Technologies for Safe & Efficient Transportation

THE NATIONAL USDOT UNIVERSITY TRANSPORTATION CENTER FOR SAFETY

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Detecting Driver Distraction

FINAL RESEARCH REPORT

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Distracted driving has become a major cause of crashes and loss of life. While there is legislation prohibiting the use of cellphones while driving, people continue to use them. We reason that if we can create a system that automatically detects when a person is distracted and warns them (even shutting down an application if necessary), then some serious accidents could be prevented.

The goal of this project was to set up an environment that could be used for data collection for the study of distracted driving with the long term goal of automatically detecting when a driver is distracted and to collect data from 50 subjects driving the course we set up. We decided to use a simulator after determining that in order to collect enough naturalistic data to be able to create statistical models, we would have to collect an immense database (over 5000 subjects) and then employ labelers to go in and find situations where the driver was distracted. Even with such a significant amount of data, we would not be assured to capture instances where certain driving conditions coexisted and where the driver's activities were distracting. By using a simulator, we were could decide at what point distracting events would take place. This decision both eliminated the need to annotate the data and enabled us to choose the combination of cellphone and route events so that individual causes of distraction could be teased out or combinations of causes could be studied as they interact with one another.

Several simulators were tested. We decided to use Open DS [OpenDS]. It enabled us to draw the route and to create events along the way, such as hairpin turns and warning signs. We purchased the relevant hardware (brake, gas pedal, steering wheel, screen with camera and microphone, cellphone for use by the driver).

The route was designed in such a manner that the driver would encounter several hairpin turns, indicated by relevant road signs. Those turns served as places where the driver would experience high cognitive load just keeping the vehicle on the road. These were places where cellphone distractions would create a dangerous situation. Our intent was to have some hairpin turns with cellphone distractions and others without, the latter serving as baselines. We therefore also designed a series of phone call and text message interruptions that were played to the driver at specific times. The driver was to answer the calls and messages. The content of these interruptions varied in cognitive load from, for example, "message from Mom, how are you today?" to "I want to get you something for your birthday. Tell me five things you want and I'll choose one".

All of the placement of turns, data from the car and backward facing video were logged and timestamped. The messages and calls on the phone were also recorded and timestamped and the two datasets were time synced. We made a list of where timestamped events, phone calls, messages and turns occurred. This list was our list of possible places where the driver could be distracted. The goal was to record many drivers and eventually use this data to determine if their driving behavior changed during a distracting event.
We watched the audio and video recordings of all of the subjects and hand labeled the places where we believed (third-party observation) that a subject was distracted.

We recorded 50 drivers, recruited from CMU graduate students in the School of Computer Science. They were introduced to the simulator and given instructions about its use. All subjects drove the same course (see Figure 1 at right), that is, the visual distractors and driving conditions (turns, etc) occurred in the same places. What changed for each driver was the placement of phone calls, emails and text messages. Those are initiated by a Wizard of Oz (WoZ) at specific places in the itinerary in order to raise the perceptual and/or memory load at places where certain driving events occur (a stop sign just came in view) or to provide control events where there is no dangerous driving context.

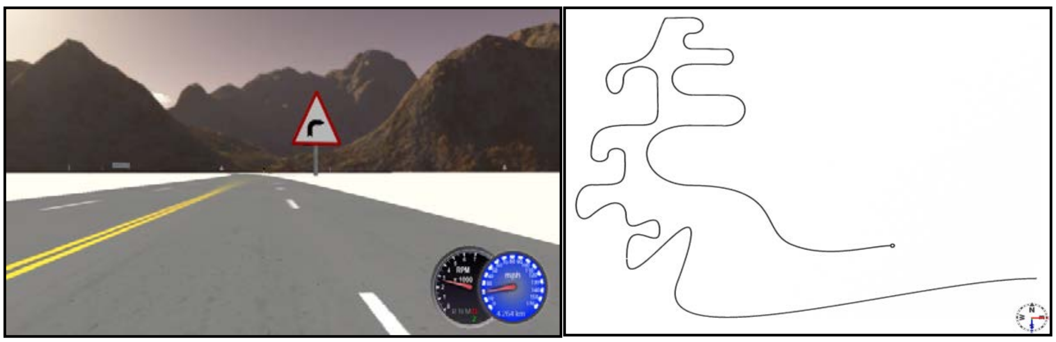

Figure 1 On left, what the driver sees, note signs far away; on right, the driving course with hairpin turns

They drove for about 15 minutes each. After driving the route, each subject took the Cognitive Failures questionnaire. Participants were remunerated with $10 gift cards.

Milestones

- Simulator – determined which simulator to use, set up the simulator with the hardware, set up logging function, set up cellphone and interruptions.
- Theoretical underpinning – chose to use measures of cognitive load to denote potential distraction points
- Data collection – recruited and recorded 50 subjects driving the course. Average driving time was 14:08 minutes per subject.

Products

Database – The database is publicly available on github: https://github.com/DialRC/DistractionDetectionDataset

References

OpenDS https://www.openhub.net/p/OpenDS

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