

# Leveraging IoT and AI Towards Customer-Centricity and Customer Satisfaction in CGD Business in India

DOI: <https://doi.org/10.47175/rissj.v6i3.1204>

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## ABSTRACT

The retail petroleum industry is undergoing a significant transformation driven by evolving mobility models, such as shared transportation and renewable energy, rising customer expectations for convenience and personalisation, and the adoption of alternative energy sources. Consumers increasingly demand tailored experiences, and digital technologies are at the heart of meeting these expectations. With rapid technological advancement, customer preferences and buying behaviours are shifting. In the Indian context, factors such as gender, income, and education have a significant influence on technology adoption in the retail fuel sector. Customers are increasingly responsive to technology-driven offerings, such as digital payments, automated fuel quality checks, transaction alerts, and tracking tools, demonstrating a growing acceptance of innovative solutions. This study explored the application of IoT and AI technologies in the City Gas Distribution (CGD) sector, focusing on enhancing customer recognition, personalisation, and satisfaction at fuel retail points. A solution was deployed at a CNG fuel station in Karnataka from August to October 2024, spanning a period of three months. Data collected during this time was analysed to assess the impact. Results revealed a 30% reduction in fueling time and an 81% increase in customer satisfaction, showcasing how technology-driven initiatives can significantly enhance operational efficiency and customer engagement. The integration of IoT and AI not only streamlined station operations but also contributed to improved customer identification, acquisition, and retention, ultimately boosting sales and revenue. This case illustrates the growing importance of digital transformation in the fuel retail sector and highlights the strategic significance of adapting to shifting consumer expectations through innovative technologies.

## KEYWORDS

Consumer experience; Indian fuel retail; digitisation in petro retail; customer experience.

## INTRODUCTION

India, a nation with high energy consumption, has intensified its focus on the retail petrochemical industry. In India, fuels such as petrol and diesel are typically sold at stations owned and worked by Oil Marketing Companies (OMCs) through their merchants and merchants. Some time recently and within the early a long time after autonomy, fuel was provided as a product. The government and state-owned oil companies set the industry's fuel prices (PSUs) with minimal competition. As the government gradually deregulated prices and private companies entered the petroleum retail market, competition grew considerably. Over time, due to exposure to cutting-edge technology, the industry has

transformed into a service-oriented sector, which has changed consumer purchasing behaviours (Purohit & Jain, 2020).

In recent decades, there have been notable technological advances from analogue to digital, and from digital to AI, IoT, and big data. This is causing a shift in how industries globally operate, from manufacturing to services (Purohit & Jain, 2020), and it has also led to more sophisticated modern consumers with different purchasing patterns. Customer expectations and experiences have generally evolved and continue to do so. The use and advancement of technology have driven a significant change in customer behaviour within the retail sector. There is an overlap between retail and petrol retail consumers. The way customers approach fuel purchasing is also changing. The upstream sector is adopting technologies such as AI, ML, Big Data, Cloud, and mobile technology. However, the adoption of technology on the downstream side is less significant in the Indian context, especially when it comes to identifying and recognising customers and meeting their expectations regarding the range of products and services. Petro retail has not yet caught up with common retail, which has quickly advanced in innovation appropriation and improved customer involvement (Purohit & Jain, 2020). IT encompasses a illustrated solid relationship with commerce benefits, particularly in near client connections, item administration, operational brilliance, and vital insights, through the utilize of the venture engineering administration handle (Sari et al., 2021). The industry benefits from strategic alignment and effectively managed ICT in several ways, including lower costs, improved customer satisfaction and process efficiency, as well as addressing structural and governance concerns (Farah et al., 2020). Over the past few decades, there has been a rise in the standardisation of customer services and productivity thanks to Information Technology (IT). In operational environments with many inputs and variable outcomes, it is seen as a strategic choice to foster success.

## **LITERATURE REVIEW**

Over the past few decades, the production of intangible services has replaced the manufacturing of tangible goods as the primary driver of market structure changes in industrialised economies. The growth of the service sector worldwide is a testament to this shift. Global deregulation in key manufacturing and service industries, including banking, energy, transportation, and communication, has heightened competition within these markets (Kotler, 2004). Creating a unique offer and delivery with innovative features has been the company's strategy to combat price rivalry. This approach has enabled the business to distinguish itself from competitors and enhance its brand image (Kotler & Armstrong, 1996). By consistently delivering superior service quality compared to rivals, a service company can differentiate itself in the market.

Many businesses recognise that delivering excellent service quality can boost sales and profits, giving them a competitive advantage. Some companies prioritise building client loyalty by providing services that surpass those of their competitors (Purohit, 2022).

### ***Retail in the Global Context***

Over recent decades, technological progress has greatly changed customer expectations, behaviours, and shopping habits across the globe. Consequently, there have been notable shifts in customer service. The manner in which consumers make decisions has also been deeply influenced by innovation and the advanced world (Purohit & Jain, 2020). Shoppers are getting to be more advanced and anticipate higher measures from advanced arrangements driven by innovation (Purohit & Jain, 2021). Moreover, social media plays a imperative part in promoting. Companies use social media to fortify their brand and

construct more maintainable client connections (Moran et al., 2014). Businesses broadly utilize social media to set up more coordinate and individual associations with their clients.

### ***Petro Retail Globally***

Petro retail has undergone significant changes globally, while some drivers, such as cost and quality, have historically been rooted, while others have emerged due to increased competition and technological advancements. The reorientation of global markets from a commodity to a service orientation is a significant shift in global markets, one that is also relevant to the Indian experience (Purohit & Jain, 2021). In addition to specials and fuel quality, customer access to the petrol station also influences their buying decisions (Petra et al., 2017). The following factors are considered important in the choices made by drivers: perception of ease, customer perception of proximity, geographical distribution of filling stations, price offered, quality of the fuel, and the driver's gender when making different decisions (Marc et al., 2012). There is also a customer end to the refuelling equation, particularly in terms of forecourt efficiency at the petrol pump. In the Nigerian context, several factors contribute to poor service delivery, including an inadequate attendant workforce, malfunctioning petrol dispensing machines, and lengthy waiting times at filling stations (Ajayi, 2017). By contrast, in the US and Europe, significant technological innovations have increased the speed of transactions at forecourts in the gas station vending marketplace, which in turn has led to more satisfied customers, providing a better overall customer experience. The savings on personnel, where manual attendants are physically retired, have led to lower costs. In America as well, the advent of self-service pumps has drastically reduced the requirement for attendants at gas stations by transferring the job of fuel fuelling from the attendant to the customer. This has enabled above-average productivity growth and improved the customer shopping experience (Emek et al., 2017).

### ***Retail & Petro retail in the Asian Context***

Given the critical financial and innovative advancement in major Asian nations over the past few decades, their retail markets have too experienced fast mechanical progression and shifts in execution. Clients anticipate inventive encounters for brand separation, and effective companies are picking up a competitive advantage over their competitors (Pham & Tivasuradej, 2019). At the same time, considers have uncovered that client fulfillment, brand believe, and brand picture all impact client dependability. It is prescribed that taking care of client desires may be a prime calculate for holding and improving client dependability (Azizan & Yusr, 2019).

The fuel retail sector has also experienced significant adoption of advanced technology. In addition to the essential need for fuel purchases, the use of technology, payment solutions, and facilities, as well as the availability of integrated convenience stores at fuel stations, has helped foster customer patronage of hybrid petrol and convenience retail in Malaysia (Sari et al., 2017).

### ***Retail & Petro Retail in the Indian Context***

The retail industry in India is currently experiencing a major shift, with unorganised retail gradually giving way to organised formats. These modern retail options offer a wide variety of products, aiming to meet the changing needs and preferences of today's customers.

In the Indian fuel retail industry, the sector has traditionally favoured Indian public sector companies. However, this paradigm is shifting as private operators introduce enhanced customer service for end-users. Private oil marketing companies are encouraging public sector undertakings to move beyond merely selling fuel and to focus on pleasing

consumers through marketing and promotion. A gap exists between what consumers desire the retail mix to be and what OMCs currently practise to market their products and services (Yadav et al., 2012). Competition among oil companies is intensifying, with many offering various deals to attract customers and meet fuel consumption demands. Meanwhile, the government has relaxed its policies for private petroleum companies to open petrol pumps, thereby fostering increased competition among service providers. (Srinivasan, 2015)

This study revealed that operating fuel establishments, fuel pricing, and the use of technology in services constitute significant determinants of retail petrol consumption in the Indian context. The other factors, such as petrol pump picture, benefit quality, item run, and extra benefits, are specifically related with buyer inclinations (Purohit & Jain, 2021). Innovation empowers changes in customers' acquiring propensities. Benefit suppliers must moreover put more noteworthy accentuation on technology-driven framework and administrations to meet the advancing needs and desires of Indian petrol retail clients (Purohit & Jain, 2021). The integration of IoT and AI in petrol retailing has improved client benefit and operational adequacy (Purohit et al., 2021). IoTs have also tremendously influenced service quality and profit maximisation (Purohit & Jain, 2021). There is also the digital payment technology adoption gap in the Indian petrol retail market. In contrast, this technology is widely embraced within the larger retail industry (Purohit & Purohit, 2021).

A study of the service quality gap in the Indian petrol retail sector indicates that the petrol retail sector's overall service quality is less than the expected service quality, resulting in a service gap. The widest gap was identified at tangibles, whereas the narrowest gap was in responsiveness (Badlani & Singhal, 2017). These studies, however, are from a customer perspective, which leaves a gap in understanding the service quality facet from the provider's angle (Purohit & Jain, 2022). It has been observed that service providers have gradually upgraded their service delivery tactics over time by increasingly integrating technology into their service design and delivery (Purohit & Jain, 2021).

CGD (City Gas Distribution) is a nascent business in the Petro retail in India. The CGD sector caters to commercial and domestic vehicles, as well as commercial and residential buildings and industrial units. These segments have different service needs, customers' expectations and satisfaction criteria. All the more reason that technology can help establish and build systems that serve customers in a way that increases their overall experience and satisfaction.

The management of fuel stations, fuel prices, and the awareness of technology in the provision of services are unambiguously identified as significant determinants of fuel consumption in India's retail segment. Several other dimensions, including the image of the fuel station, service quality, product variety, and value-added services, are associated with consumer preferences (Purohit & Jain, 2021). The use of technology influences the customers' buying behaviour. For service providers, it is essential to focus more on deploying technology-enabled infrastructure and services that align with the changing behaviour and demands of Indian petrol retail consumers (Purohit & Jain, 2022). In the current technological environment, the Internet of Things (IoT) can serve as a catalyst and driver of processes in interactive and dynamic services, enabling enterprises to engage in the next generation (Khaled, 2021). It has also been found that IoT devices are used in various other sectors. Their adoption has increased considerably in recent years (Purohit & Purohit, 2021; Purohit & Purohit, 2021). In the realm of Petrol Retail, technologies such as IoT, ML, and AI have influenced both the customer experience and operations (Purohit et al., 2021). The adoption of IoT has also led to an increase in overall service excellence and profit maximisation in organisations (Purohit & Jain, 2021).

Currently, OMCs lack automation in their CGD vertical. They have also implemented an automation system for liquid fuel management, which includes various functions and

MIS reports to control the fuel station. This system features facilities to manage dealerships and franchisees, oversee operations, and ensure customer satisfaction. Since then, CGD business practices have changed little and still operate with minimal automation, demonstrating very limited use of technology to improve customer service, enhance satisfaction, and boost operational efficiency.

### **Research problem**

Innovation appropriation in petro retailing is actualized in a scattered way inside the petro retail division, with nearly no headway within the CGD commerce. Whereas mechanization, IoT, and AI/ML-based innovative arrangements are being trialled in a divided way without a centralised diagram of the complete esteem chain, much of this potential remains unrealised. Such innovations are basically received to improve operational effectiveness and advance resource use. In any case, a few endeavors have too been made to make strides client acquiring conduct, counting distinguishing proof and fulfillment. At the same time, the use of central checking frameworks over different segments illustrated that real-time KPI checking, AI & ML-driven analytics, and cautions for exemptions and infringement of standard working strategies have driven to operational brilliance and cultivated client believe. This consider points to explore how the integration of IoT and AI can improve client fulfillment and cultivate economical advancement inside the Petro Retail CNG Trade in India.

### **Objective of the Study**

Within the current situation of CGD trade in India, benefit conveyance is primarily observed and kept up through manual forms that require occasional human mediation. The CGD commerce has constrained computerization and innovative selection in its operations and client benefit capacities. A few basic exercises related to benefit conveyance to clients, such as client recognizable proof, guaranteeing benefit guidelines at fuel stations, keeping up security hones, and directing clients to empty islands, are still performed physically at fuel outlets. In spite of the fact that OMCs have executed a few mechanization in petrol and diesel stations, it is negligible for CNG stations.

With significant progress in technology, including computer vision, image processing, artificial intelligence, and machine learning, these technologies can help develop solutions for capturing transactions, customer details, and more at CNG stations, providing valuable insights. These insights can assist service provider companies in improving (i) customer identification for personalisation and asset utilisation, and (ii) the customer experience at fuel stations, while positively affecting (a) manpower availability, (b) service standards, (c) traffic management, and (d) fuel station operations and safety.

Numerous noteworthy patterns, driven by the rise of elective vitality, developing portability models, and expanded client desires centred on Comfort and personalisation, are disturbing the retail fuel markets around the world. Clients underscore the have to be perceive each person and tweak items and administrations. Advanced innovation plays a central part in this advancing situation. Over time, client buying conduct is moving due to innovative progressions. Subsequently, the drivers impacting the client involvement have moreover changed. The consider points to investigate how advanced innovation might impact customers' recognitions of the client experience and how embracing IoT, AI, and ML-based innovation within the CGD trade can offer assistance make strides client fulfillment and operational proficiency.

### **RESEARCH METHODS**

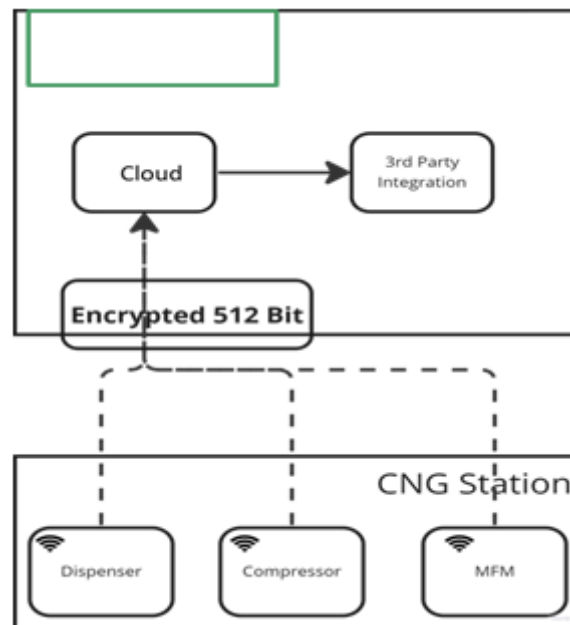
The think about was conducted from Eminent to October 2023 at CNG fuel stations within

the state of Karnataka. Deals volume information were accumulated from company authorities. The test estimate chosen for the ponder was 430 tests. The sampling was done employing a comfort examining strategy. The pretested standard overview surveys included statistic points of interest of the clients and their encounter and fulfillment levels some time recently and after the usage of the distinguishing proof framework. The information gotten through the study were analysed measurably to get it the system's adequacy within the Indian Petro retail CGD commerce setting. The essential information was collected through a quantitative field consider, and the measurable apparatuses utilized are:

1. Relative Analysis
2. Regression analysis

### **Solution Architecture**

The solution architecture is shown in Figure 1. Each piece of equipment, such as a dispenser, a compressor, and flow meters, is connected to IoT devices that have GSM connectivity. All IoT devices use independent M2M SIMs and are linked together. If any SIM fails, the IoT device can connect through other available devices. Each IoT device has a unique ID mapped to the station. The data packets include this information, and the cloud services sort the data once it is received. The equipment data, status, and information captured by IoT devices are sent to a centralized cloud server. This provides a unified view of the data, and the cloud environment enables the use of AI and ML algorithms to draw insights from the received data.



**Figure 1.** Solution Architecture

The key objectives of the proposed solution are listed below:

- Real-time sales data from CNG Outlets
- Improvement in supply chain efficiency
- Reduction in dry outs at CNG Outlets
- Reduction in downtime of the equipment
- Better safety in the CGD Network
- Trust and Convenience to the end customers – enhancement of customer experience & satisfaction.

## RESULTS AND DISCUSSION

This work is the first of its kind, whereas previous studies were based on secondary work. This primary project, utilising a technology-based solution, was observed and tested over three months, with learning and evaluation conducted using data from the experiment. Real-time data were analysed concerning the objectives, and the performance observed is shown in Table 1. The solution achieved 100% success in traffic counting and compliance with safety parameters.

**Table 1.** Performance of Objectives

Sr No	Objectives	Performance Against Expectation
1.	Real-time sales data from CNG Outlets	100%
2.	Real-time sales data from CNG Outlets	100%
3.	Reduction in dry outs at CNG Outlets	92%
4.	Reduction in the downtime of the equipment	67%
5.	Better safety in the CGD Network	100%
6.	Trust and Convenience to the end customers	73%

Information assembled over three months was dissected for (i) division of clients at the fuel station, such as vehicle sorts like 4-wheeler, LCV, etc., (ii) evaluating footfall recurrence of clients, i.e., how frequently they visit the fuel station, (iii) selecting normal clients in devotion programs based on their visit recurrence and fuel utilization designs, (iv) perceivability of standard clients, (v) improving client involvement with real-time data approximately their nearness at the fuel station, (vi) focused on showcasing, and (vii) computerized welcoming of clients utilizing existing computerization frameworks at the fuel station. The perceptions were moreover examined with respect to clients who gone by the fuel stations amid the perception period and their commitment to the station income.

The overview was conducted on 430 clients who gone to the fuel station. It was watched that most clients are male (86%) and drop inside the age extend of 25 to 50 a long time. Examination of essential information appears that the 3-wheeler and 4-wheeler fragments at the CNG fuel station produce the lion's share of income. A overview on client input and statistic investigation is displayed in Tables 2 and 3. The input on their encounter demonstrates that 73% of clients experienced palatable benefit (Table 4), which recommends that the arrangement features a positive affect on client encounter and fulfillment.

**Table 2.** Vehicle Population and Contribution to Revenue

	Classification	No. of Respondents	%	% Contribution of revenue
Vehicle Type	3 Wheeler	116	27%	28%
	4 wheeler	141	33%	36%
	LCV	126	29%	23%
	Others	47	11%	13%

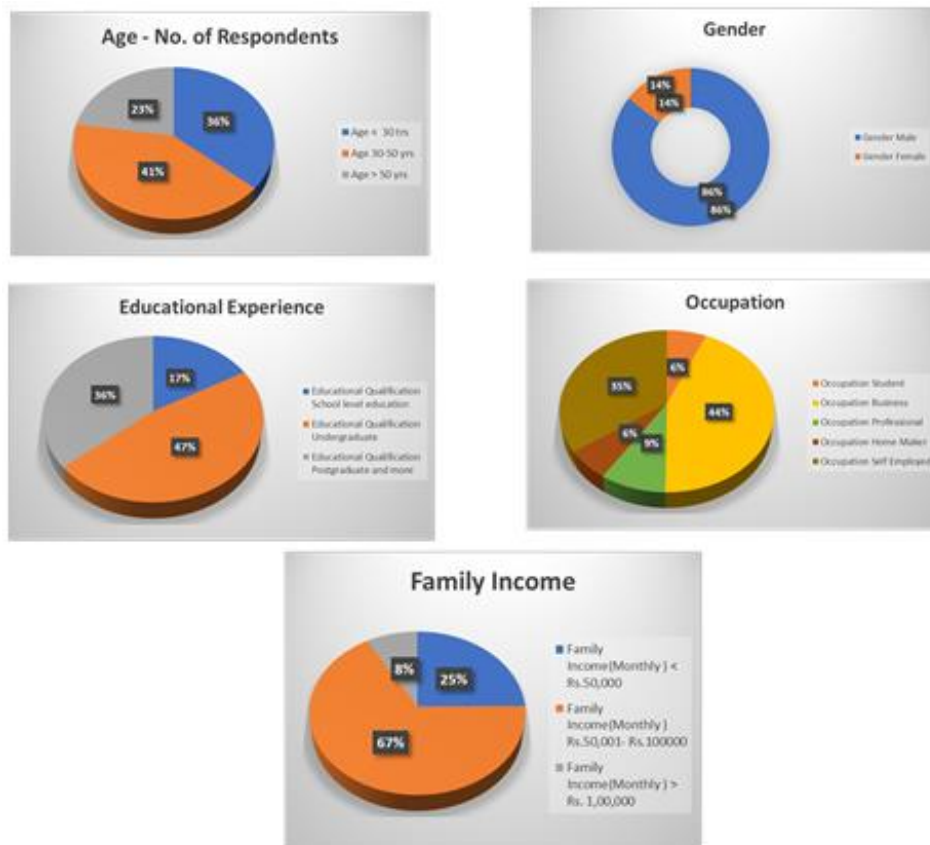
**Table 3.** Demographic analysis of customers

	Classification	No. of Respondents	%
Age	< 30 yrs	156	36%
	30-50 yrs	177	41%
	> 50 yrs	97	23%
Gender	Male	368	86%
	Female	62	14%

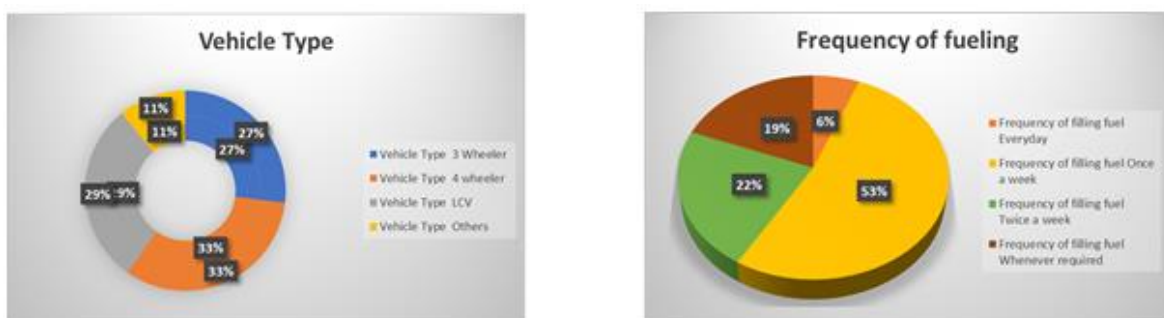
**Table 4.** Customer Feedback

	Experience	No. of Respondents	%
Customer Feedback	Happy	312	73%
	Disappointed	90	21%
	Neutral	28	7%

Examination of the respondents' age, sex, instructive capabilities, occupation, vehicle utilize, sort of fuel devoured, and recurrence of refueling (Figures 2 and 3) was carried out. It illustrated that respondents are reasonably dispersed over all parameters, guaranteeing reactions from likely client portions are included.



**Figure 2.** Demographic, Education, Occupation and Income detail of Respondents



**Figure 3.** Vehicle type and frequency of fueling of the Respondents

Sales volume data for a three-month observation period, collected from company officials, were analysed and show a steady month-on-month increase. An overall rise of

11.8% has been recorded during this period.

It has also been observed that 73% of respondents reported increased satisfaction with customer service. The functionalities created a sense of a superior experience and provided assurance and validation of the fuelling quantity, leading to higher satisfaction. (Figure 4).



**Figure 4.** Customer Satisfaction Survey

To provide a seamless experience for customers visiting fuel stations, reliance on infrastructure and technology-based solutions available at the station is essential. The integration of IoT with AI-ML solutions represents a step towards providing a smoother purchasing experience, thereby enhancing overall customer satisfaction. Simultaneously, it benefits all stakeholders, including fuel stations, customers, and service providers, such as companies.

## CONCLUSION

Innovative headways essentially impact customers and businesses, changing people's ways of life and conduct. Whereas the Web changed how people associated, the Internet of Things (IoT) is anticipated to change how machines communicate. There have been developments in client engagement and fulfillment in retail, which have influenced customers' buying conduct. IoT, and AI based predictive analytics tools play crucial roles in developing customer-facing initiatives, leading to the creation of service protocols that enhance the buying experience.

In the oil and gas sector, IoT is primarily utilised in the upstream segment for remote monitoring, planning, and executing predictive and preventive maintenance, as well as ensuring adherence to safety parameters. IoT adoption has also been observed in the midstream sector to ensure network integrity, facilitate environmental monitoring, and maintain regulatory compliance. There has been minimal research on the use of IoT in the downstream sector, primarily in refineries, storage facilities, and handling facilities. Globally, there is almost no research on the application of IoT in the field of safety and customer services in petro-retailing. In the Indian petro-retail sector, IoT adoption is minimal, particularly from a customer service perspective, despite its importance in delivering better service and maximising returns. Given the increasing role of technology in consumer lifestyles, there is a pressing need for IoT adoption to enhance customer services, improve service quality, and consequently provide better safety and security, as well as drive revenue growth.

In the petro retail industry, particularly at CNG stations, technology adoption is

scattered, with automation, IoT, and AI/ML-based solutions implemented without a centralised view of the entire value chain. Such technologies are mainly used to improve operational efficiency and asset utilisation. However, few initiatives aim to enhance customer behaviour, including identification and satisfaction. Implementing central monitoring systems across sectors has demonstrated that real-time KPI monitoring, AI & ML-driven analytics, and alerts for standard process deviations lead to operational excellence and foster customer trust. As technology advances, customer habits, lifestyles, and preferences continue to evolve. While general retail explores technologies like VR for the average customer, petro-retail has yet to catch up. A clear gap emerges between customer expectations in the petro retail sector and the broader retail context. IoT is transforming in the digital era, influencing customer expectations and experience management in India's petro-retail sector from both customer and service provider perspectives.

The IoT-based solutions have a positive impact in areas such as (i) Enhanced Customer Experience, where customers aim to have a smooth fueling experience without any hiccups at fuel stations, including personalised programmes and communication; (ii) Increased operational efficiency by reducing fueling cycle times, improving traffic management, and adhering to safety practices; (iii) enhanced brand building, including new customer acquisition and retention; and (iv) leading to additional revenue for service providers. Consequently, rapid technological advancements and increasing exposure to digitisation have driven greater adoption of digital technologies, including IoT and AI-based solutions. To offer a seamless experience during fuel station visits, there is a dependence on the infrastructure at the outlet and the functionality of technical solutions available there. An IoT-based solution is a step towards delivering a better, seamless buying experience at the fuel station. This solution enhances the customer experience and positively impacts all stakeholders, such as fuel stations, customers, and service providers, notably oil marketing companies (OMCs). The study showed that using IoT and AI to improve customer service has increased satisfaction levels at CNG stations. This research is among the first to explore this aspect of petro retail CGD sector.

IoT is the technology on which future society will rely. IoT will significantly influence the service industry, including petrol retail. Increased digitisation helps create a greener environment and fosters more sustainable development. Therefore, analysing the gap in the adoption of digital technologies will be beneficial for academicians and managers in the oil

The study is conducted using both secondary and primary data collected through a survey. The survey results are subject to all the limitations of primary data. This article aims to explain how IoT-based solutions, combined with AI-ML technologies, can be beneficial in the CNG fuel business from both service provider and customer perspectives. The study is limited to a few CNG stations in specific geographical locations. Companies can adopt and expand these solutions to improve customer experience and satisfaction. The comparison of the findings presented here highlights the essential role of IoT, AI, and ML technologies in enhancing service quality and creating databases for strategic decisions in the Petro retail industry.

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