Author: Wei-Yu Chen | Supervisor: Nicolas Hine

Improving Road Safety for Older Adult Drivers: Assessing the Efficacy of Heads-Up Display Technology

Abstract

Older adult drivers face challenges due to changing reaction times, senses, and adapting to new technology. Psychology emphasizes driving independence, while behavioural factors hinder tech adoption. HUD technology aids focus but may affect older adults' reactions and alerts comprehension. **Research aims to optimise HUD information for older drivers**.

Introduction & Background

New HUD technology

Full-width windscreen technology is available soon in the market.

Critical information

Speed limit sign, speedometers, urgent event warning, 3D navigation could put on HUD.

Senses ability

Peripheral vision, depth perception, hearing to proper use mirrors, touching feedback are essential.

Attention and distraction

Stress decide the focus range of attention.
Brain can process one action one time. Two actions in a row will cause delayed(PRP).
PRP effect on Front cars' brake lights

[Summary of the remain questions]

1 Awareness of 3D navigation

2 Legibility of speedometers and speed limit sign

3 Distraction and recovery behaviours of alerts

4 HUD vs Audio collision warning alerts

5 Safety of superimposed content

Study methodology

Literature reviews

Apart from academic research. Keep update with the new technology announced during the whole study.

Pilot Study

2 phases of pilot study. first phase with 3 tests, find out that the EMG and ACC biosensors should be replaced. The prototypes also iterate base on the feedback. The second phase improved the process smoothly and reduced the risk of losing data.

Wizard of OZ Experiment

3 routes with 3 different prototypes. Each route took 7-10 minutes. Driving in a diverse environment map through intersection, traffic lights, merging traffic and turns.

Post-study Interview

5-10 minutes follow-up interview based on the observation during their driving test and their awareness and feeling of the features in different tests.

Experiment measurement plan based on pilot study :

Eye tracking Glasses | ECG Biosensor | Facial Video Record | Pedals Visualiser | Simulator Record

4 younger (18-35)

3 older(55-70) drivers participated.

1 younger and 1 older couldn't finished due to the **dizziness**.

Prototype Design

Route 1 | Bigger size and on left side

Only 3D navigation on roads

Non-animation text base + Sound collision warning

Route 2 | Separated, less overlay front road

turn RIGHT in 400 m
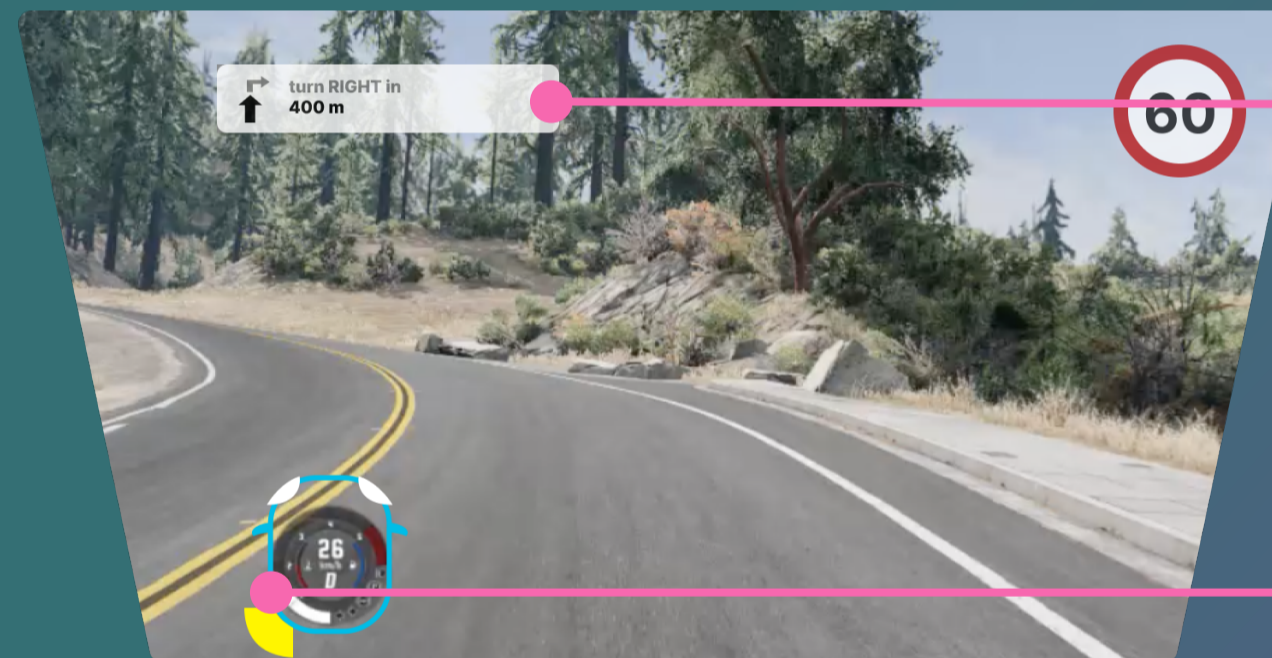
3D +2D fixed and text navigation

Warning animation from the direction of dangers

Route 3 | Centralise information at front sight

Track predict warning flash

Number-only speedometer

Test & Results

Older drivers   Younger drivers

Overall

eye fixation Heat map

R1

R2

R3

Elderly's eyes move around for 3D navigation not focus on traffic lights

Older drivers depend on reading the dial of the speedometers

Younger drivers reading the number speedometer

○ In all three routes, the collision warnings on the display are ignored

Traffic lights

Failure rates by participants

R1	22%	20%	0%	16%	0%
R2	33%	40%	0%	0%	0%
R3	0%	33%	0%	0%	0%

Scanpaths

- R1 & 2 have triangle pattern for both age groups
- R2's speed limit sign cover the traffic lights sometimes
- R3 have linear pattern for both, but youngers watched rear mirror

3D Navigation

Failure rates by participants

R1	10%	28%	0%	0%	30%
R2	0%	0%	0%	0%	0%
R3	0%	17%	0%	0%	0%

Scanpaths

- Olders' scanpaths at R1 was spread around
- R2's paths are similar, like nerve cells.
- R3, half older and younger have Z paths others are very different
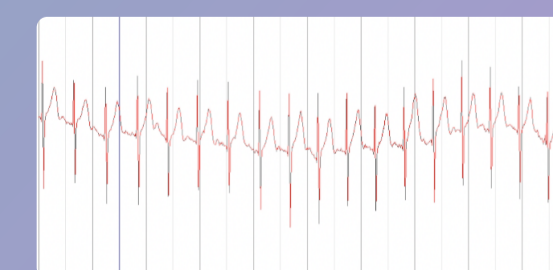
Collision warning

Scanpaths

All focus on the real environment and not watching the alert. Or look at it after the issue is handleable.

Reaction Time

All react to the front car before the alerts show

Heart rates

No different for olders in different routes or collision (**72-78**). Younger raise at first routes to **108** and it gradually drop to **72-90**.

Interviews

Spend time to understand the visual alerts. Didn't notice sound or try to ignore it.

Conclusion & Future work

Drivers, especially older drivers, depend more on looking at their surroundings to check for danger. Collision warning highlights follow the objects may be helpful for this age group that they still could see the natural environment so that they could trust the alerts.

Navigation, traffic lights hints, dial speedometer, and speed limit signs could enhance the safety by fixing in drivers' front sight on HUD without covering the traffic signs. Dial of Speedometers and text instruction need be shown for older.

Future works should focus on five points:

HDD comparison and object tracking warnings

Bigger amount and wider driving experience of participants

Longer practice time for simulator's sensitivity

Heavier traffic and moving pedestrians

More understanding about the cause of the dizziness of simulator