

Using SmartPhone Multi-Function Human-Computer Interface in Multi-User Scenarios - Example by Media facades

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Abstract: Nowadays smartphone is playing an important role in our daily life, people have become accustomed to exchange information with each other by using the smartphone. In the future smartphone will not only provide a way let people interact with each other, but also can interact with the environment. This paper explores to use the sensor inside smartphone as multi-function human-computer interface interact with environment and application in multi-user scenario, we design two prototyping system called “Nature between us” and “City under the starry sky”. Both prototyping system were extending the concept of single display groupware, the different is one using original concept to present visual feedback, the other one enhances this concept by using the multi-screen system, and people can interact with interesting way by those multi-function human-computer interface. We will implement and compare both systems, summarize the result in further research and application to other multi-user scenario in the future.

Key words: *Smartphone, Human-Computer Interface, Single Display Groupware, Media Facades*

1. Introduction

1.1 Background

In recent years, due to the growing popularity of smartphones, the mobile wireless Internet and variety of APP facilitates our daily life, people are more and more frequent use of the smartphone, let smartphone to play a very important role in people's life now, because of this, Smartphone is an ideal human-computer interface for interaction between people and the environment. Today, smartphones are packed with many powerful sensors, let it have capability to produce more applications and services[1]. Therefore, this study will design those sensors corresponding interaction modes for multi-user interaction scenarios, visual feedback will be presented through the smartphone's screen and media facades, combining these two into a multi-screen interactive system, and will be able to create a richer interactive experience.

we choose the media facades as the mainly visual feedback screen, for the reason is because media facades are usually installed at a popular place, and it conform to this study main goal "multi-user interactive environments", Sebastian (2011) also believe that media facades has great potential to be applied to the multi-user interactive scenarios, it should design a new type of interaction modes, let people can interact with the media facades[2].

1.2 Research Purpose

The purpose of this study is to design the corresponding interaction mode for the sensors installed on the smartphone, let it be human-computer interface for interaction between people and the environment, Explore the interaction mode of application multi-screen system in multi-user interactive scenarios. Design two prototyping systems, finally propose our conclusion. The main purpose of this study are as follows :

- (1) Using the smartphone as multi-function human-computer interface in Multi-user scenarios.
- (2) Explore the interaction mode of application multi-screen system in multi-user interactive scenarios.
- (3) Design prototyping of new interaction modes for smartphone in media facades application.

2. Related Works

2.1 Smart Phone Multi-Function Interface

Akira harada (1991) once said the word "interface" not only in the description of the nature of the interface, but more focus on who use the interface to interact with each other[3]. Therefore, the human-computer interface is the representative of interactive relationship between human and computer. Yu-Min Fang (2003) divided the human-computer interface into three different types (1)Traditional interface : Mechanical buttons like button 、 switch 、 knobs (2)Graphic user interface : graphically visual presented on the screen, enable people to interact with these graphics (3)Direct interaction interface : new interactive technologies like touch screen[4] °

Because of the current smartphone hardware both have those three interfaces. Therefore, this study define "multi-function" human-computer interface as user just need one device, and he can have diversity of interaction modes to interact with installation or environment through those three type interface and sensors.

2.2 Media facades

In recent years, high lumen large projector and LED lights cost decreased, media facades presents a growing trend in the metropolis. ag4 (2006) and Haeusler (2009) define the media facades is an installations which usually using the surface of the building to present the large visual feedback to the people[5,6]. These installations are usually constructed by a large projection or LED wall and placed in the location that many people will go through. media facades often attract people to stop, watch it present multimedia digital content and produce the possibility of community interaction, very suitable for design into group interact.

Because of media facades increased, so it created many different application. Fritsch & Dalgaard (2007) divided media facades into seven major categories based on functional (1)Architecture : Through the use of new materials and mechanical architecture, making media facades change status depending on the environment (2)Art : artists use media facades as a medium to Elaboration and presenting his own concept (3)Games : The game is usually accompanied by community media, and interact with the user (4)Social Media : provide social media messages on the Internet (5)News : providing real-time news message (6)Public service : public service information of the people in the city, such as buses moment and air condition information (7)Advertising : Most a common media facades applications, such as LED wall in Times Square, in order to attract the attention of passers-by to help sell the products[7] °

Compared to other interactive installations, media facades which is still in development, therefore do not have a fixed interface or interaction model, Peter & Kim (2010) put forward eight development challenge of current

media facades (1)Media facades must provide new interactive interface to let people generated interest (2)Integration into physical structures and surroundings (3)Increased demands for robustness and stability (4)Developing content to suit the medium (5)Aligning stakeholders and balancing interests (6) Diversity of situations (7)Transforming social relations (8)Emerging and unforeseen use of places and systems [8] °

Hinrichs (2011) think development of media facades have three main directions in the future (1) Interaction Paradigms : Design of past multimedia interaction mode of the media facades is always the direction toward the design is interesting, in addition to have fun, now must have design guide the user to receive the message and content of media facades presented (2)Content Design : media facades have the large size of the screen, there is a big difference with the traditional PC and print media, resolution, size, and brightness are important factors that affect the design, visual aesthetics and art will be able to arouse people's curiosity (3) Supporting Individual & Social Experiences : Related studies have shown most cases people are a group go through media facades, how to design a method, let many user can interact at the same time, will be the main design consideration [9].

According to the above literature can know the current state of development of the media facades. This study application the smartphone as multi-function interface between people and media facades, solve the new interface problem of media facades proposed by Peter & Kim[8]. The new interaction mode with the develop direction of Hinrichs proposed is coincide[9]. The results of this study will be able to as the future media facades design reference, and make rich interaction way between the media facades and the people.

2.3 Single Display Groupware

Single Display Groupware first proposed by Stewart (1997) [10], the main ideal of this concept is not to overthrow the traditional one-on-one human-computer interaction mode, but hope to make improvements in the existing hardware architecture for multiplayer interactive scenarios, So that in the future can be applied to a variety of interactive fields. The difference between single Display Groupware and traditional interaction mode is (1)The system can handle multiple users input signal at the same time (2)each user can see the system returned information (3)User operation can affect another user, make the interaction relationship between each other. The advantage of this interaction mode that enables people to interact and cooperation between in the same space, like school group lessons, play games with friends, and therefore very suitable for applications in which many different multi-user scenarios. This study new interaction mode is extends the Single Display Groupware concept and combine with multi-function interface into application to media facades.

3. Method

3.1 Interaction modes of media facades

Currently media facades cases usually let people use only one way to interact with media facades, it provide visual feedback with the large screen, but this study use smartphone as multi-function interface let people can interact with media facades many ways, and provide visual content both on large screen and phone screen. According the difference visual presentation, we can divide the new interaction mode into two categories (1)single screen : only use media facades to presentation visual content (2)multi-screen : use media facades and phone screen to presentation at same time, provide different but related visual content (table. 1) . This study will design two artwork based on the two categories.

Table. 1 categories of media facades presentation

type	description
Single screen	Main visual content present on media facades, the phone screen can only present secondary visual content like operating instructions or graphic user interface.
Multi-screen	Visual content will show on the large screen and phone screen in the same time, so the phone screen can extend the content of the large screen.

The following describes the two types of presentation in multi-user scenarios :

1. Single screen interaction mode

People use smartphone as multi-function human-computer interface interact with media facades (Figure. 1) . Each person's smartphone connect to the four animals in the picture, represent the people can use there smartphone to interact with the content on the large screen, because this is single screen interactive mode, so the phone screen is white in the picture, it means the phone screen can only provide the operating instructions or graphic user interface.

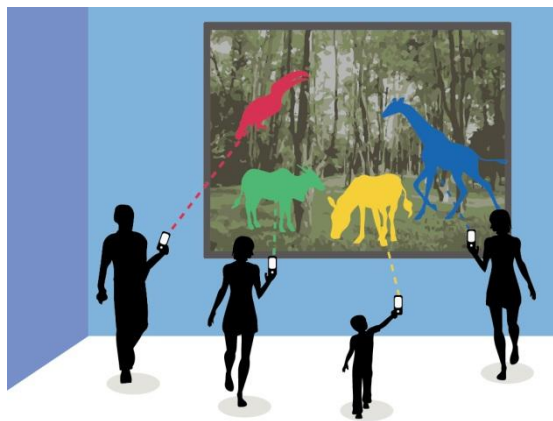


Figure.1 Single screen interaction mode

2. Multi-screen interaction mode

People use smartphone as multi-function human-computer interface interact with media facades (Figure. 2) . Each person's smartphone connect to the four animals in the picture, represent the people can use there smartphone to interact with the content on the large screen, the difference with single screen interaction mode is that visual content will show on the large screen and phone screen, so the phone screen can extending the content of the large screen, it represent media content on the big screen, may next second will go to the screen of your phone, this way can create rich interactive experience of the people.



Figure.2 Multi-screen interaction mode

This study will apply this two interaction mode, combined with the large-scale outdoor screen as presented screen, presented through a large outdoor screen is because smartphone can only use outdoors GPS positioning, but the position information is one of the important interaction, our prototyping will using the position information to know the user position, so when user change his position the system will create another media content according the position information. In this study, through the design of the works of these two modes, and implement two artwork in the further research, we can compare the differences between single screen and multi-screen and combine multi-function interface for design rich interaction module, and applied to many multi-user scenarios. We believe using the multi-function interface can breakthrough interaction mode of current smartphone, allow people interact with the environment around them, rather than confined interaction between human and smartphones.

3.2 Application of multi-function interface

This study selected six smart phone multi-man-machine interfaces, to devise five main interactive methods, use these interactive methods and two screen interaction mode combined into a complete interactive modules, in the further research implement the two artwork and analyze the use of these multi-function interface and two screen interaction mode. The following describes five main interactive methods of the artwork :

1. GPS (Global Positioning System)

The artworks will positioning people by using the GPS, according to the position information of the people, produce corresponding interactive content on the media facades. For example, control virtual characters in the media facades or interact with specific position media content. As long as it is the location-related content, are able to be interact via GPS

2. Camera

Camera representative saw the vision of the current user, through to capture images of the camera, we can know the user pay attention to which content. By using markerless augmented reality technology, we can present a rich digital content according to the users sees. We can also use touch screen let people interact with the things he saw on the screen.

3. Touch screen

As smartphones basic interactive interface, touch can be said is essential interaction of the smartphone. Touch will be the artwork basic interactive way to select the graphical user interface and the main menu, Also can

combine with the gestures to operate the markerless augmented reality application.

4. Accelerometer and Gyros

Accelerometers and gyroscopes will be the motion sensing interface in the artwork, detect the action like rocking, rotating etc. let user can use those action interact to media facades.

5. Microphone

the artwork will through the microphone to read the volume size, combined with GPS positioning information, user can make some noise in different locations, it will create different feedback.

4. Applications

4.1. 「Nature between us」 design concept

Because the busy modern city life, people only have the holiday time be able to hikers and contact with nature. Design concept of the work is the idea from the relationship between people and nature, by projection the virtual nature to a surface of building, for busy office workers or do not have time to be able to field outing people, into the nature scenario will be able to integrate into this relaxed atmosphere. This artwork is also to let people through the smart phone to interact with a variety of animals and plants, access to lot of fun and positive feelings in the interactive process (Figure. 3) .



Figure. 3 single-screen artwork 「Nature between us」

4.2. 「City under the starry sky」 design concept

Light pollution is a noun description a city building excessive lighting, Too much light pollution so that people in the city is difficult to see clean sky, there is no way in the night to see these beautiful stars, This artwork will present the night of the nature, projection on the surface of building through large-scale projection device, let people even in the bright city will be able to experience the fun of watching starry sky. This artworks will be coupled with virtual nocturnal animals and plants in the multiplayer interaction scenario, represent by the multi-screen system and multi-function interface, allow people to interact with the scenario, to be able to relax during the day (Figure. 4) .

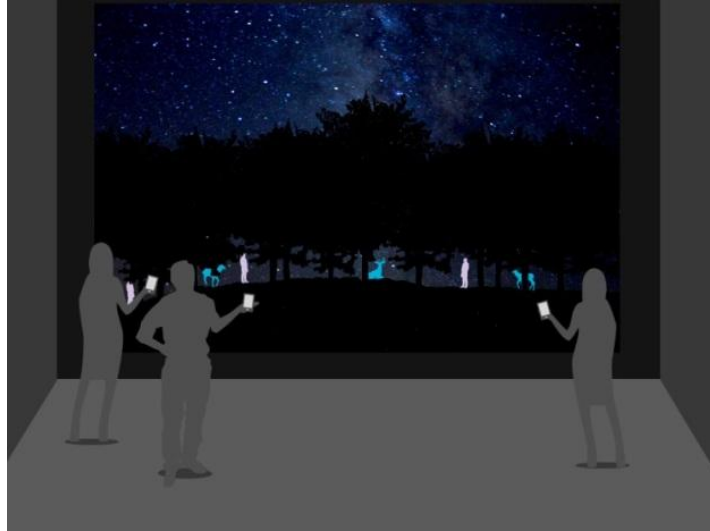


Figure. 4 multi-screen artwork 「 City under the starry sky 」

5. Discussion

Smartphone can be a great multi-function interface combine with many application, current smartphone interaction were limited between people and the smartphone, the interaction between man and the environment there is broader interactive possibilities, waiting for the designer to discover and explore. Therefore, this study focuses on exploring this section, using smartphone as multi-function human-computer interface to interact with media facades, application in multi-user scenarios. The study also found that the media facades interaction is still changing, because most designer will design different way to interact according to the work purpose, but the ultimate goal always hope to be able to attract people's attention, most of the work with the case is usually only one interactive way, and presented through media facades.

Now almost everybody has a smartphone, why not take advantage of off-the-shelf device to allow people with interactive with media facades ? The smartphone also has a screen and a variety of sensors, it will make the interaction between each other can produce more changes, and can depending on the situation, to be applied to any multiplayer scenarios. So the study combine smartphone and proposed single screen and multi-screen interaction mode, hope to bring people to use rich and interactive way to interact with media facades.

6. Conclusion

This study investigates a variety of sensors in smartphones and media facades, extending the single display groupware concept to propose single screen and multi-screen interaction mode. The advantage of single-screen interaction mode is that people can quickly learn how to interact, so it's will be helpful to those people who have not much time to stay and interact with media facades, this mode is more likely set up to the location which have large high flow rate crowds. Because of the characteristics of user can quick interact to media facades, the kind of interaction mode will be used in advertising, news, public service purposes, to strengthen its value.

For multi-screen interaction mode, it's will be more complicated to learn how use the multi-screen system, the user must clear its interactive process, therefore spend some time learning how to operate above. The kind of mode is suitable set up the location which people generally to rest, like coffee shop 、place of leisure parks, squares, etc. Because to the multi-screen interaction mode, the interaction can divided into public interaction on the big screen, as well as private interaction on the phone screen, it will be able to design a more in-depth,

interactive content, these features make the multi-screen interaction mode is more suited to the presentation used in the relevant art, or community.

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