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Review on unmanned retail recommender system based on deep learning user portrait

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Abstract. As a data analysis tool, user portrait and recommendation system can deeply analyze and describe customers and commodity resources in unmanned retail industry. The situational fusion of them can provide a new idea for resource aggregation of unmanned retail recommendation system. By way of reading and sorting of the existing literature of unmanned retail recommendation system, the literature of unmanned retail recommendation system based on deep learning user portrait is systematically classified, described and evaluated from the aspect of convolutional neural network, providing a basic literature reference for the combination of deep learning user portrait and unmanned retail recommendation system. In the upcoming new retail industry, artificial intelligence connects the supply side and the demand side and will create a new retail system, which requires a lot of data and algorithms to support, but the resulting social problems also need to be solved. This paper aims at this social phenomenon and hopes to be helpful to subsequent readers.

Keywords: Deep Learning, User Portrait, Unmanned Retail, Recommendation System.

1. Introduction

As one of the most important industries in a country, the retail industry is the most intuitive way to reflect the economic situation of a country and a region. In January 2020, the COVID-19 pandemic broke out and quickly spread around the world. Offline consumption was severely curbed by COVID-19. Because of this, there are a lot of small commercial capital circulation appearing serious fracture. In the first two months of 2020, the total retail sales of consumer goods decreased by 20.5% year on year due to the impact of COVID-19. Since March, the growth rate of total retail sales has picked up as enterprises have resumed work and production. It can be seen that the epidemic has a huge short-term economic impact on China's retail industry. However, in the absence of a complete retail concept, many Internet giants have still chosen to enter the unmanned retail industry and make massive investments in it.. At that time many unmanned retail shop fell to the ground in a row. Only after a year, a large number of unmanned retail stores reported losses, layoffs or even collapses. Although the first experiment of unmanned retail in China was not satisfactory, it is still expected to become an explosive industry again as new technologies such as facial recognition and mobile payment. On this day in 2021, the sudden outbreak of the pandemic makes unmanned retail consumption its selling point as it is contactless. But it is still necessary to consider that how much time unmanned retail needs to get out of the start stage, how it grabs a piece of ground in the current increasingly saturated market, how it combines the latest technology to have the better effect.

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This paper aims to systematically discusses the previous research results and the social problems that may arise with the emergence of new technologies.In this way, later researchers can have a general understanding of the unmanned retail industry from a macro perspective through this paper.

2. Overview

2.1. User portrait

After the information age gradually enters the big data age, it inevitably brings convenience to enterprises and companies. Among them, the biggest change is that consumers' behavior gradually develops from the previous individual to the abstract. With the in-depth research and application of big data technology, enterprises are increasingly focusing on how to use existing data to accurately promote products, serve consumers, customize personalized product recommendation, and advertise. Therefore, the concept of "user portraits" was born.

User portrait is based on the user's daily behavior and user preference to extract user's group characteristics. It uses a group feature to describe the user model, and predict the trend of users' next activities and their interests and hobbies. User portraits are mostly used in the fields of content push [1], application recommendation, product research and development, and advertising [2].User's portrait is to understand the meaning of the user, guess the user's real demand and potential demand in the future. As to the media and advertising companies, enterprise fully differentiating characteristics of cognitive group users can help itself find marketing opportunities, operational direction, and comprehensively improve enterprise core influence.

The data source of user portrait includes static data and dynamic data. Static data refers to the user's relatively stable data, such as the user's basic personal information, such as name, age, gender, residence, etc. Dynamic data is information that changes constantly with user behavior, and dynamic data varies in different application domains. Dynamic data overcomes this limitation.

Depending on the static information of users, it needs to collect dynamic information of users, including users' daily search records, browsing records, click records and so on. The process of dynamic portrait includes all kinds of users' interest preferences, and it can simulate real users' interest preferences in time. Bayesian classification, neural network algorithm, genetic algorithm and other learning techniques are often used to correct the image model.

In the field of content push, Amazon carries out user portraits through browsing records, purchasing records, rating data and other behaviors of users on the website. Wu et al. [1] collected dynamic information such as browsing information, click URL information, time point of using the mobile phone, user location information, and frequently used APP information generated by the user through the mobile terminal to generate a refined portrait of the user, thereby Corresponding push tasks can be automatically triggered for changes in the user context of the mobile terminal.

2.2. Unmanned retail

Retail is the activity of selling goods or services to the terminal consumers. Since the 1930s, retail has experienced a series of evolution from department stores to supermarkets, from shopping centers to warehouse stores and so on. At the end of the 20th century, with the development of the new technological revolution, especially the development of network communication technology, the retail mainly in the two original forms of merchants and vendors appeared again, such as telephone shopping, TV shopping, online shopping and other new business forms. In the era of Industry 3.0, as the Internet enters every household, online shopping becomes more popular as a retail business. Consumers search for goods and place orders on the Internet, and manufacturers deliver goods to consumers via Courier companies after merchants pay online. This retail format narrowed the gap between producers and consumers, and traditional retailers turned to third-party platforms to try online shopping. However, as the growth rate of online users slows down and the dividend brought by online traffic gradually decreases, retail enterprises begin to abandon traditional online retail and start to integrate online and offline ones. So far, new retail concept entered the perspective of scholars.

Unmanned retail is a form of new retail, it actually appeared in social daily life very early. Vending machines, common in stations, are a form of unmanned retail. Back in late 2016, the first Amazon Go

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unmanned retail store launched in Seattle. At present, scholars' research on unmanned retail is still in its infancy, mainly focusing on the status quo, trend and technological innovation. Industry scholars believe that the current fourth retail revolution based on the Internet is beyond the Internet, and artificial intelligence technology has promoted the growth of unmanned retail industry.

2.3. Recommender system

In recent years, the development of the Internet boosted the advertising industry, making advertising ubiquitous in people's lives, and online advertising is becoming more and more popular. According to the Report on China's Advertising market review, the entire advertising market experienced a stress response after the outbreak of the pandemic, and the advertising expenditure in China decreased by 11.6% year-on-year in 2020. The advertising market began to decline successively from February, but continued to grow month-on-month. By December 2020, the year-on-year growth rate of the advertising market was basically stable. But in terms of total investment, there is still a big gap between 2019 and even before. Due to the decrease in the amount of investment caused by the epidemic, the advertising market is expected to have a large growth space in 2021 [3]. In a successful advertising campaign, the user gets a product that satisfies his potential interests, and the business uses advertising to hide his weaknesses and emphasize his strengths to beat other competitors. At the same time, a successful advertising promotion must meet the five appropriate principles, that is, in the right time, in the right occasion, through the right method, the right advertising in front of the right users. Personalized AD recommendation attracts users' attention according to the above principles and combines users' preferences and interests. Therefore, personalized advertising recommender system is an internal demand for most professional technology companies.

2.4. Deep learning

In recent years, with the development of deep learning technology, text relevance calculation methods based on deep learning are constantly emerging. When it comes to such methods, textual vectorization has to be mentioned. Vectorization refers to the standard task of machine learning, which is to represent a text as a series of vectors that can express the meaning of the text, and then classify and cluster the text through these vectorized representations. Of course, it also includes computing the relevance of the text by calculating the similarity of the vector. At present, most of the research on text vectorization is realized through word vectorization. For example, word2VEc algorithm and some researchers regard sentences as the basic unit of text processing, thus deriving doc2VEc algorithm, etc.

3. Analysis

According to specific users and scenes, personalized advertising is made through personalized algorithm or technology to match advertising, and achieve personalized creativity, production and accurate delivery, dissemination and humanized interaction of the advertising format. The main purpose of personalized recommendation is to automatically find the best match between advertisement, scene and user through algorithm set, and in the process of realizing this goal, personalized recommendation technology and advertising related data are undoubtedly two important driving factors. The ability of data mining and processing becomes the core ability of personalized advertising which is different from traditional advertising. At present, the general overall framework of personalized advertising recommendation is shown in the figure below.

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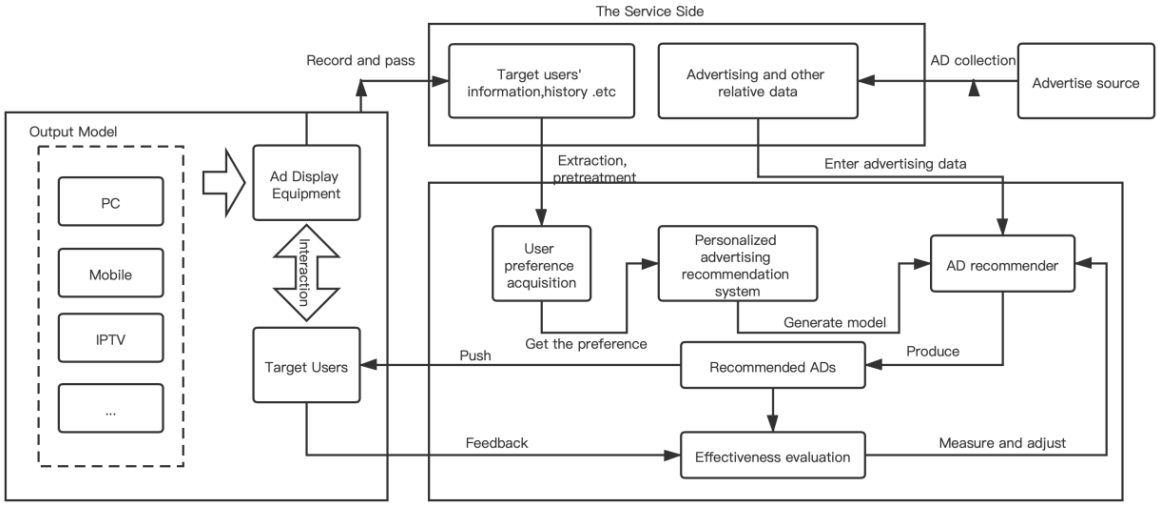

Figure 1. Evaluation analysis process.

According to the Figure 1, the analysis and summary of data collection and pre-processing, user preference acquisition technology, personalized advertising recommendation technology and personalized advertising recommendation utility evaluation are focused on as follows.

- Data collection and pretreatment. This part mainly corresponds to the processes of "advertising collection", "record and transfer", "extraction and pre-processing" in the figure above, explaining the main sources of advertising data and user data, and pointing out the existence of data noise and data loss in the original data. Subsequently, in order to reduce the influence of the above situation, data need to be preprocessed in both shallow and deep layers.
- User preference acquisition technology. According to user's information, it scores for explicit user preferences. Besides, according to the behavior information, including the use of AD clicks, browse and application situation, it gets the user preference into the potential user preferences by building user portraits or modeling, so as to obtain the purpose of user interests, and to forecast the user preferences.
- Personalized advertising recommendation technology. At present, the mature advertise recommend technology is using the traditional collaborative filtering recommendation technology. Others use advertising keywords, content, points

Context-based recommendation technology for information,a hybrid recommendation technology blends a variety of recommendation technologies in a certain combination. It also includes some deep learning methods, such as Convolution Neural Networks (CNN), Recurrent Neural Network (RNN), etc.

Utility evaluation of personalized advertising recommendation. This paper sorts out the data sets of advertisement recommendation from different sources, summarizes the traditional evaluation indexes and special evaluation indexes commonly used in personalized advertisement recommendation.

4. Possible problems

4.1. Individuation faced by consumers -- privacy paradox

As can be seen from the value of user portraits mentioned above, retail enterprises make use of consumers' personal data to depict user portraits and the future, providing consumers with more detailed, accurate and personalized services, which greatly improves the enterprise's operating efficiency, corporate performance and the satisfaction of consumers' own needs. However, the use of personal data forecasting by enterprises can also raise consumer privacy concerns [4]. In addition, the privacy problems caused by enterprises in this way will lead to more serious consequences. Data

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leakage and even illegal use of data will lead to data hidden risks, which will lead to consumers tampering with personal information and being negative about it. Therefore, Aguirre et al. [5] proposed the personalization-privacy paradox, that is, consumers must weigh privacy issues and the benefits of personalized recommendation services. On the one hand, consumers benefit from enterprises' personalized recommendation through big data to save search costs. On the other hand, they worry that their personal information will be leaked and abused. So how can consumers make optimal decisions according to their heterogeneity? Depending on the consumer motivation, the same consumer makes a trade-off between personalization and privacy[6].

4.2. Moral and ethical issues

Nike uses sensors built into the shoes to collect data on the type, frequency and proficiency of consumer activity to capture all the details of how consumers use their shoes. This approach seems to allow Nike to serve its customers more precisely. However, the moral and ethical issues implied are thought-provoking. In the process of consumption, all data of people may be unknowingly or unknowingly recorded, with unpredictable levels of detail. In order to collect more detailed information to realize effective value in many retail scenes, personal information and other privacy data and even physical information of consumers in front of them, such as face recognition system, monitoring system and security supervision system, are exposed and recorded, which undoubtedly brings unprecedented threat to consumers' basic personal rights[7]. Therefore, companies should address the ethical and moral issues they face before applying AI.

5. Conclusion

In the retail industry, AI connects the supply side and the demand side, shaping a new retail system. On the supply side, in the R&D and manufacturing process, enterprises use data mining, knowledge mapping and other technologies to insight into consumer preferences, analyze the competitive situation, and predict consumer demand. In logistics and transportation, intelligent supply chain management can be realized through machine learning technology, which can effectively respond to consumer demand, optimize inventory structure, reduce cost and increase efficiency. In the marketing link, quantitative analysis of consumer behavior is carried out through computer vision and other technologies to improve the operation efficiency of enterprises. In the after-sales service link, intelligent customer services such as natural language processing technology are used to provide after-sales services for consumers and provide data support for subsequent decisions of enterprises.

For consumers on the demand side, in the information contact link, enterprises use big data to analyze consumers' location, geographical environment, time and cross-channel shopping information to provide consumers with more personalized goals, so that consumers can choose products that are more in line with their personal preferences and meet their own needs. In the purchase decision-making process, the intelligent voice assistant, interactive robots, augmented reality technology and virtual reality technology in the store create emerging services that are more visual and perceptive to consumers, so that consumers are more involved and have a better understanding of the product. That will help to enhance the shopping experience of consumers. The automated payment system based on ARTIFICIAL intelligence and the new retail scene combining online and offline make the shopping process faster for consumers and improve the convenience of shopping decision-making. In the post-purchase use process, consumers can share information about products through different social media platforms and discuss their use feelings with other buyers, so as to create real-time, multi-dimensional and more social word-of-mouth communication for consumers.

Although the technology is still immature and much work remains to be done, deep learning is already having a huge impact on everything around us and will play an even bigger role in our lives in the future. Therefore, it is of great significance to carry out deep learning research, and hopefully the work of this paper can help.

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