ISSN: 0974-5823 Vol. 6 No. 3 December, 2021

International Journal of Mechanical Engineering

Role of Automatic License Plate Recognition System in Development of Intelligent Transportation System.

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***Abstract*—**India is thickly populated country the need of intelligent transportation system is much requirement to manage traffic in India. Intelligent Transportation system (ITS) is also required nowadays for various applications. Floating Vehicle Detection (FVD) and Automatic Vehicle Identification (AVI) are two types of data collection and communication methods used in ITS. AVI is the most important part of ITS as it gives information about vehicle which can be processed further to make decisions related to vehicle in traffic management. Different technologies are available for AVI. Most commonly used technologies in AVI are Automatic License Plate Recognition (ALPR), Radio Frequency Identification (RFID), and Bar code. In this paper a comparison has been made between these three technologies used in AVI to highlight the pros and cones of these technologies. A set of performance measurement criterion are adopted to compare different technologies.

Keywords— Automatic Vehicle Identification**,** Automatic License Plate Recognition**,** Radio Frequency Identification, Barcode, Microwave**,** Intelligent Transportation System.

I. INTRODUCTION

Intelligent Transportation system (ITS) is today's requirement as per a study on an average forty percent of population spend one hour of a day on road [1]. It is the emerging field as vehicle traffic are increasing drastically [2]. It is not easy for human alone to manage dense traffic without any intelligent system. ITS integrate various technologies and use them in the field of transportation system to manage traffic flow and other applications [3]. There are three steps in ITS Data collection, data communication and decision making. Data collection and data communications can be used an integrated step. In ITS data communication is possible between vehicles to infrastructure (V2I), Vehicle to vehicle (V2V). vehicle-to-pedestrian (V2P) and pedestrian-to-infrastructure (P2I) [4] [5].With technological developments new features and concepts are been added to the ITS. It impart an important role in reducing risks of accidents, controlling traffic on roads, monitoring carbon emissions, noise and air pollution, safety of passengers, vehicle flow, travel speeds, etc.[6]. ITS is not limited to road traffic management but it is use full in railways, navigation and airways also [7].

DATA COLLECTION TECHNOLOGGIES IN ITS

The techniques which can be used to obtain data from vehicle can be categorized in to two categories. First can be named as Floating Vehicle data (FVD), Second can be named as fixed or sensor based or automatic vehicle identification (AVI). The technologies used in FVD are GPS based method, mobile phone and Smart phone based rich monitoring, Satellite monitoring. However, technologies used in AVI are Automatic License Plate Recognition (ALPR), Radio Frequency Identifications (RFID) and Barcode etc. Each of this two categories have their advantages and disadvantages these are suitable in different applications, Table I shows advantage, disadvantage and applications of two categories.

Table I

	FVD	AVI
Principle	Collection of real time data using GPS, Mobile phone or Satellite.	Collection of real time data using Sensor/Transponder or camera.
Kind of Data collection	Vehicle speed, Location, Direction of movement, Traffic density	Identification of individual vehicle Uniquely, Determination of Vehicle speed, Location, Direction of movement, Traffic density
Application of Data	It gives real time data which can utilize in traffic management, speed detection and vehicle tracking.	Data captured by AVI can be used in all applications of FVD along with vehicle Identification.
Advantage	Less installation Cost, Large Coverage, does not effected by environmental condition.	Identification of Vehicle is Possible.
Disadvantage	Limitation due to weak/ no signal, Battery problem,	Heavy Installation cost.

	parallel road problem.	

As given in table I, FVD can be used in traffic management applications but not suitable for identification purpose. For identification AVI technologies are required. In next section different technologies available in AVI are discussed along with advantage and disadvantage.

II. TECHNOLOGIES USED IN AVI

Vehicle identification is different from facial identification, faces can be identified based on different facial feature but in vehicle a vehicle with same model and color looks similar only difference can be number plate or any other tag fixed vehicle. Therefore technologies used for vehicle identification needs a Transponder/ sensor or camera and a reflecting tag or License Plate. Technologies available in AVI are ALPR, RFID, and Barcode.

A. Automatic License Plate Recognition (ALPR)

ALPR is the technology of vehicle identification in which the image or video of License Plate (along with background) is obtain by Camera. This image is further processed for localization, segmentation and recognition to extract the information from License Plate. A camera is mounted at road side or at a height to capture the image/video of vehicle. This image/video is send to the data processing unit using any communication media to extract the License Plate information from the image. This technology can also identify the vehicles without database.

B. Radio Frequency Identification (RFID)

RFID have two components an antenna or reader and a tag. The reader can have one or more antenna transmits a radio frequency signal uses a transmitter antenna which transmits a signal and receive back signal from tag. Tag is basically an integrated circuit (IC) with an antenna and substrate. Tag uses radio wave frequency to communicate with reader, Tag is of two type active tag and passive tag. Active tag have a power source, while passive tag receive energy from the reading antenna. Depending on frequency range RFID can be of four type: Low frequency RFID (30KHz-500KHz), High frequency RFID (3MHz-30MHz), UHF RFID (300MHz-960 MHz) and microwave RFID (2.45GHz) [8] [9] [10]

C. Barcode

Barcode consist of two main components, Reader and a strip which contain printed form of barcodes in terms of width of lines or spacing between lines or any other form of coding. This strip of coded information is tagged on vehicle to be identified. A reader is installed at the side of road. [11]

III. COMPARISION OF AVI TECHNOLOGIES

The following parameters are used to compare the performance of AVI system.[12] [13].

Maximum Speed

Maximum speed means maximum speed of vehicle on which AVI system can identify the vehicle. ALPR system available now can detect the License up to a speed of 100 mph, therefore ALPR can be installed at highways to identify vehicles. However, it depends upon the shuttering speed of camera. Barcode can identify vehicle on maximum speed of 25mph, therefore this cannot be used on highways to identify vehicles, this can be used for Access control. RFID can identify vehicles with maximum speed of 60 mph, this maximum speed reduces with increase in distance between antenna and RFID tag.

Maximum Distance

Maximum distance means, maximum distance between camera/sensor and target vehicle on which AVI system can identify vehicle. This depends upon the camera resolution in case of ALPR, radiation power in case of RFID and optical power in Barcode. With increase in camera resolution to 10MP maximum distance possible in ALPR is 35 meters at which License Plate character can be detected. In RFID maximum possible distance in passive tag is 10 meters, it may increases with use of active RFID tag.

Environmental Conditions

Different whether and light conditions can effects the accuracy of AVI system. ALPR uses camera to capture image which is most sensitive to environmental and lighting conditions, accuracy of ALPR increases with good Environmental and lighting conditions. RFID is less affected by environmental and lighting conditions as transmission of radio waves are not much affected by environmental and lighting conditions. Environmental and lighting conditions also reduce accuracy of identification in barcode.

Data Base Requirement

ALPR technology can work with pre-stored data base and it can also work without data base depending upon application. In case of RFID and Barcode a pre- stored data is compulsory which links with RFID tag/Barcode strip.

Interface Rejection Ability

In AVI system there is possibility of interference due to same vehicle or other vehicles. In ALPR interference can be due to vehicles which are in depth of field of camera. In RFID this can be due to electronic components present in the same vehicle or other nearby vehicles. In barcode interference can be due to other tags present on vehicle.

Accuracy

Accuracy of AVI system is defined by the correctness in the exact identification of vehicle depending upon its data. ALPR system have accuracy of 99 percent, RFID have accuracy of 96 percent and barcode have an accuracy of 90 percent.

Operating and Maintenance cost

Operating and Maintenance cost are expenses incurred in maintenance of ALPR system and to keep it operational. ALPR system has less operation and maintenance cost as compare to other two.

Angle between Sensor and Target

Angle between sensor and license plate or tag also decide accuracy of AVI system. There is a maximum angle under which AVI system gives good result.

Applications

Due to limitation of distance and speed barcode can be used in access control commonly, RFID are used in access control, toll collection. ALPR can detect License plate from a large distance and at a high speed, therefore, ALPR can be employed on highways for speed monitoring and identification also.

Table II Summary of comparison of AVI technologies

Feature	ALPR	Barcode	RFID
Max. speed of Vehicle	100 mph	25 mph	60 mph at 5 meter distance
Maximum Distance	35 meters	1 meter	20 meters
Effect of environmental condition on accuracy	Very high	Moderate	Low
Data Base Requirement	Work with or without data base	Work only with database	Work only with database
Initial Cost	Low	High	High
Interface	moderate	less	High
Accuracy in Percent	Around 99	Around 96	Around 90
Operating and Maintenance cost	Less	high	high
Angle between Sensor and Target	+/- 30 degree	Line of sight	Depends on radiation pattern of antenna.
Applications	On highway speed monitoring, Toll collection, access control	access control	Toll collection, access control

IV. CONCLUSION

In this paper, a comparison between three technologies used in AVI are made by using fix parameters. ALPR can identify vehicle from a large distance and at a high speed with good accuracy, but disadvantages is that it has challenges related to environmental, physical and lighting conditions. RFID overcome environmental challenges but affected by interference and also have limitations of distance. Bar code have limitation of distance, speed and angle which reduces its applications.

V. SCOPE OF FUTUTRE WORK

In this paper we provide the comparison between Automatic License Plate Recognition (ALPR), Radio Frequency Identification (RFID), and Bar code. Comparison of these technologies gives idea to researcher to frame their objectives for a research problem.

VI. ACKNOWLEDGMENT

Authors are thankful to DCRUST for providing necessary facilities and infrastructure to conduct this project. The

authors would also like to thank the anonymous reviewers for their valuable comments.

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