TITLE: BUS EMPTY SEATDETECTION SYSTEM

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ABSTRACT

Abstract Public transportation plays a big role in the transportation Facility which provides mobility and creates better transport planning. Advancements in Intelligent Transportation System (IES) improve passenger traveling by providing information systems for bus arrival time and counting the number of passengers and buses in cities. Passengers still face bus waiting and seat unavailability issues which have adverse effects on traffic management and controlling authority. We propose an CNN algorithm to determine passenger seat availability via a camera-equipped at the bus stop through Object detection to learn the visual patterns and feature associated to count empty, filled, and total seats. We believe our results have the potential to address traffic management concerns and assist passengers to save their valuable time.

Keyword: Machine learning, CNN, Object Detection, Human recognition, Cameras, transportation, Seat availability.

1. INTRODUCTION

Understanding how many people are using a public transport service at any particular time and at specific points on a network is of vital importance for passengers and service providers alike. Public transport congestion can result in long waiting times, denied boarding and lower service reliability. Moreover, several studies have empirically estimated that public transport passengers are willing to pay more for crowding reduction.

In this context, timely and reliable information on seat occupancy in public transport services could lead to passengers taking better-informed decisions about how, when, where and or whether they travel. From an operator perspective, the short-term benefits of such information include more rapid responses to unexpected events. In the longer term, seating occupancy data helps operators to better identify changing travel markets so that they can adapt their service provision accordingly. Finally, government authorities benefit from a better understanding of the travel preferences of their citizens, enabling them to improve the effectiveness of subsidies, investments and other policy decisions.

2. METHODOLOGY

CNN stands for Convolutional Neural Network, which is a type of artificial neural network commonly used in computer vision tasks such as image recognition, object detection, and image segmentation.

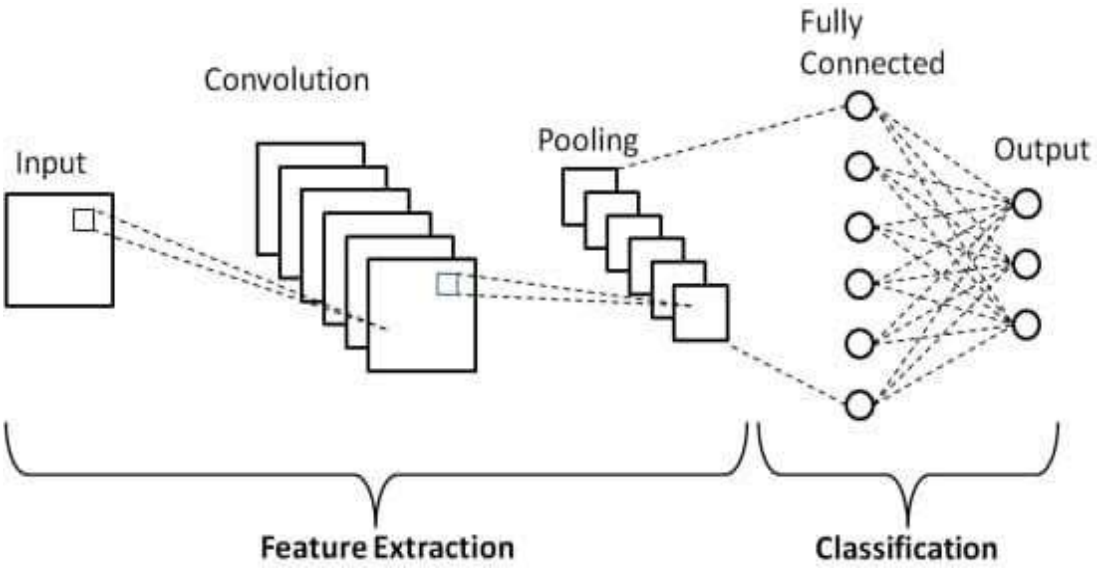

Fig. Working of CNN

Detecting empty seats in a bus using a Convolutional Neural Network (CNN) methodology can be achieved by following these steps:

1. Data Collection: Collect images of buses from different angles and perspectives, with and without passengers. These images will be used to train and test the CNN.

2. Data Preparation: Preprocess the images by resizing them to a uniform size, and normalize them by scaling the pixel values to the range [0,1]. Split the dataset into training, validation, and testing sets.

3. Model Architecture: Design a CNN model architecture that takes in the input images and learns to classify them as either having an empty seat or not. A typical CNN architecture for image classification tasks includes a series of convolutional layers, followed by pooling layers, and then fully connected layers for classification.

4. Training: Train the CNN model using the training dataset, using a suitable optimizer and loss function. Monitor the performance of the model on the validation set during training to avoid overfitting.

5. Testing: Evaluate the performance of the trained model on the testing dataset, to assess its ability to generalize to new, unseen images.

6. Deployment: Once the model is trained and tested, it can be deployed to detect empty seats in real time on a video stream of a bus, by segmenting the image into individual seats and using the trained model to classify each seat as either empty or not. This can be achieved by applying the sliding window technique to the video stream and processing each window using the CNN model.

CNNs have fundamentally changed our approach towards image recognition as they can detect patterns and make sense of them. They are considered the most effective architecture for image classification, retrieval, and detection tasks as the accuracy of their results is very high. They have broad applications in real-world tests, where they produce high-quality results and can do a good job of localizing and identifying where in an image a person/car/bird, etc., are. This aspect has made them the go-to method for predictions involving any image as an input.

A critical feature of CNNs is their ability to achieve 'spatial invariance', which implies that they can learn to recognize and extract image features anywhere in the image. There is no need for manual extraction as CNNs learn features by themselves from the image/data and perform extraction directly from images. This makes CNNs a potent tool within Deep Learning for getting accurate results. Overall, the CNN methodology provides an effective way to detect empty

seats in a bus, which could have applications in optimizing bus routing, managing passenger flow, and improving passenger safety.

3. ARCHITECTURE DESIGN

The system is mainly designed to provide the number of vacant seats present in each of the different buses to avoid the passenger overloading in different buses. The analysis of the data can be carried out using a computer-based vision approach. Based on the data sets (collected pictures of buses from the stop), we select the appropriate algorithm that gives maximum accuracy and tune the model.

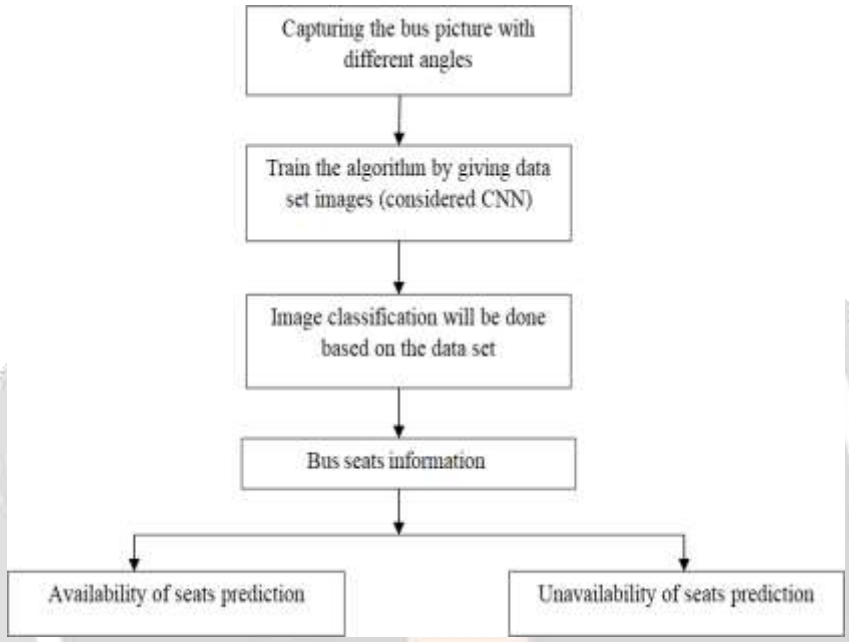

Fig.System Architecture

- Input Design

Input design is the process of converting the user-oriented input to a computer-based format.

The “Bus empty seat detection" is developed in such a manner that the validation is made for each and every data. The accuracy, economy, validation, reliability, efficiency and timelessness are considered during design. The timelessness is the most essential factor.

- Detailed Design

In detailed design, the program is studied. They are detailed under program and documented. This interface between user and computer is also design:
The objective of detailed design in as follows:

- To reduce redundancy.
- To improve program performance.
- To improve integrity and security of data.

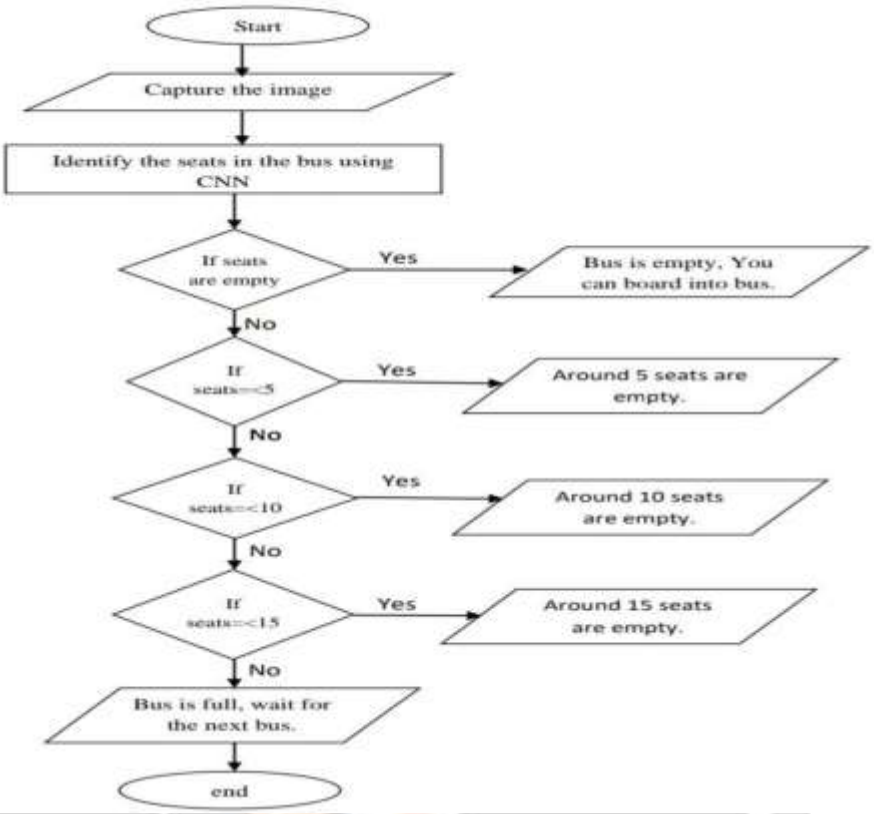

Fig. Detailed Design Flowchart

- Output Design

The main objective of any system is the generation of reports for the user benefit which depends on the inputs.

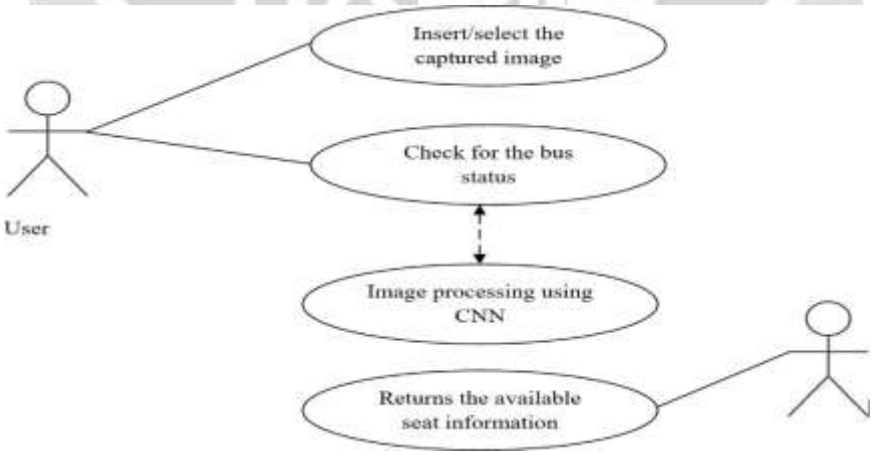

Fig. Use Case Diagram

4. TESTING

Testing is a process conducted to know information about quality of project, how it is working under test. Testing

provides process to find bugs and defect from project. It will easy to remove from project. Testing makes it easy to verifying that project /product is fit for use.
We must check following requirements during testing of product.

- Fulfilled all requirements of users.
- Responding to all kind to user inputs.
- Can be run on its intended platform or environment.

The type of testing involved in our project is system testing: System testing is a type of software testing that evaluates the behavior of an entire system or software application based on its functional and non-functional requirements. It is conducted after the completion of integration testing and before user acceptance testing. The main objective of system testing is to validate and verify the system's behavior in different environments and scenarios. It involves testing the system as a whole, including its hardware, software, network, and other components, to ensure that it meets the requirements and specifications.
During system testing, various types of testing techniques are used, such as functional testing, performance testing, security testing, usability testing, and compatibility testing. These tests help to identify defects or issues in the system and ensure that it is functioning correctly and efficiently. System testing is an essential part of the software development life cycle (SDLC) and helps to ensure that the software application is ready for deployment and use by end-users.

5. RESULT

Fig. Input the Test Image

Fig. Check the Status of the Bus

Fig. Status of the Bus is Empty

Fig. Status of the Bus Showing 5 Seats left

Fig. Status of the Bus Showing 10 Seats Left

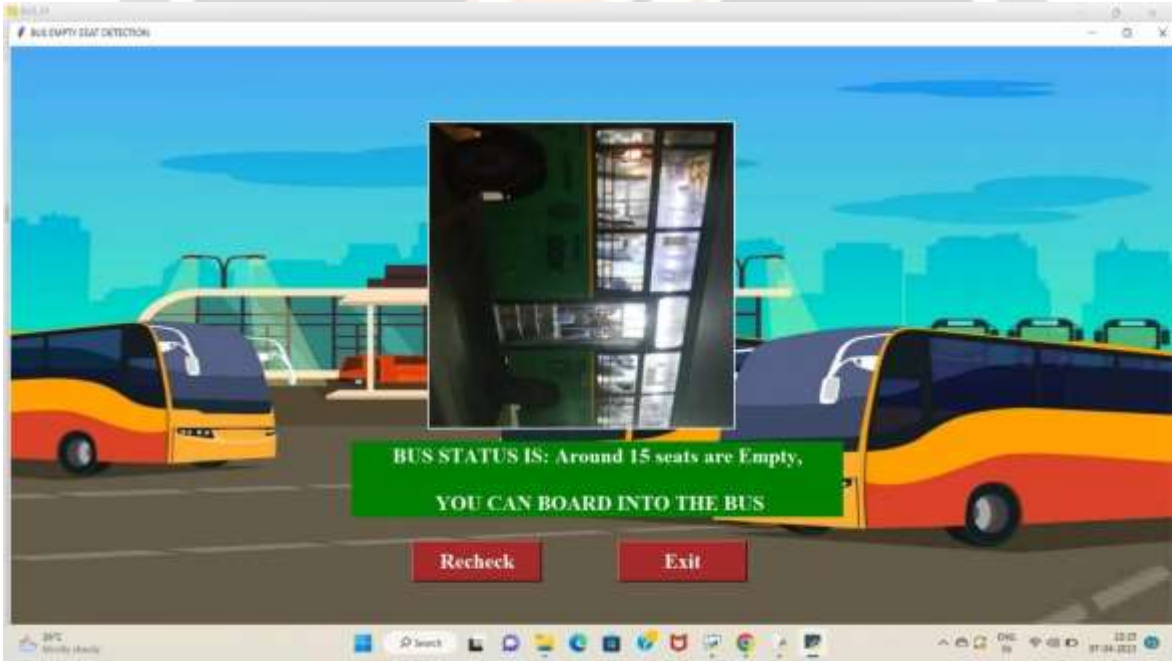

Fig. Status of the Bus Showing 15 Seats Left

Fig. Status of the Bus is Full

6. CONCLUSION

In conclusion, the use of Convolutional Neural Networks (CNN) for bus empty seat detection can be an effective approach. CNNs are a type of deep learning algorithm that can automatically extract features from images, making them well-suited for image classification tasks like empty seat detection.
By training a CNN on a large dataset of images, the model can learn to recognize the patterns and features that distinguish between images with and without empty seats. Once trained, the model can be deployed to detect emptyseats in real-time on video feeds from cameras mounted in the bus stops.

Overall, the use of CNNs for bus empty seat detection can provide a reliable and automated way to monitor passenger occupancy levels, which can help improve bus scheduling, resource allocation, and overall efficiency.
The accuracy of the CNN model for empty seat detection can be improved by using techniques such as data augmentation, transfer learning, and fine-tuning. These techniques can help to address issues such as overfitting, limited data, and model complexity.
One of the main challenges of using CNNs for empty seat detection is ensuring that the model can accurately distinguish between empty and occupied seats under varying lighting conditions and camera angles. Future work could focus on developing more robust models that can account for these variations and achieve higher accuracy rates.

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