Technology topic

Self-driving cars are currently being tested on roads around the world. The engineers running these tests are looking at the vehicle's ability to understand its environment, plan routes, make decisions and, in general, make sure the car gets where it needs to go. Broadly speaking, they can already do many of these things well, often far better than a human.

Despite these superhuman abilities, doubts remain over their ability to safeguard occupants and other road users from harm. When these systems do fail, new legal frameworks will be necessary to ensure that liability is handled fairly.

First let's talk definitions, what *is* a self-driving car?

- The Society of Automotive Engineers define five levels of vehicular automation. With a sixth level, zero, for cars without automation.
- Fourth and Fifth level vehicles can complete a trip without any driver input and are typically considered to be 'self-driving'.
- Fifth level vehicles can drive themselves regardless of limitations that may be imposed on Fourth Level vehicles such as geo-fencing. Fifth level may be considered the ultimate goal of self-driving vehicle development.

Justification

We believe this is a topic worth researching because the choices we make when introducing self-driving cars onto our roads will affect everyone.

While in the long run it is very likely that self-driving cars will reduce fatal accidents far below what would ever be possible in the current paradigm, without safeguards in place, getting to that point could have a very significant human cost.

But no amount of work will reduce the risk of failure to zero, and when that happens, there needs to be a legal framework capable of handling roads accidents caused by an unthinking machine.

Failing to adapt to these new technologies has the potential to cause the very harm it seeks to prevent and cause stagnation of and public backlash against a promising new technology.

Opportunities

With that out the way, how can the self-driving car improve road safety?

The United States Department of Transportation estimates that 94 percent of serious crashes are caused by human error.

Such errors may be the result of physical and mental conditions absent from automated systems. A self-driving car's AI will not get tired, drunk, angry, or distracted by his three noisy kids, for example.

Without the need to accommodate a driver, self-driving vehicles could be designed to be more protective of its occupants in a crash. While there is little research in this area, it's a fair assertion that steel is stronger than glass, and glass becomes a luxury rather than a necessity when human occupant and driver cease to be synonymous.

Currently, human drivers communicate with each other through simple signals. Most frequently, this is used to warn other drivers of “hazards” such as speed cameras and traffic police.

Advances in vehicle automation may allow vehicles to warn other vehicles of road hazards. This could be as simple as adding the location of a pothole to a map shared by all networked drivers.

Further advances in vehicle networking may lead to real-time sensor fusion. By sharing sensor information in real time, AI drivers can eliminate blind spots and create a more comprehensive map of their surroundings. This is particularly important for protecting the most vulnerable road users such as cyclists and motorcyclists.

Challenges and Risks

Despite these benefits, challenges remain.

AI Inscrutability

Whilst superhuman, the AIs that are behind the wheel of self-driving cars are perilously opaque. In analysing an AV crash, engineers can check logs detailing what the car sensed and what the car did, but the actual decision making exists in a black box.

Much like organic brains, an AI sophisticated enough to be useful is too complex for us to understand.

Public Acceptance

The technology itself being up to scratch isn’t enough. The public also needs to trust it, and when it's new and beyond our control, we are naturally more risk averse.

So even though 378 people were killed on New Zealand’s roads last year, for autonomous vehicle engineers, this is not the number to beat. Polling suggests that the public acceptance of AVs would require that this number be lowered by a factor of 10.

This risk aversion becomes a risk in and of itself: an excessively cautious approach caused by a few high-profile accidents could delay the adoption of self-driving cars, or even dampen its development, potentially failing to save millions from life-changing injury or death.

Transition period

The transitory period when self-driving cars are first unleashed on public roads marks one of the greatest potential risk periods. At this time, self-driving cars will be working from relatively small datasets of ‘real world’ scenarios and no amount of public messaging is going to ensure that every ‘Joe Public’ is going to respond to these new cars in a sensible manner.

Necessity of New Legal Framework

Self-driving cars won’t just *challenge* our current legal framework, they’re going to break it.

Currently all self-driving cars on the road have a ‘steward’ or ‘safety-driver’ behind the wheel that can take control if things go wrong and is ultimately responsible for the vehicle’s safe passage. This is a temporary ‘band aid’ solution that sooner or later needs to be ripped back. When it is, the current legal framework instantly becomes outdated and a new one becomes necessary.

Ethics

Safety is intrinsically an ethical issue, so we'd like to highlight one of the most talked about ethical dilemmas - what is colloquially called the 'trolley problem'.

The self-driving car version of this problem generally goes as follows:

A self-driving car is speeding towards a group of people on the road, it cannot stop in time. Does the car attempt to swerve out of the way, likely killing the occupant of the car, or does it continue on its planned path, breaking as much as it can?

According to one paper, this interest is 'entirely misplaced.' Once you factor in vehicular physics, "irrespective of outcome, it is always least risky for the car to brake in a straight line rather than swerve."

Another factor is user choice. According to one massive MIT study, dubbed the Moral Machine, users of self-driving cars don't want to use a car if they know it'll slam them into a wall at 100 kilometres per hour for the greater good.

Choices

It's clear that in many areas, those responsible for designing our roads and laws have a wide variety of options to choose from when considering how to best keep us safe.

New Legal Framework

In creating a new legal framework, the airline industry may be the most useful model to follow.

In instances of air disasters in which pilot error has been ruled out, blame and responsibility lands on those responsible for creating and maintaining the aircraft and relevant safety procedures.

This is not a novel approach for ground vehicles. For example, the Vision Zero approach, which has been widely adopted by many countries, considers road designers and vehicle manufacturers to be as important to road safety as the person behind the wheel.

Integration and transition

The end of the 'dumb car' will not happen overnight. Even in places that seek to aggressively adopt self-driving cars, there will be a transition phase. A comparison may be drawn between the adoption rate of Electric Vehicles.

The question of how self-driving cars are integrated also remains open and we can expect many different approaches to be taken.

At the most extreme, self-driving cars might be sequestered to specific roadways stripped of potential hazards, with purpose-built infrastructure to facilitate their use. This is already happening outside the public space in places like company and university campuses.

A less cautious but similar approach sees self-driving cars geofenced to a set of public roads. This option allows for far more useful data to be gathered, as the environment will be significantly less predictable, but the restricted area allows car makers and governing bodies to appropriately prepare the area and people for interactions with these novel vehicles.

Towards the tail end of self-driving integration, we can expect to see a role reversal, with privileged roadways that are exclusive to autonomous vehicles. At the most extreme, dumb cars might be restricted to roadways where their merely human drivers can do the least harm, or banned entirely.

Team Roles

All relevant data is kept in a shared OneDrive repository, as well as a team GitHub repository, both managed by Thomas.

Dylan and Matt are conducting research, compiling relevant articles and studies, and extracting the relevant information.

Thomas and Matt are coding the website from scratch in Jekyll, hosted on GitHub Pages.

Communication is being handled via a team Discord server with separate channels for each aspect of the assignment.

Finally, all three group members are contributing to writing, with referencing being handled by Dylan, and proofing overseen by Thomas and Matt to double-check all work before final submission.