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Interaction, extraction and analyses of consumer reviews: A novel e-billboard system

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ABSTRACT

With the growth of Internet and electronic devices, the position of multimedia advertisement is getting more and more important. Our research aimed to combine this new technology with a web page to design a novel interactive e-billboard system which can collect consumer emotions. We developed an interactive e-billboard based on Kinect motion sensing camera. The system provides a friendly user interface for users and improves the exposure rate and quality of advertisement with a two-way interactive communication. The back-end system captures consumer emotions actively. The data collected will be used as a reference for the follow-up marketing strategy analysis.

1. Introduction

Due to the prevailing of capitalism, competition of opponents becomes fiercer. In addition, because of the popularity of science technology, the proliferation of new media technologies has made them an indispensable part of people's lives. (Wei and Leung, 1998; Hsu, 2015a) Advertisers can use a lot of new media and advanced technologies to stay close to consumers' lives to increase their own sales volumes. Advertising plays an important role in modern free markets. Thus, personalized advertisement is currently considered as a hot topic in product promotion. (Athanasiadis and Mitropoulos, 2010; Hsu, 2015b, 2017b) It becomes a very important issue for various organizations to make good use of advertising. The advertisements now are only offered by marketers, and it is difficult to realize consumers' reactions. In order to make information flow in both directions, marketers can design an interactive advertisement as a bridge for consumers and marketers. The advertisement is just like a game and has a great presence. (Bellman et al., 2014; Hsu, 2017a) The digital interactive advertisements set on the streets, in the shop windows or in the department stores make consumers feel like playing video games. They can directly participate in the advertisement. It can make a two-direction flow between marketers and consumers (Hsu, 2010). New media, such as the Internet or interactive digital television, often combine different sensory inputs and different types of media content simultaneously. (Cauberghe et al., 2010; Hsu, 2017d) Image recognition technologies and motion sensing technologies now are used widely in many fields. Our research submits a new technology combining motion sensors. We use sensing technologies as sensory inputs with dynamic webpages to develop an interactive e-billboard system which has cross-platform databases. The collecting data of consumers' emotions can be used as a reference when making marketing strategies.

We separate our system into front-end system and back-end system. The dataflow diagram is shown in Fig. 1. Compared with

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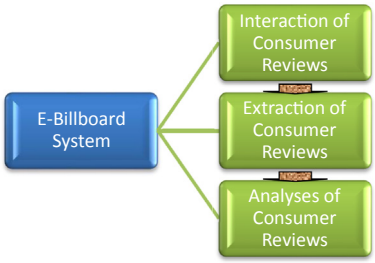

Fig. 1. Dataflow diagram.

conventional three-dimensional (3D) motion capture systems, Kinect has advantages of cost merit, easy system development and operation. (Hsu et al., 2012; Yamaoka et al., 2013) Therefore, we use Kinect as a focus in our front-end-system. It can not only increase the recognition rate, but also avoid the noises appeared in traditional RGB image processing. We can get three kinds of information such as colorful images, 3D depth images and voices. It also has tracking functionality, which means that Kinect sensor's motorized pivot will keep users in frame even as they move around. In addition, its software development kit (SDK) provides required environments and technologies that we need when developing and it also supports the open platform, Visual Studio (Hsu, 2015c). We establish a billboard platform which lets users to manipulate it with their hands. We hope to observe consumers' subconscious actions, facial expressions, or interaction synchronously. For instance, nodding represents agreement, skipping advertisements represents being disinterested, and scanning quick response (QR) code represents willing to purchase (Hsu, 2013). It captures consumers' perceptions when watching advertisements and we can use the information as a reference when designing the contents of advertisements and expecting sales volumes of products.

The front-end system focuses on the benefit of digits combining interactivity. New tendencies in digital marketing are focusing on added interactivity. (Hsu, 2012; Oliveira et al., 2014) Different from general digital signage or print advertisements, we can get consumers' preference degrees via the interactivity and consumers can also obtain more detailed information. Combine technologies with playfulness and people's curiosities to deepen consumers' impressions. In terms of motion sensing, different from touch screens, consumers can manipulate it at the remote end even if they are standing outside of glass or shop windows. If the shop is closing, consumers also can use it. It not only successfully makes propagandas but also makes the benefit of advertising getting larger. Sometimes it attracts onlookers, which can connect people's curiosities and childlike innocence to increase the appeals and visibilities of advertisements. The major difference between physical and digital advertisements is that digital one can propagandize many products as the physical one can only do a little. It decreases the costs of material objects and increases the number of products propagandas (Hsu, 2011, 2017f).

We create a database in the back-end system and use SQL Server to create cross-platform data which stores consumers' feedbacks and companies' information. Companies can upload or update the information about their products or special offers via the Web-base system, which is created with ASP.NET language, to simplify marketing process (Hsu, 2016). In addition, the Web-Base system also provides companies to search for the feedbacks of their advertisements. The information will be used as a parameter when making marketing strategies. Continuing advances in database management and communication technologies have greatly accelerated the ability of marketing to become more direct, highly focused, and increasingly interactive. (Csikosova et al., 2014; Hsu, 2018) By means of the high skilled analyzing ability of the back-end database system, companies are able to combine it with the statistical results of the front-end interactive e-billboard to understand consumers' preferences. However, studies on consumer psychology have indicated that consumer preferences are often unstable and developed over time. (Kwon et al., 2009; Hsu, 2017c,e) Therefore, via database and Web-Base system, companies can immediately submit the most appropriate marketing strategies to make it more concentrated and straighter for them to gain more benefits.

The remainder of this study is described as follows. In this section, we are discussing the motivation and the future goals of this research. Section 2 introduces related works. Section 3 discusses the implementation of the whole system, from developing, designing to creating. Section 4 is conclusion of the search and describe the effects of each aspect.

2. Objective

With the interactive function of the somatosensory detection device, the performance of the dynamic website and the convenience of the cross-platform database, we build an interactive e-billboard system. Consumers can use gestures to manipulate the interface of e-billboard system; companies can also store the information of consumers' actions into back end database where they can read the data and produce analytic graphics as a reference for companies to make strategies.

3. Motivation

Advertising provides incentives to attract consumers to buy products. Advertising serves the company as a medium of communication. The marketers can penetrate the untapped market. (Adhikary, 2014) Advertising lets consumers understand lots of information like usages, innovations, advantages and prices that they are interested in. It also explains about why their product is

superior to the product belonged to other companies. Therefore, advertising is really crucial in product marketing. Product that is high quality and inexpensive can extend its sales area and increase the visibility via advertising to catch consumers' eyes. Advertising is seen as a cost that doesn't compress the space of a product. However, companies still cannot find an effective way to access the result of an advertisement and master the emotions as well as reactions of different consumers.

The communication method keeps changing. At first, it changed from word-of-mouth into printed matter. With the booming of technology, people communicate with each other with electronic and internet method. Advertisements can deliver messages with printed matter, radio, cell phones, television and internet, etc. Because of the differences of groups and products, companies always make corresponding strategies. For instance, young people can easily receive information on the internet. Companies selling youth products will turn the market to the internet. These groups can see product information in portal sites and social sites with cell phones. This is an example of internet marketing that used to reach the goal of promotion. (Song et al., 2011) On the other hand, older people obtain new information via newspaper, magazine and television. Therefore, it becomes a very important thing to know what, why, where, when, who and how to do the marketing. Placing an advertisement to achieve maximum effect is an active and on-going research field. (Aznar et al., 2011) Our research has not only the advantage of well-developed internet, but also the advantage of mature hardware system. We integrate the software with the hardware, and also continue to develop new functions to improve our software to make an innovative multimedia advertisement. (Tiago and Veríssimo, 2014)

Internet marketing is a nonphysical advertising method. (Hsieh and Chen, 2011) The marketing objects are limited to the groups that use computers and cell phones and are not extended to all ages. Therefore, to fulfill the demands of all ages, it is inevitable to make new advertising types. If we can integrate the physical e-billboard with the mature internet multimedia, we can make the unidirectional message transform into two-way interactive communication. Advertising information can be updated in real time; therefore, consumers have more opportunities to interact with products (Varadarajan et al., 2010). For a marketer, the great potential of interactivity rests in the capability it offers for better understanding the viewer's behavior and building personalized relations with individual consumers (Lekakos et al., 2001), which must be the new advertising style. In addition, we hope that we can record and saved the situations of interaction into the database when consumers are interacting with advertisements. According to the information analyzed from consumers' feedbacks, companies can use the website to search the data reports as the guideline for future improvement. For example, when consumers are manipulating the advertising screen, fast skipping a particular product represents that such product cannot catch the attention from consumers in first impression. On the other hand, staying in one page for a while represents that such product has more attractive forces. The company will be able to know what types of product can meet the consumers' preference based on the characteristics of the products (Nishino et al., 2014) and eliminate the cost of additional execution of public opinion surveys. It can kill two birds with one stone by gaining and storing more data which can be managed with the system.

Companies use the real-time characteristic of the system to promote their ideas, products and services. Users and companies both can choose the advertisement according to their requirements. Furthermore, this interactive advertising style not only makes publics feel interested and impressive in the content, but also can let companies obtain information from back end to evaluate consumer behavior. This includes novelty, interactivity and functionality. Consumers are attracted and start being willing to receive advertising information initiatively, then they provide data for companies to analyze. This offers an advertising revolution.

4. Literature reviews

In billboard, we can find many kinds of product billboard on the roadside, which allow pedestrians and drivers to see the advertisements naturally to achieve the advertising results that advertisers wish. Because of the big size of a billboard, person driving a car is able to remember the content of it even it's just a moment passing the billboard. However, billboards cannot play videos, show graphics or display advertisements with an animated way. In addition, he contents of billboards do not have timeliness. They are usually fixed and cannot be modified in real time. It spends a lot of money and time to make every advertisement, including the ways and the places of presenting.

In printed matter, there are many stores or vendors using it to do advertising. The printed paper may be stuck on the wall or be distributed on the road and in the school. The printed matter has advertising contents which advertisers want to show on paper. By printing in large numbers, it can produce lots of pieces of advertising paper. As everyone has one in hand or everyone can see, advertisers can achieve the advertising effect. However, print matter is easy to be ignored and the contents often cannot attract consumers to try to learn more about it because of the lack of attractive animation, sound and light effects. In addition, the size of paper is too small that the amount of advertisement is limited and it cannot be modified in real time. Hence, we usually get messages and information which are incorrect. This advertising method also requires a lot of costs. Some consumers will directly discard the paper when they aren't interested in the advertisement, resulting in waste of paper. It does not save the costs of printing.

In television function, because people at home watch television commonly, many companies will use television to promote their products by putting the advertisements in the time slot between dramas or movies. Some people may find the product they want in these advertisements, then buy the product from the shop directly or order it on the website or cellphones. Since television advertisement can use animation or photography to make it more impressive, consumers can be more easily interested in it. However, television advertisement doesn't have the function of customization, so companies can't know the reactions and feelings from consumers. Due to the capricious preference from consumers and high costs of time and money, it is difficult to get best benefits from this advertising method.

In visual equipment, some companies don't use television to promote their products, but use computer or cellphone to advertise. People now use cellphones all the time. Companies just have to put their advertisements on websites or apps. When consumers use it,

they can see the advertisements to increase the impression of products. Even if people don't have network function on their cellphones, companies can still use SMS to deliver the messages about their products. The mobile channel has the potential to benefit both advertisers and consumers. However, the cost of this function is high and companies cannot know the reactions immediately. On video platforms such as YouTube, companies put advertisements in the video and make advertisements stay more time. But the disadvantage is that companies can't know the preference degree of consumers to make improvements. In addition, companies can't determine the broadcast times and orders of advertisements which are usually presented randomly, so they can't handle the effects of advertisements.

Traditional digital e-billboards are set at the places where people always "wait" such as bus station, MRT station or any other place people walk around. It can make more people notice the advertisements with the big-size screen and interesting animation. Because it can be connected with internet, companies can modify or update the contents at any time. It only needs a large screen and does not require high costs. Some billboards can use touch functionality to allow pedestrians interacting with it, but it cannot do any non-touch interaction. Hence, if billboards can let pedestrians interact with it without touching, it must attract more people to watch the advertisements.

4.1. State-of-the-art approaches

Fortenberry and French, 2010 have mentioned that the healthcare industry is increasingly turning to billboard advertising to promote various medical services. The research on billboard efficacy is encouraged in other geographic areas and healthcare service contexts. Because of the technological and societal changes, traditional advantages of billboards, such as relative freedom from clutter and short, high-impact message formats, have acquired even greater relative advantage compared with other media. Now digital displays and message-rotation schemes are further enhancing impact and flexibility. From this study, it is also evident that the effects of billboards extend well beyond generating awareness. We hope this work will spur others to investigate the medium, providing much needed guidance in a largely neglected area. In fact, we can see the effect of billboards is far beyond our knowledge, having its traditional advantages to provide good benefits in the medical field.

Frison et al. (2014) also mentioned that the effectiveness of advertising billboard in the brand marketing is higher than other small media. In Iveson's (2012) research, it presents that "advertising began outdoors" Advertising can be done through window displays, signboards, billboards, posters and other forms of outdoor advertising. The outdoor advertisement become a part of urban scene. The advantage of this kind of advertisement is "seen everywhere". Although our system has the limits of space and equipment, it has some superiority such as novelty and amount of advertisements. The most important thing is that traditional advertisement lacks of interaction, which has no way to know the reaction from consumers as well as understand whether the consumer really sees it or be interested in it.

In this study, comparing with normal billboards, we enhance the function of billboards such as more interaction and data records in the back-end system. Apart from attracting the use of consumers, we make the integrity of information more justified, which increase the benefit of billboard.

5. Methodologies

In the current advertising methods, most people abandon traditional paper to advertise, because consumers are turning away from the traditional sources of advertising such as radio, television, magazines, and newspapers (Parveen et al., 2015). Therefore, some marketers deliver information of new products, marketing campaigns, entertaining films or other updated information to targeted consumers in railway stations, airports, bus stations, hospitals, banks, movie theaters or other places where people need to be "waiting". This kind of advertising usually involves exposing an audience to a generic advertisement which may or may not draw any interest. This method of advertisement exposure does not take a personalized approach (Nettelhorst and Brannon, 2012). Now we add "interactivity" to attract consumers with somatosensory interaction, making them have more choices and skipping options. In this way, consumers no longer receive information unilaterally, but can choose their interested topics like what they do when watching television.

We propose a new architecture of interactive advertising e-billboards in this study, which is shown in Fig. 2. This somatosensory interactive system not only changes the unilaterally traditional style of advertisement, but also tracks consumers' usage simultaneously when they are receiving advertising information. In addition to improving the consumer experience, it also provides manufacturers a reference of whether to change the forms of advertising, achieving a win–win situation. The following will describe how to build this architecture in detail.

5.1. Methodology development

The foundation is built based on three main components, which are combined to make a new billboard system. The new system includes some characteristics such as novelty of somatosensory interaction, convenience of website and integrity of database system in the same time.

First, in terms of somatosensory detection device, we use Kinect and Kinect for Windows SDK to provide development environment and techniques, and supports Visual Studio 2010, the open platform to increase the convenience of development. The system detects a human body in the first step and do further background subtraction as well as depth sensing to distinguish the change of gestures which represents a special command and then performs the relative reaction. Second, we build a web-based static

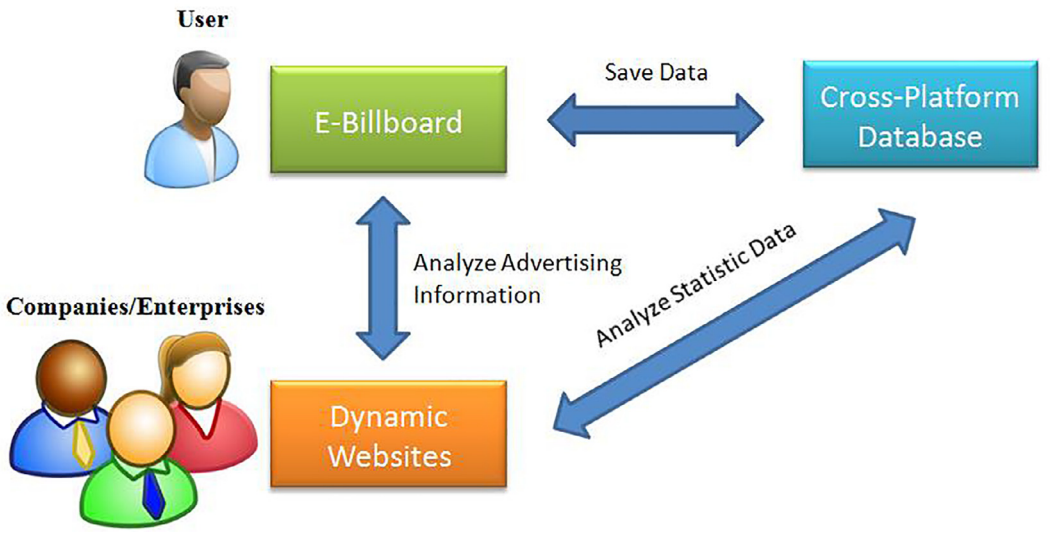

Fig. 2. Proposed interactive advertising e-billboards.

website with ASP.NET, providing companies a member login system. Companies can use this system to upload and update advertising information and new offers. Furthermore, they can also search for the feedbacks and reactions of consumers manipulating the billboard system. At last, we use SOL Server to build the back-end database, which stores information of consumers and companies including numbers of advertisement selection, the residence time of a single advertisement, feedbacks of consumers and skipping times of the advertisement. When companies are managing the content of an advertisement, information shown on the front-end system will also be updated. This is how we integrate these components to complete a real-time and interactive new advertising system.

5.2. Function development

Our system utilizes agile development and prototypes in parallel. This system focus much on user requirements, so we try to improve and make it better according to user unsatisfactory. Therefore, we use these functions to correct the defects found in the last step of process to decrease the risk of system development, and ensure the final system quality. Additionally, with the increase of functions, we can revise the system in detail at any time.

5.3. System analysis and design

The process of system analysis and design is shown in detail in the following. In operator definition and conversions, the streaming of skeleton diagram Kinect provides is defaulted to 30 frame per second (FPS). Each diagram shows the array of skeletons of each observed body. However, we cannot limit the number of viewers, so we need to determine whether the viewer has the desire to manipulate the system or not. The definition of operator here is: the body is right in front of the sensor, and the distance between the node in skeleton and the origin of sensor-centered coordinate system is less than 20 cm. After defining the operator, the skeleton is removed from the array and the control module in the design will be loaded. After loading, the property pattern is converted into integer type and it will generate several boolean attributes. For instance, is anyone in the area of manipulating or if the operator is manipulating with right hand or not? In command trigger border setting, when skeleton loads the control module, it calculates a special property, the skeleton distance. In order to avoid size differences of various users, the system uses the distance between head and hip as the unit of command trigger border. For instance, when a user manipulates the system with right hand and the node is 0.2*distance higher than his shoulder, it triggers the “up” command and performs the corresponding animation.

In animation creation, the corresponding animation generated with the triggered command is created with storyboard of WPF-XAML, which can make Canvas and Windows move to generate the animation of turning pages. In the residence time calculation, when the control status starts to be true, the timing module (counter) will record the current advertisement page. In complete raw data production, when the control status for the control module becomes false and the time of the timing module (counter) is greater than 30, it saves the number as it parameter and empties the time of counter.

In automatic conversion mode, when unattended, the system turns into auto-play mode to randomly skip the pages without going through the same path. In report providing, the website provides two models of report which are report with absolute value and report with relative value. Model with absolute value uses “seconds” as the basic unit, and the relative value is the ratio of the time an operator watching a page to the total time. According to these two models, it provides bar charts, pie charts, etc. Besides, it has the basic member managing function as well.

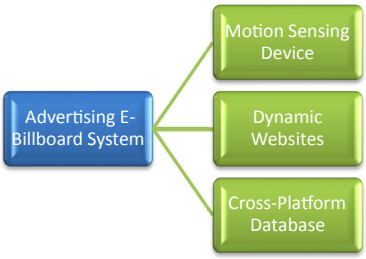

Fig. 3. Components of advertising e-billboard system. It integrates motion sensing device, dynamic website, and cross-platform database.

6. Results and discussion

Audio-visual effects capture audience's attention. By using dynamic network which connects with the database, the system can understand any problems and situations users face, modify the contents or errors in real time, and present the information rapidly. This way also can reduce the cost and get higher benefit in long term. Companies can attract more consumers and impress them with audio-visual effects and their interaction with this system. While individual interactions with the latest technology, are shown to lead addiction on the part of the users (Bhatt, 2004). Different from the general digital billboard, this system lets consumers understand product information better and creates maximum efficiency of marketing.

This interactive advertising e-billboard system integrates motion sensing, dynamic website, and cross-platform database, as shown in Fig. 3 and described in detail as follows:

In motion sensing, it is used as an input device to interact with user. More specifically, when a user stands in a specific range, the motion sensing device will start sensing the skeletons of the user and detecting his gestures. The user only needs to wave his hand to select the products he wishes to view. Clapping his hands can start playing the advertisement, clapping again can quit the advertisement.

In dynamic website, it is used to present the advertisement. That is, in terms of the front-end interface, we divide it into a 3 by 3 grid. The same column shows different products of the same company, and the same row shows different products of different companies. Users' manipulation records of the e-billboard will be saved into the database. The database connects to the back-end website so that the data can be read by companies easily. The website shows the reports to the companies that are members of the membership system. Companies can look at the record of their own advertisements and compared it with that of other companies, in order to revise their advertisements to improve them.

In cross-platform database, it is used to record the manipulating information of users and produce analytical charts. More specifically, when the motion sensing device has detected a user starting to manipulate the system, the browsing history will be recorded automatically. When the user exits, the record will be saved into the database in the same time. Simultaneously, the back-end website gets the data from the database. We provide an account to each company so that they can log in and view the browsing records of their products. Moreover, we transfer watch time into bar charts and pie charts, and provide the average watch time of all products for companies' reference. Companies can easily know how popular in the market their products are, in order to decide whether to revise the marketing strategy or maintain present conditions.

Finally, these three components, motion sensing device, dynamic website and cross-platform database, are combined to build an interactive e-billboard system. Through the intuitive manipulation of users, the system plays the advertisements according to users' motions and collects data for statistical analysis. Furthermore, it creates charts to know the whole situation of the market, enterprise can also use it to modify their marketing strategy.

7. Conclusion and future works

Technology grows rapidly, so does the communication media. There are a dazzling variety of multimedia advertisements. How can a company attract consumers, obtain their likes and stand out from competitors? This becomes an important issue for most of the companies. This system aims to utilize the innovative technology to understand consumer psychology and reach the goal of getting close to consumers.

Kinect let consumers experience themselves as if they are playing interesting games. They will have better impressions of the products when they are manipulating the e-billboard. The information saved into the back-end system is very important for companies, which makes them informed of what kind of advertisements are most loved and the defects that must be improved. This system not only can simplify the process of posting advertisements, reduce the cost of consumer survey, and increase the chances of consumers interacting with advertisements. The information generated optimizes the content of back-end-database, which helps companies understand different needs of various groups. As a result, companies can design products that meet the needs of consumers or marketing projects that attract consumers more. Table 1 lists the application areas of proposed system.

We can implement cloud services to make a single server support several interactive e-billboard systems in the future. It can analyze the preferences of various groups according to the recorded data from different places and time. Companies can improve the products on the basis of product popularity and solve the problems of unpopular products in real time. In addition, understanding the

Table 1
Application Areas of proposed system.

Business	Application
Enterprise Agencies	Corporate image, products exhibits, decree advocacy, etc
Banking and Finance	Stock quotes, activity information, news, etc
Community building	Announcement, rental information, business ads, etc
Hospitals and Clinics	Divisions Introduction, physician profile, health news, etc
Retail stores	Promotions, product ads, membership information, etc
Hospitality industry	Hotel introduction, activity information, instant news, etc
Transportation	Train information, image promotion, instant messaging, etc
Public places	Decree advocacy, meteorological & date, ground service, etc
Academic institutions	Campus image, learning materials, associations propaganda, etc

reactions and emotions of each group on different advertisements helps companies grasp the trends of markets, which maximizes the benefit of using this kind of multimedia advertisement.

7.1. Implications for advertising benefits

This interactive e-billboard system can change the types of advertising. Consumers not only “watch” the advertisements, but also “interact” with them. They can decide whether to skip the advertisement or stay on the page they are interested of. The somato-sensory interaction makes advertisements more attractive and more impressive, as well as increases the fun. The interactive e-billboard system has the characteristic of novelty which attracts consumers easily and enhances the function of advertisements so that a company’s products can be seen by more consumers. In addition, the back-end system helps companies handle the situations of consumers and helps make new strategies. Consumers have more chances of exposure to these advertisements that get closer to their lives. Furthermore, internet helps companies update their information in real time so that they don’t have to spend much on printed matter. Consumers can receive the newest information in real time, reducing the costs of reprinting.

7.2. Implications for technical extension

With the advance of Kinect technology, motion sensing becomes more precise than before. For instance, it can detect more detailed motions and reduce the misjudgment of the meanings of users’ body languages. Using the improved Kinect can have more interactions with consumers. The interactive e-billboard system can be combined with other technologies such as EEG. With EEG, we can simultaneously know consumers’ psychological reactions when they are watching advertisements. Moreover, we can add the shopping cart function which lets consumers buy their preferred products directly. The buying amount will be directly saved into back-end database and used to analyze consumers’ preferences.

8. Limitations

Although Kinect provides great interaction with users, it is not easy to be carried everywhere. It can only be placed at a specific position to wait for someone to use it. Another limitation is that Kinect cannot be used in small spaces. If the space is too small or congested, the machine is unable to get correct information from users. Therefore, small spaces are not suitable for Kinect devices.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at https://doi.org/10.1016/j.tele.2018.07.011.

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