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**Autonomous Driving Technology Proposal**

*CS250FZ — English Language Teaching*

Assessment 3 - Group Research Proposal Presentation

**About Groups**

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| --- | --- | --- |
| **Student Name** | **English Name** | **MU ID** |
| *ZhiTing Chen* | *Victoria* | *22125167* |
| *Xin Zhen* | *Tracy* | *22126988* |
| *JiangJun He* | *Mobius* | *22125582* |
| *YiYang Liu* | *Simon* | *22125159* |
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# 1.Introduction

## 1.1. Background

Technology has advanced in recent years, and autonomous driving technology is one of them. This technology is promising, with potential advantages such as increased safety, efficiency and convenience. However, as the technology is still immature and not all cars can use it, questions have been raised about its safety and reliability, especially in complex situations.

While the safety data for vehicles applying self-driving technology is impressive, much of this data comes from manufacturers collecting it under ideal conditions (Guo, J.,2019). It is impossible to provide as perfect conditions for this technology in the situations we use it in daily. For example, natural conditions such as heavy rain, snow, and hail, and man-made conditions such as drunk driving and failure to follow traffic laws, so problems arise.

## 1.2. Research Question

Thus, a question is obtained: Do human-operated vehicles exhibit superior safety performance within intricate environments compared to autonomous vehicles amid the present technological limitations?

## 1.3. Significance of the Research

The research comes from the fact that as more and more self-driving cars enter our transportation system, our daily lives, their safety in complex environments continues to come to light (Yurtsever, E.,2020).

Even though the safety of autonomous driving will continue to improve as technology continues to advance (Muhammad,2020). However, solving this problem can provide an effective decision-making basis for the future development and control of automated driving technology, and can also reveal the safety comparison between human driving and automated driving.

# 2. Literature Review

## 2.1. Autonomous driving in various weather conditions

Complex weather conditions mainly refer to rain, snow, fog, thunderstorms, sand and dust, and other bad weather conditions that seriously affect driving safety. Under such weather conditions, the image information collected by the camera of the driverless car will be seriously distorted, blurred, and noisy, which will lead to a decrease in the target detection accuracy, and the vehicle will not be able to obtain the effective information to make the correct driving avoidance, thus causing risks for the vehicle driving, which brings a great challenge to the wide application of driverless technology (Zang, S.,2019).

## 2.2. Potential Problems of Mixing Human Driving and Driverless Vehicle Operation

At the current state of the art, several problems can arise when human-driven vehicles are mixed with driverless vehicles and operated together. These problems mainly stem from the differences in behavioral patterns between the two and the lack of ability to understand and predict each other's behavior. Human drivers usually rely on experience and intuition to make decisions when faced with complex traffic situations, but their behavior does not necessarily follow traffic regulations (Wang, K.,2020). These behaviors are considered non-compliant and dangerous in the algorithmic design of driverless cars, so driverless cars may choose conservative measures when encountering such situations, leading to traffic congestion or even accidents.

## 2.3. Key Findings

### 2.3.1. Advantage of autonomous driving in bad weather:

Autonomous driving can sometimes detect obstacles better than humans, through sensors such as LiDAR (Zang, S.,2019).

### 2.3.2. Disadvantage of autonomous driving in bad weather:

Sensors may fail under adverse conditions (rain, snow, fog, sand and dust), increasing the risk of accidents (Zang, S.,2019).

### 2.3.3. Human adaptation to the environment:

Humans can adapt quickly in bad weather through experience and intuition, adjusting speed, distance, and reducing accident rates (Wang, K., 2020).

**2.3. Gaps in Literature**

There is a lack of comprehensive studies directly comparing the safety performance of human drivers and autonomous vehicles in complex weather conditions.

**2.4. Hypothesis**

Under current technological conditions, human drivers can overcome the limitations of automated driving technology in bad weather by using their experience and decision-making to provide better safety in complex situations.

# 3. Methodology

This study employs a mixed-methods approach, combining qualitative and quantitative analyses.

## 3.1 Mixed-methods approach

### 3.1.1 Qualitative Research

The qualitative research component includes a questionnaire survey aimed at understanding people's doubts about the safety of autonomous driving and the reasons behind their concerns (Krosnick, 2018), as well as conducting interviews with experts in AI technology, automotive safety, and transportation policy, and distributing surveys to drivers and passengers who have used AI-controlled cars to gather insights on their perceptions and experiences.

### 3.1.2 Quantitative Research

The quantitative research component involves analyzing both simulation and real-world data by utilizing driving simulators to test the performance of autonomous and human-driven vehicles in controlled environments under various complex weather conditions, including heavy rain, snow, fog, and strong winds (Zhang et al., 2023). It also includes collecting real-world accident records and safety data under actual complex weather conditions for both vehicle types to analyze the impact of weather on accident rates and reaction times. The safety performance metrics include the frequency of accidents for autonomous and human-driven vehicles under different weather conditions, the reaction speed and decision effectiveness in emergency situations for both driving modes, and the performance in controlling the vehicle under complex weather conditions, including incidents of skidding and loss of control.

## 3.2 Data Collection

Data sources include traffic accident databases provided by national or local traffic management authorities to obtain accident data under complex weather conditions for both autonomous and human-driven vehicles, weather data from meteorological departments to correlate traffic accidents with weather conditions, and accident reports from insurance companies and traffic management authorities, including information on accident causes, weather conditions, and accident severity. Data collection methods involve conducting surveys with drivers or passengers of autonomous and human-driven vehicles under complex weather conditions to collect subjective safety evaluations and driving experiences, performing controlled experiments in simulator labs to simulate the driving performance of both types of vehicles under various complex weather conditions, and conducting field studies on actual roads to compare the driving data of autonomous and human-driven vehicles under the same complex weather conditions(Rahmati et al., 2019).

## 3.3 Data Analysis

Data analysis will involve using statistical software such as SPSS or R to conduct descriptive and inferential statistical analysis on the collected data, comparing accident rates and reaction times under different weather conditions. Additionally, regression models will be established to analyze the impact of complex weather on the safety of autonomous and human-driven vehicles and to evaluate the weight of various weather factors. A confusion matrix will also be used to evaluate the performance accuracy and error rate of autonomous systems under complex weather conditions (Amin and Mahmoud, 2022).

## 3.4 Ethical considerations

**3.4.1 Ensure confidentiality and data security of participants**

Ensuring the confidentiality and data security of participants is critical, especially when conducting manned and unmanned research involving complex weather conditions. To protect participants' personal data, all data should be stored on servers equipped with firewalls and security measures. By implementing a role-based access control system, only researchers directly involved in the project can access sensitive data (Zhang etal., 2021). In addition, the principle of data minimization applies to collecting only the minimum amount of personal data necessary to achieve the purpose of the research and ensuring that the use of the data is consistent with the intended purpose of the research.

**3.4.2 Ensure the safety of participants and the public during the trial**

Following the "do no harm" principle, all test activities are conducted in a closed test environment with appropriate safety facilities, such as a professional driving test room equipped with emergency braking systems and accident mitigation facilities. (Gibbs et al.2017) provides all participants with professional training on how to safely drive a vehicle in complex weather conditions and drills to respond to emergencies. In addition, the test should be monitored in real time using monitoring equipment such as high-definition cameras so that immediate action can be taken if any signs of danger are detected.

**3.4.3 Obtaining informed consent of participants and protecting their privacy**

Provide a detailed consent form that clearly states the purpose, procedure, potential risks, and privacy protection measures of the test, and ensure that all information is clear and understandable (Bos,2020). All collected data should be de-identified to ensure that participants are not identified in any research publication. Research teams should also have strict data retention policies in place to safely destroy data that is no longer needed after the study ends. In addition, researchers should clearly inform participants that they have the right to withdraw their consent and withdraw from the study at any time, and that this action will not have any negative impact on them (Whelan, 2007).

# 4. Conclusion

This study comprehensively compares the safety of manual driving and autonomous driving in complex weather conditions, and evaluates the performance of both under severe weather conditions such as rain, snow and haze through simulation and real data. The results show that human drivers, with their extensive experience and adaptive decision-making, are safer in changing environments. Autonomous driving faces challenges in bad weather due to limitations in sensing systems and processing power. The study highlights the need to improve the perception and decision algorithms, navigation accuracy, and emergency response capabilities of autonomous driving technology, thereby laying the foundation for technological advancement and policy making.

# Reference

Amin F, Mahmoud M. Confusion matrix in binary classification problems: a step-by-step tutorial[J]. Journal of Engineering Research, 2022, 6(5): 0-0.

Bos, J. (2020). Research Ethics for Students in the Social Sciences. Springer Nature Switzerland AG. <https://doi.org/10.1007/978-3-030-48415-6>

Gibbs, L., Molyneaux, R., Whiteley, S., Block, K., Harms, L., Bryant, R.A., Forbes, D., Gallagher, H.C., MacDougall, C. & Ireton, G. (2018). Distress and satisfaction with research participation: Impact on retention in longitudinal disaster research. International Journal of Disaster Risk Reduction, 27, 68-74. https://doi.org/10.1016/j.ijdrr.2017.09.038

Guo, J., Kurup, U., & Shah, M. (2019). Is it safe to drive? An overview of factors, metrics, and datasets for driveability assessment in autonomous driving. IEEE Transactions on Intelligent Transportation Systems, 21(8), 3135-3151.

Krosnick J A. Questionnaire design[J]. The Palgrave handbook of survey research, 2018: 439-455.

Muhammad, K., Ullah, A., Lloret, J., Del Ser, J., & de Albuquerque, V. H. C. (2020). Deep learning for safe autonomous driving: Current challenges and future directions. IEEE Transactions on Intelligent Transportation Systems, 22(7), 4316-4336.

Rahmati Y, Khajeh Hosseini M, Talebpour A, et al. Influence of autonomous vehicles on car-following behavior of human drivers[J]. Transportation research record, 2019, 2673(12): 367-379.

Wang, K., Li, G., Chen, J., Long, Y., Chen, T., Chen, L., & Xia, Q. (2020). The adaptability and challenges of autonomous vehicles to pedestrians in urban China. Accident Analysis & Prevention, 145, 105692.

Whelan, T. J. (2007, October). Anonymity and confidentiality: Do survey respondents know the difference? Poster presented at the 30th annual meeting of the Society of Southeastern Social Psychologists. Durham, NC.

Yurtsever, E., Lambert, J., Carballo, A., & Takeda, K. (2020). A survey of autonomous driving: Common practices and emerging technologies. IEEE access, 8, 58443-58469.

Zang, S., Ding, M., Smith, D., Tyler, P., Rakotoarivelo, T., & Kaafar, M. A. (2019). The impact of adverse weather conditions on autonomous vehicles: How rain, snow, fog, and hail affect the performance of a self-driving car. IEEE vehicular technology magazine, 14(2), 103-111.

Zhang Y, Carballo A, Yang H, et al. Perception and sensing for autonomous vehicles under adverse weather conditions: A survey[J]. ISPRS Journal of Photogrammetry and Remote Sensing, 2023, 196: 146-177.

Zhang, X., Xu, M., Da, G. & Zhao, P. (2021). Ensuring confidentiality and availability of sensitive data over a network system under cyber threats. Journal of Safety Science and Resilience. https://doi.org/10.1016/j.jess.2021.107697