

Development and Utilization of Smart Projected Beam Advertising System for Public Transportation

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Abstract: The purpose of this study is to present and develop a practical advertising model that minimizes transport advertisements, indiscriminate banners and flyers, and logo light installation problems with smart advertisements using projected beams. In order to develop an integrated smart advertisement that is convenient and inexpensive for companies operating at night, the scope of the research is determined as a practical advertisement that identifies the problems of existing bus and taxi smart advertisements and the needs of customers. The smart projected beam advertisement that the author claimed is a customized advertisement that solves the advertising problems of customers and local governments in Korea based on business hours, locational information, and big data. The projected beam outdoor advertising system developed by the author was designed to reduce environmental and resource waste, avoid unnecessary advertisement exposure for consumers, and obtain necessary information for businesses. Moreover, it was developed to reduce advertising costs for businesses. This is a very appropriate solution as an alternative to reduce the night time flyers and banners that local governments in Korea are struggling with. Consumers can avoid unnecessary advertisement exposure and obtain customized information, while advertisers who use the service can directly insert their sales information into advertisements in real-time using various media at a low cost.

Keywords: beam projector; big data; locational information; smart advertisement; transport advertisement

1 INTRODUCTION

In the current economic downturn in Korea due to the Corona virus, competition among small business owners is getting fiercer, and the outdoor advertising market is a large market with a size of 3.35 trillion won, and we are living in an era of advertising competition. Fig. 1 shows the size of the digital outdoor advertising market and the analog advertising market. In particular, digital outdoor advertising is showing growth, although the change is not too significant, with 248.1 billion won in 2018 and 252 billion won in 2019.

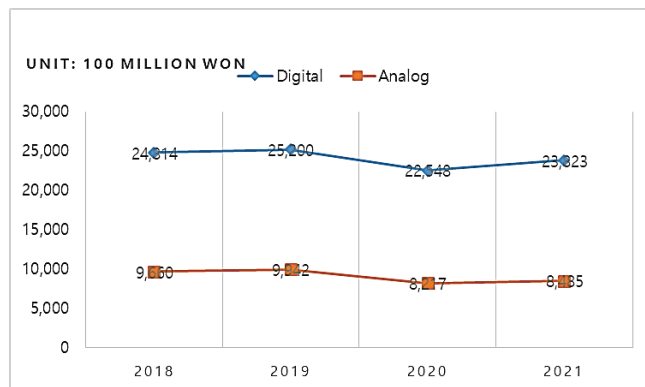


Figure 1 Digital/Analog OOH sales

However, the biggest problem with the current advertising business is that advertisers are burdened with advertising costs due to high advertising unit prices, and accordingly, business operators have difficulties in selling advertising media. Also, in recent bus advertisements, it was suggested that the media management of advertisements outside the bus was neglected and poor. Advertisements should be kept visually clean and good looking while they are posted. The fact that the visual appeal of advertisements is declining was pointed out as a major problem [1]. Therefore, the purpose of this study is to specifically study

the development and utilization of smart advertising media using convenient and efficient public transportation for small business owners.

The purpose of this study is to develop convenient and efficient smart advertisements for small businesses, through the development of public transportation smart advertisement media using Projected Beam. For this reason, the following four research methods and scopes are established.

- 1) Analyze the concept of smart advertisement using traffic advertisement and project beam based on literature data.
- 2) Compare and analyze the problems of outdoor advertisements and seek solutions.
- 3) Search for customized smart advertising methods through cases using domestic and overseas smart advertising systems.
- 4) Present a smart advertising business model using Project Beam, which is convenient for small business owners

2 RELATED WORKS

2.1 Concept of Smart Advertisements using Transport Advertisement and Projected Beam

Transport advertisements refer to advertisements that display texts, figures, etc. on transportation facilities (underpasses, railroads, subways, airports, harbors, and expressways), or installation and display of posting facilities such as wood, acrylic, and metal materials, and advertisements that display text and figures on the outside of transportation means (trains, subways, cars, airplanes) [2]. In other words, advertisements installed using transportation facilities or installed inside or outside transportation means such as buses or taxis can be regarded as transport advertisements.

In addition, domestic traffic advertising falls within the category of outdoor advertising in terms of legal and sector. Projected Beam Advertisement literally refers to an

advertisement system that uses the light emitted from a device to display phrases and images containing products or specific topics. It is also extended to a format that transmits information by connecting to various external devices as well as PC. Smart advertisement can be referred to as a comprehensive information system that interacts with users by using a digital video device in a specific place, and providing various information through a network. [3] The advantage is that people who come across advertisements can autonomously accept collective information, including advertisements, and interact with their devices.

Personalization of smart advertisements is developing into predictive advertisements that recognize and provide services that consumers want in advance and native advertisements that naturally permeate into services and minimize consumer rejection, which also contains infinite possibilities. However, if coercion enters into these interactions, it may cause problems in imprinting and lowering the effectiveness and impact of the advertisements.

2.2 Functions and roles of transport advertisement

Fig. 2 shows advertisements inside and outside of buses and taxis. Transport advertisements have individual selectivity and high reach for a wide selection of contract periods, and posters can easily reach passers-by, car or bus passengers, dealers, and wholesale/retailers, thereby fulfilling the role of an effective local poster. [4] Compared to other advertisements, transport advertisements have a high advertising effect and high cost because they have a greater chance of being exposed to an unspecified number of people. Currently, it is one of the most popular outdoor advertisements worldwide.



Figure 2 Transport advertisement attached inside and outside of public transportation

2.3 Functions and Roles of Projected Beam Advertising (Including Logo Lights) and Smart Advertising

By using the projected beam, it is possible to expand the scope to a more dynamic and active role that provides various stories or dramatic elements by projecting three-dimensionally or creating an optical illusion effect [5]. The logo light beam advertisement used in general stores has problems such as the device installation location problem and the decrease in clarity due to the light reflection of the illuminated signboard in the commercial district. Also, when used indiscriminately on the street, it can become the main culprit causing light pollution to passing citizens.

Advertising activities for events or promotions using Projected Beam are generally suitable for use during the event period and require a high cost. However, if advertising using Projected Beam is developed in the direction of maximizing efficiency and reducing costs, it can be suitable as a future advertising medium in that it does not consume unnecessary resources.



Figure 3 Installation case logo light and smart signage

It is also used for promotions, boasting excellent visuality and visibility, and creating high advertising effects. Such advertisements become landmarks in the area, such as Times Square in New York, creating cultural value beyond commercial purposes. The most easily accessible advertisement among projected beam advertisements is the logo light advertisement. It is a method of transmitting specific phrases or images using LEDs on the wall or floor, and serves to provide publicity and attractions to tourists and residents [6].

Fig. 3 is shown in the upper left image, local governments currently play a role in preventing crime and encouraging residents by illuminating dark alleys, bridges, and places where residents do not move. In addition, night time businesses use projected beams to attract customers by advertising themselves at the entrance, when their establishment is located on the second floor or underground and it is difficult to identify them. The most core functions of smart advertisement are real-time information and location-based information of those exposed to advertisements, and they provide advertising services that match the information they want to obtain. This gives people who come across the advertisement an expectation of the advertisement information, thereby increasing the credibility of the advertisement medium.

3 PROBLEMS OF EXISTING OUTDOOR ADVERTISING

3.1 The Problem with Transport Advertisements

Transport advertisements have the advantage of being able to expose a lot to passers-by as the means of transportation move. But behind this great advantage, there are also several problems. First of all, the exposure target of inside transport advertisements should be limited to passengers. In addition, if advertisements are installed on

dirty buses or taxis, the quality of advertisement products may be damaged, and there are major disadvantages in that advertisements must be regulated in terms of their content.

3.2 Problems with Flyers and Banner Ads

On-site advertising typically includes banners and flyers, and most small businesses are conducting illegal advertising using flyers and banners. This undermines the aesthetics of the street in the way that those who receive the flyer are semi-forced and they would throw it away. As a result, local governments have to pay huge costs to collect them.



Figure 4 Collecting illegal banners

As shown in Fig. 4, local government of each city, county, and district across the country, including Seoul, is responding to civil complaints by regularly taking down illegal banners, etc. For example, in the case of Seoul, the average number of complaints related to the removal of illegal banners is 172,000 per year.

An official from Seoul said that since 2015, they have been operating a mobile maintenance team to take down illegal banners on a regular basis. In addition, the official said that a compensation system for collecting illegal banners is being implemented, and a budget of 1.28 billion won has been reserved this year [7]. Those who set up illegal banners do it illegally to get a short publicity effect for temporary advertising before they are collected. To install a banner in a designated place, there must be a waiting time during the application process, which is also one of the causes of illegal banner installation.

Table 1 General OOH price

(Unit: case)	Removal	Warning
Public facilities advertisement	215	21
Transport facilities advertisement	32	4
Transport advertisement	191	134
Notice	45,511,947	818,446
Leaflet	104,281,687	113,437

Tab. 1 is a table showing the general outdoor advertising cost. In a situation where many businesses have no choice but to use flyers and banner advertisements, which are cheaper than other outdoor advertisements, in order to maintain their business in a downturn, the price of advertising products can be said to be the absolute criterion for success.

Tab. 2 is the total status of administrative dispositions for removal and warning measures for illegal advertisements in 2017. It can be seen that illegal flyer advertisements record a higher number than other illegal advertisements. It is also pointed out that the problem is that the behavior of people who illegally distribute or attach leaflets is becoming more

sophisticated, and that the fine for illegal leaflets described in the Misdemeanor Punishment Act is less than 100,000 won. Various illegal flyers and leaflets that harm the aesthetics are expanding beyond environmental problems to social problems.

Table 2 Administration disposition present condition of illegal advertisement in 2017

(Unit : USD)		Average price
Leaflet (A4)	One time (3.2sheet) price	56 - 80
	labor price	120
Banner	1 m ² by 3.2 - 4	sheet by 25.2
	installation price	16
Bus advertisement	Outside advertisement price	480 - 1,279
	Inside advertisement price	1 sheet by 20- 48
		15 s :19,185
	Inside video advertisement price	20 s : 25,580
30 s : 38,370		
Taxi advertisement	Outside advertisement price	1 unit monthly 72
	Inside advertisement price	1 unit monthly 24

For example, in the first quarter of 2019, the upper limit of compensation was adjusted from 2.5 million won to 1.5 million won in the second quarter due to the excessive budget involved in the compensation system for collecting illegal advertisements in Jecheon City. An official from Jecheon City explained the background, saying, "This year, the budget for the compensation system for collecting illegal advertisements was 50 million won, but 14 million won was paid in the first quarter alone, which exposed the problem of budget shortage [8]". In addition, the government of Haeundae-gu in Busan greatly reduced the amount of compensation to a quarter compared to the pilot implementation of the ordinance for compensation for collection of illegal advertisements. This is because too much budget was spent, i.e., 34 million won being paid in one month [9]. As such, it can be seen that the cost of collecting illegal advertisements continues to increase nationwide.

3.3 Problems of Smart Advertising Using Public Transportation

In Fig. 5, the two upper images are examples of smart digital advertisements in Korea, and the image on lower left is a picture of a bus advertisement in New York, while the one on lower right is an advertisement inside a taxi in Japan. In particular, the last image is a unique service that allows you to use a taxi for free if you see the advertisement. Developed countries are adopting smart digital advertisements for transportation due to the more advanced media environment, expansion of the transportation advertisement market, and image creation.

Smart digital technology was also introduced in domestic traffic advertisements. LED billboards are installed on both sides of the bus to advertise, while commercial and public service advertisements are displayed using taxi lights. In the case of digital taxi advertisement, a digital information display is installed on a taxi indicator in operation and real-time location-based technology is used. Therefore, it can be used for disaster warnings in addition to advertisements, according to the desired area and time [12]. However, only

side and still image ads are allowed, and the duration of the screen must be at least 1 minute and the screen transition time must be less than 2 seconds. In addition, billboards must be equipped with a controller for which brightness is limited to a certain level in accordance with the Light Pollution Prevention Act standards, and they must undergo a safety inspection conducted by the Korea Transportation Safety Authority [13]. It is a big problem to be subject to many restrictions on administrative rules such as specifications, materials, weight, and materials. Furthermore, in addition to advertising expenses of about 100,000 won per month, there is also a cost problem that a fee is charged for vehicle structure and device changes or inspections. Recently, the size of the display has been increased due to insufficient visibility, but the heavier weight and wind resistance during driving are expected to accompany the problem of reduced fuel efficiency of the vehicle. In the current transition period when smart digital advertising is introduced, a method to solve the above problems is urgently required. The author expect that it will be possible to create an optimal customer-tailored advertisement form if an advertising company exposes advertisements by combining business hours and location information, and compares and analyzes the advertisement patterns exposed to the company's sales.



Figure 5 Digital advertisement on buses and taxis

4 EXAMPLES OF ADVERTISEMENTS USING SMART ADVERTISING

4.1 Domestic Cases Using Smart Advertising

Big data, which can collect a large amount of information and use it to analyze results, is a key technology in the smart digital advertising industry. In particular, advertising companies are establishing sophisticated advertising strategies by deriving information such as who our customers are, what behavioral patterns they have, what messages are effective, and what contact points to use [10]. As a precedent, in the past, the Seoul Metropolitan Government has analyzed encrypted data excluding KT and personal information to analyze where people are at 1 a.m. and where they wait for taxis and night buses, in order to expand the night bus routes around places with high demand. In addition, NEI&COMPANY, which operates a cloud-based transportation integrated advertising platform, connects advertisers and transportation advertising agencies through the platform, and also measures the effectiveness of transportation advertisements using transportation big data

[11, 15, 16, 17]. In this way, smart advertising not only presented a new platform in Korea, but also brought about a change in the shape of the domestic outdoor advertising market.

4.2 Overseas Cases using Smart Advertising

The left image in Fig. 6 is a connected bus stop in Barcelona, Spain, which helps outdoor advertising companies to collect and analyze a wide range of big data by using the hotspot function. Outdoor advertising companies can learn about various figures about people at bus stops, and use this to create advertisements more effectively and earn a lot of profits.



Figure 6 Connected bus-stop and taxi loaded with GPS

As shown in the image on the right, US media signage provides a service that combines digital outdoor advertising with location information. Advertisements for places passing by are shown on advertisement displays such as buses and taxis.

5 CONSIDERATION FOR IMPROVEMENT DIRECTION

5.1 Presenting a Smart Advertising Business Model Using Projected Beam

Until now, lighting advertisements could not be installed on transportation means such as buses in accordance with the domestic outdoor advertisement law. However, the Regulatory Exceptions Review Committee has decided to make a special exception to these regulations.



Figure 7 Smart projector beam on the floor when open the taxi door

Therefore, it is possible to use location information to send out local-customized advertisements such as nearby stores [14], but the administrative norms that require

permission for viewing of digital display advertisements are still specified.

In order to encourage this, there is the task to prepare a system for the system.

Fig. 7 is a smart taxi advertisement using Projected Beam, which the author reconstructed with Photoshop. When passengers get out of the taxi, a projector installed inside the door displays advertisements on the floor. Advertisements are companies located in the vicinity, and customized advertisements for companies and consumers are performed based on business hours, location information, and big data.

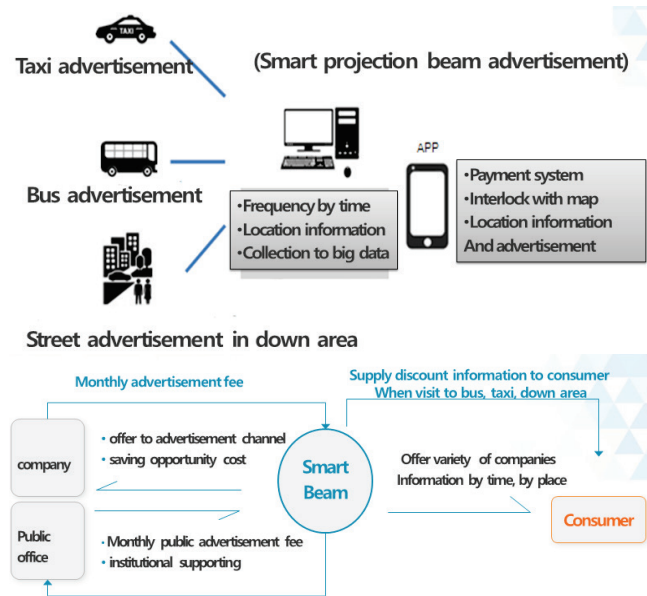


Figure 8 System operation of projected beam advertisement

Fig. 8 is a configuration diagram in which the smart advertisement business model collects consumer location information and time-specific information, and performs advertisement delivery functions through projected beams and applications. Through this, it can be seen that businesses, government offices, and consumers interact and find each other's needs. Smart beam projector advertisement system is a technology that can provide customers with general information and discount information from nearby businesses based on the current time and location by providing advertisement videos of nearby businesses through the beam projectors installed in taxis, buses, and public advertising zones in commercial areas. At the same time, it can maximize the number of visiting customers by providing effective advertising services for business owners. Specifically, the database stores the advertisement videos and matches the advertisement videos with the desired time and location of the business to be displayed. The beam projector system is composed by including a communication unit for transmitting and receiving information to and from the database, and a GPS receiver to identify the current time and location of the beam projector. The beam projector is installed on one side of the passenger side and the right rear door of the taxi, and on the exit door of the bus. Accordingly, when a passenger in a taxi or a bus disembarks, the GPS

receiver of the beam projector identifies the current time and location of where the taxi passenger's right rear door is opened or where the bus exit door is opened. The identified information is then transmitted to the database through the communication unit. If the advertisement video from the company requesting the advertisement service stored in the database is matched with the time and location information for the advertisement to be displayed, the database would transmit the advertisement video to the beam projector. The beam projector would then display the received advertisement video on the floor so that passengers can see it. As a result, passengers can get the information by watching advertisement videos of nearby businesses as soon as they disembark.

By using a single integrated service, business owners don't have to pay a lot of money to use various types of general advertisements such as flyers and banners, thereby reducing advertisement costs and at the same time using effective advertisement service. At this time, the advertisement video generated when a passenger is getting off the taxi or bus also functions to create a yellow zone that notifies nearby motorcycles and other vehicles that passengers will get off, thereby guiding passengers to disembark safely. Furthermore, in addition to advertising services for taxi and bus passengers, installing beam projectors in commercial areas where companies are densely populated would make it possible to eliminate indiscreet advertisements and provide beneficial advertisements for each time period to consumers, by forming a public advertisement zone and displaying advertisement videos of nearby companies that are mainly operating at the current time. On the other hand, it is also possible to provide a dedicated application to consumers through the app operation server. In case consumers want to get more detailed information when they get off the taxi or bus, or after watching an advertisement in a public advertising zone, it is possible to provide them with an advertisement video containing more detailed general information and discount information from the business, by executing a dedicated application and searching for the particular business to obtain information through the location-based service.

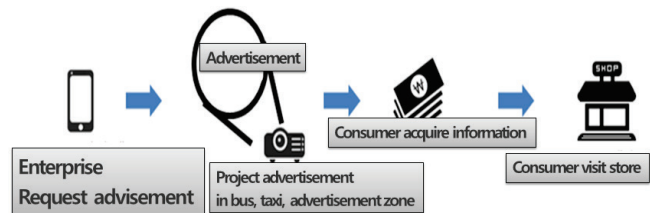


Figure 9 Process of projected beam advertisement

The smart advertisement that the author proposes is as described in Fig. 9. It goes through the process of requesting an inquiry, executing an advertisement, acquiring information, and visiting a company. It also provides integrated online and offline services through a mobile application. Based on this, it creates an advertisement zone in the commercial area to guide customers, or provides discount information of nearby businesses by time to

customers approaching the commercial district by taxi or bus. For companies, it provides a service that can maximize the

number of visitors by effectively advertising to the customers who need it.

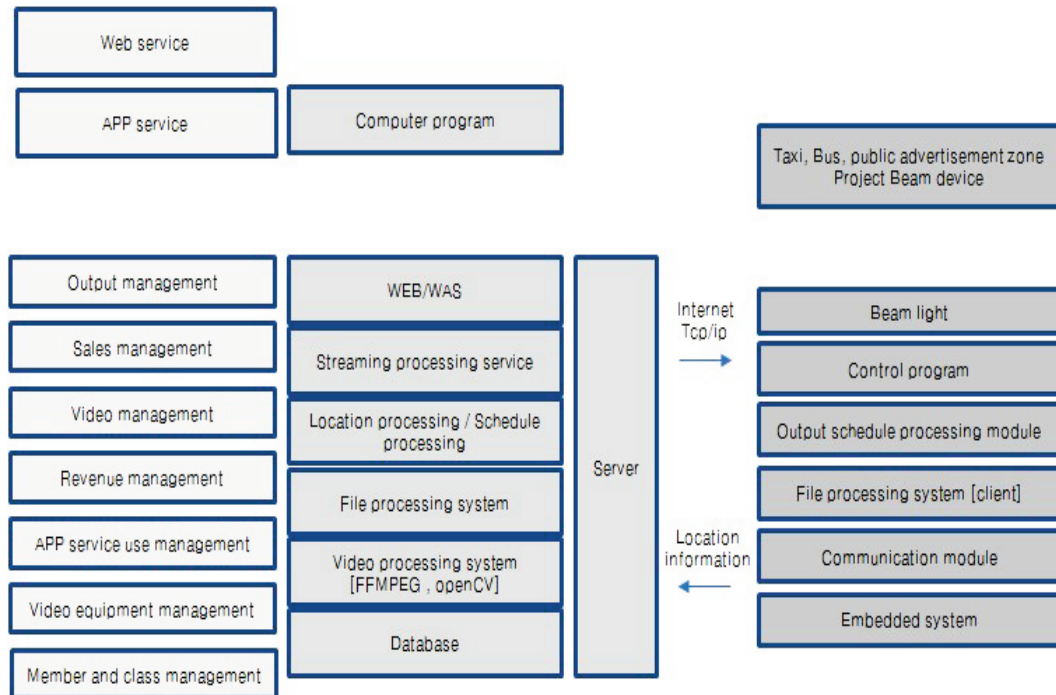


Figure 10 Smart advertisement system elements with projected beam

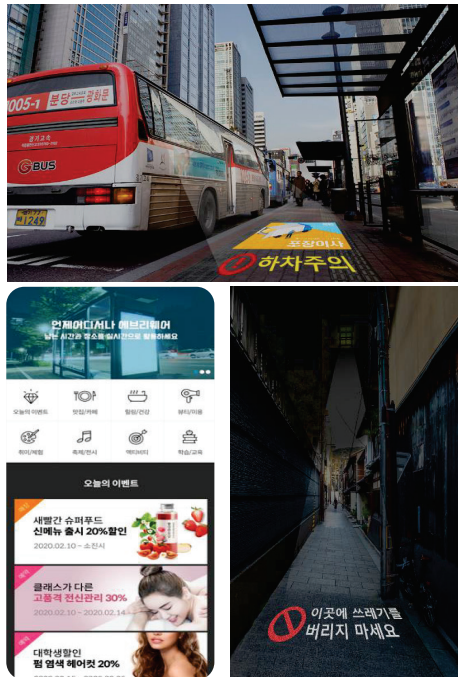


Figure 11 Street advertisement, bus advertisement, and app advertisement using smart beam

Fig. 10 shows the system components of smart advertisement using Projected Beam. In the web or app service, a computer server that manages various information and customers and uses location information transmits the discount information of the company along with video advertisements in real time. People who arrive near the company using smart beam advertisements in taxis, buses,

and public advertising zones can visit the company and enjoy discounts. Big data also stores the route of traffic and the frequency of advertising locations. It provides a service that can compare advertisement pattern history and sales to the company's management, and handles various real-time events and free transportation fee payment service for consumers.

5.2 Smart Beam Projector System Advantages and Uses

The advantages of smart advertisement (Fig. 11) that the author proposes are that it is not affected by the weather, it has a natural gaze fixation effect in the advertisements, it is inexpensive to transmit videos and images, and it also has various directing effect compared to the unit cost ratio. In addition, advertisements using the Smart Beam Projector System can target all age groups due to the advertisement effect targeting an unspecified number of people, while advertisements by region and route are made possible using GPS location-based technology.

5.3 Addressing Natural Environment and Economic Problems

Just because illegal flyers are made of paper, it doesn't mean they're all recyclable. It is impossible to recycle coating paper or magnetic leaflets, which have been widely used recently. This is also the reason why smart advertisements using projected beams are urgently needed to minimize waste. Since it is not an object but a form of light, there is no waste of material and resources required for printing. It can

also be displayed at night time, to replace eventful flyers and banners. Therefore, it is expected that it will be able to save local governments' budget costs for collecting illegal advertisements. Again, smart advertisement using project beam provides business owners with an all-in-one method that integrates multiple types of outdoor advertisements into a single service; provides the effect of directly reducing environmental problems caused by thrown-away flyers and banners, as well as reducing resource costs that the government offices have to spend to deal with the problem; and provides customers visiting business districts with opportunities to learn about general information and discount information of the nearby business through the video

6 CONCLUSION

Recently, the overall outdoor advertising market and digital outdoor advertising market are growing. However, ironically, despite the overflow of advertisements, small business owners feel burdened with advertising costs due to high advertising unit prices, while consumers who consume advertisements have the opinions that smart advertisements using existing public transportation are neglected and poorly managed. Flyers and banners, which are on-site advertisements, are not only making the urban environment messy and distracting, but they are also subject to initial intrusion and are expensive for local governments to deal with.

Therefore, the development of cheap smart advertisements that are convenient and efficient for small businesses is the most important issue in the advertising industry. It is an improvement of resource waste and cost problems in advertising method. Smart advertisement using Projected Beam, for which patent the author claimed, collects consumer location information and time-specific information, and delivers advertisements through Projected Beam and applications. Through this, businesses, government offices, and consumers may interact to find each other's needs. In the web or app service of the system presented by the author, a computer server that manages various information and customers, and uses location information to transmits the discount information of the company, along with video advertisements in real time.

People who arrive near the company using smart beam advertisements in taxis, buses, and public advertising zones can visit the company and enjoy discounts. Big data also stores the route of traffic and the frequency of advertising locations. It provides a service that can compare advertisement pattern history and sales to the company's management, and handles various real-time events and free transportation fee payment service for consumers. In conclusion, smart advertising using Projected Beam is very appropriate as an alternative solution to reducing advertisements for flyers and banners at night, which local governments in Korea are struggling with. Consumers can avoid unnecessary advertisement exposure and obtain customized information, while advertisers who use the service can directly insert their sales information into advertisements in real time using various media at a low cost.

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