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Smart Bus for Smart City Using IoT

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Abstract – *Time is the most indispensable thing in the world. There are many people wasting their time by waiting in bus stops for long time without knowing the exact arrival time and status of bus. Even though many buses are available for the same location, there is no proper platform to get their details. There are many reasons for irregular timing of bus. If people travelling by bus, get the next bus information and the approximate arrival time based on normal traffic conditions along with the count of passengers in the bus, it will increase the trustworthiness in public transport. This system proposes an android application which will provide a way to track the public bus using GPS (Global Positioning System), to find out the number of passengers in the bus and also to inform the estimated time of arrival to the passengers. The Location and Occupancy of Bus can be displayed in application along with expected arrival time. It will also contain the details of all the bus like Bus number, Bus routes, Type of Bus service and Bus timings. Existing bus transport system doesn't provide any digital assistance to the passenger. Moreover, in country like India it is difficult for the passengers to plan their departure time. In this system an IOT based sensor is integrated in the buses to monitor the seat occupancy and a way to pay ticket fee digitally is also provided. By using cashless payment method corruption and paper receipt can be avoided. This methodology helps the passengers to plan their trip accordingly. This approach helps the passenger to track the live status of the bus using GPS sensor.*

KEYWORDS: Public Transportation, Bus, Real Time Tracking, Internet of Things, GPS, IR Sensor, Android

1. INTRODUCTION

"Time fleeth away without delay", as the quote says time is precious. In our daily routine transportation pays a major role, but it also consumes more time especially in bus transportation which is due to traffic this can be avoided by giving exact information. The status, availability and their arrival time are not known. Our app "Occupancy Identification and Location Tracking of Bus" provides a way to overcome it. Nowadays android phones are used by almost everyone, our idea is to make it available for everyone so we have developed an android application and also match the current trend. Our android application provides user the details (location, time and status) about the buses of the particular route. Along with bus timing it will also provide additional details such as Estimated Arrival Time (ETA) of Bus and Occupancy details. In order to find ETA of bus K-Means algorithm is used, which gives the most accurate ETA. To give details about occupancy level of the bus, IR sensors are attached to the both the doors (entry and exit) so that the count of passengers getting in and going out are calculated. The Delay of bus due to various reasons are analysed using the Decision Tree algorithm and the current status of the bus is given to the user. Our also provides secured payment method to the user to pay their ticket fare via online, so that it reduces the time of issuing the ticket.

This paper consists of four sections. The first section shows the survey made on existing systems and the findings. The second section elaborates on the methodology or the proposed work. The third section shows the experimental setup and the results. The final section gives the conclusion and future work.

2. LITERATURE SURVEY

Basically, the android application facilities for the passengers will majorly fall under two categories:

1. Location Tracking
2. Occupancy Identification

The following section provides the details about the existing systems and related works.

1. Rose Mary John, Finky Francis, Jinesh K J, Alwyn Antony, "Smart Public Transport System". This system helps the user to provide current location of the bus and alert the passengers if the driver goes over speed. The output of the web application is to give details about the current position of the bus.

2. Suleyman Eken , Ahmet Sayar ,"A Smart Bus Tracking Based on Location –Aware Services and QR codes". The system is used to provide the current position of the bus along with the Estimated Arrival Time. The output of the application is showed when user scanned the QR code from the bus stop.

3. S. Sharad, P. Bagavathi Sivakumar, V. Anantha Narayanan, "The smart bus for a smart city". This system provides the details and estimated arrival time of bus for subscribed one alone. The output of this system is to give the location and Estimated Arrival Time for the subscribed buses alone.

4. A J Kadam, Virendra Patil, Kapish Kaith, Dhanashree Patil, Shambhavi Bendre," Smart Bus for Smart City Using IOT Technology". This is used to know the Estimated Arrival Time and occupancy of the bus. The output of this system provide the bus live location and Estimated Arrival Time of the bus along with seat occupancy.

3. PROPOSED WORK

The proposed system is based on IoT and Android approach which uses methodologies like Decision tree, K-means algorithm for processing.

The process is divided into 3 different phases which employs various algorithms and methods for implementation.

3.1. LOGIN AND LOCATION FETCH MODULE

This module allows the new users to create account if already not created. The Login Form module presents application visitors with a window with username and password fields. If the user enters a valid username/password combination they will be granted access to application. If wrong/forgot password, the application allows the user to change password. After credential validation it directs to new window which having map. It automatically fetches the location from the user mobile but user must grant location permission to this application or else it throws error in fetching.

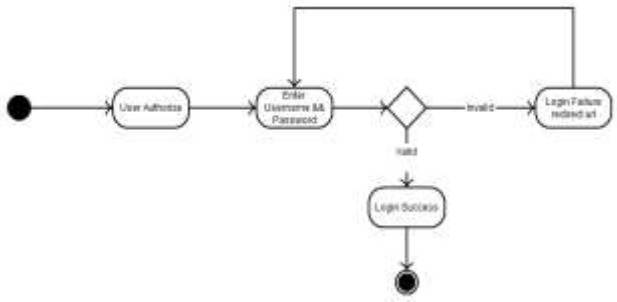

Fig-2.1 shows the flow of login process.

After successful login it automatically fetches the location and shows in the application window with pin point icon.

3.2. PIR AND GPS SENSOR DATA COLLECTION MODULE

The GPS sensor placed in the bus fetches current location of bus and that location is sent to server for every 1 minute. So the location of bus can be fetched and displayed accurately. Two PIR sensors are placed in entry and exit way of bus. Both detects the count of human by the heat emission of body. So the plastic bags, covers and walk sticks can be avoided in occupancy count. Count from entry way sensor is incrementally added to the occupancy count. In parallel, the count from exit way sensor is decremented by value fetched from this sensor.

Sample Calculation:

If bus total capacity is 52 and Value of PIR Sensor in entry(PIR1) is and in exit(PIR2) is 15

Availability = Total - (PIR1 – PIR2) = 52 – (30-15) = 52 – 15 = 37 Seats

This seat occupancy calculation is done for each bus stop and also it calculates whenever value thrown from sensors.

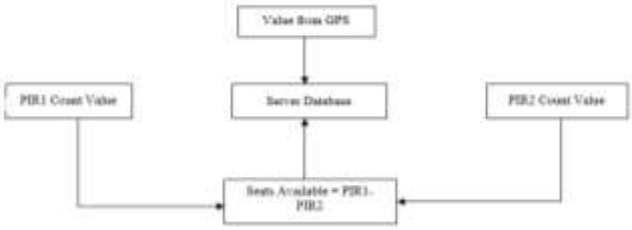

Fig - 2.2 PIR and GPS Sensor Data Collection

The Figure No. 2.2.a shows the flow of how location and occupancy value is stored in server database. Both data are fetched in frequent time difference. So accuracy in data can be maintained.

3.3. SEARCH AND PAYMENT MODULE

The application allows the user to enter destination. User location can be either manually entered or automatically fetched. Based on destination, it will show the various buses available in that route for next 4 hours. Search result window also shows the details of bus such as bus no, number of stops, bus route, ETA, current location of bus and occupancy level of bus. K-means algorithm is used to calculate ETA. Based on past week data of bus timings, it will calculate the arrival time.

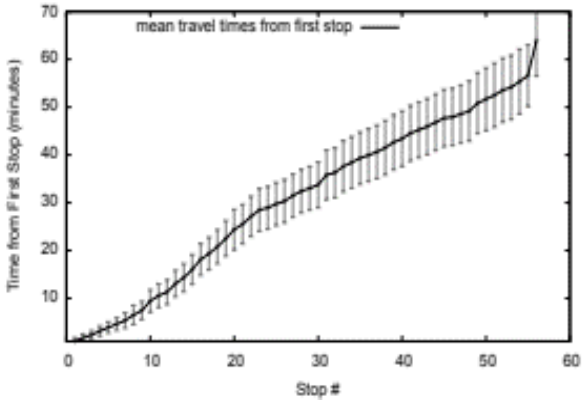

Fig-2.3. a K-means algorithm graph

The Fig- 2.3.a shows the arrival time of bus in each stop in various time intervals**.**

Decision tree algorithm is applied to alert the passenger if any breakdown or traffic. If bus stays in same location for more than specified time in predefined data, it alerts the passenger.

training data set

ID	LateTime	Reason	WeatherCon	BusStopTime	RouteNum	StopId
1	6	Traffic	Rainy	10:00	23	1
2	4	PassengerDen	Normal	10:00	23	1
3	9	PassengerDen	Normal	10:00	23	1
4	10	Traffic	Snowy	10:00	23	1
5	22	Breakdown	Snowy	10:00	23	1
6	8	PassengerDen	Normal	10:00	23	1
7	13	PassengerDen	Snowy	10:00	23	1
8	14	PassengerDen	Rainy	10:00	23	1
9	14	PassengerDen	Snowy	10:00	23	1
10	30	Accident	Rainy	10:00	23	1

Fig- 5.3.b: Decision Tree sample set

4. SYSTEM ARCHITECTURE

Fig-3 architecture diagram consists of GPS sensor and PIR sensor, which are placed in the bus. The GPS sensor is fixed in the bus to get the current location of the bus. The PIR sensor is fixed in the steps of the bus to count number of persons getting in and out of the bus. The GPS and PIR sensor are connected to the Arduino uno and a Wi-Fi module is also connected to transmit the sensor collected data to the Database. The user has to install the android application and login to the application. Then the user location will be fetched by the admin after that user have to search for a destination. The admin provides the nearby bus details from the database.

Fig -3: System Architecture

5. IMPLEMENTATION OF THE SYSTEM

The Arduino UNO board embedded with AtMega2560p microcontroller is used. The PIR sensors are added to detect humans in entry and exit of bus. The GPS modules are connected to the board for fetching location from bus. The implementation is shown in Fig-4.

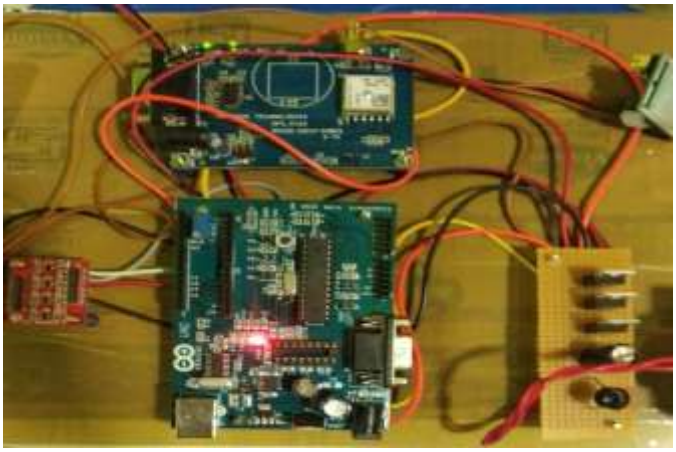

Fig -4.1: System Implementation

The K-Means implementation is carried out according to the bus timings value of previous week dataset obtained.

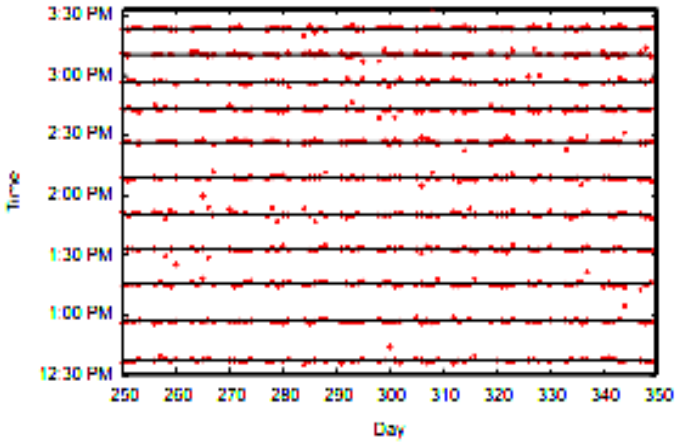

Fig -4.2: K-Means Calculation

Fig -4.3: Android UI Implementation

6. RESULTS

The output of the system shows the location fetching and list of various buses available as shown in Fig-5.1 and Fig-5.2. It allows the user to search buses based on destination and current location is automatically fetched.

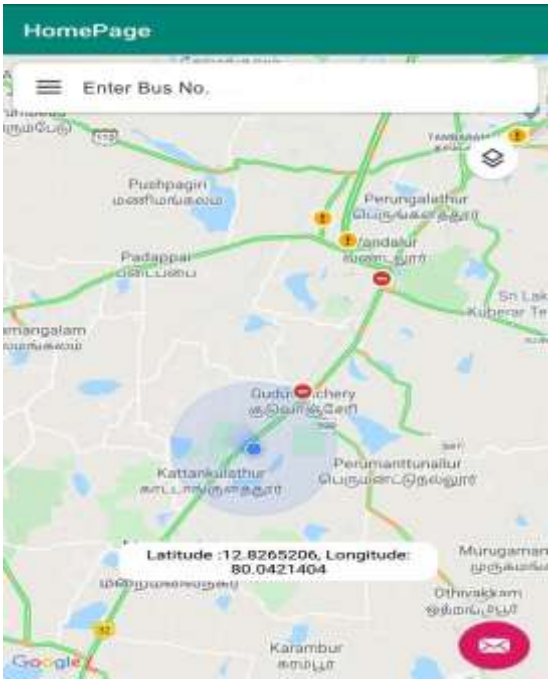

Fig -5: Location Fetch

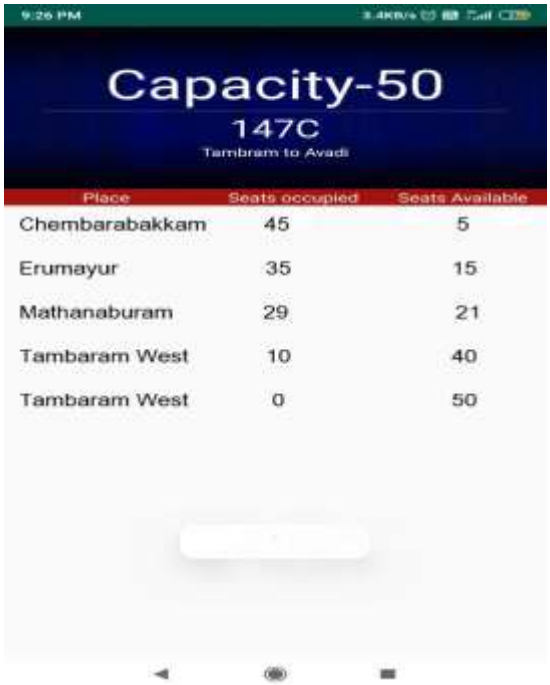

Fig -7: List of buses available

7. CONCLUSION AND FUTURE WORK

This system is useful for the bus passengers to access a flexible and easy android UI platform when around other people. This helps the commuting people to understand timings of bus and occupancy level of bus. In future work, it can be implemented in unreserved long distance travelling buses and reservation of seats can be done through android application.

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