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Smart Bus System in Mumbai

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Abstract: ***Transportation is the important system of our economy as every day the world relies on a complex network of transportation system which enables trade between people, which is essential for the development of civilization. In Mumbai, public transport mainly involves transportation by road, railway and water. Mumbai has the largest organised bus transport service among major Indian cities.***
In daily operation of bus system, the bus movement is affected by undetermined conditions as the day progress such as traffic congestion, irregular vehicle despatching time, unexpected delays, and randomness in passenger demand. This paper focused on implementing smart bus system by installing GPS devices on buses, Real time passenger information system, also implementing smart bus stops that provide real time information about bus to public. In this system, internet of things(IOT) and integrated sensing technology such as global positioning system(GPS), general packet radio service(GPRS) and geographic information system(GIS) are used to monitor the movement of bus. This research will enable the GPS tracking devices to obtain current bus locations, which it will then transfer it to control unit and represent it by stimulating image of buses in the approximate physical positions on the route map. Specific software's will be used to interface the data received to the map.
Keywords: GPS, GIS, GPRS, WI-FI, RTC

I. INTRODUCTION

The bus service of Mumbai is supposed to be the best in India. It is run by Bombay Electrical Supply and Transport company(BEST), whose network is so vast that it connects every road of the city. There are three types of buses, single decker, double decker and air-conditions. The red double-decker buses are Safe, cheap and comfortable which provides you with a beautiful view of the actual Mumbai.

But in daily operation of bus system, the bus movement is affected by undetermined conditions as the day progress such as traffic congestion, irregular vehicle despatching time, unexpected delays, and randomness in passenger demand. Many times, the passengers are often late because they wait for the bus instead of using alternative way of transport.

The public transport system is often unattractive for passengers because of waiting time and uncertainty in bus arrival time. During peak hours, there are not enough buses available, which results in overcrowded buses and discomfort for passengers. The bus stops are dirty/vandalized. There is lack of information/ knowledge about bus timings. Ladies don't feel safe waiting at bus stops. Visual impaired people face many challenges as well when using public transit system. This include: getting to the appropriate bus stop, reading bus numbers, to know when and which bus is arriving, boarding the correct bus and knowing when to alight from the bus.

These challenges could all be overcome through the utilization of existing technologies such GPS, RFID, Wireless Communication Protocol. Therefore, there is a need of smart system which provides real time information to passenger of bus. With the development in technology, there are more objects which are being installed with sensors and are having the ability to communicate with each other. Internet of things (IOT) deals with having physical objects we see around us in a network. It mainly deals with RFID, infrared sensors, global positioning systems and scanners. These have helped the objects to sense information and interact with the physical world. The system will manage the data about current location of bus, and by using this data the real-time position of bus will found out and provided this information to passengers. It provides the public with an easy and comfortable way of travelling. The use of private vehicle will reduce when many people use public transit vehicles, which in turn reduces traffic and pollution.

II. LITURATURE REVIEW

On the shores of the Arabian Sea settles the charm of India's crown – Mumbai. With a total metropolitan area population of approximately 21.5 million in 2017, it is the largest urban centre in India and the fifth most populous city in the world. [1] Public transportation plays an important role in Mumbai. Simply put, the city cannot live without buses and trains. statistics claim that by the year 2020, the city's population will be 26 million making it the world's second largest city. [2]

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88% of all commuters use public transport as it is the most convenient, most efficient, and cheapest form of business mobility. Statistically, buses carry roughly 5.5 million people every day. [3] BEST operates a fleet of more than 4500 buses which includes red single and double-decker buses running on compressed natural gas. [4]

Even as Mumbai weather swings from the uncomfortable heat in summers to heavy downpour during monsoons, commuters who use bus services on a regular basis are generally left themselves to deal with the unexpected changes of nature as there are only a few sheltered bus stops across the city. There are total of 5,862 bus stops of Bombay Electrical Supply and Transport company(BEST) Undertaking in the city, of which 2,584, or 44 per cent, do not have a bus shelter. [5]

So, the passengers are in dire need of bus shelters which would not only offer them shelter bus also provide real time information about bus.

The smart bus system is one of the possible solution to overcome this issue.

In this paper, we proposed smart bus system in which GPS module is installed on bus for transmission of real time location which it will then transfer it to control unit and represent it by stimulating image of buses in the approximate physical positions on the route map.

Each bus stop will install LED boards that shows information like real-time arrival time, bus capacity for all buses servicing the stop. A microcontroller with 4g router that requests updated bus arrival times from Transit schedule server over 4g network. If in case the bus breaks down the transit centre will be notified to send another bus.

III. OVERVIEW OF PROPOSED SYSTEM

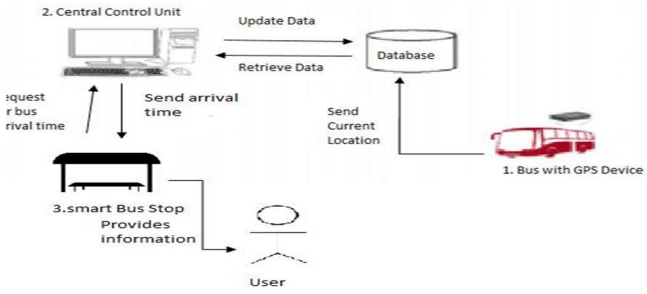
A. *Problem Statement*

Now a day in Mumbai, management of public transportation system is the main problem. The current bus system does not provide information about the expected arrival time, the current location of the bus, route of the bus etc. The number of buses running daily is huge hence it is a big challenge to keep the track of all buses in front of depot authorities.

B. *Solution*

The smart bus system provides the relevant information regarding all the bus numbers going from users source and destination along with the route details, real time location, bus capacity. Generally, the system is operated by GPS which is installed on bus. The location of the bus is determined by the GPS and transmission mechanism. After receiving the data, the data is transmitted by using GSM/GPRS. Bus stops will be equipped with an RF link to receive data from the transit centre. A Real Time Clock (RTC) is a computer clock that gives information of the current time. The Automated Passenger Counter (APC) sensors are mounted above the door which record a boarding and alighting of the passengers. The APC computer can also join in with an on-board GPS system to connect passenger data to vehicle location.

C. *Architecture Of The Proposed System*



D. *GPS (Global Positioning System)*

GPS is a satellite navigation system used to determine the geographic position of an object. Today, GPS receivers are used in many commercial products, such as smartphones, automobiles and exercise watches etc. GPS tracking system will improve the efficiency of city bus system. The GPS tracking device allows passengers to monitor each bus schedule. GPS tracking system uses the Global navigation satellite System (GNSS) network. This network incorporates a range of satellites that use microwave signals that are transmitted to GPS devices to give information on location, vehicle speed, driver information, time and direction.

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E. RTC (Real Time Clock)

A Real Time Clock is a computer clock that gives information of the current time.
RTCs are present in almost all electronic device which needs to keep accurate time.
The RTC maintains seconds, minutes, hours, day, date, month, and year information. The clock operates in either the 12 hour or 24 hour format with an AM/PM indicator.

F. WI-FI

Wi-Fi also allows connectivity in peer-to-peer mode, which enables devices to connect directly with each other. Wi-Fi compatible devices can connect to the internet via WLAN network and a wireless access point. Wireless communication systems consist of transmitters, antennas and receivers.

G. Automated Passenger Counter

Automated Passenger counter sensor provides high counting performance based on image processing method. Sensors mounted in bus doorways count passengers boarding and exiting at bus stop.

H. On-Board Passenger Information System

1) *Bus LED Destination Sign:* LED Display at front and rear side of the bus provides information about bus number and bus destination in monochromatic line. The LED signs are easily visible day and night and in many weather conditions.
2) *Bus Next-Stop Sign :* The bus next-stop sign provides bus passenger the information of bus next stop on LED display. The next-stop display can be installed with an audio voice announcement system to be able to serve both the visually and hearing handicapped. The next-stop sign works independently of the bus driver through GPS in conjunction with a pre-programmed route map. Built-in analytics allow the system to continue its working even when the GPS signal is lost.

I. Smart Bus Stops

The smart bus is designed to help visually impaired, senior citizens and others with physical disabilities. CCTV camera is installed on bus stop to ensure public safety. The smart bus stops will have following facilities:

1) *LED Bus stop sign:* The bus stop sign is a LED display installed at bus stops provides details of arrival times of approaching buses to waiting passengers. Details may include bus number, destination, arrival time and bus capacity.
2) *Audio Voice announcement system:* This system uses RFID to detect which bus is arriving. It will announce the bus number and destination to the commuter waiting at bus stop. This system is helpful for visually impaired person.
3) *RF Transmitter:* Every bus stop will be having the RF transmitter. The RF transmitter will be interfaced to the controller through an RF encoder to encode the data received by the controller and to transmit the data.

IV. CONCLUSIONS

In this paper, we have presented smart bus system. It is based on GPRS, GPS and RFID technologies. The proposed system, basically tracks the position of busses, estimates the passengers present in the bus and provides this real time information on bus stop to avoid unnecessarily wait at bus stops. This system is more helpful for physically challenged passengers. This system will improve the transportation safety and the quality of the service.

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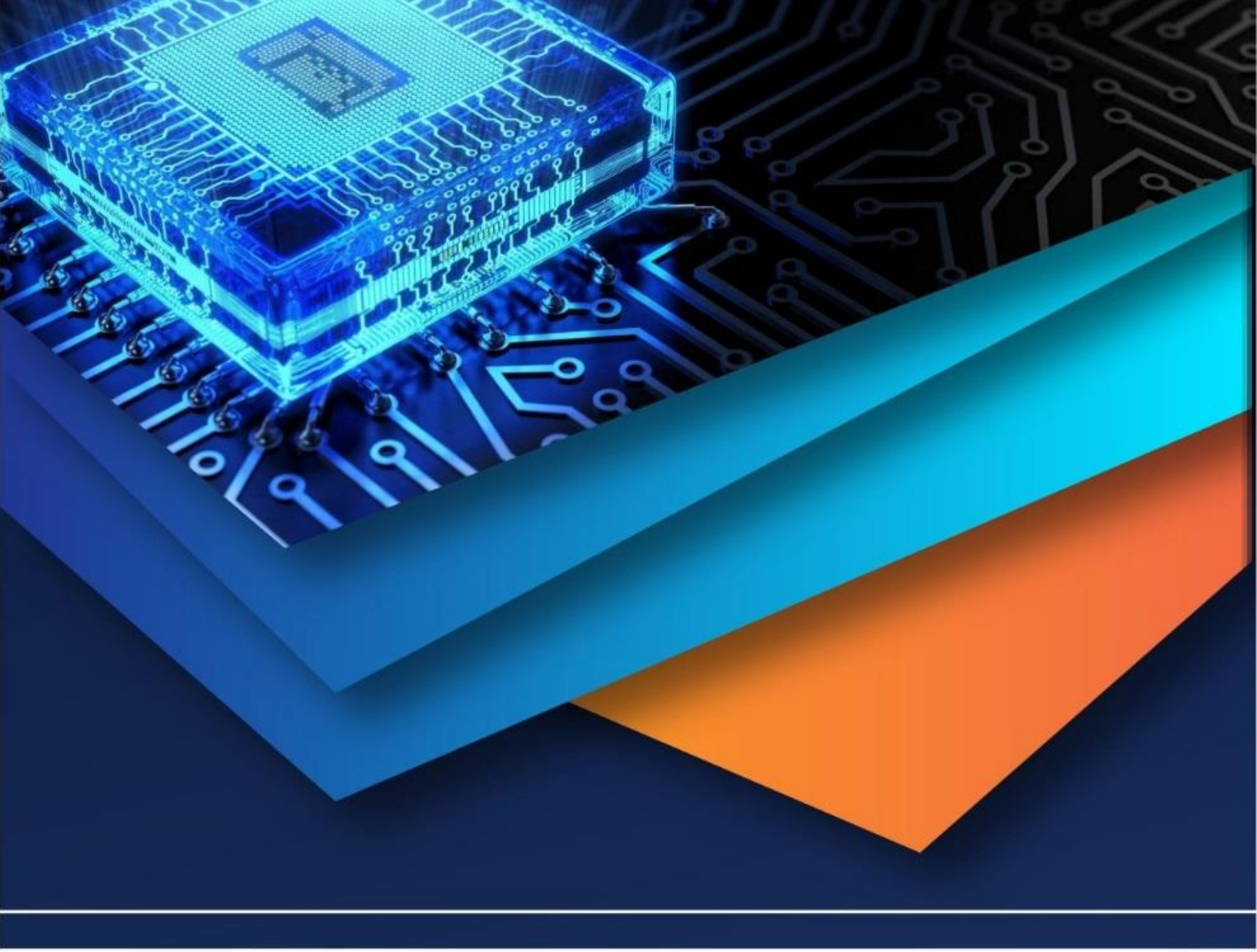

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