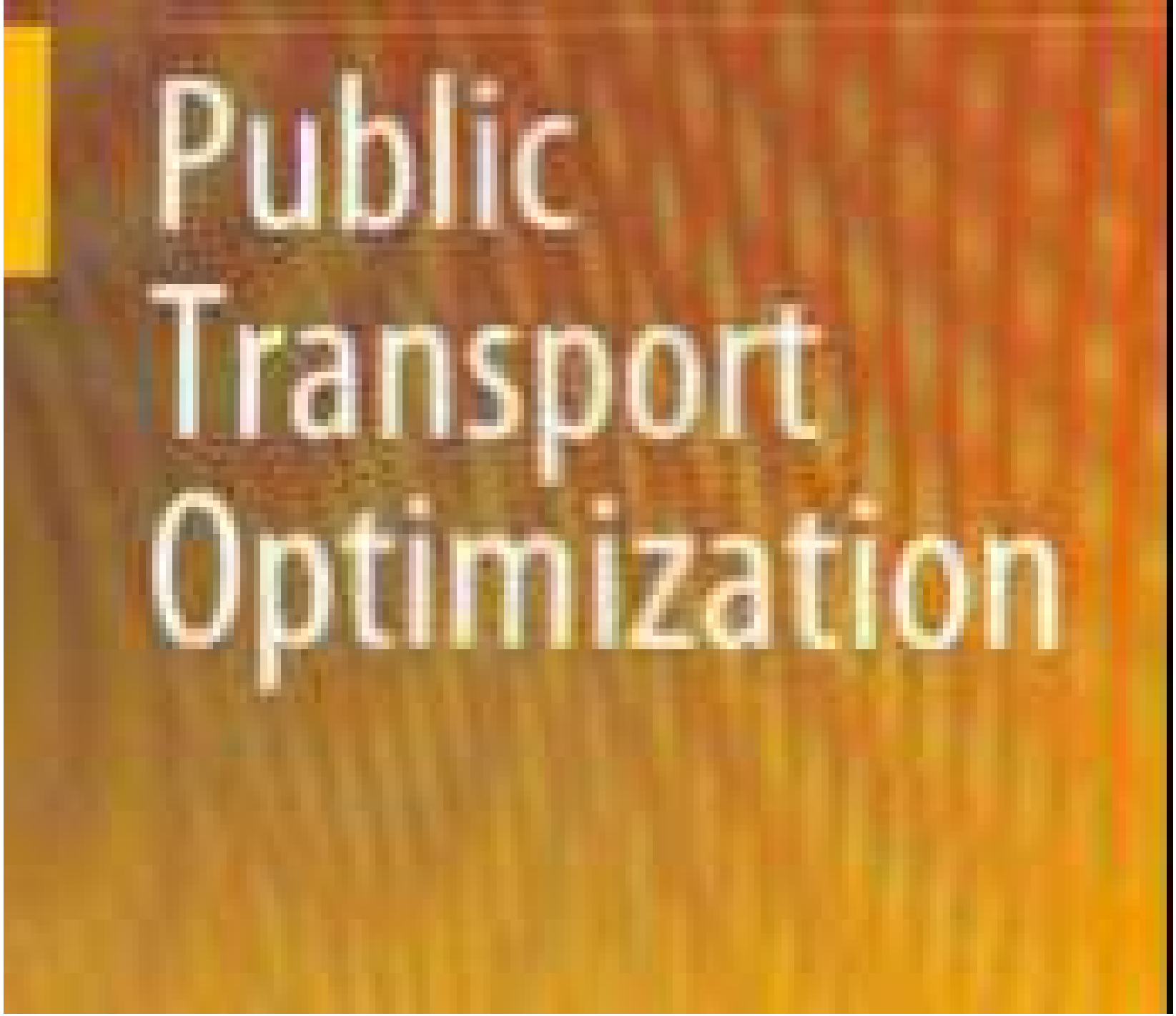

A Smart Information System for Public Transportation Using IoT

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Abstract— New application and businesses are created continuously with the help of technology through the internet. IoT(Internet of Things) can assist in integration of communication, control and information processing across various transportation systems. In public transportation, there is lack of real time information. The public transit usage can be improved if real time information of the vehicle such as the seating availability, current location and time taken to reach the destination are provided with easier access. It would also be helpful for the passengers to find alternate choices depending on their circumstances. As excessive long waiting often discourage the travelers and makes them reluctant to take buses. A smart information system has been proposed where the travelers get prior information about current location, next location of bus and crowd level inside the bus. This system is designed using ARDUINO UNO, IR Sensor and GPS Module. An Intelligent Transport System (ITS) removes the barriers for public transport usage and creates the positive impact about the bus journey.

Keywords— public transportation, crowd density, smart information, navigation, IoT.

I. INTRODUCTION

Public transport is a service available on sharing basis for the benefit of general public. It includes city buses, trolleybuses, trams, passenger trains, ferries and rapid transit like metro and subways. Unlike transportation modes like carpooling, rickshaws and taxis, this system encompasses an entirety of strangers.

The main reason why the people choose public transportation over other modes of transport are its subsidized rates, environment-friendly attributes and easy accessibility. Firstly, public transport is very economical allowing a large population to have access to it. Using a bus or a train to commute is comparatively cheaper than using a private car. If people have their own car, they have to spend a lot of money on fuel, car servicing, repairs, and insurance. There are many discounts available for some individuals, like students and senior citizens who choose public transport as their transportation option to get to work or to school. Secondly, public transport can preserve the environment by reducing the amount of pollution. With an increase in the use of public transportation, there will be a reasonable dip in the number of private vehicles on the road, therefore, improving the environment and in addition, solving the traffic congestion issue[10].

Furthermore, public transportation has good accessibility in big cities, making it easier to travel to any part of the city, making buses a favorable option. It provides personal mobility and freedom for people. Taking into consideration the other aspects of public transportation, there are some downsides to this service as well. Public transportation, by its very nature, is far more time consuming than any other mode of transportation. Most trains and buses run in accordance with a scheduled timetable. However, these time schedules are seldom followed. There is always an uncertainty regarding the arrival of a bus. Often, buses break down causing further problem to commuters. Another pitfall we see is that public transportation often lacks organization. Commuters are often confused with regards to bus routes and bus stops. Even if the buses are running on time,

III. PROPOSED SYSTEM

In this paper we present the smart information system shown in figure 1 which will allow the travelers to take alternative transport choice by providing information about location of the bus and crowd level inside the bus.

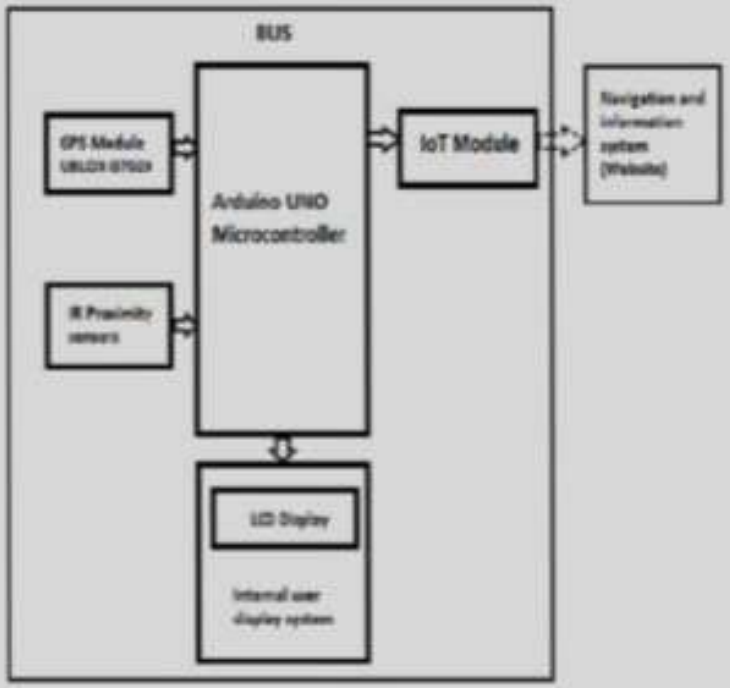

Figure 1. Block Diagram of the Smart Information System

The vital components of smart information system are micro-controller, IR proximity sensor, GPS Module, IoT Module. Inside the bus, GPS module and four IR proximity sensors are used. Two IR sensors are kept at entry path and another two kept at exit path. IR Proximity Sensor is used to count the number of persons inside the bus. GPS Module is used to find the latitude and longitude of current location of the bus. Information from sensors and GPS module is sent to Controller and via IoT module information will be displayed in webpage. IoT Module is used to establish

IV. SYSTEM IMPLEMENTATION

The Embedded device in the bus collects the information of bus related to its location and time and gives out the information about arrival time, current location and vacant seats available in the bus, for this purpose Arduino Uno is used.

4.1. Crowd density estimation

Our approach utilizes an infrared sensor which is an electronic device, that emits IR rays in order to sense some aspects or objects around it's the surroundings. This sensor measures the IR radiation which considering the infrared spectrum, where all the objects radiate some form of thermal radiations. These kinds of radiations are invisible to our eyes that can be detected by an IR sensor. The emitter is called as IR LED (Light Emitting Diode) and the detector is an IR photodiode which senses the IR light of the same wavelength as that emits the IR LED. When IR ray falls on the photodiode, the resistances and these output voltages of the IR receiver change its magnitude.

This sensor is used to detect any human crossing entrance and exit path of the bus. These signals are processed by our embedded system. The bi-directional counter is used which senses the human hindrance and increments the counter each time, when Infrared signal is cutoff at the entrance. This embedded system also receives the signal from the exit points which is used to decrement the counter. This counter provides us real time estimation of density of people who are inside the bus.

For crowd density estimation, four infrared sensors are used. Two infrared sensors (IR1&IR2) are fixed at entrance and another two infrared sensors (IR3&IR4) are fixed at exit path. Because, in urban bus people may use both the entrance and exit to enter and leave the bus. The bi-directional counter is used which senses the human hindrance and increments the counter by 1 when infrared signal of the IR1 is cutoff and then the infrared signal of the IR2 is cutoff. The counter gets decremented by 1 if infrared signal of the IR2 is cutoff and then the infrared signal of the IR1 is cutoff. Similarly, at exit path the counter gets incremented by 1 when infrared signal of the IR3 is cutoff and then the infrared signal of the IR4 is cutoff. The counter gets decremented by 1 if infrared signal of the IR4 is cutoff and then the infrared signal of the IR3 is cutoff. This provides us real time estimation of density of people who are inside the bus. The flowchart for the operation of bidirectional counter at entrance is shown in the figure 2.The operation of bidirectional counter at exit path is same as the counter at entrance path.

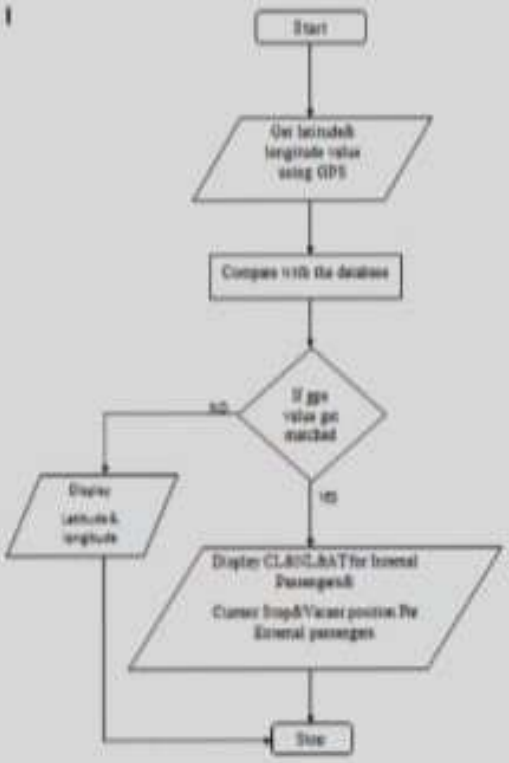

Figure 3. Flowchart for Bus location Prediction

4.3. IoT module

To establish the communication between urban bus and passenger's smartphone IoT Module is used. If we use Bluetooth it will provide only short range communication, so we are using IoT module.The Internet of Things (IoT) is internetworking of physical devices with electronics and network connectivity that control these objects to collect and exchange the data. IoT is not only used to sense the information but also to interact with the physical network.SIM800C is used here for the transmission of data and it is a complete quad-band GSM solution, which can be embedded in the customer applications. These modules are the sub-system of the internet-of –everything hardware. It Supports quad-band of 1900MHz and it can transmit voice, SMS and data information with low power consumption. It can smoothly fit into slim and compact demands of customer design.

V. RESULTS AND DISCUSSION

The system provides real time information about arrival time of the bus, crowd density and transmits information of bus. All these help public about the occupancy status and upcoming buses which enables them to take better decision which in turn helps in crowd management this information also helps bus operators, to analyze patterns in public transportation usage in different routes, based on which they can provide extra service.

Figure 4 Final prototype of the proposed system

Figure 5 Information displayed in LCD at SRIT Parking

By using the smart information system, the public bus usage can be improved and so private modes of transportation get reduced. It will play vital role in controlling traffic congestion and pollution .This system is created and developed using simple and cost-efficient components. It can be easily installed inside the bus because of its small size.

We have tested our project in all the five stops that we have taken as reference location. All the other units in the system, including sensors, GPS module and power unit are tested and are found to be in working condition. The outputs taken at SRIT Parking when the bus moves in forward direction i.e., SRIT Parking to Perur is shown in the figure 4 and figure 5.For Internal passengers the current location is displayed as "SRIT Entrance", the next location is displayed as "SRIT parking" and the time taken to reach SRIT is displayed as "5 Minutes" in LCD Display .

For External Passengers, the information will be displayed in the webpage www.iotclouddata.com/project/305/iotview.php as shown in the figure 6.The maximum capacity of the bus is fixed as 55 in our proposed model. Difference between the maximum seating availability of the bus and the number of passengers inside the bus is displayed as vacant position for external passing.

Figure 6 Information displayed in Webpage at SRIT Parking

Table 1. Bus route details when bus moves in forward direction

S.No	Source	Destination	Approximate time to reach the destination (in mins)
1	SRIT parking	SRIT entrance	5
2	SRIT entrance	Pachapalayam	10
3	Pachapalayam	Chettipalayam	10
4	Chettipalayam	Perur	7

The outputs are checked at each stop when the bus moves in reverse direction i.e., Perur to SRIT Parking also. Bus route details when bus moves in forward direction are shown in the table 1.

VI. CONCLUSION AND FUTURE WORK

In this paper a smart information system is presented for the bus passengers that have the ability to interconnect passengers with real-world public bus. The Smart information system based on distributed IoT System consists of IR Sensors, GPS Module, Arduino UNO, and IoT Module to count the number of passengers and to provide information about current and next location of the bus. Since the users are provided with real time information about the vacant seats, the passengers will able to take better decisions in terms of which bus they would take.

Future work includes adding details about waiting time in signal and traffic congestion to provide better accuracy in arrival time. Enabling the voice information in app to help the visually-impaired passengers and tracking System to trace special passengers like kids and women for safety purpose. To provide better information service to the passengers map based visualization about the location of the bus may also be provided.