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RECENT ADVANCES IN DEEP LEARNING–BASED IMAGE ANALYSIS

Dr.Mubina B
Assistant Professor,
Department of Commerce,
SDNB Vaishnav College for Women,
Chennai, Tamil Nadu, India.

Dr.Asma Zainab
Assistant Professor,
Department of Commerce,
SDNB Vaishnav College for Women,
Chennai, Tamil Nadu, India.

Laksha P
UG Scholar,
Department of Commerce,
SDNB Vaishnav College for Women,
Chennai, Tamil Nadu, India.

Abstract

Deep learning has emerged as an effective technology for image analysis and computer vision. It enables computers to automatically identify, classify and interpret visual information with high accuracy. Techniques such as Convolutional Neural Networks (CNNs), Transfer Learning and Vision Transformers are widely used in image classification, object detection, segmentation and image enhancement. These methods have applications in healthcare, agriculture, security, transportation and industrial automation. This paper reviews important deep learning techniques used in image analysis, their major applications, advantages and limitations. It also discusses challenges such as data availability, computational cost and model accuracy. Overall, deep learning provides promising solutions for developing intelligent and efficient image analysis systems.

Keywords: Deep Learning, Image Analysis, Computer Vision, CNN, Image Classification, Object Detection, Image Segmentation.

Introduction

Consumer behaviour is a central area of study in commerce and marketing because the success of a business depends not only on the products and services it offers but also on how individuals perceive, evaluate and respond to them. Consumers are influenced by a combination of psychological, social, cultural and economic factors. Their decisions may involve rational comparisons of price, quality and utility, but they are also shaped by feelings, past experiences, expectations, habits and perceptions of risk. Understanding these influences enables businesses to develop products, services and communication strategies that are more responsive to customer needs.

The growth of internet access, smartphones, online marketplaces and digital payment systems has altered the commercial environment. Consumers can compare products, read reviews, communicate with sellers and

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complete transactions without visiting a physical store. Digital payment facilities have also reduced the practical barriers associated with cash transactions. However, the convenience of digital commerce is accompanied by concerns about privacy, fraud, payment failure, product quality, delivery and the handling of personal information. These concerns can create uncertainty and anxiety, especially when consumers are unfamiliar with a platform or payment method.

Emotions therefore form an important part of digital purchasing decisions. Trust may reassure a customer that a transaction is safe; excitement may encourage product exploration; convenience may reduce effort; and anxiety may discourage a purchase or lead a consumer to abandon a payment. Satisfaction after a successful transaction can strengthen the intention to return, while a negative experience may weaken confidence and loyalty. Emotional responses interact with practical assessments, rather than operating independently of them.

The Technology Acceptance Model developed by Davis (1989) emphasises perceived usefulness and perceived ease of use as important determinants of technology acceptance. In online shopping, the Stimulus–Organism–Response (S–O–R) perspective offers another useful explanation: features of the shopping environment act as stimuli, influence consumers' internal cognitive and emotional states, and contribute to behavioural responses such as purchase intention or repurchase. Research applying this framework to online shopping has considered website cues, shopping values and emotional responses (Peng & Kim, 2014).

Against this background, the present paper considers the psychological drivers of commercial behaviour in digital markets. It concentrates on the emotional dimensions of digital payment use and online shopping, and on their possible implications for satisfaction and loyalty. The paper combines a review of relevant concepts with a proposed descriptive research approach. Its purpose is to provide a framework for examining how consumers think and feel while engaging with digital commerce.

2. Review of Literature

2.1 Consumer Psychology and Buying Behaviour

Consumer psychology examines the mental processes that influence how people identify needs, seek information, evaluate alternatives, make purchases and assess their experiences. Perception, motivation, learning, attitudes, memory and emotion all contribute to buying behaviour. A consumer may select a product because it offers practical value, but brand familiarity, recommendations, visual presentation and anticipated enjoyment can also influence the decision. Consequently, consumer behaviour is best understood as an interaction between cognitive evaluation and affective response.

2.2 Technology Acceptance and Digital Transactions

Davis (1989) proposed that perceived usefulness and perceived ease of use are fundamental beliefs associated with the acceptance of information technology. Applied to digital commerce, usefulness may relate to faster transactions, access to a wider range of products and convenient payment options. Ease of use may involve simple navigation, clear instructions and a straightforward payment process. When a

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platform is difficult to understand or repeatedly fails, consumers may experience frustration and become reluctant to use it.

2.3 Emotional Responses in Online Shopping

The online shopping environment contains stimuli such as product images, website design, prices, promotions, reviews and recommendations. These features can influence consumers' emotional and cognitive states. Peng and Kim (2014) applied the S–O–R framework to online shopping and examined how shopping values and website stimuli relate to attitudes, emotional purchasing and repurchase intention. Their work supports the relevance of considering both the shopping environment and the consumer's internal response when analysing digital behaviour.

2.4 Trust, Risk and Purchase Intention

Trust is particularly important when buyers cannot physically inspect products or meet sellers before making payment. Consumers must rely on platform information, seller reputation, reviews, payment safeguards and service policies. Kim and Peterson (2017), in a meta-analysis of online trust research, identified significant relationships between online trust and factors including perceived privacy, service quality, loyalty and repeat purchase intention.

A 2024 meta-analysis also reported that trust, perceived risk, perceived security and electronic word-of-mouth are relevant to e-commerce purchase decisions (Purchasing in the Digital Age, 2024). These findings indicate that consumers' sense of safety and confidence is closely connected with their willingness to transact.

2.5 Satisfaction and Loyalty in E-commerce

Customer satisfaction is an evaluation formed by comparing the actual experience with prior expectations. In digital commerce, satisfaction may depend on product quality, accurate descriptions, delivery performance, ease of payment, responsiveness and complaint resolution. Loyalty is reflected in continued preference, repeat purchases and willingness to recommend a platform. Trust and consistent service experiences can support these outcomes, although loyalty may also be affected by price, competing offers and switching costs. Businesses should therefore avoid treating a single successful transaction as proof of lasting customer loyalty.

3. Psychological Foundations of Consumer Behaviour

3.1 Perception and Attention

Perception refers to the way consumers select, organise and interpret information. In digital markets, consumers encounter large volumes of product descriptions, advertisements, ratings and recommendations. Clear information and consistent presentation can help reduce uncertainty. Conflicting claims, hidden charges or exaggerated promotional messages may create suspicion and weaken confidence.

3.2 Motivation and Needs

Motivation provides the internal drive that directs behaviour towards desired outcomes. Online purchases may be motivated by functional needs, such as saving time or obtaining a necessary product, as well as experiential needs, such as entertainment, novelty or self-expression. Understanding these motives helps explain why consumers may

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respond differently to the same platform or promotional message.

3.3 Learning, Attitudes and Experience

Consumers learn from previous transactions, product use, customer service interactions and the experiences of others. A smooth payment and reliable delivery may reinforce a favourable attitude towards a platform. Failed transactions, misleading information or unresolved complaints may create negative learning and avoidance. Repeated positive experiences can build familiarity, although trust must continue to be supported by reliable performance.

4. Consumer Emotions and Digital Payment Behaviour

4.1 Trust and Confidence

Trust refers to the consumer's willingness to rely on a payment provider or platform despite some degree of uncertainty. Familiar interfaces, transparent charges, recognisable payment options, prompt confirmations and effective grievance mechanisms may strengthen confidence. Trust is not created solely through promotional claims; it develops through dependable service and responsible handling of customer information.

4.2 Convenience and Perceived Ease

Convenience includes the ability to make payments quickly, access services at different times and avoid unnecessary procedural steps. Simple authentication, clear instructions and timely transaction notifications can improve the experience. In line with the Technology Acceptance Model, perceived ease of use may contribute to acceptance, while perceived usefulness helps consumers understand the practical value of the payment method (Davis, 1989).

4.3 Anxiety and Perceived Risk

Consumers may experience anxiety about unauthorised transactions, incorrect transfers, data misuse, payment failure or difficulty obtaining refunds. Such concerns may cause hesitation, repeated checking or abandonment of a transaction. Clear security information, accessible customer support and transparent dispute-resolution procedures can help reduce uncertainty. Businesses must also ensure that reassurance is supported by genuine safeguards.

5. Emotional Drivers of Online Shopping Behaviour

5.1 Product Presentation and Website Experience

Website layout, navigation, product images, descriptions and loading speed shape the online shopping experience. A well-organised interface can make product discovery easier and reduce frustration. In contrast, confusing navigation, intrusive pop-ups and unclear product information may discourage consumers from proceeding to checkout.

5.2 Promotions, Discounts and Urgency

Discounts, limited-time offers and promotional messages can attract attention and generate excitement. They may also create urgency and encourage rapid decisions. While promotions can be legitimate tools for communicating value, misleading scarcity claims or unclear conditions can damage trust. Consumers benefit when prices, eligibility criteria and return conditions are communicated transparently.

5.3 Reviews, Ratings and Electronic Word-of-Mouth

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Online reviews and ratings provide social information that may reduce the uncertainty associated with buying unfamiliar products. Positive and credible reviews can increase confidence, while repeated negative feedback may discourage purchase. The usefulness of reviews depends on their relevance, detail, authenticity and recency. Platforms should take reasonable steps to discourage fabricated reviews and make review policies clear.

6. Trust, Perceived Security and Convenience

Trust, security and convenience are closely connected but represent different aspects of the digital experience. Security concerns the safeguards used to protect transactions and information. Perceived security refers to the consumer's belief that those safeguards are adequate. Trust is a broader willingness to depend on the platform or provider. Convenience concerns the effort, time and accessibility involved in completing the transaction. A system may be technically secure but still be perceived as difficult to use; similarly, a convenient service may fail to gain acceptance if consumers do not trust it.

E-commerce businesses and payment providers should communicate transaction steps, charges, privacy practices and refund procedures in plain language. They should provide accessible customer support and ensure that payment confirmations are clear. Security measures should be effective without creating unnecessary complexity. These practices can support both functional performance and positive emotional responses.

7. Consumer Satisfaction and Loyalty

Satisfaction is influenced by the complete customer journey, from product search and ordering to payment, delivery and after-sales service. A positive checkout experience cannot compensate indefinitely for poor product quality or unreliable delivery. Likewise, a good product may not lead to repeat purchases if payment procedures are confusing or customer complaints remain unresolved.

Loyalty develops through repeated experiences in which consumers perceive consistent value and dependable treatment. Trust may encourage repeat purchase intention, while satisfaction can strengthen favourable attitudes and recommendations. Nevertheless, loyalty should not be assumed from satisfaction alone: consumers may switch platforms because of price differences, product availability or changing preferences. Businesses should monitor feedback and improve service continuously.

8. Role of Digital Marketing and E-Commerce Platforms

Digital marketing influences consumer awareness, expectations and perceptions through search results, social media, personalised recommendations, email communication and online advertising. Relevant information can help consumers discover suitable products, while excessive targeting or opaque personalisation may cause discomfort. Marketers should use customer data responsibly, respect privacy preferences and avoid deceptive communication.

E-commerce platforms can improve consumer experience by presenting accurate product details, transparent total prices, reliable delivery estimates, accessible return policies and verified customer feedback. Personalisation

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should make product discovery more relevant without restricting consumer choice or concealing alternatives. A customer-centred platform combines usability, reliability, transparency and responsive service.

12. Suggestions and Recommendations

Based on the conceptual discussion, the following suggestions are offered:

1. Provide simple, accessible and consistent website and payment interfaces to reduce effort and frustration.
2. Communicate security, privacy, charges, refund procedures and transaction status clearly.
3. Strengthen customer support and make complaint and dispute-resolution channels easy to access.
4. Ensure that product descriptions, images, delivery estimates and promotional conditions are accurate.
5. Encourage authentic customer reviews and take action against misleading or fabricated feedback.
6. Use personalisation and promotional techniques responsibly, avoiding manipulative urgency or hidden conditions.
7. Collect and analyse customer feedback regularly to identify sources of anxiety, dissatisfaction and service failure.
8. Build loyalty through reliable value, service quality and transparent relationships rather than incentives alone.

13. Conclusion

Consumer behaviour in the digital marketplace is shaped by more than price, product features and technical access. Psychological factors such as perception, motivation, trust, excitement, anxiety and satisfaction influence how consumers evaluate online shopping platforms and digital payment systems. Convenience and perceived ease can encourage adoption, while concerns about privacy, security and transaction failure may create hesitation. Positive experiences can support satisfaction, trust and repeat purchase intention, whereas inconsistent service can weaken consumer confidence.

This paper has brought together consumer psychology, technology acceptance and the Stimulus–Organism–Response perspective to explain the emotional drivers of commercial behaviour. It has also outlined a descriptive research design to investigate the influence of emotions on digital payments, online shopping and consumer loyalty.

The proposed study can offer useful insights to e-commerce businesses and payment providers, provided that primary data are collected and analysed systematically. Ultimately, sustainable success in digital commerce depends on creating experiences that are not only convenient and efficient but also secure, transparent and responsive to consumers' emotional needs.

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