

Thumbnail Selection : Delivering Digital Signage Contents to Mobile Phone

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Abstract—An access to digital signage displaying contents with a mobile phone has been in the limelight to improve advertising effects of the digital signage. There have been developed several methods to transfer digital signage contents to a mobile phone, but these methods are still lack of the cognitive convenience for users. In this paper, we design a novel method that enables users to easily access to digital signage contents with their mobile phone. In user's point of view, he just sees a content displayed in a digital signage, starts a mobile phone application, and selects a thumbnail from a list that is the same to what the signage displays. We developed a prototype to evaluate the proposed method. Conventional QR code recognition and photo recognition methods are compared to the proposed method and it is shown that the proposed method is superior to the conventional approaches in terms of time required to access to the detailed information and user preference.

Keywords— Digital Signage, Mobile Interaction, Linkage Method, RSSI, Thumbnail Selection

I. INTRODUCTION

Digital signage is a form of electronic display that displays advertisement and local information in public spaces. The digital signage industry is growing fast these days and the signage has become a common-place feature of public venues including restaurants, retail shops, and stations.

Electronic displays of digital signage provide new advantages compare to conventional static signage [1]. The digital signage presents dynamic multimedia digital contents, and changes the contents adaptively to the context such as time, location, and user interaction. It also provides flexibility and scalability to content providers and service providers, since it can be managed over networks.

As a digital signage become popular as an information display device, it is required for digital signages to interact with mobile phones. Since the digital signage usually presents high-level information to get people's attention, people need to interact with the signage, e.g, search in depth, to get more detailed information from the digital signage. However, there are many cases that they cannot access for the detailed information, because they might not want to spend their time in front of the signage or the digital signage can be located far away, not enough to interact with the signage using their body. In this regard, interaction between the signage and mobile phone which overcomes those limitations is preferred to access and store the detailed information.

Eric Schmidt, CEO of Google, said that mobile search activities for a product tend to spike during its commercials [2]. In the same context with which Schmidt said, digital signage can also cause people to do mobile search activities for what the signage is showing. It is obvious that advertising effects of the digital signage increase when people are allowed to access and store detailed information of the product displayed at the digital signage, through their mobile devices. The signage displaying can be used to refer to a web site for more detailed information and interactive opportunities [3].

In this paper, we propose a simple contents delivery method from a digital signage to a mobile phone. The proposed method uses wireless signals of digital signages to get information of nearby signages and allows users to access the detailed information played at target signage through their mobile phone. In this paper, as a wireless signal, we adopt a Wi-Fi technology since it is mounted on majority of mobile phones and communication range of Wi-Fi is enough to cover a distance between a user (mobile phone) and the digital signage.

Since we use wireless signals, our method does not require users to be very close to or to be line-of-sight position to the signage. Our major design principle is to minimize additional burdens caused by the content delivery process. Users are able to connect to signage displaying contents by just starting a mobile phone application and touching an item he/she wants to see.

The rest of this paper is organized as follows. We present some related works in Section II and our proposed method in Section III. Experiments to evaluate the proposed method are conducted with discussions in Section IV and we conclude the paper in Section V.

II. RELATED WORKS

In this paper, we present a method to deliver digital signage contents to mobile phone. To our best knowledge, interacting between digital signage and mobile phone or accessing signage contents with mobile phone haven't been studied a lot, while they have been in the limelight from stakeholders of the digital signage.

'DigitalSignageToday.Com' introduced several interaction technologies between digital signages and mobile phones including DTMF(Dual Tone Multi-Frequency), SMS(Short Message Service), 2-D bar codes, Photo recognition, and AR(Augmented Reality) [4]. Some of them such as DTMF

and SMS are already well established in the market place while others are still on the research. Sato et al [5], proposed a linking method between digital signages and mobile phones that uses a contactless smart card or phone call to connect those two different devices and communicates through voice recognition or DTMF(Dual Tone Multi-Frequency).

While there are not many works for interaction between digital signages and mobile phones, many solutions for mobile to mobile device pairing have appeared in literatures. Rekimoto et al [6], showed an interaction technique 'SyncTap' to make a network pairing between digital devices. SyncTap just requires users to synchronously press and release buttons on both of the devices and compare the time difference to identify each other. Similar to SyncTap, Mayrhofer et al [7], suggested to shake two devices together and to use movement patterns to pair the devices securely. Varshavsky et al, used common radio profiles between devices close to each other, to differentiate the pair of devices [8]. Peng et al, suggested to recognize user gestures to pair mobile devices [9]. Measuring the distance reduction between two devices during user's pointing out gesture is applied to main feature for the recognition.

Solution approaches for general mobile pairing can be also used to link mobile phone with signage contents, but specific constraints for interacting with the signage, e.g., distances between signage and mobile, user mobility, no guarantee for line of sight etc., should be considered. In this paper, we try to consider those constraints so that allow users to comfortably access to the signage displaying contents with their mobile phone.

III. PROPOSED METHOD

Digital signage is located in public and mainly used to advertise target products to audiences. Signages in position of transit might not be able to make people stay and concentrate on their displaying contents. People just pass by the signages and glance at the contents they displays. They might be affected by the signage contents indirectly, but they might forget what they see in a short time after they leave the signage. They may not write a memo or search web to find detailed information of the advertising contents. It is because memo or web search are cumbersome for them, even though they are interest to the contents at the moment.

By providing an easy method for users to access signage contents for further information, advertising effects of signage will increase. In our proposed method, people just see a signage content, start signage application on their mobile phone, and select a thumbnail of the displayed content at target signage from a list, to access to the detailed information. Our design principles of this method are discussed in subsection A and details of the method are presented in subsection B.

A. Design principles

We started the design process with following design principles.

- **Quick:** The design should be transient and accessible in short time, when needed.
- **Scalable:** The design should be scalable to the number of signage near the user.
- **Versatile:** The design should be used in various environments – close/remote signage, the number of signage around the user, static/dynamic user-mobility etc.
- **Minimal distraction:** The design should minimize bothering or distracting user's precedent behavior.
- **Familiar:** The design should be familiar to users so that they know how to use it intuitively.

B. Delivering signage contents information to mobile phone

To satisfying design requirements above, we make the proposed content delivery method as simple as possible in the user's perspective. It just requires the user to select one thumbnail from a list on the mobile phone and access to a web site having details.

The basic assumption of the proposed method is that a kind of wireless communication device is equipped on a digital. In this research, we attached WAP(wireless access point) to the signage. We use wireless signals to measure the distance from the signage and apply a property of that signal strength decreases proportional to the square of the distance. The assumption will be very practical in very near future, since digital signage are already connected to wired network and it is highly probable for signage service provider to provide the WAP to serve their customer free internet. Recent improvements of device-to-device communication technologies also support the practicality of our assumption.

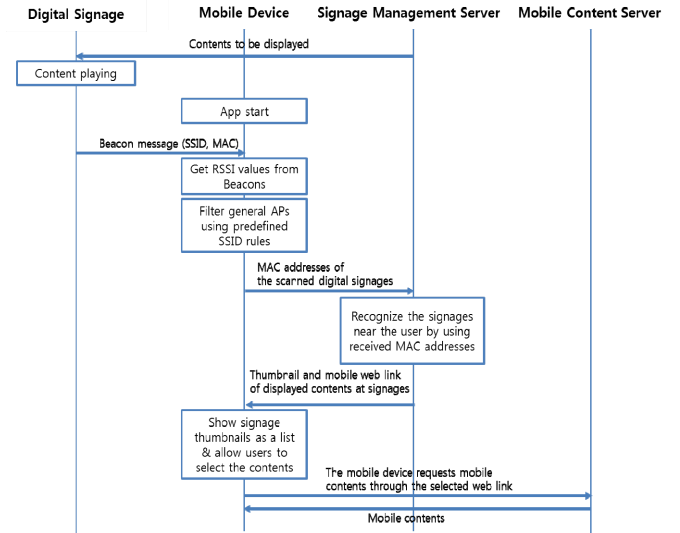


FIGURE 1. PROCESS DIAGRAM FOR THE PROPOSED CONTENT LINKING METHOD

Figure 1 presents a process of our method to get detailed content information from digital signage. There are three components: content server, mobile device, and digital signage. Content server stores the contents and schedules what, when, and where the scheduled content is going to be

displayed. The mobile device is a general smart device that has a function of wireless communication and a 'signage application' to communicate with both the digital signages and the content server. A digital signage connects to content server to download displaying contents and displays those contents on the scheduled time. As we assumed, a WAP is attached to each digital signage and it periodically sends Wi-Fi beacon messages.

We supposed that the content server also stores < a mobile content, a link address, a thumbnail image > for each signage content, for ease of interacting with mobile application. The mobile content is a type of content that is optimized to be viewed at the mobile device. It can contain detailed information. In this research, we use a mobile web page as a form of the mobile content. The link address is an address used for mobile device to access to its corresponding mobile content. The thumbnail image is a reduced-size version of the digital signage content.

The process starts when a user sees and gets an interest for content e.g., advertisement for shoes, displaying at a signage. He starts the signage application on his mobile phone and the application scans Wi-Fi beacon signals. From scanning process, the application can get information of nearby WAPs such as, SSID, BSSID, MAC address etc. from beacon frames, and calculate a RSSI(received signal strength indication) value for each WAP. We use 3-tuple (SSID, MAC address, RSSI) for the user in process of identifying the target signage. Since recognized WAP set includes non-signage WAPs, it is necessary to filter them. We solved this problem by assigning a same prefix for SSID of signage WAPs. The SSID identifies a service set of WAPs that differentiates the service set from others. After filter the non-signage WAPs, the mobile application uploads MAC addresses of signage WAPs to the content server. MAC address of a WLAN card is unique and differentiates itself from the others. Hence, by matching the MAC address, the content server now can recognize which signages are near the user.

Since the content server also has a playing schedule for each signage, it knows what contents are being displayed near the user. In our proposed method, then the content server sends thumbnails and link addresses of signages to user's mobile application. When the mobile application receives the thumbnails and link addresses of signage contents, it makes a list composing of the received thumbnails and allows users to select a thumbnail that he is interest in, to access to the related mobile content, e.g., web site for further information.

We select Wi-Fi transmission technology because the transmission range of Wi-Fi is longer than Bluetooth or Zigbee. In case of 802.11n, approximate transmission range is from 70m(indoor) and 250m(outdoor). When considering the vision of human, the transmission ranges are enough to cover the human ability to distinguish the digital signage.

It is also possible that more than 10 digital signages can be scanned at downtown in near future. To minimize user's burdens to find the thumbnail he wants, we arrange the thumbnails of the list in descending order of their corresponding RSSI values. The signage closer to a user is

more likely to be interested by the user. The user can estimate the distance and it would be better to find a thumbnail with an estimation.

IV. EXPERIMENTS

A. Goals

The experiment compares the performance of the proposed method to conventional methods based on QR code recognition and photo recognition in terms of time to taken for a single success of content access on mobile phone. We also investigate effects of the distance between a user and a target signage.

B. Apparatus

We implemented a prototype to evaluate the proposed method. Twelve digital signage WAPs were in a building and we performed experiments in a room where four of the signages were installed in. The signages in the room were displaying different contents. They can be equally divided to two signage groups. Members of each group are close to each other and distance between groups is about 5 meters as shown in Figure 2.



FIGURE 2. EXPERIMENTAL ENVIRONMENT
(4 DIGITAL SIGNAGE DISPLAYS IN A ROOM)

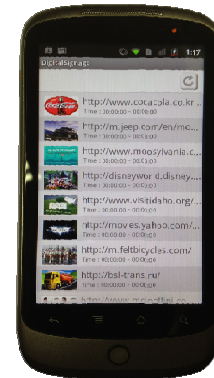


FIGURE 3. MOBILE APPLICATION DEVELOPED ON ANDROID PLATFORM,
DISPLAYING THE THUMBNAILS OF NEARBY DIGITAL SIGNAGE DISPLAYS

They receive contents from the content server and play the contents according to a playing schedule. We developed an android mobile application which performs functions of a mobile phone as we design. We used 'Scan Search', the most

popular and powerful application for QR code and Photo recognition in Korea [10], as comparisons. Our signage display is 42" TV and The QR code image beside an original content image were rendered as a 220mm square box.

C. Participants

Three female and eight male volunteers participated in the experiment. All participants had experience using QR code and photo recognition application, but four participants were new for one of the applications. They were trained about how to work with the mobile applications before the experiments.

D. Task

The task for this experiment was a success in accessing to the contents being displayed on the target signage. In first experiment, a participant stood in front of a digital signage, about 1.5 meters far from the signage. He was asked to access to the signage contents in three ways (QR code recognition, Photo recognition, and the proposed method). We measured the time taken from starting each application mode to accessing to the related site. This experiment represents a situation where a user is already using the signage.

The second experiment is the same to the first one, but the participant was requested to access the content displayed on the signage that is 5 meters far from him, i.e., he starts his job at the same place but the signage is 5 meters far from him. This experiment is for a general situation where a user is not close to the signage, looks at the signage and just has an interest on the content. We also measured the time for each method.

E. Results and Discussions

We analyzed the results for each experiment. Table 1 shows the time taken to access the related information. It is noticeable that the proposed method is the best among three methods for both of average and standard deviation. It takes only 3.38 seconds on average and has little variances between participants. QR code recognition is better than photo recognition on average, but it varies a lot depending on participants.

TABLE 1. TIME TO TAKEN TO ACCESS THE RELATED INFORMATION (1.5 M FAR FROM THE SIGNAGE)

Measure	Type		
	QR code Recognition	Photo Recognition	The proposed method
Average (s)	8.60	10.36	3.38
Std. (s)	3.61	2.28	0.55

The results for the second experiment have a similar trend to those of the first experiment. Table 2 shows the results and the proposed method is superior to the others. It takes 1.3 seconds more on average. This may be because of the additional process for participants to find the thumbnail. We designed the thumbnail list in descending order of their corresponding RSSI values so that in the first case, participants tried to find the target thumbnail from the top of

the list and found it in a short time. In the second case, they could not use the advantage since the received signal strength in a middle range varies more than that in a short range. Compared to the first experiment results, average time of the proposed method in the second experiment increases a little, while standardization is 4 times greater. It is because selecting thumbnails in the second experiment is more likely to depend on searching abilities of participants.

It is also noticeable that standard deviations of QR code and Photo recognition in the second experiment are very similar to those of the first experiment. The average time difference between the experiments for QR code recognition is somewhat similar to that of photo recognition. For those methods, it is required to walk to the signage for the recognition and it seems that time to walk to the signage is stable among the participants and it takes about two seconds.

TABLE 2. TIME TO TAKEN TO ACCESS THE RELATED INFORMATION (5 M FAR FROM THE SIGNAGE)

Measure	Type		
	QR code Recognition	Photo Recognition	The proposed method
Average (s)	10.33	12.69	4.67
Std. (s)	3.78	2.31	2.20

We asked to our participants pros and cons of our prototype compared to the other methods. They felt more comfortable with the prototype than the others. It takes shorter times and has lower error rates. It does not require users to get closer to the signage and to hold on their arms for some seconds, which causes additional burdens. Areas of improvement for the prototype are designs of thumbnail list and wireless signal usages. In current prototype, the image size seems to be a little small, not enough to select it naturally. It needs to be larger or changed to more intuitive way. It should be also considered that how we interact with the list in case that there are a lot of signages near a user, e.g. 100 signages in a room.

V. CONCLUSION

Digital signage is coming into wide use these days as a public display infrastructure. The main role is to deliver information such as product or service advertisement, public information, to public users. To increase the information delivery effects, linking signage contents to users' mobile phone is getting important. In this paper, we propose an intuitive and simple method that allows user to access the detailed information of contents displayed at the nearby signage through his mobile device. We measured the time taken for a user to access to the information and compared the proposed method to conventional QR code recognition and photo recognition applications. The experiment results show that the proposed method is superior to the conventional methods in terms of average and variance of demanding time. The future work for this research will investigate to apply more elaborate distance measuring method and to design the thumbnail list more intuitive.

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