Android-based Smart Bus Occupancy System
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Abstract— Majority of the buses today are completely occupied during peak hours i.e., in the mornings and evenings. Many travellers find themselves getting into buses and eventually standing due to the unavailability of vacant seats. This system enables a passenger to check if an incoming bus of the route he prefers has vacant seats or not on an android smartphone within an app named ‘Seatify’. The system consists of an infrared sensor for each seat and a GPS module for a bus. The sensors work together to detect seat availability whereas the GPS module tracks the location of the bus. This data is combined and processed using an Arduino microcontroller and is repeatedly offloaded to a database on a server that is online 24/7. The android app fetches data from the server and it is displayed to the user. Passenger comfort and safety is improved with this system.

Keywords—Bus occupancy system, Bus location tracking, Bus seat check, Android bus seat system, IR sensors, Arduino, Seatify

I. INTRODUCTION
Mobile technology has advanced a lot since 2010. With Google’s development of the feature-rich Android operating system, it is easier to create android applications with the help of their Android Studio IDE. More than 70% of the mobile devices in the world run Android. Android applications have become an important part of a person’s daily routine. This paper describes a system that uses sensors installed in buses combined with the android app ‘Seatify’ to provide the user with the information he needs before getting into a bus. It shows the location of that bus with its seat availability so the user is aware and can decide what bus he needs to take for a comfortable traveling experience.

II. BACKGROUND
Flights, trains, ships, or taxis have booking systems that let passengers board or hire them so that guarantees a seat for the traveller. But not a lot of development has been made to know if a passenger has vacant seats in a bus even though it is one of the most common modes of transport locally. The system we have developed isn’t another seat booking system. Rather, it is a tool that aims to reduce the number of standees on the daily by displaying what seats are vacant for a given bus on a user-friendly mobile app along with its GPS location. Many bus tracking systems using GPS have been developed in the past¹. This system includes seat detection as well.

III. PROPOSED SYSTEM
Android-based Smart Bus Occupancy system consists of an Android app ‘Seatify’ on the software-side coupled with sensors and a GPS module on the hardware side that offers all the information travellers and passengers need to know before catching a bus. Seatify also includes a user-friendly administrator panel that lets the admin perform administrative functions; viewing, adding, updating or deleting buses from the database. These changes will be reflected on every phone that has Seatify installed, globally. This system is designed keeping the general public in mind and to improve the standard of traveling in a locality.

The proposed system consists of an Android application in which there are two modes i.e., user and administrator. The hardware segment of this system contains IR sensors which are connected to the Arduino microcontroller that give input to the Arduino on detection of a human². The sensors are attached on the top for each seat in the bus to detect vacancy by sensing the body or head of the person below. When a person occupies a seat, number of available seats decrements by one and when it is vacant, that number is incremented by one. The GPS module gives the current location of the bus in latitude and longitude to the Arduino. The Arduino is connected to the internet using a Wi-Fi module which enables it to send collected and processed data to the database. The database is managed on a web server that runs MySQL, PHP and phpMyAdmin.

IV. IMPLEMENTATION
The physical system design of the system is depicted in Figure 1. The following algorithm has been implemented to fetch IR sensor and GPS data and upload them to the database:

1. Set required pins of Arduino to input mode for IR sensors.
2. Check the Boolean values of each sensor.
3. If any of the sensor values is LOW, it indicates an occupied seat. If it is HIGH, it indicates a vacant seat.
4. Store the status of each seat in a variable.
5. Using TinyGPS library, get GPS latitude and longitude values and store them in variables.
6. Append the IR sensor and GPS variables to the URL.
7. Send the URL to the WiFi module.
8. Execute an HTTP GET request with the URL.
9. If HTTP code 200 is returned, data has been uploaded successfully.
10. Repeat this process from step 2 in order to provide the user with real-time information on the Android app.

### V. HARDWARE AND SOFTWARE REQUIREMENTS

#### A. Arduino

It is a microcontroller used for building digital devices and interactive objects that can sense and control objects in the physical and digital world. In this system, we make use of an Arduino Uno.

#### B. Infrared Sensors

An infrared sensor is an electronic instrument which is used to sense certain characteristics of its surroundings by either emitting and/or detecting infrared radiation. We use these sensors to detect a seated person for each seat in the bus.

#### C. GPS Module

A GPS navigation device, GPS receiver or simply GPS is a device that is capable of receiving information from GPS satellites and then to calculate the device’s geographical position. In this system, this module is used to plot the location of the bus on Maps API provided by Google.

#### D. Wi-Fi Module

It is a self-contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your Wi-Fi network. In this project, we make use of an ESP8266 Wi-Fi module. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor.

#### E. Internet Access

It is the ability of individuals and organizations to connect to the Internet using computer terminals, computers, and other devices; and to access services such as email and the World Wide Web. In this project, we need an active internet connection to upload collected sensor data from Arduino to the web server.

#### F. Web Server with DBMS

It is used to maintain a database of buses and their information in real time to be fetched and displayed by the android application running on any phone. The web server runs the latest version of PHP, MySQL and phpMyAdmin.

#### G. Android Smartphone

This is used for accessing data from web server using the mobile application we have developed for Android version 5.0 (Lollipop) or above. The smartphone must have internet access and location access turned on.

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Figure 2 shows the various modules the system consists of that have been implemented.

The complete system flow design is shown in Figure 3.

VI. RESULTS

Given below are screenshots of the Android app ‘Seatify’ that depict the core functionality of the system.
Figure 5: User selects route ‘3B’

Figure 6: All seats of bus vacant

Figure 7: Few seats of bus occupied

Figure 8: Location of all buses of selected route
The proposed system allows the user to enter a bus route of his choice and displays a list of all available buses based on the route provided. The user can then view the number of available seats on a particular bus which is shown in a user-friendly graphical interface, or he can view the location of buses belonging to that route on Maps including his location.

The application is lightweight and isn’t power-hungry. It shows the most updated information to the user. Changes made by the admin on bus details are reflected onto the database immediately and seat or location data are fetched by the application from the database within one second on request.

VII. CONCLUSION

The android application ‘Seatify’ along with the hardware that completes the system has been successfully implemented. Users can view the occupancy status and location of the bus they prefer to travel in at any given time since the server will be running round the clock with 99.9% uptime. On the other hand, the administrators have been provided with a user-friendly graphical interface to edit, add or delete any of the bus details in the database and that will be immediately reflected onto everyone’s phone which has Seatify installed. The software and hardware have been tested thoroughly to eliminate app crashes so the users can have a pleasant experience with this service.

Standing in a moving vehicle is unsafe and uncomfortable taking into consideration the roads of Mangalore. The cost of developing such a system depends on the how many seats the bus has. Larger the bus in terms of passenger capacity, more expensive this system gets for development as more sensors are required.

VIII. FUTURE WORK

In the future, an Apple iOS version of ‘Seatify’ may be developed so passengers who own iPhones can also install this app and use it. Another feature that can be implemented is to notify the user when a bus of the route they prefer has vacant seats and is approaching him or her within a few minutes based on where he is located.

Furthermore, the application can be improved by letting users type in a destination and calculate and display available routes using his current location instead of inputting the bus route directly.

References

[1] Leeza Singla; Partee Bhatia, International Conference on Computer, Communication and Control (IC4), 2015. GPS based bus tracking system