Multi-View Point Drowsiness and Fatigue Detection

Anne Veenendaal, Elliot Daly, Eddie Jones, Zhao Gang, Sumalini Vartak, Rahul S Patwardhan

***Abstract*— Detecting driver drowsiness has many applications such as car safety, vehicle operator safety and accident preventive systems. This paper examines use of RGB-D data for driver drowsiness detection. The data was captured using front and side view camera and sensor. The facial features, hand movement and body pose was used to classify drowsiness and boredom using support vector machines (SVM). Only the upper body parts (above waist) were tracked. The evaluation of actions was done in dim as well as natural lighting. The recognition accuracy was better when data from both views was combined. The accuracy was lower in dim lighting conditions.**

***Keywords*— Drowsiness, Fatigue, Human Activity Recognition, Emotion Recognition, Safety System, RGB-D, SVM**

I. Introduction

Several occupations require that the operator of the vehicles is alert and completely fit in terms of physical and mental capability. Sometimes work related fatigue causes drowsiness and boredom adversely affecting the ability of the operators of the vehicle to perform their duty. After long driving hours and continuously sitting behind the wheels, stress, tiredness and sleepiness takes over. Such symptoms are extremely dangerous for the safety of the vehicle operator, people around the vehicles, vehicles in the surrounding and any passengers. This paper focusses on detecting fatigue, drowsiness, boredom among vehicle drivers. Specifically, the research focusses on capturing the driver behavior from the dashboard and side view using two video cameras and an infrared RGB-D sensor. Study [1] presented the current developments among various automobile research departments to develop car safety features. Research [2] has focused on the driver fatigue and the causes behind road accident. The survey compares various techniques to recognize and prevent fatigue. Drowsiness among vehicle operators has been examined in research [3] on automatic recognition systems. Research by Frank [4] focused on recognition of driver tiredness and drowsiness. Walger et. Al [5] have examined use of head pose and its contribution in effective driver emotions, physical and mental states. Several studies have been done on human activity recognition [6] to [18]. Researchers [19] to [31] have used various RGB-D and sensor based techniques for automatic multimodal emotion and intensity recognition.

II. Method

A total of eight participants enacted drowsiness and fatigue in a controlled environment. Two cameras and a sensor was place to capture side-view as well as frontal view of the actor. The actors sat against a desk under controlled lighting and only the upper body parts were tracked. The facial expressions, hand and body movement were tracked. The feature vector was used to train an SVM classifier. The data was divided as 70% for training and 30% for testing. We used 3-fold cross validation to train the classifier. Weka data mining tool was used for the training and classification. Once the classifiers were trained, the recognition accuracy was evaluated using following five scenarios:

1) Front-only view data (controlled lighting)
2) Side-only view data (controlled lighting)
3) Front-side view data combined (controlled lighting)
4) Front-side view data combined (dim lighting)
5) Front-side view data combined (actual field test under natural conditions)

III. RESULT

The recognition accuracy results between front and side combined, front-view only and side-view only were compared. The results are as below:

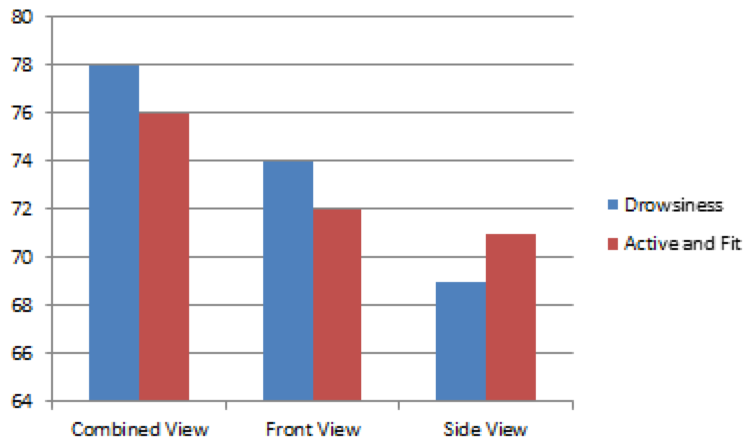

Fig. 1 Accuracy comparison between front, side and combined view

The accuracy results of combined data (78%) from front and side view cameras was better compared to front only (74%) or side only (69%) view data alone. Additionally the experiment was performed in dim lighting and actual field test on the road. The results are as below:

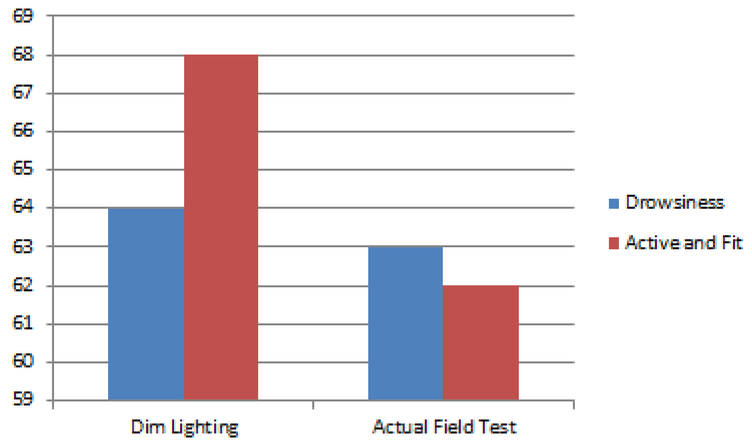

Fig. 2. Comparison of recognition accuracy between dim and field test.

The results indicated a drop in recognition accuracy when compared to controlled conditions. The tests under dim lighting produced 64% and tests under actual field (natural lighting) showed 63% recognition accuracy.

IV. CONCLUSIONS

The frontal and side view data combined resulted in better recognition accuracy for drowsiness and fatigue when compared to unimodal front only or side only recognition. The recognition accuracy decreased when the conditions of lighting were poor (dim) or in natural lighting during actual field test. This was because we did not consider the noise, bumps and jitter that occur during actual driving, during the training and enactment of drowsiness under the controlled indoor environment. As a future scope, a more realistic simulator needs to be used to obtain data and train the classifiers.

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