OCR for ITS

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Abstract: - The use of Optical Character Recognition (OCR) to identify vehicles enables better monitoring of various processes, such as local bus, unauthorized vehicles and so on. These systems, known as Intelligent Transport Systems (ITS) allow the company to use the facilities to carry out activities, so that, this study investigated the use of LPR (License Plate Recognition) as a tool for its BRT operation.

Key-Words: - ITS, BRT, Operation, OCR, LPR, Mobility, Transportation

1 Introduction

The opportunities are central to bringing diverse and substantial social and economic benefits to world, however, these decisions affect the design, accessibility and use of these technologies could open wrong ways [1]. This mobility, permit to have information in anywhere, then the ITS systems can be more effective allowing to have real-time information. Also the accessible cost of devices and communications channels permit using in more services in order to inspect the road and supply chain. The operation purpose determine whether a particular technological solution will be used to trace the statistical analysis of evidence of irregularities or if tracking systems & monitoring will be combined with other technologies to support the BRT operations in real time. As for the object, different solutions and technologies are used for tracking and monitoring of vehicles (bus).

Technologies and solutions adopted are also influenced by the type of operation to be monitored:

- Operational purpose:
  - Statistical analysis of routes, location, time and business with real time monitoring (bus);
  - Non-authorized vehicles.
- Object: Vehicles

This paper presents an effective solution for the surveillance of vehicles with LPR (License Plate Recognition) and integration with the ITS, allowing in real-time identify which vehicles are using the BRT Lane. The LPR is one of most important component of ITS.

2 Proposed Solution

A possible solution to problem presented in the anterior topic is the need to use an integrated solution, consisting of vehicle identification, means of communication and integration with ITS. For this purpose, this paper proposes the solution presented in this topic.

LPR Technologies

The LPR (License Plate Recognition) has been implemented through a combination of sensors, cameras, software and other equipment for the recognition of characters on the plates, using OCR (Optical Character Recognition) algorithms on images captured on the road or street, as shown in Figure 1.

Figure 1: License Plate Recognition

LPR system usually requires that each lane (road, avenue or a toll plaza, for example), figure 2, is equipped with a sensor that detects the presence of vehicles and then shoot one infrared camera, as shown at figure 3.

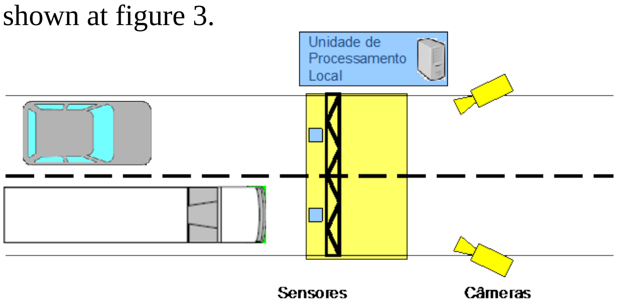


Fig. 2: Overview of LPR

Sensors and cameras of all stripes are usually connected to a local processing unit, whose main component is a computer that captures or select the images generated by cameras, processes the OCR algorithm, stores and / or send plates for later recognized processing.

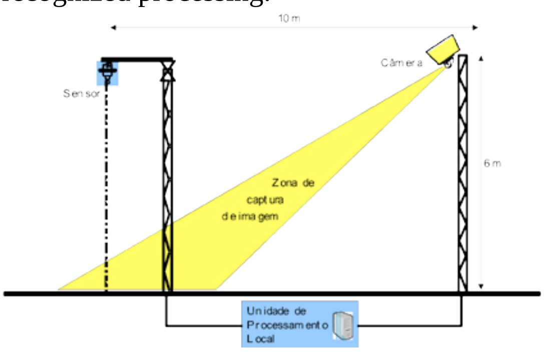


Fig.3: Typical Infrastructure of LPR

Recent advances in performance with reduced costs, OCR algorithms and communication channels (mobile, Internet, etc ..) allow LPR computing evolving in terms of system reliability (accuracy more than 90% of the plates), operating units, maintenance and cost . LPR systems operate with stationary or moving vehicle (depending on the detection equipment) in areas inside or outside, but its performance is influenced by adverse weather conditions such as fog or heavy rain. Still, these systems can be used in various situations, even with vehicles traveling at high speed.

The detection of vehicles performed by sensors embedded in the track, such as inductive, optical detector, among others. More sophisticated systems LPR that rely on sensors, cameras capture multiple frames per second (like a movie) continuously and LPR software automatically selects the most relevant images - that is, vehicle license plates. Although relying on cameras and processing software, or more expensive, this option is the lower cost of installation and operation.

Telecommunications Channels

Appropriate communication channels are required for interconnection between the equipment that makes the identification of vehicles on the track (LPR), checkpoints (mobile or fixed), the ITS. The telecommunications industry offers several technologies for data transmission; with different profiles cost, speed, mobility and availability. This paper studies the transmission via mobile.

In Brazil, there are technologies available for transmission via cellular data, generally (GPRS) from second and third generation (3G), which are available along the main road, see Figure 4. The main advantages of mobile technology are mobility and wide availability of equipment and operators offering these services. Also 3G technologies offer rated speeds up to 7 Mbps (the speed of business systems in real conditions, however, rarely exceed 1Mbps). [14]

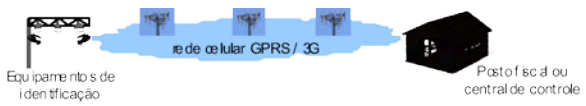


Figure 4: Communications Channel by Mobile

Operational Process using LPR

This scenario assumes that the vehicles are traveling on a track the usual speeds permitted by law. automatic license plate readers (detectors and vehicle cameras) are installed at the bus stop or pass.

When the vehicle passes through the detector, a plate of the picture is taken and a system that uses an image processing algorithm to OCR (Optical Character Recognition) get the license plate in question. You can check that a vehicle has passed or was present at the place where the equipment is installed LPR without the same need to stop or slow it. In the scenario described the following statements can be made, see Figure 5: 1. The sensors detect the passage or stationary vehicles;

2. The cameras capture images of detected vehicles;

3. The local processing unit processes the OCR algorithm on the image to recognize the license plate;

4. The local processing unit sends the card to the central control identified by the communication channel, to find the vehicle information concerned. In the central control is installed ITS;

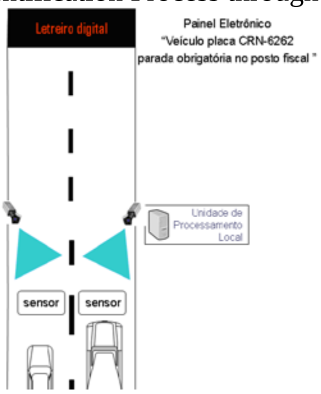
5. Standard Central query control of your identify the authorized bus;

6. Central Control sends back vehicle board that need to be investigated;

7. The local processing unit displays message on the electronic board with the vehicle plate, notifying you. The message is also sent to the tax in the inspection station.

A wide range of devices and systems for vehicle detection may be used in conjunction with LPR, which may range from the popular inductive links via microwave for systems for various purposes (including weight) as described in Table 1. This table It shows a comparison between the detection systems. The most comprehensive detection system is the optical scanner, however, maintenance is complicated because it requires the sensors are always clean.

Figure 5: Identification Process through LPR



More traditional sensors, such as inductive loops, while the popular and lower cost of acquisition, have higher operating cost, lower accuracy and high failure rate, partly explained by the fact that they are invasive or groom the lane.

Alternatively, there LPR systems that do not require sensors for image capture is continuous as a video camera, about 30 frames per second. But this solution requires more sophisticated LPR systems because of the need to select the image that contains vehicle and its license plate, without repetition and in real time, before processing the OCR algorithm.

Table 1: Comparison between main vehicle detection systems

System	Detection Precision	Classification Precision	Installation Facility	Maintenance Requisites	Mounting Lane
Inductive Loop	Good	Good	Poor	Poor	Intrusive
Magnetic Sensor	Good	Poor	Good	Good	Intrusive
Pneumatic Tube	Good	Poor	Excellent	Poor	Intrusive
Optical Scanner	Excellent	Excellent	Excellent	Poor	Non Intrusive
Passive Infrared	Good	Poor	Excellent	Excellent	Non Intrusive
Microwave Radar	Good	Poor	Excellent	Good	Non Intrusive

Requirements for Information System

This item presents the requirement for information system necessary to implement the proposed solution.

LPR Systems Requirements

The LPR system must meet the following requirements:

- It should be possible to identify the characters of license plate for at least 90% of the stored images, regardless of the situation or lighting;
- The rate of false positives (plates whose reading differs from the real characters) must be less than 2% of the plates read by LPR, except cases of fraud. A high rate of false positives implies higher cost of operation of the LPR, depending on required processing;
- The maximum speed for image recording should be greater than 160 km / h;
- Each system must be able to record the images and perform LPR in following condition: a road or street with at least 4 lanes with traffic of 500 vehicles per minute, traveling at 120 km / h.

Telecommunication Requirements

This item describes the requirements for the communication channel between the LPR System and Central Control. The bandwidth needed for transmission of data already processed on the identification of vehicles (LPR). If these situations is considered as a premise that:

- Identification of 100% of the vehicles via

LPR;
- Each identify has 200 bytes;
- In those circumstances are sent 500 x 200 / 60 = 1,667 bytes / s, or 13.3 kbps data useful.

Therefore, in these conditions any link available in the locality can be used, because it is not necessary broadband channels.

4 Conclusion

The proposal permit to have an efficient system that permit to monitor vehicles though license plate recognition system with the following characteristics:

- Capacity to identify vehicles without disrupting the normal flow or even cause a decrease in speed;
- Non-intrusive scenario in perspective of owners or users of vehicles, for example not rely on devices or tags installed in all vehicles, as opposed to RFID;
- Possibility to sending images or other types of high-volume data by the communication channel;
- The use of others technologies, like RFID, are more sophisticated than LPR and it is subject to fraud, as use of adhesives or mud applied on the plate;
- The LPR may have read rates with less success than RFID. This can result in higher operating costs, mainly associated with inspections generated by errors on LPR. Moreover, the performance of LPR can be harmed by adverse climatic conditions, such as storms.

The next step of research is to evaluate the collected information on pilot project and identify the number of false positive results, in order to evaluate if this technologies is appropriated for real time monitoring operation.

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