

運用機器視覺實作智慧型廣告推播系統

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摘 要

隨著資訊技術的快速發展，人們接收信息的方式與傳統的方式有所不同。傳統廣告的投放方式已無法滿足受眾感官上的需求。如果能夠根據受眾的喜好精準地提供合適的廣告，將會大大提高廣告的點擊率和互動率，從而使企業主精心設計的廣告內容可以有效的增加獲利。本研究使用資訊技術來收集有關群眾喜好的訊息，並使用演算法對觀看廣告後觀眾的感受進行分類與分析。研究中發現廣告內容大部份會因為年齡或環境因素差異，影響對廣告的喜好程度，藉由獲得的結果來設計廣告播放的喜好規則。在實作平台方面，主要可分為兩個模組。一為受眾分析模組，該模組使用圖像捕獲方法來收集資料，並使用網際網路上傳至 AWS 雲端運算平台以分類算法進行建模。另一為，廣告投放模組，將前一個模組生成的規則模組與攝像頭結合起來，根據鏡頭獲取受眾的臉部參數，應用演算法進行分類計算，並提供合適的廣告內容於屏幕上。經本研究實作測試，提供合適的廣告給受眾，能有效影響受眾對產品的消費。

關鍵字：智慧型廣告推播系統、機器學習、機器視覺

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Implement A Smart Advertising Promotion System With Machine Vision

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Abstract

With the rapid development of information technology, the way people receive information is different from the traditional way. Traditional advertising methods can no longer meet the sensory needs of the audience. If suitable advertisements can be accurately provided according to the preferences of the audience, the click-through rate and interaction rate of the advertisements will be significantly improved so that the advertisement content carefully designed by the business owner can effectively increase profits. This research uses information technology to collect information about people's preferences and uses algorithms to classify and analyze the audience's feelings after watching the advertisements. The research found that most of the content of advertisements would affect the degree of preference for advertisements due to the differences in age or environmental factors. The results obtained are used to design the preference rules for advertising broadcasts. In terms of implementation platform, it can be divided into two modules. One is the audience analysis module, which uses image capture methods to collect data, uploads to the Amazon Web Services (AWS) cloud computing platform, and uses the web services to model classification algorithms. The other is the advertising module, which combines the rule module generated by the previous module with the camera, acquires the facial parameters of the audience according to the lens, applies algorithms for classification calculation, and provides appropriate advertising contents on the screen. After the actual test of this research, it demonstrated that providing suitable advertisements to the audience can effectively affect the audience's consumption of the product.

Key words: Smart advertising promotion system, Machine learning, Machine vision

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I. Introduction

In the era of information explosion, people can quickly get news from various media, and advertising is one of them. Using advertising can quickly convey product information to consumers. According to the Heider balance theory, consumers in advertising, advertising spokespersons, and products have a balanced relationship. Advertising spokespersons can fully demonstrate the product's characteristics in describing the product to improve consumers' confidence in product purchase and desire. Advertisements can attract people's attention, arouse lively discussions, help drive relevant preliminary talks, and create word-of-mouth marketing. The advertisement highlights the ideology of the product, and the ultimate goal is to motivate consumers buy products.

In terms of theoretical derivation, when pushing advertisements, this research refers to the theoretical methods of communication psychology, using machine vision technologies and classification algorithms to analyze the advertisements and the audience's facial response data. After training and learning a large amount of data, the corresponding rules are obtained. Then, appropriate advertisements can be accurately pushed to the audience to increase consumption power through these rules.

In terms of implementation, this research uses the Raspberry Pi development board as the agent of the smart advertising billboard. Through the sensors and cameras on the agent, the various information parameters, such as the temperature, humidity, gender, and age of the audience, etc., are recorded and stored in the cloud. The collected cloud data will be analyzed through communication psychology theory to find out the behavior and reaction of the audience after watching the advertisement to understand the impact of the advertisement on the audience. Finally, the generated playing rules are written back to the advertising billboard agent. After the agent's camera obtains the audience parameter information, the corresponding advertisements are placed according to the playing rules so that the advertisements can also be provided to the appropriate audience scientifically.

II. Literature Review

The field of computer vision mainly studies how to make machines "see" the world and understand that the world can interpret the meaning and information of images.

1. Machine Vision

Machine vision is a comprehensive technology, including image processing, machine engineering technology, control, electric light source lighting, optical imaging, sensors, analog and digital video technology, computer software, hardware technology, etc. Machine vision mainly uses computers to simulate human visual function. Thus, it is not only an extension of the human eye. However, it primarily includes capturing, processing, and analyzing, extracting information from the image of objective affairs, and understanding it, and finally actually detecting, measurement and control, as shown in Figure 1.

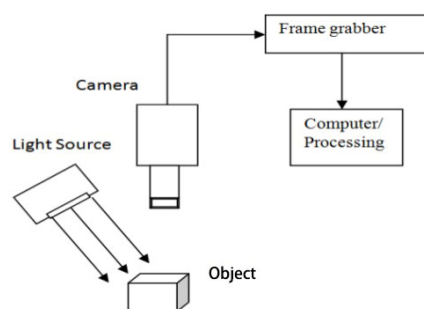


Figure 1. Machine Vision

2. OpenCV

Intel launched the OpenCV project in 1999. The main goal is to advance machine vision and provide open source and optimized libraries to make the developer code easier to read and transfer. OpenCV has evolved to now mainly used for human-computer interaction, object recognition, image analysis, face recognition, motion recognition, motion tracking, and robots. OpenCV is written in C++ and also provides interfaces such as Python, Java, and Matlab.

In terms of face recognition, OpenCV version 2.4 is based on the three algorithms in the Robust Real-Time Face Detection (2004) paper, namely Integral Image, Ada boost, and Cascade classifier, to quickly find examples of face detection. Rainer Lienhart improved it, and the harr features of the sample (about a few hundred sample pictures) were used for classifier training to obtain a cascaded boosted classifier. The training samples are divided into positive samples and negative samples. The positive samples are samples to be tested, such as human faces. Negative examples refer to any other pictures, and all sample pictures are normalized to the same size.

After the classifier is trained, it can be applied to detect the region of interest (the same size as the training sample) in the input image. If a face in the target area is detected, the classifier's output is 1. Otherwise, the result is 0. For the system to capture the entire image, the user can move the search window to detect every position to find possible targets. The system to search for target objects of different sizes automatically, the classifier is designed to change the size, which is more effective than changing the size of the image to be inspected. Therefore, to detect the target object of unknown size in the photo, the scanning program usually scans the image several times with search windows of different scales. The "cascade" in the classifier is to divide the feature into several classifiers at the beginning. The first classier has the lowest recognition rate, and most of the pictures that are not faced can be filtered out first; the following classier processes the images filtered out by the more complex cases, and so on, until the last classier. The last thing left is a photo of the desired face. As shown in Figure 2. (PAUL VIOLA, MICHAEL J. JONES, 2003)

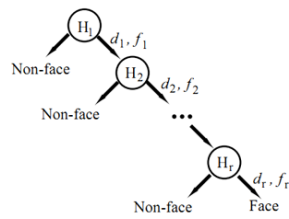


Figure 2. Cascade Classifier

3. Advertising and age

The definition of advertising is extensive publicity. The American Marketing Association mentioned: Advertising must be paid for advertisers to provide goods, ideas, or services for advertising activities. The advertiser is usually not a person but an organization. Advertising is a persuasive communication activity; the purpose is to persuade consumers to buy goods. In advertising, there are two very important processes-encoding and decoding. The decoding process after consumers watches an advertisement may be completely different from the information that advertisers expect them to receive when decoding. An essential part of the basic principles of advertising is the consumer's decoding process. We can know how consumers deal with it through exposure, acceptance, attention, understanding, acceptance, reputation, memory, information integration, attitude, decision-making, etc. A few tens of seconds will leave a slight impression in the minds of consumers. The purpose of advertising is to convince consumers that the content in the advertisement is reasonable and credible and to accept the information provided in the advertisement, establish a good consumer attitude towards the product, or change the negative attitude towards the original product. By persuading consumers to buy, consumers can have a good attitude towards the product and thus positively buy behavior.

Psychologist He Fulan and others mainly focused on two issues when studying persuasiveness: one is the persuasive power of the information source, and the other is the persuasive power of the information itself. (Hovland, Carl Iver, Irving L. Janis, and Harold H. Kelley, 1953) Usually, it is to shape advertisers' image, find persuasive spokespersons carefully, and use others' beliefs to increase one's own beliefs, which can increase confidence. All three methods can be seen in video ads. Wu's research shows that when viewers of different age groups browse various advertising media, they will focus on the advertising content. Young audiences are more likely to be attracted by the advertising products of spokespersons, while older audiences are more likely to be attracted by trademarks and product brands. As shown in Figure 3. (Wu Wanxuan, 2010)

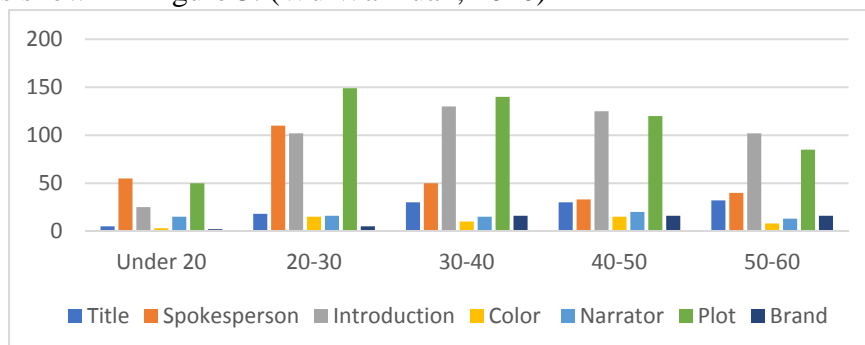


Figure 3. TV media advertising age and the relationship between advertising

III. Smart Advertising Promotion System

This research uses scientific methods to collect information on the audience's facial reactions after reading electronic billboards. This method is different from the traditional questionnaire survey method. The feelings and thoughts that the audience reacts immediately after reading the advertisement message can be collected immediately. After the advertising agent obtains the data, the data is uploaded in batches and stored in the virtual host of AWS EC2. In this study, Python code was written on the server to classify the data, find out the emotional reactions of different age groups after watching the advertisement, and find out the relationship between gender, environmental parameters, and advertisement content. Based on the results of the analysis, personalized advertising strategies are generated based on these characteristics. These trained broadcast strategies will update the advertising agents in a continuous update manner. Furthermore, this research will store the strategy offline. The main reason is that after the agent obtains the facial expression information of the audience, the agent can immediately determine that the broadcasted advertisement is played, reducing the unplayable advertising video caused by network delays. failure.

On the hardware device, this research uses the Raspberry Pi 4B development board and Logitech's web camera on the agent side. Use this to obtain facial expression data and broadcast the video.

On the server-side, this study uses an AWS EC2 virtual host with Windows Server installed. This research system is mainly divided into two parts: 1. Advertising agents: These agents are scattered at various advertising push points, can play video and audio advertisements and record the facial expressions of the audience watching the advertisements. 2. Cloud data center: There are mainly two data sets: (1) Face recognition database. The main task of this part is to find faces in pictures or videos and check the emotional reactions of faces to advertisements. (2) Advertising strategy library. This part is mainly to provide advertising push and play strategies for advertising agency owners. After the face recognition database and the advertising streaming video database hand over the data to the AWS cloud analysis system for analysis, the cloud data center are stores the advertising video rules according to the age group and environmental data audience preferences. In addition, batch updates the broadcast policy on the proxy host through the batch update. The system architecture is shown in Figure 4.

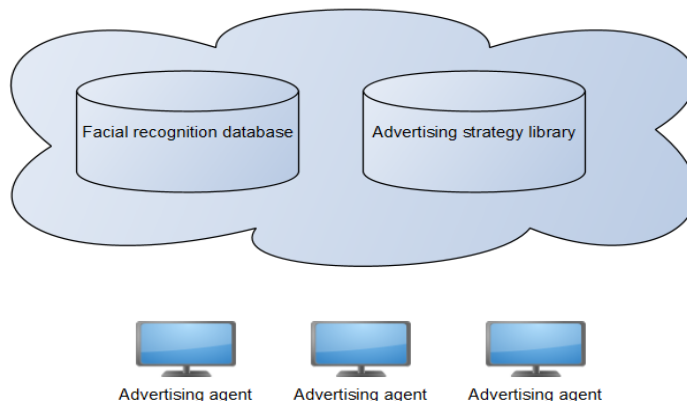


Figure 4. Smart Advertising Promotion System

This part explains the core component of this system, the advertising agent. Each agent module has the function of collecting data and playing advertisements. In the initial stage, the agent mainly collects facial data and pushes advertisements through the data obtained through facial recognition and the playback strategy obtained after back-end analysis. In the advanced application stage, this research collects contextual data of the space at the time, gets related data such as temperature and humidity through various sensors, and analyzes the correlation between advertising content and environmental parameter information to generate advertisements due to different environmental parameters—broadcast strategy. For example, when the temperature is too high, the advertising player will provide audiences of varying age groups to watch cool clothes advertisements according to other age groups.

On the other hand, the humidity is too high. According to the data, it may be raining soon. Therefore, provide advertisements for nearby rain gear stores. In this way, increase the audience's hit rate by advertisements. In terms of system implementation, this research chooses a development board with easy-to-expandable functions as the agent's core in terms of system implementation.

On the cloud analysis platform, this research uses the AWS cloud platform. The data analysis module is used on the platform to train and learn to find the appropriate playback rules and then push the results to the front-end advertising agent for advertising selection based on the face recognition data And play. In the analysis of the strategy model, this research uses the advertising psychology of communication psychology to analyze the collected data, find the relationship between the advertising video preferences of each age group, and convert this relationship into an agent strategy used.

In terms of system verification, this research placed the system at the entrance of the campus food court. When the subjects entered the restaurant for a meal, they played the recommended restaurant advertisement video based on their facial features. The age range of the testees is mainly between 18 and 65 years old for three months. The advertising billboard pushes the content of the advertisement, mainly in the restaurants in the food court. In the other part, this research puts a camera in front of the partner store's checkout counter to capture the purchaser's facial data to verify the hit rate of the advertisement. The test results are shown in Table 1.

Table 1. The level of preference for food advertisements by age groups

Age Group	Recommended A.D. Type	Hit Rate
18-20	Light Food, Fast Food.	82%
20-24	Braised Dishes, Western Meals	80%
24-30	Coffee, Chinese Food	75%
30-65	Healthy eating	90%

IV. Conclusions

This research uses facial recognition technology and machine learning methods to find out the audience's psychological thoughts. According to the facial parameter information extracted from the audience's expressions, it will be able to improve advertisers' chances of effectively selling their products. The target audiences of this research are mainly university teachers and students. The system test results are verified. In terms of age group, college students can accept recommendations from buffets, fast food, and western food. For graduate students, recommending Chinese food, coffee, and light meals can promote their desire to buy. As for faculty and staff, suggestions for healthy vegetable food are more likely to arouse their interest in buying. Through this research, it is found that accurate advertising can allow the audience to increase their consumption of products of interest through the recommendation of advertisements when they are hesitant.

References

- Hovland, C. I., Irving, L. J., & Harold, H. K. (1953). *Communication and Persuasion: Psychological Studies of Opinion Change*, New Haven: Yale University.
- Liu, J. Y. (2011). The era of Internet of Things is coming, *Trade Magazine*, 10-13.
- Liu, S. Q. (2010). *The relationship and analysis of communication theory and advertising psychology*. Retrieved from <http://163.23.113.72/sjses/lifetype/gallery/74/74-1742.doc>.
- Lain, Z. C. (2014). *Principle and Application of Image Processing Technology*. Retrieved from <http://web.nccu.edu.tw/~lanjc/lesson/C9/class/11.pdf>.
- Man, K., Songrong, Q. (2018). Application of Face Recognition Technology in Intelligent Advertising Based on OpenCV, *Microcomputer Applications*, 10, 104-106
- PAUL, V., MICHAEL, J. J. (2003). Robust Real-Time Face Detection, *International Journal of Computer Vision* 57(2), 137-154.
- Wu, W. X. (2010). *The impact and effectiveness of different media advertisements on different age groups*. Retrieved from <https://prezi.com/eifa-lhww-jm/presentation>.