専門家の選択的注視機能を利用した高効率機械学習による自動運転車の実現

平成28年いわてものづくり・ソフトウェア融合テクノロジーセンター研究課題　採択課題

課題名：**専門家の選択的注視機能を利用した高効率機械学習による自動運転車の実現**
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技術キーワード：自動運転・機械学習・分類・専門家の選択的注視機能

▼研究の概要

Driverless car or self-driving car projects are undertaken not only by many car companies, but also tech companies like Google, uber, Softbank. The general approach is to collect video and audio data from all directions, in addition to sensor
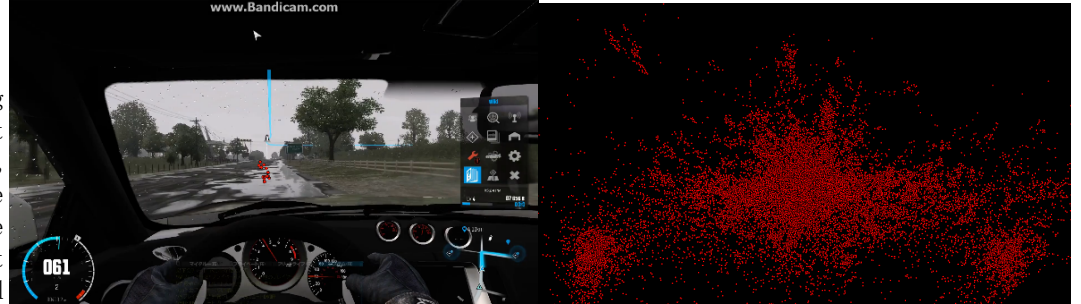

Fig. 1 Outline of the proposed system

like LIDAR, GPS, odometry data. In addition to the cost of these sensors, processing of the data needs enormous amount of computations, warranting high end computational power on board.and   as well as many car companies. Humans perform the same task, with two eyes and ears. Through experience, human drivers learn to attend to important aspects. Learning this selective attention is the key to reducing the amount of data to analyze for taking driving decisions efficiently.

▼研究の内容

In this research, we did our experiments in two steps, (1) investigate whether the visual attention pattern between expert driver and novice one are different or not, (2) to identify the visual cues where an expert driver focuses. In Fig. 1, while driving on a road as shown on the left, where there is no other traffic or pedestrians, visual attention is straight or on side mirrors. There is little difference between an expert driver and a novice one. When the driving is tricky, like narrow mountain road or on a crowded road inside city, the difference in visual attention pattern are very different. In addition, we collected bio-signals like electroencepahlogram, electrocardiogram, pulse, and muscle contraction data from the driver's body. This data is used to find out the time lag between an alarming event on the road and breaking or steering the car, with minute details to compare between an expert driver and a novice one.
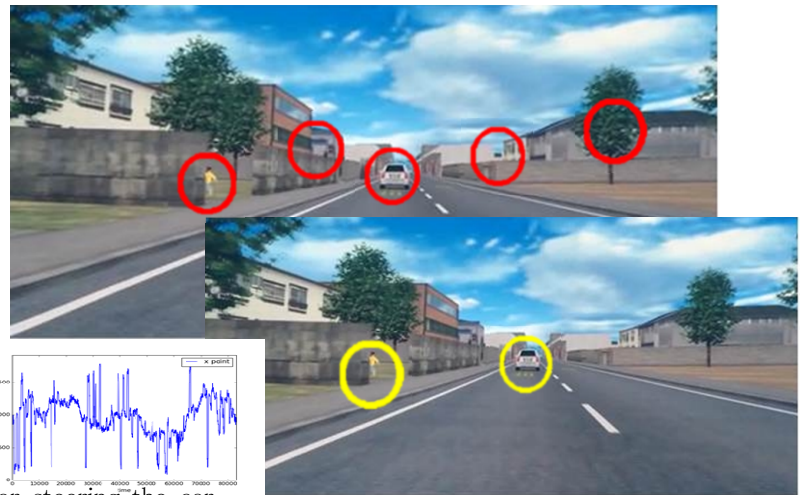

Fig. 2 視覚情報

▼研究の成果

We collected data from 10 subjects, 4 of whom are regular drivers and rest 6 do not drive. The time-series data of eye-fixations (point of attention) are collected. The distance between two time series is calculated using dynamic time warping (DTW), and signals are clustered. When the data is collected in a scenario like in Fig. 1, no clear cluster was observed. When the data is taken while driving narrow mountain roads, two clear clusters were formed, reflecting that the visual attention for two groups are different. In addition, as shown in Fig. 2, as shown in the upper part, a novice driver watches many objects (red circles), whereas an expert driver's attention is attracted by the car in the front and a pedestrian about to cross the road.
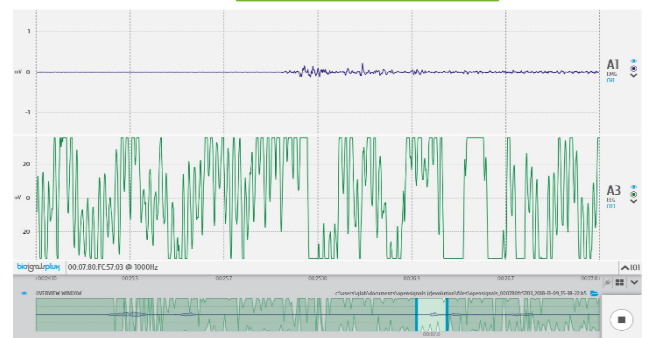

Fig. 3 EEG と ECG デタの相関

▼おわりに

From the above results, we conclude that novice drivers' attention is attracted at different objects of little importance to safe driving. On the other hand, expert drivers' visual attention is towards object which are important, like a pedestrian who may try to cross the road, or the car in front which may suddenly break. The list of such objects were divided into two categories, (1) all moving objects, (2) a few stationary objects like signal. For driverless car, it is important to detect such objects only, and take necessary decision and corresponding action. In addition, as shown in Fig. 3, we collected bio-signals from both young drivers and old drivers. The recognition time are different, with old drivers responding slowly. When an old man switch to diverless mode, the car should behave according to the original user. This needs training from previous driving data.