ADOPTION OF AUTONOMOUS VEHICLES AMONG THE AGING POPULATION

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A Research Paper Submitted to the School of Computing Faculty of Middle Georgia State University in Partial Fulfillment for the Requirements for the Degree

DOCTOR OF SCIENCE IN INFORMATION TECHNOLOGY

MACON, GEORGIA
2024

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Abstract

As the aging population grows and technology persists, autonomous vehicles (AVs) present a significant opportunity to enhance safety and mobility for the elderly. This qualitative literature review identifies the specific challenges faced by elderly drivers in safety and technical concerns.
The study identifies four emerging themes: financial barriers to AV market access, resistance to autonomous vehicle trust, quality of life, improvements, and cognitive decline in driving abilities.
The results reveal the benefits AVs can offer, however high cost and trust issues among the elderly prevent their broad acceptance and usage. The study highlights the requirement of developing user interfaces that are more accessible for the elderly, implementing pricing strategies that consider their financial constraints, and establishing AV educational programs. These strategies are essential for enabling elderly drivers to AV technology. This allows the elderly to leverage AV innovations to maintain their independence and improve their overall quality of life.

Keywords: autonomous vehicles, ADAS, driverless vehicles, shared autonomous vehicle, elderly, healthy aging

Introduction

When the global elderly population accepts autonomous vehicles as part of their daily life, it can allow organizations to create new business offerings to society by reducing car accidents caused by senior drivers, reducing emissions, helping the environment when implementing public elderly autonomous transportation, and educating the elderly how to maintain mobility independence when their driver's license is revoked due to old age, however, with the help of autonomous technology can allow the elderly to maintain their license.

In 2015, the U.S. Department of Transportation data indicated over 40 million licensed drivers in the United States were aged 65 and over, meaning nearly one in five drivers on American roads belonged to this age group (Fireman, 2017). The development of autonomous vehicles and accident prevention technologies like Automatic Emergency Braking will likely transform the occurrence and types of collisions on the roads (Fireman,2017).

In 2020, 29.7% of South Korea's population experienced transportation challenges, and by 2025, the elderly are expected to make up 20.3% of the populace, resulting in a "super-aged" society. The Korean government advocated for elderly drivers to voluntarily give up their licenses and introduced free public transportation to ensure the safety of pedestrians and drivers. Still, these measures are not sustainable (Kang, Park, Seo & Kim, 2023).

The purpose of this paper is to examine the technological advances leading to the creation of autonomous vehicles that may benefit elderly citizens in different countries to fit personal needs. Adopting autonomous vehicles can save lives, prevent future automobile accidents globally, and reduce the emissions impacting our environment today. This research will answer the following questions:

RQ1: What are the leading factors contributing to the resistance of the elderly population to adopting autonomous technology, and what potential benefits might they miss out on as a result?

RQ2: What are the key findings (major themes/points and/or key issues) that emerge from the literature regarding the adoption of autonomous vehicles among the aging population globally?

Review of the Literature

Autonomous Vehicle Levels

Autonomous vehicles (AV) entering the automobile marketplace are becoming known to the global society and available for use by interested consumers. Autonomous vehicle technology can confuse the level of autonomous driving to the user. It is critical to investigate the key issues that may be associated with an individual's perception and awareness of various levels of AV technology in existing vehicles and their viewpoint (Nurliyana et al., 2020). There are constraints to adopting driverless vehicles by the elderly global population today due to the concerns of personal safety on operating autonomous driving features. The National Highway Traffic Safety Administration (NHTSA) established 5 different levels of automation in a vehicle (Lajunen & Sullman, 2021). We can initially start from level 0 where the human driver operates the vehicle all the time while in motion. In levels 1 and 2, the advanced driver assistance system (ADAS) is placed in the vehicle allowing steering, braking, and accelerating to initiate while driving, but the human driver must be ready to gain back control of the vehicle during operation. In level 3 and higher levels, start using the automated driving system ADAS where the autonomous vehicle performs the driving task. Still, when prompted, the human drive must be ready to take back control. When driving conditions are not favorable, level 4 ADAS can be an advantage to monitoring the environment and does all the driving operations in certain conditions where the human driver doesn't have to take control. Lastly, in level 5 ADAS while the vehicle is in operation, any human occupants do not need to be involved during the driving operation as the fully autonomous feature is in control. (Lajunen & Sullman, 2021)

Research was conducted in Naples, Italy on passengers who use public transportation and their acceptance of change toward shared autonomous services. The European population is more accepting of shared autonomous vehicle (AV) services than in America due to a lack of trust (Cateni, 2020). The benefits of using AV services can reduce the number of accidents and traffic congestion on public roads and help reduce fuel consumption, preserving our environment. This is when implementing Level 4 and Level 5 ADAS achieves the goal of being driverless without a human operator. An average commuter gets delayed 38 hours per year due to traffic congestion and current trends indicate road traffic injuries will be the fifth leading cause of death by 2030 (Kyriakidis et al., 2015). Automated driving systems have the potential to improve vehicle safety and road transportation efficiencies.

The Global Aging Population

In the United Kingdom, 20% of the current population will be 60+ years old by 2050, where the elderly will face mobility challenges such as being unable to drive or be susceptible to accidents due to age-related impairment and physical and sensory disabilities (Zandieh & Acheampong, 2021). This is an opportunity for automobile manufacturers to focus on AVs to address the increase of elderly drivers in the coming decades. Most importantly, the industry must make autonomous technology user-friendly to its consumers, including the elderly, as complexity can lead to negative experiences. In the United States, the population of seniors aged 65 and older will reach 94.7 million by 2060. While many of them may have years of driving experience, this age group often shows signs of mild impairments that could impact their ability to drive

safely. Examples include poor vision, declining memory performance, and slower response time (Liang et al., 2020). The use of ADAS can help mitigate the dangers of impairment the elderly experience as they age. A study conducted in 40 countries, with at least 25 respondents from each country, showed that 69% of those surveyed believed fully automated driving in automobiles would reach a 50% market share between now and 2050. (Kyriakidis, Happee & De Winter, 2015).

In Canada, individuals aged 65 years and older make up 17% of the total population, and this percentage is anticipated to rise over the next decade (Hassan et al., 2019). Research shows that older Canadians, aged 65 and above, showed less interest in autonomous vehicle technology compared to younger individuals aged 18-64, while in the United States, a significant number of older Americans were more open to autonomous vehicle technology than younger Americans. (Hassan et al., 2019). These numbers suggest that the elderly population of Canada may not be entirely aware of the benefits of autonomous vehicle technology in comparison to their counterparts in the United States. Proper training and awareness campaign programs for autonomous vehicle technology should be implemented in Canada so that the elderly populace can be informed of the benefits of this technology, such as safety.

Elderly Challenges

The elderly population faces many challenges, such as mobility issues, as they continue to age. The elderly can expect to have many of their mobility issues resolved with the help of ADAS. Implementation of AV technologies creates an opportunity to help improve the safety and mobility of senior citizens. Outdoor mobility is an important factor for the elderly to healthy age to meet the physical and mental demands that come with being at an advanced age. The elderly can have more access to opportunities that encourage physical activities and social interactions with others which may reduce mental isolation. When the elderly stop driving and have their mobility limited, their lives can be negatively impacted by the reduction of social engagement. Driving cessation can negatively affect aging adults and it can impact other areas of their life because social engagement is critical to sustain a life of well-being. (Stowe, Cooney & Proulx, 2013). The ability to drive is an important mechanism that contributes to many adults, young and old, to fulfill their social roles and engage with their environments (Chihuri et al., 2016). Autonomous vehicles can aid in lowering the risks the senior driver faces while allowing them to maintain their independence by removing the direct need for human control (Huff et al., 2019).

Artificial Intelligence

Elderly occupants can face mental fears when trusting artificial intelligence (AI), the core technology behind AVs, to drive them safely to their destination as much of the population has reservations about riding in autonomous vehicles due to potential system failure and not being guaranteed to perform better than an actual human driver (Schoettle & Sivak, 2014). Mass adoption of AVs may depend more on the psychological mindset of the populace rather than technological improvements. The general public may be skeptical of relying on new autonomous vehicle technology, and this needs to be addressed so that they can overcome any fear and safety concerns they may have. (Cateni, 2020). Trust in technology starts to diminish with age and learning a new set of skills becomes difficult when routines are already established (Liang et al., 2020). The development of trust and familiarity with AVs can be initiated by providing autonomous public transportation to the populace. This will enable future AV users to familiarize themselves with the technology. The initiative can start with local governments providing autonomous services to the public. This approach would not only cater to the needs of the elderly but also allow those approaching old age to become educated and develop trust in AV technology.

Cybersecurity

The elderly continue to face many technical challenges, and trust in the technology is essential for AV to be adopted globally. Increased cybersecurity risks are expected to be a significant challenge for AVs, as their dependency on technical components such as sensing, communication, and AI makes them attractive targets for potential cyber-attacks (Seetharaman et al., 2021). Increased cybersecurity concerns can contribute to the resistance to AV adoption by the elderly populace, and automobile manufacturers must ensure safety is top priority for potential consumers. Automobile manufacturers must maintain trust with their consumer, as technical challenges continue to persist for the elderly population. An increase in the familiarity of AV technology and the safety measures they offer would allow manufacturers to better attract elderly drivers, and properly assist in their transition from non-AV to AV vehicles.

Autonomous Vehicle Cost

Elderly individuals face financial obstacles when acquiring AVs. This challenge is not exclusive to this demographic, as a substantial majority of consumers also experience similar difficulties when considering the purchase of AVs for personal use. An issue is that most individuals are unwilling to pay extra for autonomous technology (Schoettle & Sivak, 2014). A survey of Canadians indicated that most elderly individuals were not willing to pay more for a vehicle with autonomous features (Hassan et al., 2019). One concern was the assumption that future maintenance and repair costs for AVs may be more expensive than traditional vehicles. However, elderly individuals with a higher income were more willing to pay more to add the automated driving feature to their next vehicle (Kyriakidis et al., 2015). Failing to consider the needs of the elderly can be disastrous for the mass adoption of autonomous technology (Huff, DellaMaria, Brinkley & Posadas, 2019). How can it be adopted by the general populace if most of the elderly population can't afford it, especially those on a limited income? It presents the question as to whether autonomous technology is reserved for the wealthy. Obstacles exist in seeing autonomous vehicles being used by the elderly population on a large scale. One solution may be the use of government subsidies in countries where the elderly population is more prominent, as it can help negate the cost of acquiring an AV and become an attractive option for the elderly consumer. While this may or may not be the solution, the issue will continue to persist unless it is properly addressed.

Methodology

This research utilized aggregate data, primarily sourced from scholarly articles, using thematic analysis as the primary methodology. Implementing a thematic analysis literature review involves three separate phases: Stage I includes determining the sample size of scholarly articles and tackling design-related issues, Stage II involves the creation of themes and a coding system, and Stage III encompasses the validation and application of the established code (Boyatzis, 1998). These articles will be identified using academic databases such as GALILEO and Google Scholar. The search terms will encompass a range of topics including but not limited to Elderly drivers, Senior citizens, Autonomous vehicles, Driverless vehicles, Driverless cars, Driving cessation, and Advanced driver assistance systems (ADAS).

The research was focused on scholarly articles that were published in the last twelve years, specifically between 2012 and 2024.This time frame ensured that the research data reflected current trends and was relevant. The data was meticulously analyzed using Delve, a qualitative data analysis software. The software was instrumental in organizing the data and identifying recurring patterns or themes, which were then coded. Once the themes were identified, they were critically reviewed and refined to ensure accurate encapsulation of the study's findings about research questions. Any inconsistencies were addressed during the review process to provide a clear and concise understanding of the data.

Data analysis

The implementation of the thematic analysis method facilitates the identification, analysis, organization, description, and reporting of themes within a data set (Nowell, Norris, White, & Moules, 2017). Table 1 displays the key findings from approximately 27 identified scholarly articles into four emerging themes that provided theoretical foundations for each theme to include: (1) Financial barriers to AV market access, (2) Resistance to autonomous vehicle trust, (3) Quality of life improvements, (4) Cognitive decline in driving abilities.

Table 1: Themes, References and Main Contribution

Theme	Authors (Year)	Main Contribution
1	Zandieh & Acheampong, (2021)	Autonomous vehicles are a new invention and that could be unaffordable to most people in old age
1	Huff, DellaMaria, Brinkley & Posadas, (2019)	Failure to adequately consider the needs and concerns of this group could prove disastrous for consumer adoption of self-driving vehicles given the financial wherewithal of many older adults
1	Hassan, Ferguson, Razavi, & Vrkljan, (2019)	Most older adults are not willing to pay more for a vehicle with autonomous features
1	Kyriakidis, Harper & De Winter, (2015)	Older people seemed less likely to pay for such technology, but showed higher acceptance
1	Liang, Lau, Baker, & Antin, (2020)	Seniors appeared less willing to pay for ADAS, highly automated, or driverless technologies
2	Mesquita, Maciel, Antonialli, & de Rezende, (2022)	Implications of automated vehicles for anxiety, intensity of disability, prior knowledge of AVs
2	Hryniewicz & Grzegorczyk, (2020)	AVs is connected with multiple challenges such as safety, legal liability, ethical questions and regulatory issues, which result in consumers' fear toward this tech.
2	Murtaza, Cheng, Fard & Zeleznikow, (2022)	There are a number of challenges and potential risks in the adoption of ADAS and autonomous driving functions in modern cars
2	Ji, (2015)	HCI researchers should pay more attention to research about autonomous vehicles and about aging drivers with autonomous cars.
2	Nurliyana, Lestari, Prasetio, & Belgiawan, (2023)	The relationship between an individual's awareness of AV technology in current vehicles and their perspective toward different levels of AV technology
2	Seetharaman, Patwa, Jadhav, Saravanan, & Sangeeth, (2021)	Cyber-threats are likely to be a more prominent concern in AVs
2	Schoettle & Sivak, (2014)	High levels of concern about riding in self- driving vehicles, safety issues related to equipment or system failure
3	Das et al., (2017)	Autonomous vehicles can cater to the unfulfilled travel/activity demand of the elderly.

Table 1: Themes, References and Main Contribution (Continued)

3	Sun, Jing, Zhao, Chen, Zhan, & Shi, (2020)	Mobility is closely related to the physical condition and quality of life of the elderly and promotes society's overall development.
3	Kadylak, Cotten, & Fennell, (2021)	As a growing number of adults may face transportation limitations in the future, AVs may be able to help overcome transportation limitations.
3	Curl, Stowe, Cooney, & Proulx, (2013)	Driving is a critical component of autonomy, freedom of choice, and engagement for adults, just as it is for younger people
3	Chihuri et al., (2016)	Driving cessation in older adults appear to contribute to a variety of health problems, particularly depression.
3	Gasne, Paire-Ficout, Bordel, Lafont, & Ranchet, (2022)	Autonomous vehicles could benefit older adults by prolonging or even improving their mobility, security, autonomy and quality of life.
3	Lajunen & Sullman, (2021)	ADS can significantly increase the years of healthy living and life quality for the elderly
4	Ljungholm, (2019)	U.S. adults who expect driverless vehicles would help elderly and disabled be more independent
4	Tappen et al., (2023)	Reconfigured in-vehicle sensing systems could provide widespread, low-cost early warnings of cognitive change and decline to the large number of older drivers on the road in the U.S. and elsewhere.
4	Kutoku, Mihara, Yasuda, Tani, Akamatsu, Nakahata, Miyake & Sunada, (2023)	It is inevitable that cognitive decline by aging, most of elderly people must consider how long they should continue to drive.
4	Sekadakis, Katrakazas, Santuccio, Mortl, & Yannis, (2022)	*Cognitive abilities and cognitive performance such as measures of speed processing declined in the older population.*
4	Bastola, Brinkley, Wang, & Razi, (2024)	This is a serious concern for older individuals and individuals with low cognitive abilities who are more likely to have poor situational awareness of the system.
4	Rhiu, Kwon, Bahn, Yun, & Yu, (2015)	Elderly drivers show a decreased driving ability due to a decline in perception, cognitive response time, cognitive memory and attention
4	Harper, Hendrickson, Mangones & Samaras, (2016)	Issues related to mobility exist within the senior population due to reduced cognitive abilities and increased medical issues or disabilities.
4	Taeihagh & Lim, (2019)	Adopting AVs can potentially reduce or eliminate the largest cause of car accidents while also outperforming human drivers in perception

Notes: Theme 1 = Financial barriers to AV market access, Theme 2 = Resistance to autonomous vehicle trust, Theme 3 = Quality of life improvements, Theme 4 = Cognitive decline in driving abilities

Results

This research identified four themes: financial barriers to AV market access, resistance to autonomous vehicle trust, quality of life improvements, and cognitive decline in driving abilities.

Theme 1: Financial barriers to AV market access

The first theme identifies the financial implications for the elderly when trying to obtain an autonomous vehicle. Huff et al. (2019) found that participants highlighted that cost was the primary concern in the potential purchase of a self-driving vehicle and expressed the affordability of such vehicles for the average person was out of reach. Automobile manufacturers must consider the income limitations of the elderly, which often exclude them from accessing autonomous vehicle technology. Hassan et al. (2019) conducted an explanatory factor analysis of survey data, which revealed that a higher income and higher education level were the significant factors affecting the number of in-vehicle technologies utilized by older adults.

As the elderly are less likely to pay autonomous vehicles, but have greater acceptance for highway travel, navigating through traffic jams and automatic parking indicates that cost is a significant barrier (Kyriakidis, Harper & De Winter, 2015). If the cost of automated driving technology becomes unaffordable, making it accessible only to those with the financial means to own it rather than through public transportation options, then price could appear as an obstacle to offering equal mobility and access to older adults across different financial situations (Zandieh & Acheampong, 2021). According to Liang et al. (2020), seniors avoided using the Advanced Driver Assistance System (ADAS) because they believed it provided minimal benefits, limited functionality was high in cost and untrustworthy.

Theme 2: Resistance to autonomous vehicle trust

The second theme highlights the elderly population's resistance to trusting autonomous technologies. As autonomous vehicles have the potential to enhance mobility and independence, the elderly express concerns about their reliability, safety, and the challenge of learning how to operate them
(Mesquita et al. 2022). According to Hryniewicz & Grzegorczyk (2020), the research data indicated that safety concerns did not impact the elderly's acceptance of autonomous vehicles (AVs), with the observed pattern pointing towards a neutral stance on AV technology adoption. Research should be conducted to study the effective and best possible training structure for elderly AV drivers
(Murtaza, Cheng, Fard & Zeleznikow, 2022).

As vehicle technology changes rapidly, research in Human-Computer Interaction (HCI) is focusing on future vehicles and needs to consider the potential difficulties the elderly may face in learning new technologies, highlighting the need for inclusive vehicle design that accommodates their capabilities
(Ji, 2015). Individuals often resist change and may be cautious in adopting new technologies with which they are unfamiliar, particularly when such technologies markedly transform the way they interact with autonomous vehicles (Nurliyana et al., 2023).

Cybersecurity threats pose a significant concern in AVs since they represent a progression from modern vehicles and directly link to the associated cybersecurity issues (Seetharaman et al., 2021). Schoettle & Sivak (2014) administered a survey where the majority of participants across various age groups expressed high levels of concern about riding in self-driving vehicles, system failure, and self-driving vehicles not performing as well as human drivers.

Theme 3: Quality of life improvements

The third theme explores the health and well-being benefits when adopting features of autonomous vehicle capabilities. Using autonomous vehicles (AVs) enables the elderly to improve their mobility, which in turn can expand their personal travel options and consumer behavior in retail activity (Das et al., 2017). A survey conducted in China by Sun et al. (2020) found that the introduction of autonomous vehicles (AVs) and shared autonomous vehicles (SAVs) enables independent travel for the elderly. This capability positively influences their well-being and increases social engagement during travel. According to Kadylak, Cotten, & Fennell (2021), researchers anticipate that AVs may enable older adults to live actively, be more independent, and have healthier lifestyles.

Curl et al. (2013) have determined that the cessation of driving negatively impacts the well-being of older adults and is also expected to affect additional aspects of their lives. Chihuri et al. (2016) reported that the cessation of driving is linked with a decrease in overall health, in physical, social, and cognitive capacities and is associated with a greater risk of admission into long-term care facilities and a greater risk of mortality. The aging population in France presents new challenges in terms of health and mobility, where recent advances in vehicle automation are positioned to transform the landscape of transportation and mobility for the elderly (Gasne et al., 2022). Automated driving systems and self-driving technology have the potential to not only enhance the safety of elderly citizens but also to increase years of physical and mental health (Lajunen & Sullman, 2021).

Theme 4: Cognitive decline in driving abilities

The fourth theme examines the decline in driving abilities among the elderly due to cognitive impairment. American adults believe that autonomous vehicles would improve the independence of the elderly and those with disabilities to feel confident about being on the road (Ljungholm, 2019). As more sensors are integrated into vehicles, upgrading in-vehicle sensing systems may offer an affordable method for early detection of cognitive deterioration among the growing population of seniors to drive safely in the U.S. Tappen et al., (2023)

Japan is encountering the challenges of an extremely aged population, leading to a rise in the number of older drivers who may be experiencing cognitive decline, thereby increasing their susceptibility to being involved in traffic accidents (Kutoku et al. 2023). Sekadakis et al. (2022) discovered a significant relationship between diminishing cognitive abilities and driving performance. Autonomous vehicles will eventually take over the driving decisions without any human intervention, making it crucial to create ethical guidelines that prioritize the safety and well-being of all occupants (Bastola et al., 2024)

Smart car technologies can help reduce the impacts of elderly drivers' functional decline, reduce uncertain behaviors by assisting them with their driving activities and increase road safety (Rhiu et al., 2015). Not only does vehicle automation reduce crashes, but also has the potential to traffic congestion, travel times and potentially energy consumption (Harper et al., 2016). According to Taeihagh & Lim (2019), human error is responsible for 90% of car accidents and the adoption of AVs could significantly reduce the largest cause of car accidents surpassing human drivers in perception, decision-making and execution.

Discussion

The first research question on the resistance to adopting AV is the economic challenges the elderly face when acquiring AVs. The literature focuses on significant cost barriers among the elderly demographic being cost-sensitive and not able to afford AV technology. The research discovers high cost of AVs may limit access for older adults based on income and education levels. Automotive manufacturers must consider the financial constraints and develop a market for AV technology to guarantee access for the elderly. The resistance to trusting AV technology among the elderly raises concerns over safety, reliability, and the technology learning curve. There are concerns about system failures and the overall performance of AV technology when compared to a human driver.

The second research question on the key findings that emerged from the literature has indicated when the elderly adopt AV technology, it can significantly improve the quality of life for older adults by enhancing mobility, independence, and social engagement. When utilizing AVs can lead to additional travel options, maintaining an active lifestyle, increasing social activities, and potentially living a healthier life overall. The cessation of elderly driving has been associated with declines in physical, social, and cognitive health, recognizing the importance of AVs in supporting the mobility needs of the aging population.

When the elderly face cognitive decline, AVs can help address aging and cognitive impairment. The integration of sensors and smart car technologies into AVs offers opportunities for early detection of cognitive decline, potentially enhancing the safety and independence of elderly drivers. The shift towards fully autonomous driving systems requires the development of ethical guidelines to ensure the safety and well-being of all occupants. The potential reduction in human error-related accidents and improvements in traffic congestion and energy consumption further highlight the societal benefits of AV adoption.

Implications

Based on the research, the high cost of AVs may impair income inequality by limiting access to those who can afford it, specifically affecting the elderly population with limited income. The literature reveals that automobile manufacturers must recognize the market adjustment to make AVs affordable to the elderly, perhaps utilizing subsidies to help reduce costs. The literature suggests integrating AV technology into public transportation to provide fair access to the elderly from different income levels. There are studies have shown that age, income, gender level, and nationality have a significant effect on autonomous vehicle adoption (Nurliyana et al., 2023). Also, with cybersecurity concerns, automobile manufacturers must prioritize and communicate the safety and security measures in place to gain public trust.

Additionally, there is a significant need for effective training initiatives aimed at increasing the elderly's confidence and trust in using AVs, which may be crucial in AV adoption. Training programs must be developed to assist elderly drivers in learning the use of ADAS to understand the system's limitations Liang et al. (2020). The introduction of AVs has the potential to significantly improve the elderly's quality of life by enhancing mobility, independence, and social engagement, implying a positive impact on public health. There is an implication for policy support to promote AVs to maintain the well-being of the elderly, which may reduce the burden on healthcare and long-term care facilities. Lastly, the research findings highlight the need for regulatory frameworks that support the integration of AVs with a focus on elderly drivers. AVs could offer an alternative solution to address safety concerns associated with cognitive decline and enable the elderly to maintain impendence.

Conclusion

The thematic analysis identified four themes that expose the elderly resistance to adopting AVs and the key findings impacting the global elderly population. Existing financial barriers significantly impact the elderly's access to autonomous vehicle technology and the cost of AVs and related technologies like ADAS is currently beyond the reach of many older adults. Elderly trust in AVs is a complex issue that needs to be addressed and it is not entirely dependent on safety concerns. There is existing resistance due to unfamiliarity with the AV technology and cybersecurity anxieties among the elderly population that need to be addressed. There are potential benefits of AV technology to reduce human error to decrease elderly traffic accidents and improve road safety as cognitive decline is a concern among the elderly allowing greater autonomy. Overall, the elderly's quality of life can change substantially including improved mobility, independence, and social engagement, which leads to a healthier lifestyle.

There are limitations to this research based on the existing scholarly articles retrieved through the academic database and Google Scholar may not comprise all available academic content or relevant literature based on the search keywords used. The rapid technological advancements in AVs may cause the research findings to be obsolete after publication. Additionally, the research did not account for the broad legal and regulatory challenges associated with AVs that can influence elderly adoption in their respective countries.

This research highlights the specific needs of adopting AVs as part of their daily routines by the elderly population. Future research should focus on improving elderly training and education programs. These programs can improve their understanding utilize AV technology and increase their comfort levels. Additionally, technical accessibility requires further research to ensure user-friendly interfaces within AVs accommodate physical and cognitive changes associated with aging. Lastly, future research should examine the affordability of AV technology for the elderly population and allow financial accessibly to those on a limited budget.

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