

The Application of IoT to Study Consumer Behaviour and Decision-Making Process

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ABSTRACT

The Internet of Things (IoT) is developing as a substantial tool in information technology. It can potentially enhance the efficiency and convenience of human life. This study presents a review of recent experimental studies that suggested applications of the Internet of Things (IoT) on sensing human behaviour and aims to present an understanding of the possible applications of IoT in marketing to monitor and analyze potential consumer purchasing behavior and decision-making process.

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1. Introduction

Marketing professionals and academicians have always been interested to analyze and review mutual, demographic, commercial, psychological and many other considerations that affect the consumer decision-making process. Having insights into online buying behavior and the customer's intentions is still of a great level of importance for vendors and businesses to take advantage of fast-growing online businesses and virtual purchasing platforms in modern days, and the constant advancements of online purchasing platforms and tools are gradually changing this industry into a key lucrative industry. However, shoppers are getting more knowledge and their demand for more exciting platforms and better offers is increasing. There is a huge difference between the online decision-making process and the decision to buy directly from stores, in terms of purchasing environment, marketing strategies and communications. One attractive interaction of shopping online is that consumers usually have access to multiple reviews from users and other consumers about their experiences using a specific product.

In the traditional purchasing decision-making process, shoppers' buying intentions generally begin with their attitude, need, or acknowledgment, asking for information, evaluating alternatives, intentions to buy, and eventually, buying behavior [1]. Numerous other considerations influence online purchasing behavior. Consumers can consider numerous appealing infomercials or online offers, and compare prices, shipping time, and after-sale services from multiple different sellers, which will attract their concentration and accelerate their shopping behavior for even not necessary products. A well-designed online platform with an attractive and easy to use design are important factors to attract potential consumers. Furthermore, online shopping possibly will modify or change the process of getting information about specific products that benefit potential customers from special characteristics of the Internet [1].

Moreover, the most recent development and advantages of Internet of things (IoT) technology is going to revolutionize many industries as well as online shopping platforms. By using embedded sensors, tools, machines, and products that are all connected and communicate with each other, businesses are able to distinguish more precise data patterns, behaviors, and performances.

Speedy change in transactions and supply systems in recent years with a major concentration on consumer-related purchasing behavior has altered purchasing behaviors and led to the growth of more personalized products [2].

Growing numbers of pioneering technologies based on the combinations of different tools such as cryptocurrencies, big data, IoT, and cloud computing are going to advance the business models [3]. The new technologies are being utilized to evaluate the customers' purchasing behavior, loyalty, and demands.

Developing and expansion of the internet of things applications will help businesses and marketing experts to gather and process huge quantities of streaming data, to evaluate consumer behavior or their decision-making more precisely. Internet of Things or (IoT) technology, uses different types of sensors to obtain data, such as location, position, posture, temperature, and even human activities.

2. Literature Review

Bigné-Alcañiz *et al.* [4] argued that the information sources' nature may influence buyer behavior. Businesses' dependency on consumers' shopping data can be increased in near future. The main application of the internet of things will be to improve the quality of life for people by improving their security, accessibility, and comfort. It might include optimization of the utilizing numerous devices and resources [5;6]. An experiment done by the World Economic Forum suggests that connected electrical devices and gadgets will consume more than fifty percent of the web traffic supplied to households by 2025 [7]. Therefore, it can be expected that nearly all electrical devices in many houses are connected and communicate with each other to act independently of human involvement or intervention [6].

For instance, Radio Frequency Identification (RFID) tags, actuators, sensors, and mobile phones are able to interact with each other through unique addressing schemes, to reach common goals [8]. Consumer behaviors and preferences now can be monitored and analyzed more precisely based on the monitored data, which is of great importance in all businesses, specifically online businesses [3].

Various sensors can be connected to one item or gadget to monitor multiple shoppers' physical activities. Nowadays, by using modern and recently developed sensors, for instance, eye-tracking sensor technology, we can accurately track and monitor consumers' behavior when shopping online. Furthermore, data obtained from sensors possibly will be sent to the cloud to be processed by the big data platforms and eventually use for web page design, e-commerce and online marketing.

In their study, Karjol, Holla & Abhilash [9] proposed a system that provides the nearest path to pick up the listed items in separate racks at Walmart. Also, with the added feature, enabled Cart to Cart communication can help customers to share their purchasing lists with other shoppers. That feature will facilitate parallel shopping, by using two or more carts.

Yamamoto *et al.* [10] conducted an experiment to study consumer perception by observing and evaluating the data on consumer behavior. The focus of the study was to analyze the consumer's behaviors such as listening, eye gaze, and smell, to acquire an understanding of user's reactions and attractions regarding certain products.

For instance, they observed and analyzed the gazing point of both right and left shoppers' eyes, using eye tracking sensors EMR-9 by NAC Image Technologies Inc. by comparing the gazing points of both eyes when the customer is focusing on a specific product, they concluded that it is possible to monitor their interesting products when they shop online. According to their results detection of gaze, points can be considered one of the important features of offering adaptive recommendations of products that takes user interests into account.

Fu *et al.* [3] examined the intelligent decision-making process of online shopping behavior by utilizing IoT technology. They examined the application of grip force and eye-tracking sensors to detect the searching behaviors of online consumers while reading online reviews. By comparing the fixation

time participants spent on the areas of interest (AOIs), they explained the cognitive activities and visual attention of the participants. They also argued that the grip force test makes the test results closer to respondents' cognition based on their subconscious activities.

In another study, Renart *et al.* [11] suggested a program that supports applications to identify data-driven, location and resource-aware processing of data streams. Specifically, the program delivers models to specify where and how a data stream is processed, according to its spatial, content, and temporal qualities. They also offered a way to implement the framework using an event-driven runtime, by explaining events, associatively. Sohaib, Lu & Hussain [12] offered and introduced an integrated framework of cloud computing and the IoT for disabled individuals such as a motor (imperfect use of hands), sensory (hearing or vision loss), and cognitive (learning weaknesses or language incapacities) in the context of business to consumer online market context. They argued that IoT-enabled services may present the possibility for a successful online shopping experience for people with disability.

Rashid, Peig & Pous [13] suggested an Augmented Reality (AR) interface to develop hand-held devices, associated with a physical Radio Frequency (RFID) Smart shelf to bridge the gap between online and offline retail. Their proposed system permits shoppers to interact with physical products through AR interfaces on PCs and smart devices. They argued that this system will give users or shoppers, more sense of influence and instant satisfaction by interacting with physical spaces, while they are interacting digitally. This could be an innovative idea to bring traditional street-side shopping to online shoppers. Initial assessment indicated the possibility of user interaction with the products in the physical spaces while having access to online shopping features.

Consequently, a multitude of sensors can be implemented and connected at the point of sales systems to get the shopper's data to improve shoppers' experience and satisfaction. These live data devices can enable online stores to deliver "smart" messages, featuring more products according to their interests (figure 1).

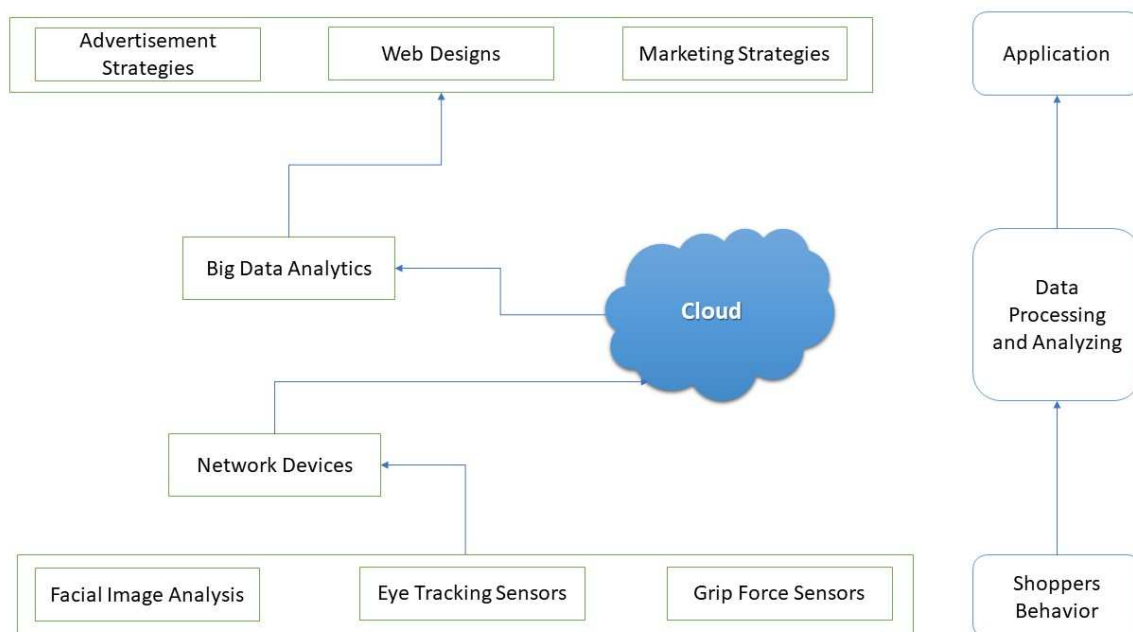


Figure 1. IoT Application Framework

3. Conclusion

Presently, IoT and information technology (ICT) are expanding, and devices are being smarter. The Internet is the most important cornerstone of IoT and an intermediate data platform that can provide users with a rapid and cost-effective way to share, gather or process information, where it links geographically distributed users and provides innovative business opportunities. Following the growth of ICT, it can be projected that smart devices can advance novel and revolutionary concepts and further technological advancement will shape the advent of the Internet of Things (IoT). IoT is an innovative example that is rapidly gaining ground in the scenario of modern ICT [14].

The implications of emerging IoT devices will generate dimensions of measures and detections which had never formerly existed. Gathering countless data on consumption quantities with interactions among devices and computers.

Researchers have conceptualized consumer experiences as an important factor that provides ways to understand the system better and this may influence consumer's purchase behavior [15;16;17]. Research on models of consumer behavior has used methods such as experiments, surveys, and focus groups to understand how consumers feel about their experiences and their emotional associations. Marketers now endeavor to gain an advantage from IoT applications to monitor customers' practices with products they might purchase.

Obviously, IoT data might not be popular or provide meaningful or vivid data as produced from traditional research methods used in consumer behavior research. However, IoT is now become commonly recognized and will be extremely useful to monitor and study customer experience and behavior. The IoT technology might connect the digital and the physical world, and this experience offers new insights into emerging research methods and particularly market research [17]. IoT technology is still in its initial stage and needs to be explored more. The new applications of the Internet are expanding significantly through a new generation of electronic devices which opened the door for the swift development of e-commerce. This technology is likely to support many exciting e-commerce practices and more research on IoT application can be done in the new world of Internet-connected consumer-product experiences.

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