Technology-Enabled Bus Terminal Solutions for Senior Citizen Mobility

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***Abstract*—Countries in the Asia region have hot weather around 2–6 months of the year, which might lead to uncomfortable conditions for elder, physically challenged public commuters. Technical teams have made some major enhancements to existing bus stops as Model bus stop by installing Updated version of smart boards, This paper proposes a smart IoT-based environmentally - friendly enhanced design for existing bus stop services in our cities. The microcontroller transmits the sensor readings to a real-time database hosted in the cloud and incorporates a mobile app that notifies operators or maintenance personnel in the case of abnormal readings or breakdowns. Give systematic information to the bus stop smart display board. The mobile app encompasses a map interface enabling operators to remotely monitor the conditions of bus stops such as the temperature, humidity, estimated occupancy, and space availability. In addition to presenting the system's architecture and detailed design, a system prototype is built to test and validate the proposed solution.**

The suggested system uses a mobile app or simply view the smart board that enables users to view current bus stop conditions and related information on Google Map. An added benefit of the proposed system is that by keeping an estimated track of the number of people at the bus stop and other related components will be examined and proposed expert system.

***Index Terms*—Internet of Things; intelligent transportation systems; air pollution; energy efficiency;**

I. INTRODUCTION TO IOT CONCEPTS

II. 1 SPECIAL COVERAGE PEOPLES

If people come with special time sensitivity like, sick people, students during exam times, time oriented daily wages, medical appointment for critical patients, teaching faculties and so on. A clear understanding of bus arrival times to ensure timely arrival for work, medical appointments, or other important commitments. Real-time updates to avoid delays or missed buses. This technology provides Priority bus services or dedicated lanes for time-sensitive passengers.

These different groups of people may face unique challenges in our daily life while accessing bus arrival details. Providing

tailored updated technology-oriented solutions, such as accessible apps, printed schedules, audio and video notifications, smart help desk, customer service, and multi-language support, can help and ensure that everyone, regardless of their

circumstances, easily access essential
public transport information. It will be a great help to face their working environment

Individual accessibility figures of all the sample members.

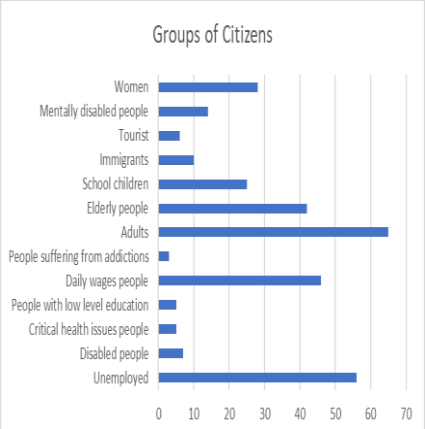


Figure 1:Vulnerable group of citizens

III. LITERATURE REVIEW

A Modern IoT architecture platform utilizing the IoT concept was proposed to provide neighborhood, elder citizen home, childcare centre watch and medicare as well as some additional features such as smart medication management and patient network applications. Recently, IoT applications have been extended to smart bus stop services, smart kitchen, Smart Medicare, Smart Old age, Smart Park and so on.

Smart Transport management is a crucial phenomenon in smart city applications. In the literature, an IoT-based school bus tracking with arrival time prediction was reported in [6].

IV. PROPOSED SYSTEM HARDWARE ARCHITECTURE

The microcontroller continuously reads and transmits the most recent sensor values to the remote database. In turn, a remote database pushes the most recent values to a database available to the levels of operators .Time to Time information collected and processed by the system and will be display in the smart model bus stop smart board with all Audio, video display.

For example, If special people waiting for specific bus means they can access the right information from the digital display whether that bus arrived or late, it has adequate capacity or not, If it is filled, What is the next option how time he has to wait. Some time it didn't arrived, provide detail whether can wait some more time or not necessary. So all these basic info related to particular route bus will be displayed using more than three languages visually as well as voice people can get their data without anybody's help and without any device.

GSM/3G/4G Module: To send data via mobile networks. Wi-Fi/Bluetooth: If the bus is within the Wi-Fi range of a local network. NB-IoT or LoRaWAN: These are low-power wide-area network (LPWAN) technologies that can be used in rural or remote areas. Connect bus with central server or cloud. The IoT device will send data (GPS coordinates, speed, and bus status, images of the capacity) to a central server or a cloud service. The data is processed, and the real-time status of the bus (such as its estimated arrival time, route information, present location, traffic status, estimated arrival time, whether place available or not etc.) is calculated and will be displayed. In smart board On the server, the data is stored and analyzed. This analysis can include, Current Bus Location: From GPS coordinates, Speed and ETA (Estimated Time of Arrival): Based on the bus's current location and route.Route Status: If there are any delays or traffic-related issues. communication Protocol: The server sends the processed data to the smart digital board using protocols like MQTT, HTTP, or WebSocket. Data Display on Digital Board: The digital board at the bus stop receives this information and displays it in a user-friendly format such as, Real-Time Bus Arrival Time: Based on the bus's GPS location and traffic conditions. Bus Route and Next Stop Information: For passengers to know the bus's path and upcoming stops. Status Updates: Such as delays or early arrivals. Real time bus mobility status will be displayed, Architecture set up, Bus IoT Device: A GPS module GSM/3G/4G module. Server or Cloud Platform: AWS IoT, Google Cloud IoT, or a custom cloud solution for processing data. Digital Board: Smart display connected to the internet or a local network with software to display real-time bus information. Smart alert : It produce smart alert via digital board because of special issue bus may crossed platform in advance, any other special additional bus facilities provided means that information, otherwise bad traffic no other way to reach means all these alert may be given.

Bus Stop Side: Smart Digital Board (LED/Display Screen),Communication device for receiving data

(Wi-Fi, Ethernet, etc.),Software for managing and displaying information on the board

V. PROPOSED SYSTEM SOFTWARE ARCHITECTURE

The suggested techniquesmodern architecture for the Smart model Bus Stop project utilizes a combination of cutting-edge technologies to provide a robust, efficient, and cost-effective solution. At the heart of the system lies the data collection and processing unit, which employs Python as the primary programming language due to its simplicity, flexibility, and extensive libraries. Specifically, the Scikit-learn library is utilized for implementing the Random Forest algorithm, which predicts bus arrival times, passenger demand, and traffic congestion.

To store and manage the vast amounts of data generated by the system, MySQL is employed as the relational database management system. MySQL provides a reliable, scalable, and secure platform for data storage and retrieval. Additionally, its compatibility with Python enables seamless integration with the data processing unit.
To ensure cost-effectiveness and scalability, the unit is deployed on a cloud platform. After careful consideration, Amazon Web Services (AWS) is recommended as the preferred cloud provider. AWS offers a comprehensive range of services, including computing, storage, databases, analytics, machine learning, and more. Specifically, the AWS Lambda function is utilized to run the Python code for data processing and prediction, while Amazon S3 is employed for storing and retrieving data. Furthermore, AWS provides a free tier for new users, making it an attractive option for startups and small-scale projects.

Overall, the proposed system software architecture provides a robust, efficient, and cost-effective solution for the Smart model unit. By leveraging the power of Python, Scikit-learn, MySQL, and AWS, the system can effectively predict bus arrival times, passenger demand, and traffic congestion, ultimately enhancing the overall passenger experience.

VI. NEW TECHNIQUES MODEL APPLICATION AND VERIFICATION

Relevant details should be stored time to time in main database which could be handled by three more admins to take proper actions same can be displayed on the smart board for special peoples.

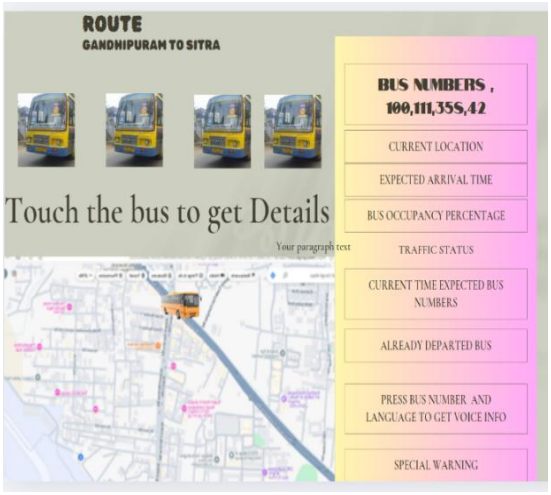


Figure 2.(a) IoT based Smart model Bus Stop (b) System Hardware prototype

The sensors used were GPS (Global Positioning System) Sensors, Traf-Sys, Amsonic, and SenSource offer affordable solutions that can provide essential passenger traffic data without the high upfront costs of more advanced technologies, sensors from brands like DFRobot, and Honeywell provide an economical way to count passengers, with prices ranging from $10 to $300 depending on the functionality and complexity of the sensor. These sensors are great for small public transport systems, bus fleets, or DIY smart model projectsRaspberry Pi camera modules, ESP32-CAM, and Arducam Mini Modules are among the best budget options. These cameras are easy to integrate with IoT systems, . The DFRobot Sound Sensor, KY-038, and Adafruit MAX4466 offer budget-friendly solutions, while the ReSpeaker array offers higher quality sound capture for more advanced applications.These sensors integrate well with microcontrollers like Arduino, Raspberry Pi, or ESP32, and can be used in conjunction with smart board systems, alert systems, or passenger services.proximity sensors such as the HC-SR04 Ultrasonic, JSN-SR04T, and APDS-9960 Gesture Sensor offer a low-cost and reliable solution for

detecting the presence of passengers or vehicles.RFID readers such as the HID Global, ThingMagic M6e, and Zebra RFD8500 can be used for various applications, passenger management.Using RFID tags like the MIFARE Classic 1K or Smartrac Frog 3D ensures reliable identification of passengers, improving the efficiency of public transport system.

VII. CONCLUSIONS

This approach introduced a smart solution IoT-based model bus stop that provided smart monitoring and maintenance solutions and great help to the needy people.

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