COgnitive assessment of Remote Drivers (CORD)

Publik rapport

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Projekt inom Trafiksäkerhet och automatiserade fordon

FFI Fordonsstrategisk Forskning och Innovation

VINNOVA Energimyndigheten TRAFIKVERKET
PKD SCANIA VOLVO

Innehållsförteckning

1 Sammanfattning

Vid övergången till självkörande trafik så finns det fortfarande ett behov av att hantera fordonsflottor och dess uppgifter samt lösa problem för självkörande fordon, t.ex. beslutsproblem för fordonet p.g.a förändrad omgivning som kräver stöd från en fjärroperatör. Detta kan t.ex. vara att ge ett godkännande att fortsätta, ge en ny säker bana att följa eller även ta över kontrollen för fjärrstyrning.

För att stödja introduktionen av självkörande trafik har konceptet med fjärroperatörer introducerats där människan inte längre sitter i fordonen utan i ett kontrollrum eller i en station utformad för fjärrstyrning av fordonen. Detta betyder att föraren hamnar i en ny miljö för att manövrera fordonen, där all realtidsinformation och fysisk återkoppling som föraren känner kommer att bli virtuella vilket kan ha en påverkan på förarens kognitiva förmåga. Men monitorering av förarens tillstånd och kognitiva förmåga för att framföra fordonet på ett säkertsätt är en stor utmaning och kan hindra tillämpningen av fjärrstyrningskoncept för vägfordon.
I detta projekt är målet att studera möjligheten att använda en ny valideringsteknik baserat på neurovetenskap och AI för att utvärdera kognitiva förmågan av fjärrförare, vilket kan ge direkt förståelse för viktiga områden som kognitiv belastning, distraktion, koncentration, vakenhet eller åksjuka.

2 Executive summary in English

To facilitate the transition to fully autonomous mobility, the concept of remote driven vehicles has been introduced where the human intervention is not needed from inside the vehicle; instead, the human controller is remote in a traffic control tower or a remote driving station, i.e. moving the driver/operator from an in-car on-road situation to a remote location and totally new operating environment. Even in this situation there is a need to manage fleets and their operation as well as solve problems that the autonomous vehicle might have, e.g. decision-making challenges due to change of environment that needs remote assistance. This could either be given the vehicle permission to proceed, give it a new safe path, or even taking over control, and remotely drive the vehicle.

In addition, all the real-time and physical exposures to drivers will be virtual which has an influence on the operator's cognitive performance. However, monitoring the capability and cognitive performance of such operators to perform the driving tasks safely is a big challenge which hindered the use of remote control concepts for road applications until today.
In this project, the aim is to study the feasibility of employing a new neuroscience-AI based technology to evaluate the cognitive performance of remote drivers, which can provide deeper insights on related cognitive features of a human operator such as cognitive load, distraction, concentration, alertness, or motion sickness.

3 Bakgrund

While moving towards an automated road transport system, there is still a need to manage fleets and its operation as well as solve problems that the autonomous vehicle might have, e.g. decision problems due to changing environment needing remote assistance. This could either be giving the vehicle permission to proceed, planning a new safe path or even taking over control and remotely drive the vehicle.

Remote control of vehicles has been out there for quite a while in various domains such as unmanned aerial vehicles, unmanned submarines, military vehicles, etc. Within the automotive sector the application is however relatively new. Employing remote control of road vehicles can be an important enabler to facilitate a transition to autonomous mobility where remote control acts as a back-up for the automated driving function. So remote driving can be used during development and test of automated driving and as a separate application where automation is difficult or too expensive.

In this context as a necessary transition to fully autonomous mobility, the concept of semi-autonomous and tele-operated or remote operated vehicles has been introduced. In this concept, the human intervention is not needed from inside the vehicle; instead, the physical location of the human controller is remote in a traffic control tower or a remote driving station. Therefore, the location of driver or operator is moving from an in-car on-road situation to a remote location and totally new operating environment. It means that, all the real-time and physical exposures to drivers will be virtual which have an influence on operator's alertness level, responsiveness and in general cognitive performance.

4 Syfte, forskningsfrågor och metod

The main intention of this pre-study is to tackle these challenges from a totally new approach, to secure further safety measures, as a crucial element in moving toward autonomous mobility. Available approaches in monitoring the driver are known as Driver Monitoring Systems (DMS) that use different sensors to keep track of drivers. Also, the recent introduction of techniques such as eye-tracking, heart rate measurement, and facial expression recognition has further facilitated the driver monitoring needs. However, none of the current methods are yet providing the psychological metrics of the drivers which can provide direct insight on key features such as cognitive load, distraction, concentration, relaxation, excitement, or motion sickness.

5 Mål

In this project, the aim is to study the feasibility of employing the Brain-Computer Interface technology using the foundation of neuroscience and the analyzing power of artificial intelligence to evaluate the cognitive performance of remote drivers. The intention is to explore this new approach and realize the possibility of providing deeper insights on related cognitive features of a human operator, i.e. cognitive load, distraction, concentration, alertness, or motion sickness.

6 Resultat och måluppfyllelse

The result of this pre-study can contribute to increase the safety of autonomous mobility. A new approach was investigated to better understand why incidents and accidents occur due to human errors and how best to design new safety systems and HMI interfaces to mitigate safety-critical situations raised by human error. The obtained knowledge from this pre-study will establish a basis to see how a Neuro-AI based approach can be used in the context of semi-autonomous and remote driving and contribute to increased road safety.

7 Spridning och publicering

7.1 Kunskaps- och resultatspridning

Hur har/planeras projektresultatet att användas och spridas?	Markera med X	Kommentar
Öka kunskapen inom området	X	
Föras vidare till andra avancerade tekniska utvecklingsprojekt	X	The results of this project will further be used in a full scale study called REDO2.
Föras vidare till produktutvecklingsprojekt	X	The results will contribute to the product development process of involved industrial partners.
Introduceras på marknaden	-	The results of this project will help the industrial partners of this project to introduce their product in the market in a near future.
Användas i utredningar/regelverk/ tillståndsärenden/ politiska beslut	-	The knowledge obtained in this project will be used in another project which will consider the regulatory aspects.

7.2 Publikationer

The results of this pre/study will be used in future scientific studies and publications are planned accordingly.

8 Slutsatser och fortsatt forskning

This pre-study has confirmed the benefits of involving a Neuro-AI based approach in evaluating and understanding operator's cognitive performance during different operational environments. This will help to extract deeper insights which are useful to develop the concept of remote driving.
This approach will introduce a break-through method for monitoring the drive/operator behavior and can put the Swedish vehicle industry in competitive position in terms of Driver Monitoring System and remote driving. However, further development and research is required to make the technology fully functional in proposed operational environment such as collecting relevant data to justify the AI algorithms as well as system architecture.

9 Deltagande parter och kontaktpersoner

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