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Investigating the Misidentification of Automatic Number Plate Recognition Systems

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Abstract

The aim of this study is to analyze the patterns of an automatic number plate recognition system, AVI (Automatic Vehicle Identification) misidentification errors. ITS performance evaluation results show that the performance level of the equipments becomes lower as they are old. Also, AVI is more suitable for day time traffic data collection than night time because of its visibility. Most errors come from similar shaped letter such as consonant, vowel or number, and different plate types such as old fashioned plate, plate of vehicle kept for business and new model (long-width type) plate types. In the results and discussion part, we talk about these types with figures. In conclusion, it is a necessary to maintain the equipments regularly to assure the ITS reliability.

Keywords: Automatic Number Plate Recognition, Misidentification, Intelligent Transportation System

Introduction

The number plate recognition plays an important role in numerous applications such as making ITS link travel information, parking lots, traffic law enforcement, toll collection and other purposes. In KOREA, number plate recognition is called AVI(Automatic Vehicle Identification). AVI performs as a system which collects the plate number and passing time of vehicles that pass through the spot where the equipment installed. From the data collected by AVI, we can estimate the link travel speed and time by comparing the upstream information (plate number and passing time) with the downstream information.

For effective traffic information of ITS (Intelligent Transportation Systems) the ITS equipments in local site need to be evaluated regularly. MLTM (Ministry of Land, Transport and Maritime Affairs) in KOREA reports the evaluation manual and develops PODES (Portable roadway Detector Evaluation System) which is utilized to evaluate the performance of ITS for evaluation of VDS (Vehicle Detection System) and AVI. There are three phages in this process; technical, pre-completion and regular evaluation. The KICT (Korea Institute of Construction Technology) has an authority which can perform ITS equipments evaluation on the National Highways.

According to the manual, performance level of the equipment has to pass 80% of identification rate of success by PE (Percentage Error).

$$PE\ (\%) = E/Y * 100 \quad (1)$$

E = Misreading and Error in analyzing time interval

Y = Number of sample in analyzing time interval

The reasons of misidentification are weather, characteristics of local sites, time, a manufacturing company and angles of view. Also AVI cannot read damaged plate, plate of army and diplomat vehicle, temporary plate, and bicycle plate. In this study, we exclude these error cases to find errors that come from external factors. Therefore, we only analyze the case of normal plate data and suggest the improvement way to go for effective ITS traffic information collecting.

Figure 1 AVI schematic

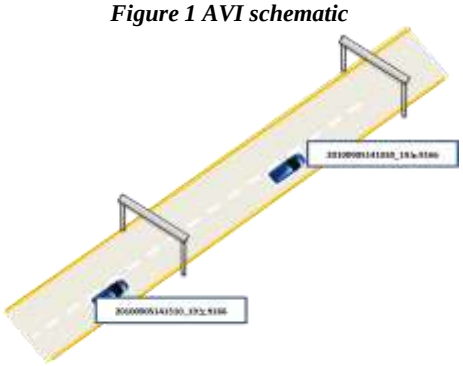

Figure 1 shows that AVI schematic, vehicles which travel in AVI installation area are taken photo images A and B sites. We can estimate travel time and speed by using two spots data. Suppose that a

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vehicle passed B site at 10:00 a.m. and passed A site at 10:10 a.m. and the length between A and B is 1 Km. From the data, we can measure the speed 1Km/10min, 6Km/h. In this method, interval travel speed can be made and provided to users by VMS (Variable Message Signs).

Background

Leonard G.C.Hamey et al.(-) researched automatic number plate recognition for Australian conditions. There are special designs issued for significant events such as Sydney 2000 Olympic Games. Also, vehicle owners may place the plates inside glass covered flames or use plates made of non-standard materials. In these reasons, the research developed the system which incorporates a novel combination of image processing and artificial neural network technologies to successfully locate and read the number of Australian vehicles.

Shyang-Lih Chang et al.(2004) showed that the proposed license plate recognition technique consists of two main modules: a license plate locating module and a license number identification module. This conceptualized in term of neural subjects and that characterized by fuzzy disciplines. In the experiment on identifying license number, the identification rate of success is 95.6%, and that is 97.9% in the experiment on locating license plates. Also LPR algorithm which combine the above two rates and was made in this study shows 93.7% identification rate of success.

Haris Al-Qodri Maarif et al. (2006) had the purpose to build a semi-automatic name plate recognition system by using artificial neural network (ANN) in Jakarta, Indonesia. By using ANN, among the 21 samples, the system performs approximately 71% for the value of successful recognition.

Friedrich, M. et al. (2008) analyzed automatic number plate recognition according to vehicle classification, travel time measurement, traffic surveys, route choice observation and estimation of O-D matrices. In the research, the author mentioned that rate of detection depends on the time like day and night. Also camera angle can be an important element to decide rate of detection. 40° and 45° angles of view are the best position and the rate of detection decreases with lower angles a well as higher angles. Finally, the paper shows that ANPR-systems can be used purpose of transport planning, traffic engineering and traffic operation. The data which was collected by ANPR can inform the drivers and optimize traffic control system.

Materials and methods

To analyze the types of misidentification, we utilized all data which collected in ITS equipments performance evaluation project which was performed in four regions; Seoul, Busan, Iksan and Wonju RCMA (Regional Construction and Management Administration). Table 1 shows the results of evaluation in the project, and the average of results is approximately 90%. It means that most of equipments passed the test with higher scores, but there is a difference between pre-completion and regular evaluation. The results of pre-completion are higher than those of regular evaluation. From this, we can estimate that the performance level of equipments decreases as the equipment becomes old. Also, we recognize that it is necessary to maintain the system and equipment regularly for effective ITS.

Table 1 Result of evaluation in 2009 ITS equipments performance evaluation project

	Pre-completion Evaluation		Regular Evaluation		Average	
	Day	Night	Day	Night	Pre-Completion	Regular
Seoul	94%	92%	89%	91%	93%	90%
Busan	92%	91%	82%	88%	92%	85%
Iksan	90%	87%	86%	80%	89%	83%
Wonju	94%	91%	N/A	N/A	93%	N/A
Average	93%	90%	86%	86%	92%	86%

The identification rate of success of day time is high, in comparison with that of night time. The cause of this is AVI characteristic which has more troubles to identify figure and word clearly in dark condition than bright condition.

Results and discussion

From the results of analysis, we can figure out six types of errors in AVI system. Most of them occur because of misreading of shapes which are similar to each other. In U.S. studies, there are some errors such as D and O, 1 and 7 and A and H. Korean language 'Hangul' has two main elements; consonant and vowel. Two elements make one word, for example ㅇ(consonant) + ㅏ(vowel) = 아 (word). Korean plate has figures and words. The figure means vehicle type such as truck, bus and car, region of registration and identification, and words mean the vehicle use such as rent-a-car, personal and business, region of registration and identification. Also, we can classify vehicles according to plate color, for instance vehicles kept for business have orange color and personal vehicles have green color plate.

Similar shaped letter and number errors

Figure 2 shows that the system misread 모

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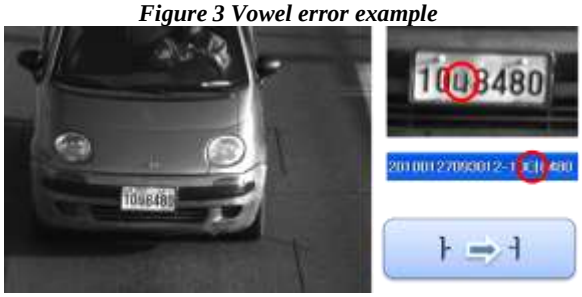
to 오. The error occurred between consonant ㅁ and ㅇ because two consonants have similar shapes.

Figure 2 Consonant error example

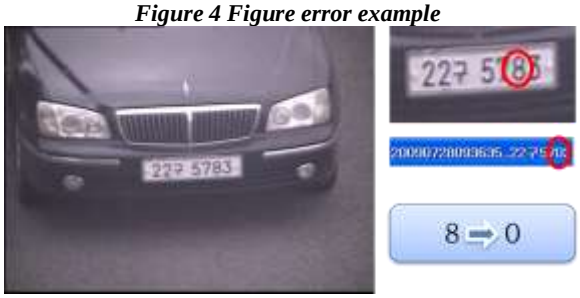
We see from Figure 3 the error type in vowel between ㅏ and ㅓ. Because two vowels have similar shape, the system cannot identify exactly. It occurs only one case in sample of this study.

Figure 3 Vowel error example



The results of studies which were performed in other countries are quite similar to this result in figure error. (Figure 4)

Figure 4 Figure error example



Errors from different plate types

The new model of plate has been used since Jan. 1. 2004. The character of this new plate is that there is no words which present region of registration. Due to this change, AVI system misread regional identification like Figure 5. Most of them are read as 0x such as 서울 1→서울 01, 경기 3→ 경기 03 and 경북 7 → 경북 07.

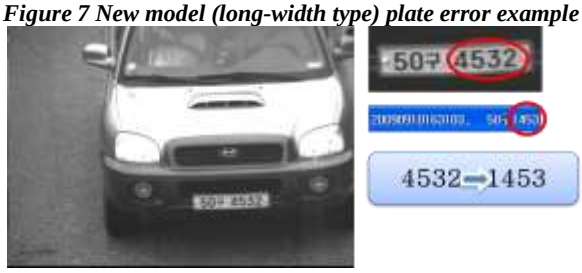
Figure 5 Old fashioned plate error example

The plate of vehicle kept for business should show the region for registration. In this reason, errors occur. From Figure 6, we can see that the 광주(Gwangju) was misread as the 서울(Seoul) although two words are not similar each other.

Figure 6 Plate of vehicle kept for business error example

New model (long-width type) plate can be a problem in reading by AVI. Figure 7 shows that 4532 was misidentified as 1453. Number 1 is added in front of the figures of plate in most cases, and last digit of plate could not be read by AVI.

Figure 7 New model (long-width type) plate error example



Conclusion

So far, we have seen results of evaluation and error types of AVI system in Korea. The identification rates of success of pre-completion evaluation and day time are higher than those of regular evaluation and night time. In here, I would like to state the following two reasons. First, the performance level of equipment decrease as the equipment becomes old. Second, the AVI in day time can identify figure and word of plate more exactly

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than night time. Also, we can classify the misidentification types as two; similar shaped letter or number and different types of number plate.

To get more reliable traffic information, it is necessary to maintain ITS equipments steadily. It is also important to provide more accurate information for users who need and use traffic information for their travel.

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