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AI Based Smart Information System to Forecast Passenger Flow using Video Surveillance for Intelligence Transport System

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Abstract

The Intelligent Transport System (ITS) being a popular platform of research, dealt with enormous technologies to standardize the public transportation system. To deliver an adequate transport facility to the public, it is highly important to gather information on crowd density in a public transport medium to the commuters of every region. India being more populous needless to say, it drags the attention of people to increase private transportation rather than a public one, which then increases global warming and traffic congestion. The paper presents taxonomy of image processing techniques to gather crowd density information and to provide commuters a suggestion on availability of seats in a bus using Artificial Intelligence(AI) based Smart Information System, which then saves time, avoid catching crowded bus and to standardize public transportation system which has practical significance. Finally, the open challenges are identified and outlined which are promising research directions for ITS.

I. INTRODUCTION

In a highly Populated country like India, preferably in an urban area's population growth increases rapidly due to rising Job opportunities, modernization and Comfort. It is very common to find huge crowds in a public transport medium, which lays a critical burden on city administrators to ensure adequate transportation to the entire crowd which then drags attention of commuters to have private transportation. With the existing public transport system, a person who is in urgency to make his presence at places like interviews, exams, functions may get afraid to take the public transport which automatically drags the person to prefer private transport. Increased number of Private vehicles increases Global Warming and Traffic Congestion. Public Transportation plays a major role in Growth as well as to make a pollution free environment for any city. The Intelligent Transport System has become a popular area of research for about a decade and it deals with enormous technologies to standardize the public transportation system. The Intelligent Transportation System (ITS) aims to improve Safety, Mobility and Environmental performance of road transport. This Work provides a structural Prototype of ITS to improve the Passenger's comfort. To improve the bus Passenger's Degree of comfort, it is necessary to determine the real time crowd coefficient in the bus[1]. To this concern, this Paper employs the camera to detect the number of Passengers in the bus and to determine the collected information to the forthcoming commuters so that they could avoid catching a crowded bus which then enables them to save time. The main scope of this work is to attract commuters to prefer public transportation with help of a Smart Information System**.**

II. STANDARDIZATION OF PUBLIC TRANSPORT SYSTEM

Artificial Intelligence (AI) is the combined attribute of science and computer that makes the system or program or any machines perform the Intelligent and Imaginative functions of a human, independently and provide solution to problems, be able to make decisions. Our future world is much dependent on these Artificial Intelligence technologies which provide valuable information and save time. An Intelligent transport system (ITS) utilizes technology to improve the quality of public transportation systems. Crowd sourcing in ITS makes use of communication technologies to assist the

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passengers in making informative decisions and provide leisure and safe travelling experience [2]. Crowd sourcing is the practice of engaging a 'crowd' or group for a common goal, often innovation, problem solving, or efficiency. It is powered by new technologies, social media and web 2.0. Crowd sourcing can take place on many different levels and across various industries. Thanks to our growing connectivity, it is now easier than ever for individuals to collectively contribute whether with ideas, time, expertise, or funds to a project or cause. This collective mobilization is crowd sourcing. It is a process of tapping into individuals or groups of people, paid or unpaid who are linked together with a common interest to bring forward powerful, increased results through their aggregated actions or activities. India is one of the fastest growing economies in the world. With a growing population too, the country is working hard to transform itself over the next few decades. Improving public transportation is high on the agenda [3]. Private vehicle ownership in India is growing and therefore causing major congestion problems in cities. Indian cities are facing a multitude of issues such as severe congestion, deteriorating air quality, increasing greenhouse gas emissions from the transport sector, increasing road accidents; and an exploding growth in the number of private vehicles [4]. Indian roads are also popular for heterogeneity of vehicles sharing the same road space. Buses are the most popular and convenient mode of transportation in urban cities [5]. However, bus transportation has not been able to cater to the growing travel demand. There must be a systematic approach in analyzing real-time numbers of passengers travelling in the bus and giving suggestions to passengers to choose the bus for boarding [6]. Therefore, an AI based smart information system to forecast passenger flow using video surveillance for the Intelligent Transportation System is proposed to improve public transportation [7]. This paper describes the architecture, sensors, processing algorithms, output modules and advantages of the developed system. This enables the improvement of the standard for public transport systems. It helps in pushing the quality of the public transportation system. To give the accuracy of buses time and routes for passengers and to provide the global count of each and every bus to the commuters and thus helps to save money and time for governments.

III. ARCHITECTURE

A **block diagram** is a specialized, high-level flowchart used in engineering. It provides functional views of the blocks within it. In the proposed system, the Bus, Camera and GPS module plays a vital role. Bus is mounted with Camera and GPS. Camera runs the face detection algorithm through Haar Cascade Classifier which in turn identifies the number of passengers travelling in the bus [8]. This face count is sent to the server with the prediction of the number of available seats in the bus. On the other hand, GPS takes care of identifying the position of the bus and updates the live location of the bus at the time. Figure 1 illustrates our proposed methodology.

On combining both Camera and GPS modules, our Smart Information System takes care of predicting the number of passengers travelling in the bus with its live location. This information is then updated to the Ubidots.

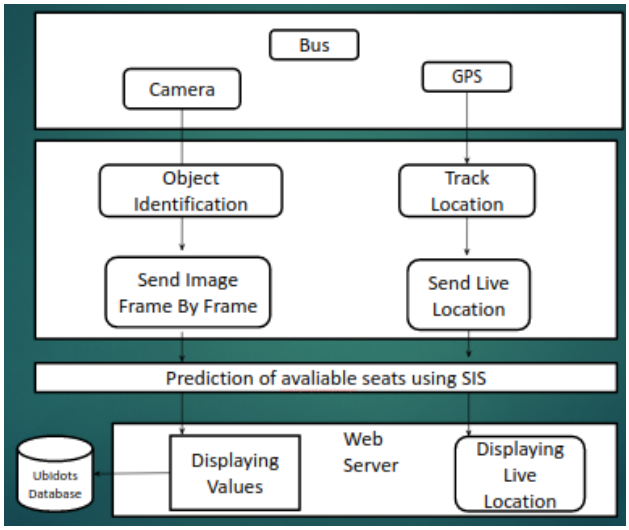

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Fig.1 Block diagram

- In the face detection part, we take a frame from the video surveillance camera and detect a number of faces.
- Public transportation systems play an increasingly important role in the way people move around their communities.
- The realized system tracks pedestrian targets equipped with GPS-enabled devices. It concentrates on the tools it provides for real-time arrival information, which is available through a web application. The system is operated by GPS which is attached to the bus. Firstly, it receives the satellite signals and then the position coordinates with latitude and longitude are determined.
- After receiving the location, the tracking information can be transmitted using any wireless communications systems
- Haar Cascade is a machine learning object detection algorithm used to identify objects in a video. It is a machine learning based approach where a cascade function is trained from a lot of images. It is then used to detect objects in other images.
- It finds the best threshold which will classify the faces to positive and negative. Obviously, there will be errors or misclassification. We select the features with minimum error rate, which means they are the features that most accurately classify the face and non-face images.
- In an image, most of the image is non-face region. So, it is a better idea to have a simple method to check if a window is not a face region. If it is not, discard it in a single shot, and don't process it again. Instead, focus on regions where there can be a face.
- After identification of faces in the video for every time interval frame by frame images has been generated.
- The total count of the passengers will be identified by SIS, and we provide the total number of seats in the bus. By this we can identify the available seats in the buses.
- Simultaneously the location of the bus will be provided by the GPS present in the bus.
- Ubidots database will contain all the information about the buses and total number of passengers. The information will be displayed to the passengers through ubidots web server.
- The approximate time of the next bus also will be displayed which is helpful for passenger's comfortability.

IV. DATA HANDLING AND MANIPULATION

Data is an integral part of SIS. The details such as the number of vehicles, position of the vehicle and number of people travelling through the vehicle plays a vital role for SIS[9]. In short, the data is heterogeneous in nature. Historical data notifies the past event while real-time data can be gathered by means of sensors, using Global Positioning System (GPS), Video surveillance camera. Video surveillance cameras are installed in public buses. The collected data helps in making the decisions and to improve its smartness. The data collected is not only useful for detecting the crowd, but also to predict a suitable model for intelligent transportation. The combination of historical and real-time data provides the accurate prediction of future events.

A. Video surveillance camera

The number of people in buses is difficult to calculate in traditional methods. Such a process is slower, and involves manpower. Moreover, the accuracy of the data is of no guarantee. So the video surveillance camera is introduced which provides the accurate people count and helps the passengers to make decisions. For every minute nearly 20 to 30 Frames can be collected using a video surveillance camera [10].

B. Global positioning system

In recent days, the number of users using the internet continues to increase. Most of the mobile phones, laptops and electronic devices are equipped with GPS, offering location information of the

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users. It enables one to collect real-time and accurate data. This results in trouble-free and infrastructure less mechanism. GPS provides accurate location so the people can gain more knowledge about the crowd in the buses.

C. Data repository (Service provider)

The data repository is a data library or an archive that stores related information. It is a historical data that helps in effective data analysis, sharing and reporting. ITS is used globally and implemented for a specific requirement. For example, countries like the USA, Japan, UK, Europe, and Canada implement intelligent transportation systems. Ubidots is the service provider which is helpful in transmitting the sensor data to the Ubidots database which provides the historical data which can be monitored at any time.

D. Data processing

The data collected from video surveillance camera and GPS should be processed and transformed to the server. These data processing are carried out by Raspberry Pi. The Raspberry Pi is a series of small single-board computers. GSM module is connected to the Raspberry Pi which helps in transferring data to the server. The server thus receives the data from Raspberry Pi which gives the live count of passengers travelling in the bus and the live location of the bus to the commuters.

V. RESULT

This Smart Information System(SIS) will provide the number of passengers available in the bus via headcount. Upon execution, the surveillance camera will send the frames with faces identified in it. Figure 2 shows the faces identified in frame.

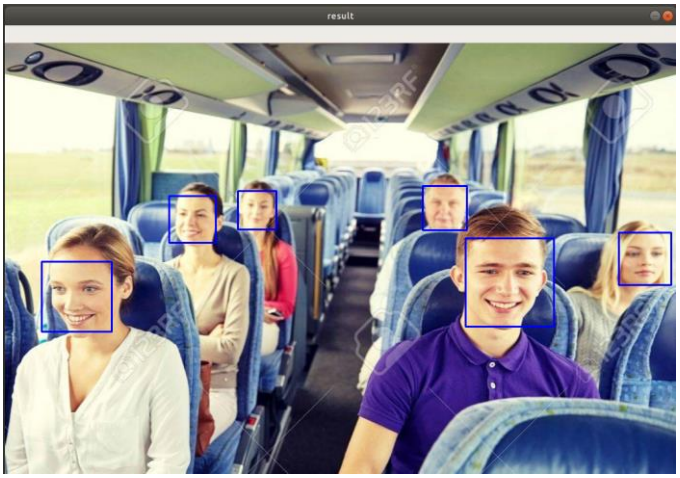

Fig.2 Detection of faces in frame

The total number of faces identified in the frame are updated periodically to the server. With this count of faces identified, our system predicts the availability of seats in the bus. If a bus has no vacancy, then it will display as “Seats Unavailable”. Along with this information, our system also displays the approximate time for the availability of the next bus on that route. This value will be updated periodically, thus helps the commuters to know the available seats in the upcoming bus near their location. Figure 3 shows the detailed view on the number of faces identified in the bus. It displays the number of seats available in the bus along with the approximate time for arrival of next bus.

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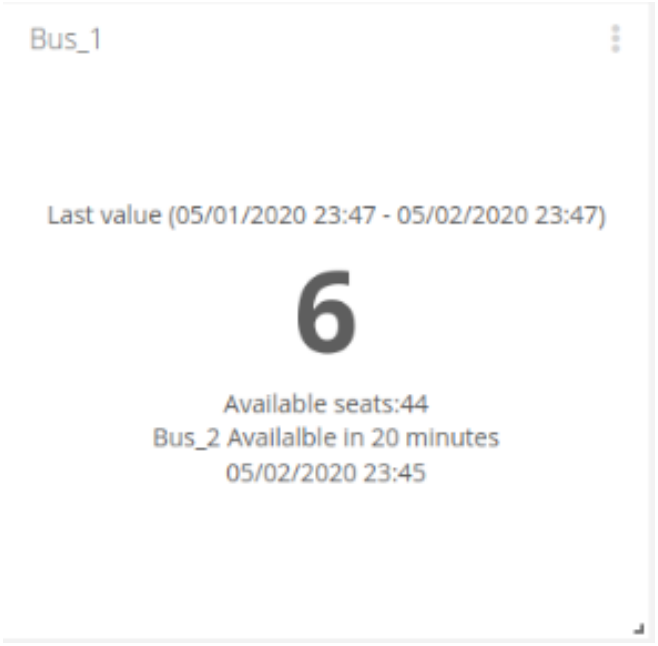

Fig.3 Number of passengers with seat availability

The GPS module takes care of tracking the live location of the bus and it updates the location of buses to the server. Figure 4 shows the buses plotted in the map. Upon selecting a bus in the map, it will also display the passenger count in the bus. With this map, we can see all the buses in the current location.

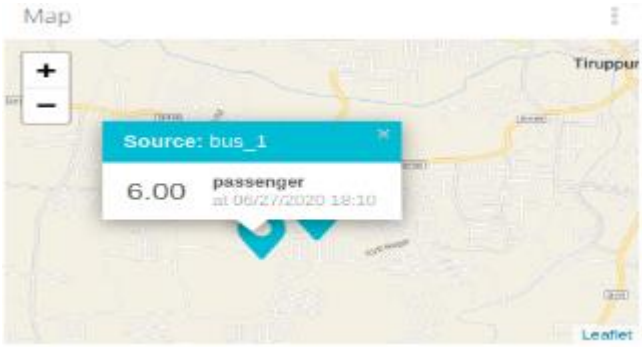

Fig.4 Bus location with passengers count

Our proposed system also stores the historical data of the number of passengers travelling in the bus. This historical data gets updated periodically and can be fetched at any time whenever a user is in need. Figure 5 describes the historical data of passengers travelled in the bus at the time.

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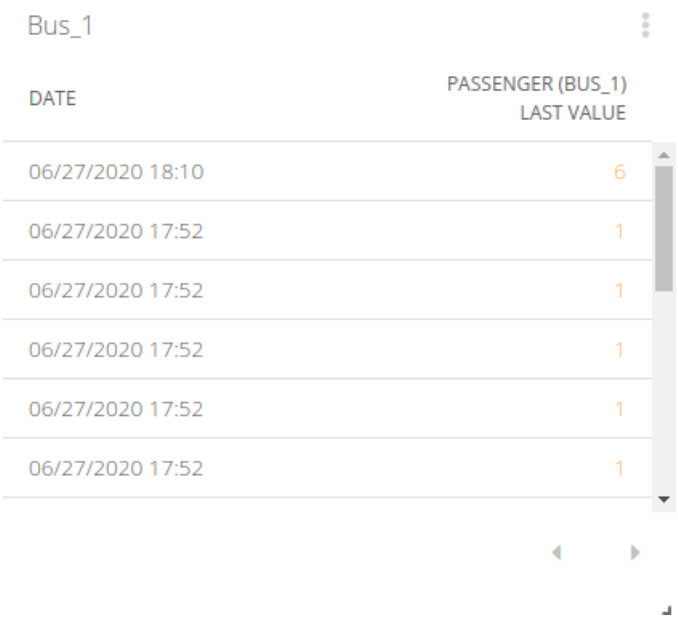

Fig.5 Passenger's count history

The dashboard of the Smart information system comprises live frames returning from the surveillance camera of public transport along with the number of passengers travelling in bus. This dashboard also portrays the live location of buses available at the time. Figure 6 portrays the Smart Information System Dashboard.

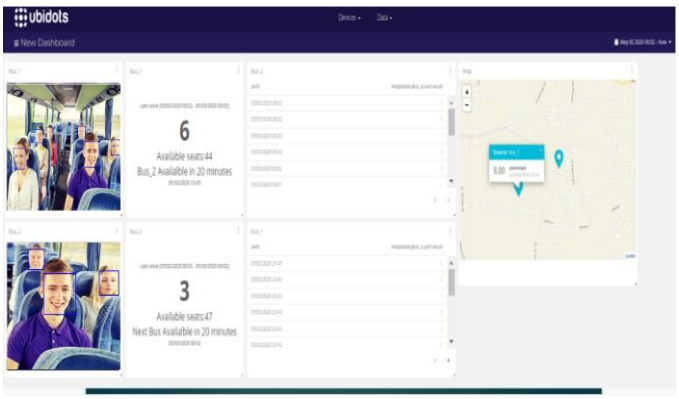

Fig.6 SIS Dashboard

Hence the combination of Historical and real time data are handled and manipulated through several mechanisms.

VI. CONCLUSION

The proposed intelligent transport system has clear knowledge about increasing public transport. So that it helps the passengers to decide about bus timings and routes. Passengers can also know about the bus crowd's details and location. This will lead to a flexible and scalable implementation in practice. This paper highlights the limitation of passenger interference and to develop a working model to display the collected data inside the bus through an LED display outside the bus which would make an ITS much more smarter that would be a future work of research, thus to implement this application in android to provide passenger's count through smartphone thereby, Bus arrival and departure time could be monitored by every passenger using this application. Past travel history of every passenger could be identified using an android application. Mode of transport could be of train, cab, auto be included in this application.

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