안드로이드 미니PC를 이용한
Retail-Store형 디지털사이니지 솔루션 개발 및 사용성 테스트
Retail-Store Type Digital Signage Solution Development
And Usability Test Using Android Mini PC

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요약

디스플레이를 활용해 사용자에게 광고 및 정보를 노출 할 수 있는 디지털사이니지는 공공장소에서 광고 채널로서의 역할에서 확장되었다. 최근에는 음식점 및 소매상점으로 널리 확장되어 이용되고 있다. 그러나, 특정 용도에만 맞게 개발되어 있어 확장이 어렵고 단말의 가격 또한 비싸다. 본 연구에서는 이러한 단점을 모두 보완할 수 있는 합리적인 가격과 안정적인 운영성, 높은 확장성을 가진 안드로이드 스틱형 디지털 사이니지 상품을 개발하였다. 안정성 및 사용성을 테스트 하기 위해 H/W 및 App의 Performace Test실시하였다. H/W성능, 시나리오별 최대성능을 Load Runnner로 측정한 결과 모두 목표지수에 도달하였다. 사용성 테스트를 진행한 결과, 피험자들은 비 디지털사이니지 시스템 사용자를 포함해 모두 기능을 쉽게 습득하였다. 설문지를 통해 만족도를 측정하였다. 그 결과 어플리케이션의 학습률 및 사용성(LEU), 유익함 및 문제해결능력(HPSC), 정감적요소와 멀티미디어특성 (AAMP), 제어력 및 단기기억부담의 최소화(CMML), 작동과 효율성(CE)에서 긍정적인 반응을 보였다.

■ 중심어 : | Retail-Store 디지털사이니지 시스템 | 사용성 테스트 | 안드로이드 미니PC | 안정성 테스트 |

Abstract

Digital Signage, a way of advertising or delivering information to viewers through digital displays, has expanded from being just an advertising channel in public places. Recently, it has become widely prevalent in restaurants and retail stores. Despite its wide expansion, digital signage is limited to specific usages and services and the devices it uses are also quite expensive. This study introduces a stick-type digital signage product that operates on Android OS, which addresses all the weaknesses of digital signage with much more reasonable pricing and stable operation. For stability, performance tests were executed on the hardware and applications. The results for hardware performance were extremely promising, as each scenario's maximum performance results, measured by Load Runner programs, reached target indexes. Also, as a result of the usability test, all participants, including non-digital signage system users (novices), were able to easily learn all the tasks. As a result of user satisfaction survey, positive responses were exhibited for ease of learning and usability (LEU), helpfulness and problem solving capabilities (HPSC), affective aspect and multimedia properties (AAMP), commands and minimal memory load (CMML), and control and efficiency (CE).

■ keyword : | Retail-Store Digital Signage System | Usability Test | Android Mini PC | Stability Test |

I. Introduction

Digital signage services are receiving more and more attention as a new form of outdoor advertising, exposing viewers to ads and providing information via digital displays. According to a research study carried out by BIA/Kelsey, a regional advertising and marketing expert group, the digital signage market in the US is growing at an average of 13.5% per year, and was prospected to reach a market share of 3.7 billion US dollars in 2013, from 2.2 billion in 2009[1].

It has not been long since domestic digital signage services began to be perceived as an advertising media, since their initial appearance in 2006. Companies such as LG U+, KT, CJ Powercast, etc., are providing regional advertising and useful information services by installing digital signage in public places such as public transportation and apartment areas[2].

Table 1. Major signage industry trends of different fields

Classification	Representative Company	Applications
Solution	KT	Securing media in the living space of the customers, such as subways, buses, etc.
Operator	LG U+ CJ Powercast	Application of digital signage based on transmitting advertising broadcasts
Hardware System	HYUNDAI IT	Developed specialized solutions through cooperation with Intel and Nexite
Content Provider	Daum	Signage content provided as part of N-Screen service

Recently, as more are becoming interested in digital signage, this form of advertising has expanded into department stores, golf resorts, and retail stores such as apparel stores and restaurants, and are operated as the its public relations, floor information, or as menus,

etc. However, the current market-ready digital signage solutions have high costs and are problematic in devices and content management. In addition, because the signage operating systems (OS) are varied between Microsoft Windows (CE, XP, 7) and those that are Linux-based, integrated management and expansion into new, customized forms is quite difficult.

In this study, the result of developing a stick-type, Android OS-based digital signage product with a reasonable price and stable operability is explained. The purpose of this study is to establish a digital signage solution suitable for retail store owner-operators. In order to achieve this purpose, 'non-reputable advertisement layout' templates were provided so that customers would effectively recognize the owner-operators' non-reputable products. Moreover, usability tests of web applications were executed in order to find out whether non-experts like retail store owners were able to operate them, and if the experience was satisfactory

II. Related Research

2.1 Definition of Digital Signage

The most basic definition of digital signage is a remotely controlled digital display that links with sales, marketing, and advertising[3]. In simpler terms, digital signage is an information exhibition medium that has the potential to reach a wide range of customers. Another possible definition of digital signage is a system that relays information via a telecommunication network on electronic screens of various sizes in different places such as on public transportation or in other public places (outdoors or in front of a store)[4][28]. Ultimately, digital signage can

be defined as a digital video/image device that delivers various types of information through text and images in public places.

In comparison to existing outdoor advertisements, digital signage is not only capable of showing customized (set time and place) advertisements to specific targets, but is also capable of providing participative and customized services linked with various smart devices, user interactions, or multimedia content. Accordingly, it has the potential to become the forth type of media, following Internet and mobile.

2.2 Characteristics of Existing Digital Signage

Existing digital signage includes multimedia using displays, and is installed in places with a large floating population, such as public places and elevators. It is not just a digital information display, but instead is an interactive media that converges with various software, hardware, content, network technology, etc.

The major characteristics of digital signage are as follows: first of all, multimedia using images, video, and music can be provided as content, and other useful information such as weather or stocks can be easily provided. Such strengths, in the long term, allow one to save on advertising costs. In addition, through a web-based management system, images or videos can be immediately created, modified, and distributed, and problems can be discovered and fixed on the spot.

Second, the content of each digital sign can be controlled. This advantage allows region- or site-specific targeted advertising, using detailed advertisement broadcasting functions in public places or in places like apartments. In addition, time-slot floating population-targeted advertisements are also

possible.

Third, the cost for initial infrastructure establishment is large. Frequent large investments for aspects such as installation, maintenance, and operation are required for advertisements that require one to install a number of devices in public places.

Fourth and finally, content broadcasting status and D/S device status are all remotely managed through a network. For example, in order to increase operational efficiency, CJ Powercast and LG U+ operate a Network Operation Center (NOC), a remote control operational center. Here, the organization and broadcasting of content, digital signage monitoring, and error control are monitored 24 hours a day by specialized experts

2.3 Trends of the Digital Signage Market

When digital signage was first introduced in Korea in early 2006, D/S devices were focused in public areas with a large floating population such as bus stops or subways, targeting region-specific products. These are still operational today. Because the devices had to be installed and managed in various places, installation and operational costs were high. The advertisement income was enough to cover these costs. However, hardware depreciation is inevitable in a long-term operation, and this reason was enough to spur the development of B2C (business to customer) advertisement platforms and prototypes with lower operational costs.

Following such recent trends, global digital signage producers such as Samsung Electronics Co. Ltd. and LG Electronics Co. Ltd. are introducing digital signage solutions that can be used in owner-operator stores such as small restaurants or clothing stores. LG Electronics has introduced about 50 digital signage products since the beginning of 2014 for retail store owners. Samsung Electronics, the leader in the

global digital signage industry[2][25], began selling a product in August 2014 named 'Smart Signage' that provides MagicInfo Express, an editing/broadcasting software, as part of a solution for owner-operator digital signage[5]. Two models (40-inch – RM40D, 48-inch – RM48D) were introduced into the market with prices at 1.1 – 1.3 million KRW. However, a solution allowing owner-operators to use their own LCD/PDP TVs or displays as means of digital signage is still required. If they could use their existing TVs or displays as digital signage, owner-operators would be able to save on the cost of purchasing the product.

2.4 Effects of Digital Signage Advertisement

In conjunction with the recently published digital signage advertising effect, case studies have been largely divided into 'media effects research,' 'research on the interaction with the consumer attitude,' and 'exploratory research' on digital signage media characteristics[6].

The first category, 'media effect research,' is the study of the effect of media on individuals. Yang studied the effective process of the Tunnel Advertisement System (TAS) and has argued that the reliability of the advertising and brand affects the brand attitude[10]. Shim proved that if advertisements showed both TV and Internet on the 'Media Pole' Device installed in Gangnam Station, they were more effective. Shim also proved that certain products should be advertised through digital signage. Some of the most effective products were a mobile phone and telecom company, electronic appliances, clothing, bakery items, fast food, ice cream, and coffee[11].

Second, in Kim & Kim's research[12] on the interaction between digital signage and consumer attitude, the population of the accommodation on the assumption that mobile and digital signage is a highly interactive media in a study. To analyze the effect of the digital signage advertisement on the experience of the statistical characteristics and mobile coupons, attitude use experience of both mobile coupon of women and men for the digital signage advertising than those who did not experience, and attitude toward brand, purchase time is higher of revealed towards the women is showing a strong reaction than men. The others research, summarizes the case study of the D/S management[13][14].

However, while digital signage research has been conducted on the operation of different advertising platform types, research on the development and operation of a small self-employed digital signage product is an advertising solution that has not been adequately explored. For the administrator of individual advertising solutions, such as a small self-employed product, the understanding of the user is relatively immature. For this reason, there is a need for a study on user experience employing usability tests. Furthermore, using a small self-employed device, it is difficult not only to produce effective advertising content, but also to produce effective advertising concepts for non-reputable products.

Therefore, in this study, self-employed is to develop a digital signage solution that uses, usability tests were conducted in order to understand whether the digital signage solutions were easy to use for non-experienced users. An advertising layout appropriate for non-reputable product advertisement was employed.

2.5 Technology Related to Digital Signage

Digital signage services, large display and Android board and Hardware (H/W) made up of advertisement Player app, is divided into Web-based management system. The H/W and system are designed to communicate, through the system,

content delivery and management, and also allow one to control the system. Related technologies are as follows.

2.5.1 Digital Signage Standards

Digital Signage (D/S) devices already introduced in the existing digital signage market use various operating systems such as Windows, Linux, and Mac OS, and they support media formats such as HTML, Flash, JPEG, and MPEG. D/S devices are appropriately processed by executing the Player Application, which usually uses DOM type formats such as XML, HTML, SMIL (Synchronized Multimedia Integration Language), and SVG files.

Digital Signage is related to the standardization of ITU – T, defined POPAI, service of architecture at the W3C, content format, and standardization of digital signage device control. For ITU-T, a part of the International Telecommunication Union Telecommunication Standardization, Japan leads the standardization. Approved in May 2012 SG16 meeting, a new recommendation H.780 which has been proposed in the draft, ITU-T, 1910 digital signage content IPTV architecture to base that is defined in the network meta-data, higher requirements on the device side, architecture, and incorporates the content of such mechanism[15][21][29].

POPAI (point of purchase advertising international) is a standard from the Advertising Association for marketing in the US retail market[24]. It was originally going to become an international standard such as screen media format, standard device control, standardization, and advertisement play log did before 2007. But, now we are in a state in which standardization has been given the chop. On the other hand, the W3C (World Wide Web Consortium) created a standard for web-based signage solutions that was promoted as a broadcasting interface

between signage devices and a server, a communication protocol. Additionally, W3C can be proposed as a standard for the SMIL (Synchronized Multimedia Integration Language) multi screen layout format that is available to combine various types of content such as video, audio, images, text and scheduling of multimedia[22][23].

2.5.2 Digital Signage Content and Device Management Technology

Content management is a technique for managing the information in the content to be sent to the device processing unit of the digital signage executed, including 'scheduling information' and 'playlist information'. Specifically, the device corresponds to the specified number of items to be played during a period of time, the play list, and the execution time. Statistical information corresponding to the content is also used as important data when reinforcing future advertising.

Device management is a technique for remote manipulating of the digital signage device, such as checking for device error (connection, failure, etc.) and device control (advertisement broadcasting, power off, restart). In order to accomplish this technique, the system adds to the device 'installation area information', 'Mac Address', and 'IP' information. Furthermore, the server periodically sends the current state of the device to enable recognition of the presence or absence of failure. If there is an abnormal device failure, the owner must be able to resolve the device problem directly using a remote control technique, and if he or she is able to efficiently resolve the issue without having to physically visit the device, it is possible to reduce the effort required[27].

A VNC (Virtual Network Computing) Application can be used to perform remote device management,

but may be exploited; this should be noted as a security issue.

2.5.3 Broadcasting Advertisement Content Technology

In general, in accordance with the transmission method of the content, the device is in accordance with the time and circumstances in which 'polling type' and operators in the form of receiving requesting content was defined to be classified into 'broadcast type' of transferring content from the server to the device can be.

In a polling transmission system, the device confirms the presence or absence of data to be transferred when it connects to the server for each given period. In order to receive stable download content and access the number of devices more easily, the system has to develop the 'traffic load balance function' that creates efficiency.

On the other hand, with the broadcast transmission method, multimedia data services are increased due to the efficient use of limited bandwidth, the content by using the time zone night more network utilization is low device it is the efficient operation assigned to are possible[1].

Sometimes, instead of network problems, the device's digital signage delivery system unexpectedly has a problem that prevents advertisements from being broadcasted. To resolve this issue, it is important to have field experience with the D/S operation rules. Additionally, research on content broadcasting technology is constantly required for minimizing unexpected issues.

III. RETAIL-STORE DIGITAL SIGNAGE SOLUTION DEVELOPMENT

In this study, we developed an Android-based application, the SMIL player, and managed the web application system. To see whether it was possible to use one's own display, such as a TV, we carried out usability testing and performance testing. Through the research, we attempted to build a self-employed digital signage solution.

Recently, the low-cost Android mini PC (such as the Droid PC) has invigorated the H/W market and can be used as digital signage. The Android mini PC features easy and quick installation available to any person.

3.1 System Diagram

The systems, as shown in [Fig. 1], are configured as 'content management systems', 'D/S control systems' and 'D/S device'. Because of D/S control systems' best performance, we separate the content management application and D/S control system. Because each server role is clearly different, in order to avoid affecting the content, broadcasting traffic is configured to operate independently. It is arranged to link the information in JSON format using both APIs that are promised between servers.

The communication method between the device and the server is configured as polling type. Polling type is defined as a D/S device that accesses the control server and requests work commands (content download, firmware update, etc.) at predetermined periods. If the device has a work command (response), the D/S device downloads XML files from the server.

Table 2. Example of server-device request (Req.) and response (Res.)

CMD	Type	Explanation
Request	http	http://[domain name]/status.did ?mac information=000000000&conn ectivity=A0&onoffstatus=on&ipi nformation=192.167.0.11

Response	XML	\<?xml version="1.0"?\> \<Root\> \<Command\>CMD_UPDATE\</Command\> \<settingXml\>http://digitalsignageNas.com/SMIL/command.smil\</settingXml\> \</Root\>

The Digital Signage delivery system requests between devices are configured to communicate in response format. The Digital Signage system communicates with the D/S device using 'Request-Response' type communication.

Fig. 1. Digital signage solution process and framework

3.2 SMIL Player

SMIL is used to define a list of digital signage advertising to prepare the ad player's Android operating system. The reason for using the SMIL standard is that it organizes relatively standard specifications and is able to variously express animation, especially that which appears when paging from one image to the next.

The Digital Signage device downloads the ad organized list in the form of SMIL as an extension form of XML in the delivery system. The SMIL file stores the content server path, file name, playback time, and the schedule. To play the SMIL file, the SMIL Player application is employed. The following features for the SMIL Player were developed.

Table 3. Major function developments of SMIL Player

Category	Explanation
Broadcasting server linkage	Regular device status transmission, command received following transmission, command executed following command name
Self-upgrade function	Self-upgrade function support through transmission system
Parsing data management	Management of parsing results of information files (XML, SMIL) received from the server
Event schedule processing	Processing of data that was generated each hour as events, based on data parsed
Statistics	Transmission of the log file consisting of played advertisement data
WIFI linkage function	Processing application in order to obtain network information (MAC/ network address/ connection status/ static IP setup) during Wi-Fi network usage
SMIL parsing function	Parsing function support of the SMIL files transmitted from the server

Through the development of the following features, the SMIL Player communicates as shown below. First, an SMIL file is generated from the advertisement broadcasting server. Second, the 'SMIL Player' downloads its own SMIL file (including a unique ID). Third, the SMIL player was able to play the content after it was confirmed to have been delivered to the SMIL specification.

Fig. 2. SMIL Player system diagram

3.3 Content Management and Broadcasting Management System

The service flow of the content management and delivery system are as follows. First, an upload is

created. Second, the frame is set up. Third, the playlist and scheduling are generated. Last, the delivery to the D/S device is configured. The uploaded content for delivery matches the device resolution, after making a frame to fit it, and generates a playlist that defines the playback order of the content. Add a playlist created on the schedule, after including a group of target device sent, was constructed from a device to reduce the sending command to continue to collect information.

The advertisement broadcasting function, which can be controlled internally through the content management system, is developed to separate the delivery system of the line item system. It is possible to suppress the role of between each system to minimize interference in isolation and debug the log required for expert technical support solutions, features such as confirmation of details operational state, in the delivery system management account only I have applied to work.

3.4 Designing a Content Management System

This system is in charge of the content organization and scheduling works.
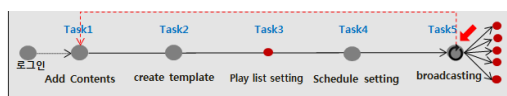
Fig. 3. Process of digital signage solution work

This content management system provides a 'non-reputation product advertisement template' that is suitable for the self-employed. Self-employed of goods are most of the non-reputation commodities. It is difficult for business owners to create effective advertising content by themselves. In order to solve this problem, we developed our solution in reference

to Kim et al.'s work[16]. According to Kim's research, non-reputable product advertisements are much more effective when using an 'explained/separated' type template, compared to reputable advertisements (as follows in [Fig. 4]).
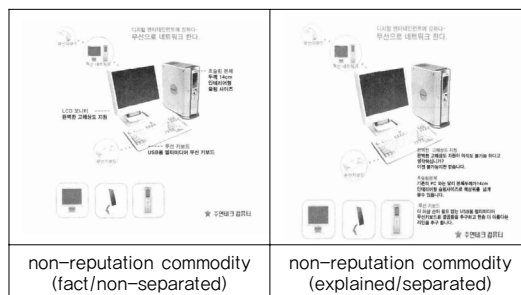

Fig. 4. Kim et al.'s comparison of two layout types

In this research, if the advertisement layout style is easily designed, the consumer will be held by induced negative recall and recognition because of their cognitive surplus resources. For this reason, the consumer not only experiences a negative reaction to the advertisement, but also evaluates the advertisement as negative too. Therefore, it is necessary to design advertisements to have no cognitive surplus resources for consumers. In other words, the advertisement layout type of 'explained/separated' is needed to enhance satisfaction for non-reputable brands' advertisements. The consumers, act to induce cognitive effort, are restrained inference through the surplus resource then focus on the advertisement.

This study was configured to provide 'separated/explained' layout templates in the D/S content management system. Furthermore, it offered 'free-style' templates, which were freely designed advertisement templates.

3.5 Designing a Content Broadcasting System

From a broadcasting system, one may control the device commands, device operation, and traffic.

The higher the number of devices, the more traffic control functions of the server-side becomes an essential need. For large number of videos of the device is to go retrieve the content to access the NAS (Network-attached Storage), sometimes induce peak instantaneous traffic. In order to solve this problem, we developed a scheduler that can be managed by the distributed advertisement broadcasting traffic. Create a repository of Master / Reserve control command, the mechanism used to save a control command to the Reserve DB table when I went up to a maximum value of network traffic specified by the user, traffic is executed sequentially reserve store control command when got off certain level.

Table 4. List of Major Functions of the Broadcasting System

Category	Explanation
Advertisement Management	Advertisement Content and Advertisement Broadcasting Management
User Management	Admin control, privilege executions and management, etc.
Region/Device Control	Regional, District, Socket, and Device Management
Device/Transmission Control	Device control (rebooting, firmware update, volume, on/off settings, content broadcasting, server changes, connection time changes)

IV. Performance Test

4.1 Experiment Design

This paper attempts to test for whether the template for non-reputable advertisements is effective and verify the stable operation of the system and its usability.

4.2 Experiment 1 – H/W Stability Test

The proposed system is compatible with both the specified requirements, whether stably operated can, in order to assess whether the outstanding performance, 1) Hours, 2) the type of the Android PC, 3) the four elements of the capacity of the content type and 4) the content I was carried out performance tests of foundation.

Spec	Android Board	Android Stick
Product	Droid PC	MK908 Mini PC
CPU	Dual Core 1.2Ghz	Quad Core 1.8Ghz
GPU	MALI400MP GPU	MALI400 MP4
OS	Android 4.2 Jelly Bean	Android 4.1 Jelly Bean
Memory	1GB DDR3+4G Nand Flash	2GB DDR3+4G Nand Flash
WIFI/Ethernet	O	O
Output	VGA to FHD (1920*1200)	VGA to FHD (1920*1080)
Price	$49	$55
Picture		

Fig. 5. PCB and Stick-type Device Comparisons

Furthermore, we attempted to determine whether it could process stable control command in a moment of high traffic and issue a control command to collect statistics of the traffic that frequently occurred at a specific time. The statistical information from the device about a specified time on the server was designed to be published so that a plurality of devices which had been previously registered for the experiment would send information to the server at the same time we tried to induce traffic.

Condition list	condition
Operation period	**20 Days**
Operating HR (per day)	**15Hours (AM 8:00~PM 11:00)**
Contents type	JPEG image 8ea (800KB) - 1024*768 MP4 movie 1ea (22MB) - 1280*720
Sample reference	Windows7 provided default images
H/W Type	2 Types test (Board type, Stick type)

Fig. 6. Details of the Experiment Design

On all 20 days, from 8:00 to 23:00, for a device operation of 15 hours, the application delivery system was broadcast inside the SMIL Player device. The advertisement content was organized into eight images and one of the images on the schedule was shown at a given time on an infinite repeat. Schedule the no time was restarting control command once the device is predetermined time period to be changed to the Sleep mode.

4.3 Experiment 2 −Web−application Performance Test using HP Load Runner Tool

Using the Load Runner program developed by HP, a performance test program, the digital signage solution performance tests were carried out accordingly. The target performance was calculated on the basis of the target value after one year of the solution was implemented[17][18]. Separately, maximum performance and scenario performances were carried out according to the server specification. The scenarios are as follows.

To measure the yield performance, the number of devices after a year was set at 7,000EA (expected rate), and processing D/S status info in a three−minute unit, the TPS (Traffic Per Second) was calculated as 29.25 TPS. The results are as follows.

(39 units/sec) =Yield Performance (7000 operations after 1 yr.) at 3−min. (180 sec.) Controlled Access Units
Target Performance = Yield Performance *150% /2 (n of Servers)
29.25TPS = 39*1.5 / 2

To estimate the maximum performance TPS rate, we defined the major transaction type and connected to the number of virtual users, which gradually increased.

V. PERFORMANCE TEST RESULT

5.1 Experiment 1 – H/W Stability Test

The result of the H/W stability test was successful. Testing the SMIL Player with two types of Android PCs for a total of 300 hours resulted in normal operation. The broadcasts with the server were normal during the high traffic time periods.

5.2 Experiment 2 − Web application Performance Test using HP Load Runner Tool

The result of the web application performance test was successful. There were no errors in the operation of transactions per second during the scenario-based transaction test. The results of the maximum performance are as follows in [Fig. 7].
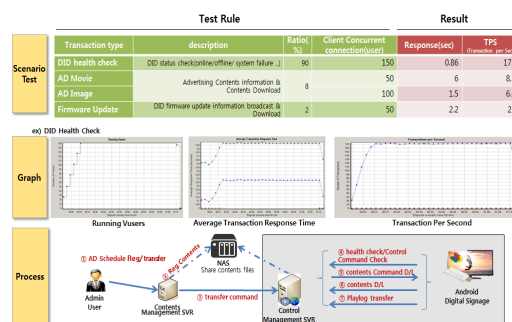
Fig. 7. Scenario and Result

VI. Usability Test Meterials And Methods

6.1 Participants

12 civilians (M = 28.72, SD = 1.56, male = 6, female = 6) participated in the digital signage usability test that was developed. Among them, six participants had experience with operating advertisement-related systems (expert users). The other six participants were non-experienced users (novice users).

6.2 Design

The pre-questionnaire was employed to assess participants' computer literacy, including skills such as uploading an image file and setting a schedule. Experiment participants used a web application and Google Chrome browser that had been installed on a normal PC in the laboratory. Behaviors of participants were recorded in order to measure the task execution time. Ease of learning was measured during the tasks. After the tasks, participants' satisfaction was surveyed.

6.3 Measurement

Ease of learning: The time (in seconds) it took to perform 4 tasks related to digital signage operating work for the first image was measured twice, at the first attempt and at the last. The second measurement time subtracted from the first measurement time was the learning rate. This represented participants' rate of learning how to operate the application.

Satisfaction: After the tasks, participants answered a questionnaire measuring their satisfaction with using the application[19].

6.4 Procedure

An experiment was carried out in order to confirm how easy it was to use the web application interface.

Before starting the experiment, an experimenter explained the purpose and procedure of the experiment to the participants. Then, a participant read aloud information about the application from the introduction page. Participants were given a notebook to access the web application. Participants agreed to record the behaviors[20]. Task 0 (sign-up and login) was completed before the experiment began.

Participants were asked to perform five other tasks according to instructions from an experimenter.
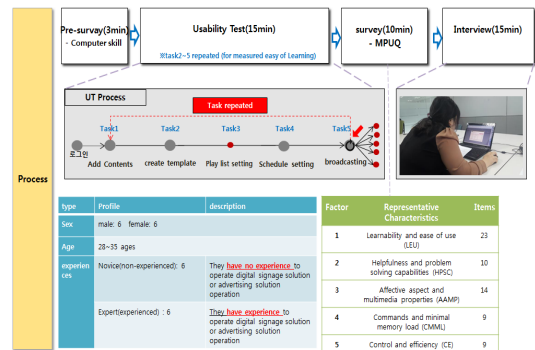

Fig. 8. Procedures of Experiment

VII. RESULTS

Application LEU was measured after measuring the total time of application usage, and the data was compared between users with similar system user experiences and users without such experience. After the experiment, a survey was carried out in order to measure application satisfaction. The results are as follows. The usability evaluation and satisfaction survey for the web application 'Digital Signage Solution' was analyzed.

7.1 Ease of learning

To investigate the ease of learning between the initial task and final task, the time (in seconds)

between the two tasks was compared. A paired-samples t-test was conducted. As a result, the initial task (M = 487.14, SD =165.75) and final task (M =239.57, SD = 56.78) were found to be significant (p = .01, n = 12).
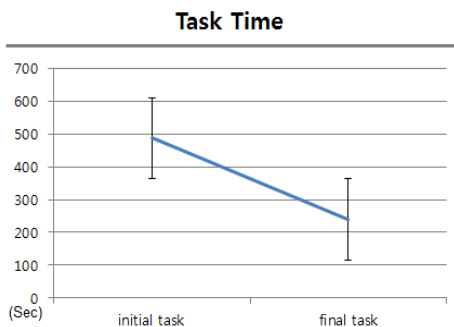

Fig. 9. The means of task time and error rate: All participants showed reduced task time and no difficulty in using the application.
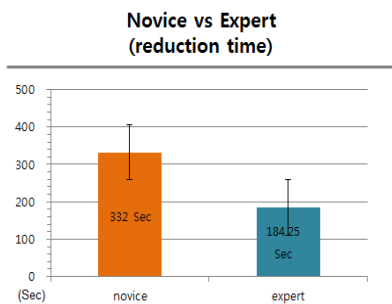

Fig. 10. The mean of reduction time comparing novice and expert users: Novice user participants felt no difficulty in using the application at the same level of the expert users in the final task, even though they had hardly used a digital signage solution before

All participants showed reduced task time and no difficulty in using the application. Novice user participants felt no difficulty in using the application at the same level of the expert users in the final task,

even though they had hardly used a digital signage solution before.

Table 5. The result of Ease of Learning from usability testing

	Initial task		Final task	
performing time (second)	M	SD	M	SD
	487.14	165.75	239.57	56.78

The effect of prior similar experience with digital signage solutions was analyzed. There were six users with no similar experience. The time reduction index was calculated by subtracting the final task time from the initial task time. An independent-samples t-test between the novice group as an independent variable and the reduction index as a dependent variable was conducted. The results showed that the difference between the two was not significant, t = 1.77, p = .12, meaning that the novice participants felt no difficulty in using the application at the same level of the expert users in the final task, even though they had hardly used a digital signage solution before.

Therefore, the application was significantly easy to learn regardless of whether people were experienced users or not.

Table 6. The ratio of decrement numbers for task time by expert / novice users

	Expert User			Novice user		
the Reduction index(sec) (Initial Task – Final Task)	N	M	SD	N	M	SD
	6	332	130.5	6	184.25	100.8

7.2 Satisfaction

For measuring the satisfaction level, MPUQ, a questionnaire developed by Ryu and Smith-Jackson (2006), was revised. It was composed for usability, so some items related to web applications only were excluded.

The revised satisfaction questionnaire included sub

categories: ease of learning and use (LEU), helpfulness and problem solving capabilities (HPSC), affective aspect and multimedia properties (AAMP), commands and minimal memory load (CMML), and control and efficiency (CE). There were 23, 6, 11, 2, and 7 items for each subcategory, and a 7-point scale was used. [Table 7] represents the results of this questionnaire.

Table 7. Result of MPUQ Questionnaire

Subcategory	Average	Standard deviation
LEU	5.7	1.1
HPSC	5.31	1.33
AAMP	5.08	1.37
CMML	5.36	0.93
CE	5.43	1.38
Total	5.38	1.27

The comparison of average and standard deviation results by satisfaction level

As a result, participants reported positive answers on average for all subcategories. Thus, they were generally satisfied with the application.

VIII. CONCLUSION

In this study, we have looked at the digital signage market trends and related technological trends. Based on related research, we developed a reasonably priced digital signage application for retail store owners. We confirmed the stability of advertisement broadcasting, H/W stability, and web application stability.

As a result of the study, we can say that 'Digital signage solution' is usable and stable for a web application, such as a D/S health check, content upload, advertising broadcasting and D/S remote management. The results of the experiment indicate that 'Digital Signage Solution' is easy to learn

whether one is an expert user or not and that participants were generally satisfied with the product. The new solution is moving in the following direction.

8.1 Easy to Use, Low-Cost Digital Signage Solution

In the case of small business owners, they do not have positive feelings about promoting their products in the form of digital content advertising. Because of high operating expenses, such as content production fees, server hosting fees and device purchases, they are not prepared to pay the high costs.

In contrast, big parent companies that directly manage retail shops, like convenience stores or franchise restaurants, strongly support the smaller businesses through digital content and promotion costs. They use the digital content to promote products and attract customers. With aims to improve this imbalance, a new solution that is reasonably priced and stably operational has been developed. Moreover, usability tests were carried out in order to determine the feasibility of the new system to unfamiliar owner-operators to easily create and edit content and broadcast advertisements. We are hopeful that it will benefit small business owner-operators, as this new way of product promotion will help them reach their customers effectively.

8.2 A Solution with High Expandability

SMIL standard format is a simple but powerful expanded markup language for specifying how and when advertisements play, and also supporting animation effects. By keeping with the 'SMIL' Digital Signage standards format, it can become a continuously expanded digital signage solution.

Also, the 'SMIL' standards format makes it easy to expand the interactive digital signage. For example,

advertisement content can be downloaded through the sensor activation, and the procedure is as follows: by linking the touch panel, motion sensor, and IR sensor on the SMIL player that plays the advertisement, as the viewer approaches the advertisement panel and clicks on a coupon, a video may be played.).

8.3 Limitation

Until now, we have discussed the development of a new, reasonably priced digital signage solution capable of delivering various types of information and interesting content, and its usability test results.

Based on these results, it is evident that more research is needed on ways to increase the effects of retail store-type digital signage advertisements, and that interactive retail store digital signage advertisement content should be created. Moreover, customized templates for non-reputable products of retail store owner-operators have been developed, and the satisfaction has been measured in reference to Kim's research[16]. She examines advertisement layout type for enhanced visitor advertisement satisfaction of non-reputable products. However, Kim has only proven effectiveness for image advertisements. Combination advertisements with both image and video have not been tested. For further research, we will experiment to find an effective combination of content layout for satisfaction of advertisements for non-reputable products.

It is our hope that the digital signage industry, the so-called fourth generation media industry, may expand further through a more popular preoperative solution than the one that we have proposed in this study.

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