Journal of Advances in Science and Technology
Vol. 15, Issue No. 1, March-2018, ISSN 2230-9659

Efficient Bus Monitoring System using the Simulation and Real-Time Mobile Device GPS System

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Abstract – The use of mobile devices has become a part of our daily routine. Tracking the buses using Mobile GPS system is very efficient to use and handle in daily basis. The mobile base Bus Tracking system is very cost effective and it is using the less resources in user side for execution. The Bus Tracking System are widely used as compared with the previous years. The concept of Bus Tracking System can be viewed as a real Buses acting as nodes in network where these nodes are traced in real on Google Map in order to form the mobile network. Therefore Bus Tracking System is a dynamic mobile System. The distributed architecture is completely based on this methodologies called as Bus Tracking System. The main focus of our work is on GPS. There is need of accurate estimation of Bus location. There are many research solutions proposed recently for efficient estimation of Bus Locations and position, but suffered from the limitations of scalability and efficiency. In this project, we proposed novel approach for location estimation called B-T-S based on current GPS methodology. We first designed novel GPS based location estimation method. Self-correction is performed in order to minimize the location errors by learning and correcting network topology scenarios.

Keywords—GPS, Google Map, Bus Tracking System, Dynamic Mobile System.

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I. INTRODUCTION

The real time bus monitoring system uses GPS (Global Positioning System) to identify the current location of the buses. The location calculated by the GPS is in the form of latitude and longitude. The latitude and longitude are directed to the Mobile Tracking System through GPRS service. It chooses GPRS network for its superiority in transmitting speed. It forever on-line character and most importantly its reasonable cost (Yunus Ozen et. al., 2015).

The location data are stored and then it is retrieved on the map server to locate and display the location to users in the graphical user interface. This system uses the three techniques to tracking the buses that is the 1. GPS, 2. GSM, and 3. RFID. This techniques is described below (SeokJu Lee, et. al., 2014).

The GPS (Global Positioning System), it has many techniques were available and used but they were different in accuracy on global basis (Jianli Pan, et. al., 2012).

LORAN was one system which determined the position from signal pulses received at regular intervals from the radio transmitters. Another system used the radio signals from fixed navigational points to determine the location of ships and aircrafts; this was called Decca navigator system. TACAN System was also used in the Aircrafts (Sarah Aimi Saad, et. al., 2018).

The new global positioning system based on the satellite was based on the first satellite and space missions. The first American satellite Sputnik was launched in 1957; this was the first step towards to GPS System establishment (Muhammad Umar Farooq et. al., 2017).

These satellites were used with some effects that is needed into any future systems which has ability to investigate and note. The main point of effects is Doppler effects and the speed of satellite depends on the ground stations (Nusrath Jahan et. al., 2017).

The GSM means the Global System for Mobile Communication. In this system the signals are captured using the SIM which is installed in the user mobile. This is a digital phone technology which is used for transferring the mobile voice and data service. The GSM used are the phone based mobile radio system. This research is done at the Bell

Laboratories in 1970. GSM is the first name of a standardization group. It is established in 1982. This group creates the common European mobile telephone standard (Jay Lohokare et. al., 2017).

In this system application R-F-I-D uses electromagnetic field for connect the objects for buses track and specify automatically. The tag comprises electronically stored information. Passive tag gathers the energy from nearby R-F-I-D reader interrogating radio wave. Cooperate the hundreds of meter from R-F-I-D reader.

Independently, from barcode tag not required inside the line of sight reader, so it embedded in bus tracked object. Automatic Identification and Data Capture (A-I-D-C) R-F-I-D is one of the process for bus tracking (Christeena Joseph et. al., 2013).

In this paper, to alleviate the current research problem, we proposed novel algorithms for tracking the bus based on efficient node localization approach. We proposed the adaptive localization algorithm. The novelty of our work is that the efficiency of proposed method is evaluated by both simulation studies and real time implementations. The accessing the bus information and route information for we proposed Bus tracking system it access the bus real time location and send to the users devices and google map to showing the bus location (Christeena Joseph et. al., 2013) (Dhruv Patel et. al., 2017) (Amol Dhumal et. al., 2015).

In this system it is provide the android smart devices it is used to show the real time locations of buses on user's devices. In section II, we are presenting the study on recent works conducted for vehicle monitoring. The section III presents the proposed algorithms for vehicle tracking based one efficient location estimation. The section IV, presents the results for both real time implementation and simulation work. In last the conclusion and future work are described in section number V.

II. RELATED WORK

This section presents the review of recent works reported on bus monitoring or vehicle monitoring using different methods.

Yunus Ozen et.al. (2015)

In [1] author are described Mobile devices are common and mobile internet access is increasingly possible everywhere in daily life of modern people. Commonly used mobile operating systems are Android, iOS and Windows. Android stands out with its open source nature and working capabilities on inexpensive mobile devices. Real-time location tracking is continuously monitoring a vehicle or a person by using obtained coordinates with GPS, Wi-Fi or Cell-Id. Considering that the client person uses mobile phone with internet on it, location tracking can be done with a mobile application. Therefore, using GPS sensor suffers from rapid energy consumption. This paper presents design and implementation of an android based energy aware real-time location tracking system (EWAREL) using GPS sensor.

SeokJu Lee, et.al. (2014)

In [2] author are presenting An efficient vehicle tracking system is designed and implemented for tracking the movement of any equipped vehicle from any location at any time. The proposed system made good use of a popular technology that combines a Smartphone application with a microcontroller. This will be easy to make and inexpensive compared to others. The designed in-vehicle device works using Global Positioning System (GPS) and Global system for mobile communication / General Packet Radio Service (GSM/GPRS) technology that is one of the most common ways for vehicle tracking. The device is embedded inside a vehicle whose position is to be determined and tracked in real-time. A microcontroller is used to control the GPS and GSM/GPRS modules. The vehicle tracking system uses the GPS module to get geographic coordinates at regular time intervals. The GSM/GPRS module is used to transmit and update the vehicle location to a database. A Smartphone application is also developed for continuously monitoring the vehicle location. The Google Maps API is used to display the vehicle on the map in the Smartphone application.

Jianli Pan, et.al. (2012)

In [3] authors are introducing the Current building designs are not energy-efficient enough due to many reasons. One of them is the centralized control and fixed running policies (e.g. HVAC system) without considering the occupants' actual usage and adjusting the energy consumption accordingly. In this paper, we discuss our multi-disciplinary project on a green building testbed on which we introduce mobile location service into the energy policy control by using the now popular GPS-embedded smart phones. Every occupant in the building who has a smart phone is able to monitor their usage and adjust their own energy policy in real-time. This changes the centralized control inside the building into a distributed control paradigm. It allows the occupants with different roles to participate in the energy consumption reduction efforts. Latest information technologies such as mobile smart device-based location service, distributed control, and cloud computing are used in this project. The major idea and experimental system is expected to be applied to not only green buildings but also vast number of the conventional buildings to reduce the energy

consumption without sacrificing the human comfort and convenience.

Sarah Aimi Saad, et.al. (2018)

In [4] author are focuses on the Real-time update is very important in Advanced Public Transportation System (APTS). However, due to the lack of information on the bus's estimated time of arrival (ETA), current location and occupancy (number of seats available) commuters are reluctant to use public transport. The study in this paper focuses on developing a bus tracking system that can track, display the location of the bus in real time and estimate the bus arrival time to the next bus stop. Monitoring system that consists of tracking device and web-based application for monitoring purposes are developed. GPS-based tracking device is used as location tracking mechanism and the location is reported for every 1 second to cloud database. Web application is developed as the graphical user interface (GUI) to assist user in monitoring real-time location of the bus and plan their journey based on information provided such as bus routes, bus stop number and bus arrival time. The updated location of the bus is plotted into Google Maps. Thus, based on result it was found that the proposed method is able to track and monitor the real-time location of the bus and able to estimate the bus's arrival time to the next bus stop.

Muhammad Umar Farooq et.al. (2017)

In [5] author are presenting the Users of public transport, in developing countries, face a lot of problems such as long waits on bus stops and often no bus arrival after a long wait. One of the novel solutions to the problem is to display the expected arrival times of the buses on respective bus stops. Many prediction systems have been developed based on different techniques. This paper presents a public transport arrival time prediction system relying on real time Automatic Vehicle Location (AVL) data rather than the old-fashioned techniques. Global Positioning System (GPS) and Global System for Mobile Communications (GSM) are used for developing a Real-Time Locating System (RTLS) and communication between different nodes respectively. On server side, an efficient and optimized algorithm is developed to predict the arrival times accurately. Many test drives were done on a selected route under various test conditions. And resulting predicted times and their deviation from Final Traveling Time (FTT) at each bus stop are shown in graphs at the last of the paper.

Nusrath Jahan et.al (2017)

In [6] author are introduced the dynamic life where everyone is in a hurry to reach their destinations, waiting for bus is hectic and even many of us are unaware of the bus timing. To overcome this difficulty, an easy system is proposed in this paper to aid tracking real time bus location. The proposed solution takes advantages of the two main features in mobile platform nowadays which are location services, mainly GPS based, and basic telephony services, mainly SMS based. The system consists of two sides, server side and client side. The server device's main responsibility is to provide the exact location of the bus to the server, or to the user in case of SMS based query from client's device. On the other hand, client's device can find bus location either using SMS service or using internet service. If clients' device is an android based smartphone, he can install our application to track bus location using internet service. The server's device will be placed on the vehicle of interest with android application installed on it. Experiments were made with this system and found that it performs better in many ways than other similar vehicle tracking systems.

Jay Lohokare et.al (2017)

In [7] author are presenting the Reliability in public transport is of great importance today. Millions of people travelling by public buses waste a lot of time waiting at bus stops. This paper focuses on presenting a solution to tackle the said problem by harnessing IoT technology stack. If the people travelling get accurate real time location of the buses along with estimate time for arrival at bus stop based on the real time traffic conditions, it will facilitate an overall increase in reliability on the public buses. The solution proposed in this paper involves using the existing internet enabled devices on the bus (like the e-ticketing system) or a simple android tablet to capture the real time location and send to the servers. Accessing this location data from servers will be facilitated by Representational State Transfer (REST) APIs which users can access through android application, SMS or web-portals. The system proposed will have distributed architecture in order to tackle high number of requests from users. Although there are existing solutions which harness the use of Global Positioning System (GPS) for bus tracking, they aren't ready to handle high demand on the backend which will exist in the near future. We have addressed this problem. The primary contribution of this paper is that it shows that a backend based on Message Queue Telemetry Transport (MQTT) instead of the traditionally used Hypertext transfer protocol (HTTP) based REST will be light weight, data efficient and scalable. We have proposed and implemented the backend as well as the front end required for the tracking system and presented the improvements.

Christeena Joseph et.al. (2013)

In [8] author are introducing Vehicle tracking systems are available vastly in market, but a good and effective product tends to be of more cost. This paper is proposed to design and develop a tracking system

that is much cost effective than the systems available in the market. The tracking system here helps to know the location of the college bus through mobile phone when a SMS (Short Message Service) is sent to a specific number thus noticing the bus location via SMS. By incorporating a GPS (Global Positioning System) and GSM (Global System for Mobile communication) modem the location of the device by sending a SMS to the number specified. No external server or internet connection is used in knowing the location at user end which in return reduces the cost.

Dhruv Patel et.al. (2017)

In [9] author are use the Unusual and unexpected conditions on the roads affect the smooth operation of the bus system and the movement of vehicles? Also, everyday problems such as traffic congestion, unexpected delays, randomness in passenger demand, irregular vehicle dispatching times take place and as a result of which the schedule of the passengers are affected and they inevitably have to wait for the arrival of their respective bus. This passenger inconvenience can be avoided by introducing a system which provides real-time information about the location and estimated time of arrival of the buses.

Amol Dhumal et.al. (2015)

In [10] author are presenting everyone is using mobile phones for communication. At the same time Mobile Providers are also providing the variety of services to users. In attempt to expand on this, we propose a GPS based vehicle tracking system for an organization to help to find addresses of their vehicles and locate their positions on mobile devices. The organizations are investing money in monitoring and tracking vehicles aiming at improving services and ensuring the safety in cargos transports. The proposed technology allows organizations to track real-time information about their organizational vehicle during travel.

III. PROPOSED METHODOLOGY

The proposed Bus Monitoring system has six modules are as follows:

1. Server: - the server keeping all longitude and latitude coordinates obtained by the tracker.

2. Mobile Device – the mobile device are used to users interface and showing the bus locations.

3. Client PC: - the Client Pc is used to access location using web base systems.

4. Bus Tracker: - the Bus Tracker is installed in the bus to obtain the bus current coordinates and send to the server.

5. Internet: - the internet is medium to transfer the coordinates in this system.

6. Satellite: - the satellite is used to get the longitude and latitude values of bus. The satellites are play important role in this system.

In this section, the proposed algorithms are presented. We used Bus Monitoring System to identify the accurate location of bus. Above architecture working is based on two main algorithms such as: bus tracking algorithm (algorithm 1) and advanced bus tracking algorithm (algorithm 2). Both algorithms steps are written below:

Algorithm 1: Bus Tracking Algorithm

Notations:

BNO: Broadcasting Node

BN: Bus Node

LOC: Location

Inputs:

Routing Table Entries;

Node ID;

Longitude;

Latitude;

Output:

Estimated Location

Step 1: BNO (b) at Time (ti)

oneHopBoadcast(ID, LOC);

scheduleNextBroadcast(∆t);

Step 2: BN (v) at time (ti)

WHILE t < ti + ∆T

IF msg_received THEN

nearestBeaconList.add (beacon(ID, LOC, mdist));

oneHopbroadcast(ID, LOC, mdist, ownerID);

IF forwarded_msg_recieved THEN

farthestBeaconList.add(beacon record);

Estimation phase:

beaconList = nearestBeaconList;

IF beaconListSize >= 3 THEN

selectBestThreeNearestBeacons();

estimateLocationByTrilateration();

ELSE

IF previous_location_is_available THEN

beaconList.add (previous Location);

IF beaconListSize < 3 THEN

Selected Beacon = chooseBestFarthestBeacons( );

beaconList.add(selectedBeacons);

IF beaconListSize = 3 THEN

sampleList= samplingBeaconMeausredCircle(selected_beacons);

FOREACH sample(i) IN samplesList

estimateLocationByTrilateration ( );

ELSE

estimateLocationByTrilateration ( );

Correction and alignment phase:

IF beacon (i) is a nearest beacon and mi > mth THEN

measuredDistanceList (i) = generateNewMeasuredDistance (mi , Δm);

visibleSolutionsList = createVisibleSolution (measuredDistanceList (i));

FOREACH visibleSolution (j) IN visibleSolutionsList

estimateLocationByTrilateration( );

chooseBestSolution( );

bestSolutionAlignment ();

Algorithm 2: Advanced Bus Tracking Algorithm

Notations:

BNO: Broadcasting Node

BN: Bus Node

LOC: Location

WLD: Weighted Localization using Distance

SINR: Signal to Interference Noise Ratio

Inputs:

Routing Table Entries;

Node ID;

Longitude;

Latitude;

Output:

Estimated Location

Step 1: Start ABT () for estimation

Step 2: Measure the time of estimation start Te

if (Te> Thr)

Go to Step 3

Else

Wait for ABT () to finish

Step 3: Estimate Location using WLD

In the network every node periodically broadcast beacon messages.

Every node assigns a weight to all of its neighboring nodes using equations.

Every node estimates its location using SINR

Step 4: Return Estimated Location

The both algorithms are simulated and real time implemented for evaluation performance.

IV. RESULTS AND DISCUSSION

The practical development of proposed techniques is done using Java and android programming language. We implemented our algorithms on the location tracking. This section first presents the snapshots for implemented Bus Monitoring System. Then the performance evaluation results are presented with comparison with previous methods. The first step was

applying proposed algorithm for Bus Monitoring system.

A. Simulation Results

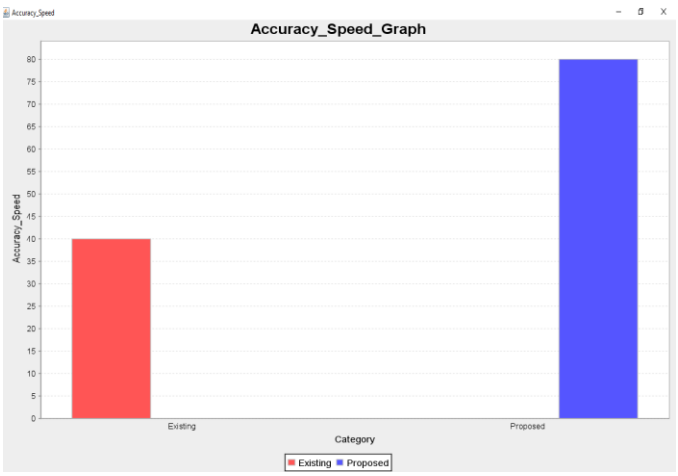

Figure 3: Accuracy Speed Graph

The above graph shows accuracy speed graph. That graph represents the accuracy of speed between the both system existing and proposed system. In this graph red bar shows the existing system and blue bar shows the proposed system. In this graph represents the accuracy of speed in the both system the accuracy speed of existing system is 40 and the accuracy speed of proposed system is 80. Means the accuracy is high in proposed system

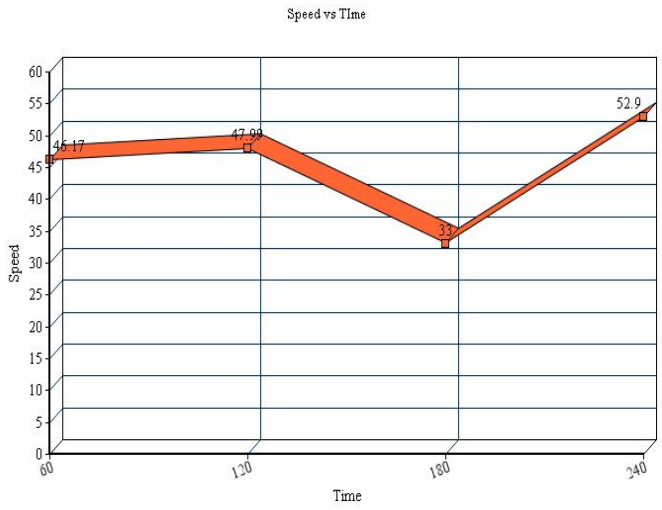

Figure 4: Speed of bus at different location

Considering the user to represent at point F (19° 2' 14.4054" 72° 51' 39.8334"), from where he has messaged to server to search location of the bus and expected arrival time. Now, in sequence to search the expected arrival time, startlingly the distance during E and F is measured. It came out to be 4.356 km (to 4 SF*). Now server knows the distance to be travelled and average speed of bus.

B. Real Time Results

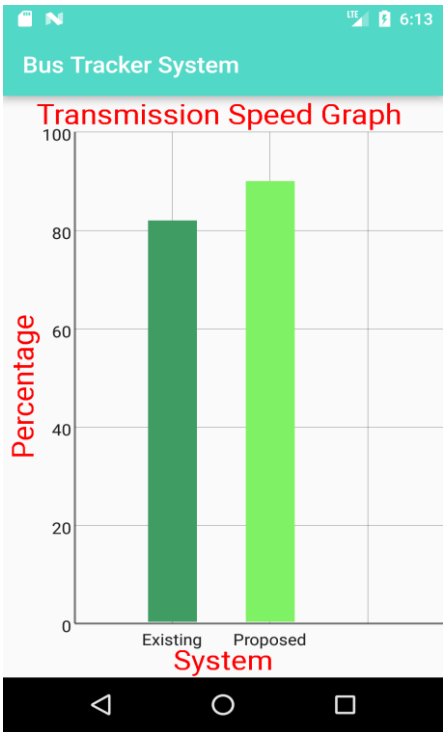

Figure 5: Transmission Speed Graph

In this graph the system shows the Transmission speed of existing and proposed system.

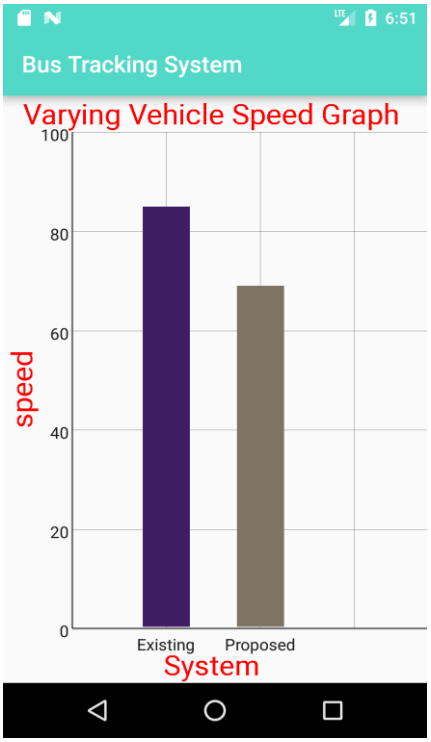

Figure 6: Varying Vehicle Speed Graph

This graph shows the Varying Vehicle speed of both systems. The speed of transmission in the existing

system is 85 and the speed of transmission in proposed system is 70. Means the difference of bus speed in the proposed system is better compare to the exiting bus system.

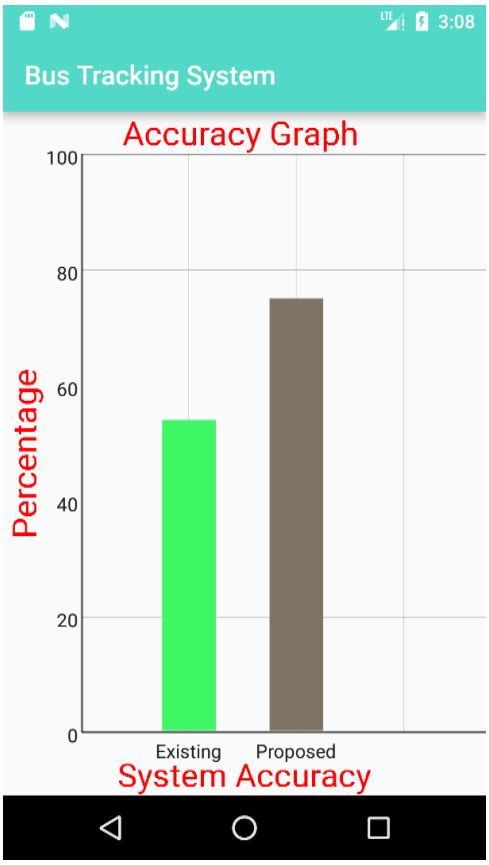

Figure 6: Real time Accuracy Graph

In this Graphs Activity the graphs display the accuracy of both systems and comparing the Existing and proposed system.

V. CONCLUSION AND FUTURE WORK

In this paper, we discuss the existing tracking system using simulation or etc. we develop the new technique for monitoring the bus and provide the bus accurate location to the mobile device users. The Real-Time Bus Monitoring System Using GPS is developed to obtain the accuracy, reduce the cost and design simple user interface.

This system save the time and increase the work efficiency of end users because it reduces the user's efforts to travelling for work and avoid the wastage of waiting time for bus. It also consider the points that is Robust, Reliable and efficient for traveling in city. This proposed system removes the wastage of time for reaching destination on works. In this proposed system we use GPS for location tracking it is less accurate with minimum satellite but using multiple satellite the GPS is more accurate about location.

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