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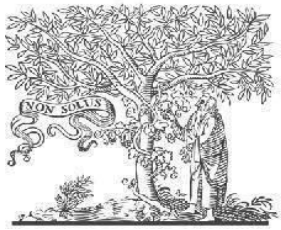

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ADVANCED PUBLIC BUS TRANSPORT MANAGEMENT SYSTEM: AN INNOVATIVE SMART BUS CONCEPT

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ABSTRACT

In the present era, public bus transportation services often lag behind in adopting modern technologies, resulting in numerous operational complexities. These issues encompass challenges such as poor passenger density control, operational inefficiencies, inadequate live tracking, limited realtime capabilities, suboptimal resource management, route ambiguities, safety concerns, and more. This research paper introduces a comprehensive solution an Advance Public Bus Transport Management System (APBTMS) that aims to address these challenges for the benefit of both passengers and transport management authority. Our proposed system leverages various sensors and IoT (Internet of Things) modules deployed within buses to monitor various onboard activities and physical environmental factors. These enable the making of data-driven decisions in real-time, Facilitating improved operational control. Key components of the system include GPS (Global Positioning System) tracking for real-time bus location updates, passenger density/count through CV (Computer Vision), and continuous monitoring of physical environmental factors such as temperature, humidity, sound magnitude, and vibration magnitude which facilitate accident/abnormalities detection, Fire detection and helps in continuously monitoring road quality. The application of CV technology, along with passenger count, can detect harm-causing objects inside a bus and can compare the faces of passengers with black-listed passengers (involved in previously reported crimes such as theft, and nuisance). Passengers benefit from these advancements through a dedicated mobile application. A User-friendly website is also offered to public bus transport management authority providing various useful functionalities. With the addition of safety features like realtime speed detection and many other capabilities in the future, our proposed system can expand its benefits to school bus services and other public transportation services.

I.INTRODUCTION

Major changes are occurring quickly in many facets of urban life, including roadside development and infrastructure development. One area of particular concern is the current state of public transportation, specifically the city bus system. The existing system is not safe and easily trackable. Often general public has to wait for long durations at bus stops. There is a pressing need to develop and implement a smart transportation system due to the significantly increasing population in major cities. It is proposed to upgrade the existing system by incorporating modern technologies like IoT, CV, Cloud Computing, and ML (Machine Learning)) to address these issues. This would allow for real-time tracking of bus locations and improve the efficiency of the overall transportation system[1]. Incorporating a

smart bus system would make it easier to deal with operational complexities, providing passengers and transport authority with a more efficient and reliable service. The bus transportation system is plagued by overcrowding, with too many passengers and not enough seats. This problem is compounded by the lack of technology to predict passenger density, leading to uncomfortable and potentially dangerous situations such as pushing and injuries. To Overcome this problem CV techniques can be used. In the unfortunate event of a serious collision or accident, our IoT device immediately detects it by recognizing abnormal trends in collected data. This ensures that injured passengers get help promptly, potentially saving lives. Additionally, our IoT system constantly monitors road conditions by studying collected vibration magnitude from sensors respective to latitude and longitude. If there's a fire on the bus, our system is equipped to detect it using a flame sensor and instantly alert the transport authorities. This quick response enhances passenger safety during emergencies. Furthermore, the IoT device placed within buses will continuously monitor temperature, humidity, and other physical environment factors. The Internet of Things (IoT), CV, ML, and Cloud computing have the potential to revolutionize the way public transport is managed. Data generated by IoT devices is seamlessly transmitted to and managed by AWS(Amazon Web Services). In this research paper, we propose the Advance Public Bus Transport Management System (APBTMS) as an innovative smart bus concept. The APBTMS can help a large portion of the population every day by reducing their wait times. Even if each passenger saves 5 minutes, the total time saved can be significant. It contains features such as real-time threat and nuisance detection which ensures safe travel for every passenger. The rules and regulations for the passenger capacity of buses can be constantly checked by management authority using the passenger counting feature. passengers carried by the vehicle must not exceed the maximum limit set by the transportation authority. Additionally, in the event of accidents or high-impact collisions, the system swiftly detects and is notified to initiate assistance, prioritizing passenger safety. The Android Application for passengers is built taking inspiration from [2]. The sensor collected data can be used to predict many trends and recognize patterns such as peak passenger density time, prediction of an optimal number of buses on a particular route, and optimal position for setting up bus stops[3]. APBTMS is a concept for a smart bus system that improves the management and operation of public bus transportation. This would make it possible for the transportation authority to monitor and manage the bus system in real-time and to make data-driven decisions that would optimize operations and enhance the overall passenger experience. The APBTMS project aims to develop a flexible public bus transportation system that can respond to changing conditions and user demands.

II.EXISTING SYSTEM

Current bus transport management systems lack heavily on technology utilization and hence majority of work is done manually. In [4], the authors proposed a programming model where an application can be distributed onto a wide range of devices such as CCTV cameras, and roadside units. Also, IR sensors mounted near entry/exit doors are used extensively for calculating the crowd, which has many drawbacks such as less accuracy in counting when multiple people are entering or leaving the bus simultaneously. The authors in [5] discuss the

characteristics of fog computing and the services that can be provided on a fog computing platform for vehicular ad-hoc networks (VANETs). They also mention some challenges and issues that need to be addressed in order to fully utilize fog computing in VANETs, as well as potential research directions for future work in this area. In reference [6], the authors utilize V2I (vehicle-to-infrastructure) communication techniques to collect information from vehicles such as speed, heading, and acceleration. The authors in reference [7] propose the use of an architecture called vehicular fog computing (VFC) to utilize the collaboration of multiple end-user clients or nearby edge devices for communication and computation in smart traffic control systems

III.PROPOSED SYSTEM

The primary objective of this research is to develop a system that will enhance public bus transportation for local commuters and management authority. Our proposed system, called the Advance Public Bus Transport Management System (APBTMS), provides various functionalities such as live tracking of bus location, passenger density monitoring, streaming of real-time bus information, High collision, Fire detection, Continuous monitoring of road quality, and detecting abnormal trends. Fig. 1 provides a general overview of APBTMS. IoT device is placed inside the bus at a strategic position which periodically captures the bus inside image and collects data about physical environment factors using various sensors. The pictorial circuit diagram is presented in Fig. 2. The OV2640 Camera module is used to capture bus inside image and transmit image data, GPS module provides real-time latitude and longitude information of the bus. Temperature, Humidity, Sound magnitude (dB), and Vibration magnitude are also being collected. Sensors and IoT module information is provided in the The Collected data is transmitted to storage and database services provided by Amazon Web Services (AWS) using the GSM (Global System for Mobile Communication) module. Bus inside image is stored as an object in a dedicated AWS S3 bucket and processed using AWS Rekognition service to get passenger density count, detect harm-causing objects and black-listed passengers (people suspected of previous crimes such as theft and nuisance) using DetectLabels and CompareFaces API (Application Programming Interface). Collected data about physical environment factors gets updated in a dedicated table provided by AWS DynamoDB service. Mobile Application and management website fetch real-time bus information from these periodically updated tables and S3 bucket objects. Bus inside images and collected data of physical environment factors are also being stored with Date Time for future data analysis to predict trends, extract patterns, make data-driven decisions, and optimize transport resource allocation. AWS S3, DynamoDB, API Gateway, and Lambda services are extensively used. represents the Complete Cloud Architecture diagram of APBTMS. Mobile Application for passengers is built using Flutter SDK and uses Google Maps API to represent the live location of the bus. The application provides live passenger density in buses, Notifications from management authority, a Portal to report nuisance or any other issue, Bus related information (Bus number plate, driver photo, driver name, etc). Website is built using Node.js, HTML, and CSS for transport management authority, Providing features like live location, sensor-collected data, passenger density monitoring, Portal for sending notifications to passengers, Tabular representation of real-time bus

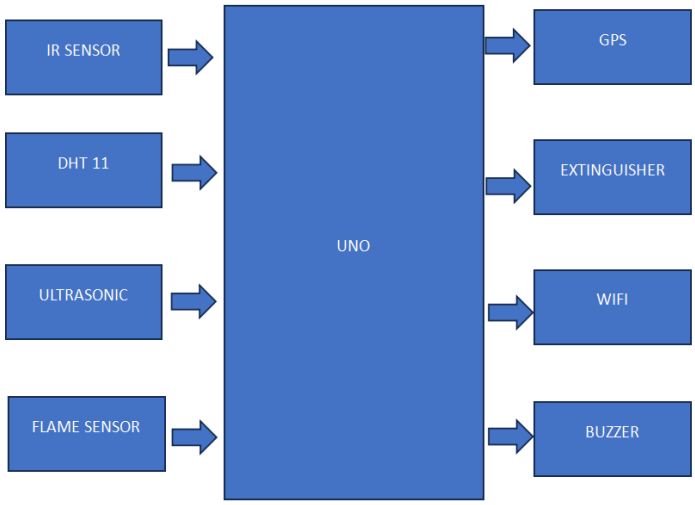
information, functionality for updating bus-specific information, Notification panel which alerts authority in case of accident and abnormal physical environment factor readings.

IV.LITERATURE SURVEY

S. Akter, T. Islam, R. F. Olanrewaju and A. A. Binyamin, "A Cloud-Based Bus Tracking System Based on Internet-of-Things Technology," 2019 7th International Conference on Mechatronics Engineering (ICOM), Putrajaya, Malaysia, 2019, pp. 1-5, doi: 10.1109/ICOM47790.2019.8952037.

The technological rise in public transportation is on the horizon, but the bus network structure and intelligent bus tracking system should first be in place. Bus transport service is on the edge of digital revolution, generating real-time tracking information about the bus service using smartphones. In this paper, a cloud-based bus tracking system based on IoT is proposed to reduce human intervention, waiting time and energy. The exact location and arrival time of the bus can be tracked dynamically by using a mobile application to provide better and efficient bus service. Furthermore, passengers can buy tickets without queueing and book the available seats by making online payments. The proposed scheme allows more flexibility and user satisfactory service to the rider in terms of time loss and encourages more people to ride by providing real-time bus tracking information to improve passenger satisfaction. The main objective is to minimize the unnecessary waiting and queueing time uncertainty of passengers. Riders can utilize their waiting time more productively by choosing the nearest route and alternative transportation. The sustainability of public transport service can be maintained by providing noteworthy benefits to the passengers using the proposed IoT-based bus tracking system. In the early stage of human civilization, people depended on animals for moving goods and themselves from one place to another. The invention and proper uses of the wheel were the great blessings of human life. As a sequence, vehicular transportation brings a new era of human movement. Since the beginning of the transportation system, public transport especially the bus plays important roles in moving faster [1]. With passage of time, the demand for public transport has increased due to the need to convey more passengers at a time and costeffectiveness [2; 3]. However, the accessibility of public transport is never an easy go by issue. People always have to go through hard times getting public transport on time due to mismatch in the bus schedule. Consequently, passengers have to face tremendous trouble in almost every country in the world. This is the case most especially during festive moods, it gets really tasking getting ticket for public transportation because of the high demand and low cost [5; 6]. To cap it all, there is tendency to waste valuable working hours and energy every single day for waiting and queueing for the public bus services. This paper proposes a mobile application architecture on the Internet of Things, IoT, for public bus service, so that, passengers can be able to track the specific location of bus and know when the next bus is coming to a particular stoppage. Besides, this app will allow a passenger to buy a ticket online via an online wallet or mobile banking system that reduce the queueing time for buying ticket manually. In addition, the user will be able to choose available seat via the proposed app.

Block diagram



V.CONCLUSION

Custom CNN model(s) for improved accuracy and case relevance can be trained on the collected bus inside images for passenger count, detection of harm-causing objects, and facial comparison with black-listed passengers. AWS Rekognition service usage can be replaced with this model in the future. Accurately predicted wait durations, arrival times, and other important metrics can also be shown in the future to passengers and management authority. IoT devices can also be installed at bus stops to predict real-time passenger traffic and allocate/redistribute buses based on prediction. Along with management authority, hospitals, and fire stations can also be notified in case of accidents and fire. The implementation of V2V (Vehicle-to-Vehicle) communication can also be done in the future.

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