Study of techniques for detecting near-miss images by utilizing AI image recognition technologies

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1. Introduction

When implementing traffic safety measures in areas where traffic accidents occur frequently, etc., in order to select effective measures, it is necessary to properly grasp the process of occurrence of an accident and the factors of the accident that are inferred from such process. If image data that have been obtained on roadside cameras can be utilized, as compared with the accident statistics data and accident occurrence status drawings, etc. that have conventionally been used, the situation of surrounding areas and behavior leading to the occurrence of the accident can directly be grasped, and besides samples of latent hazards that do not lead to an accident (near-miss) can also be obtained, and it is considered that the accuracy of inference of the factors of the accident will increase. On the other hand, there is a problem that time and efforts are required to check the images visually and to extract the near-miss only. If the extracted images are only those of the near-miss, the above problem can be solved, and an increase in the efficiency of accident factory analysis can be achieved. Therefore, the NILIM is conducting a study of techniques for mechanically detecting near-miss images, and this paper presents the results of such study.

2. Detection of near-miss images by utilizing AI image recognition technologies

A near-miss has been defined to be a "phenomenon in which two parties come close to each other," and from the images of roadside cameras that were installed in two intersections on national highways, 60 events each of "image data including those of a near-miss" and "image data not including those of a near-miss" were extracted in advance by visual checks. By applying the AI image recognition technology (YOLO) to the continuous images of these phenomena, objects such as vehicles and bicycles, pedestrians, etc. in the images were detected (the rectangular frames surrounding the vehicles in the figure). Then, the near-miss was detected by means of the method shown in Table 1, by using as indexes the "distance between the parties" and "speed change (with or without deceleration)" based on the position of the detected object.
In order to verify the accuracy of detection, the accuracy verification indexes shown in Table 2 were calculated, assuming the results of distinction by visual checks were accurate. Consequently, the accuracy rate was about 70 to 80%, thus achieving a certain level of accuracy, but the rate of precision was around 30% in both of the intersections, and the highest rate of reproduction was around 45% at intersection A. The "distance" was used as the detection index as the major factor of erroneous detection or overlooking, but the directions of travel of the parties are not considered by the index, and phenomena with no possibility of crossing could have been detected.

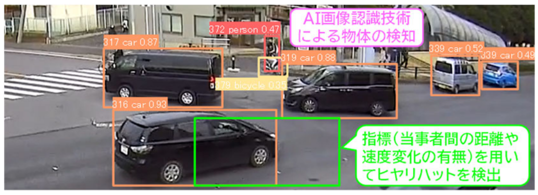

Figure: Image of near-miss detection

Table 1: Near-miss detection method

当事者	ヒヤリハット検出指標・閾値
歩行者・自転車対自動車	当事者間の距離が6m以下（①）
自動車対自動車	①かつ減速があり、直前1秒間の移動距離が4m以下

Table 2: Results of verification of the near-miss detection accuracy

交差点	精度検証指標			
	正解率	適合率	再現率	F値
交差点Ａ	67.0%	30.6%	45.6%	36.7%
交差点Ｂ	80.3%	35.5%	29.6%	32.3%

正解率：指標による判定結果のうち、正しかったものの割合
適合率：指標によってヒヤリハットと判定したケースのうち、本当にヒヤリハットである割合（誤検出の少なさ）
再現率：全てのヒヤリハットケースのうち、指標によってヒヤリハットと判定できた割合（見逃しの少なさ）
F値：適合率と再現率の調和平均（バランス）

3. Conclusion

We would like to review the detection indexes and threshold so that no specific near-miss phenomena will be overlooked (for example, only the near-miss involving bicycles will be overlooked, or the like), while aiming at an increase in the rate of precision so that extraction of non-near-miss images will be suppressed, in order to increase the efficiency of work at the site, and to enable the technologies to be applied at the site.