Undergraduate Thesis Prospectus

The Role of Remote-Sensing Technology in Roadway Infrastructure Upkeep

(technical research project in Aerospace Engineering)

Discouraging Distracted Driving: The Power of Encouraging Change Online

(sociotechnical research project)

by

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On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.
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General Research Problem: Driver Safety in the United States.

How can road and driver safety conditions within the US be improved?

In 2019, 38,800 Americans lost their lives to car crashes, and 4.4 million were injured seriously enough to require medical attention (NSC, n.d.). These crashes can be caused by any number of things, including driver error or poorly maintained roadways, but it should be a priority wherever possible to reduce the amount of preventable deaths caused by a lack of driver or roadway safety. Some automakers have promised that technology will deliver "zero crashes" (GM, 2017). Widely cited published data purportedly attribute 94 percent of crashes to driver error (NHTSA, 2008). From these data, some conclude that driver error is an intractable problem, exacerbated by the inevitability of driver distraction due to mobile devices. This interpretation is then used to justify road safety efforts that are addressed exclusively to engineering—for example, in the form of automated driving systems (ADS). But the 94 percent figure has been widely misinterpreted (Koopman, 2018), and even expensive ADS has delivered only marginal overall safety benefits. For now, at least, road safety remains a sociotechnical problem requiring integrated social and technical innovation.

The Role of Remote-Sensing Technology in Roadway Infrastructure Upkeep

How can infrastructure monitoring methods be improved in order to upkeep road safety?

This is an aerospace engineering capstone project run by Professor Goyne, and this particular project has nine people working on it, including myself. At the end of the project, a plan for remote-sensing-enhanced non-destructive evaluation of roadway infrastructure will be presented to Professor Goyne and to MITRE, the company that is sponsoring this capstone through the University of Virginia.

Maintaining transportation infrastructure is vital for the wellbeing of the state and public. Research indicates that as road conditions deteriorate, there are more collisions, and accidents tend to be more severe (Alhasan, 2018). Currently, roadway infrastructure maintenance in Virginia is costly, slow, and takes up a large amount of time while being terminally behind schedule. This project focuses on improving the current methods used by VDOT to keep track of roadway infrastructure by coming up with a remote sensing alternative to the current system, which is entirely ground based.

Ground based systems in general have many drawbacks, including traffic buildups, lane closures, and the fact that they are labor intensive (Vaghefi, 2012). Remote-sensing alternatives would involve attaching sensors to satellites or drones that can then gather the required infrastructure data more quickly and at a cheaper cost. Current state of the art sensors that can be used in this way include Synthetic Aperture Radar (SAR), Interferometric Synthetic Aperture Radar (InSAR) on satellites, and a sensor called Light Detection and Ranging (LIDAR) on drones (Ma, 2019). Even when using state of the art technology, there are challenges associated with both drones and satellites; Virginia has many restrictive laws regarding drone flight, and satellites have limited optical resolutions, meaning it is difficult for them to sense smaller deficiencies in roadways.

Due to the many challenges of this project, it was decided that the best solution would be to design a system with an overarching satellite that collects information on all roadways daily, with a few drones or cars that can be sent to analyze the problematic areas in more detail. At the end of this project, a design for the satellite and the drones and/or ground system will have been created, along with a new roadway inspection schedule, all of which MITRE can then build/implement at their leisure.

Discouraging Distracted Driving: The Power of Encouraging Change Online

How do groups of people online attempt to discourage distracted driving?

Distracted driving has always existed, but with the advent of smartphones it became almost impossible to avoid, even though it greatly decreases driver performance and increases the risk of getting into car crashes (Choudhary et al., 2020). As a response, warnings against driving distracted have been placed into driver education curricula, and car manufacturers have been introducing features meant to help drivers keep their eyes on the road while doing things like talking on the phone or changing their music (DriversEd.com, 2019). However, many Americans have taken matters into their own hands, and have turned to the internet to speak against distracted driving. They communicate through company-branded hashtags, local police departments, or even just personal social media accounts. These advocates are diverse and they employ diverse tactics to discourage strangers from distracted driving. They are a neglected component in the complex sociotechnical systems that promote road safety.

Researchers who investigate distracted driving often study teenagers and young adults, though there is evidence to suggest that limited executive function is a better predictor of distracted driving than age (Bell et al., 2017). Teenagers are actually likely to support laws that ban dangerous practices such as texting or emailing while driving, and to understand that distracted driving is a direct threat to safety (Mirman et al., 2019). However, Rupp et al. (2016) found that even when people know distracted behaviors are risky and rate them as such, they typically continue to engage in these activities while driving, calling into question studies that assume high associated risk with an activity would prevent engagement. The effects of anti-distracted driving campaigns are not well documented, although there is some evidence that they

may be useful (Zangbar et al., 2014); there have apparently been no studies of informal online efforts to deter distracted driving. Overall, scholarship about distracted driving tends to focus on how people feel about individual behaviors or what motivates distracted driving, not on campaigns, organized or informal, to prevent it.

Major participants include unorganized individuals and organized groups. Among the individuals, some have engaged in distracted driving; others have witnessed it. The organized groups include police departments, companies (such as AT&T), and nonprofit advocacies (such as End Distracted Driving). While all of these groups want to discourage others from driving distracted, they often have different perspectives on how best to do that. For example, people who have driven distracted and post about it online often do so in order to use the bad consequences of their decision to illustrate why no one else should do it. One such driver observed: “My first and only major accident was due to fumbling for CDs on a long drive back from college. I just drifted off the road” (Jethro_Cull, 2018). These posters are generally more lenient towards distracted drivers, and sometimes advise limiting distractions, rather than eliminating them.

People who post after witnessing distracted driving tend to be much harsher. Typically their posts are not directed towards anyone in particular, but express frustration and shame distracted drivers who may see their post. They will often use strong language and frame whoever is distracted as being unintelligent or irresponsible. User BashfulTurtle on Reddit is a good example of this type of participant; distracted driving is: “Beyond moronic. Sure, you get home fine 80% of the time. 10%, you fuck your car up and the other 10%, you kill other people and probably yourself” (2018).

Organized groups approach the situation much differently than unorganized individuals; many represent some kind of brand that is trying to maintain a good reputation. They tend to post less on forum sites like Reddit, and more on larger sites like Twitter or Facebook, often with a much friendlier tone and with more overt pleas to drivers. Police departments in particular will often frame distracted driving as a legal issue rather than a moral one, citing state laws or statistics in very neutral tones. They also often end with a direct request towards drivers such as "Help us end distracted driving." (SLC Police Dept, 2020).

Some corporations campaign against distracted driving, most notably AT&T, which started the "It Can Wait" campaign to discourage people from using their phones while driving. They mainly operate on Twitter, where they use a friendly and conversational tone to remind people to take the pledge to not drive distracted (AT&T It Can Wait, 2020). AT&T may be motivated to post about distracted driving because it is good PT for their brand, an ulterior motive that is at odds with other organized groups like End Distracted Driving.

End Distracted Driving (EDD) is a nonprofit organization founded by the parents of a girl who was killed by a distracted driver (EDD, 2020). This group tries to stop distracted driving through moral appeals to individual drivers, and overall seems more personally connected to the anti-distracted driving content they put out than the police departments or AT&T are.

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