Case study: Telemetry

Pavan Kumar Jonnadula
School of Computer Science and Engineering,
University of Missouri,
Kansas City.

Vamsi Alapaty
School of Computer Science and Engineering,
University of Missouri,
Kansas City.

Harish Jaladi
School of Computer Science and Engineering,
University of Missouri,
Kansas City.

Ramya Deshetti
School of Computer Science and Engineering,
University of Missouri,
Kansas City.

Shajahan Mohammad
School of Computer Science and Engineering,
University of Missouri,
Kansas City.

Raju Thada
School of Computer Science and Engineering,
University of Missouri,
Kansas City.

Sarath Boddu
School of Computer Science and Engineering,
University of Missouri,
Kansas City.

Naveen Krishnam
School of Computer Science and Engineering,
University of Missouri,
Kansas City

Abstract:

The history of autonomous cars is a journey of technological advancements and visionary concepts. While tracing back several decades, recent years have seen significant progress. The milestones showcase the evolution from early concepts to active development and commercialization. Despite challenges, autonomous vehicles hold the potential to revolutionize transportation, improving safety, efficiency, and accessibility. Automatic cars, also called automatic transmission cars, have an automatic transmission system that shifts gears without driver intervention. It utilizes a torque converter or dual-clutch system based on factors like engine speed and vehicle speed. This offers advantages like ease of operation, smoother gear changes, and convenience in heavy traffic. Automatic cars have different modes like Drive, Park, Reverse, and Neutral. It's important to note that automatic cars refer to the transmission system and do not imply autonomous capabilities. Autonomous vehicles, on the other hand, can drive without human input.

Description:

To facilitate further research and testing of our project's control system, we undertook the construction of a custom track within a real parking lot. This track was purposefully designed to meet our specific research requirements and enable the collection of valuable data. By strategically placing blocks along the track, we created challenges and obstacles for the car to navigate. This approach allowed us to simulate real-world driving scenarios and assess the efficacy of our control system in diverse situations.

For remote control of the car during testing, our project team members utilized a wireless remote system. This system afforded us the flexibility to operate the car from a distance, ensuring the safety of our team throughout the testing process. Furthermore, the integration of a mobile application provided us with the means to remotely control the car's movements, monitor its performance, and gather data for analysis.

To carry out tests and evaluate the control system, the entire project team actively participated in operating the car. Leveraging the remote system, we could wirelessly control the car from a distance. The remote system was complemented by a mobile application that offered a user-friendly interface and real-time information regarding the car's status. Notably, the mobile application incorporated a first-person perspective (FPP) view, providing us with an immersive experience akin to being seated inside the car. This perspective facilitated a more realistic understanding of the car's behavior, empowering us to make informed decisions during testing. By closely observing the car's movements, anticipating potential challenges, and making necessary adjustments to the control system, we could assess its effectiveness in real-time from a driver's standpoint.

By constructing a custom track, introducing obstacles, employing a remote system, and integrating a mobile application with a first-person perspective, we conducted comprehensive testing and evaluation of the car's control system. This approach enabled us to develop a comprehensive understanding of its capabilities, identify its strengths, and pinpoint areas for improvement. The valuable data and insights garnered from these tests will inform the refinement of our control system and advance our research in autonomous driving technologies.

Hardware Requirements:
A track has been designed to validate the the driving skills of users in both the modes.

Track details:
Length: 42 feet
Loops: 5
Width: 1.5 feet
Obstacles: 12

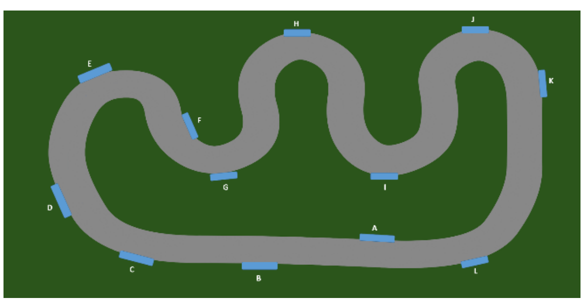

Figure-1: Track with obstacles

Car details:
Name: Defender High Speed
Top speed: 20kmph / 12.5 mph
Length: 1 feet
Width: 0.8 feet
Control: Remote and Mobile operation

Figure-2: Car user for driving

Limitations:
During our operations of the car using a mobile application, we encountered a significant challenge pertaining to speed control, particularly with regards to over-acceleration. Despite our diligent efforts to maintain the desired speed, the car exhibited a tendency to accelerate beyond the intended limit. This issue presented difficulties in effectively controlling the car's speed through the mobile application.

The problem of over-acceleration can be attributed to various factors. It is possible that incorrect calibration or sensitivity settings in the mobile application were responsible for the car's heightened response to acceleration inputs, surpassing the intended levels. Alternatively, there may exist a discrepancy between the speed commands transmitted from the mobile application and the car's actual speed regulation system, resulting in inaccuracies in speed control.

The issue of over-acceleration raises concerns regarding safety, as it can lead to the car exceeding safe and legal speed limits, potentially compromising overall control and vehicle stability. Therefore, it is crucial to address this problem to ensure the safe and reliable operation of the car through the mobile application.

To resolve this issue, thorough investigation and analysis are necessary. This may involve examining the control algorithms employed by the mobile application, reviewing the communication protocols between the application and the car's speed regulation system, and considering potential software or hardware adjustments that can enhance speed control accuracy and responsiveness. Additionally, conducting real-world testing and validation with a specific focus on speed control will aid in identifying and rectifying the root cause of the over-acceleration problem.

By comprehending and addressing this speed control challenge, we can improve the functionality of the mobile application, optimize speed control capabilities, and ensure a safer and more reliable user experience when operating the car.

Working:

A group of eight dedicated individuals united with a shared passion for racing, embarking on the creation of their very own racing track. Diligently toiling, they constructed a track designed to push their driving skills to the limits. As anticipation filled the air, they prepared to put their abilities to the test, employing both remote control and a specially crafted mobile application.

The track they meticulously built boasted a compact size, presenting a formidable challenge for the drivers. Its twists, turns, and tight corners demanded precise maneuvers and finesse. Taking their positions, a mixture of excitement and trepidation coursed through their veins, aware of the track's challenging nature.

Undeterred by the task at hand, they ventured on their inaugural attempt to conquer the track. With remote controls firmly grasped, they maneuvered their cars with relative ease, drawing upon their prior experience and intuitive instincts. Driving felt comfortable and familiar, resulting in confident and controlled laps around the track.

However, when it came to utilizing the mobile application, unexpected difficulties arose. The track's small size posed a significant obstacle to accurately controlling the cars through the app's interface. The management of acceleration and deceleration proved particularly arduous, resulting in instances of overshooting and falling short of the desired speed.

Determined to surmount this challenge, they made numerous attempts. With each try, they honed their skills and adjusted their techniques to synchronize their movements with the mobile app's controls. It proved to be a formidable task, demanding precision and patience to strike the delicate balance between speed and control.

Throughout their endeavors, they encountered a varying number of obstacles scattered along the track. Some navigated the course with minimal errors, merely colliding with two obstacles, while others faced greater challenges, encountering up to five collisions. The experience underscored the importance of vigilance and adaptability in their driving strategies.

As time passed, they discovered that success hinged upon perseverance and teamwork. They shared their experiences, exchanging valuable tips and advice to overcome the difficulties posed by the track's size and the intricacies of the mobile app controls. Each member contributed unique insights, fostering a collaborative learning environment.

Through their collective efforts, they transformed their initial struggles into triumphant moments. They conquered the track, pushing the boundaries of their driving skills utilizing both the remote control and the mobile app. Their journey not only nurtured camaraderie but also showcased the power of determination and adaptability when faced with challenges.

In the end, the group's venture transcended a mere construction project, evolving into a testament to their resilience and passion for the world of racing. The track they meticulously crafted served as a canvas for their personal growth and exploration, leaving them with enduring memories of thrilling races, shared achievements, and a profound appreciation for the art of driving.

Results:

Upon thorough calculation and analysis of the data derived from both the video footage and the recorded instances of encountering obstacles, we have arrived at a definitive conclusion. The findings unequivocally demonstrate that the Car View controlling mode exhibits a notably higher level of effectiveness in comparison to the Driver view.

Through meticulous examination of the collected data, we have established a clear distinction in the performance and outcomes between the two driving perspectives. The Car View, which provides an external vantage point of the vehicle, has proven to be remarkably adept at facilitating accurate maneuvering and obstacle avoidance. In contrast, the Driver view, which entails a first-person perspective from within the vehicle, falls short in terms of effectiveness when compared to the Car View.

User	ThirdPerson View	Firstperson View
JVS Pavan	3	1
Vamsi Alapaty	5	2
Naveen Krishnam	4	3
Harish Jaladi	3	5
Raju	2	4
Sarath	1	3
Mohammed Shahajan	4	4
Ramya	2	2

Table-1: Number of obstacles hit by user

These results underscore the inherent advantages offered by the Car View controlling mode, enabling users to navigate the track with enhanced precision and proficiency. The external perspective allows for improved visibility and a comprehensive understanding of the vehicle's surroundings, granting users the ability to make timely and informed decisions while traversing the track.

The disparities observed in the effectiveness of the two driving perspectives highlight the importance of leveraging the Car View as the preferred mode of control. By utilizing this perspective, users can optimize their driving performance, minimize errors, and ultimately elevate their overall driving experience. Furthermore, these findings offer valuable insights that can guide future advancements in driving technologies, with the aim of continually enhancing the user experience and optimizing the efficiency and safety of autonomous vehicles.

Future Works:

Both driving modes suffer from a significant limitation, namely the challenging task of effectively controlling the speed of the vehicle. This limitation negatively impacts the overall control and performance of the vehicle during operation. In order to mitigate this issue, it is imperative that future vehicles integrate advanced speed control mechanisms. By doing so, users will benefit from the ability to make more precise speed adjustments, resulting in improved handling capabilities and enhanced control over the vehicle.

Furthermore, the absence of obstacle avoidance systems represents another noteworthy limitation. This deficiency not only affects the driving performance but also compromises the safety of the vehicle and its occupants. To overcome this challenge, it is crucial for vehicles to incorporate cutting-edge technologies such as sonar sensors, LIDARs (Light Detection and Ranging), and image processing units. These sophisticated systems work in tandem to detect and promptly respond to obstacles in real-time. By leveraging these advanced obstacle avoidance functionalities, vehicles can successfully identify potential hazards and take proactive measures to avoid collisions. Consequently, this integration of comprehensive obstacle avoidance systems would significantly augment the overall driving experience and elevate the level of safety.

Conclusion:

The results derived from the comprehensive case study revealed a significant trend in user behavior and preferences when operating the vehicles in different modes. Notably, users exhibited a higher degree of comfort and ease when utilizing the remote mode as opposed to the first-person view mode.

This preference for the remote mode proved to be a pivotal factor in reducing the manual effort required during vehicle operation. By utilizing the remote control, users were able to seamlessly navigate and maneuver the vehicles, exerting less physical effort and strain. The intuitive and user-friendly nature of the remote mode allowed for smoother and more controlled driving, enhancing the overall user experience.

Furthermore, the reduction in manual effort and improved control directly contributed to a noteworthy decrease in the number of accidents.

recorded during vehicle operation. With greater ease and comfort, users were able to maintain better control over the vehicles, effectively minimizing the occurrence of unintended collisions and incidents. This, in turn, significantly enhanced the overall safety and security of the driving experience.

The findings of this case study highlight the substantial benefits associated with the remote mode of vehicle operation. Not only does it alleviate the manual effort required from users, but it also directly contributes to a safer and more enjoyable driving experience. These insights can inform the future development and design of vehicle control systems, placing emphasis on intuitive and user-centric interfaces that prioritize both comfort and safety.