F216304
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MAJOR PROJECT PRESENTATION

AR-HUD SYSTEM DESIGNED TO HELP FOREIGN DRIVERS ADAPT TO DRIVING IN THE UK

Background

Introduction

The continued growth of the foreign population in the UK has resulted in a large influx of foreign drivers onto UK roads. One report (Massey, 2015) showed that the number of accidents involving non-UK HGVs was unusually high, increasing from 929 in 2012 to 1,061 in 2014, an increase of 14.3%, a 14% surge in just two years.

Research questions

1. Are foreign drivers confused when they start to use the right-hand cab/cockpit layout?

2. How difficult is it for foreign drivers to adapt to UK traffic signs and road alerts?

3. Can AR technology (e.g., via HUD) help foreign drivers adapt to driving on the left-hand side?

The significance of this study is also to explore how AR HUDs can be designed so that users can receive and respond to information more efficiently and with less psychological burden when using them.

Overview

Prototype Development

Empathize

- Online questionnaire

Define

- Data analysis & summary

Ideate

- Focus group

Prototype

- Video prototype
- Pilot study

Test

- Control study
- Data analysis

Online questionnaire

Background

In order to understand the main concerns and pain points of foreign drivers driving in the UK, the first step of this study was to conduct background research and problem identification through an online questionnaire.

Sample characteristics

Drivers from left-hand drive countries

Sample size

Estimated: 50
Collected: 32

Demographic background

Age

18-24: 59.4%
25-34: 40.6%

Nationality

Chinese

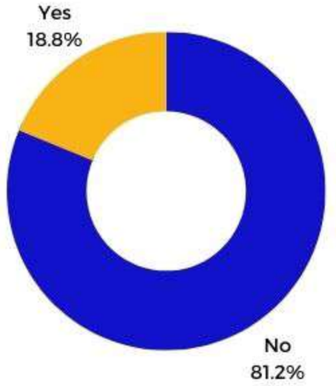
Gender

50%

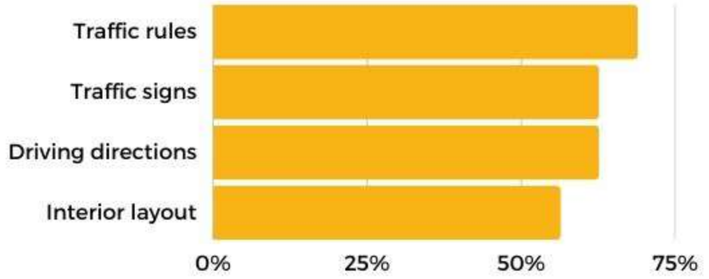
46.9%

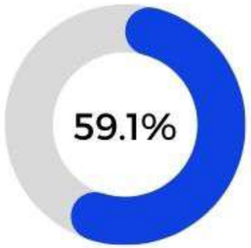
Results

Have you driven in the UK

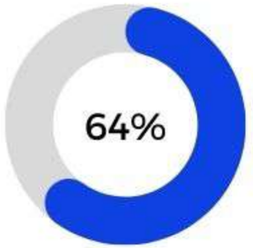


The most worrying factor about driving in the UK

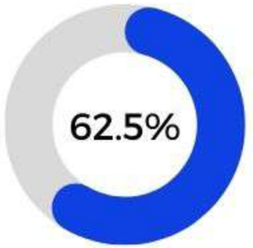




of the respondents studied the local regulations, road conditions and other information in the UK



of respondents use GPS or navigation software while driving



were not confident in driving in the UK

Focus group

Background

After identifying the problem, the next step in this study was to conduct a focus group (Hanington and Martin, 2019) to inspire prototyping, taking key information to create models that visually communicate the core idea and interaction. This allowed for rapid experimentation and iteration based on user testing results.

Setting

01 Warm-up interview

Discuss why they don't want to drive in the UK

02 Identify traffic signs

Examine participants' awareness of traffic signs

03 Rapid Response Game

Examining participants' short-term instinctive responses during left-right reversals

04 Pick up session

Participants make a selection of AR HUD features

Results

01

- Different driving habits
- Complex road conditions
- Ignorance of traffic rules

02 Poor at identifying most traffic signs with only graphics

Good at identifying traffic signs with words or numbers

03 3 participants made the wrong moves.

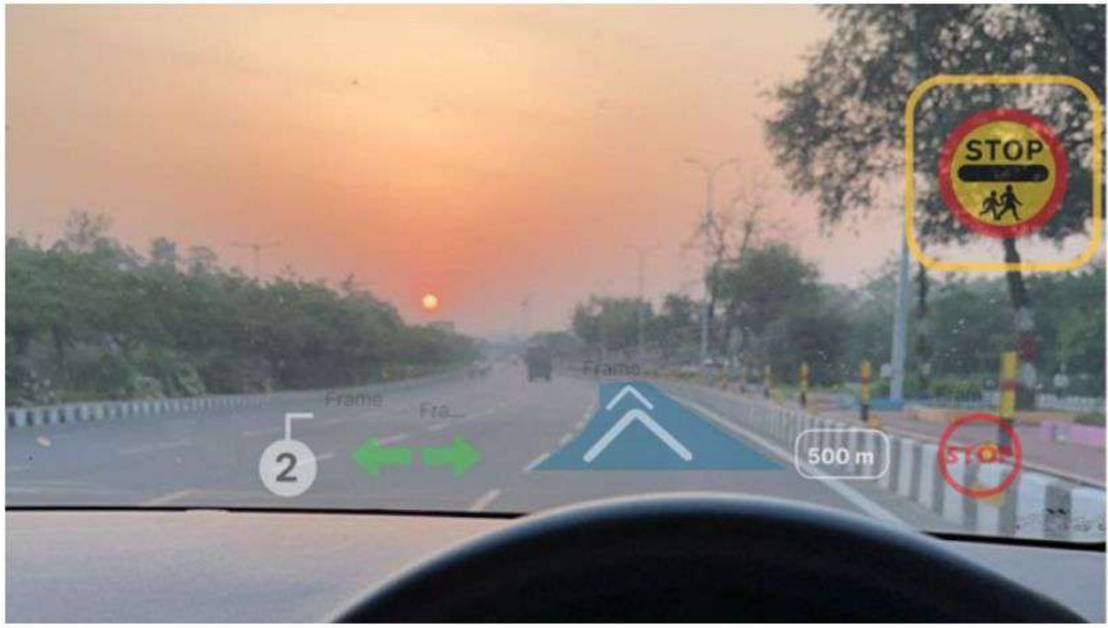
04

1st 2nd 3rd 4th 5th

Prototype

Info

When designing the prototype, to facilitate subsequent user testing and with time efficiency in mind, this study culminated in creating a medium-fidelity prototype presented in the form of an AR HUD driving video simulated on a monitor. It was also improved and iterated through a pilot study.



Video Prototype

Prototype

According to the theory (Dünser et al., 2007), the content displayed on the AR HUD should correspond to the elements in the real world, so in the design, the icons displayed on the AR HUD are chosen to have strong suggestive icons such as route icons with arrows, gear markers, etc. for the visual display of the corresponding information, and according to the theory from (Debernard et al., 2016), the location layout of these elements on the HUD corresponds roughly to their corresponding functions in the cab, which has played a role of having cueing the cab layout and road information.

Pilot study

Prototype

Feedback

- The steering wheel obscures the display and road when simulating AR HUD using an iPad
- The position of AR HUD elements in the video is too close to the corner to be easily seen.
- The position of the elements in the AR HUD content needs to correspond to reality.

Study design

- 10 minutes driving simulation with/without AR HUD
- 4 tasks, 22 actions: switching gears, controlling turn signals and the steering wheel, and depressing the clutch, brake and accelerator.
- NASA TLX
- Think aloud

Data collection & analysis

Quantitative data

Error rate
Average response time
Raw TLX

Qualitative data

Oral feedback

Statistical tests

Descriptive Statistical
Boxplot
Shapiro-Willk test
T-test(dependent)
Wilcoxon signed rank test

Results

Qualitative feedback

Positive

- Helps with driving in unfamiliar environments and can assist in learning and adapting to new driving habits
- Can provide operating instructions in advance
- Reduces the effort of acquiring information and reduces cognitive load.

Negative

- AR HUD display content obscures the view
- Icon locations are not easy to see
- System reliability and dependency concerns
- May not be very helpful for those familiar with driving

Test

Summary

Conclusion

Foreign drivers can be confused when starting out with a right-hand cab/cockpit layout and have difficulty adapting to UK traffic signs and road alerts, which are characterised by higher error rates, longer reaction times and an increased mental load when driving. However, with the assistance of the AR HUD, cognitive load can be effectively reduced, reducing the number of driving errors and making it easier for drivers to adapt to driving on UK roads.