Wearable Drowsiness Detection on-the-go

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Problem Statement

Human – Machine Interaction for the operation of an automobile is commonplace across the modern industrial world as an occupation and survival skill. The operator (driver) falling asleep during the operation of an automobile is a leading cause of road-accidents and casualty (2nd highest overall, after suicide), and naturally is a major concern to the automobile industry and related policy making [1]. Therefore, detecting when the driver has fallen asleep during the operation of an automobile or predicting the event in advance is of great interest as it may help reduce the road accidents and bring operational safety by an intelligent automobile that can detect when the driver is drowsy and is at the risk of falling asleep [2].

State-of-the-Art

Currently, consumer solutions using video data of the driver from inside the automobile can practically detect when the driver has fallen asleep and sound an alarm in an attempt to wake up the person. However, there are a number of limitations that reduces its effectiveness such as the lack of appropriate lighting within the automobile, especially during nights beside the dependency on clear visibility of the driver's eye [3]. The video data captures behavioral manifestations of the drowsiness while neural signals such as EEG measures the underlying causal phenomenon in the human brain. As the physiological circumstances of the human body is the result of an underlying neurological phenomenon and bio-markers signifying these neurophysiological events could also be used as a signal to observe the driver's drowsiness [4].

Electroencephalogram or EEG, a high temporal resolution imaging technique, is a useful technology for analyzing neurocognitive processes with relatively low costs. The measured signal is a summation of an ensemble of cortical neurons. With recent advances in cognitive neuroscience, the current technologies can exploit natural brain responses triggered by an ever-changing environment in synchronization with the subject's action for human behavioral analysis [5]. Further, the direct observation of the causal neurocognitive phenomenon leading to drowsy driving events is advantageous since it can provide signals that could predict an upcoming sleep event and facilitate preventive measures before the event occurs. Such additional characteristics may provide a drowsy driving detection system with robust detection abilities and might enable us to predict sleep events in advance so as to take preventive action [6].

Product Development Proposal

The present proposal is to combine the existing image – based drowsiness detection technologies [7] and state-of-the-art EEG based analysis for developing a commercial drowsiness detection system [8]. The integration of existing commercially viable image-based detection and EEG – based may additionally increase the robustness by using an additional modality for monitoring and effectiveness by providing predictive capabilities to the detection system [9].

Prototype

We designed an android based software application (CameraEEG) that can synchronously collect EEG signals and video data captured through the camera of an android based smartphone[10].

Currently the CameraEEG app is designed to obtain sychronized EEG signals and collect video data of external environment through the back camera of the same android device. It also has a marker button to record events of interest. The app is designed to be used with a portable amplifier known as SMARTING [11]. The software has been validated through recording of resting state eyes closed and eyes open data. The presence of alpha waves during eyes closed condition confirms the app's reliability.

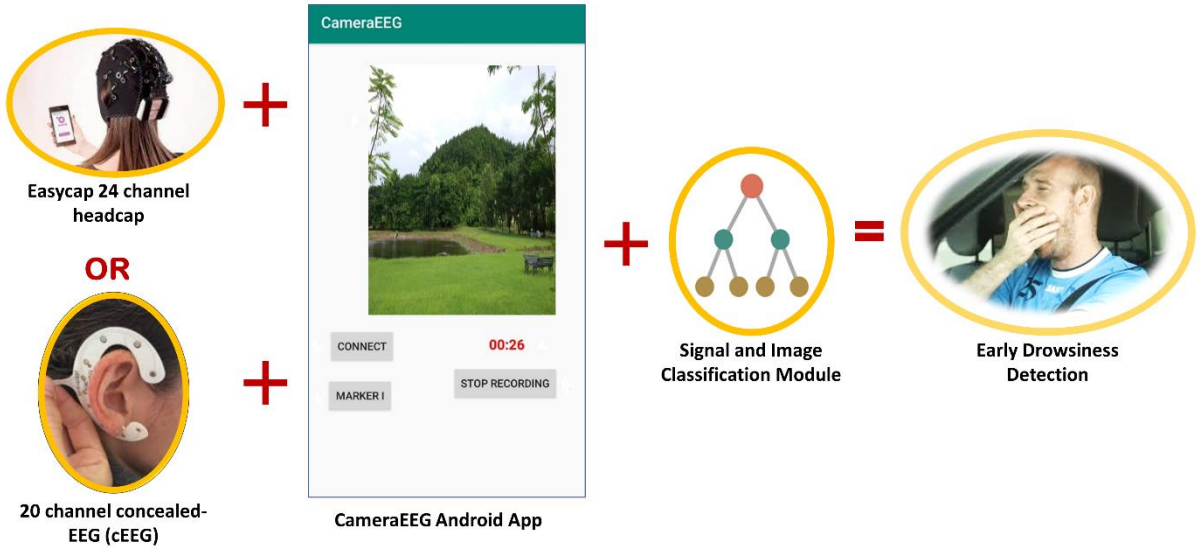

Figure 1: Graphical abstract for the prototype software designed for drowsiness detection on the go.

Audience

The commercial domain of drowsiness detection have a consumer base catered for by companies pursuing image-based analyzing methods. Our extension of the existing products by combining neural imaging technologies will be aligned with the emerging multimodal biosensing technologies. Other than the business to business (B2B) strategy, there could be an end-user consumer base in the future considering how widely the automobile is used in the modern world as it being a leading non-disease cause of human mortality

Future Development Plans

We seek initial monetary investments and interns for developing the proposed products under our start-up company. The CameraEEG app potentially can serve as the basal framework on which an on-board device on an automobile, that can observe, detect, and alert the driver about drowsy driving and prevent fatal accidents caused by the driver falling asleep during the operation of an automobile.

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