

Exploring Real-World Applications of GenAI in Retail

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ABSTRACT

In this paper we provided a perspective on the integration of Artificial Intelligence (AI) in the retail sector, highlighting their transformative potential in reshaping industry dynamics. It delves into the multifaceted applications of AI in retail, including inventory management, personalized shopping experiences, dynamic outreach, and conversational support, underscoring how these technologies drive customer engagement, operational efficiency, and innovation in product and service offerings. Emphasizing the necessity of adopting these technologies, the paper contends that AI is not mere competitive advantages but crucial for maintaining relevance in the swiftly evolving retail landscape. The strategic integration of these technologies presents significant opportunities for growth and differentiation, although it necessitates substantial investment in resources and workforce upskilling.

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Introduction

Logic-based algorithms represents the core of traditional computer science. For decades, computer scientists were trained to think of algorithms as a logic series of steps or processes that can be translated into machine-understandable instructions and effectively used to solve problems. Logic-based algorithms have derived transformative value over the last 50 years in all aspects of business - from enterprise resource planning to supply chain, manufacturing, sales, marketing, customer service, and commerce [1].

Today most organizations have been trying to digitize their processes for the last two decades, and new technologies such as Industry 4.0 have emerged as a business buzzword. Conversely, computing devices have harnessed the power of artificial intelligence (AI) to enhance their capabilities [2].

The field of AI was reinaugurated in 2000s, driven by the major three forces. First was Moore's law in action - the rapid movement of computer of computational power. By the 2000s computer scientists could leverage dramatic improvement in processing power, reduction in the form factor of computing with mainframe computers, minicomputers, personal computers, laptop computers, and the emergence of mobile computing devices, and the steady decline in computing costs [3].

AI has long been predicted as one of the prominent technologies capable of allowing communication among devices and machines as well as AI can simplify processes by solving problems at higher levels of speed and accuracy while at the same time managing large volumes of data [4-7].

A significant catalyst for this renewed fervor surrounding AI is the advent of Open AI's Chat GPT in November 2022 [8]. Chat GPT, an acronym for Generative Pre-trained Transformer, introduced the public not to AI but to a specific facet of AI – generative AI [9].

This article embark on a comprehensive journey into the realm of Artificial Intelligence, specifically focusing on AI. Our primary goal is to highlight the importance of these AI fields and emphasize the critical need for businesses to grasp their capabilities. The aim is to provide organizations with a deep understanding of AI, empowering the retail organizations to make informed and strategic decisions regarding the integration of these technologies. This exploration is grounded in the acknowledgment that adopting AI is not just a choice but a compelling need, considering a potential to fuel innovation and improve competitiveness in an increasingly technologically advanced world.

Methodology

The data for this research was sourced from well-regarded academic databases, such as Google Scholar, IEEE Xplore, journals, and studies. We performed thorough searches using keywords like 'Industry 4.0', 'Smart Shopping', 'Generative AI', 'AI use cases for retail and 'Generative AI use cases' This method enabled us to uncover a wide array of sources that could potentially contribute to our study.

The Retail Industry

The retail industry consists of all companies that sell goods and services to consumers. There are many different retail sales and store types worldwide, including grocery, convenience, discounts, independents, department stores, DIY, electrical and specialty stores. The retail industry shows steady growth year on year and employs a huge number of workers worldwide, particularly with

the growing popularity of online retail.

The competitive nature of this fast-paced industry was especially pronounced during the past few years. For 2022, retail outlets have been compelled to reconsider their long-standing processes and tactics that have structured the sector for years. These global changes in management and ways of thinking about supply chains for many well-known brands only help prove how important retail sales are for the economy.

In an increasingly competitive retail landscape, players in the industry must employ various strategies to capture a portion of the market share. Today, consumers demand top-notch customer service and a unified shopping experience, and the emergence of omnichannel retailing underscores this trend.

Consumers seek to blend traditional shopping practices with the convenience offered by modern technology. They may shop online using tablets or smartphones, or they might visit physical brick-and-mortar stores in person.

Consumer enthusiasm for retail purchases remains strong, necessitating that retailers must provide a seamless and hassle-free experience to stay competitive. This applies to a wide range of retail businesses, irrespective if they operate as market stalls, or are part of the US retail sector, or are internet-based retailers. As consumers continue to spend within the retail sector, it becomes crucial for brands to maintain competitiveness and uphold service.

AI – Artificial Intelligence

The term 'AI' encompasses a broad and intricate realm of non-human intelligence, marking a notable departure from conventional computational approaches [10]. It signifies the field dedicated to creating computer systems capable of performing tasks typically associated with human intelligence [11].

In concordance with the succinct articulation by Demis Hassabis, Co-Founder and CEO of DeepMind, AI can be succinctly characterized as “the science of making machines smart.” Fundamentally, AI grants machines the ability to understand natural language, identify complex data patterns, make informed choices, and acquire knowledge through experiential interactions [12]. This replication of human-like cognitive functions enables machines not only to process and interpret information but also to adjust to various contextual situations, progressively improving their performance through continuous learning [13].

In contrast, deep learning, a subdomain nestled within machine learning, harnesses intricate neural networks comprising interconnected layers, drawing inspiration from the intricate synaptic structure of the human brain [14]. These neural networks exhibit an innate proficiency in deciphering complex patterns within data, rendering them particularly well-suited for tasks such as image recognition [15]. The ubiquitous applicability of AI traverses a diverse spectrum of industries, manufacturing, construction, finance, energy, healthcare and primarily for our focus retail [16]. In these domains, AI takes on diverse roles, equipping computer systems with the ability to intricately analyze vast datasets, perform challenging and repetitive tasks with unwavering accuracy, provide personalized recommendations to users, and importantly, emulate human-like interactions through the utilization of chatbots and virtual assistants [17, 18].

Despite its historical origins, the recent surge in attention and enthusiasm surrounding AI has led to a noticeable blur in its definition and capabilities. Therefore, to foster a deeper and more insightful understanding of AI's significant role in the modern business landscape, it becomes essential to undertake a comprehensive exploration of the various categories of AI.

The AI Lifecycle

Problem Understanding and Risk Considerations

Start by establishing a clear definition of the problem you intend to address. Gain a deep understanding of the demands and limitations within the problem domain while taking into account ethical considerations, fairness, transparency, and privacy. Seek additional guidance from the AI Assurance Framework for further information [19].

Data Acquisition and Pre-Processing

Identify and collect pertinent data for your AI solution. Prioritize data preprocessing and cleansing to guarantee its quality and appropriateness for modeling purposes. Ensure strict adherence to relevant legal regulations, laws, and ethical guidelines.

Additional AI Techniques

Contemplate the inclusion of supplementary AI methods that extend beyond conventional machine learning, based on the specific needs of your solution. This may encompass the integration of techniques such as natural language processing (NLP), computer vision, knowledge representation, as well as inference and reasoning methods.

Integration and System Design

Incorporate the machine learning models or AI components into a broader system or application framework, considering factors such as scalability, performance, and alignment with the current infrastructure.

User Experience and Interaction

Create the user interface and interaction components to ensure effortless user engagement and interaction with the AI product.

Continuous Monitoring and Improvement

Establish systems for ongoing monitoring of the AI solution's performance, collecting user feedback, and iteratively enhancing the system in response to new data or evolving requirements.

Classification Algorithms Used in Artificial Intelligence

In the realm of artificial intelligence categorization, one encounters a variety of algorithms tailored to address particular requirements and confront distinct obstacles. The choice of the most suitable algorithm hinges on the characteristics of the problem at hand, the available data type, and the intended result [20]. Let's explore in greater detail some of the frequently employed categories within AI classification.

Binary Classification

At its core, binary classification involves categorizing data into one of two distinct groups, akin to a straightforward yes-or-no decision.

A prevalent example of binary classification is in the context of image recognition. Images can be classified as either containing a specific object or not containing it. For instance, an image classification model might determine whether a given picture contains a cat or not.

Another practical application of binary classification can be found in sentiment analysis for product reviews. Reviews can be categorized as 'positive' or 'negative' sentiments, helping businesses gauge customer opinions and feedback effectively.

Multiclass Classification

Expanding the classification system to encompass more than two categories leads us into the realm of multiclass classification. As the name suggests, 'multi' implies the presence of many, and in this context, it pertains to the numerous categories or classes into which data can be organized.

A notable example of multiclass classification is in the field of natural language processing, where text documents can be categorized into various topics or themes. For instance, news articles can be classified into topics like politics, sports, entertainment, or technology.

Another application of multiclass classification is in the field of medical diagnosis. Patient diagnoses can fall into multiple disease categories, and a machine learning model can be trained to classify them into these different medical conditions based on various diagnostic tests and patient data.

In the context of image recognition, multiclass classification can involve categorizing images of animals into various species, where each species represents a different class. This can aid in wildlife monitoring and conservation efforts.

Multilabel Classification

While binary and multiclass classifications assign data to a single category, multilabel classification allows each data point to be associated with multiple labels. In this scenario, the algorithm assigns multiple descriptive labels to each data point.

For instance, in a product categorization system for an e-commerce website, a particular item like a smartphone could be labeled with multiple attributes, such as 'electronics,' 'mobile devices,' and 'Android.'

In the realm of social media content moderation, a platform may employ multilabel classification to flag user-generated posts that violate its community guidelines. A single post could receive multiple labels indicating the specific rule violations it has committed. For instance, a post containing hate speech, nudity, and spammy links could be labeled with 'hate speech,' 'nudity,' and 'spam,' allowing the platform to take appropriate action based on these multiple violations.

AI Subfields

Figure 1 provides a visual framework for understanding the hierarchy of subfields within the expansive domain of Artificial Intelligence (AI). At the core of AI, it introduces four primary subfields: Generative AI, Machine Learning (ML), Natural Language Processing (NLP) and Computer Vision. Generative AI encompasses various facets, such as text, images, voice, video, and code generation by learning from data patterns, emphasizing its diverse content generation capabilities and its role in identifying anomalies in data. In contrast, Computer Vision encompasses Image Detection, Image Tracking, Image Reconstruction, Image Classification, Motion Detection, and Text recognition (ICR).

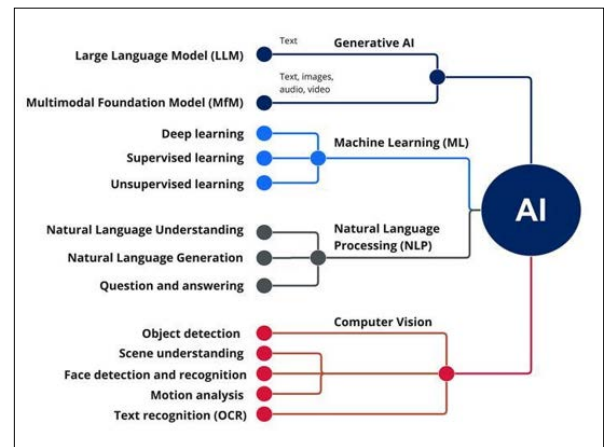


Figure 1: Various Branches of AI

Retail Use Cases For AI

The current retail landscape is characterized by a shifting paradigm, emphasizing data-driven retail interactions and elevated consumer demands. However, providing a personalized shopping experience on a large scale, one that remains pertinent and valuable, presents a significant challenge for retailers. With the convergence of digital and physical purchasing avenues, those retailers capable of innovating across their retail channels will distinguish themselves as frontrunners in the market. Below are some examples of how AI in retail can reshape the entire industry.

- Inventory Management in the retail sector is being revolutionized by the implementation of Artificial Intelligence (AI). This transformative technology is enhancing demand forecasting by harnessing insights derived from various data sources, including marketplace data, consumer behavior, and competitor data. AI-driven business intelligence tools excel in predicting industry shifts, enabling companies to proactively adjust their marketing, merchandising, and overall business strategies. Furthermore, this innovation extends its impact to supply chain planning, pricing strategies, and promotional planning.
- The adaptive homepage experience in e-retail is becoming increasingly sophisticated, thanks to AI. Mobile and digital platforms are now capable of recognizing individual customers and tailoring their online shopping experiences based on current context, previous purchases, and browsing behavior. AI systems continuously evolve a user's digital journey, ensuring that each interaction results in hyper-relevant displays and recommendations.
- Visual Curation leverages algorithmic engines to translate real-world browsing behaviors into digital retail opportunities. This is achieved by enabling customers to discover new or related products using image-based search and analysis. Recommendations are curated based on aesthetics and product similarity, enhancing the shopping experience.
- Guided Discovery is facilitated by automated assistants that help customers narrow down product selections based on their individual needs, preferences, and fit. These AI-driven assistants simplify the decision-making process for shoppers.
- Personalization & Customer Insights are at the forefront of AI-powered retail spaces. Intelligent stores recognize shoppers and adapt in-store displays, pricing, and services through biometric recognition, reflecting customer profiles, loyalty accounts, rewards, and promotions. Retailers also utilize AI and advanced algorithms to understand customer interests based on demographic data, social media behavior,

and purchase patterns, thereby enhancing the personalized shopping experience both online and in physical stores.

- Dynamic Outreach is another area where AI is making a substantial impact in retail. Advanced Customer Relationship Management (CRM) and marketing systems leverage AI to learn and understand consumers' behaviors and preferences over time. Through repeated interactions, these systems create detailed shopper profiles, which are then utilized to deliver proactive and highly personalized outbound marketing efforts. These efforts may include tailored product recommendations, rewards programs, and content.
- Interactive Chat programs, powered by AI and machine learning, have become a valuable tool for improving customer service and engagement in the retail industry. AI-driven chatbots engage with customers, answer common inquiries, and guide them to relevant solutions. These chatbots not only enhance customer support but also collect valuable customer data that can inform future business decisions.
- Conversational Support is elevated through AI-supported conversational assistants that use natural language processing to assist shoppers in navigating questions, FAQs, or troubleshooting. They seamlessly redirect customers to human experts when necessary, providing on-demand and always-available support while optimizing staffing.
- Emotional Response is an emerging frontier in retail AI. By recognizing and interpreting facial, biometric, and audio cues, AI interfaces can discern shoppers' in-the-moment emotions, reactions, or mindset. This information enables them to deliver appropriate products, recommendations, or support, ensuring that retail engagements resonate with customers on an emotional level.
- Customer Engagement is bolstered by IoT-enabled technologies that interact with customers. Retailers gain valuable insights into consumer behaviour and preferences without direct interaction. These technologies, such as interactive tablets, leverage IoT and machine learning to gather consumer data and behaviour trends, enhancing customer engagement and overall success.
- Operational Optimization is greatly facilitated by AI-supported logistics management systems. These systems continuously adjust a retailer's inventory, staffing, distribution, and delivery strategies in real-time, optimizing supply chains and fulfilling customers' expectations for high-quality, immediate access, and support.
- Demand Forecasting is a key area where AI excels, utilizing insights from marketplace, consumer, and competitor data to predict industry shifts and enable proactive adjustments to a company's marketing, merchandising, and business strategies. This proactive approach is vital in the ever-competitive retail landscape.
- Finally, Responsive R&D is driven by deep learning algorithms that collect and interpret customer feedback, sentiment, and purchasing data. This wealth of information guides the development of next-generation products and services that better align with customer preferences and unmet market needs.

In conclusion, AI can reshape the retail industry across various dimensions, from enhancing customer experiences to optimizing operations and driving innovation in product and service offerings. The potential for growth and competitive advantage in the retail sector through AI adoption is substantial, as evidenced by the revenue increases observed in brands that offer personalized experiences and leverage advanced digital technologies.

Conclusion

To reap the benefits of AI in the retail industry, it is essential to incorporate AI as soon as possible. However, doing so demands a substantial investment of time, effort, and resources, as well as the upskilling of your workforce.

The paper emphasizes the transformative potential of AI technologies in reshaping the retail industry. The ability of AI to enhance customer experiences, optimize operations, and drive product and service innovation presents a substantial opportunity for growth and competitive differentiation in the retail sector. Retailers that leverage personalized experiences and advanced digital technologies have observed significant revenue increases, underscoring the critical role of AI adoption in the industry. However, harnessing the full benefits of AI in retail requires substantial investment in time, effort, and resources, as well as a commitment to upskilling the workforce. As the industry continues to evolve, the strategic integration of AI will be a key determinant of success for retail businesses.

References

1. Siebel T (2019) Digital Transformation: Survive and Thrive in an Era of Mass Extinction <https://www.amazon.in/Digital-Transformation-Survive-Thrive-Extinction/dp/1948122480>.
2. Boone T, Ganeshan R (2007) The Frontiers of E Business Technology and Supply Chains. *Journal of Operations Management* 25: 1195-1198.
3. Guzman AL, Lewis SC (2020) Artificial Intelligence and Communication: A Human– Machine Communication Research Agenda. *New Media & Society* 22: 70-86.
4. Dwivedi YK, Hughes L, Ismagilova E, Aarts G, Coombs C, et al. (2019) Artificial Intelligence (AI): Multidisciplinary Perspectives on Emerging Challenges, Opportunities, and Agenda for Research, Practice and Policy. *International Journal of Information Management* 57.
5. Schutzer D (1990) Business Expert Systems: the Competitive Edge. *zExpert Systems With Applications* 1: 17-21.
6. Schniederjans DG, Curado C, Khalajhedayati M (2020) Supply Chain Digitization Trends: An Integration of Knowledge Management. *International Journal of Production Economics* 220.
7. Models GPT-3 (2023) OpenAI, San Francisco, CA, USA.
8. Brown TB, Benjamin M, Nick R, Melanie S, Jared K, et al. (2020) Language models are few-shot learners. *Proc Adv Neural Inf Process Sys* 33: 1877-1901.
9. Caner S, Bhatti F (2020) A conceptual framework on defining businesses strategy for artificial intelligence. *Contemp Manage Res* 16: 175-206.
10. Fogel DB (2022) Defining artificial intelligence. *Machine Learning and the City: Applications in Architecture and Urban Design* 91-120.
11. Samoilis S, Cobo ML, Delipetrev, Martinez-Plumed F, Gomez E, et al. (2021) AI watch. Defining artificial intelligence 2.0. towards an operational definition and taxonomy of AI for the AI landscape. JRC Res Tech Rep <https://publications.jrc.ec.europa.eu/repository/handle/JRC126426>.
12. Welsh R (2019) Defining artificial intelligence. *SMPTE Motion Imag J* 128: 26-32.
13. Hao X, Zhang G, Ma S (2016) Deep learning. *Int J Semantic Comput* 10: 417-439..
14. Hussain M, Al-Aqrabi H, Munawar M, Hill R (2022) Feature mapping for rice leaf defect detection based on a custom convolutional architecture. *Foods* 11: 3914.
15. Li BH, Hou BC, Yu WT, Lu XB, Yang CW (2017) Applications

- of artificial intelligence in intelligent manufacturing: A review. *Frontiers Inf Technol Electron Eng* 18: 86-96.
16. Patel NP, Parikh DR, Patel DA, Patel RR (2019) AI and webbased human-like interactive university chatbot (UNIBOT). *Proc 3rd Int Conf Electron Commun Aerosp Technol (ICECA)* 148-150.
 17. Shiyong Z, Zixuan M, Beibei C, Xiu Y, Xinran Z (2021) Motivation, social emotion, and the acceptance of artificial intelligence virtual assistants-Trust-Based mediating effects. *Frontiers Psychol* 12: 1-10.
 18. Davenport T, Mittal N (2023) All-in On AI: How Smart Companies Win Big with Artificial Intelligence. Amazon <https://www.amazon.in/All-AI-Companies-Artificial-Intelligence/dp/1647824699>.
 19. NSW Artificial Intelligence Assurance Framework. Digital. NSW <https://www.digital.nsw.gov.au/policy/artificial-intelligence/nsw-artificial-intelligence-assurance-framework>.
 20. Plat AI (2023) What Is Classification in AI? Plant AI <https://plat.ai/blog/ai-classification>.