DETECTION AND WARNING OF PASSENGER COUNT IN BUSES USING ARDUINO

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Abstract

Indian buses can accommodate a maximum of only 80 people. But in our country, buses carry a huge amount of passengers. Due to this accidents occur [because of foot boarding]. Overloading in the buses may sometime leads to the accidents and fatal deaths due to the foot boarding. We have proposed an idea to overcome this problem occurring in our country. There are no existing methods in our country to overcome this problem. The objective of this work is to simply count the passengers while they are boarding the buses. If overloading of the passengers occurs, then immediately the bus number along with the bus details will be sent to the nearby police station number or traffic policeman's mobile. This will help them to monitor over the loading in the buses and to take necessary action against the one who violates the rules. In this work we used a RFID detector and RFID tag. Once RFID tag is detected then passenger count will be incremented. When the passenger count exceeds the value that is already stored in the Arduino processor, then message will be sent to the policeman through GSM module.

KEYWORDS: ARDUINO UNO, RFID Tag, GSM module, passenger count warning.

1. Introduction

The overloading of Indian bus, by flouting the rules and ignoring the safety norms is resulting in mounting road mishaps in the State. It is turning out to be a matter of concern for the road-users and traffic-planners. As per statistics, goods vehicles are involved in about 11 percent of accidents in the State. In 2002, the city reported 105 accidents caused by goods vehicles compared to 65 accidents involving private buses and 153 involving KSRTC buses. The increase in accidents involving goods vehicles is mainly due to overloading, rash driving and traffic congestion, according to Mahesh Chand, Chief Project Coordinator, National Transportation Planning and Research Centre (NATPAC). Stashing goods way beyond the capacity of the vehicle is a regular phenomenon.

Many a time, vertical loading is so high that the vehicle becomes quite unstable due to upward shifting of the vehicle's center of gravity. With the advent of multi-axle vehicles, highways are also facing serious problems from overloaded goods vehicles. The proposed work
is capable of overcoming all these difficulties. This work is to simply count the passengers while they are boarding the buses. If the overloading of the passengers occurs then immediately the bus number along with the bus details will be sent to the nearby police station number or traffic policeman’s mobile. This will help them to monitor over the loading in the buses and to take necessary action against the one who violates the rules. In our project we used a RFID detector and RFID tag.

2. Literature Review

On bus routes, knowledge of ridership data is pivotal for the efficient operational planning and quality of public transport companies. Automatic passenger counting (APC) can represent a powerful resource for supporting this activity, because it can provide a databank of accurate counts. However there are some relevant challenges, such as data validation, matching of data to the bus stop, building intelligible performance reports and tackling anomalies must be faced in order to make APC data a mainstream source of information. This paper proposes an offline framework for addressing these challenges. The use for setting bus frequencies is investigated in order to illustrate a possible application of the framework. The results are represented by easy-to-read control dashboards composed of tables and graphs. The methodology is experimentally tested with data records provided by the bus operator CTM in Cagliari, Italy.

Currently, ridership data play a crucial role on the quality of service provided by public transport companies (PTCs). Two standards on service quality in public transport have been issued. They require several quality-based criteria to be satisfied for a predefined percentage of passengers. Moreover, knowledge of ridership data on bus routes is pivotal for efficient planning and operations. Currently, PTCs collect passenger data typically by human procedures, if at all, which may be inconsistent and affected by inaccuracies, or by automated systems such as APC, which result in huge amounts of data.

This paper aims to develop a framework for processing the collected APC raw data. Several questions must be answered in investigating this topic effectively, such as follows. Which scopes could be faced by APC data? Which additional data are required to process APC raw data? How could APC raw data be handled? How could they be represented in a user-friendly way? The contribution of this paper is to answer these questions which are of particular relevance for PTCs interested in improving their services. This paper provides an overview of which scopes can be investigated from APC data, presents a framework addressing common challenges deriving from APCs, and focuses on frequency setting as a possible application of the proposed framework. It is experimentally tested with a real case study for which APC technology is available. To the best of our knowledge, although APCs may collect all kinds of raw data, PTCs must face challenges, such as matching APC data to bus stops, validating data, tackling anomalies, and building intelligible performance reports, regardless of how APC data fields are organized.
The proposed framework addresses these challenges and handles huge amounts of data effectively, resulting in mainstream source of data on ridership volumes, as well as in significant savings for the workload of PTCs. For example, the possible application on bus route frequencies would be otherwise performed by manually collected data at point or ride checks and only for limited periods. Finally, this framework builds efficient evaluation tools, which could possibly show how to reduce service costs, to manage the service effectively over the entire transportation network.

Passenger volumes can vary systematically by season, day, time of day, route, and direction. Moreover, PTCs usually provide well-established routes and receive politically predefined levels of subsidies. Therefore, it is important for PTC planners to tweak frequencies (vehicles/hour) or headways (minutes/bus) for every route of the entire network to serve users who generally perceive frequency as an important attribute of the service. Further states that there are no well-accepted methods used in practice by PTCs for setting frequencies for both high and low demand services. Nevertheless, at least two main classes of approach can be identified: the MBA and the SSBA.

In using the MBA, frequencies are set by solving analytical models where objective functions optimized such that specific constraints are satisfied. Models can be solved exactly or heuristically. In the first class, Mohring reports the so-called square root rule proposed by Newell. Variants of this are investigated by Banks in several cases considering different values of subsidy, fleet size, capacity, etc. Hadas and Shnaidermans show how to use the stochastic properties of collected data to set bus frequency by an optimization model.

Their generation of random data didn’t shed light on the main challenges deriving from the processing of APC data. Generally speaking, methods often use aggregated data on boarding passengers in both directions of a route, collected by manual methods or forecasts. Therefore, they may result in narrow conclusions. More complex models plan both routes and frequencies at a strategic level however, they are hardly employed, since they cannot incorporate practical and operational considerations in the optimization analysis. In addition, PTCs prefer adjusting frequencies rather than passively implementing drastic changes from the MBA blackboxes. Moreover, owing to their complexity, these models can be solved by heuristic methods only.

Therefore, as pointed out by Furth and Wilson, it is more common for PTCs to establish frequencies by SSBA considering past experience, personal opinions, average travel time, given vehicle capacity, passenger counts, and different criteria (e.g., crowding levels and policy headway). However, these standards need to be methodologically strengthened to optimize the use of available resources. Ceder proposed four methods for the efficient tweaking of bus frequency based on two main criteria: 1) adequate space provided to satisfy the demand; and 2) minimum required frequency or policy frequency at time $t (Fr(t))$. These criteria account for the possible differences between routes. Some routes serve many users and are the most profitable for PTCs, whereas other routes serve fewer customers and are provided to fulfill a social role. According to these criteria, passengers are expected to find good levels of service and the PTCs
to minimize the number of bus trips. Nonetheless, these methods require ridership data in a disaggregated space-time dimension.

Measuring ridership data on bus routes is crucial for the quality and the efficient operational planning of PCTs. This paper sheds light on the use of APC data to perform this task, because many PTCs may be interested in adopting APC and handling collected raw data. Although APCs provide a much larger level of detail than manually collected data, they also give rise to a number of challenges, which must be addressed in order to successfully operate. The main contributions of this paper are as follows.

1. To generate a mainstream source of data on ridership volumes in an automatic way, which is a great topic for the future smart cities.
2. To present a framework integrating procedures to link collected data to a trip of a route, perform a validation step to process significant data only, remove possible anomalies, and build a profile of on-board passengers between consecutive bus stops for each time period.
3. To improve the level of detail provided by APC data by defining and implementing two matching algorithms, which associate APC-collected data with any trip and, hence, derive disaggregated on-board passenger volumes.
4. To illustrate the practical effectiveness of this framework in a real case study. User-friendly CDs are constructed to demonstrate possible improvements in the efficient management of bus frequencies.

If properly handled, APC-collected data provide insights into passenger volumes for each route. The user-friendly representation can be used by transit managers, to focus on where and when changes in service need to be performed. The proposed framework is currently being tested in the setting frequency application by the bus operator CTM in Cagliari (Sardinia, Italy), whose experience will be used for further validation. Future research will provide results that are more accurate via the equipping of additional vehicles with APCs. Possible improvements to the algorithm may be achieved by the integration of bus stop sequences into the daily tasks of buses. Generally, the integration provides room for intelligent analysis of passenger data, which can be processed for service evaluation. For example, the bus routes cooperation in the whole network and the tradeoff in terms of bus route frequency could be investigated.

Finally, a more ambitious project will be to develop an online framework that is able to calculate the free seats of a bus in real time. These data will be transmitted to a central station that is able to broadcast this information to dynamic message signs at bus stops or web services, where a customer could connect to estimate the arrival time of the bus and to check its current capacity. As a result, users could be distributed in the scheduled buses according to their needs, and the PTC could adjust its service in real time.

The experimentation was performed with CTM, which is a bus operator providing public transport services in eight communalities of the metropolitan area of Cagliari (Sardinia, Italy), which has about 400,000 inhabitants. CTM manages about 300 buses serving around 38,500,000 passengers a year with 29 routes. Tests are carried out on the most traveled high frequency route of CTM. At the moment, CTM collects passenger data by TDS and manual counting. However,
because managers and planners have little trust in manually collected data, CTM was motivated to test APC technologies. Moreover, the objective of certifying its routes according to the standard was a further motivation for the use of this technology. Therefore, a bus serving the considered route was equipped with APC technology in 2010 and monitored for less than two months. The tested APC system was provided by a vendor. This APC system uses active infrared sensors with beams in the invisible infrared spectrum. The sensors are unobtrusively installed over the vehicle doors and deliver passenger count data. A local unit mainly records data on boarding and alighting passengers as well as the stop and start time of the bus at every bus stop.

3. Research Objectives

To make it cost-efficient and simple to use and to make it understandable to illiterates. To make an app or website which will provide detailed information to desperate passengers waiting in bus stops about the location of bus and the count of passengers and availability of seats. To make it useful for individuals so that they can plan their schedules accordingly, thus reducing time wasted in bus stops. This will explain the transportation needs of public, thus it acts as a platform between individuals and government. This can also be used in other public transports such as passenger trains to control the crowd during peak hours.

4. BLOCK DIAGRAM OF THE PROPOSED WORK

The above Fig 5.1 shows the block diagram of the working and arrangement of components of the proposed method. An RFID tag detector is used at the entrance of the bus. Every passenger must carry a RFID tag. When the passenger gets on bus, RFID tag is detected and count is manipulated. Similarly when the passenger gets down RFID tag is detected and count is reduced. The count is manipulated and recorded using a microprocessor/microcontroller (like Arduino/Raspberry pi). The recommended standard count range is stored in the microprocessor/microcontroller. If the count exceeds the recommended range, then an alert or warning message is sent to the nearby traffic police or police station by using GSM module [6]. The program is loaded into the PC. An array of RFID numbers is stored in the form of a matrix.
which will act as a database. Whenever an RFID tag is detected the array is continuously updated. This method can be used to overcome the problem of overloading in buses in an effective manner. Figure 5.8 shows the implementation of the project.

5. Results and Discussion

5.1 AURDINO BOARD:

Fig 5.1 shows the arduino board. Arduino is an open source computer software and hardware company, project, and user community that designs and manufactures single-board microcontrollers and microcontroller kits for building interactive objects that can sense and control objects in the physical and digital world. Uno type arduino board has been used for the proposed work.

![Arduino Board](image1)

**Fig 5.1 Aurdino Board**

5.2 RFID

Radio-frequency identification which is so called as RFID uses electromagnetic fields to automatically identify and track tags attached to the objects. The tags contain electronically-stored information in it. EM18 RFID is used for this work.

![RFID Module](image2)

**Fig 5.2 RFID Module**
5.3 GSM MODULE

GSM stands for global system for mobile communication and it is a mobile communication modem as shown in Fig 5.3. In the current work SIM 900A GSM module has been used. A GSM digitizes and reduces the data, then sends it down through a channel with two different streams of client data where each will be sent in its own particular time slot. This digital system has an ability to carry 64 kbps to 120 Mbps of data rates.

![GSM Module Image](image)

**Fig 5.3 GSM MODULE**

6 WORK COMPLETED:

Thus the program is successfully executed and desired output is obtained. Interfacing of the RFID reader and GSM module is done. For this work, it is considered that the standard or legal count as 'one', for simplicity. Thus a warning message is sent if the number of RFID tags exceed 1. Arduino uno, EM18 RFID reader module and SIM 900A GSM module are used for this work. The interfacing circuits are shown in Fig 6.1 and Fig 6.2.

![Interfacing Circuits](image)

**Fig 6.1 SIM 900A Interfacing To Arduino Uno**
This work had been tested for various possibilities and same favourable outcomes are obtained. The proposed method is simple to implement and is very cost efficient. The prototype of the work is shown in Fig 6.3.

Fig 6.3 Prototype of the module
Fig 6.4 Controller output

Fig 6.5 shows the warning message received at the receiver side. hence a safer transport system can be developed by using the proposed methodology.

7. Conclusion
Thus this method is far better while compared with the conventional passenger sensing devices present in buses. They are more accurate and reliable. This can effectively reduce
passenger crowding and accidents while travelling in buses and provide an efficient transporting. This method can be further developed to produce intriguing results. This helps the bus drivers to follow the road norms and effectively reduce the loss of the lives due to the foot boarding and passenger overloading. The proposed method helps to reduce the accidents and provide a better transporting in a simple and cost efficient solution.

8. Limitations and Future Research

An app or website can be created which will provide detailed information to desperate passengers waiting in bus stops about the location of bus and the count of passengers and availability of seats. This will be useful for individuals. They can plan their schedules accordingly, thus reducing time wasted in bus stops. This will also explain the transportation needs of public, thus it acts as a platform between individuals and government.

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