Ethical Considerations on Future Vehicle Design

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***Abstract*—The automotive industry is currently facing a variety of challenges that could transform the industry in a way it has never changed before. One main driver of this transformation is connectivity, enabling cars to communicate with devices to offer new features to the customers. Many of which depend on personal data of passengers. This creates threats and opportunities at the same time. As data privacy is a very sensitive topic in today's world, it is necessary to discuss certain frameworks that ensure that customers are protected and that ethical standards are being implemented. Although many people show interest in these features, a lot of concerns regarding privacy are threatening people. To gain trust among society and to ensure that those features will be of benefit for humans, it is necessary that thoughts about security, privacy, and ethics are made before those features are introduced to customers.**

Keywords-ethical framework; connected car; electric mobility; autonomous driving; future of mobility; decision making

I. INTRODUCTION

The Internet of Things (IoT) is becoming more and more present in today's world in many different parts of life. While a lot of ideas and technologies exist, many people do not seem to be ready or willing to adapt to technological changes and seem skeptical about them mainly due to privacy concerns. Furthermore, ethical concerns have been raised in the past, but have not been clearly answered. As many new connectivity features could and will potentially be integrated in electrified cars in the future, several ethical questions need to be answered, to be able to set the right focus on the most promising technologies.

When thinking of ethics, it is important to consider the functionality of certain connectivity features. Do they really improve the life of the passengers in terms of safety and convenience or do they rather distract them? Do they add value and how relevant are they at the cost of data? It has been found that both handheld as well as hands-free cell phone conversations are interlinked with decreasing driving performance [1].

However, with increasing levels of autonomous driving, this threat will decrease, and other applications will be in focus that improve productivity. In general, an increasing productivity will be of benefit for the whole society as in many Western countries, societies are aging. Making driving safer, more effective, and more efficient will bring benefits for all. For instance, IoT health applications might provide improvements for people that are unforeseen so far. Another example is a potentially increasing level of fairness due to higher transparency as drivers could profit from good driving behavior through benefits such as lower insurance premia. In addition, with a digital identity existent from car usage, public transport could be made fairer as fare evaders would be identified at any point in time. With cars recognizing their passengers, they could be disabled from the outside in case of theft or to catch a criminal [2, 3, 4, 5].

One important connectivity feature in the future will be a digital assistant that is facilitating the life of passengers. This is opening up the question about the scope of virtual assistants and connectivity features in general with AI supporting them. Will vehicle intelligence outperform human skills and what will be the consequences? It is debated whether the intelligent car might become the first social robot that will interact with a large number of humans.

A very important issue is whether virtual assistants will only remain to assist people or whether they will take over decisions and tasks whenever possible. Literature defines two types of scenarios in which virtual assistants become "virtual butlers" only reacting to user requests or in which they will become proactive, self-aware, and autonomous as a "virtual companion". Recently a declaration has been published that recommends a limited or "constrained autonomy" due to the fear of intelligent robots replacing humans in a variety of fields. Following this argumentation, virtual assistants should only provide options to humans who will then have the power of decision-making [6, 7, 8, 9].

Furthermore, with an increasing importance of IoT applications, it may become difficult to leave the network if wished as with time, dependability increases. Another important topic is IoT globalization, meaning that data will be exchanged across borders and potentially saved on a server in another country. With sensitive data crossing borders, potential problems could arise if, for instance, privacy and cyber security laws in that country change and, unexpectedly, third parties might receive access to private data.

This is also linked to the issue of identification. It has to be guaranteed that every device that is sending or receiving data has an individual identification that is unique. A data transfer to a wrong receiver could result in severe damage imagining, for example, that health data could be linked to a

wrong personal profile. With gathering and digitizing data that has not been available before and is now exposed to potential threats at every time bears a high risk especially for highly sensitive data related to health or personal information. Whereas IoT solutions in the health sector could support decisions by doctors, wrong information included in a health profile, due to potential hacking attacks, creates new threats that have not existed before. Moreover, public and private life melt together and become accessible for a broader group of individuals than in the past leading to both positive and negative effects [10].

There is a broad consensus that car connectivity features have the capacity to provide major benefits for customers. Looking at social benefits, they create a time surplus when being in the car through providing driver freedom leading to increased productivity. Additionally, they can help reduce congestion and fatalities saving lives, time and costs. With higher transparency and more data collected, it might be easier to measure the ethical footprint of every individual leading to an improvement of overall behavior of people. However, all of this comes at the price of data collection. According to studies, a large number of people is willing to provide some sort of data when receiving a fair value of benefits in return [11, 12]. However, one important question is what this fair value is and how it can be measured.

II. THOUGHTS ON ETHICS

A. Responsibility of Stakeholders

Although a large variety of connectivity features has already been existent in the past, many drivers resisted to buy or use them due to different reasons, such as not trusting or understanding the new technologies or by neglecting the value that they offer. However, with new technological developments coming up, it is projected that the value of connected car data and new business models emerging from the digitization of the car could be worth up to $1.5 trillion a year by 2030 [13]. With such an economic impact and many different parties involved and interested in connected car data, it is crucial to define certain ethical standards that need to be applied.

In literature, eight critical questions are mentioned that are necessary to be answered for an ethically sound connected car ecosystem. First, who owns the data? Second, who is able to control the data? Third, who can access the data? Fourth, is data integrity ensured, meaning that the data is accurate and consistent? Fifth, is data authenticity guaranteed, meaning that data is not manipulated? Sixth, is the data available at any moment when needed? Seventh, is the data processed in a confidential way? Eighth, are involved parties committed to keep ethical standards up? Especially the question of data access is of high importance as many parties such as governments, companies, employers, and insurances are interested in connected car data and personal data providing them power to make decisions upon people [14, 15, 16, 17, 18, 19].

According to Arkin [20] autonomous technology is created faster than we are able to "1) understand its implications, 2) interpret is with moral frameworks, and 3) create policy and legislation to govern its development and deployment." Often, technical progress evolves fast whereas legal and ethical aspects are not discussed in such a detailed way at an early stage when actually necessary. However, this is essential when it comes to sensitive data that is collected in the connected car as wrong usage could lead to harsh damage for individuals. Therefore, it is of high importance to establish ethical standards that find broad acceptance [21, 22, 23, 24].

B. Customers' Willingness to Share Data

According to a study, personal data privacy does not seem to be of major concern for many customers. Many people share much data already today via their smartphones or social media. Only 25% of customers categorically refuse OEMs to use their driving and position data. Another study found that 82% of drivers surveyed worldwide are willing to share their vehicle data. Although different consent rates can be found depending on the study, a general tendency towards acceptance of connectivity features among society can be found. However, differences in the customer perception depending on the region exist. Chinese citizens, for example, tend to be more willing to share their data in comparison to Germans. In some regions, customers are even willing to share more data with their car's OEM than with their smartphone manufacturer. In general, driving-related connectivity features such as connected navigation or networked parking seem more important to customers than driving-unrelated ones such as e-mail or web browsing [25, 26].

On average, 71% of consumers consciously decide to grant certain applications access to data that they would not share with other applications. This number keeps increasing, as people tend to become more aware of potential benefits. Depending on the field of application, there are different levels of acceptance to share data. 37% would not like to use a car with many connectivity features due to privacy concerns. However, this differs on a regional level. Germans are above average with 51% being skeptical, whereas Chinese tend to be more willing to use them with only 21% being doubtful. On a global scale, 32% of car buyers would vote for a law that allows connected cars to enforce speed limits and would stop over speeding. However, large regional differences exist. In China 58% would support this initiative whereas in Germany only 15% would be willing to do so [11, 13, 26].

With new connectivity features coming up, new business models will evolve that will allow customers to use their data as a currency. One exemplary use case from the sharing segment would be a customer that receives free miles in the car in return for personal data that could be used for targeted advertising. In 2014, 35% of customers were willing to trade driving data in order to receive insurance benefits. Yet, when having the option to choose either chargeable services or free services in exchange for viewing advertisements or providing data or, the customer view depends on the type of feature. Whereas people would rather pay for networked parking, they would tend to use free connected navigation. For connected navigation features, 70% of the customers in the US are willing to share personal data, while the number drops to 58% for usage-based tolling and taxation features. One very extensive discrepancy could be identified for features using fitness and health data. In Germany, only 23% were willing to use those features in comparison to 43% in the US, and 79% in China. Besides the regional differences, in general it could be observed that younger people and people who spend more time in their car tend to be more open towards car connectivity features and rather see them as exciting [11, 13, 27].

C. Decision Making Processes

For a variety of connectivity features, decisions will be made autonomously by algorithms that have certain decision patterns and ethical frameworks underlying. In order to make ethically sound decisions, it is important to clarify several questions. One critical aspect is the question of fairness when using algorithms. This does not only concern safety issues in case of an upcoming accident, but also any kind of decision making that involves different stakeholders such as parties with commercial interests. Moreover, it needs to be clarified how much programmers are allowed to deviate from certain ethical standards and how it can be ensured that they stick to them. In addition, it is necessary to create an authority that has the capability to decide whether an ethical framework is applicable [28].

As decisions made by autonomous bots have ethical consequences, it is necessary to have the ability to control them. Are the decisions trustworthy and ethically justified and which ethical principles were applied when creating them? This is especially important for self-improving or self-learning machines that need to have a certain ethical code of conduct to prevent them from developing into a wrong direction. Machine learning can be taught in a variety of ways, namely through supervised learning, unsupervised learning, and reinforcement learning. Supervised learning is defined as a supervisor teaching the machine to correlate inputs and outputs by using labelled examples. This can then be transferred to new inputs or outputs. Unsupervised learning means giving input only and letting the machine find out which input patterns are related to certain outputs. Reinforcement learning means that the machine learns that a specific goal can be achieved through a certain sequence of actions. What is important is the question of the ethical principle that lies below the decision-making [29, 30, 31].

There is a variety of ethical theories and frameworks in literature. Among the most often discussed ones are the following three. First, following a deontological approach, tracing back to Immanuel Kant's categorical imperatives, decisions would be made upon specific principles or rules no matter what the outcome will be. Examples of those rules are the principle of non-harming or the principle of honesty. Second, following an ethics of virtue approach, originally created by Aristotle and Plato, machines would search for the highest good, which is often to be found between the extremes. However, this approach could lead to highly controversial discussions and it might be difficult to create transparency with it. Third, using a utilitarian approach, a form of consequentialism introduced by Jeremy Bentham and John Stuart Mill, one would urge to create the greatest overall happiness by choosing the option with the highest sum of utilities produced. A consent in literature exists that this could be the most transparent approach [29, 30, 31].

Empirical studies have shown that a majority of people would prefer a minimization of overall harm, accepting a decrease of their own safety as long as everyone has the same risk level, implying a utilitarian approach. One showed that drivers would choose a more severe collision with a lower likelihood of own survival if overall damage was lower. Furthermore, the age and size of the potential victims was of importance for the decision. However, in interviews with those participants it was found that although many people made the same decision, the individual justification differed heavily as they had embodied their own moral concepts. In general, contrasting opinions exist between advocates for overall happiness and those endorsing the rights of individuals. Finally, it needs to be said that one of the most important aspects regarding the usage of autonomous decision-making is that it should be transparent which principles are applied, no matter which approach is used in the end. It is recommended that those norms should be understood and commonly shared as far as possible [20, 28, 32, 33, 34, 35].

D. Data Privacy

While many connectivity features in the car and IoT features in general bring comfort and benefits, this usually happens at the cost of privacy. As more and more smart things will appear in the daily life, individual privacy will be reduced. Whereas currently, people often have to take an active role to put their privacy at stake, in the future data might be collected without even noticing it due to the increasing number of sensing devices around every individual. Therefore, it is highly important for people to know what data and information is collected by their vehicle and that they are able to control this in a responsible way [36, 37].

Another technological development linked to connectivity features in the car is the topic of digital identity that is currently being discussed by governments around the world. This is linked to applications such as social security benefits, employment assistance, health care, or tax filing. Many governmental services are digitized nowadays, lifting a digital identity up to a high level of personal, commercial, and legal importance. Whereas a digital identity has the potential to bring transparency, accuracy, credibility, and honesty, it is the question whether personal privacy or justice for the overall society is more important [38].

It needs to be considered that privacy is a fundamental right in the Universal Declaration of Human Rights. Thus, while technology has the potential to create many opportunities and to transform society, it is important to differentiate between innovative and risky aspects of technology. One example is 360-degree cameras installed in cars that are used for ADAS but capture every second from any angle leading not only to a threat of own privacy but also for third parties. As those developments bring some irreversible changes to society, it is crucial that regulators create ethical governance. In the case of dashcams, it depends on the national legislation whether they are allowed or not, being currently under discussion in Germany. One recent example of unexpected use of personal data and a threat for privacy was Cambridge Analytica that used data from Facebook of more than 87 million people. To prevent such cases regulators are working on data protection regulations. For instance, the European Union published a new data protection law that becomes binding in May 2018 [39, 40, 41, 42, 43].

Besides national institutions, science and industry are also working on frameworks and initiatives to ensure that IoT applications will fulfill ethical standards and that trust among consumers is created as those are important keystones for success. To address the topic of customer privacy, several car manufacturers signed a privacy principles list of the Alliance of Automobile Manufacturers to ensure that sensitive data is handled in an ethical way. In total, they found seven principles of importance. First, transparency, ensuring that

customers are informed about which information is collected, how it is used, and with which parties it is shared. Second, choice, providing users the opportunity to decide upon data usage. Third, respect for context, meaning that data is only used for its original purpose. Fourth, data minimization, de-identification, and retention, referring to collecting data only when really needed, minimizing the time of storage, and separating identities from data where possible. Fifth, data security, obliging car manufacturers to implement high security standards to prevent loss and unauthorized access or use of data. Sixth, integrity and access, ensuring that data measured is valid and that customers could correct wrong information. Seventh, accountability, meaning that car manufacturers stick to those principles [44, 45, 46, 47, 48].

III. Conclusion and Future Works

With the technological developments in the field of connectivity features in the car many new opportunities are created. However, they do not come without any risks and threats. To ensure that future decisions will not only be reasonable from an economic point of view, but also from a moral one it is highly important to examine technological process in detail from an ethical perspective.

This thesis aimed to provide insights on the ethical perspective on connectivity features in the car. However, many questions have been left unanswered. As this is a constantly changing field of technology, new questions arise frequently. Interesting further research topics could be, for instance, the different customer perceptions on connectivity features depending on the region on a national or an international scale.

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