International Journal of Advance and Innovative Research
Volume 13, Issue 1 (II): January - March 2026
ISSN 2394 - 7780

AI IN ELECTRIC VEHICLES: CONSUMER'S READINESS TO ADOPT VEHICLE AUTONOMY FROM LEVEL 0 TO LEVEL 4

Ms. Dhanwantari Narawade[1] and Dr. Pramila Patil[2]
[1]Assistant Professor, Modern College of Commerce and Computer Studies, Nigdi, Pune 44
Research Scholar, Department of Commerce, SNDT Women's University, Pune
[2]Associate Professor & Head, Department of Commerce, PG Department, SNDT Women's University, Pune

ABSTRACT
Artificial Intelligence (AI) in the transportation sector enhances urban mobility by giving more efficient service to transportation. It has a tremendous potential to enhance safety, reduce risk and grow efficiency in driving. AI enables real-time decision making, object detection, and automation in driving systems. These technologies demonstrate how AI enhances vehicle functionality and improves safety in today's driving environment. Looking ahead, AI is expected to enable full autonomy in vehicles, foster integration with smart city infrastructures, and drive innovations in fleet management. These advancements are anticipated to significantly improve vehicle safety, operational efficiency, and the overall user experience, solidifying AI as the fundamental technology for the future of intelligent transportation systems. Since there is a rising interest in usage of AI in transforming the automotive landscape, the study highlights the consumer expectations of AI for technology advancements in electric vehicles which will, in future, be one of the significant causes for transformation from Level 0 to Level 1 vehicle autonomy. This revolutionary combination holds the promise of reshaping traditional development processes, enhancing efficiency, and accelerating innovation. AI technologies are becoming integral within numerous facets of software development within autonomous vehicles, leading to a paradigm shift towards Software-Defined Vehicles. In this study, a survey of 125 electric vehicle consumers has been analyzed, focusing on consumer expectations towards AI in electric vehicles as a factor while making purchase decisions. The findings show the growing expectations of AI in electric vehicles from the consumers.

Keywords*: Artificial Intelligence, Autonomy in vehicles, Intelligent transportation, Consumer Expectation*

1. INTRODUCTION
It is generally acknowledged that electric cars (EVs) are the most promising way to address the issues that fossil fuel-powered vehicles confront. They have lower particulate matter emissions, are quieter, simpler to maintain, and do not directly emit carbon dioxide. **(Sovacool. B.K. 2010)** As energy systems move toward a decarbonized and digitalized future, artificial intelligence (AI) is anticipated to play a significant role in integrating EVs into infrastructure. Algorithms that display behaviors considered intelligent are known as artificial intelligence (AI) algorithms.

(Russell, S., 2002) Optimization, planning, forecasting, modeling, etc. are necessary for the successful integration of EVs into the grid. Many AI algorithms are made to perform these kinds of tasks. It is thought that as technology advances in areas like sensors, cameras, GPS, and microprocessors, the use of autonomous vehicles will become essential in the near future. For many years, people found driving to be thrilling and enjoyable, which prevented the development of technologies that would make driving less enjoyable. The idea of driverless cars is now possible because to a number of technologies that have been introduced to the market throughout time. Due to the distracting nature of driving, an increasing number of people are using cell phones, iPads, or the internet while operating a vehicle. As a result, there is a considerable need for autonomous cars, which provide a way to reduce their idle time. The era of autonomous cars is emerging as a result of businesses responding to these desires. There are already many technologies on the market that help drivers, like collision avoidance, lane deviation correction, and self-parking. As a first step toward completely driverless vehicles, certain automakers have released semi-autonomous technology packages. **(Amey Phatale, 2018)**

1.1 Levels of Autonomous Vehicles
In the actual world, implementing autonomous vehicles is a challenging undertaking. Implementing it gradually, step by step, is one realistic way to address the issue. For this, different tiers are defined. In the increasing order of autonomous capabilities, these levels range from Level 0 to Level 4. The United States government's National Highway Traffic Safety Association (NHTSA) is responsible for enforcing the nation's traffic regulations. In order to make the levels of automation clear, the agency has divided cars into the following five categories.

a) Level 0: No Automation
At this level, the driver always has total control over the car. Vehicles contain mechanical continuity systems, but the driver has complete control over braking, steering, throttle, and safety functions. These cars might only

have warnings, but they don't do anything about it. Wipers, indicators, parking lights, headlights, and taillights can all still operate semi-automatically. This level includes Vehicle 2 Vehicle (V2V) warning technology.

b) Level 1 – Function - specific Automation

The vehicle is in charge of one or more particular control functions at this level. These functions won't interfere with other processes and will operate independently. Safety activities are still the driver's responsibility. On the vehicle, limited authority may be implied. As an illustration, consider adaptive cruise control. This level includes primary controls such as Electronic Stability Control (ESC), which functions automatically. This level includes dynamic brake support, which can help in collision situations. When performing tasks like driving or braking, the vehicle's automatic system may help the driver.

c) Level 2 – Combined Function Automation

At least two key functions are automated at this level, working in tandem with the driver. The driver is in charge of operating safely and keeping an eye on the roads. At this level, vehicles can share authority. Despite this, drivers must keep an eye on everything, perform safety procedures, and be ready to take over at any time. Use adaptive cruise control with lane centering, for instance. The ability for the driver to physically disarm the vehicle and let it operate independently is the primary distinction between level 2 and level 1.

d) Level 3 – Limited Self - Driving Automation

Vehicles of this category allow the driver to have complete control over the vehicle. The driver must take over when necessary because not all traffic situations permit complete control of the vehicle. The car has the ability to operate safely. One significant change from level 2 to level 3 is that drivers are no longer required to constantly monitor and perform safety procedures. For instance, the car will request that the driver take control when there are road work areas.

e) Level 4 – Full Self - Driving Automation

Vehicles can carry out every operation during the journey at this level. The driver only needs to enter the location; the automobile will take care of the rest. At no point during the journey is the driver expected to take control of the vehicle. Only vehicles are used for monitoring and safety tasks.

2. REVIEW OF LITERATURE

1. **Weiqi Hua, et al. (2024),** in their paper, **An Overview of Artificial Intelligence for Electric Vehicle Eergy Systems Integration,** draw attention to electric cars (EVs) as a sustainable substitute for fossil fuel-powered automobiles because of its lower emissions, quieter operation, and ease of maintenance. The authors highlight how artificial intelligence (AI) will play an increasingly important role in integrating EVs with future digitalized and decarbonized energy systems. By analyzing user behavior, improving charging schedules, and supporting infrastructure design, AI apps promote the adoption of EVs. In support of this, De Rubens examined EV consumer motives using the k-means clustering approach and found that pricing and vehicle-to-grid (V2G) capabilities were important adoption drivers. In a similar vein, Bas et al. classified potential EV purchasers and identified important characteristics impacting EV purchasing decisions using machine learning techniques like support vector machines, deep neural networks, and gradient boosting.

2. **Javier Bas, et al., (2021)** in their paper **Classification of potential electric vehicle purchasers: A machine learning approach,** conclude that EV adoption is influenced by multiple interrelated factors, including the county of residence, intended engine type of the next vehicle, key vehicle characteristics, and positive attitudes toward EVs and technology. The county variable acts as a proxy for income, emphasizing the sinificance of spatial economic gaps, even when charging infrastructure and power grid availability do not differ considerably between Maryland counties. The report highlights financial factors as key factors influencing EV adoption, specifically vehicle cost and government income tax benefits. Purchase decisions are also greatly influenced by useful car features like driving range, fast charging time, and availability of home charging infrastructure. Overall, the authors show that consumer attitudes, vehicle-related characteristics, and economic considerations all influence EV adoption, and that machine learning methods are useful for identifying and forecasting prospective EV purchasers.

3. **Zarazua de Rubens, Gerardo. (2019),** in his paper, **Who will buy electric vehicles after early adopters? Using machine learning to identify the electric vehicle mainstream market,** investigates the shift in EV adoption from early adopters to regular consumers. The study uses the k-means clustering method to establish six consumer segments based on the likelihood of EV adoption using data from 5,067 respondents in five Nordic nations. Nearly 68% of respondents, who represent the near-term mainstream market, fall into one of three clusters with a strong readiness to embrace EVs, according to the results. The results show that the most important factor in EV adoption is car affordability, while new features like vehicle-to-grid (V2G)

technology also increase consumer interest. The study also highlights how mainstream adoption is influenced by economic and environmental issues, as well as technological appeal and status worth. Overall, the research concludes that effective EV policies and market strategies must be aligned with the preferences and expectations of mainstream consumers to accelerate widespread adoption.

4. **Noviati, et al. (2024)** in their paper Artificial Intelligence in **Autonomous Vehicles: Current Innovations and Future Trends,** examine how AI will change transportation in the future with driverless cars. The authors discover that by decreasing human error, AI improves route accuracy, fuel economy, and safety, increasing overall dependability and cost effectiveness. According to the study, there is a high potential adoption rate of 85%, suggesting considerable consumer demand. However, public trust is still a major worry, as almost 40% of respondents expressed worries about the safety and dependability of completely autonomous vehicles. In order to improve real-time decision making, vehicle safety, automation, and operational efficiency in autonomous vehicle systems, the research believes that advances in artificial intelligence—specifically, machine learning, computer vision, and sophisticated sensor integration—are essential.

5. **Amey Phatale,** in his paper, **Autonomous Vehicle Levels & Trends,** discusses the increasing reliance on technology and the increasing emphasis on driverless cars made for a broad range of customers. According to the report, driverless cars are intended to offer reduced traffic congestion, enhanced safety, and freedom from driving. The study highlights the active participation of large corporations in the development of autonomous vehicle technology, citing Google's driverless vehicle as a notable example that uses GPS, cameras, radar, laser scanners, and LiDAR to function autonomously while following traffic regulations. These technologies reduce accidents by enabling real-time detection of roads, obstructions, and pedestrians. The National Highway Traffic Safety Administration's (NHTSA) five levels of vehicle automation, which range from Level 0 (no automation) to Level 4 (complete self-driving automation), are also described in the report. These levels represent the progressive development of autonomous driving capabilities.

3. RESEARCH GAP

The adoption of electric vehicles, AI applications, and autonomous vehicle technologies are all covered in great detail in previous research, primarily from a technological, economic, and policy standpoint. There is little empirical study on customer acceptance and readiness for AI-enabled car autonomy, especially at varied levels of autonomy. The majority of research ignores the gradual shift from Level 0 to Level 4 autonomy in favor of either completely driverless vehicles or early-stage driver assistance systems. Studies examining AI characteristics as a major factor influencing EV purchasing decisions are scarce, particularly in the Indian setting. The relationship between consumer expectations of AI features and acceptance of rising autonomy levels is not well studied, and there is still little region-specific consumer research in emerging EV markets. Understanding consumer attitudes and preparedness for AI-driven vehicle autonomy in EVs is clearly lacking.

4. Statement of Problem - Artificial intelligence developments have made it possible for electric cars to prgress from Level 0 (no automation) to Level 4 (complete self-driving automation). Higher levels increasingly add AI-based driver assistance, partial automation, limited self-driving, and full vehicle autonomy, while Level 0 cars are completely controlled by humans. Even with the speed at which technology is developing, consumer adoption of these degrees of autonomy is still unclear, especially in developing EV markets. Despite the growing availability of AI-enabled features like driving assistance, safety systems, and smart infotainment, it is unknown how consumers view and trust these features across various levels of autonomy. Research on customer preparedness for a gradual transition from Level 0 to Level 4 autonomy and its impact on EV purchasing decisions is scarce.

Examining customer expectations, readiness, and acceptability of AI-enabled electric vehicles from Level 0 to Level 4 autonomy, with reference to electric vehicle users in the Pune metropolitan region, is the issue this study attempts to solve.

5. OBJECTIVES OF THE STUDY

1. To overview the AI techniques used in transportation
2. To understand the merger of AI in electric vehicles.
3. To understand the Level 0 to Level 4 vehicle autonomy.
4. To analyze the expectations of the consumers towards AI features in electric vehicles.

6. RESEARCH METHODOLOGY

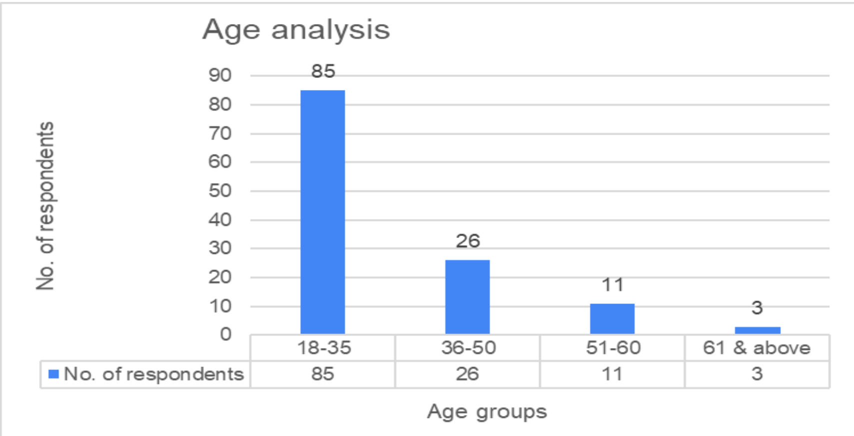
1) Area of the Study	The Study is conducted in Pune metropolitan region
2) Research Design	Design of descriptive research through structured questionnaire, interview, survey and case study.
3) Sources of data collection	1) Primary data 2) Secondary data
4) Sample and sample size	Consumers of electric vehicles in Pune metropolitan region. Sample size is restricted to 125 consumers.
5) Limitation of the study	1) The study is restricted to electric vehicle consumers in the Pune metropolitan region only. 2) The study is restricted to 125 consumers only. 3) The study is restricted to only two wheelers and four wheelers consumers.

7. ANALYSIS AND INTERPRETATION

The results of the data analysis showed that: Data was gathered from 125 electric vehicles consumer respondents using a structured questionnaire.

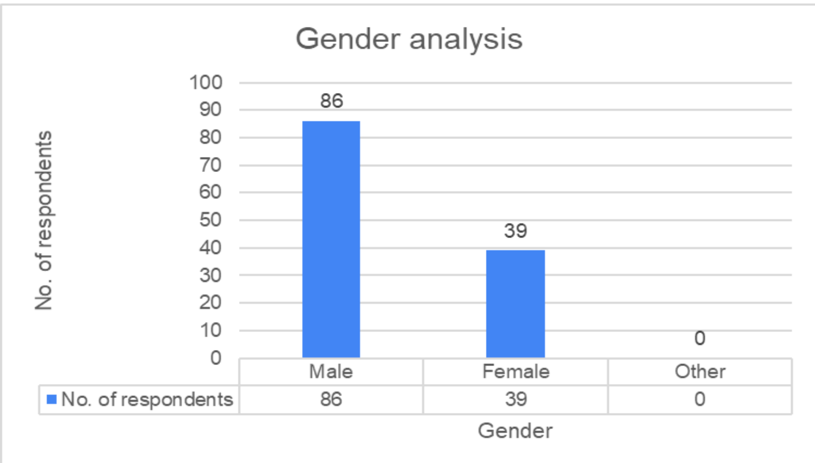
A) Demographic Factors

1. Age



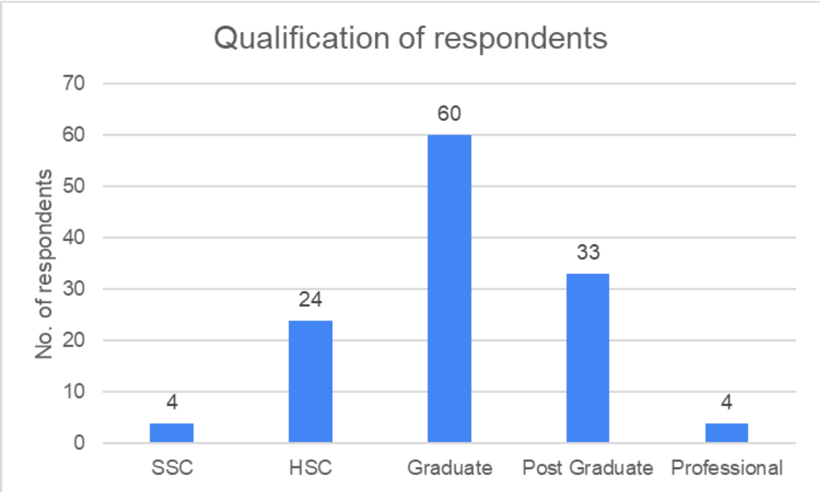
It is concluded that most of the respondents fall in the age bracket of 18-35, who are the young generation and are more anxious to adopt the new technologies.

2. Gender



It is concluded that out of 125 respondents 86 respondents are males which make 68.8% of total sample size.

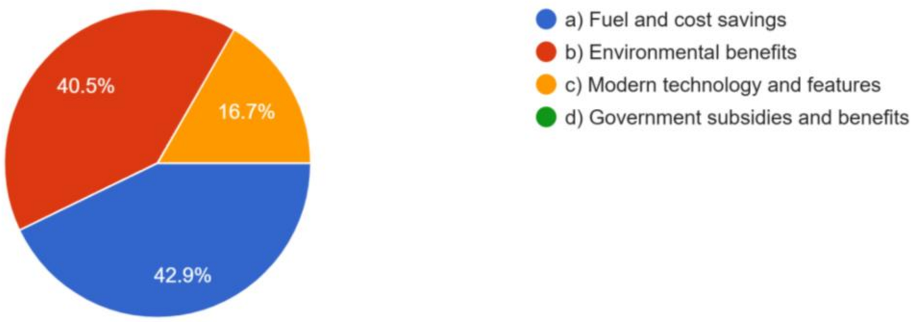
3. Qualification



It is concluded that 60 respondents out of 125 respondents are graduates which make 48% of total sample size.

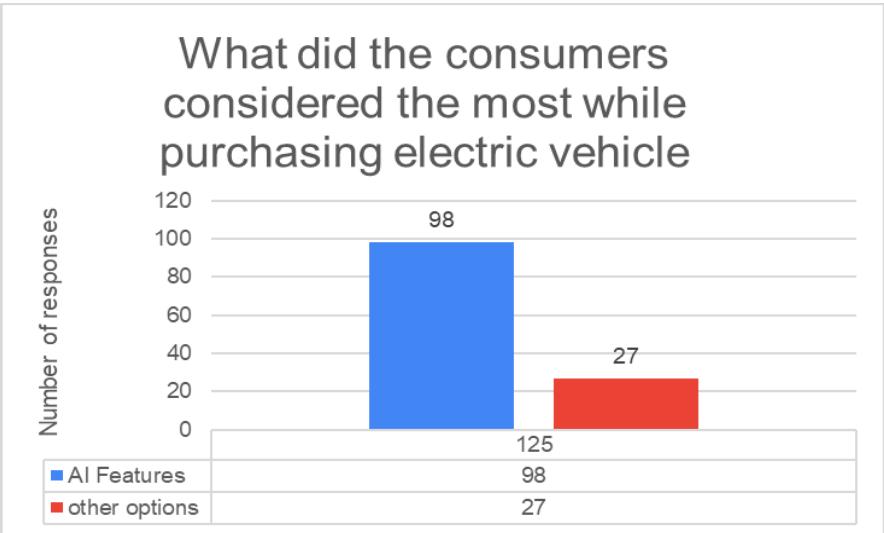
B) Technical Factors

1. What message in electric vehicles promotion appeals to you the most?



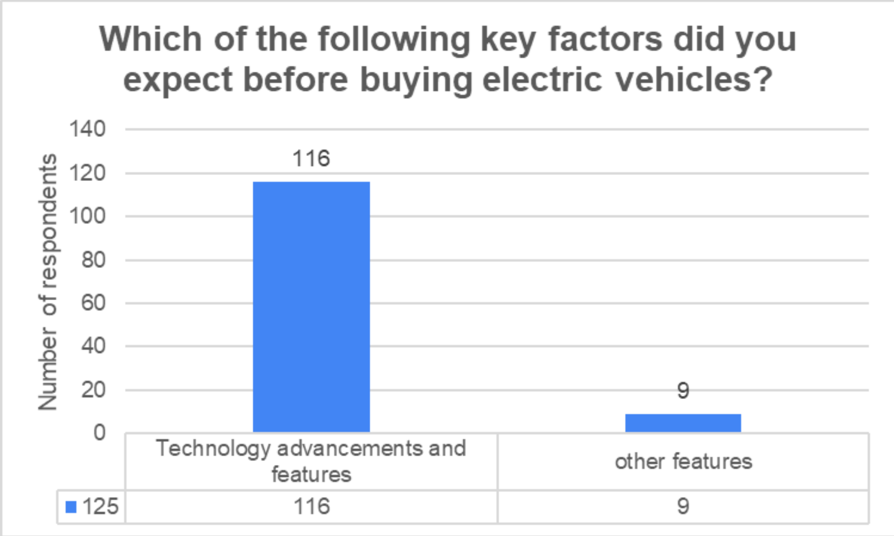
It is concluded that out of 125 respondents 16.7% of electric vehicle consumers are attracted towards the electric vehicles due to modern technology and features.

2. Which of the following factors did you consider while buying electric vehicles?



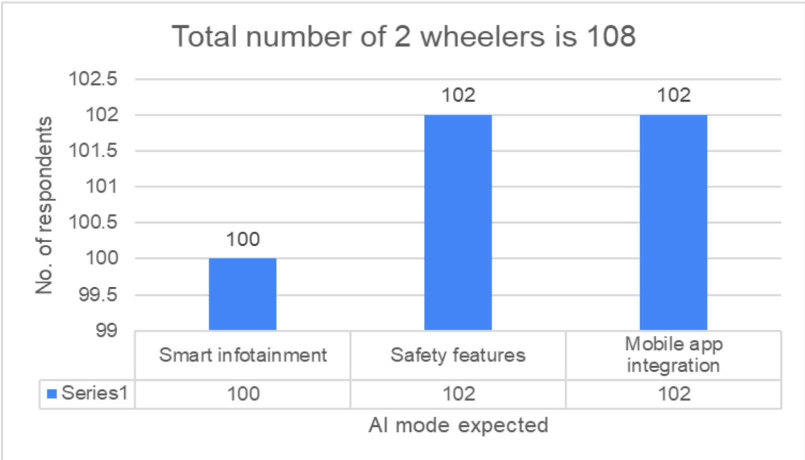
It is concluded that out of 125, 98 respondents considered the AI features while purchasing the electric vehicles which are 78.4% of respondents.

3. Which of the following key factors did you expect before buying electric vehicles?



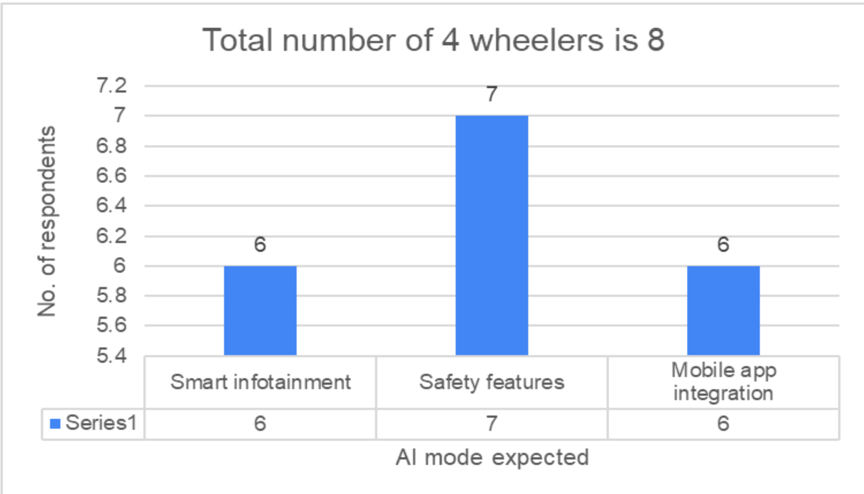
It is concluded that out of 125 respondents 116 respondents expected the technology advancement features in their electric vehicles which are 92.8% of respondents.

4. Number of consumers who expect smart infotainment, safety features and mobile app integration from electric 2 wheelers.



It is concluded that 94% and above consumers expect AI features from the electric vehicles.

5. Number of consumers who expect smart infotainment, safety features and mobile app integration from electric 4 wheelers.



It is concluded that out of 8 4 wheelers 6 to 7 respondents are expecting AI modes from the electric vehicles.

8. FINDINGS

The following important conclusions are drawn from an examination of data gathered from 125 electric vehicle users in the Pune metropolitan area:

1. Younger consumers are more receptive to implementing AI-based technology in electric vehicles, as seen by the majority of responses being in the 18–35 age range.
2. Although the segment suggests possibilities for broader gender participation, male respondents make up 68.8% of the sample, indicating stronger EV adoption among males.
3. Higher education appears to have a good impact on awareness and adoption of AI features in EVs, as evidenced by the high percentage of respondents who are graduates.
4. Promotional messaging that emphasizes the value of contemporary features and innovation in EV marketing has a substantial impact on consumer interest.
5. When purchasing electric vehicles, 78.4% of respondents said that AI-enabled technologies are important.
6. The majority of respondents (92.8%) anticipate that their EVs will have smart controls, safety features, and smart systems.
7. Even in price-conscious markets, over 94% of two-wheeler EV buyers anticipate smart infotainment, safety alerts, and mobile app integration.
8. Customers of four-wheeler electric vehicles (EVs) also show that they are prepared for AI-based features, suggesting that increased autonomy levels in premium vehicle categories are acceptable.
9. Customers favor a gradual shift toward increasing levels of autonomy and are more prepared for aided and semi-autonomous features (Level 0–Level 1).

9. SUGGESTIONS

Based on the findings, the following suggestions are proposed:

1. To gain the trust of consumers, automakers should concentrate on integrating AI functions gradually, starting with Level 1 and Level 2 autonomy.
2. In order to inform consumers about AI functionality, safety advantages, and dependability, consumer awareness initiatives had to be reinforced.
3. To boost customer confidence, safety-focused AI features like intelligent alerts, driver assistance, and collision avoidance should be given top priority.
4. To boost market penetration, two-wheelers should have reasonably priced AI-enabled features.
5. Along with environmental benefits, marketing campaigns should highlight smart technology and future readiness.
6. Adoption of AI-enabled EVs can be accelerated by government support through pilot projects, infrastructure development, and incentives.

10. CONCLUSION

By improving safety, efficiency, and user experience, artificial intelligence is becoming a more significant factor in determining the direction of electric vehicles. According to the study's findings, customers have high expectations for AI-enabled capabilities, and these features have a big impact on judgments about what to buy. While assisted and semi-autonomous technologies are widely accepted, complete vehicle autonomy is still viewed with trepidation.

The results show that a gradual shift from Level 0 to Level 1 and Level 2 autonomy fits in nicely with the readiness of consumers today. This change is being spearheaded by young, educated customers, which bodes well for future widespread adoption. In general, customer awareness, safety assurance, technological innovation, and supportive legislative frameworks will be necessary for the successful integration of AI in electric vehicles.

REFERENCES

1. Bas, J., Cirillo, C., Cherchi, E.: Classification of potential electric vehicle purchasers: a machine learning approach. Technol. Forecast Soc. Change 168, 120759 (2021)

2. Hua, W., Mullen, D., Wahid, A., Sitabkhan, K., Mason, K. (2024). An Overview of Artificial Intelligence for Electric Vehicle Energy Systems Integration. In: Nowaczyk, S., et al. Artificial Intelligence. ECAI 2023 International Workshops. ECAI 2023. Communications in Computer and Information Science, vol 1948. Springer, Cham. https://doi.org/10.1007/978-3-031-50485-3_17
3. Mr. Bhoir A.G. & Dr. More R.R. (2025). The Role of AI in Transportation: Special Focus on Autonomous Vehicles in India. In Educreator Research Journal: Vol. XII (Issue I), pp.153-158.
4. Ms. Narawade D. (2025). AI and E Vehicles:Road to sustainable and User Friendly Way to Transportation. In Educreator Research Journal: Vol. XII (Issue I), pp.273-277.
5. Noviati, Nuraini & Putra, Fengki & Sadan, Sadan & Ahsanitaqwim, Ridhuan & Septiani, Nanda & Santoso, Nuke. (2024). Artificial Intelligence in Autonomous Vehicles: Current Innovations and Future Trends. International Journal of Cyber and IT Service Management. 4. 97-104. 10.34306/ijcitsm.v4i2.161.
6. Phatale, Amey. (2018). Autonomous Vehicle Levels & Trends. International Journal of Science and Research (IJSR). 7. 1944 - 1948. 10.21275/SR24314005404. professionals must care (2010)
7. Russell, S., Norvig, P.: Artificial intelligence: a modern approach (2002)
8. Sovacool, B.K.: A transition to plug-in hybrid electric vehicles (phevs): why public health
9. Zarazua de Rubens, Gerardo. (2019). Who will buy electric vehicles after early adopters? Using machine learning to identify the electric vehicle mainstream market. Energy. 172. 10.1016/j.energy.2019.01.114.