

Smart Airport with Universal Announcement Using Bluetooth Low Energy

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Abstract—Airport management provides all the facilities for the passengers inside the airport but they are unable to utilize it due to lack of time, proper guidance or unawareness of the facilities at airport. In order to provide a better and reliable solution to this problem, Bluetooth low energy technology is used. Bluetooth dongles are placed at various places inside the airport to provide all the information to the users especially flight information. The Bluetooth low energy's broadcaster mode is used for this purpose. This information will be delivered to user's mobile. Bluetooth dongles which has the Zigbee and Bluetooth low energy chip can communicate with each other or with the central server. This technology has the advantages of replacing the traditional signs and digital displays. This helps the passengers to increase their mobility inside the airport as well as to access the facilities they need without manual assistance.

Keywords— Bluetooth Low energy, digital signage, mobile application, flights details, indoor navigation

I. INTRODUCTION

Airport management enhances the passenger experience at airport by providing various amenities they need at the airport arena. It includes providing digital displays and manual announcement for passengers and sign boards that guides the passengers. Airplane passengers express their inconvenience regarding the information they get and also lack of opportunities to access the amenities in the airport. The people who travel in the flight for the first time may not know the procedures to follow at airport which tends them to choose other modes of transport. These will degrade the growth of the airport economy, which constitutes a country's economy. The best solution to avoid all these problems is to provide all the information the passenger require at their mobile phone. In this context, this paper can provide various services to the mobile application that receives the data from the central server of the airport and displays the information that is needed by the passengers at the airport. This allows the passengers to utilize various facilities available at the airport without efforts and thereby saving their time at airport.

II. SMART AIRPORT ARCHITECTURE

The Smart Airport Architecture includes the coordination between the announcement server at the airport, Bluetooth Dongles and the Mobile Application. The system architecture is shown in Fig. 1.

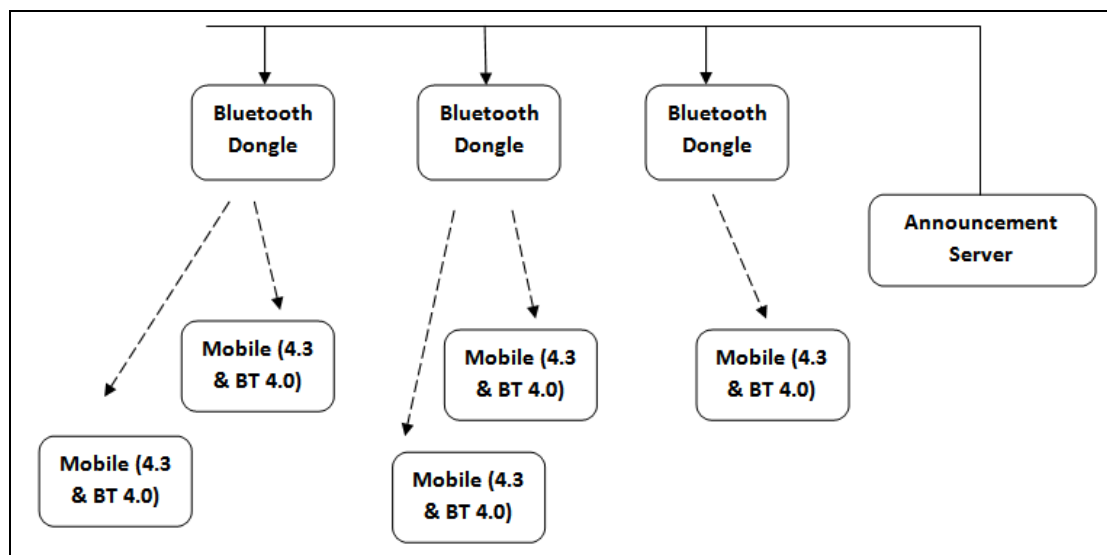


Fig. 1 System Architecture

The airport has wide range of facilities and these facilities have to be made known to the passengers based on their demands. The various services provided by the proposed system are

A. Flight Details

This provides the details about all the flights along with their status. It also provides the provision for the passenger to search for a particular flight to know its details. The details also include the terminal number, gate number. The passenger can use navigation service to reach the particular Terminal or gate.

B. Boarding Guidance

This provides the details for the passengers who want to know the boarding procedures. This mobile application will guide him/her through the various stages such as Check In, Security Check, and Immigration etc and also useful for those who use the flight for travel for the first time.

C. Navigation Guidance

This allows the passenger to access the various amenities available at the airport. It also provides the distance and time to reach the amenity which helps the passenger to choose the amenity such as restaurant, shops etc.

D. Personalized Store Service

This service provides information about the discounts and offers provided by the shops inside the airport.

E. Passenger Flight Details Update

This service allows the user to get his/her flight details update as well as notification when there is a change in his/her status update. This replaces the manual announcement for the call of passengers at the gate and also allows the passenger to be stress less inside the airport.

III. BLUETOOTH LOW ENERGY

Bluetooth Low Energy is a technology evolved recently for reduced energy consumption and for longer battery life. Everything is optimized in such a way that short packets reduce transmission peak current and also reception time. It improves the discovery and connection time. The basic features that makes BLE desirable for the above mentioned purpose is done by comparing the different technologies such as Classic Bluetooth and Zigbee as shown in Table.1.

TABLE I
 COMPARISON OF TECHNOLOGIES

Feature	Classic Bluetooth	Bluetooth Low Energy	Zigbee
Active Slaves	7/16777184	Unlimited	65535
Total Time to Send Data	< 100ms	< 3ms	< 10ms
Power Consumption	1 as the reference	0.01 to 0.05	2
Peak Current Consumption	< 30 mA	<15 mA	<15 mA

Bluetooth Low Energy has four states: master, slave, broadcaster, and observer. The master and slave can be connected to each other and can transmit the data. However, only one to seven slaves can be connected at a time to the master. On the other hand, in the broadcaster mode the number of slaves who can receive the data is unlimited. This paper makes use of the broadcaster and observer roles. BLE has only one packet format and two types of packets (advertising and data packets), which simplifies the protocol stack implementation immensely. Advertising packets serve two purposes:

- To broadcast data for applications that does not need the overhead of a full connection establishment
- To discover slaves and connect them

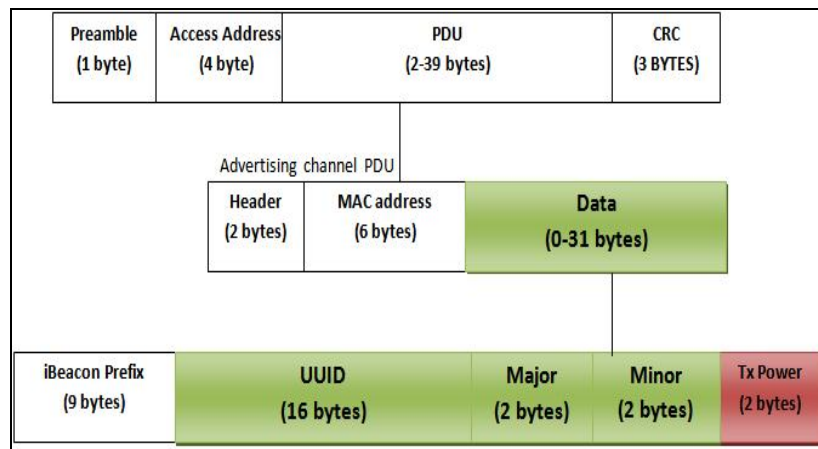


Fig. 2 Advertising Packet Format

Since Bluetooth Low Energy chip are used in the Bluetooth dongle can broadcast the data to any number of passengers at the airport, the efficiency of the system is not affected by the number of user’s accessing the data from the Bluetooth

Dongles. The dongles continuously broadcast the data, therefore the passengers reaching the airport at any time can receive all the information without any loss of information. Each advertising packet can carry up to 31 bytes of advertising data payload along with the basic header information. Such packets are simply broadcast blindly over the air by the advertiser without the previous knowledge of the presence of any scanning device. They are sent at a rate defined by the advertising interval, which ranges from 20ms to 10.24s. The advertising packet format is shown in Fig. 2. In advertising mode UUID is changed to send the desired packet. The server operator will enter flight updates. This will modify the Bluetooth dongle's UUID, Major & Minor (20bytes) by using AT commands.

IV. SYSTEM DESIGN

The system design is shown in Fig. 3. The airport server operator can enter the information, especially flight details updates, to the server which will in turn will give the information to the transmitter as shown in Fig. 3. The microcontroller in the transmitter will perform the processing of the information and pass on this information to the Zigbee inside the transmitter. The Zigbee in the transmitter will transmit this information to the Zigbee in the receiver. Zigbee receiver will give this information to the Bluetooth Low Energy module. The Bluetooth Low Energy is set in its broadcaster module. The Bluetooth Low Energy module in each Bluetooth Dongle will broadcast this information to the passenger's mobile application.

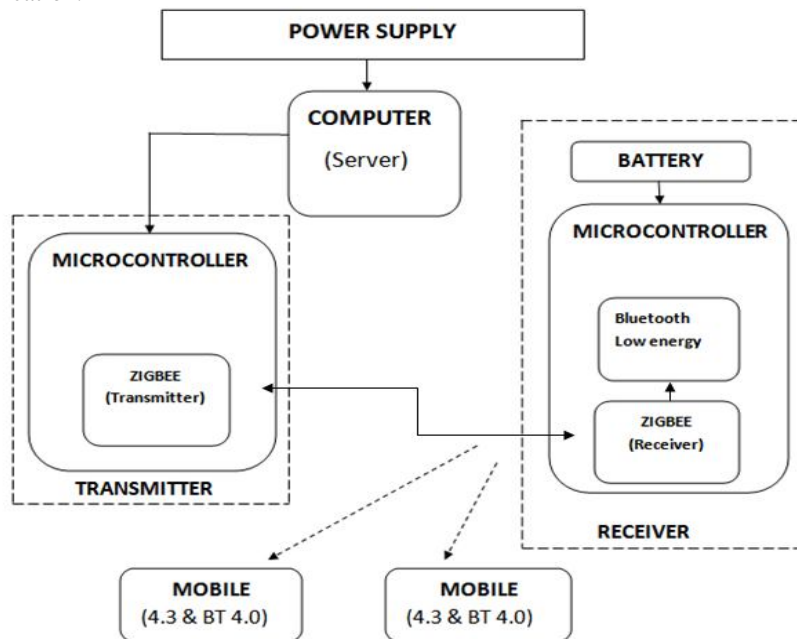


Fig. 3 System Design

Zigbee can be used in mesh topology to give this information to other Receivers which consists of receiver Zigbee and Bluetooth Low Energy module. One of the Zigbee receivers act as routers which will help to transmit the data to dongles placed at far distance from the server. The static data such as distance to shops and other amenities present can be also be sent through server which will be configured once and continuously broadcasted by the Bluetooth Low energy module at regular intervals so that all the passengers arriving at different times can access the data without any loss of information.

V. MOBILE APPLICATION

The Mobile Application is to be developed to pick up the data from the Bluetooth Dongles. The requirement for the mobile application is that the phone should have an android version of 4.3 or above and also a Bluetooth version of 4.0. The flowchart for the development of the mobile application is shown in Fig. 4. Firstly the user has to create an account. The user having an account can login and enter his/her name, ticket number and other details to get a reminder of his/her journey at the day of his journey. This update will be provided to only the users with valid account as well as ticket number. It will also provide the guidelines to reach the airport by invoking the Google Map service. Once he/she reached the airport he/she can login and search for flight information, boarding procedures, various shops located inside the airport and distance to reach there. In addition, he/she will also get a notification in his/her mobile when there is a change in his flight update irrespective of his position inside the airport. Firstly the user has to create an account. The user having an account can login and enter his/her name, ticket number and other details to get a reminder of his/her journey at the day of his journey. This update will be provided to only the users with valid account as well as ticket number. It will also provide the guidelines to reach the airport by invoking the Google Map service. Once he/she reached the airport he/she can login and search for flight information, boarding procedures, various shops located inside the airport and distance to reach there. In addition, he/she will also get a notification in his/her mobile when there is a change in his/her flight update irrespective of his/her position inside the airport.

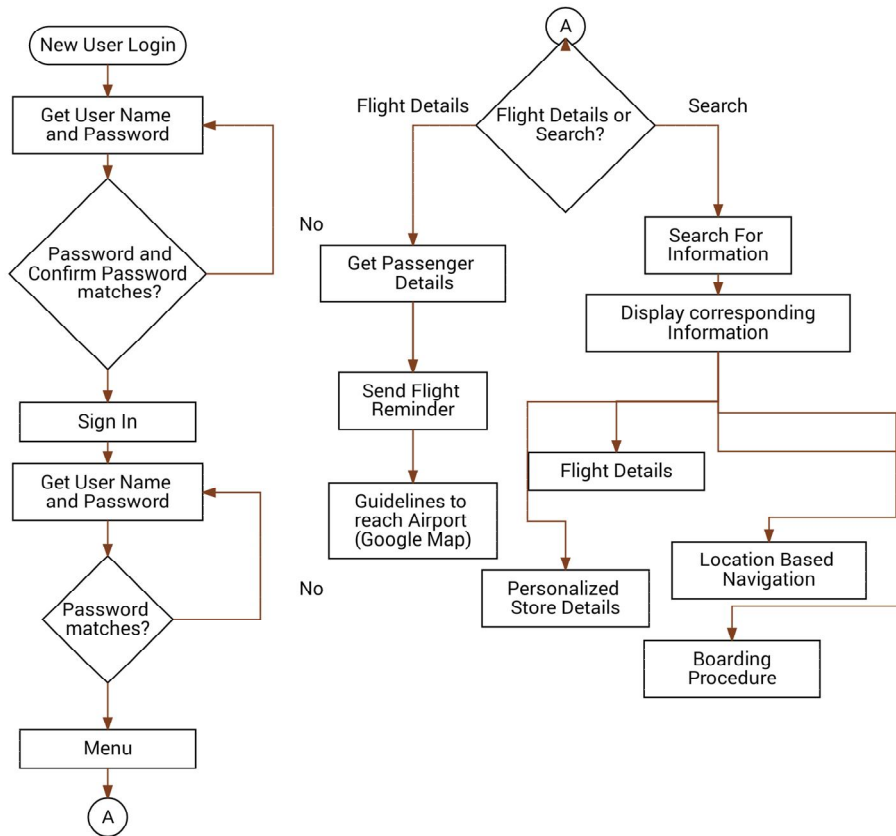


Fig. 4 Flowchart of Mobile Application

VI. RESULT AND DISCUSSION

The mobile application developed can be used by the passenger having a valid ticket .The user can create an account using the mobile application which requires a user name and password .Once the account is created the user can sign in using the user name and password he/she used at the time of creating the account . The user who successfully signed in get a Menu with two options such as Enter the Details or Search. If the user clicked Enter Flight Details mobile application will show another screen where he/she can enter the details such as Passenger Name, Ticket Number and Mobile Number. The server at the airport gets all these details and verifies whether the ticket is valid and also verifies the passenger. It is to be noted that passenger will get a flight reminder only if he/she is a valid user or passenger as per the database at the airport. It also finds the date of passenger’s travel from the database and sends a reminder to the passenger on that date. The server will also store the Flight Number of the corresponding passenger to give status update. On the other hand the Search option in the menu can be used by the passengers once they are inside the airport. This search option provides various icons such as Flight Details, Navigation Details, Offer Details, Boarding Details and also Passengers Flight Details update .And the user get a flight reminder on the date of his/her journey. It also provides the map service to the user to reach airport. Once the passenger enters the airport he/she can sign in and click the search button. The mobile application picks up the data broadcasted by Bluetooth Dongles. If the passenger clicks the flight icon in the application the flight details will be displayed as shown in Fig. 5.



Fig. 5 Flight Information

Flight Information includes Flight number ,Source ,Destination ie.Place of boarding and arrival .It also includes status and time of flight schedule and also Terminal Number and Gate number.Whenever the status of the flights are changed it will be automatically updated by the mobile application.



Fig. 6 Location Based Navigation Service

The navigation icon displays details that guides the passenger to various place inside the airport is shown in Fig. 6.Based on the time he/she has and time to reach a particular place he/she can choose the destinations such as shops, restaurant etc.



Fig. 7 Personalized Store Service

If any offer or discount is given by any shops or other amenities inside the airport that is made known to the user by providing broadcasted information at their mobile phone i.e. Personalized store as shown in Fig. 7.Thus it provides better airport management and global coordination and also helps passengers to save time by making appropriate decisions .It also helps the passengers who don't have prior knowledge about the boarding procedures .They can click boarding icon to get these details as shown in Fig.8.It is provided with the time they need to reach .



Fig. 8 Boarding Procedures

This mobile application also provides the conviction for the passengers to get the flight status update even when the application is not opened. Once the passenger's flight status is changed it will automatically open the screen as shown in

Fig. 9. This will provide freedom of movement to the passengers inside the airport as he/she will get the updates about his/her flight at the place he/she is positioned.

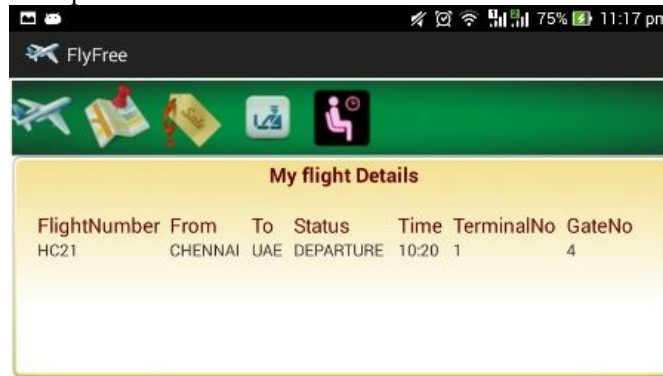


Fig. 9. Passenger's flight details Update

VII. CONCLUSIONS

Smart Airport with universal announcement is equally suited for people who often choose airline as the means of transportation as well as those who rarely choose airline for travelling. This project eases the management of airport as well as eliminates the error caused by the manual guidance. The Bluetooth dongles gets the data from the server and give this information to each passenger according to the current position of passenger inside the airport. Bluetooth Low Energy's peripheral and central mode is used to achieve this. It provides freedom of movement inside the airport as they can get their flight details being anywhere at airport. Also they can make efficient use of their time inside the airport by doing shopping or other things of interest as they have clear idea of the amenities inside the airport as well as their flight status. It also avoids the confusion that a person can have inside the airport .

This concept is not only limited to airport but can be used in any public places where the people find it difficult to get proper guidance and information such as Railway stations, Bus stations, Shopping Malls, Tourist places etc. Moreover Bluetooth Low energy is an upcoming innovative technology that can explore a lot of applications.

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