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A Study on Intellectual Scheme to Monitor Traffic Time in Bus Transportation Using Smart Phone Application

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Abstract: Accessing automatic public transportation through Smartphone application is introduced to provide intelligent bus status informing scheme exploiting Smartphone application for Smartphone users. Since more number of users are become customers of Smartphone's, this project is targeted for Smartphone users. The project objective is to increase the convenience of public transportation system. This can be achieved by improving key factors like safety, reliability, efficiency and quality of public transportation system. Smartphone users waiting in the bus stop can view the details of the bus including current location of the bus, number of passengers and vacancy of seats in the bus. A middleware web service acts as an inter-mediator between Smartphone users waiting in the bus stop and server. It performs two functions. First, it gets the request from mobile client in vehicle and second it responds to the Smartphone users waiting in the bus stop. As soon as the request gets initiated, details of the bus including current location of the bus, number of passengers and availability of seats in the bus will be updated in the database. When more than one mobile user access the Smartphone application at a time a session is created and managed by a session management.

Keywords*:* GPS, APC, ITS, ICT, SDK, ADT, DVM, JIT, MSIL, CTS, MCU.

1.INTRODUCTION

According to a survey conducted in India during 2011, the number of citizens using public transportation is about to ten millions every day. In particular, the congestion at the bus stop during rush hour is becoming more and more serious and frequently it causes passengers to be stranded at bus stops and delays public transportation system. The Intelligent Transport System(ITS) [3] is mainly used in transport infrastructure so as to enhance the safety, efficiency, reliability and to standardized the public transportation system.. ITS helps the people to enjoy the transportation system despite the region and mode of transport.. The commuting time [6] will be reduced in ITS and the citizen will get more satisfaction. Besides the ITS system dispense the users by giving real –time location information and exact arrival time of buses so that users can save their waiting time and track the location using smart phone.

Every passenger is having a transportation card. The card has to be read with the help of a card reader. The passenger comes one by one to use the card reader. Sometimes there may be a situation where passengers will be stuck at bus station. As the number of passenger is high the boarding time will be more and thus the boarding time will be more. This makes more delay. To increase the efficiency of the bus system for making the passenger getting on and off fast a hi-pass scheme based on RFID technology with an passenger automatic counting scheme [4] is introduced. It is hard to know whether the bus is crowded or not when there are lot of passengers waiting for a bus at the bus stop. The bus comes with enough passengers then the waiting process is unnecessary .Even if the bus stops the passengers cannot enter the bus because of crowd. This makes the passenger to use other transportation systems like taxi. This makes the entire transportation system inefficient. The ITS should be useful for the passenger in all ways. They have to get all the information in finger tip.

In this work, an intelligent bus status informing scheme based on Smartphone application is proposed. With the proposed scheme, the real-time

information of the number of passengers on the bus can be obtained and sent to the bus application in the smart phone of each user. Thus, it not only saves the time of passengers but also enables to create profits through effective vehicle deployment and management of their employees for large-scaled transport companies. In the proposed scheme, a new type of RFID reader device and a new bus application for smart phones are developed and the effectiveness of proposed scheme is validated through experiments to show the possibility of implementation.

1.1 Automatic Passenger Counting

Automatic Passenger Counting (APC)[1] systems are designed to provide accurate rider ship information by automatically recording the number of passengers who get on and off a vehicle at each stop and storing that data in a database system for statistical analysis and reporting. This information is typically used to help measure progress of a transit agency (rider ship growth), to help improve efficiency of operations through schedule and route changes based on rider ship, to improve quality of service through wayside amenities and increased service to heavily traveled stops, and even for revenue distribution between multiple transit providers.

In order to accomplish these purposes, APC systems collect vast amounts of information: GPS Coordinates, Time / Date, Vehicle Stops / Starts, door open/closes, wheelchair lift usage, and passenger counts on/off. With regular use of the technology, providers are better able to manage routes and resources leading to cost savings in operational efficiencies, as well as better customer service leading to higher rider ship. Passenger counting techniques in use include treadle mats, infrared cross-beams, and infrared sensors are designed to provide accurate rider ship information by automatically recording the number of passengers that get on and off at each stop and storing that data in a database system for statistical analysis and reporting.

Other uses of this data are possible including offline Schedule Adherence analysis, deviated route service tracking, and various forms of route analysis. These techniques increase the return on the APC investment, and can also provide low cost alternatives to smaller transit authorities to solve tracking problems that typically require large, complex systems such as CAD/AVL.

1.1.1APC Data Collected

Automatic Passenger Counting systems [2] create usable data from basic groups:

- *Raw Data*
- *Processed Data & Reports*

Raw Data and Vehicle Systems

Raw Data comes from the equipment installed on the vehicle, which typically include passenger sensors (Counters), a positioning system (typically GPS), a group of electrical contact sensors, and an on-board computer. One of the most important elements on the vehicle is the sensor. This is the device placed at each door which must count the number of passengers entering and exiting the vehicle at all stops. The accuracy of these sensors is critical to the validity of APC results for reporting. In addition to the APC Sensors, there are a great many other inputs monitored on the vehicle. These include GPS Signals for position, Odometer signals for dead-reckoning and detection of vehicle motion, door contacts for sensing door activity, wheelchair ramp/lift cycles, and vehicle ignition. These inputs can provide a clear picture of the vehicle's activity for the day including 'when' and 'where' information for all major vehicle operations and events.

Processed Data

Raw vehicle data gets correlated, validated, and transformed into vehicle events which will be stored in the historical database and used for vehicle reporting. Several different types of processing may be done depending on the system implemented: Matching, Validation, Consolidation, and Balancing.

Reports

The underlying purpose for implementing an APC system is to get detailed reporting on Rider ship activity. Some of the typical targets of this reporting include:

(1)Vehicle

- Passenger flow per door
- Passenger flow per stop
- Time of day –vs.- passenger flow and loads
- Vehicle loads
- Wheelchair lift activity

(2)Aggregated Data – Routes

- All vehicles on a route – flow and load averages
- Time of day –vs.- passenger flow and loads

1.1.2 Other APC Possibilities

APC Systems collect a wide range of data which is accessible at various points in the system and hold information not directly related to passenger counts and rider ship reporting. This information can be utilized for a variety of purposes, including tracking performance and schedule adherence, validating schedule data, validating GPS stop coordinates and baseline information, validating GPS coverage, monitoring flag routes, and monitoring off-route conditions.

1.2 Vehicle Tracking & Monitoring System (VTMS)

Vehicle Tracking & Monitoring System (VTMS)[3] is to offer benefits to provide on time information to the operating staff, control centre staff, bus stand staff, and commuters. The system is expected to provide quality real time information on arrival and departure status, handling of incidents and accidents, increase safety of commuters and staff, reduce operational costs, improve traffic efficiency etc.

VTMS application software shall support both time mode (periodic update based on time interval) and distance mode (periodic update based on distance interval) configurable intervals. VTMS application software shall support calculation of distance travelled by a vehicle on a schedule/ trip and average distance travelled and time taken in a schedule for a period. Calculation of Travel time estimation between two places class-wise.

The overview of the VTMS requirements includes the following from the system perspective:

- Ability to locate a specific bus in real time to know the position and status
- Ability to highlight exceptions through Alerts by monitoring of, deviations such as route, arrival and departure times etc.
- Ability for effective planning & management through a decision support system by collecting, collating and storing information on real time basis about the transport system and its effectiveness
- Provide access to real time information related to bus schedules, Expected Time of Arrival (ETA), Estimated Time of Departure (ETD), etc., through Display at Bus stands, self-service Short Messaging Service (SMS) as well as the Internet.
- Facilitate timely management of Incidents / Accidents, effectively monitoring break downs and the related information, route diversion in the event of any incidents on the highways – State and National
- Establish meaningful instant two-way voice facility between Driver – and control stations or pre specified numbers
- Ability to Monitor and manage the Distributed IT infrastructure of entire VTMS

The tracking and locating the vehicle(s) will cover all those buses that are equipped with monitoring units and shall include those in movement those stationed in the bus depots/Bus stands/workshops/Pickup points ,stops, etc. These features shall be available to the users on demand.

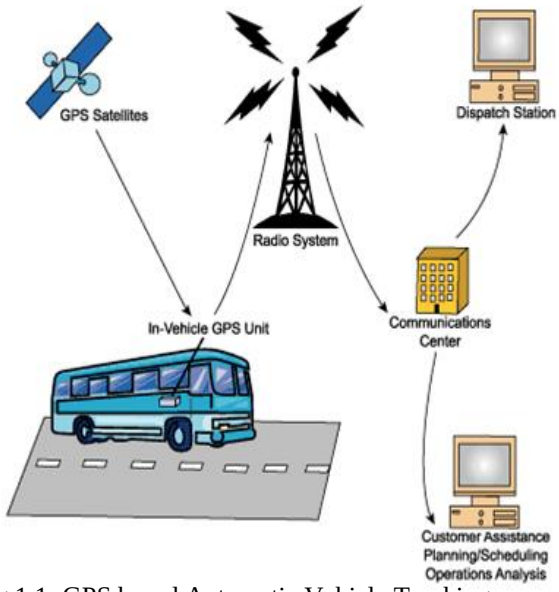

Fig 1.1: GPS based Automatic Vehicle Tracking

The VTMS receives the current position of all the buses from the tracking unit, will disseminate the data received and transfer the relevant information like the Schedule No, Destination of the bus and the Expected Time of Arrival at that bus stop, to the bus stand display, which has requested for the data.

1.3 Passenger Information System

Passenger Information System (PIS) to provide the estimated time of arrival and departure and arrival of buses at various destination and intermediate points calculated based on the vehicle position at any point in time.The passengers can be get some components from PIS. Busstand and platform are provided with some display unit to show the PIS information at busstand. This will be more

helpful for the passengers. The display system uses LCD,LED, Plasma panels etc to display the text and video in a useful manner. The information will be displayed until the next data arrives. The display unit is placed I such a way that all passengers can easily view the information. So that they can view the main information likes arrival and departure of particular bus.

1.4 Module Description

1.4.1 *Bus Location Posting*

The first and foremost module in our project is the bus location posting.Global Positioning system (GPS) is mainly used to locate the exact location of the bus with latitude and longitude which can be said as the aim of this module. GPS will provide the location irrespective of any weather condition and due to any unobstructed line of sight.. The user will get the timing and positioning services easily which is of US owned utility.

This system consists of three segments

- *Space segment*

  It consists of a nominal constellation of 24 operating satellites that transmit one-way signals that give the current GPS satellite position and time.

- *Control segment*

  It consists of worldwide monitor and control stations that maintain the satellites in their proper orbits through occasional command manoeuvres, and adjust the satellite clocks.

- *User segment*

  It consists of the GPS receiver equipment, which receives the signals from the GPS satellites and uses the transmitted information to calculate the user's three-dimensional position and time.

Thus, the GPS with the minimum of three satellites locates the current position of the bus by identifying the latitude and longitude. The latitude and longitude are used together to specify the global coordinates of a location on earth.

Measuring Latitude and Longitude

- The latitude of a location is measured by observing the inclination of the sun or the position of known stars in the sky and calculating the angular distance from the horizon to them.
- Longitude represents the angle between the lines connecting two meridians to the centre of earth.

After locating the position of bus via GPS, the tracked location is sent to the database through the middleware web service. Again through the web service, the tracked information in the database is sent to the Smartphone application of the user via GPRS.To display the tracked location of the bus in the Smartphone application, Location manager, a software component is in-built in the Smartphone. Location Manager is a software component which allows application to receive location and movement information generated by GPS system.

Thus, finally the location of the bus is depicted in the Smartphone application of the user.

1.4.2 Rush Monitoring Service

The second module described in this part is the Rush Monitoring Service.The aim of this module is to increase the number of buses operating during rush hours between the source and destination specified.
This module consists of the following three major phases

- *Setting up door/seat sensor*
- *Counting the number of passengers*
- *Sending the data to centralized server*

1.4.2.1 Setting up door/seat sensor

Setting up of door sensor includes setting the IR sensor on the front as well as back doors of the bus to count the number of boarding and alighting passengers on the bus respectively. Since, setting up of door sensor is not much accurate anyone go for seat sensors. Setting up of seat sensor includes setting the IR sensor on each and every seat available in the bus. Sensor is a device which detects or measures a physical quantity and converts it into a signal. The passengers occupying the seat is detected by the seat sensor is then converted into a signal which in-turn is processed by a micro-controller.

1.4.2.2*Counting the number of passengers*

The IR sensor controller or the micro-controller processes the signal received from sensor and calculates the number of passengers travelling in the bus especially during rush hours. Thus the number of passengers travelling in the bus from the specified source to destination can be obtained. Also, the availability of seats can be obtained.

1.4.2.3 Sending the data to Centralized server

After obtaining the passenger count as well as the availability of seats, it is sent to the centralized server using a Bluetooth dongle from the micro-controller. Thus, after the retrieval of rush monitoring services from the Bluetooth dongle, the control centre of the public transportation system or the administrator of the public transportation system gets an idea to run or operate the additional number of buses during the rush hour between the specified source and the destination.

1.4.3 Middleware Web Service

The third module of our project is the middleware web service. The aim of this module is to update the database with the information received from mobile client in vehicle as well as provide services to the smart phone users waiting in the bus stop. A Web service is a method of communications between two electronic devices over the World Wide Web. It is a software function provided at a network address over the web with the service always on as in the concept of utility computing.

The W3C defines a Web service as:

A software system designed to support interoperable machine-to-machine interaction over a network. It has an interface described in a machine - process able format (specifically WSDL). Other systems interact with the web service in a manner prescribed by its description using SOAP messages, typically conveyed using HTTP with an XML serialization in conjunction with other Web-related standards.

It describes a standardized way of integrating Web-based applications using the XML, SOAP, WSDL and UDDI open standards over an Internet protocol backbone. XML is used to tag the data, SOAP is used to transfer the data, WSDL is used for describing the services available and UDDI is used for listing what services are available.

Components of Web Service

- SOAP - Simple Object Access Protocol
- UDDI - Universal Description, Discovery and Integration
- WSDL - Web Services Description Language

The middleware web service is the one which acts as the inter-mediator between the End User Application and the Database. When the End User Application module requests for bus details including the current location of the bus, number of passengers travelling in the bus and the availability of seats, the web service described as a function in the web server collects the required information from the database and displays them in the application when opened.

In the similar way, the details are updated to the database by obtaining the information generated by both the Bus Location Posting module as well as the Rush Monitoring Service module with the help from this middleware web service only.

1.4.4 End User Application

The core objective of our project is finally achieved in this End User Application module. The aim of this module is to display the output of Intelligent Bus Status Informing Scheme in the smart phone application of the end users. The application created is an android application built using eclipse Android Developer Tool (ADT). End users are the smart phone users waiting in the bus stop. As soon as the application is installed in the GPS as well as GPRS enabled mobile device, each and every one owning the device gets the benefits of Intelligent Transportation System (ITS).

The overall integration of the above mentioned three modules results in the successful creation of End User Application. The middleware web service is the one that acts as the interface between this End User Application and the database. The database used for the android application is the SQLite. The web service receives the bus information from both the Bus Location Posting module as well as the Rush Monitoring module. After receiving the details it updates them in the database. Again, when the smart phone users requests for bus information, the web service is the one which satisfies those requests by providing the details to the end users from the database.

The output of the Bus Location Posting module is the finding of current location of the bus and sending it to the server via GPRS. The output of the Rush Monitoring module is to gather the number of passengers travelling in the bus and the availability of seats through door/seat sensors and transfer the information from MCU fixed in the sensor via Bluetooth dongle to the centralized server. Thus the output of the first two modules received by the web service is finally depicted in the android application of the smart phone users.

1.5 CONCLUSION

In this project, an intelligent bus status informing scheme based on Smartphone application is proposed to increase convenience of public bus system by providing the seating capacity and number of passengers of the coming buses to waiting persons at the bus stop. The proposed scheme not only provides a real-time information of number of passengers in the bus to each user by the Smartphone application, also helps people to know whether the coming bus is crowded or not in advance. Thus, the proposed scheme makes the bus system run more quickly and efficiently.

1.6 FUTURE ENHANCEMENT

RFID technology will be utilized in the Intelligent Bus Status Informing Scheme Exploiting Smart phone Application and a smart server for benefiting both the passengers and public transport companies. The system also can send the real-time temperature, humidity and air flow condition in the bus with the help of sensors.

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