Position Paper: Society and Autonomous Driving

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***Abstract*—This position paper presents our view on the hurdles in assessing the acceptance of autonomous vehicles by society. Key factors that influence interest and acceptance are listed, and safety is used as an example factor to demonstrate the efforts required to drive understanding and adoption.**

Keywords—Automation Metrics, Autonomous Driving, Society and Technology,

I. INTRODUCTION

Autonomous driving will bring about significant changes to how people and materials move globally. As with paradigms such as the electric bulb, trains, and automobiles themselves, there are fears, concerns, and misconceptions among the very public that autonomous driving will serve. The scientific and engineering communities also share some of these concerns. If understood and addressed appropriately, autonomous driving will find rapid adoption and acceptance across society.

Societal acceptance is vital. It will drive government motivation to advance or incorporate new infrastructure and infrastructural elements and the regulatory and economic frameworks necessary for the optimal functioning of autonomous transportation.

Key elements that drive public interest in this new paradigm in transportation will include unambiguous messaging, combatting "autonomy-washing," affordability, and access, compatibility with semi-autonomous and manual modes of transportation, cybersecurity, consumer behavior management, and above all, safety and explainability.

We believe that guidelines, benchmarks, and standards must be established with input from a cross-section of the stakeholders, including manufacturers, universities, government, public safety advocacy groups as well as members of the public. The appropriate data that will demonstrate safety and effectiveness must be identified, collected, analyzed, and presented in a format that the public can understand and apply in assessing autonomous driving solutions.

The levels of automation in vehicles are listed on a scale from 0 – 5 [1]. For researchers and industry personnel, and consumers with a high level of interest in automation, this is a well-understood metric. It is questionable whether the public is even aware of the scales, the nuanced differences between levels 2, 3, and 4, and other related issues. While broad research in public sentiments and acceptance towards autonomous vehicles that might be developed and deployed is available, research in the societal understanding of such classifications in relation to autonomy has been insufficient [2]. A 0 – 5 ordinal scale is simple; however, the levels of autonomy classified within the strata of the scale may or may not be easily understood. Manufacturers and other stakeholders do not always agree on whether specific products fit the definition of levels accurately. There is a significant gap in the comprehensibility of a study by MIT on Tesla Drivers and their levels of distraction, when it is compared to how it was reported by CNN, a news agency [3], [4]. The translation of scientific findings into forms understandable by vast portions of society is fundamental to the acceptance of any technology or paradigm.

It is imperative that the issues, news, metrics, and other parameters surrounding autonomous driving be stated in terms that are easily understood and can withstand efforts to confound consumers or other stakeholders. With the emergence of *fake news* and other variables that influence, alter or dilute reality, truthful messaging and presentation of facts are no longer trivial exercises [5]. Standardization, standard testing, and technical benchmarks may be valid determinants that influence portions of society, while it may prove to be incomprehensible, alarming, or uninteresting to other sections.

II. BENCHMARKING FUNDAMENTALS

A. Safety

The highest amount of concern with autonomous driving arises from consumer perception of safety [2].

There has been a recorded fatality with a nascent, potential level 4 prototype system, designed and operated by Uber [4]. While it was ultimately determined that the human operator was careless, it is disconcerting that the organization responsible for designing and training the prototype and hiring attentive operators was not charged. The decision has received criticism [6].

Accurately identifying and demonstrating the source of the error that causes injuries or fatalities may be insufficient. Semi-autonomous cars, positioned as fully autonomous, have been misused by drivers resulting in significant fatalities. Claims by the manufacturer, which are not independently verified or robustly tested, have not alleviated concerns [7]. The manufacturer, Tesla, has failed to regulate the misuse of semi-autonomous features effectively [3]. This adds to ongoing safety concerns with the product, which then translates to safety concerns for all autonomous driving vehicles.

B. Demonstrating Safety

Significant infrastructure exists for automotive safety testing and demonstration. It is conceivable that similar infrastructure will become available to demonstrate the safe operation of autonomous vehicles in various situations. Credibility will be enhanced by factors including

1) While manufacturers perform independent tests and might make some of the data available, third-party testing will lend higher credibility to safety claims.

2) Testing, whether performed by manufacturers or independent bodies, will have to a certain amount of standardization, aligning with the various levels of autonomy under which specific vehicles are classified.

3) The results of testing must be unambiguously presented. Testing failures and limitations with autonomy must be readily transparent to the consumer.

4) When safety incidents occur, investigations must be swift and thorough. The first fatality arising from an autonomous vehicle incident took several months to complete [7]. While the delay is understandable, given this is a new area of endeavor, as the technologies and the assessment techniques mature, timely investigations will strengthen the credibility of the results.

5) Explainability in all areas of safety, whether it is in initial reporting or post-investigative reporting, should be high. With Machine Learning and Deep Learning quickly becoming a key component of autonomous solutions, it is vital that the decisions made by such systems be understood and explicitly explained. This must then be translated to the consumer without ambiguity and room for discombobulation.

6) Human involvement, intervention, and focus on driving, except at the highest level of autonomy, must be the focus of any safety plan. Regulations and feature control should minimize chances for distracted driving to the highest possible degree.

7) At every level of automation, implicit in level 0, human drivers must stay in the loop and take control where they deem necessary.

8) Driver's Licenses, testing for the licenses, and the restriction of permits based on age and ability should be adjusted gradually in response to analyses of both individual drivers' performance and those arising from the deployment of autonomous vehicles with humans in the loop. The ability of a driver to assume control as desired or necessary will be well understood.

9) Liabilities and punishments must be appropriately adjudicated promptly. Humans who deliberately misuse autonomous vehicles should have such privileges suspended, and manufacturers must be required to make such mechanisms available.

10) Cybersecurity, while a factor on its own is a growing concern among industry experts as well as consumers. Spoofing, DDoS and several other forms of attack are possible, even in vehicles that have very low levels of autonomy equipped with Vehicular Connectivity. Preventive and counteractive measures cannot be static, as cybersecurity attacks typically tend to evolve to exploit gaps in security.

The aforementioned list of factors is not comprehensive, and vehicular safety concerns will continue to evolve with developing technology, both in the areas of vehicular autonomy and control, as well as in transportation infrastructure. Stakeholders must be consistently polled and invited to participate in continual efforts to consider and improve vehicular safety norms.

III. THE AUTHORS

The authors of this position paper, Srihari Yamanoor [9] and Narasimha Sai Yamanoor [10], have a background in Robotics, IoT, Machine Learning, and the Development of Industrial and Healthcare Applications in commercial and non-profit settings. We have a mix of experience in Surgical Robotics, Medical and General Robotics, IoT Devices, and Medical Devices. Our personal interests and work span the themes of open hardware and software design implementations ranging from Proof-of-Concept solutions to prototypes, within the framework of Frugal Engineering. We will engage our diverse perspective in the discussions on promoting societal understanding and acceptance of the safety of autonomous vehicles.

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