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Research Article

Intelligent Advertising Design Strategy Based on Internet of Things Technology

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With the rapid development of modern economy, the advertising industry is crucial to economic and social development, and information technology has made a significant contribution to the development. Outdoor advertising is not only an important part of a city's image but also reflects the overall appearance of a city's economy, politics, and culture. With the emergence of IoT technology, new advertising communication modes are constantly updated. The Internet of Things is at the forefront of information technology and provides a major impetus for the development of the advertising industry today. This paper studies the intelligent advertising design strategy based on the Internet of Things technology, which is a truly responsive advertising communication mode that serves the needs of the audience. Through multisensory interaction design, an effective interaction between people and advertisements can be formed. And it adopts a variety of crawling strategies to analyze the intelligent web advertisement crawler system to collect advertisement data in the Internet. The research results show that the repetition rate of advertisements captured by the best priority strategy is stable at around 25%, and the overall advertising information repetition rate is the lowest.

1. Introduction

With the rapid development of information technology, the Internet of Things, known as the third information revolution, has attracted widespread attention from all walks of life. It has played an important role in accelerating economic and social development and has become an important driving force for today's global economic and social development. As an important means of disseminating information, the Internet has naturally become an important place for advertising. Unlike traditional media such as television, newspapers, radio and magazines, advertising on the Internet has its own unique advantages. This is unmatched by traditional media advertising.

People found that the current offline advertising did not achieve the expected effect. There is a certain blindness in the advertising process. With the development of economy and the advancement of science and technology, people are no longer satisfied with simple sensory interaction of information. Instead, it pays more attention to multisensory interactive design that is experiential, intuitive, and interesting. This is getting more and more attention. Humans use the five senses of sight, hearing, taste, smell, and touch to perceive things at the same time. Therefore, in the dissemination of a certain experience, if the media mobilizes the audience's senses more, the human perception will be more simulated. At present, much of outdoor advertising is still only a form of communication; visual and sound advertising is the most common. The target audience is very diverse, and the lack of information from other senses tends to affect people's experience with an advertisement, thereby affecting its reach and persuasiveness. For example, there are currently many outdoor advertisements in many subway stations, mostly in the form of billboards. But they only communicate information to the public through visual images and words. Of the tens of thousands, very few actually stopped to look. Therefore, it is necessary to introduce the concept of multisensory interaction into the advertising field in order to better utilize the commercial value of advertising.

In the era of big data, information is flooding the work, life, and study of modern people. Information as a communication tool is inseparable from advertising, but people's

sensory experience in public spaces must be respected. The novelty of this work is to combine the concept of multisensory design, select the appropriate communication medium, take the new media as an effective platform, and take the audience's perspective as the starting point. It is people-oriented. It considers the relationship between the media and the audience in a three-dimensional and multidimensional manner. It fully mobilizes the audience's sensory experience, allows the audience to actively participate in the advertising experience, and creates a different sensory experience. It is not only an innovation in media technology but also a new interaction between different media.

2. Related Work

Today, the Internet of Things (IoT) and robotic systems are the main drivers of technological innovation trends. Leveraging the strengths of both technologies, IoT-assisted robotic systems can reveal a potentially disruptive opportunity. Scilimati et al. provides an experimental analysis of an IoT-assisted robotic system for environmental monitoring. The main results of the analysis show that (i) drones do not incur any significant overhead due to on-board IoT devices and (ii) the overall quality of service in terms of network join time, data retrieval delay, and packet loss rate meets the mission requirements. These results facilitate further development in a larger-scale setting [1]. Loureiro and Kaufmann explore the impact of individual attitudes toward advertising and country-of-origin images (brand origin and country of manufacture) on brand equity creation and examine how brand typicality moderates the impact of brand origin macroimages on perceived quality. Three criteria guided the choice of brands. The first criterion is to choose a brand that is well known to consumers. The second is to choose a brand with a unique brand origin and major country of manufacture. The third and final criterion is to consider brands at different positions in the brand ranking. In order to estimate the structural path coefficient and Bootstrap technology, the partial least squares (PLS) method is used in the research. The partial least squares method is used to find the fundamental relationship of two matrices, that is, a latent variable method that models the covariance structure in these two spaces, but the practicability is not strong [2]. An estimated 85% of social TV activity discusses TV shows, so it is valued by broadcasters and advertisers. This has led to research into audience behavior when engaging in multiscreen events. Fossen and Schweidel provide real-time feedback on how an advertisement is being considered by viewers. First, the study conducted an in-depth study of word-of-mouth induced by TV commercials in social TV. At the same time, the study also looked at the impact of the brands advertised and the programs aired by the advertisements. The second question studied was the interaction between online engagement programming and advertising brands. However, studies have found that excessive engagement with programming can negatively impact advertising viewing [3]. Nwokah and Ngirika examine the impact of online advertising on customer satisfaction of Nigerian online retail companies. Of the 384 questionnaires distributed in total, 285 were used for analysis. The findings show a positive and strong relationship between online advertising and customer satisfaction. Online advertising has a clear impact on customer satisfaction. The study concluded that online advertising largely affects customer satisfaction. However, online advertising is a key factor in determining customer satisfaction. Because it is considered to be the point of interaction between the customer and the company that buys its product. But research is not comprehensive enough [4]. Man discusses the impact of brain function on the creative aspects of graphic design. Creativity is the basic component of the psychological structure of graphic design talents, and creativity is the soul of advertising design. Without innovation, where can creativity come from? It refers to the ability of advertising design talents to have new ideas and new structures and to invent new images, new methods, and new ideas in advertising design activities. The main purpose of modern advertising is to create customers, create images, create benefits, and create the future. Therefore, creativity is an important part of the entire advertising design intelligent structure and design talents [5]. With the rapid development of NFC (Near Field Communication) technology, Tian-Yu and Liu proposed a laundry label with NFC tags to meet the digital requirements of the clothing industry. They developed a clothing information system with NFC-enabled mobile phone, mobile Internet, and enterprise information center. After the experiment, consumers can read and write NFC laundry tags on their mobile phones to easily obtain information on washing and clothing care. NFC laundry tags will meet the standards required for washing. The emergence of NFC laundry tags will provide a natural basis for smart fitting recommendations and accurate targeted clothing advertising information. However, it is difficult to realize all aspects at present [6]. The above research has carried out a detailed analysis of the application of intelligent advertising design and Internet of Things technology. It is undeniable that these studies have greatly promoted the development of the corresponding fields. We can learn a lot from the methodology and data analysis. However, the research on intelligent advertising design in the field of IoT still needs to continue to develop and improve. It is necessary to fully apply these techniques to research in this field.

3. Intelligent Advertising Design Strategy Method Based on Internet of Things Technology

The Internet of Things is a connected combination of the Internet, communication networks, and television networks. The Internet of Things (IoT) refers to the use of information sensors, such as radio frequency identification (RFID) sensors, infrared sensors, global positioning systems, and laser scanners, to connect any object with the Internet in accordance with the agreed information exchange and communication protocols to achieve a network for intelligent identification, tracking, monitoring, and control. The core and foundation of IoT is the Internet. It is a network that extends and expands on the basis of the Internet. IoT

provides connectivity between sensors. It uses various smart technologies such as cloud computing and pattern recognition for sensor connection and smart processing to expand its application field. Through intelligent analysis, processing, and data mining, it is possible to understand the interactions between people and things. Ultimately, the goal of intelligent control and scientific governance of the physical world can be achieved [7]. This is why, for IoT, application development is at the heart of development. And user experience is the goal of this development [8].

Today, advertising can be divided into two main forms. The first is offline advertising, such as billboards, advertising machines with rotating images, and video advertisements that play on screens. The second is online advertising, such as advertisements placed by major websites through advertising platforms. Each type of advertising has its advantages and disadvantages, especially offline advertising [9]. Offline advertising is generally in the form of distribution. The website is very flexible. Offline advertising is also mainly achieved by means of store sales, road shows, and in-depth distribution. Offline advertising is more direct, fast, and accurate in terms of product sales feedback and long-term market response analysis. Because of its complex and changeable environment, it needs to have a wider range of production requirements. But its shortcomings are also obvious, such as lack of purpose, poor interactivity, and inability to catch people's attention [10].

The advertiser's purpose of advertising is to use the least amount of money for advertising to get the most profit. They do not care about which advertising technology the advertising service provider chooses and do not care whether the advertisements are placed in newspapers, magazines, TV, or the Internet. However, for advertising service providers, what kind of advertising form to use, what kind of advertising technology to use, what kind of media to put in, and how to locate target users are all factors that they need to consider, because these factors will affect the click rate of advertisements, the conversion rate of advertisements, and then their own profits [11]. Figure 1 shows the ecological environment of Internet advertising. Advertisers hand over advertising information and advertising requirements to advertising networks. An advertising network mainly refers to advertising network and brand advertising network. The advertising network aggregates network media resources such as portal websites and a large number of small- and medium-sized websites and places Internet advertisements on the specific web pages of the websites in the network media. When a network user browses to a specific page through a browser, the Internet advertisements delivered by the advertising network will be displayed to the user. If the user sees the advertisement and has click behavior and subsequent purchase of goods or services, the advertiser's advertisement will be processed and delivered by the advertising network, affecting the user and reaping its value as an advertisement [12].

Outdoor advertising based on the concept of multisensory design refers to the effective interaction between people and advertisements through the interaction between people's five senses on the basis of traditional visual communication as the main form of expression. This form of

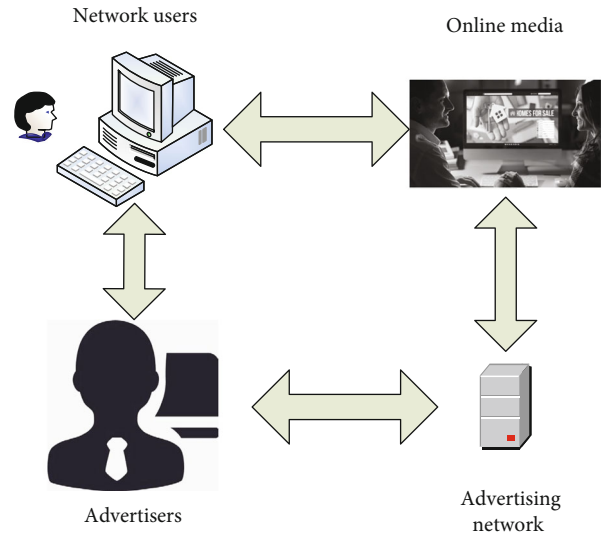

Figure 1: The ecological environment of Internet advertising.

communication can be expressed through different communication tools [13]. Advertising increases multisensory interaction and is aimed at creating a good advertising experience for the audience. Through innovative and attractive interactive methods, we can better understand the ideas conveyed by advertisements and deepen the audience's understanding of the value of advertisements and brands [14]. In the process of selecting and paying attention to information, consumers' senses are increasingly fatigued, and their personalized requirements are greatly enhanced.

According to the different sensory objects of interaction, interaction can be divided into "visual interaction" and "behavioral interaction." "Visual interaction" refers to the interaction of an audience with an image through visual media. This is a traditional "one-way" information transfer method [15]. "Behavioral interaction" refers to the actual participation of the audience in the interaction of the space through the presentation of the medium. This is an experiential "two-way" information transfer [16]. No matter how perfect the visual interaction is, even if it is flat and three-dimensional, it is just an image. People are unable to experience the sound, smell, weight, texture, and other sensory stimuli of objects in images. But through behavioral interactions, these sensations that require imagining can take place. Other sensory functions, such as touch and hearing, can give the audience a more realistic sense of presence [17]. Other sensory functions, such as touch and hearing, can give viewers a more authentic sense of immersion. Most sensory research focuses on sight and hearing. These are generally considered to be the two most important human senses. Sight and hearing are two senses that are relatively easy to integrate and associate. The biggest advantage of audiovisual advertising is that it is intuitive and imaginative, spreads fast, and has a wide coverage. The combination of image and sound gives people the opportunity to imitate and reproduce real life. Table 1 is a comparison of the retention rate of auditory memory with that of visual memory [18]. It can be seen from Table 1 that the memory retention rate of the

Table 1: Comparison of retention rates of auditory memory and visual memory.

Holding time	After 3 hours	After 3 days
Auditory memory retention rate	68%	10%
Visual memory retention	75%	25%
Audiovisual combination retention rate	80%	60%

Table 2: Market share of different forms of online advertising in China, 2016-2018.

	Online advertising market size (billion yuan)	Year-on-year growth (%)
2016	2808	34.10%
2017	3508.1	24.90%
2018	4186.7	19.30%

audiovisual combination has been greatly improved after 3 days, reaching 60%.

The advertisement itself uses relatively simple interactions, combining visual interactions and qualitative click interactions to analyze IoT business models. The business model refers to the law and logic of value creation. It refers to the process of creating value for customers under the action of a certain value transfer mechanism in the value network environment of different places [19]. Through the analysis of IoT business models, we can understand the development process of IoT business models and the basic types of IoT business models. Only by clarifying the development needs of the IoT market and connecting related IoT topics can we create value for customers faster and more effectively, discover the rules of IoT value creation, and provide basis and guidance for IoT technology-based advertising. Designing an IoT-based business model will provide the foundation and guidance [20].

The emergence of new media applications such as big data, cloud computing, Internet of Things, mobile Internet, and O2O has changed the information dissemination method of online commercial advertising. O2O stands for Online To Offline, which also combines offline business opportunities with the Internet, making the Internet the front desk for offline transactions. On the one hand, "online thinking" is changing people's way of thinking; on the other hand, "Internet+" is rapidly innovating in all walks of life. Table 2 shows the market share of various forms of online advertising in China from 2016 to 2018. As can be seen from Table 2, the scale of the Internet and netizens in China is growing rapidly.

The significance of new media is to spread and share experiences. From a media development perspective, the use of multisensory compensatory media is in line with the audience's tendency to experience comprehensive and authentic experiences when receiving information [21]. In the era of big data, the public receives information from all directions every day. They prefer two-way communication with the communicator rather than simply passively receiving information. The more senses used to receive information, the more authentic the information and the more effective the communication [22]. In conclusion, technology has brought countless changes to people's way of life. In the context of IoT development, designing advertisements that enable multisensory interaction can gain many benefits [23]:

(1) Various forms of expression and richer creativity

(2) Use media integration strategies to achieve high returns with low investment

(3) Create a contextualized experience to reach a wide range of people

These advantages largely meet the needs of most advertisers. The advertising communication mode based on the Internet of Things technology is composed of seven elements: source, channel, sink, advertiser, advertising effect, personal data center, and data resource library. The interrelationships among various elements and the dynamic information flow process composed of interrelationships jointly construct this communication mode, as shown in Figure 2.

Generally speaking, IoT data is fragmented and irregular. Most user data is vague and indeterminate. Therefore, these data need to be quantified and processed before they can be analyzed. This includes data preprocessing, data normalization, and clustering. Among the related functions of data mining rules, the Apriori algorithm is often used. This algorithm has certain advantages. It uses an iterative method of layer-by-layer search to find out the relationship of item sets in the database to form rules. The process consists of concatenation (matrix-like operations) and pruning (removing unnecessary intermediate results). The research proves that the algorithm achieves good correlation results on user data. In this paper, we use the Apriori algorithm to correlate IoT data in data mining mode and complete data analysis.

Before applying relevant rules to IoT data samples, the data samples need to be divided into batches. The IoT data then needs to be normalized before applying the Apriori algorithm for data association.

Suppose the incomplete data sample set is $X_a = \{x_1, x_2, .., x_n\} \subset S^R, x_c = (x_{c1}, x_{c2}, \cdots, x_{cr})^T \in S^R$. The subsets of sample set X_a are X_w and X_p, which have

$$X_w = \{x_c | x_c \in X_a, 1 \le c \le n\}, \tag{1}$$

$$X_p = \{x_i | x_i \in X_a, 1 \le i \le n\}, \tag{2}$$

$$X_w \cap X_p = \varnothing, X_w \cup X_p = X_a. \tag{3}$$

The set of eigenvalues is

$$X_m = \{x_{cj} | x_{cj} = ?1 \le j \le s, 1 \le c \le n\}, \tag{4}$$

$$X_u = \left\{x_{cj} \middle| x_{cj} = \text{determine the value } 1 \le j \le s, 1 \le c \le n\right\}, \tag{5}$$

$$X_m \cap X_u = \varnothing, |X_m| + |X_u| = |X_a|. \tag{6}$$

$||$ represents the number of elements in the set.

Suppose the completeness rate of data sample X_a is denoted by p:

$$p = \frac{n_u}{n_s} = \frac{|X_u|}{|X_a| \times s}. \tag{7}$$

The impact factor of data sample x_c on cluster analysis is represented by θ_c:

$$\theta_c = \begin{cases} 1, & x_c \in X_w, \\ 1 - \dfrac{|x_{cj}|}{|x_c|}, & x_c \in X_p, x_{cj} \in X_m, 1 \le j \le s. \end{cases} \tag{8}$$

Similarity λ between data samples x_i and x_j:

$$\lambda = \left\|x_{ic} - x_{jc}\right\|, (1 \le c \le s) \wedge (x_i \in X_u) \wedge \left(x_j \in X_u\right). \tag{9}$$

Let the sample set $X = \{x_1, x_2, .., x_n\} \subset S^R$ be a finite set of samples of n modes in the mode space. Among them, $x_c = (x_{c1}, x_{c2}, \cdots, x_{cr})^T \in S^R$ is the feature vector of the data sample x_c. x_{cj} is the assignment on the jth dimension feature of the feature vector x_c.

The affiliation between x_c and $x_i (1 \le i \le c)$ is constrained by $h_{ic} = h_{X_i}(x_c) (h_{ic} \in [0, 1])$. In order to facilitate the calculation, it is recorded in the form of a matrix, denoted as $u = [u_{ic}]_{k \times n}$.

Let user information domain $X = \{x_1, x_2, \cdots, x_n\}$ be the object to be classified. Each object is measured by m indicators, $x_i = \{x_{i1}, x_{i2}, \cdots, x_{im}\}$, $i = 1, 2, .., n$, and the original data matrix can be obtained as

$$\begin{pmatrix} x_{11} & x_{12} & \cdots & x_{1m} \\ x_{21} & x_{22} & \cdots & x_{2m} \\ \cdots & \cdots & \cdots & \cdots \\ x_{n1} & x_{n2} & \cdots & x_{nm} \end{pmatrix}. \tag{10}$$

Once you have the raw data, you can standard deviation transform the data:

$$x'_{ij} = \frac{x_{ij} - \bar{x}_j}{s_j} \quad (i = 1, 2, \cdots, n; j = 1, 2, \cdots, m). \tag{11}$$

Among them,

$$\bar{x}_j = \frac{1}{n} \sum_{i=1}^{n} x_{ij}, \tag{12}$$

$$s_j = \sqrt{\frac{1}{n} \sum_{i=1}^{n} \left(x_{ij} - \bar{x}_j\right)^2}. \tag{13}$$

After transformation, all variables take values between [0, 1]. After the original matrix has been established, a fuzzy similarity matrix is established according to the original matrix. The fuzzy similarity matrix represents the degree of similarity between objects, $\lambda_{ij} = r(x_i, x_j)$. There are four main ways to calculate λ_{ij}:

The angle cosine method solves the similarity coefficient:

$$\lambda_{ij} = \frac{\sum_{c=1}^{m} |x_{ic} - \bar{x}_i| |x_{jc} - \bar{x}_j|}{\sqrt{\sum_{c=1}^{m} (x_{ic} - \bar{x}_i)^2} \sqrt{\sum_{c=1}^{m} \left(x_{jc} - \bar{x}_j\right)^2}}. \tag{14}$$

Among them,

$$\bar{x}_i = \frac{1}{m} \sum_{c=1}^{m} x_{ik}, \tag{15}$$

$$\bar{x}_j = \frac{1}{m} \sum_{c=1}^{m} x_{jk}. \tag{16}$$

The maximum and minimum method is

$$\lambda_{ij} = \frac{\overset{m}{\underset{c=1}{\circ}} \min \left\{x_{ic}, x_{jc}\right\}}{\overset{m}{\underset{c=1}{\circ}} \max \left\{x_{ic}, x_{jc}\right\}}, \quad i, j = 1, 2, \cdots, n. \tag{17}$$

The arithmetic mean and minimum method is

$$\lambda_{ij} = \frac{\overset{m}{\underset{c=1}{\circ}} \min \left\{x_{ic}, x_{jc}\right\}}{1/2 \overset{m}{\underset{c=1}{\circ}} \left\{x_{ic} + x_{jc}\right\}}, \quad i, j = 1, 2, \cdots, n. \tag{18}$$

The geometric mean and minimum method is

$$\lambda_{ij} = \frac{\overset{m}{\underset{c=1}{\circ}} \min \left\{x_{ic}, x_{jc}\right\}}{\overset{m}{\underset{c=1}{\circ}} \sqrt{x_{ic} \cdot x_{jc}}}, \quad i, j = 1, 2, \cdots, n. \tag{19}$$

After calculating λ_{ij}, the fuzzy similarity matrix can be obtained, which is the similarity between different elements.

The IoT market has broad prospects, but most of the existing IoT advertising business models are extensions of traditional media advertising business models. Therefore, the targeted advertising business model based on IoT technology should improve the IoT advertising business model based on the existing IoT advertising business model. Through the effective aggregation of the operating entities of the Internet of Things advertising business model, the

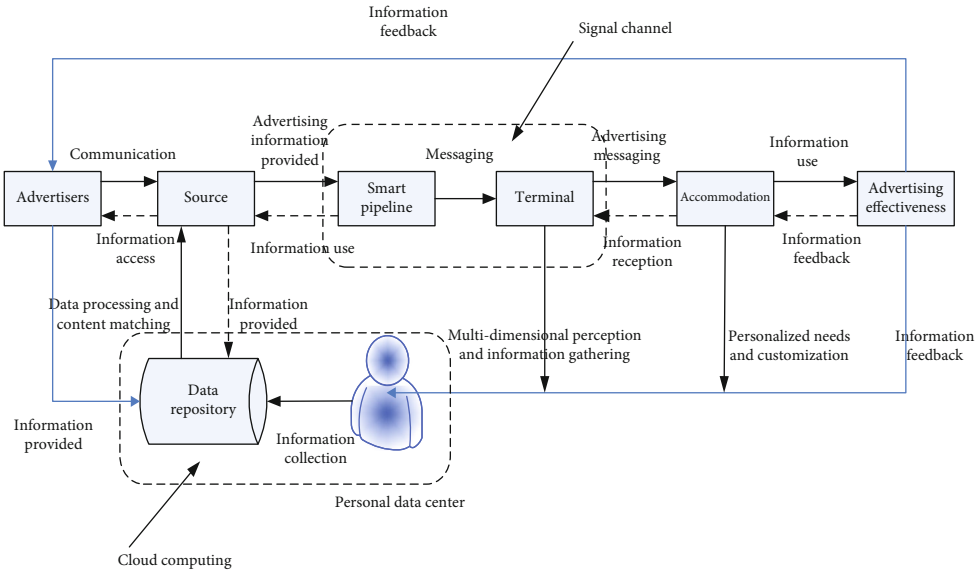

Figure 2: Advertising communication model based on IoT technology.

application of the targeted advertising business model based on the Internet of Things technology can be realized. The targeted advertising business model based on the Internet of Things technology is composed of four elements: operating entities, users, product (service) provision, and value acquisition, as shown in Figure 3.

In this mode, hardware equipment manufacturers, system integrators, telecom operators, and service and content providers are formed to jointly provide products (services). It builds an advertising platform for the dissemination of advertising information between advertisers and consumers and realizes targeted advertising dissemination based on the Internet of Things technology. It also derives benefits and value from advertisers' sales performance and consumers' advertisement subscriptions. The development of triple play and multiscreen integration has prompted the integration of various terminals such as computers, smart TVs, and mobile phones. The collaboration and aggregation between operating entities and the application of cloud computing technology enable the establishment of personal data centers and data resource libraries and then build a targeted advertising platform based on the Internet of Things technology. The targeted advertising platform perceives user, context, geography, and other related information through the terminal. It collects and aggregates relevant information through intelligent channels and establishes a personal data center and data repository. Through cloud computing, data mining and analysis processing are carried out to achieve intelligent matching between advertisements and users. The advertising content is determined according to the behavior characteristics and needs of each user, and the orientation and precision of advertising communication are truly realized.

The Internet advertising market has grown so rapidly and has reached a considerable size. Internet content providers and advertisers pay more attention to the placement of advertisements and the marketing effects brought about

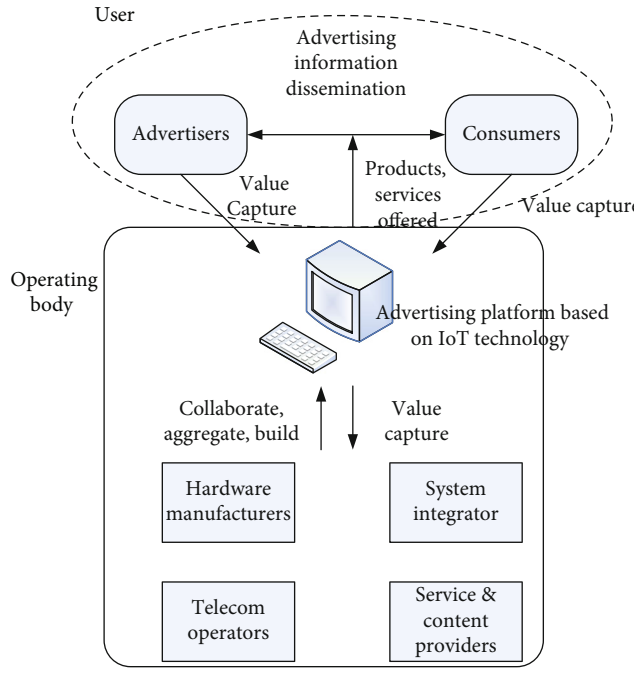

Figure 3: Advertising business model diagram based on IoT technology.

by them. These are very important for Internet advertising. The main function of the intelligent web advertisement crawler system is to capture the network advertisement data from the massive web pages. In the face of extremely large-scale web page data, the system must be able to quickly find pages containing online advertising information. The repetition rate of advertisement information contained in these pages should be as low as possible, and these pages should cover as much advertisement information as possible. Then, the advertisement data is extracted from the source code

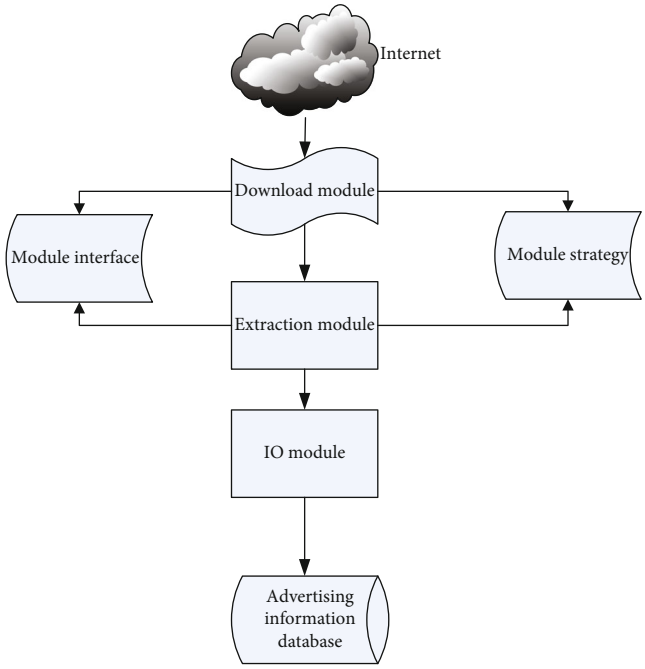

Figure 4: Overall system frame diagram.

corresponding to the web page according to the specified format, and the data is saved in the database. The overall design of the system is mainly divided into five modules: download module, extraction module, strategy module, interface module, and IO module, as shown in Figure 4. Combined with the research on the web advertising crawler system in this paper, the system should achieve the following functional goals:

(1) Realize the best crawling strategy. Under the guidance of the strategy, the system can capture a large amount of advertising data quickly, without repetition

(2) The advertisement extraction algorithm should be universal and efficient. On pages with different page layouts on different websites, advertising data can be extracted efficiently

(3) Provide a graphical interface. It is convenient for users to control the operation of the advertisement crawler system, and at the same time, it can support the test of the advertisement extraction effect on a single web page

Client SDK: integrate with third-party applications developed by application developers and encapsulate advertising update and display logic. *Advertising delivery system*: communicates with the client SDK through a specified protocol to provide advertisements for integrated third-party applications. *Advertising display system*: it communicates with the client SDK through a specified protocol to provide support for advertising display on third-party applications integrated with the SDK. *Data analysis system*: originally record the data of the advertisement delivery effect in the client-side SDK. It includes display, click, browse, and download, to conduct summary data analysis and form corresponding reports and statistical results. *Advertising management system*: it is the unified management background of this system. Through this background, users with different roles can perform operations such as advertisement management, report browsing, and system management according to the definition of role permissions. According to the functional definition of each subsystem, combined with consideration of the nonfunctional requirements of the system, the hardware topology is defined as shown in Figure 5.

The subsystem deployment structure on the server side can be seen from Figure 5. The advertisement delivery system corresponds to the delivery server, the advertisement display system corresponds to the advertisement display server, the advertisement management system corresponds to the advertisement management server, and the data analysis system corresponds to the data analysis server. The database server consists of a server and a server node. Both the advertisement display server and the delivery server are composed of one server, which can achieve load balancing. The advertising management background only has the advertising management function. Considering security, usability, and improving the efficiency of advertisement delivery and display, it is deployed on a separate server physical node to reduce the impact on advertisement delivery and display and reduce the possibility of the entire system platform crashing. Because the statistical analysis server needs to undertake large statistical computing tasks, it will also be deployed on the physical node separately at this stage.

4. Intelligent Advertising Search Design Strategy Experiment

4.1. Overall System Architecture. In recent years, with the increasing influence of the Internet in people's daily life, it has become a very important advertising medium alongside TV and newspapers. With its wide coverage and strong interactivity, online advertising has attracted many advertisers to go online. In this paper, a method for extracting advertisement data from web pages is designed. By monitoring and analyzing advertisement data in a large number of different types of web pages, it collects advertisement data from the Internet based on an intelligent online advertisement search system. The system starts with a predefined sequence of URLs, automatically downloads web data from the Internet, and then extracts advertising data from web pages. It consists of two main processes.

(1) Crawl web pages containing advertisement information from massive web pages on the Internet

(2) Perform subsequent processing on the crawled web pages. Divide the web page into blocks, locate the advertisement data block, and then extract and save the advertisement information

The overall system architecture of the general web crawler is shown in Figure 6.

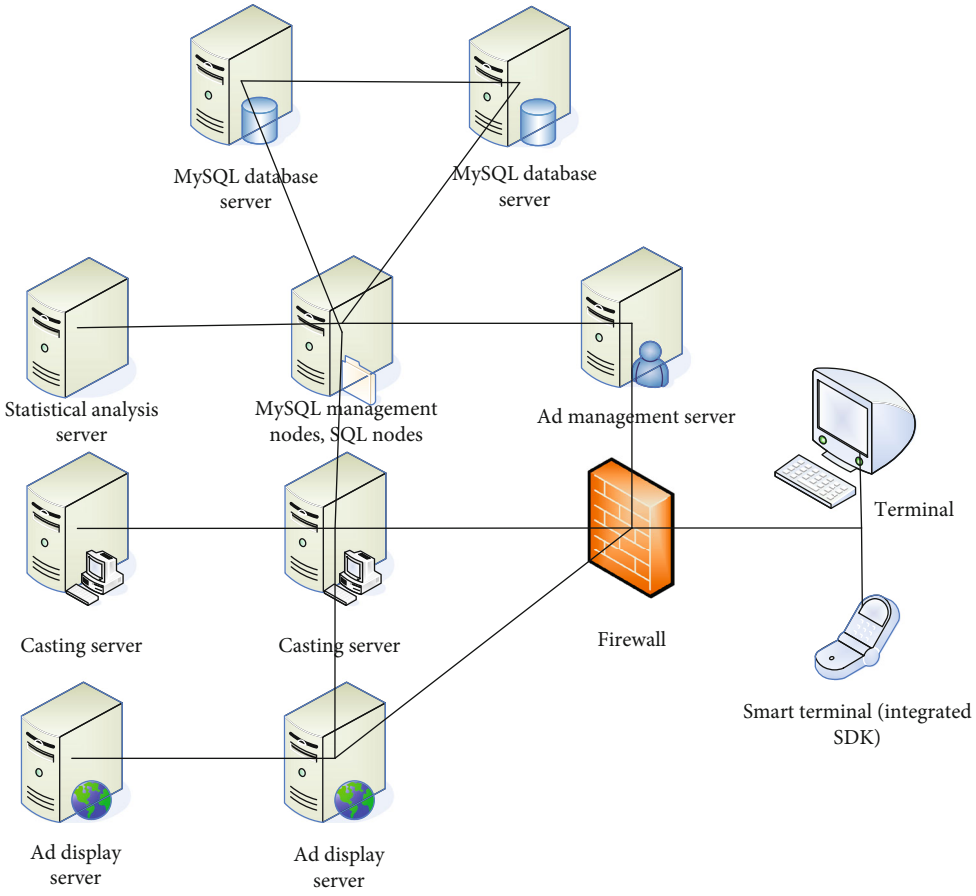

Figure 5: Topology diagram.

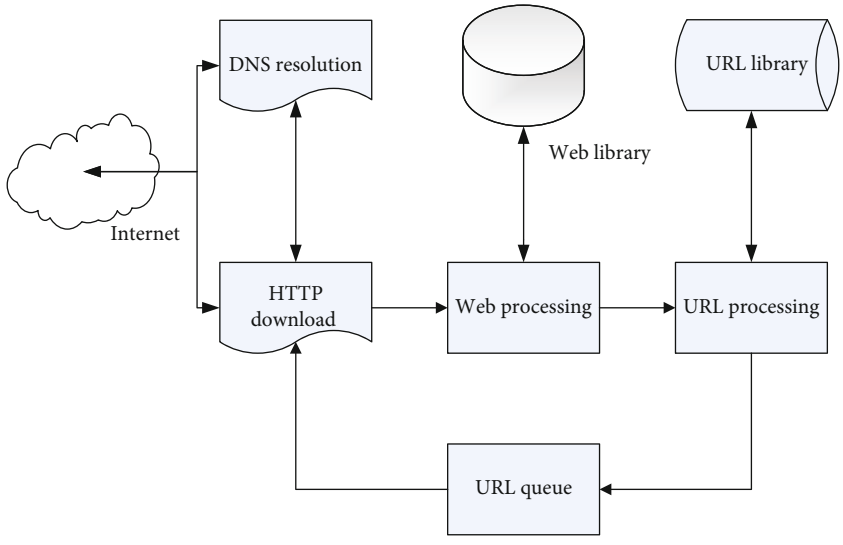

Figure 6: General web crawler system architecture diagram.

According to the architecture in Figure 6, the DNS resolution module is used to resolve the host part in the URL into the corresponding web server IP address. This module also caches the parsed information for quick query in the future. The HTTP download module gets the URL seed from the URL queue. Request the DNS parsing module based on the URL seed to get the IP address of the web server. It uses the HTTP protocol to request the robot.txt file of the site to determine whether the web page corresponding to the URL is allowed to download. If allowed, the web page is downloaded with an HTTP request. Otherwise, skip this URL seed and continue to the next cycle. If the web page is

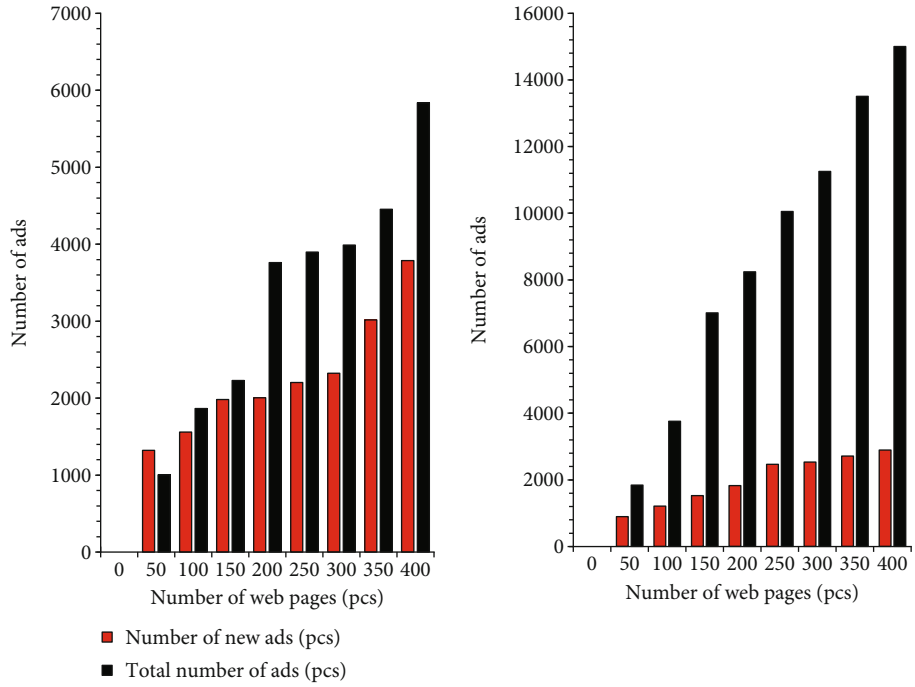

Figure 7: Statistics of the number of advertisements.

downloaded successfully, the web page is handed over to the web page processing module for processing. The module saves the source code of the web page in the database, extracts all the hyperlinks in the web page, and passes the extracted hyperlinks to the URL processing module. The module first filters the URL. The filtering process includes removing invalid hyperlinks and expanding the links whose path information in the hyperlinks are relative paths into absolute paths. Then, the URL is deduplicated, and finally, the URL is processed according to the crawler's strategy, and the URL is added to the queue after the processing is completed.

4.2. Crawling Strategy. In graph theory, breadth-first search is a graph search strategy. Only two basic operations can be performed during the search process: (1) visit and check a node in the graph; (2) gain access to all other nodes connected to the current node.

Depth-first search is also a graph search algorithm. Depth-first search starts from the root node and traverses along a certain path until a node has no further downward path. At this point, backtracking to the parent node of the node, the execution flow of the specific algorithm is as follows:

(1) Visit the root node, and add the root node to the node stack that has not completed the visit

(2) If the node element on the top of the stack has a child node that has not completed the visit, then take out the child node and visit and add the child node to the node stack of the unfinished visit

(3) If all the child nodes of the node element at the top of the stack have completed the visit, the current node is marked as visited, and the node is popped out of the node stack that has not been visited

(4) Repeat steps 2 and 3 until the unfinished node stack is empty, and the states of all nodes are marked as visited

Best-first search is also a graph search algorithm. During the search process, it selects the most valuable nodes to visit according to certain rules. On how to calculate the node value, a heuristic evaluation function is generally used. This evaluation function usually takes into account the description of the node, the description of the ultimate goal of the search, the information collected in the search process so far, and additional knowledge about the problem domain. Of these, additional knowledge about the problem domain is the most important. Best-first search selects the current best candidate node. Algorithms often use priority queues to achieve efficient selection. The execution flow of the algorithm is as follows:

(1) Calculate the value of all initial nodes, add them to the priority queue to be accessed, and initialize an empty list to save the visited nodes

(2) Obtain the head node of the priority queue, visit the node, and add the node to the visited node list

(3) Get all child nodes of the currently visited node. If the child node does not exist in the visited node list, calculate the value of the child node and add it to the priority queue of the node to be visited

(4) Repeat steps 2 and 3 until the priority queue of the node to be accessed is empty and all nodes have been accessed

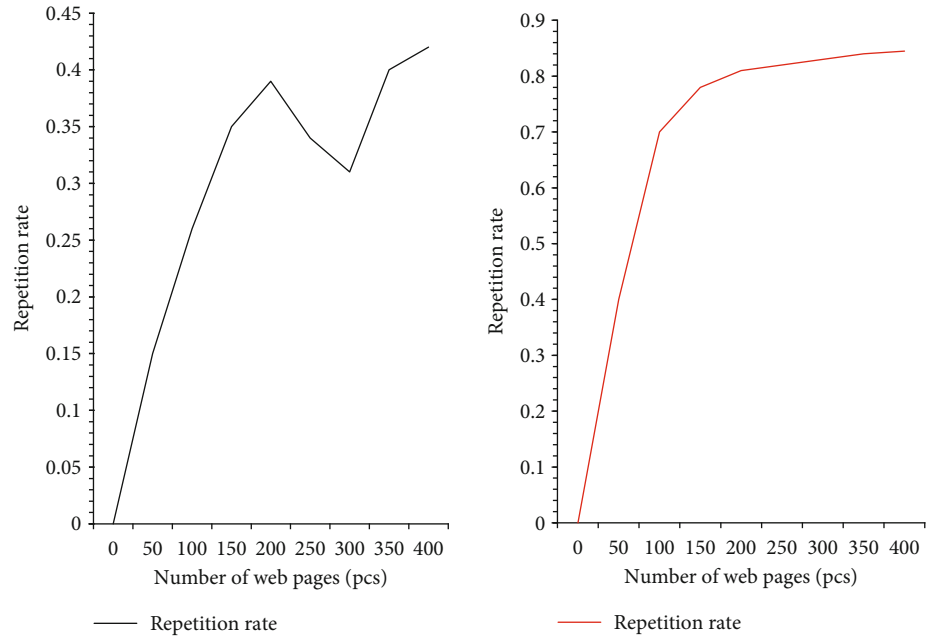

Figure 8: Statistics of repetition rate of breadth-first strategy and depth-first strategy.

When the best-first search algorithm is used in the crawler system, the system must have a clear goal, analyze the similarity or correlation between the URLs of all the pages to be crawled and the system goals, and calculate the importance of the URL. The calculation process can combine the link graph formed by all the discovered URLs and the specific content of the downloaded web page. The system always chooses the most important URL to download first.

The advertisement extraction algorithm is the foundation of the entire web advertisement crawler system. If there is no good extraction algorithm to distinguish and extract all the advertisement information and other information in the web page, the resources consumed by the system will be wasted. Therefore, an efficient advertisement information extraction algorithm can greatly improve the performance of advertisement crawler. The performance of the extraction algorithm can be evaluated by the precision rate and the recall rate. The definitions of each index are as follows:

$$\text{Accuracy} = \frac{\text{Number of advertisements extracted from the web page}}{\text{Total number of results extracted from the web page}}, \tag{20}$$

$$\text{Recall} = \frac{\text{Number of advertisements extracted from the page}}{\text{Total number of advertisements in the page}}. \tag{21}$$

5. Experiment Analysis of Intelligent Advertising Search Design Strategy

According to the rules of the breadth-first policy, the torrent URLs extracted from the same page should have the same priority, and the torrent URLs corresponding to the page have a higher priority than the torrent URLs extracted from the page. According to the rules of the depth-first strategy, the seed URL extracted from the web page has a higher priority than the corresponding seed URL of the web page. But all torrent URLs extracted from the same web page have the same priority. This is consistent with the breadth-first strategy. Moreover, the depth-first strategy usually has a limit value of search depth, which can ensure that the crawler does not sink too deep into a website. Using the breadth-first strategy and the depth-first strategy to assign the priority of seed URLs, the statistics of the number of advertisements obtained are shown in Figure 7. Figure 8 shows the statistics of the advertisement repetition rate for the breadth-first strategy and the depth-first strategy.

When the breadth-first search algorithm is used in the crawler system, the system can quickly cover a large number of different sites. But the deep pages of the site take a long time to collect.

The advertisement crawler system selects the torrent download network with the highest priority in the current state. The statistics of the number of advertisements obtained by the system operation are shown in Figure 9.

By observing the results of the previous three crawling strategy experiments, it can be found from the statistics of the number of advertisements that after the advertisement crawler system has downloaded the same number of web pages, the best priority strategy grabs the most nonrepetitive advertising information, followed by the breadth priority strategy, and the least is the depth-first strategy. All three strategies will capture certain repeated advertisement information. Among them, the number of duplicate advertisements captured by the depth-first strategy is the largest. It can be seen from the figure that the repetition rate is stable at around 80%. The number of duplicate advertisements captured by the breadth-first strategy is second only to the

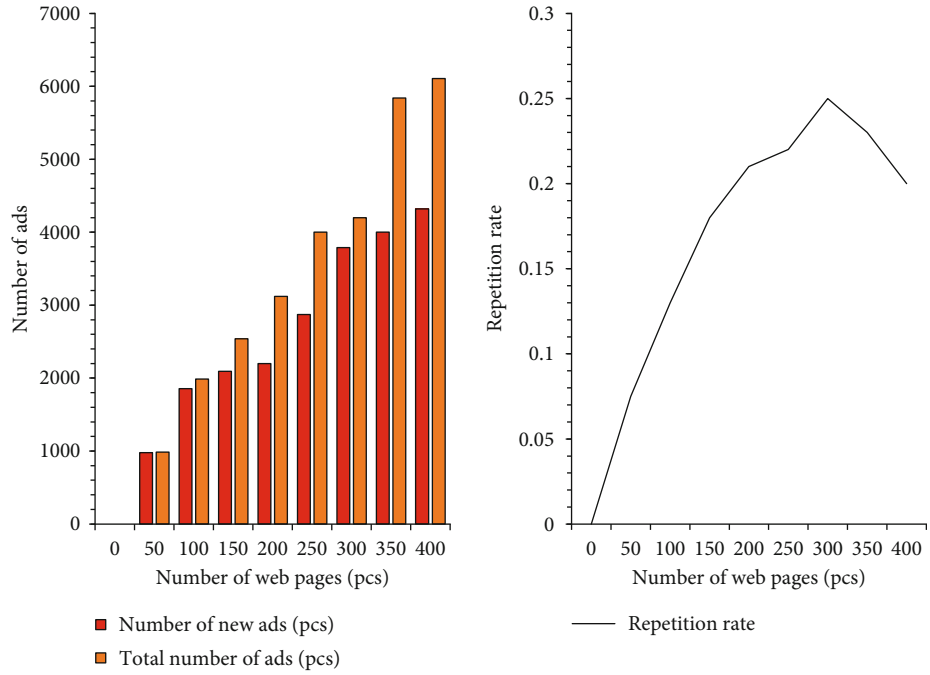

Figure 9: Statistical graph of the number of advertisements and repetition rate of the best priority strategy.

Table 3: Advertisement extraction results for different page numbers.

Dataset	Average accuracy rate	Average recall rate
100	0.833	0.842
200	0.835	0.878
300	0.83	0.88

depth-first strategy. It can be seen from the figure that the repetition rate is stable at around 40%. The best-first strategy also crawls the fewest number of duplicate advertisements. Its overall advertising message repetition rate is the lowest. It can be seen from the figure that the repetition rate is stable at around 25%.

We collected 100 different large-scale comprehensive portal websites and small- and medium-sized websites from the Internet and used the home pages and specific content pages corresponding to these 100 websites. A total of 200 web pages are used as the test dataset for the web advertisement information extraction experiment. The designed web advertisement extraction algorithm is used to extract advertisement information, and the results are shown in Table 3.

Figure 10 counts the statistics of web pages containing advertisements among the 1000 downloaded web pages under each policy condition. As can be seen from the figure, when the optimal priority strategy is used, the most web pages that do not contain advertising data are downloaded. At the same time, the most downloaded web pages did not contain duplicate advertising data.

Compared with the breadth-first strategy and the depth-first strategy, when the best-priority strategy is adopted, the advertising crawler system can crawl nonrepeated advertising information more quickly and comprehensively, and the captured advertising information is less likely to be repeated. When the breadth-first or depth-first strategy is adopted, the advertising crawler system will capture a large amount of duplicate advertising data, wasting a lot of resources. This is because the best-priority strategy determines that the crawler can spread to the entire Internet more quickly. It is more inclined to preferentially download web pages that contain a lot of advertising information and have a small repetition probability. So it is easier to download to pages that do not contain any advertising data and pages that do not contain any duplicate advertising data. While breadth-first and depth-first are based on a graph of links between pages, it is easier to download to many pages on the same site. The number of advertisements placed on the same site by the advertising system is certain, so the probability of duplicate advertisement data on the downloaded web page is greater.

Traditional media advertisements are not interactive due to technology and time constraints. The interactivity of intelligent advertising makes "interpersonal communication" more and more prominent. It breaks the time limit; users can send instant feedback to advertisers. Through the feedback, you can know the user's attitude towards the advertisement to improve and adjust in time. This enhances the effectiveness of the advertisement. Smart advertisements combine a variety of design expressions to make the advertisements have a stronger sensory impact and attract users to browse the advertisements. Compared with traditional advertisements, interactivity brings a stronger experience, attracts users' attention, and creates a sense of immersion when watching advertisements.

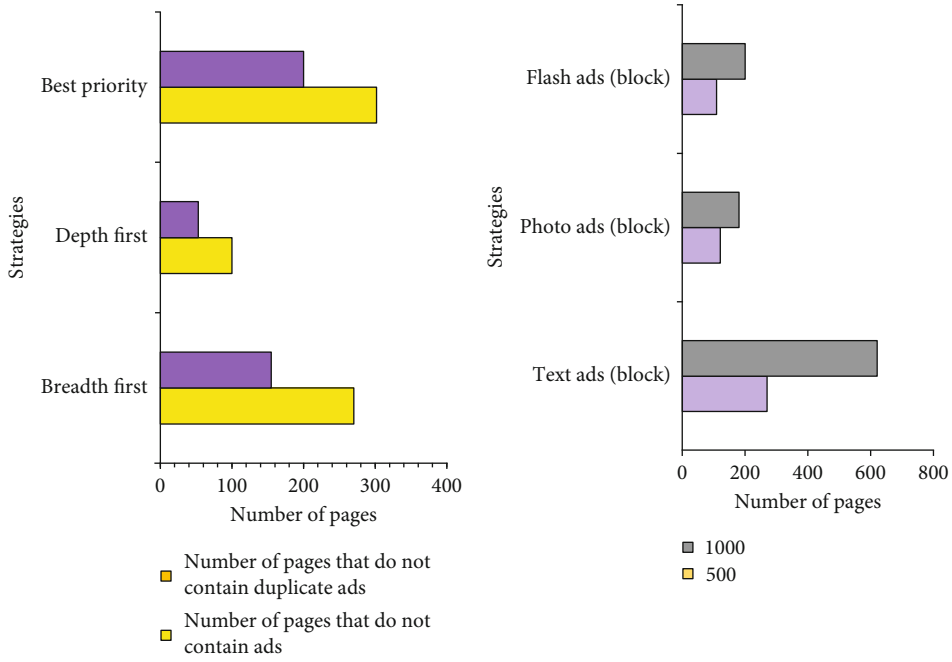

Figure 10: Statistics of downloaded web pages containing advertisements under each policy condition.

6. Conclusion

Smart advertising is an advanced stage in the development of Internet advertising, with many unique advantages. However, due to technical limitations, many advantages are not really reflected, resulting in poor matching effect and inaccurate targeting of targeted advertising. With the development of Internet of Things technology, the two fields of IT (Information Technology) and CT (Communication Technology) have been integrated, forming a new technical field of ICT (Information Communication Technology). The physical network technology provides technical support and guarantee for the improvement and development of targeted advertising. With the changes of the times, people's material life has become richer. There are more and more product brands in the same category, and market competition continues to intensify. In the new market strategy, each consumer is an independent existence. But among a consumer group, they have similar values, consumption outlook, and even aesthetic habits. The multisensory interaction design of advertisements can make good use of this feature to segment consumers. It can disseminate information for specific consumer groups.

Data Availability

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

Conflicts of Interest

The author states that this article has no conflict of interest.

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