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Internet of things time saving and management system for bus passengers

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ABSTRACT

This article presents a novel type of mobile phone application approach using the wireless fidelity (WiFi) system. Which is capable of facilitating the public transport user and its drivers efficiently. The application support passengers when there are scenarios where commuters face problems while using public transport. If users get bus information beforehand, such as bus location and arrival time, the number of passengers in the public transportation system. This application has been developed for the Android operating system. The application includes bus details like real-time bus location, bus arrival time, bus routes, bus stops, bus numbers, and so on. After the trip is booked, users' devices allow real-time geolocation to be shared in the application, helping the bus driver decide to stop at one stop or move to another when there are no users.

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1. INTRODUCTION

Public transport is being observed as having the most significant influx of users, this is mainly due to the reason that it is user-friendly, efficient, cost-effective, and helps people and goods to move from one place to another [1]. The range of modes of transportation can provide basic safety demands, health, harmony, ease, fiscal growth, and social growth to groups of people in a diverse fashion. A few modes are extra effective than the rest. However, all modes contribute towards increased agility and approach to a range of services, resources, markets, and opportunities [2]. It has substantial benefits, such as saving time, lowering the cost of energy and parking, and chances for more social contacts, reducing congestion and emissions, reducing stress, and conservation of energy, this also supports a healthier future [3] for coming generations. The reliance on personal automobiles is linked heavily to the non-availability of proper infrastructures and tactics rather than to sharing other modes of transportation [4]. Crowding in transport, accidents, and pollution are becoming more severe day by day, due to an extraordinary rise in various commuting systems. These commuting means to cover vehicular, freight, public transport, and even pedestrian traffic.

To find solutions to such issues, intelligent transport systems (ITSs) have been grown up. The system is capable to integrate a wide range of systems for a commute. This includes sensing data, dissemination of information, and communication data relevant to traffic [5]. Often the frequency and location of a certain route bus, its schedules, recognized routes, its commencing points, and its potential to carry some travelers are not available to passengers, this may deprive the users of a particular service [6]. Whereas, the contributing authors of this article pay attention to comparing the architectures which are based on the internet of things (IoT) to serve to monitor the bus and its management system. This consists of radio

frequency identification (RFID), global positioning system (GPS), general packet radio service (GPRS), and geographic information system (GIS). Besides the transportation systems mentioned here, a range of enabling technical approaches have also been used for tracking animals, objects, and humans. Likewise, these systems are widely known as real-time location systems (RTLS) [7]. RTLS is based upon software and hardware, which can monitor and discretely determine/provide the online position of an asset or resources to the user accurately. The technology which works without physical wires is being used to communicate between software writers devised in a range of forms, including RFID, Bluetooth, wireless fidelity (WiFi), ZigBee communication, ultra-wideband (UWB), infrared, and global system for mobile communication (GSM). All these technologies are considered for a special type of application and possess their advantages and disadvantages [8].

IoT technology has the potential for usage in transport systems shortly. By the year 2025, it is estimated that a mark of 75 billion device connections to the internet will be achieved [9]. The components which are responsible for data-collection help to gather all useful information about the transportation system, e.g. parameters such as the flow of traffic at a particular location of the road network, average time to travel for a particular section of a road network, and number of travelers who are boarding onto a commuting line [10]. The ITS is announced to take all the benefits of prevailing public commuting infrastructure and to augment its efficiency, efficacy, and allurement. The ITS is considered an application to support advanced systems in communication, information data processing, control, and related electronics technologies which improve the commutation system. This extends its help in terms of saving precious lives, time, and funds [11] and provides sources that are responsible for enriched data, with an increased resolution, and thereof, dissemination of methods for information. Therefore, give access to higher levels of real-time detailed management opportunities [12].

In this connection, another example may be quoted as the forecast of coach arrival time at a particular point which depends upon the information which is transmitted by the coach drivers, through mobile phone signals across different cell tower areas [13]. The core of bus arrival time (BAT) prediction is the model construction, which includes two key issues; one is impact factors selection, while the other is defining the prediction model. Predictions by the BAT system are considered to be closely about several features which are supposed to be about bus stops. These features to be considered are well timed, traveler's location, and lane number, and are considered as the basic specs for the BAT prediction.

Han *et al.* [14] describe GPS and GIS technologies are considered as new sources of collecting data about transportation, more precisely travel data. The GPS data can provide real-time spatial and temporal information. It shows travel behavior, including distance, travel speed, trip time, and other information in digital formats all at once [15]. Moreover, it is believed that the GIS which is usually based upon GPS calibration of data method appears to be an aid for preprocessing of raw data set hence to reach hands onto vehicle's coordinates about its location. Castro *et al*. [16] proposed a new type of map that is oriented to the road network and match method. Subaweh and Wibowo [17] presented a method that identified a method to develop a link to the land. This was achieved by connecting a GPS and hence displaying the data into an Android-based application system. In their article, they explained the method of using GPS coordinates data values and the level of usage for application program linkage which in turn builds an interface between the android and IoT. The application then displays data coordinates on the designated maps.

Singla and Bhatia [18] suggested another system for bus movement tracking as a result of using GPS. In this article the author dominantly concentrated on retrieving the bus movement location data coordinates as a result of using the GPS. These data coordinates are transmitted using the GPRS in the GSM networks. This is attained through short message service (SMS), RFID-based control units or directly using radio frequency (RF) receivers which are installed at various bus stops. While relying on the speed pattern of the bus, the arrival time at a particular point may be computed by the use of K-means and artificial neural networks (ANN) algorithms. This data information which is related to the bus can also be collected by the use of a smart TV set which may be mounted on the bus stops, or SMS or web application and Android systems. The use of these algorithms facilitates the accuracy in the calculation of the arrival time of the bus in an extra reliable manner. The suggested application functioned efficiently subject to the quality of the internet signals. There is no doubt that GIS oriented method is based on a foundation of map matching. There always exists room for improvement in any system. Researchers believe that map-matching performance is influenced by a series of factors, such as heading information [19], and time information [20]. A total of 2,667,837 mobile applications were published for the Android operating system, however, the maps and navigation category contains 40,728 published applications, which ranks it 18th. This is an indicator of the need for a graphical representation of the main points of interest on the map. Intelligent public transport system (IPTS) aims to control public transport networks in favor of commuters.

The GIS-oriented method is the foundation of map matching, this facilitates users with an up-to-date piece of information about the trips and terms of usage [21]. Whereas, the relative Google Maps application

remains standing out having downloads by achieving a mark of over 5 billion [22]. The global share of Android has reached between 85–87%, this is due to the reason that it is an open-source, however, in case of a problem, the solution may be gained with the help of carrying analysis of the source code [23]. The main concept by Harini *et al.* [24] needs to be satisfied through the demand of citizens for public transport services, this too is helpful in conjunction with emerging technology named IoT. They also tried to redress the drawbacks which are coexisting with the existing transportation system. The suggested system facilitates a couple of outclass contributions to urban territories with the contribution of providing navigation due to tracking of journey progress about individuals and the overcrowded route. This is done by recommending of the system which is capable of suggesting the best alternative route. This type of system is considered as highly efficient for the territories in urban areas covered by local transport system. The project used web applications and servers to store data which is then displayed as maps to users on android operating system [25].

2. RESEARCH METHOD

Development of an application that is capable of providing many services to help improve the quality of public transportation by making use of many technologies. The user can book a ticket and pay the fare through the application. The application will provide the immediate location of the bus route which is required by the user. Therefore, the passenger gets ready to ride on the bus.

The application will also help passengers to avoid congestion problems, this congestion may be due to other buses in the vicinity of the desired bus. The application will be a convenient option for the user and driver. The application may become a preferred method of using transportation at a comfortable level and help reduce the number of private vehicle users on the road, thus helping to improve the environment. Figure 1, shows a general flow chart for the overall suggested software system.

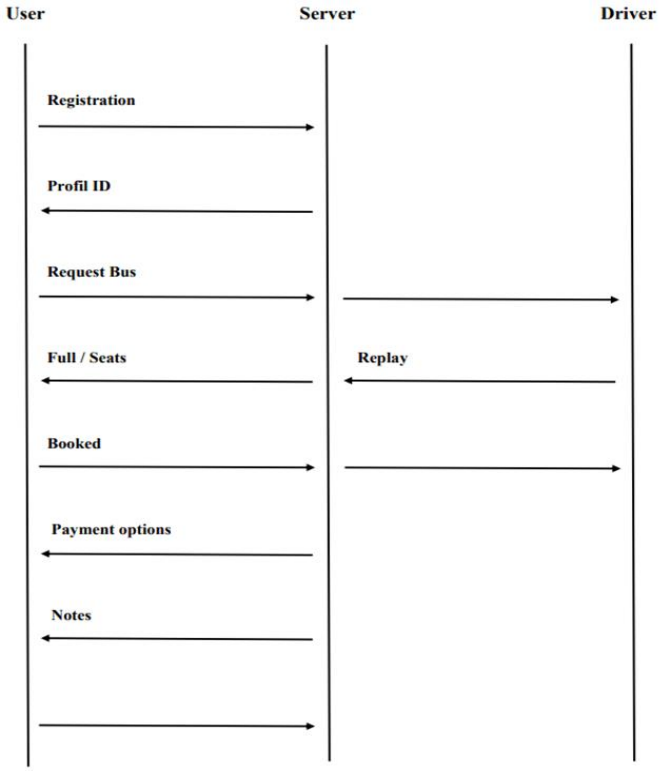

Figure 1. Application workup flow chart

3. SYSTEM MODULES

3.1. Passenger's module

The passengers will download and install the application and open it for the first time; welcomes the user and displays the introduction page which describes the general introduction and necessary guide to use the module as shown in Figure 2. The user will be asked to register (registration is required to complete the

application) as shown in Figure 3, and he will be asked to enter necessary data, after which the user will receive a verification code via an SMS text as shown in Figure 4. Next, an interface will appear which will be consisting of Google Maps, where the user will be able to choose his destination and submit his request as shown in Figure 5. There is also a list of dates and times that the user can choose and schedule his future trips as shown in Figure 6. Afterward, an interface page will also appear consisting of the driver and bus data and the remaining time for the bus to arrive at a particular stop and the user will also be shown with remaining arrival time and the route of the desired bus, see Figure 7. At the end of the trip, the user will be presented with the driving and service notes screen as shown in Figure 8.

Figure 2. The instruction screen is shown to the user

Figure 3. Passenger login screen

Figure 4. Verification code generation screen

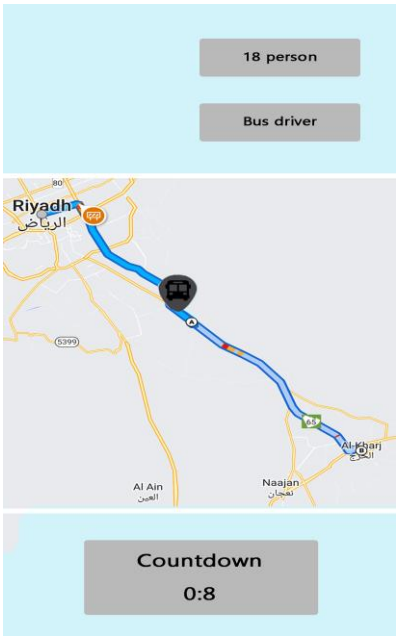

Figure 5. Available buses screen

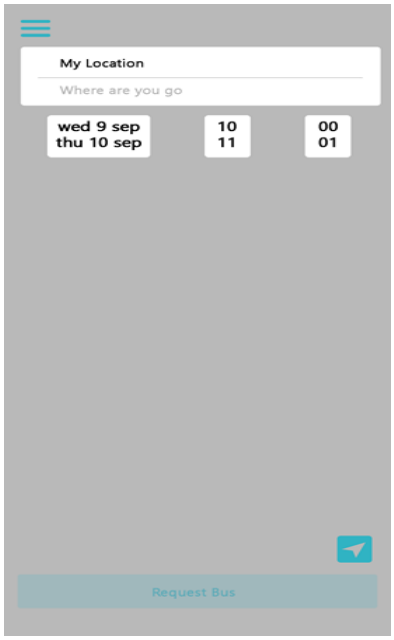

Figure 6. Schedule for the next ride screen

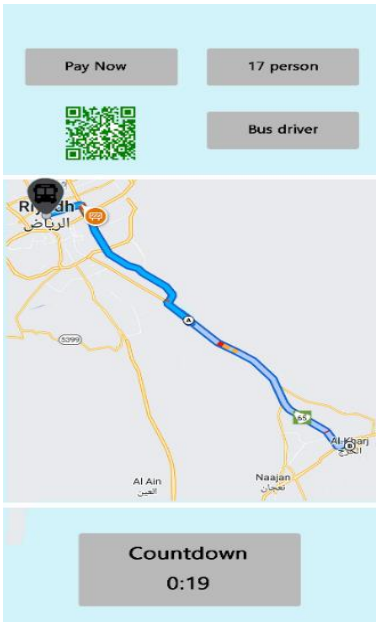

Figure 7. Bus progress page

Figure 8. Application feedback page

A sample of 10 people was chosen to function test the performance of the app under consideration. The functional tests and development of the connection between the passenger and the database were checked. The tests met the functional requirements as perceived while developing the application. The functional sequence of the application is shown in Table 1.

Table 1. Test for the sequence for the function test

Functional requirements	Functionality test
The system allows user registration and login.	The user logs in to the user unit.
The system will display the flight schedule in the application.	The user chooses his trip or schedules his trips.
The system will display options (payment, driver data, and number of people) and the time of the bus's arrival.	The user can view these details by clicking on it.
During the trip, the system will display the itinerary, number of stops, and arrival time.	The user can follow the journey and stops.
The system will display a feedback screen for users.	The user can record driving and service notes.

3.2. Driver's module

The bus driver's module has a special option for bus drivers. The driver will see instructions for using the application. This module will help the driver of the vehicle to get acquainted with the ground situation such as whether a passenger is waiting to get on board the bus and how far the passenger is from his bus. The application will also provide necessary statistics about the bus seating and the passengers on the wait. After registration, a number list of the people on the bus and the destination of each person will appear.

The same sample size as used for the passenger module was used here. Functional tests and development of the connection between the driver's module and database were checked here as well. The tests met the functional requirements as predicted during the development of this application. The testing sequence of the driver's module is presented in Table 2. Figure 9 shows the driver login page of the application, Figure 10 shows the driver's main page on the application, and Figure 11 shows the feedback page on the application.

Table 2. Functional tests sequence

Functional requirements	Functionality test
The system allows driver registration and login.	The driver registers the login in the driver module.
The system displays the users' location in real-time.	The driver checks users' location and tracking.
The system displays user data.	The driver can register his attendance through the application.
The system displays the itinerary and the stop points.	The driver can know the route and the time of arrival.
The system displays a feedback screen for the driver to add any comments.	The driver can take notes.

Figure 9. Driver login page

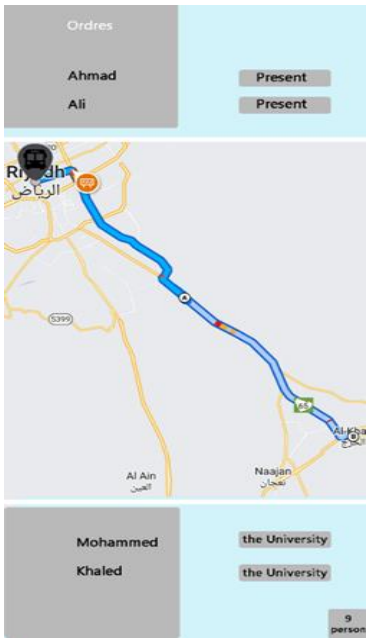

Figure 10. Driver's main page

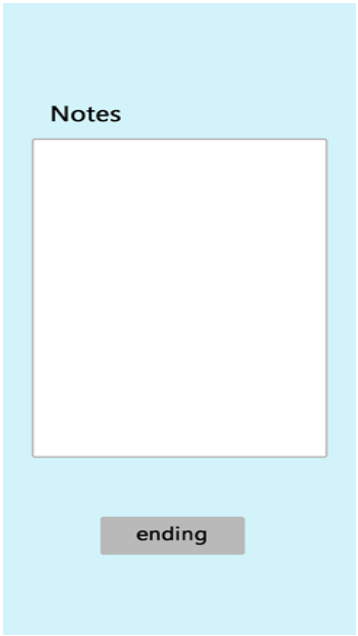

Figure 11. Feedback page

4. CONCLUSION

It has been a great deal of research work to obtain the requirements and needs of public transportation. Networks are a vital feature to improve urban mobility and improve travel information and provide convenience to the public. Many widely distributed tools show their usefulness to passengers and bus drivers via mobile phones and interfaces. The goal is to improve the satisfaction and confidence of the public with public transport and increase its usage. It also helps to provide quality service and contributes to improve the environmental parameters.

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