REAL TIME BUS AVAILABILITY SYSTEM

Tejas N A[1], Younus Zain[2], Mrs.Panimozhi K[3]
[1,2]UG Student, Dept. of CSE, BMSCE, Bangalore
[3]Assistant Professor Dept. of CSE, BMSCE, Bangalore.

***Abstract*-In this fast paced world, everybodyis in a hurry to reach their destinations.Public transport is sufferingfrom a number of conditions which are highly uncertain such as congestions, delays, rider demand and accidents. This calls for a real time dynamic system that is flexible to meet the needs of the operators and users whichis also affordable and efficient. An important problem in creating efficient public transport system is obtaining data about passengers' end to end journey. Obtaining this data is problematic and expensive since buses do not have an onboard ticketing system to record where and when passengers get on and off the bus. In this paper we perform a survey on different dynamic bus availability systems implemented across the world to propose a method to make this data available to the transport department as well as the daily commuters using an inexpensive wireless system using an android device.The proposed system depends on the collective effort of the participating users and is independent from the bus operators, so it can be easily adopted without the need or support from bus operating companies.At the same time, the proposed solution is more generally available and inexpensive devoid of hardware.**

***Index Terms* - Android,Cloud, GPS, GSM,Public Transport.**

I. INTRODUCTION

Transportation demands in urban areas continue to increase rapidly as a result of both population growth and changes in travel patterns. This requires designing a system, that is affordable, reliable and economical from the users' as well as operator's perspectives.Transport is a crucial a part of India's economy. Ever since the economic liberalization of the Nineties, infrastructure has progressed rapidly; today there are a variety of modes of transport by land, water and air. Public transport remains the primary mode of transport for most of the population, and India's public transport is among the most heavily used in the world.

Tejas N.A, *Dept. of CSE, BMSCE, Bangalore, India, Mobile No., 9901836272.*
Younus Zain, *Dept. of CSE, BMSCE, Bangalore, India, Mobile No., 9035875130.*
Mrs. Panimozhi K., *Assistant Professor, Dept. of CSE, BMSCE, Bangalore, India, Mobile No. 9742980606,*

Buses take up over ninetieth of public transport in Indian cities, and provide an inexpensive and convenient mode of transport for all categories of society. Services are mostly run by government owned transport companies. This Paper is a survey to implement a method that makes transport much convenient for individuals who commute daily using the public bus transport of the city, for effective time management and making it trouble-free, not just for the commuters but the Transport Department to create an efficient public transport system. There are applications available in the market today which specifies the route and the timings, predict arrival times of different buses But the survey presented here aims to builds an application that takes it to the next step by making information about the vacant seats and the current location of any bus in Real-Time, accessible to the daily commuters with a novel and economical wireless system.

II. LITERATURE SURVEY

MuktiAdvaniand Geetam Tiwari[12] deal with a road based bus system to improve transportation system within urban cities. Their goal is to implement and review the recent planning methodologies and selected decision support systems for optimizing urban bus transport services. These methodologies offer incremental improvements in bus system to meet the capacity requirements of different size cities and presents a review of strategies which can be employed to satisfy public transport demands of different city sizes Their aim is to build a flexible, comfortable, easily available and reliable bus service which may encourage shift from private vehicles to public transport They delve into urban travel demand of various Indian cities along with their population and prove that there is large variation in the travel demand met by public transport, intermediate public transport or private modes in these cities of India. The paper also works with the size of the city and Public Transport Demand, Public Transport Demand, Capacity Improvement Strategies for Bus system, Operational Strategies.They finally conclude by showing that substantial improvement in services and performance of the system is possible by employing better methods for route optimization and synchronization of feeder services. However, with the growth in urban areas,

ISSN: 2278 – 1323

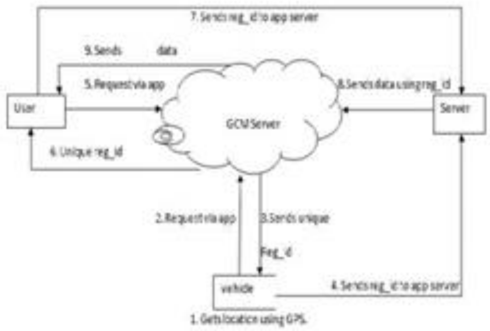

Fig. 1: System architecture

GIS based decision systems have been found to be very effective in designing optimal servicesprovided by buses. WhileReview of Capacity Improvement Strategies for Bus transit service presents a series of strategies which can be employed to satisfy public transport demands of different city sizes, however, they do not handle the specific instance of making this information available to the public commuters in Real Time, readily available to the user's perspective as described in the paper.

Every GPS tracking system is a common approach to get vehicle location information in real-time. The proposed GPS tracking system called tRackIt[20] that is composed of commodity hardware i.e. GPS enabled Android Mobile as GPS Device, open source software and an easy-to-manage user interface via a web server with Google Maps. The system includes GPS/GPRS hardware for location acquisition and message transmission, GCM to transfer location information, and third party open source App Server to temporarily store location. The real-time tracking management system is composed of four components, a GPS Device, a server and a database, GCM & Client application as shown in Fig. 1.

GPS Supported Android Application for City Bus Scheduling and Tracking System [15] develops a GPS supported application for android to track a city bus and then displaying that data. The architecture is broken up into the client and the server side. The client side is basically the user with an android phone with the app installed to view the current position of the bus along with density of passengers inside the bus. The server stores the position of a particular bus and the data from the people counter and keeps updating it at regular intervals. The transport department is provided with a separate server to handle changes in the schedule which is reverted back to the app on the phone. Appealing as it sounds; the GPS on the buses need a clear access to the GPS satellites for a proper location without which the purpose behind the entire model fails. The schedules in the server go haywire and the app crashes.
As "Internet of Things" is turning into a game changer in the technological industry, feasibility of implementing Internet of Things in bus transportation system should also be considered. The dire need for the consumer to understand and evaluate different bus options inan efficient manner is satisfied by The Internet of Things infrastructure in the paper. Implementation of Internet of Things in bus transport system of Singapore [8] proposes an app where Internet of Things can be used topredict arrival timings of buses as well as the crowd inside each bus. It uses protocols for communication between the devices. The architecture proposed by the research wouldestablish a connection between the bus and itsinformation and the passenger through the means of sensors to calculate the vacant seating capacity of a particularbus, embedded devices are used to collect the temporalinformation, geographic location and how fast the bus is moving. These details are also sent to thecloud server after every minute through any standardprotocols that use 3G/LTE, satellitetransmits signals to the bus on ground as well as a very accurate time reference which is provided by blocks of atoms, phone app is used to access all the bus information and a cloud server including a database to save and classify the multiple bus information.Finally, they conclude sayingbus transportation improves in a number of parameters including management of time and efficiency, crowdmanagement and a number of options beingoffered to users. It would provide to all the sections of thesociety satisfying their varying demands. However the research has help structure a technical architecture in place for an app where Internet of Things can be used topredict arrival timings of buses as well as the crowd inside each bus. It fails to implement the structure due to the current limitations of IoT.The architecture of the proposed model is shown in Fig. 2.

Now to focus on the implementation of an RTPI (Real Time Passenger Information) system [6] proposes an idea by including GPS devices on city buses. The Information system is a standalone system designed to display the real-time location(s) of the buses in city that will enable the tracking devices to obtain GPS information of the buses.

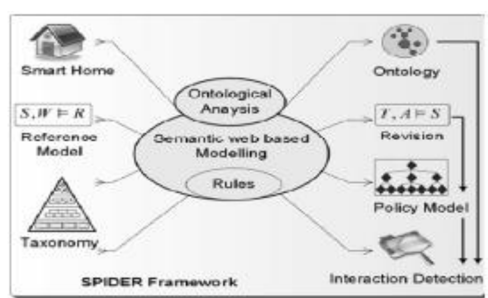

Fig. 2: Architecture of the proposed system whit The Internet of Things as infrastructure

This is then transmitted to a centralized unit and depicts it by activating symbolic representation of buses in the

ISSN: 2278 – 1323

approximate geographic positions on the route map. A Real-Time Passenger Information System (RTPIS)uses a variety of technologies to track the locations of buses inreal time and uses this information to generate predictions of busarrivals at stops along the route.The main parts of RTPIS are simulators of the application,simulator for the buses and a central data processing server. Thesimulators download names and coordinate of bus stops and points of interest from the server and compute current location, direction and finally transmit the computed information to the centralserver using GPRS.The RTPIS tracks the current location of all the buses andestimates their arrival time at different stops in their designated routes. Estimates are updated every time the bus transits an update, although the paper proposes partial implementation details of RealTime Bus Monitoring and Passenger Information System.

In order to overcome the lack of information available to passengers regarding buses and their exact timings,A Mobile Application for Bus Information System and Location Tracking using Client-Server Technology [16] comes up with a solution which involves an app installed on the android OS. This model is split into two modules, the first one of which gives all possible routes from a source to a destination entered by the user and the second one gives all possible buses to the respective route and the location tracker on the bus sends the current location to the user. This module makes use of client-server technology. The entire development process makes use of the eclipse IDE, Android SDK, a database which manages all the data and updates the user's screen at regular intervals and LBS (Location Based Service) which results in a mobile application used to track the location of the bus.

Online Bus Arrival Time Prediction Using Hybrid Neural Network and Kalman filter Techniques [9] presents an effectivemethod that can be used to predict the ETA at individual bus stops along a specified route.They implement a method which isa hybrid scheme that combines neural networks that infers decision rules from historical data with Kalman filter that fuses prediction calculations with current GPS measurements.In the proposed system, all data collected and stored are multi-dimensional. Neural networks are statistical representation of real world systems that are built by controlling a set of values. Thesevalues are seen as inputs to an associated set of values, which in-turn are the required outputs. The process of controlling the weights to the correctvalues – training – is carried out by passing a set of examples of input-output pairs through the model and adjusting theweights in order to minimize the error between the answer the network gives and the desired results. Once this is taken care of, the model is able to produce answers, which were notin the training data.The Kalman filter uses a dynamic model, where the known inputsand multiple sequential measurements (such as from sensors) to produce an estimate of the system's varyingquantities (its state) that is better than the estimate obtained by using any one measurement alone.To determine the prediction times of a moving bus to the bus stations, the GPS values of eachequipped bus need to be uploaded onto the transit network. In these digitized transit network model, bus routes areviewed as a sequence of line features as an approximation to their true geographical location.The end points of each link are called nodes, which are specified by their latitudes and longitudes. All links and nodes aregiven numbers according to the sequence in which the bus passed, and then they are stored into a file for later use. The proposed algorithm relies on real-time location dataand takes into account historical travel times as well as temporal and spatial variations of traffic conditions. A case study ona real bus route was conducted evaluating the performance of the proposed algorithm in terms of the predicted accuracy. Theresults indicate that the system is capable of achieving satisfactory performance and accuracy in predicting bus arrivaltimes for only Egyptian environments.

OneBusAway presented by Brian Ferris, Kari Watkins, and Alan Borning [3], uses a set of transit traveler information tools designed to take some of the uncertainty out of public transit by providing real-time arrival information for Seattle-area bus riders. Proper mapping between stop id and real-time arrival are constructed so that users could quickly access information using a stop's posted id. Multiple interfaces were developed to promote greater access to information. An interactive voice response telephone interface, an instant SMS interface, an iPhone-optimized web interface, and a very basic text-only web interface were added so that a user could easily access information using a variety of devices. An iPhone application that includes automatic localization of the information is presented using the phone's GPS capabilities. The OneBusAway server back-end is written in Java and uses a variety of standard open source development libraries and frameworks in its implementation. The system comprises a number of service modules, each of which provides a specific function, which is paired together using the spring inversion-of-control framework. Java object persistence to a relational database is handled by the Hibernate framework. The Tomcat servlet container combined with the Apache Struts MVC3 web framework does the bulk of the heavy lifting for web-based publishing. The Client's AJAX applications are written primarily using Google Web Toolkit, which compiles Javasource code into optimized JavaScript.However, the survey results are self-reporting, which questions the reliability of responses and limits the potential strength of claims we can make using response data. Also, they do not have a control group of users who have not heard of or used OneBusAway or other real-time arrival information tools, which limits the strength of claims we can make regarding changes in

ISSN: 2278 – 1323

behavior resulting from the OneBusAway tool. Despite these limitations, they believe the results from the survey, fastened by the survey respondents' qualitative comments, make a strong case for the value of systems such as OneBusAway.

In order to tackle the "bus bunching" phenomenon which results from early buses catching up to buses in front and late buses falling behind, Yiguan Xuan , Juan Argote, and Carlos F. daganzo [14] propose a "schedule-based" bus holding strategy. It is featured to embed slack time in bus schedule and holding buses at each station before their scheduled departure. A lot of assumptions are made which constitute of bus dispatches, bus loading time, enough slack exists so that holding time never runs short and buses stop at all stations and holding is applied. There are various variables that are used for each element of the model to formulate the control method of buses using arrival, departure & slack timings. And to incorporate large disturbances like bus breakdowns, the published schedule will be abandoned and the headways are regularized. This enables the bus to recover from the effect of large disruption and still provide service with regular headways.

A system with the goal of improving access to transit information for potential bus riders at a minimum of cost to users and without requiring the assistance of a central authority is Bishkek [17] For the solution, three existing technologies appropriate for Bishkek are augmented SMS, GPS, and GSM. The *box (pronounced star box) was designed to require minimal interaction with the bus driver.The overview of the *bus system is shown in the Fig. 3. In order to use the *box, the driver only needs to turn it on, and then enter a route number using a keypad. The selected route number is displayed on a small LCD and stored locally on the *box to be appended to each location update message sent to the server. The *box is a low-cost vehicle tracking solution that utilizes GPS satellites to locate *box-equipped vehicles. The *box hardware includes a GPS device and a GSM modem integrated into a single package that just requires alocal SIM card. The GSM modem allows the *box to send SMS messages with the GPS data to the server, taking advantage of the widespread GSM cellular phone networks. On the back end, the central server continually collects the GPS location data from all *boxes and stores it in a database. The server consists of a laptop computer connected to a mobile phone capable of sending SMS messages and that serves a gateway to the SMS services. The server does not need to be connected to the Internet, and the service does not require cooperation with mobile

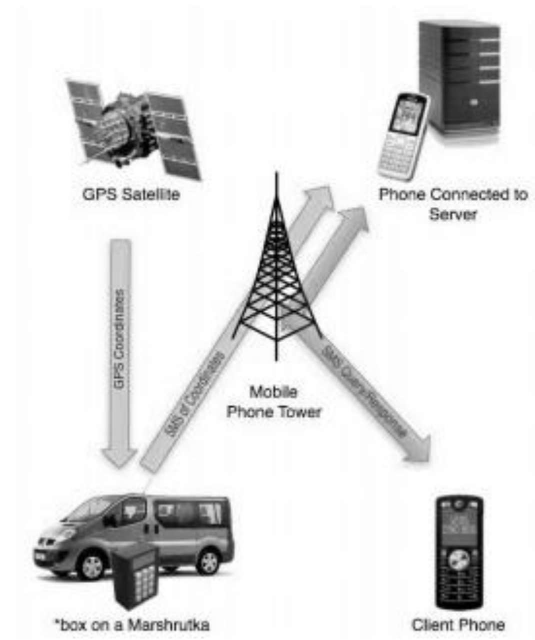

Fig. 3: Overview of Bishkek

providers. Potential bus riders can use their cell phones to send SMS queries to the *box server and receive transit information in response. Initially, the system will just support riders' queries for transit arrival times.

Mei Chen, Xiaobo Liu, Jingxin Xia and Steven I. Chien [7], Make use of an Automatic passenger counter (APC) system that has been implemented in various public transit systems to obtain bus occupancy along with other information such as travel time, location etc. To predict bus-arrival times a dynamic model is developed in this study from data collected from a real-world APC system. Two major elements constitute the model: the first one is an artificial neural network model for predicting bus travel time between time points for a trip occurring at given day-of-week, time-of-day, and weather condition; the second one is a Kalman filter-based dynamic algorithm to adjust the arrival-time prediction using up-to-the-minute bus location information. The travel times between consecutive time's points were foretold considering random traffic jam, weather and ridership distributions. The actual bus time and predicted travel time collected from APC's were then combined and fed into the developed Kalman filtering algorithm, which enabled the predicted travel times to be adjusted dynamically based on real time information. Based on historic bus trip information, artificial neural networks (ANN) were developed for predicting bus arrival times. In the developed neural-network model, the Kalman filtering algorithm has been integrated with the ANN because of its dynamic features to adapt to stochastic conditions in real time. The ANN models give a better estimation of travel

ISSN: 2278 – 1323

times than that posted on a timetable. The primary concern with this model is the insufficiency in data in training neural networks and data quality. While measures were taken to reduce the no. of network weights in ANN models, the required data amount to network weights ratio was still insufficient. For data quality, corrections have to be made manually and some data had to be abandoned to development purposes.

The dynamic bus station proposed by Enne de Boer and Ronald Krul [18] solves the problems of a static bus station. They do a comprehensive study on the dynamism of the bus stations available across Netherlands and come up with an ideal process to be developed. According to their research, the ideal bus station should have the following parameters; an easy pathway to a sheltered waiting area with a display showing the timings of the upcoming buses with their current locations, an incoming bus is allotted a platform with multiple stops for immediate departure and a display at the platforms informing about the departure timing of the bus at the stop. The dynamic stations are certainly not fail-safe. The cumbersome nature of the staff leads to buses crowding up at a stop leaving others empty. There is a need for a design taking into account of physical and psychical needs of people especially the disable ones.

Gps enabled android application for bus schedule system [19] tries to make local bus transport easier for everyone by coming up with a mobile application on the android OS. This app has all the information about buses and their respective routes. The user has to enter the source and destination or just enter the destination as the app gets his/her current location and shows all possible routes to his destination. The app also has an emergency button to send an alert along with their exact location to the authorities or the updated emergency contacts if the traveller feels uneasy while travelling. The buses also have RFID’s to track their current capacity which in turn is showed as red or green on the map indicating whether its board able or not.

To tackle the decrease in frequency of estimation of the buses arriving at their right timings, Dynamic bus timetable using GPS [1], an android application which has the ability to obtain accurate prediction of bus arrival time on real time basis which can be viewed by the transport department as well as the user. Three privileged access levels are provided to avoid unauthorized access, namely; Admin, who add/remove buses from the timetable and controls the same for of all buses and, Conductor, who selects the route and starts the app on his phone and therefore the User, who will read the timetable of solely the desired buses and can't modify timetable of buses.

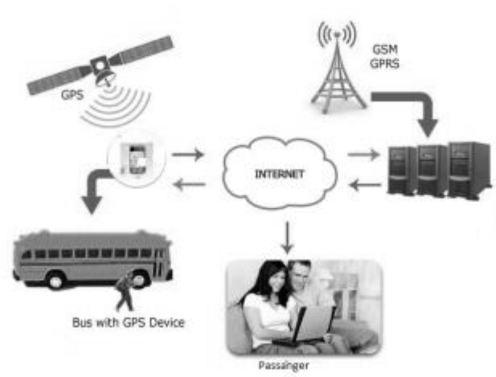

Fig. 4: Architecture

The architecture is shown In Fig. 4. The whole system is divided into 3 models; The android application, the website which has the information of the database for customers not having access to an internet-connected android device and a Remote database which holds all of the information in a MYSQL databaseThe conductor of the bus has to manually start the service on his phone and battery issues also come into the picture. The timings of the bus can change from the time he accesses the website at his home to the time he reaches the bus stand. The direction in which the bus is headed is not given.

A town route on a significant passageway has issues of high variation in demand of the traveler, high frequency of desired bus movements and completely different patterns of traveler arrivals as bus stops. The system of mounted headway operation cannot handle the above mentioned complexities. Dynamic scheduling of buses on a corridor and sensitivity analysis for generation of primary bus routes [11], proposes a model which adopts dynamic scheduling of buses to improve the system. The model records the flow of passengers at every stop and therefore the movement of buses on the route. The output of the model is employed for best style of the dynamic headway. This proposed model for simulation and dynamic scheduling generally involves generation of passengers at different stops according to different probability distributions usually normal or Exponential, Simulating the movement of buses from one stop to the other and using OD matrix to scan passengers in the buses and the stops, estimating the statistics of passengers with respect to waiting time and collection of information about the queues at different stops and Showing the animation of vehicles movement from one stop to other on network and giving instantaneous information about stops and buses.
Although it suggests deployment of an Additional bus from any of the terminals with the aim of maximizing the saving in passenger waiting time based on heuristic approach, it fails to implement operations at both the operator and the user side.

ISSN: 2278 – 1323

A more recent type of dynamic transport system called demand-bus system[5] is introduced by Naoto Mukai and Toyohide watanabe, whose feature includes on demand processing i.e. the transport vehicle, can be called anytime by customers and can get on/off anywhere. This system is classified into two on the basis of bus station types: semi-demand where the no of stations are fixed and full-demand where they are not fixed hence is more flexible. Two methods are used to fully realize the dynamic system, namely, assigning and scheduling. The vehicles which transport the customers are chosen in assigning which is based on the table of predicted future routes which are stored in a communication server. The transport vehicles are required to send their predicted future routes whenever new customers are assigned to each vehicle and anticipated future routes are modified. Scheduling is responsible for how delivery order for customers is scheduled and includes two concepts.

The GPS Tracking Module is based on the GPS enabled android device. The android device must be based on version 2.2 or more. This type of mobile device can have the access to GCM service. Android Device in the vehicle gets its position using GPS. The position we get is the latitude, longitude & time and is sent to the App Server through GCM. This process repeat after every 2 or 5 minutes i.e. set by Admin of the system. The firmware of the GPS Tracking module is written and compiled using an open source compiler. The firmware performs three functions, the initialization, the GPS position tracking, and the GPS data is formatted and transmitted to GCM server via 3G/LTE networks. Once the GPS Tracking Module is connected to GPRS networks, it transmits locations to GCM Server. The application server receives the information from the Google Cloud Module. The in-built storing function formats the receiving data into the database that is designed to provide real-time query response for real time tracks and to provide search query response for the post- analysis of vehicle tracks. On request from the client for location for a particular vehicle the server sends the information to GCM server and GCM server then sends the location information to the client.

The Automatic Passenger Count system used by Horst E. Gerland and Dr. Kurt Sutter [13]is called the IRMA. The system utilizes specially made high-quality sensors which allow for both accurate passenger counts and discrimination between boarding's and de boarding's through one single sensor. Using non-radiating, passive infra-red technology for detection, the no. of people moving through a door is recorded. The technology comprises of one infra-red sensor which is mounted in the door frame, and another unit called analyzer to transform the sensor information into counts and transmit the data to the onboard data collector. This system can be given as a "stand-alone" solution or as an integrated component of Intelligent Transportation Systems (ITS). The working is based on the fact each individual person emits thermal long-wave infrared radiation which creates a temperature contrast to the person´s environment. This radiation can be measured by special pyro-electric detectors which are exclusively used in the IRMA system. Major system components of IRMA are the infrared sensors (usually one sensor per door), the analyzer unit to transform the sensor information into counts, and the communication unit or onboard storage to store the counting data for immediate or subsequent off-load. By changing the detectors array's field of view to the corresponding vehicle door, both the count of people and their direction of movement can be measured by one single sensor per vehicle door.

An important problem in creating efficient public transport systems is obtaining data about the set of trips that commuters make, generally known as an OD (Origin/Destination) matrix. Obtaining this data is problematic and inefficient in general, specifically in the case of buses because on-board ticketing systems do not record where and when passengers get off a bus. Vassilis Kostakos [10] describe a novel and inexpensive system that uses off-the-shelf Bluetooth hardware to wirelessly detect and record passenger journeys. Each bus is equipped with an on-board GPS technology, along with a digital odometer (distance travelled) and door sensors. These three are used to determine the bus location at any given instant. Buses transmit their location using a GPRS connection, and all the locations of buses are stored in a real-time commercial simulator that estimates when each bus will reach the next stop. This data is then transmitted to bus stops using GPRS technology, and each bus stop displays the estimated arrival time of each service on an electronic display. This system uses a class 1 Gumstix Waysmall Bluetooth adapter, referred to as a "scanner" which constantly issues a Bluetooth discovery request and saves the results. In accordance to Bluetooth protocols, a Bluetooth device set to "Discoverable" mode must respond to the discovery request. The scanner constantly issues the same discovery request, and keeps track of the presence of various devices it encounters. The solo requirement is that passengers set their devices' Bluetooth adapter to "Discoverable" mode.This model is limited by the fact that the Bluetooth enabled devices have to be carried by individuals entering the bus along with the device set to "discoverable". The cost of incorporating such a system on a public transport bus is not economically feasible.

In order to better the estimation of passenger flows entering or exiting from buses, Real-time passenger counting in buses using dense stereovision [2], proposesstereo vision as a basis of counting system. To obtain three-dimensional information in a reliable and trustworthy way, they make use of a dense stereo-matching procedure in which the winner-takes-all technique minimizes a correlation score. After calculating

ISSN: 2278 – 1323

disparity maps for every image, a binarization with multiple thresholds and mathematical operations are used to localize the heads of people passing right below the sensor. The indicators indicating the heads of the passengers getting on or off the bus are then tracked during the image sequence to reconstitute their trajectories. And in the end, passengers are counted from these reconstituted trajectories. They showed that it is possible to obtain counting accuracy of 99% and 97% on two large realistic data sets of image sequences showing realistic scenarios.The whole setup of the model leads to very complex image processing algorithms which becomes very time consuming and economically infeasible.

There have been a variety of location-based services and almost all have failed to gain widespread use or to be exquisitely useful.Thomas Sheppard and Alan Graham [4] developed this technology which has the capability of listening to the signal your smartphone broadcasts as it searches for Wi-Fi networks, and provides an aggregated and anonymized open data stream showing, accurately, where every person is in real-time. With the software of Presence Orb installed on the ever-increasing number of public Wi-Fi hotspots, you could know exactly how a place will be before you arrive. Presence Orb records only required amount of data in order to provide an aggregate picture of group of people, not individual persons, and that the identification of specific devices would only be with the explicit consent of the owner in an opt-in model. With the presence Orb installed citywide, you could practically know how full a bus would be before it reaches a particular stop.

III. CONCLUSION

With public transport being used by more than 90% of the people within India, it comes down to a single question as to how it can be well built with a solid organized structure to make it feasible to the users and the operators as well.
The models discussed in the literature survey all require hardware in some form which is summarized within the TableI. To address these issues we eliminate total hardware dependency with a solution that uses an Android application which solely utilizes crowd sourcing to obtain temporal and geographical bus information and a QR code to perform security checks. Since this dynamic information is available right at the users fingertips it offers a reliable and an inexpensive solution providing answers to a number of problems.

Table I: Comparison of Features

Features / References	A	B	C	D	E	F	G	H	I	J
[1]							✓	✓		
[2]						✓				✓
[3]		✓							✓	
[4]								✓		
[5]							✓			
[6]		✓								
[7]				✓	✓					
[8]		✓								✓
[9]				✓	✓		✓			
[10]		✓	✓							✓
[11]							✓			
[12]	✓	✓				✓				
[13]										✓
[14]							✓			
[15]								✓		
[16]								✓		
[17]		✓						✓	✓	
[18]	✓						✓			
[19]		✓	✓					✓		
[20]		✓						✓		

A - GIS Based decision systems
B - GPS
C - RFID’s or Bluetooth
D - Kalman Filters
E - Neural Networks
F - Image Processing or capacity improvement
G – Predicts Routes or schedule based strategy
H - Mobile Application (iOS, Android)
I - SMS/Voice interactive response
J- Counters/Sensors

IV. ACKNOWLEDGEMENT

The work reported in this paper is supported by the college through the Technical Education Quality Improvement Programme[TEQIP-II] of the MHRD, Government of India.

ISSN: 2278 – 1323

REFERENCES

[1] Gunjal Sunil N, Joshi Ajinkya V, GosaviSwapnil C and KshirsagarVyankatesh B, "Dynamic bus timetable using GPS". International Journal of Advanced Research in Computer Engineering & Technology (IJARCET), Volume 3, Issue 3, March 2014.

[2] TarekYahiaoui, Cyril Meurie and LouahdiKhoudour, "Real-time passenger counting in buses using dense stereovision",Electron Imaging, Volume 19, Issue 3, July 2010.

[3] Brian Ferris, Kari Watkins, and Alan Borning, "CHI '10 Proceedings of the SIGCHI Conference on Human Factors in Computing Systems," pp.1807-1816, June 2010.

[4] Thomas Sheppard and Alan Graham, Wired, Technology(2014, April 22)"Presence Orb" using Wi-Fi to detect if buses are full".

[5] Naoto Mukai and Toyohidewatanabe, "Dynamic transport services using flexible positioning of bus stations", Autonomous Decentralized Systems, pp. 259-266, April 2005.

[6] Mrs.SwatiChandurkar, SnehaMugade, SanjanaSinha, MegharaniMisal and PoojaBorekar, "Implementation of Real Time Bus Monitoring and Passenger Information System."International Journal of Scientific and Research Publications, Volume 3, Issue 5, May 2013.

[7] Mei Chen, Xiaobo Liu, Jingxin Xia and Steven I. Chien, "A Dynamic Bus-Arrival Time Prediction Model Based on APC Data" Computer Aided Civil and infrastructure Engineering, 2004,Volume 19, Issue 5, pp. 364-376, June 2004.

[8] Menon, R. Singha, D. Ediga and SubbaIyer, "Implementation of Internet of Things in bus transport system of Singapore"Asian Journal of Engineering Research,Volume 1, Issue 4,July-Sept.2013.

[9] M. Zaki, I. Ashour, M. Zorkany, and B. Hesham, "Online Bus Arrival Time Prediction Using Hybrid Neural Network and Kalman filter Techniques.", International Journal of Modern Engineering Research (IJMER), Volume 3, Issue 4, pp-2035-2041, Jul - Aug. 2013.

[10] VassilisKostakos, "Wireless detection of passenger trips on public transport buses", Intelligent Transportation Systems, pp. 1795-1800, 2010.

[11] B.R.Marwah, Raman Parti, and G.Sayee Ram, "Dynamic scheduling of buses on a corridor and sensitivity analysis for generation of primary bus routes" Transportation research board, pp. 157-62, August 2002.

[12] MuktiAdvaniand GeetamTiwari, "Review of Capacity Improvement Strategies for Bus transit service."Indian Journal of Transport Management,pp. 363-391, October 2006.

[13] Horst E. Gerland and Dr. Kurt Sutter, "The Automatic Passenger Count system", APTA Bus Conference 1999.

[14] Yiguang Xuan, Juan Argote, and Carlos F. daganzo, "A Dynamic Holding strategy to improve bus schedule reliability and Commercial speed".

[15] Shefali Agrawal, Neha Ahire and Prof. Samadhan Sonavane, "GPS Supported Android Application for City Bus Scheduling and Tracking System." International Journal of Enhanced Research in Management & Computer Applications, ISSN: 2319-7471Vol. 3 Issue 12, December-2014, pp: (26-29).

[16] Yasha Sardey, Pranoti Deshmukh, Pooja Mandlik, Saurabh Shelar, Minal Nerkar, "A Mobile Application for Bus Information System and Location Tracking using Client-Server Technology" International Journal of Emerging Technology and Advanced Engineering.

[17] Ruth E. Anderson, Anthony Poon, Caitlin Lustig, Waylon Brunette, Gaetano Borriello, Beth E. Kolko, "Building a Transportation Information System Using Only GPS and Basic SMS Infrastructure" .

[18] Enne de Boer and Ronald Krul, "the dynamic bus station, a user friendly facility?" Association for European Transport and contributors 2005.

[19] Abhishek Dilip Bhonge, Deepak Dattatray Kankhare, Prasad Laxmanrao Takate, "Gps enabled android application for bus schedule system", IJRET: International Journal of Research in Engineering and Technology eISSN: 2319-1163 | pISSN: 2321-7308.

[20] Nilesh Manganakar, Nikhil Pawar and Prathamesh Pulaskar, "Real Time Tracking of Complete Transport System Using GPS" Proceedings of National Conference on New Horizons in IT - NCNHIT 2013.

ISSN: 2278 – 1323