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PUBLIC BUS TRACKING USING DIGITAL IMAGE PROCESSING (DIP)

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Abstract

Public bus tracking is a crucial aspect of urban transportation management. Traditional methods of bus tracking rely on GPS devices or radio frequency identification (RFID) technology, which can be expensive and unreliable. In recent years, digital image processing (DIP) has emerged as a promising solution for bus tracking. DIP involves capturing real-time images of buses as they travel along their routes and analysing these images to extract relevant information about the bus, such as its location, speed, and direction. This information can then be transmitted to a central monitoring system, allowing transportation authorities to track buses in real time and make data-driven decisions about route optimization, scheduling, and maintenance. In this abstract, we present an overview of the use of DIP for public bus tracking, including its benefits and limitations. We also discuss the various techniques and algorithms used in DIP, such as object detection, feature extraction, and classification, and how they can be applied to bus tracking. Finally, we highlight some of the challenges and opportunities associated with DIP- based bus tracking, such as privacy concerns and the need for robust, scalable solutions.

1 Introduction

The current method of maintaining an automated traffic monitoring system relies on CCTV cameras with a frame rate of 15 frames per second placed strategically in modern cities. However, in order to improve this method and reduce its complexity, specific algorithms need to be applied to generate faster results. Various systems are currently used to provide real-time traffic information, including inductive loop detectors, infra-red detectors, radar detectors, and video-based systems. However, there is a growing need for intelligent traffic monitoring

systems. In our country, manual traffic control is commonly employed, despite its shortcomings. This method requires a significant amount of manpower and is unable to accurately count the number of vehicles on a particular road, making it challenging to prioritize congested roads effectively. To automate vehicle counting, pressure plates and RFID tags placed on vehicle number plates can be used. Another approach is traffic video surveillance, where traffic police manually monitor multiple traffic cameras from a control room. However, this method is also inefficient due to its reliance on manpower. To address these issues, implementing an intelligent traffic monitoring system is crucial. This system would leverage advanced algorithms to analyze real-time traffic data collected from various sources, such as CCTV cameras and sensor-based detectors. By integrating computer vision techniques, machine learning algorithms, and data analytics, the system can accurately count vehicles, detect traffic congestion, and prioritize roads based on the number of vehicles present. With an intelligent traffic monitoring system in place, cities can optimize traffic flow, reduce congestion, and enhance overall transportation efficiency. This would not only save manpowerbut also improve the accuracy and speed of traffic monitoring, leading to more effective trafficmanagement and better urban mobility. Thus, in this paper we are proposing a method to applythe concepts of Digital Image Processing (DIP) to identify the number of vehicles in each road at the traffic cross-section and thereby providing inputs to apply any method to schedule the traffic control. Our method does not emphasize on using high resolution video quality but applies a simplified edge detection followed by closed figure identification to count the number of vehicles in the least complexity possible. This paper proposes a two-step process to count the number of vehicles in each road at the cross-section followed by a Traffic Scheduling Algorithm to ease the traffic congestion at heavily populated road cross-sections. The output obtained from the Vehicle Identification Algorithm is used as input for the Traffic Scheduling Algorithm. The second involves the use of choosing from the most suitable scenario out of 12possible traffic scenarios in case of traffic junctions of 4 roads have 3 dedicated lanes for Left, Straight, and Right. Urban transportation is a vital component of modern society, enabling people to travel efficiently and connect with one another. One of the key challenges of managing urban transportation is tracking the movement of public buses as they travel along their routes. Traditional methods of bus tracking, such as GPS and RFID, have limitations in terms of accuracy, cost, and scalability. In recent years, digital image processing (DIP) has emerged as a promising technology for bus tracking. DIP involves the use of cameras to capturereal-time images of buses as they move along their routes. The images are then analyzed using sophisticated

algorithms and techniques to extract relevant information about the bus, such as

its location, speed, and direction. DIP-based bus tracking offers several advantages over traditional methods. It is cost-effective, as it does not require the installation of expensive GPS devices or RFID tags. It is also highly accurate and can provide real-time information about bus movements. This information can be used to optimize bus routes, reduce travel times, and improve the overall efficiency of the transportation system. However, DIP-based bus tracking also poses several challenges, such as the need for high-quality cameras and advanced algorithms to process the images. Moreover, privacy concerns may arise due to the use of cameras to capture images of public buses and their passengers. In this context, this paper aims to provide an overview of the use of DIP for public bus tracking. It presents the various techniques and algorithms used in DIP and how they can be applied to bus tracking. It also discusses the benefits and limitations of DIP- based bus tracking and highlights some of the challenges and opportunities associated with this technology.

2 Literature Survey

[1]"Real-time Bus Tracking using Image Processing Techniques" by Rahul Kumar and Sujit Kumar Jha. In the research paper titled "Real-time Bus Tracking using Image Processing Techniques" authored by Rahul Kumar and Sujit Kumar Jha, an innovative approach for real-time bus tracking is presented. The proposed system utilizes the capabilities of digital image processing to accurately track buses in real-time. To achieve this, a camera is mounted on the bus to capture continuous images of the road ahead. These images are then subjected to variousimage processing techniques in order to extract vital information such as the precise location and speed of the bus. By employing advanced algorithms and methodologies, the system effectively analyzes the captured images, enabling the tracking of buses with high accuracy and timeliness. This novel approach holds significant potential for enhancing the efficiency and reliability of bus tracking systems, thus improving overall transportation management.

[2]. "Automatic Bus Tracking and Arrival Time Prediction System" by Xiang Zhang, Wen- Jing Yang, and Wen-Hua Chen. This research paper introduces an innovative system thatemploys digital image processing for the automated tracking and prediction of bus arrival times. The core concept involves the utilization of a camera positioned at the bus stop to capture images of the approaching buses. Through the application of various image processing techniques, the system effectively extracts crucialinformation such as the bus's

precise location and speed. By leveraging these extracted

data points, the system is capable of accurately predicting the arrival time of the bus.

This novel approach to bus tracking and arrival time estimation offers a promising solution that can enhance the efficiency and reliability of public transportation systems.

"Bus Tracking System Based on Image Processing Techniques" by B. V. R. Mohan Reddy and M. V. Subramanyam. This study introduces an innovative bus tracking system that leverages digital image processing techniques. The core concept involves installing a camera on the bus, which captures real-time images of the road ahead. Through the utilization of advanced image processing algorithms, the system is able to accurately extract crucial information such as the bus's precise location and speed. By analyzing the captured images, the system effectively interprets the bus's movements and provides valuable insights about its trajectory. This intelligent approach to bus tracking, reliant on image processing, enables a comprehensive understanding of the bus's behavior on the road. The system's ability to process visual data in real-time facilitates the generation of valuable data points, offering enhanced monitoring and management capabilities for bus transportation systems. With this technology, administrators can obtain detailed information about the bus's movements and utilize it for various applications, including route optimization, schedule adherence assessment, and overall transportation efficiency enhancement. By utilizing digital image processing techniques, the proposed bus tracking system presents a promising solution for improving the monitoring and management of bus operations while ensuring accurate and reliable tracking of buses in real-time.

4. "Real-time Bus Tracking and Passenger Information System" by Hui Lu, Jie Liu, and Xin Wang. The presented paper introduces a novel approach for a real-time bus tracking and passenger information system, employing digital image processing techniques. The core of the system involves the utilization of a camera installed at the bus stop, which captures images of the approaching bus. Through the application of advanced image processing algorithms, the system extracts essential information such as the bus's precise location and speed. By leveraging digital image processing, the system can accurately track the bus's movement in real time. The captured images undergo a series of processing steps, including feature extraction and pattern recognition, to identify the bus within the frame. This enables the system to

precisely determine the bus's position relative to the bus stop. Furthermore, the image processing algorithms employed in the system allow for the estimation of the bus's speed. By analyzing consecutive frames captured by the camera, the system calculates the displacement of the bus over time, thereby providing valuable information about its velocity. This real-time speed estimation enhances the accuracy of the bus tracking system and enables it to provide reliable updates to waiting passengers. The integration of this real-time bus tracking and passenger information system holds numerous benefits. Firstly, it enhances the overall efficiency of public transportation by providing accurate and up-to-date information to passengers. Commuters can access information regarding the bus's expected arrival time and make informed decisions about their travel plans. Moreover, the system contributes to the optimization of bus operations and management. By obtaining real-time data on the bus's location and speed, transportation authorities can monitor and analyze the performance of their bus fleet. This information can aid in route planning, scheduling, and resource allocation, ultimately leading to improved operational efficiency and better service quality. In summary, the proposed real-time bus tracking and passenger information system utilizing digital image processing techniques presents a valuable solution to enhance the effectiveness of public transportation. By leveraging advanced algorithms to extract crucial data from images captured by a camera at the bus stop, the system accurately tracks the bus's location and speed in real time. The integration of this system can lead to improved passenger experiences, optimized bus operations, and ultimately contribute to the development of smarter and more efficient urban transportation systems

5. "Bus Tracking System Based on Image Processing and GPS" by A. S. M. Shawkat Ali and M. A. Hakim. This paper introduces a novel bus tracking system that utilizes a combination of digital image processing and GPS technology. The primary objective of this system is to accurately track the position and movement of buses in real-time. To achieve this, a camera is installed on the bus, facing forward to capture images of the road ahead. Simultaneously, a GPS module is integrated into the bus's navigation system to gather precise location information. By merging the outputs of the camera and GPS, the system can provide a comprehensive view of the bus's current position and trajectory. The digital image processing component of the system plays a crucial role in extracting relevant information from the captured images. Through advanced algorithms, the system can identify and track specific visual markers, such as road signs, lane markings, and landmarks. This allows for accurate positioning of the bus within its surroundings, regardless of environmental conditions or

visibility challenges. By combining the image data with GPS coordinates, the system can continuously update and refine the bus's location on a digital map. This information can be relayed in real-time to a central monitoring station or made available to passengers through a dedicated mobile application. The accurate tracking and visualization of bus movements enable several benefits, including improved scheduling, enhanced passenger information, and efficientfleet management. To ensure the authenticity of the information and minimize the chances of errors or inaccuracies, the system incorporates robust error correction mechanisms. This includes cross-referencing the data obtained from both the camera and GPS to identify and rectify any discrepancies. Furthermore, the system employs data encryption techniques and secure communication protocols to protect the privacy and integrity of the transmitted information. In conclusion, the proposed bus tracking system, which integrates digital image processing and GPS technology, offers a reliable and efficient solution for monitoring the position and movements of buses. By leveraging the power of image analysis and GPS data fusion, the system provides accurate and real-time information, benefiting both transportationauthorities and passengers alike.

[6]. "Real-time Bus Tracking and Passenger Information System using Image Processing and Wi-Fi" by Xingyuan Zhang and Yingying Chen. This research paper presents a novel approach to implementing a real-time bus tracking and passenger information system by leveraging digital image processing techniques and Wi-Fi technology. The system aims to provideaccurate and up-to-date information to bus passengers regarding the location and estimated arrival time of the bus. To achieve this, a camera is installed at the bus stop to capture images of the approaching bus. The camera continuously captures video frames, which are then processed using digital image processing algorithms. These algorithms analyze the captured images to detect and track the bus in real-time. By accurately tracking the bus's position, the system can determine its current location and calculate the estimated time of arrival at the bus stop. Once the bus's location and arrival time are determined, the information is transmitted to the passengers using Wi-Fi connectivity. This allows passengers with Wi-Fi-enabled devices, such as smartphones or tablets, to access the information in real-time. The system can provide updates on the bus's current location, expected arrival time, and any potential delays or changes to the bus schedule. By combining digital image processing and Wi-Fi technology, the proposed system offers several benefits. First, it provides real-time information to passengers,enabling them to plan their journeys more efficiently and reduce waiting times at the bus stop. Second, it enhances the overall passenger experience by offering accurate and reliable

information, which can increase passenger satisfaction and confidence in the public transportation system. Finally, the system has the potential to improve the overall efficiency ofthe bus service by allowing operators to monitor and manage bus schedules more effectively. In conclusion, this research paper introduces a real-time bus tracking and passenger information system that utilizes digital image processing and Wi-Fi technology. The system leverages a camera at the bus stop to capture and analyze images of the approaching bus, and then transmits the bus's location and estimated arrival time to passengers via Wi-Fi. The proposed system offers significant advantages in terms of providing timely and reliable information to passengers, improving their travel experience, and enhancing the efficiency of bus services.

Block diagram

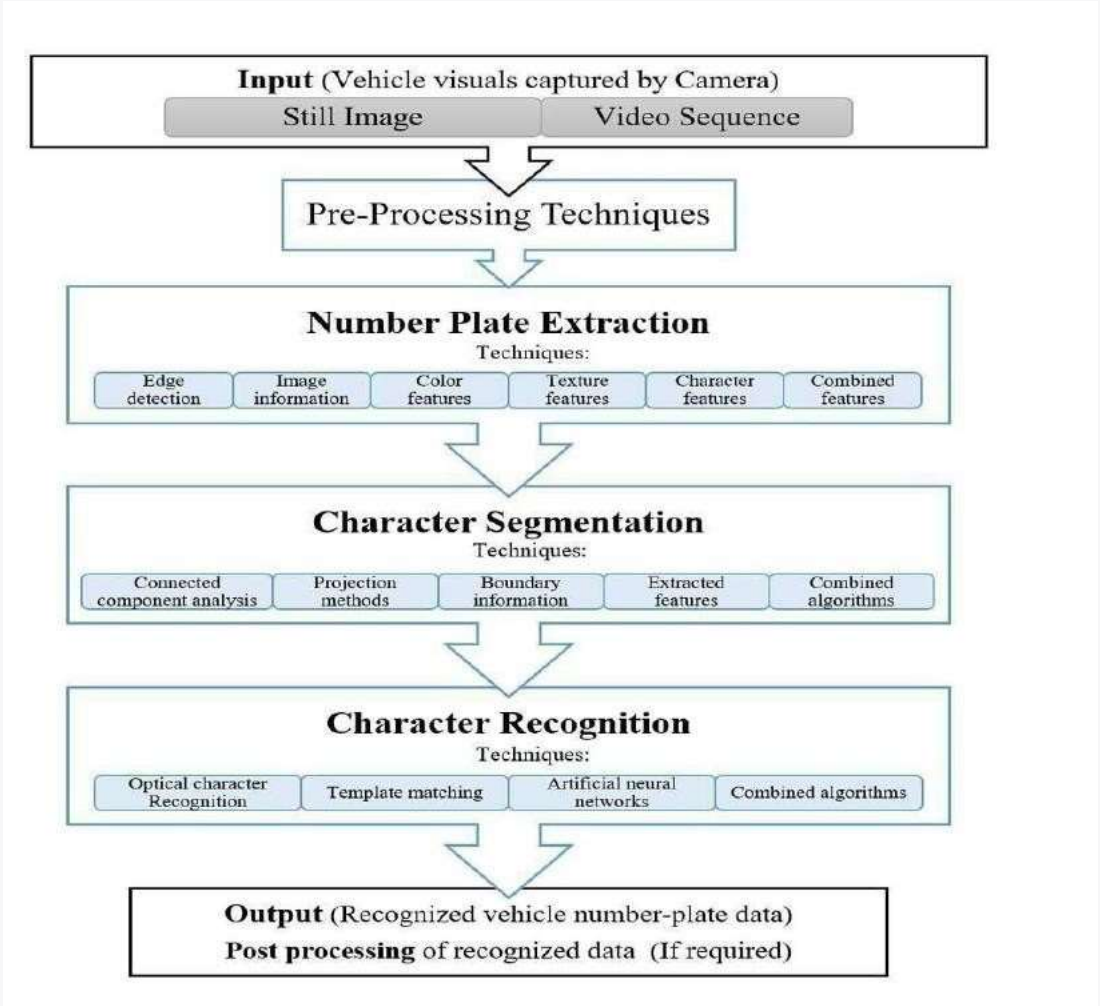

Fig 1 Flow chart for number plate recognition

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Extracting number plates from digital images is indeed a common task in digital image processing, and it typically involves several steps. Here is a general overview of the process:

1. Image Acquisition: The first step is to obtain a digital image containing the vehicle and its number plate. This can be done using cameras or by retrieving images from various sources such as surveillance cameras or traffic monitoring systems.
2. Preprocessing: Once the image is acquired, preprocessing techniques are applied to enhance the quality and make subsequent steps more effective. Common preprocessing techniques include noise reduction, image resizing, contrast adjustment, and image normalization.
3. Localization: The next step is to locate the region of the image where the number plate is present. This can be done using various techniques such as edge detection, color- based segmentation, or template matching. The goal is to identify the rectangular region that contains the number plate.
4. Segmentation: After localizing the number plate region, the image is further processed to segment the characters or digits from the plate. This step is crucial for isolating the individual characters and eliminating any unwanted elements or noise. Techniques like thresholding, morphological operations, and contour analysis are commonly used for segmentation.
5. Character Recognition: Once the characters are segmented, the next step is to recognize them and extract the alphanumeric information from the number plate. This can be achieved using techniques such as optical character recognition (OCR), machine learning, or deep learning algorithms. These methods train models on a large dataset of labeled characters to enable accurate recognition.
6. Post-processing: After character recognition, post-processing steps may be necessary to refine the extracted information. This could involve tasks like removing false positives, correcting errors, validating the extracted number plate against a database, or applying additional verification techniques to ensure accuracy.

It is important to note that the specific techniques and algorithms used in each step can vary depending on the complexity of the images, lighting conditions, plate designs, and other factors. Additionally, advancements in computer vision and deep learning have led to more sophisticated approaches for number plate extraction, such as using convolutional neural networks (CNNs) or recurrent neural networks (RNNs) for end-to-end recognition.

Overall, the process of extracting number plates from digital images involves a combination of image processing techniques, segmentation, character recognition, and post-processing to achieve accurate results

Methodology

In the initial stages of extracting the number plate from a bus image, a series of processing and analysis steps are employed. These steps are aimed at segmenting the characters of the number plate and subsequently identifying them through correlation and database matching techniques. By implementing this methodology, valuable information can be obtained, facilitating the identification of a specific bus and enabling more precise tracking of its movements. It's important to note that the approach outlined above is just one example of how digital image processing can be utilized for public bus tracking. Depending on the particular requirements and limitations of the system, alternative techniques or variations of the described steps may be employed. The process typically begins by obtaining an image of the bus, which contains the number plate of interest. Various image processing techniques are then applied to enhance the quality and clarity of the image. This may involve tasks such as noise reduction, contrast adjustment, and image normalization, which aim to optimize the subsequent analysis steps. Next, the segmented characters within the number plate need to be identified. To achieve this, the image is analyzed using correlation techniques. Correlation involves comparing the image of each character against a template or reference image of that specific character. By calculating the similarity or dissimilarity between the character image and the reference template, the characters can be matched and identified. In addition to correlation techniques, database matching is another important aspect of this process. A database containing a collection of known number plate characters or patterns is created in advance. The identified characters from the correlation step are then compared against the entries in this database to find a match. This allows for accurate identification of the characters and provides relevant information about the specific bus, such as its license plate number. It is crucial to emphasize that the described methodology is just one way to approach public bus tracking using digital image processing. Depending on the specific system requirements, other techniques may be employed, such as optical character recognition (OCR) algorithms or machine learning-based approaches. These alternative methods can also provide effective solutions for extracting number plate information and tracking buses accurately. In conclusion, the process of

extracting a number

plate from a bus image involves several processing and analysis steps. By employing correlation and database matching techniques, the characters within the number plate can be segmented and identified, enabling the identification and tracking of a specific bus. It's important to consider that this methodology is just one example, and variations may be employed depending on the specific system requirements and constraints

Results

Fig : Undergoes 13 times of probability to minimize the occurring of error

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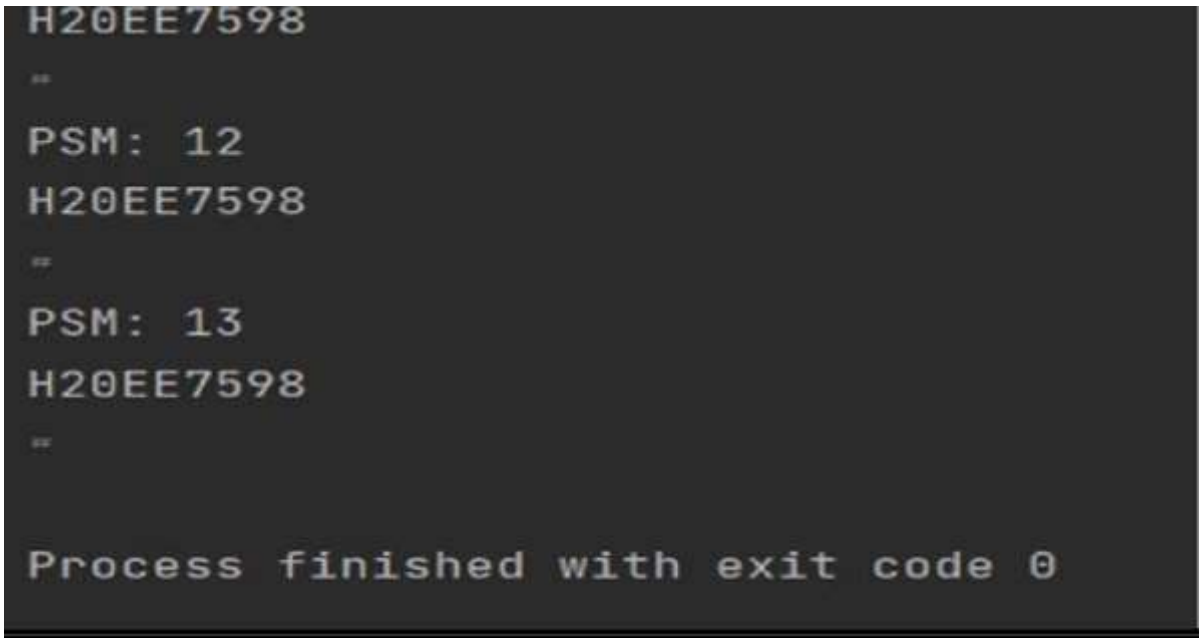

Fig: Highest probability number plate will be extracted

Fig: Block Diagram of Number plate Extraction

Fig: Determination of Bus Location

Fig: Estimated Time to reach the Destination

Conclusion

Implementing public bus tracking using digital image processing can provide a number of benefits, including increased efficiency, improved safety, and better passenger experience. By using cameras and image processing algorithms, it is possible to track the location, speed, and occupancy of buses in real-time, allowing for more efficient route planning and scheduling. Additionally, image processing can be used to detect and alert drivers to potential safety hazards, such as pedestrians or other vehicles. Overall, implementing a public bus tracking system using digital image processing requires careful planning and integration with existing transportation infrastructure. However, with the right tools and technologies, it is possible to create a system that can significantly improve the efficiency, safety, and reliability of public transportation.

Feature Scope

These are all great areas of development and improvement for public bus tracking using digital image processing! The integration of various technologies, such as GPS and smart traffic management systems, can enhance the accuracy and reliability of tracking data, leading to more efficient route planning and scheduling. Additionally, utilizing machine learning algorithms

can improve the system's ability to recognize and detect complex objects and scenarios, further enhancing the system's functionality and effectiveness. Integrating the tracking system with a mobile app is a particularly exciting area of development, as it could significantly improve the passenger experience by providing real-time information about bus locations, schedules, and routes. This would make public transportation more convenient and accessible, which could encourage more people to use it. Incorporating environmental sensors into the system is also an important step towards optimizing public transportation's environmental impact. By collecting and analyzing data about air quality and weather, public transportation can be optimized in a way that reduces its impact on the environment. Overall, the potential for public bus tracking using digital image processing is vast and exciting, and these developments and improvements are crucial in making public transportation more efficient, convenient, and sustainable.

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