finder real-time bus location screen

Electronic signs at bus stops, many other types of media being used to distribute real-time bus arrival information. Seven of the responding U.S. Figure 11 provides the distribution media for the survey respondents

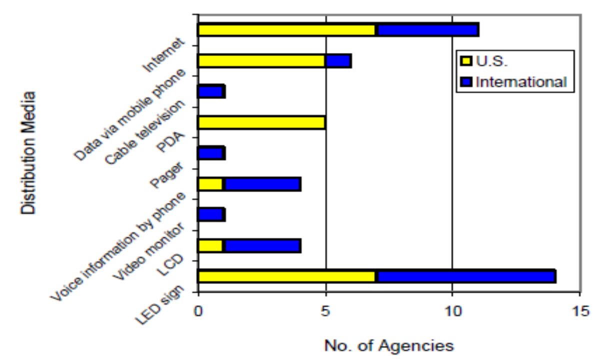

Fig 11:- Distribution media for real-time bus arrival information.

4. SYSTEM ARCHITECTURE AND OVERVIEW

As illustrated in Figure 12, the Easy Tracker architecture Consists of a data gathering subunit in each vehicle, a number of algorithms for online and batch data processing, and one or more user interfaces for the transit user.

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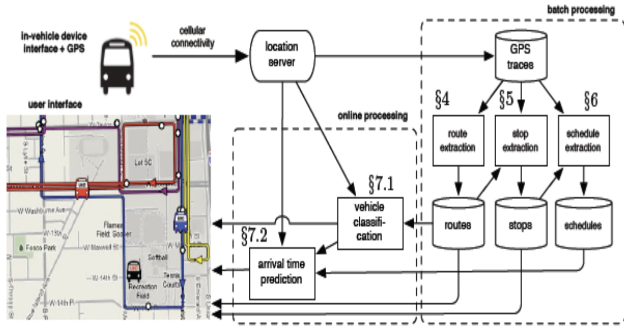


Fig 12:- Architectural overview of the Easy Tracker system.

Prediction of real time bus arrival system implemented vehicle data are passed through batch and online processing, resulting route shapes, stop locations, vehicle classifications, and arrival time predictions, which are displayed through a user interface, other information will be indicated.

4.1. Batch Processing

This design is based on three observations:

- Accurate road map.
- Transit routes
- Route extraction algorithm

4.2. Online Processing

It classifies vehicles as "in-service", or "out-of-service" if the traced location does not match up with a known route.

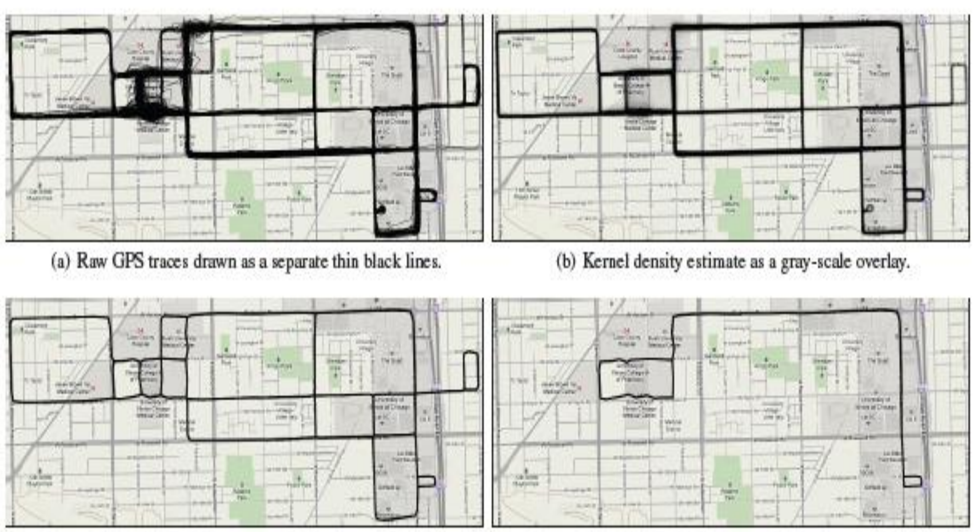
5. GPS TRACES AND GROUND TRUTH DATA

GPS traces have the following characteristics:

- They are labeled only with a vehicle ID number.
- Locations are recorded any time.

5.1. Route Extraction

Figure shows the complete automated route extraction process at a high level. Starting with an input of raw GPS traces (Figure13 (a)), a kernel density estimate of the full set of traces is computed (Figure13 (b)). A road map is extracted using which is subsequently smoothed using the Douglas Peucker algorithm (Figure 13(c)).



(a) Raw GPS traces drawn as a separate thin black lines. (b) Kernel density estimate as a gray-scale overlay.

(c) Road map extracted from all traces, after smoothing. (d) Single extracted route, out of several.

Fig 13:- High-level overview of the route extraction process, overlaid on a screenshot of the local road map.

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6. MODEL OF BUS ARRIVAL TIME PREDICTION

The algorithm on bus arrival time prediction includes two components.

1. Real-time bus-tracing model.
2. Bus arrival time prediction (Wei-hua Lin and Jian Zeng, 1999).

This method calculate the average travel speed to the immediate downstream route segments, denoted by *i,* based

$$V_i = \frac{av_r + bv_{at}}{a+b} \qquad \text{------------(1)}$$

Where,

vi predicted speed of route segment i (to the immediate downstream route segments),

vr current speed of bus derived from GPS data,

vai historical average speed of route segment i in current time period, and

a,b weighting factors defined in Equation 1.

6.1. Real-Time Bus Tracing

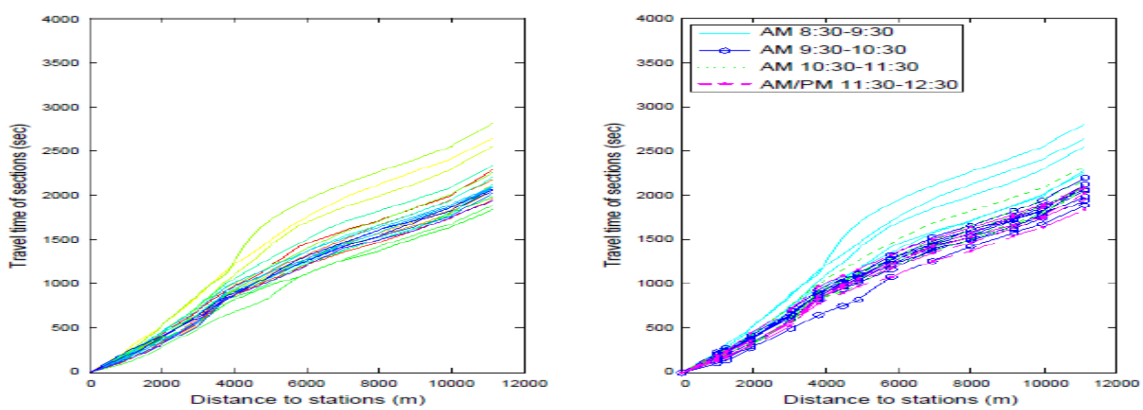
Bus arrival time can be estimated by first step is to determine the exact position of a bus on the linearized route based on its GPS data. Consider that a particular position with its coordinates denoted by (*xc*, *yc*) and its closeness to a given route link *i,* denoted by its end nodes (*xui*, *yui*) and (*xdi*, *ydi*), can be defined as follows:

$$D_i = L_{cu} + L_{cd} - L_{ud} \qquad \text{---------(2)}$$

The link with the smallest Di value is considered as the matched link i. Once a link is matched the length of the individual links along the route can be predicted.

6.2. Real-Time Bus Arrival Time Estimating

Figure 15 shows the time–space diagram of buses along a service route by four different time periods.



(a) (b)

Fig 14:- Bus time–space diagrams: (*a*) travel time, April 4, 2006; and (*b)* travel time clustered by time period, April 4, 2006.

7. INTELLIGENT SYSTEM FOR PREDICTING BUS ARRIVAL TIME

M = Q , ∑ , δ , q_0 , F

At any point of time, the system could be in one of the four states, namely, *Q* equals {beginning state, prediction state (*F*), terminus state, unknown state (*q*0)}. The relationship among the four states is shown in Figure 16. In first state, the system identifies the route that a bus is currently servicing and the direction. The underlying procedures are shown in Figures 17 and 18, respectively.

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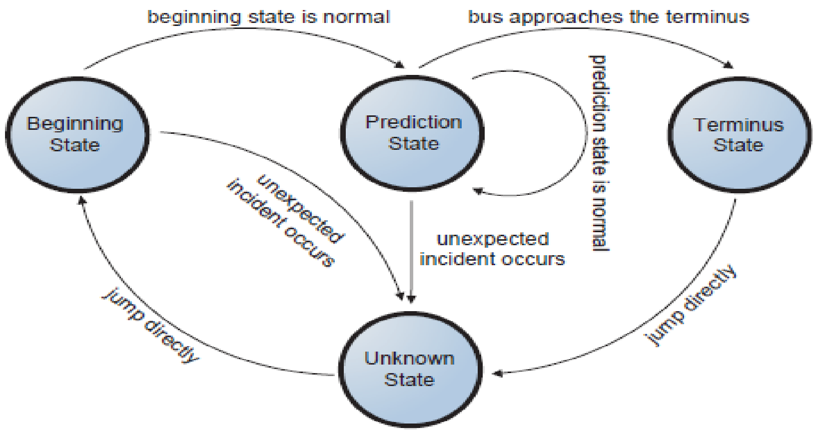

Fig 15:- The four states of the proposed intelligent system for predicting bus arrival time.

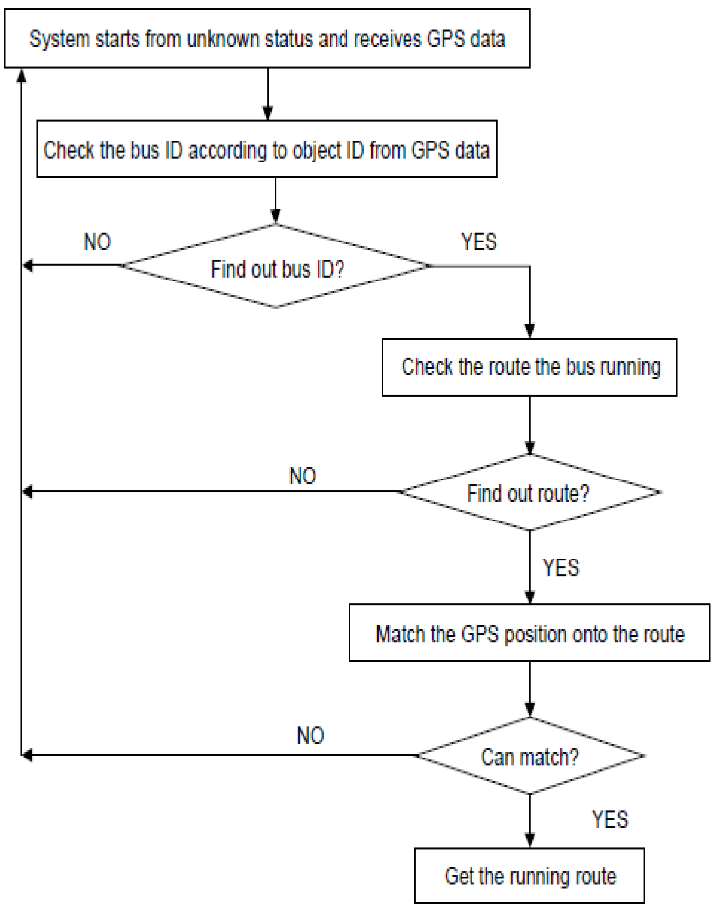

Fig 16:- Algorithm for determining bus route.

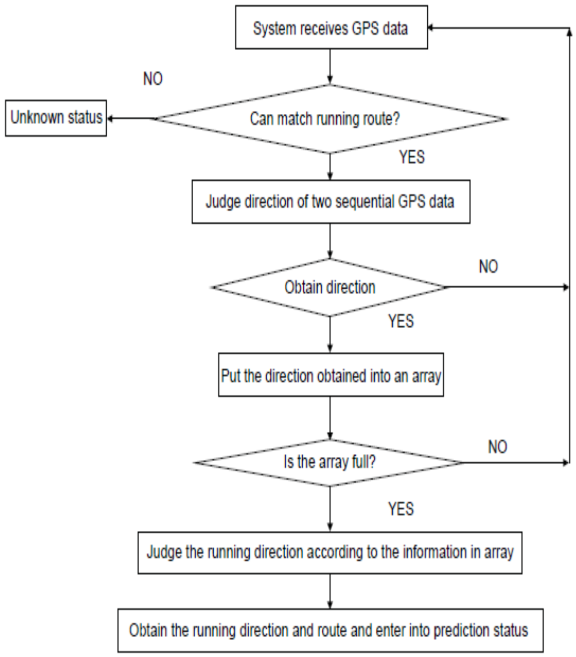

Fig 17:- Algorithm for determining bus running direction

8. SYSTEM DESIGN

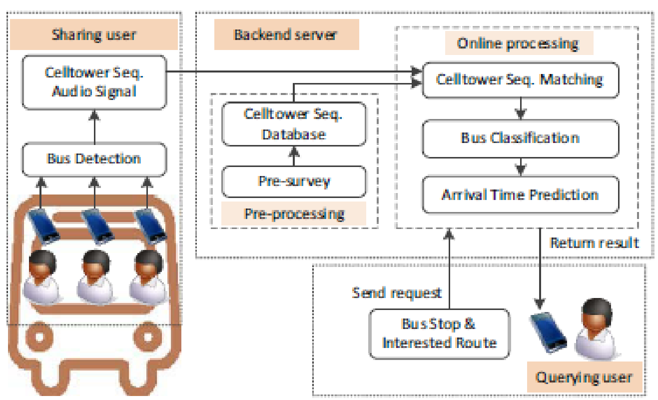

Fig 19:- System architecture

Figure 19 sketches the architecture of our system. There are 2 major components.

8.1. Sharing user

The sharing user uses contributes the mobile phone sensing information to the system. After a sharing user gets on a bus, the data collection module starts to collect a sequence of nearby cell tower IDs.

8.2. Backend server

Uploaded information from sharing users is processed and the requests from querying users are addressed.

9. AUDIO DETECTION

Audio clip are implemented on the bus at the sampling rate of 44.1 kHz with Samsung Galaxy S2 i9100 mobile phone. Figure 21 (bottom) plots the raw audio signal in the time domain, where the IC card reader starts beeping approximately from 11000*th* sample and lasts to 18000*th* sample. After that time domain signal are converted to the frequency domain through 512pt Fast Fourier Transform (Figure 20), we observe clear peaks at 1kHz and 3kHz frequency bands. Both time domain and the frequency domain signals are plotted in Figure 22.We find no peaks at 1kHz and 3kHz frequency bands. With the knowledge of the frequency range of the dual tone beep signal sent by the

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IC card reader, in our system we can lower down the audio sampling rate of the mobile phone to 8kHz which is sufficient to capture the beep signals with maximum frequency of 3kHz.

Fig 20. On buses

Fig 21.At rapid train station

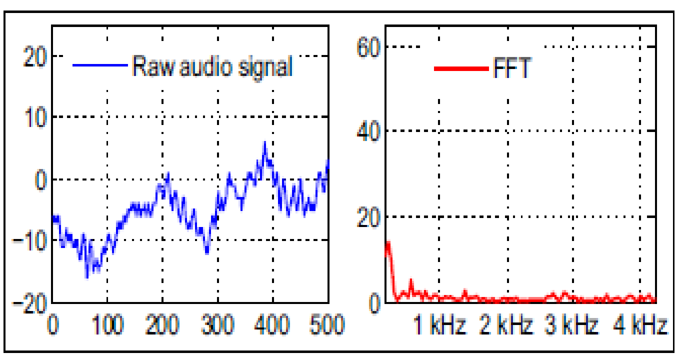

Fig 22:- Transit IC card readers
(a) Background audio signal

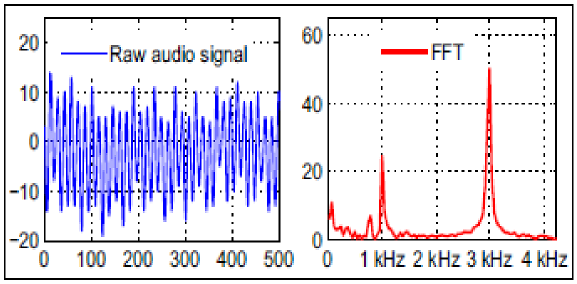

Fig 23. IC card reader indication audio signal

10. ARRIVAL TIME PREDICTION

Figure 26 illustrates the calculation of bus arrival time prediction. The server estimate the time for the bus to travel from its current location. The server first estimates the dwelling time of the bus at the current cell denoted as *t*2. The server also computes the traveling time of the bus in the cell that the bus stop is located denoted as *tbs*. The historical dwelling time of the bus at cell 3 is denoted as *T*3. The arrival time of the bus at the queried stop is then estimated as follows, (Wei-hua Lin and Jian Zeng, 1999)

$$T = T_2 - t_2 + T_3 + t_{bx}$$ ----------

(3)

Without loss of generality, we denote the dwelling time in Cell *i* as *Ti*, 1 ≤ *i* ≤ *n*, the bus's current cell number as *k*, and the queried bus stop's cell number as *q*. The server can estimate the arrival time of the bus as follows,

$$T = \sum_{i=k}^{q-1} T_i - t_k + t_q$$ --------(4)

The server periodically updates the information about the bus and responds to querying users.

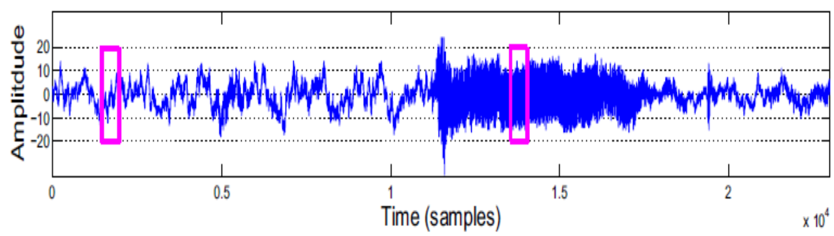

Figure 23:- Bus detection using audio indication signal

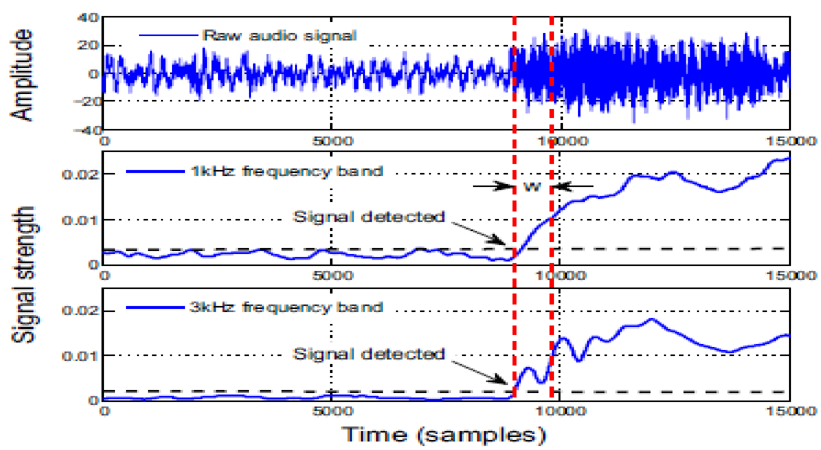

Fig 24:- Detecting audio beeps in the frequency domain

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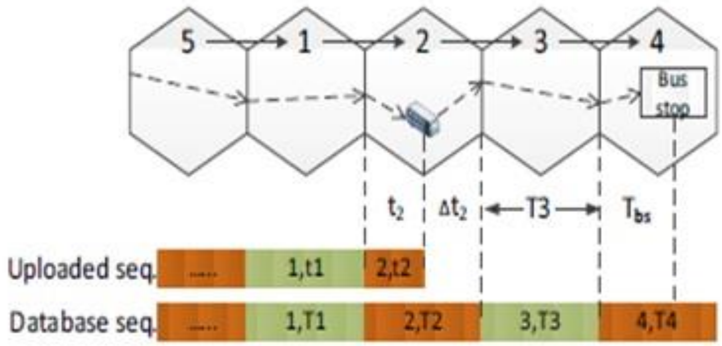

Fig 25:-Bus arrival time predication

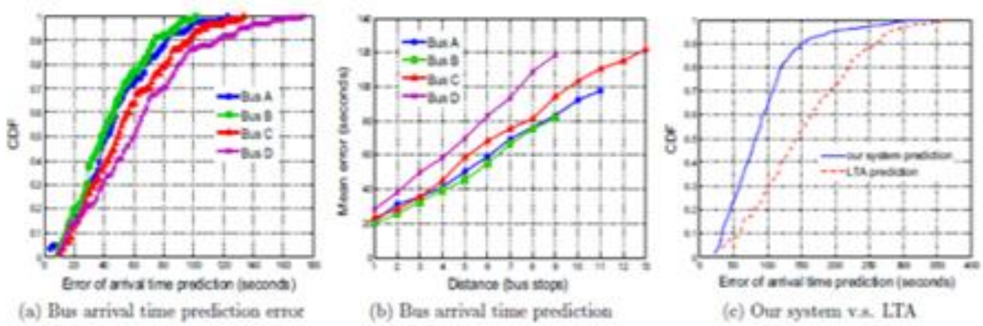

Fig 26:-Arrival time predication performance

11. BUS LOCATION SYSTEM USING A SMARTPHONE

11.1. Outline of the system

Smart phones are install with GPS in a route bus. The smart phone sends information about a longitude and latitude, a bus service to the server every minute. As a base for these information, the server calculates a bus delay and updates information.

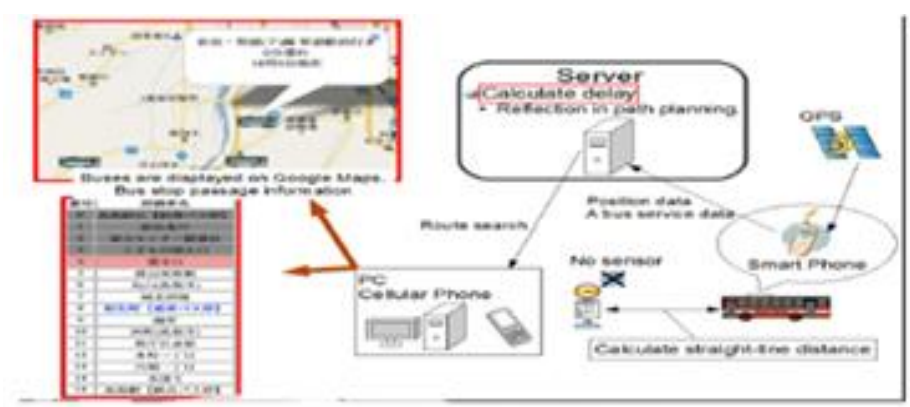

Fig 27:- Construction of our bus location system.

12. DISADVANTAGES

Needs satellite for Operation, hence if there's no satellite link, it does not work.

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13. CONCLUSION

This work improve the efficiency of bus systems by providing improved connectivity between lines buses and passengers with an added advantage of time saving and minimizing the overheads of Traffics without compromising the safety issues.

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