

BAUHAUS UNIVERSITY WEIMAR

MASTER THESIS

Comparison of Interactive and Non-Interactive advertisement in public display

Author:

Hasibullah SAHIBZADA

Supervisor:

Prof. Dr. Eva HORNECKER

*A thesis submitted in fulfillment of the requirements
for the degree of M.Sc*

in the

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Human Computer Interaction, M.Sc

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Declaration of Authorship

I, Hasibullah SAHIBZADA, declare that this thesis titled, "Comparison of Interactive and Non-Interactive advertisement in public display" and the work presented in it are my own. I confirm that:

- This work was done wholly or mainly while in candidature for a research degree at this University.
- Where any part of this thesis has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated.
- Where I have consulted the published work of others, this is always clearly attributed.
- Where I have quoted from the work of others, the source is always given. With the exception of such quotations, this thesis is entirely my own work.
- I have acknowledged all main sources of help.
- Where the thesis is based on work done by myself jointly with others, I have made clear exactly what was done by others and what I have contributed myself.

Signed:

Date:

“Thanks to my solid academic training, today I can write hundreds of words on virtually any topic without possessing a shred of information, which is how I got a good job in journalism.”

Hasibullah Sahibzada

BAUHAUS UNIVERSITY WEIMAR

Abstract

Faculty of HCI
Human Computer Interaction, M.Sc

M.Sc

Comparison of Interactive and Non-Interactive advertisement in public display

by Hasibullah SAHIBZADA

The Thesis Abstract is written here (and usually kept to just this page). The page is kept centered vertically so can expand into the blank space above the title too...

Acknowledgements

The acknowledgments and the people to thank go here, don't forget to include your project advisor...

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List of Abbreviations

LAH List Abbreviations Here

WSF What (it) Stands For

Physical Constants

Speed of Light $c_0 = 2.997\,924\,58 \times 10^8 \text{ m s}^{-1}$ (exact)

List of Symbols

a	distance	m
P	power	$\text{W} (\text{J s}^{-1})$
ω	angular frequency	rad

For/Dedicated to/To my...

1

Introduction

1.1 Introduction

Advertisement is the mean of conveying message(s) to people about something from which both producers and consumers get benefit, as P. Kotler [77] defines advertisement as “*any paid form of non-personal presentation and promotion of ideas, goods, or services by an identified sponsor. Advertisers include not only business firms but also charitable, nonprofit, and government agencies*”. Technology is dramatically changing our lives and it is integrating in our environment and obviously it is affecting the advertisement too, with the use of media advertisements are published in TV, newspapers, radio, magazines, banners, mobile phones, public displays and more and currently advertisements are found in the form of, (1) Non-Interactive advertisement and (2) Interactive Advertisement.

Non-interactive advertisement is the traditional advertisement that “the presentation of content is linear and the consumer is passively exposed to product information” [34], user has no control over the flow of the advertisement. It is delivered using media like TV, radio, public displays, banners and many other various mediums. Above all, still most of these advertisements are boring, not clear for a lot of viewers, people tend to ignore advertisements [41, 32]

Where on the other hand, the use of innovative technologies, advertisers can make interactive advertisement, which can be more attractive and interesting and open new ways and techniques to boost advertisement effectiveness [89], Interactive advertisement is a type of advertisement that is done by using various interactive media like Internet, mobile phones and public displays, and it allows users to actively traverse the advertisement content and depends on where the user want to go from one step to another [34]. Advertisers reserve famous websites section for their interactive advertisements or the use of interactive public displays are increasing to provide passers-by opportunity to interact with advertisement contents, for example using smartphone to control interactive elements or by using body-sensing technologies, like Kinect¹ cameras, which could be used to allow passers-by to be engaged without the use of any other device, these technologies with which it would be easy for us to explore more possibilities of attraction methods, novel interactions and engagement techniques and provide the users with better experience and increase their interest.

There is a need to investigate that how much interactive advertisement in public displays are attractive, engaging and can change user behaviors compared to non-interactive advertisement, if they are significantly different, what kind of models and interactive design space would be suitable for future interactive advertisings to improve audience attention level and engagement experience. Furthermore, this thesis explores and investigates public display advertisements in general, what makes a suitable advertisement for audience, what are the common attraction attention methods, is there a difference in body interactive advertisement and mobile interactive advertisement and what kind of environmental setup is required.

In order to be able to conduct the advertisement research, there was a need to create realistic advertisement and realistic target groups and environment, therefor at the beginning for attracting attention application’s evaluation University Mensa² was chosen and for the advertisement’s content *Bauhaus-Walk*³ was chosen to make advertisement for and through Bauhaus-Walk members *Weimar Tourist Information Center*⁴ was contacted to install the

¹Microsoft Kinect: <https://developer.microsoft.com/de-de/windows/kinect>, Last accessed: 1/05/2016 at 13:21:00

²Bauhaus University Mensa: <http://www.stw-thueringen.de/english/dining-halls/facilities/weimar/mensa-am-park.html>, last accessed 25 may 2016

³Bauhaus Walk: <https://www.uni-weimar.de/en/university/profile/bauhausatelier/bauhaus-walk/>, last accessed 25th May 2016

⁴Weimar Tourist Information Center: <http://www.weimar.de/homepage/>, last accessed 10 April 2016

advertisement display and evaluate our applications in wild.

1.2 Advertisement performance

When a company develops an advertisement and campaigns it for long time in different locations, mainly expects to have a higher *conversion rate*, Conversion rate is “*The percentage of visitors who take a desired action.*”[50] there are different forms of action goals, like it could be buying the product, joining an event, registering for a website, paying a charity or even could be participation in a rally or protest, so it really depends on what is the main goal behind a particular advertisement, and the conversion rate is measured by the number of people who performed the action divided by total number of visitors. Occasionally conversion rate is measured in Internet advertising with various metrics like, CPM, CPT, CPC, CPA and more, which are discussed in detail in background chapter, and to understand the motive behind the conversion like what made them converted is an important question to ask, if we tackle those questions then we can create effective and efficient advertisements, those main reasons are the level of attention, motivations, involvement and emotions of people with the advertising product [76].

Attention: , “*Attention is the process that, at a given moment, enhances some information and inhibits other information. The enhancement enables us to select some information for further processing, and the inhibition enables us to set some information aside.*”[8], Higher attention would increase the high recall of advertisement too [89], attention is the first phase that can take user to be involved.

Motivation: To be motivated means *to be moved to do something*[47].The motivation is an important thing after a person has been attracted toward display; the motivation can be achieved by making passers-by curious about the screen, challenging them by a game or bring some sort of fantasy in application. In the design of body and mobile interaction models, the above factors were taken in mind for motivation and two features were implemented as described bellow.[43].

Involvement: Involvement describes the relationship of audience to a product and the strength can define effectiveness of the advertisement and engagement is a form of involvement with the product. Technologies are there that can measure involvement like the attention level or duration of interaction with a product.

Emotion , “*Emotions is an affective state of consciousness in which joy, sorrow, fear, hate, or the like, is experienced, as distinguished from cognitive and volitional states of consciousness.*”[27], these emotions always can influence users to change their attitude and how they think about a product or service and by tracking user emotions advertisement could be adjusted in real time.

1.3 Research Questions

The *Conversion rate* for Bauhaus-walk advertisement would be that, how many people participated in the walk after the advertisement campaign, but in this thesis, I do not measure the conversion rate, because it is possible that people maybe converted from other unknown reasons like a friend might tell or existing advertising campaign. To measure conversion-rate the only solution is to take small interviews of each individual, who joint the walk and question the reason of joining, which is time consuming process and should be continued for long time to track all the person, who were exactly affected by one of advertisement campaign.

Because of the reasons mentioned in advertisement performance section like, attention, motivation, engagement, and emotions, that influence the *conversion-rate* of an advertisement, therefor it would be more appropriate to compares these important aspects between interactive and non-interactive advertisement, rather than comparing the *conversion-rate* itself. The bellow lists the main research questions that need to be find out for interactive and non-interactive advertisement.

- Which method is better to attract passers-by's attention?
- How is the attention level in interactive (body and mobile) and non-interactive advertisement?
- How many passers-by are engaged in interactive (body and mobile) and non-interactive advertisement?
- What are passers-by behavior toward interactive (body and mobile) and non-interactive advertisement?

1.4 Procedures

The main purpose of the thesis is the comparison of Non-interactive and Interactive advertisement in the domain of attracting attention, engagement and passers-by behaviors, but it would have not been compared unless the well functional and meaningful advertisement applications were not developed and evaluated.

Therefore, first, this thesis researches on advertisement in general to find out what are the people interests and expectations from public display and how could the existing advertisement be changed in a way that people would like it and pay attention.

Second, it investigates on attraction attention phase for public display advertisement to find out which of suitable methods attract passers-by attention toward the screen.

Third, it conducts user studies and focus groups to find out what make suitable advertisements that fits *Bauhaus-Walk* theme, in which two are interactive and one is non-active advertisement. Two of interactive advertisements consist of body interaction and mobile interaction.

Fourth, it evaluates the low-fidelity and high fidelity of the interactive advertisement applications (mobile and body) and explores that which of these interactive modalities perform better and how the participants give feedback about their usage in public space.

Finally, it conducts a comparative study on non-interactive advertisement with interactive advertisement (body and phone), which was installed in tourist Information center location, to find out which of them attracted the most passers-by, how many of the users were engaged and how their behavior was in relation to the display.

And based on the result and findings, it proposes new enhanced interactive advertisement technique in the context of public displays and compares it with the previous advertisements techniques.

1.5 Methodology

Public displays are very complicated medium for advertisings, but the fact is that they are replacing traditional paper based advertisements, This thesis was mostly based on qualitative

research and uses a user-centered design approach to carryout evaluation in different stages of prototype and for advertisement comparison quantitative statistical analysis tools were used to compare the performance of them. describe more if required

1.5.1 Prototypes

In this thesis prototypes were created in each stage like low-fidelity, high fidelity and the enhanced version of high fidelity prototypes, Each of the prototypes had their different versions and the latest versions were selected for the evaluation. There were lab prototypes and also on field prototypes, excessive efforts have been done to assure to make prototypes to be similar in various stages like low-fi and high-fi prototypes, and at the same time these prototypes should be robust and comply with technologies.

1.5.2 Evaluations

Before even starting evaluations, many questions arise like where the location should be, what hardware shortcoming you have, and if you have other moderators to help you with the evaluation process and when they are free to assist you. During the thesis work different stages of evaluations have been completed like there were some evaluations that required only indoor in a controlled environment and some others required outdoor to get real data from public, The Low-fi and High-fi prototypes were evaluated in lab to do usability testing and do performance measuring, and the actual comparison of the advertisements (interactive and non-interactive) were done on field.

The lab evaluations were fairly easily managed, but for the onsite field evaluations we had to deal with the many level of responsible personal to fix a date and location.

During the evaluation process in public, privacy issues was an important factor that we had to be clear about and we tried to avoid taking pictures or video recordings unless by taking their permission and Kinect color silhouette recordings were used to hide identity of people.

Different methods of data gathering were used like interviewing people, taking onsite notes of the passers-by behavior, system logs and Kinect depth recording and some pictures.

1.6 Research context

The research was carried out under Human Computer Interaction department in Bauhaus University Weimar over the course of one semester period the advertisement prototype was officially made for *Bauhaus-Walk* event and the main location that the comparison happened was in Weimar Tourist information center. describe more if required

1.7 Thesis outline

To make the thesis document more readable and understandable for the readers, it is divided in to five parts, and each of these sections contain various chapters

TABLE 1.1: Thesis Outline

Sections	Chapters
Introduction	#1: Introduction
	#2: Background
Pre Advertisement Comparison	#3: Attention Attraction
	#4: Advertisement Decision
	#5: Advertisement Low-Fi evaluation
	#6: Advertisement Development
	#7: Advertisement High-Fi Evaluation
Advertisement Comparison	#8: Comparison of Interactive and Non-Interactive Advertisement
	#9: Design and evaluation of ExtendedInteractive Advertisement
Conclusion And Appendices	#10: Conclusion
	References
	Appendices

- **Chapter 2:** This chapter discusses in-depth on various related issues like Advertisement, how it began, why is it influential, what is pervasive advertising, what are the common metaphors, in the second part of this chapter, it discusses on Public displays, the history of it, what are common technologies, what are they mostly used for, how engaging, attention and motivation methods are being used, what are the interaction techniques and how these displays could be evaluated.
- **Chapter 3:** This chapter focuses on advertisement to figure out what public really expect from advertisement in public displays and qualitatively summarizes good and bad advertisement, then this chapter discusses on various methods of attention level in public displays and proposes three different methods and evaluates them to chose the best one, the decision of this method will be used in further studies.
- **Chapter 4:** This chapter goes through the process that how and why the advertisement for Bauhaus-Walk was selected.
- **Chapter 5:** This chapter is the paper prototype evaluation, this chapter discusses on how the paper prototype was created for interactive advertisement public display and what were the results and findings from the participants.
- **Chapter 6:** This chapter explains all the functionality and requirements of the applications, what technologies and hardware were being used and how to get the system running.
- **chapter 7:** This chapter conducts an advertisement high-fi evaluation and compares body interaction with mobile interaction techniques.
- **chapter 8:** This chapter makes the main goal of the thesis which is the comparison of non-interactive and interactive advertisement, the chapter explains about the study design along with data gathering techniques and how the data were evaluated and compared.

- **Chapter 9:** This chapter is an extension of the previous chapter and discusses the issues with the body interaction and how the body interaction could be enhanced to perform better in current existing public display setup, The chapter discusses on design study and how the experiment was conducted and how the results were compared with the older version of body interaction.
- **Chapter 10:** Conclusion

2

Background

2.1 Advertising

Everywhere is advertisement of something, some event or a product and it is meant to provide the audience information about those things and gain the planned goals and effects from the specific target audience, it is a mean of mass communication that is created to alter the audience's behavior and attitude [59]. In particular Kotler and Keller defined the advertisement as bellow

Definition: Advertising

Advertising is any paid form of non-personal presentation and promotion of ideas, goods, or services by an identified sponsor. Advertisers include not only business firms but also charitable, nonprofit, and government agencies

[77].

So based on the definition above advertisement is non-personal meaning it is meant to a group of people or target groups, secondly it should represent an idea or basically it should have something to deliver for the people which matters to the audience and normally it does have sponsor(s) to launch it somewhere for example on TV, Radio or print a poster version outdoor. The way message is being delivered has been changing at every era of development as discussed bellow.

2.1.1 History of advertisement

The first paper advertisement was published at 1704 in an American newspaper called Boston News Letter, which was about houses and lands to be sold¹ and after that lots of business started to do their advertisements in newspapers, posters and banners. The first television ad was shown at 1941 on an American TV², this ad brought attention to a wide area of application and big business industries toward advertisement as a result the budgets raised much higher for advertisements and later advertisement entered the World Wide Web or so to say online advertising, which has evolved now to multi-billion dollar industry. Now because of the emerging new technologies and advancements, advertisements are in our smart phone applications, smart TV sets, tablet PCs and many other smart devices. And from past decades display screens are replacing print advertisements because of the easy reusability of the screen and convenient usage of them and providing dynamic contents.

2.1.2 Pervasive Advertising

Currently computers play important role in life, and it is becoming nearly common and found everywhere and these computers do not have to be like traditional computers like desktops having keyboard and mouse, it has various forms like it could be our laptop to a smart watch or even a smart pen and these technologies blend in our environments too like different kinds of displays, sensor, security cameras, fridge, washing machine and more, so as a result we have ubiquitous computing environment that is supported by underlying technologies like Internet, middleware and microprocessors, as explained by Mark Weiser ³ [82] “Ubiquitous

¹Paper advertisements: <http://infoacrs.com/a/adhistory.html>, Last accessed 16th March 2016

²First TV ad: <http://www.openculture.com/2013/08/watch-the-first-commercial-ever-shown-on-american-tv-1941.html>, Last accessed 16th March 2016

³Ubiquitous Computing: <http://www.ubiq.com/hypertext/weiser/UbiHome.html>

computing is the method of enhancing computer use by making many computers available throughout the physical environment, but making them effectively invisible to the user”. The term pervasive computing is also used instead of ubiquitous [64] and it is constructed from basic elements [78] (1) ubiquitous access, (2) context awareness, (3) intelligence and (4) natural interaction and when advertisement is made with the help of pervasive computing which is called “*pervasive advertising*” would really help to improve advertisement in general because of the powerful properties of the pervasive computing like ubiquitous feature that computing is integrated seamlessly in environment and it disappears, like as Mark Weiser’s [66] another central statement was “*The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it*”. Based on above explanation, the pervasive advertising is defined as bellow.

Defination: Pervasive Advertising

“*Pervasive advertising is the use of pervasive computing technologies for advertising purposes.*”[76].

2.1.3 Advertisement models

Describe these models | Describe the CRP and other measurements

2.2 Public displays

Displays are increasingly getting cheaper and being used in various locations like restaurants, hotels, sport stadiums, homes and now in public space like shop windows, supermarkets, airport and streets and roads. Most of these displays shows advertisement in which dynamic or static content is being shown and at few of them are interactive like purchasing train tickets with a touch capability, checking in airport and even interactive advertisement in which passers-by can be engaged and play game. This section discusses on the history of public display, novel applications of display, sensing technologies that are being used in displays, attraction of display and how engagement is designed for displays by the design of novel interaction techniques and at the end how displays are evaluated and what are the methods and tools to do so.

2.2.1 History of public display research

Various researches have been done from the past three decades and are still continuing until today, as the first research was conducted in 1980 called the “*Hole-in-Space*” ⁴ that connected New York and Los Angeles one side-walk with a live video and sound system, people at both end could hear and see each other, in this research common behavior and interactions of people were explored and other similar researches had also been done.

Different sized displays were also designed to fit working area and space for various tasks, like Mark Weiser illustrated in his paper “*Computer for 21th century*” [42], in which he present tabs, pads, and boards devices which could be used as a personal use and also showed large scale displays equivalent to blackboard for public use, and demonstrated that how can these technologies be integrated as ubiquitous and be adjustable based on user demands and context.

⁴Hole-In-Space: <https://www.youtube.com/watch?v=SyIJr6Ldg8>

Another research on situated displays that projects content based on location for-example *FLUMP*⁵ [24], this project was designed to research and illustrate the effectiveness and adaptability of ubiquitous computing systems. Many researches also conducted to design wearable displays like Meme tags and group tags [13] that by wearing the displays participants could share ideas and opinions called “memes-succinct” among themselves, and through large display called “community Mirrors” these memetics exchanges were visualized live for conference audience. Another “Name tags or thinking Tag” from IBM [22] that would show the name of the person when facing another person and also display relevant information on who is viewing the tag.

Furthermore, ambient displays were also researched for-example the *Waterlamp and the pinwheels* used *ambientRoom* of Ishii and ullmer [5], in which they showed how tangible bits could connect the cyberspace and physical environment and foreground and background of human activities. The room was kind of augmented space using light, sound and airflow and water movement. Another was *office plant#1* [23], which was an exploration of a technological object adapted to the office ecology, another was *Information Percolator* [15] this ambient display was designed to show expressions placed within decorative objects⁶, Greenber and Michael [21] investigated on how people transition from individual interaction to group work with the use of PDAs and shared displays and based on this they introduced SharedNotes system and illustrated how people can switch to different modes.

Encouraging social interaction was another important aspect for public displays, researchers like Chew and leclerc [18] focused conversation in a conference setting using display called *Sparks* which “an ambient social networking and communication facilitation interface” this had interactive features on information related to elements presented in the space. Another interactive display designed for hospital *AwareMedia* [48], which facilitated social, spatial, and temporal awareness and supported coordination at an operation ward. Gesture based interactions with ambient display was researched by Daniel Vogel [55] that developed interaction framework for sharable, interactive public ambient displays⁷ it could also support implicit and explicit and multi-user interactions, *Blueboard* [63], which was developed at IBM Research, was a display system for groups to exchange information in a walk-by situation, *IM here* [40] by Elaine M.Haung that researched on LDGAs⁸ and proposed a design on how to share IM⁹ large displays by using mobile phone, this helped to be an awareness and communication tool.

At end of 2000s mobile phones became popular and common among people and was also a good mean of interaction with displays, *C-Blink* [56] that used mobile phone display, which was used as light source that sent various hue color to a camera from which the camera would detect and encode information and present on large display. Another approach was the use of Flashlight of phones as a pointing device as Shirazi and winkler [73] described the design of public-private display with flashlight simple interaction. Other features of phone like Bluetooth, Infrared were also used as an interaction mean with display (e.g., [65, 74]).

Consequently advertising also became a focus for researchers as Krüger and Müller illustrated their design of how to recognize passers-by via Bluetooth [45] and how long did they stood in front of display or whether they read the content or not by video based face detection and by doing this the most relevant information would be presented in the screen,

⁵flexible ubiquitous monitor project: <http://research.cs.ncl.ac.uk/cabernet/www.laas.research.ec.org/cabernet/workshops/radicals/1996/papers/flump-finney.html>, last accessed May 15, 2016.

⁶Information Percolator : <https://www.youtube.com/watch?v=9LGQWhCePc8>, last accessed:16 May 2016

⁷Interactive Public ambient display: <https://www.youtube.com/watch?v=aFl71SPeYto>, last accessed: 16 May 2016

⁸Large display groupware applications

⁹Internet messaging

BlueScreen [26] which selected and displayed adverts in response to users detected in the audience, Stepping more further to give users choice of changing and reforming the content shown on display, *Prospero project* [46] that developed a display framework that could be configurable and controlled in public, *RunWithUs* [33] a social sport application that motivated people to do sport and share their progress, *Digifieds* [25] another plateform that users could post ads in public displays.

2.2.2 Auto-active displays

Beside hundreds of researches on public displays, there are other displays, which were and are made by private advertisement industries and most of these displays are auto-active or non-interactive displays, these displays are situated in train station, airports, malls, restaurants and various locations mainly for advertisement purposes. zipper[81] at year 1928 made LED display at the front corner of the New York Times building, this display was showing current headlines, in Olympic 1979 the very first large display was deployed, which had video enabled¹⁰, and there are various other companies that until now are working like *printsign*¹¹, a big company in UK that designs and advertises in big displays for their customers, *Sony Ziris*¹², This company sells advertising screen, and supports advertising content to be played on their screens, *BBC big screen*¹³, which started at 2013 by installing many of their big screens and shows BBC big live events, and even people who travel by taxi can watch on going advertising and news on go like *taxis TV*¹⁴, Another world famous out door advertising company is *ClearChannel*¹⁵, *Dynascan*¹⁶ is a company that advertises in 360 degree big outdoor and indoor screens, enabled with Content management system that advertisement could be edited, changed, *Kinton*¹⁷ another cylindrical LED screen company that supports for big solutions like advertising, cinema and more.

2.2.3 Interactive displays

Beside auto-active displays, there are a lot of interactive outdoor and indoor displays that is made by private companies, restaurants and some events, *CocaCola*¹⁸ is involved to make interactive advertisement in public display, *MC Donald*¹⁹ allowed passers-by to connect to the advertisement board and play game and by winning get a coupon number from which he/she could get something for free from MC shop, Other public awareness interactive ads are also there like Interactive Hair-raising awareness²⁰ an interactive ad that was installed in train station and used ultra-sonic sensor to detect the arrival of train and the model hair was beautifully blown up, Another was an interactive billboard that to let passers-by stop child

¹⁰Olympic glory a short history of Olympic games timing. London in August 2012 <http://www.runnersworld.com/olympics/a-short-history-of-the-olympic-games>, last accessed: 18 May 2016

¹¹printsigne: <http://www.printsign.co.uk/>, last access 19 May 19, 2016

¹²Sony ziris: <http://pro.sony.com/bbsc/ssr/cat-monitors/>, last accessed 19 May 2016

¹³BBC big screens: <http://www.bbc.co.uk/blogs/aboutthebbc/entries/ea215929-b57e-3bb9-8d01-e0433f93fd62>, last accessed 19 May 2016

¹⁴Taxi TV: <http://verifonemedia.com/networks/taxi-media/>

¹⁵<http://clearchanneloutdoor.com/>

¹⁶Dynascan: <http://www.dynascanusa.com/products/360-degree-led-video-displays/>

¹⁷Kinton: <http://www.kinton.de/de/home.html>

¹⁸Coca Cola Interactive: <https://mg337group10.wordpress.com/2015/04/04/coca-cola-and-interactive-advertising/>, last accessed 19 May 2016

¹⁹MC Donald Interactive Ad: <http://en.nolapeles.com/2011/06/16/mc-donalds-interactive-ad/>, last accessed 19 may 2016

²⁰Hair awareness: https://www.youtube.com/watch?v=qqd6hg0_AOI last accessed 20 May 2016

abuse²¹, Advertisement could be done in various forms and now are in restaurants and bars like Clo Winebar²² a bar that customers are able to view and select orders from an interactive screen, or pizzaHut²³ an interactive display that allows customers to design their own pizza and order through it, floor and wall projected interactive advertisement are also common like Aristoz²⁴ that illustrates various examples of projection based interactive advertisement in supermarket, hotels and airports, JCDecaux²⁵ a france famouse advertisement company is booming in innovative outdoor and indoor advertisement, And many more interactive advertisement are out there in public that brings joys and engaging experience to audience.

2.2.4 Engagement with displays

There is not a single application which would claim to be perfect, it could be good for a specific domain but would lack a lot of things from other perspectives, same applies for public displays that are another mean of communication for passers-by and is more complex than other single user device like mobile phones, There are many layers of complexities that needs to be addressed when dealing with public display, for-example how passers-by be attracted toward display, and when they are attracted how to motivate them toward display to come near and interact and how to design a better interaction medium for the users at that situation, these are all issues that needs to be worked on, Müller et al [1] illustrated a model of different interaction phases in which he called it Audience Funnel, as he describes that there are many stages until users actually interact with the advertisement as shown bellow Attention and motivation will eventually lead to interaction and these stages follow each other if the first step fail the rest would not happen, so there is certain thresholds that people should exceed to transition from mode to other, the Audience funnel model was actually based on the model by Brignull and Rogers [14] in which they researched on social and interactions and behaviors and how to improve them in a way that people do not feel embarrassed or stop them from interactions and engagement.

Attention

Most devices that are being used has an owner and the owner is aware of the device and pays attention to it, for example a mobile phone or a laptop, the owner pays attention and then uses the phone or laptop to do certain task, public displays do not have an owner, or in other words everyone can use them if higher attention is given to them, therefor the job is on displays to be able to provide enough attraction for the passers-by to be engaged. Various models of attracting attention have been developed and proposed, Itti and Baldi [67] made the bottom-up attention model meaning that the attention could be attracted if a strong external stimuli happen, the model shows various of representation of input image like color, orientation that human brain cells are capable of interpreting them and based on input images the model predicts which area of the picture could have more attention, the model is also equipped by top-down (the brain before shifting attention knows, or has experience to certain regions) processes too. Florian Alt [76] stated from previous researches that the attraction attention could be gained by behavioral urgencies and honeypot effect has also strong impact on attracting attention.

²¹Child Abuse: <https://www.dramafever.com/news/powerful-billboard-lets-you-stop-child-abuse-/>, last accessed: 14 May 2016

²²17 Awsome bars: <http://walyou.com/bars-and-restaurants-themes-geeks/>, last accessed 19 May 2016

²³PizzaHut: <http://www.fastcocreate.com/3027282/pizza-huts-interactive-touch-table-could-be\coming-to-a-restaurant-near-you>, last accessed 19 May 2016

²⁴Aristoz: <https://www.youtube.com/watch?v=FH2TON7LRIY>, last accessed: 19 May 2016

²⁵JCDecaux: <http://www.jcdecaux.com/en/>, last accessed 19 May 2016

Behavioral urgencies models predicts how much a specific external stimuli can gain attention of someone, for example Franconeri and Simons [72] stated that “*Attention capture is often operationally defined as speeded search performance when an otherwise nonpredictive stimulus happens to be the target of a visual search. That is, if a stimulus captures attention, it should be searched with priority even when it is irrelevant to the task*”, beside this may other things captures attention like sudden appearance of object [9].

Honeypot, Brignull and Rogeres [14] describes this effect effect that when ever a bunch of people gather around a display automatically other people are being attracted toward the display. They showed this effect in a party in which they had an interactive system installed called Opinionizer which was a shared display in which people could type their opinion with keyboard and these opinions would be projected in display in a more acceptable way, by doing this people started to notice the messages and most importantly the people taking part, which built an awareness of people toward display.

Motivation

To be motivated means *to be moved to do something*[47], Motivation is another big challenge for public displays, passers-by may glance toward display but necessarily not motivated to interact with the display, there is significant need to understand how to motivate passers-by toward display as Thomas [43] describes activities that motivates “*An activity is said to be intrinsically motivated if people engage in it “for its own sake,” if they do not engage in the activity in order to receive some external reward such as money or status. I will use the words “fun,” “interesting,” “captivating,” “appealing,” and “intrinsically motivating,” all more or less interchangeably,*” he states that challenge, fantasy and curiosity could be categories of motivation instructions.

Challenge is a driving force for motivation, Florian alt [76] summarizes *Flow*[44] that state of mind in one sentence by saying “*is a state of mind where the user is fully immersed in an activity while feeling energized and focused. Simply said, flow can be achieved in a channel between too little challenge (leading to boredom) and too much challenge (leading to anxiety).*” So there should be balance between them, and to change and interaction to a challenge the end goal should not be clear and known for participants.

Curiosity happens when something is not so clear, and people tend to find what is actually there, but some may feel insecure to try it because of shy or because of social context, therefore proper explorative behavior is required to overcome these insecurities [47], and to increase curiosity the application should send to the participant a sense of incompleteness and at the mean time should also show how to over come that incompleteness through the use of that application [76].

Fantasy is another deriving factor to motivate people toward display, if something imaginary or unrealistic is shown people gives more attention, now with the increasing technologies and computer capabilities, virtual reality, augmented reality and others sensing technologies these fake environments can be built [52], BigBoard ²⁶ which was installed in a bus station and was showing the video of the side of the bus station and meanwhile was augmenting some fairies coming from sky and approach the participants, by doing this people got motivated and was look the backside to confirm if in reality the fairy exist. JCDecaux²⁷ creates innovative advertisements which most of them are full of fantasy.

²⁶ <https://www.youtube.com/watch?v=UIHwHqaY3SY>, last accessed: 19 May 2016

²⁷ JCDecaux Innovative ads: <https://www.youtube.com/watch?v=Gw0Gfp5LVgQ>, last accessed 19 May 2016

2.2.5 Metaphors

Advertisements are posted in various forms and there are different mental models categorized by J. Müller [1] which are Posters, windows, mirrors and overlays.

- **Posters:**

From poster definition by Ghosting and peter[6] is “*A poster is any piece of printed paper designed to be attached to a wall or vertical surface*”, these poster does contain texts, graphics or combination of both and now a days they are not necessarily have to be paper based it could be digital poster that with the use of media like screens a more dynamic contents could be shown. Most of these types of these digital posters show traditional advertising contents but the difference is only being dynamic, which is often ignored by passers-by [41], and by integrating sensing technologies these posters could be interactive too to increase the user engagement.

- **Windows:**

There are advertisements shown at windows facing outside the shop, this type of mental model gives the viewers some sort of clue of a virtual location from one side, but the actual window model should have two sides (this side and remote side) and brings some sort of intercommunication of two sides together, foreexample *Hole-in-Space*[75], which there were two big screens installed in two major cities and live video and audio streams was available for public to communicate

- **Mirrors:**

Mirrors are reflective surfaces, displays with mirror model to show the reflection of the passers-by would allow to encourage them for interactions, this is normally done by projecting silhouette representation for example J.Müller [11] experimented by mirroring image, silhouette and abstract representation of passers-by.

- **Overlays:**

Overlays are not bounded to the fixed frame and size like screens or mirrors, they could have various shapes and does not have frames, it could be glass door or a part of a window or a whole wall, the fact is that they can integrate with environment, Normally these are done by using high performance projectors like CLD projector²⁸, one of this type of interaction was *Jumping Frog* [13]that was projected on surface and by touching it the frog would jump to other surface.

2.2.6 Interaction models

Different interaction models are created as shown bellow that illustrates how passers-by would behave and react at certain regions (zones) toward display, how groups are audience can form and what could be their next step for interaction.

1. Hallo.Wall [69, 68], which was a context-dependent display reflecting Identity and proximity of passers-by, designed to communicate detailed information, the display was interactive and passers-by could communicate through RFID and WaveLAN technologies though a “distance-dependent Semantic manner” meaning based on different distances various interactions were offered. The interaction model consisted three zones ambient zone, notification zone, and cell interaction zone as can be seen in the picture.

²⁸LCD projector: <http://www.projectorreviews.com/projector-categories/lcd-projectors/>, last accessed 19 May 2016

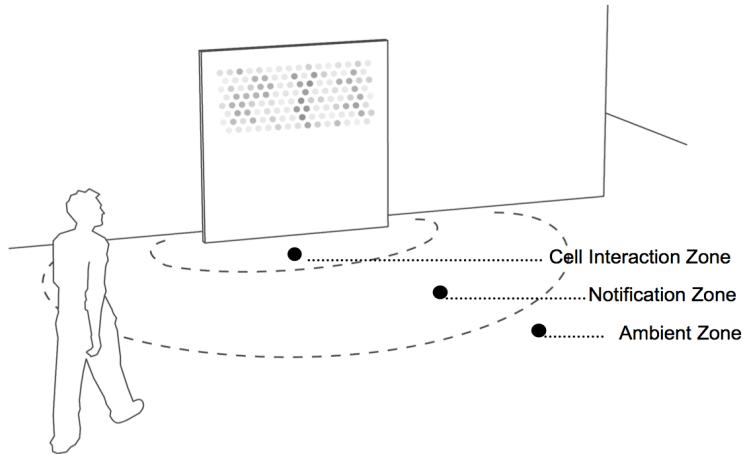


FIGURE 2.1: Three zones of interaction, [68]

Ambient zone is outside the sensing area where people cannot be tracked or sensed and passers-by are experiencing ambient mode, in this mode the display shows some information and content independent to the people. Notification zone is the place where is under sensor range and the sensors can detect people and show particular light pattern on the display. Cell interaction zone is the zone, where the passer-by is very near to the screen and can start interacting with display.

D. Vogel [55] used the same interaction design and enhanced that could support transition of implicit to explicit interaction with both personal and public information, He introduced implicit, subtle and personal interaction zones or stages that has smooth transitions in between, as can be seen bellow.

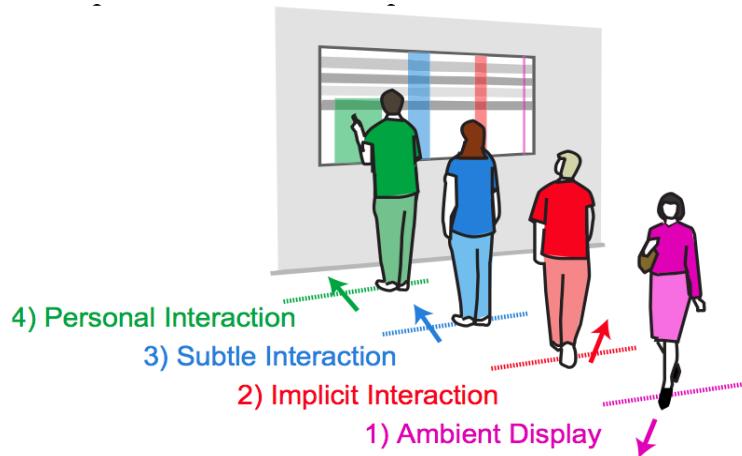


FIGURE 2.2: Four interaction phases, [68]

Implicit interaction phase the system detects the person information like position orientation and projects notification when user passes, or presents a kind of representation of the person so that the passers-by can see the reaction to be convinced to enter the subtle interaction phase, the subtle mode activates when user give implicit hint like stopping by screen then more detailed notification or state is shown at this point the interaction area is for multiple users too, but when exploring more personal content then the users moves closer to the screen to enable personal interaction phase, in this phase the user is very close to the screen and the interaction could be done by touching the screen and explore more personal contents.

2. Another interaction model designed by Brignull and Rogers [14] conceptualized an interaction model based on their observation they had done on opinionizer system in a lunch party, and divided the space around display in three categories as space (a) peripheral awareness, space (b) focal awareness and space(c) direct interaction, and illustrated how people switch between these spaces by crossing some thresholds, this model is limited to the interaction medium because on keyboard was used and other phases like implicate and explicit interactions are not considered, and the model is made to be in an environment that people are somehow familiar and standing for long time to know each other which in result removes social embarrassment and people can interact freely with the system instead of ignoring it.

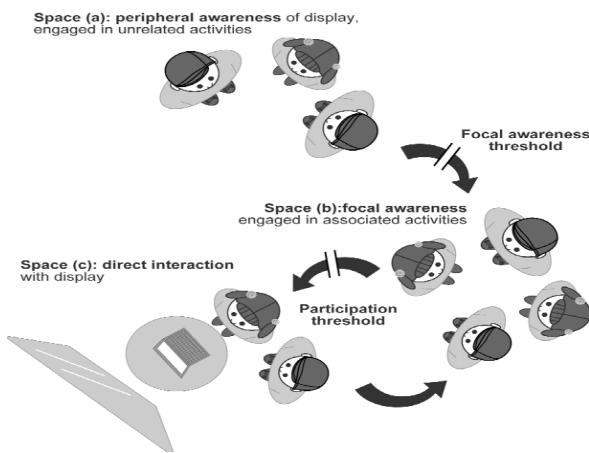


FIGURE 2.3: A diagram of public interaction flow accross thresholds, [14]

3. *Audience funnel* [2] is another design based on public interaction flow model that have several interaction phases and the phases shows a linear process type in which first should happen then next happens, the phases are passing by, viewing / reacting, subtle interaction, direct interaction, multiple interaction, and follow-up actions as shown in bellow diagram. This type of model is very interesting for advertising applications.

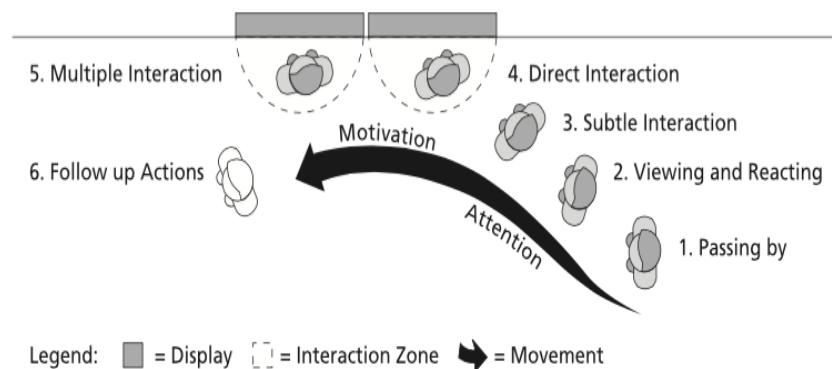


FIGURE 2.4: The Audience Funnel, [2]

2.2.7 Technologies

The driving force for all these designs and concepts and advancements are the technologies behind them, without the use to advanced technologies it would have not been possible to implement and evaluate the prototypes and designs. This section explores various technologies used for different purposes as listed bellow.

- Displays:

Currently four technologies are used in displays

- CRT (Cathode Ray Tube), which was invented by German physicist Ferdinand Braun²⁹ in 1897 that has three electronic guns (Red, Green, Blue phosphor dots) and high speed electrons from these guns hit the flat fluorescent screen line by line by which the image is created on the screen.
- LCD (Liquid crystal display), which is widely used in Television sets and other computer screens, and has almost replaced CRT, it uses Light-modulating properties of liquid crystal³⁰, which does not shot light rays, to show images.
- PDP (Plasma display panels), unlike LCD display is free of distortions if seen from sides, uses tiny neon light for each pixels in the screen and that illuminates the pixels and is designed to display both analog and digital computer inputs³¹.
- OLED (Organic Light-Emitting Diode) this technology uses light emitting diodes, that allow for higher resolution and screen size, is one of the expensive displays and has wide viewing angle, better power consumption,
- There are various other display technologies used for different purposes and screen sizes as listed bellow.
 - * E Ink (Electronic paper)
 - * PDP (Plasma display panel)
 - * ELD (Electroluminescent display)
 - * DMS (Digital microshutter)
 - * ...

- Sensors:

Now technology is highly advancing and day-by-day new sensors for different purposes are being made, and the sensors which in past was difficult to use because of many dependencies and had cost a lot of money is now easy to use with very limited requirements and less price. Sensors are listed based on their purposes as bellow.

- **Presense**

Presence is the state or fact of being present as with others or in a place³², there are sensors that can sense if someone is at the proximity or vicinity of the display and can even sense how far the person is in meter or centimeter in relation to display.

- Cameras:

Now there are many cheap and powerful cameras that has integrated firmware that does Human tracking capabilities so easy for example Microsoft Kinect

²⁹Ferdinand Brown: <http://www.britannica.com/biography/Ferdinand-Braun>, last accessed 21 May 2016

³⁰Liquid Crystal: https://en.wikipedia.org/wiki/Liquid_crystal, last access 21 may 2016

³¹PDP: <http://whatis.techtarget.com/definition/plasma-display>

³²Presence: <http://www.dictionary.com/browse/presence>

Camera³³, which comes in two versions Kinect xbox360(V1) and Kinect One (V2) these cameras can sense the location of the person, other cameras could also be used and computer vision applications to do track people.

- * Audio sensors³⁴:

The use of microphones allow us to track sound frequencies and source of sounds originating and from which the distance can be estimated.

- * Audio sensors³⁵:

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- * Bluetooth:

Mobile phones that have enabled Bluetooth can be detected near display.

- * IR (Infrared):

this could be used to sense the people around as it was used in MemeTags [13]

- * RFID (Radio-Frequency Identification):

RFID serves the same as bar code it can be attached at backside of card, this technology could be used to sense if there is someone near display.

- **Body position and Posture** Body position can be detected with pressure sensors installed on the ground floor this would accurately detect the exact coordinate, and beside that Camera can also detect exact position like Kinect camera. Body posture is the orientation of body where actually the body is facing to; this can be detected using 3D Camera or motion tracking.
- **Gestures** Gesture gives more control to the system while interaction, it could be used for manipulating some objects on the screen or control elements, there are many technologies that recognize gestures, like touch screens, accelerometer, and most widely used now is the use of camera in which the user hand or eye or different body posture can be used as some sort of gestures.
- **Touch** There are various touch technologies available, the use of touch technology evolved from smart phone like iPhone, and spread to screens, Now mobile screen can support multi-touch and screens beside multi-touch can even support multi-user multi touch, touch could be sensed by the display directly or by IR camera that uses computer vision software to track users finger.
- WiFi WiFi allows computers, smartphones, tablets or other personal smart devices to connect to private LAN (Local Area Network) or Internet, the use of this technology has become very frequent and almost all handheld devices has the capability to connect, By using this technology people can connect to public displays and interact by using some applications or web controllers.

³³Microsoft Kinect: <https://developer.microsoft.com/de-de/windows/kinect>, Last accessed: 1/05/2016 at 13:21:00

³⁴Audio sensors: <https://www.sparkfun.com/categories/186>, last accessed 22 may 2016

³⁵Audio sensors: <https://www.sparkfun.com/categories/186>, last accessed 22 may 2016

3

Interactive and non-Interactive Advertisement field study

3.1 Introduction

Norman [83] describes that there are three different level of interactive computer system, (1) *visceral*, *behavioral* and *reflective*, visceral level is about the first impact or impression of a product it is about its appearance and look, (2) *behavioral level* is about the use and experience with something, and finally the (3) *reflective level*, which is the highest level of feeling, emotions and thoughts on something. Taking these levels in consideration, non-interactive advertisement can reach only the first visceral level that can only show content on the screen and cannot go further than that, but Interactive advertisement can reach the behavioral and reflective levels too, and can build strong experience and impressive effects, as a result more audience would likely pay significant attention to the content, which would consequently equate to higher advertisement recalls [89], and would increase involvement of both users and product that is believed to have an effective advertising to convey the advertiser message [88]. To observe the above effects in advertisements, there is a need to do field study.

Field studies are conducted outside the lab environment like workplaces, street, shop or even home, and the studies are involved in people observations in their everyday life and their behavior to a specific product or service [80], these field studies focus on social behavior of people, individual behaviors, product effectiveness and more. There were a lot of field studies on public displays, as Beyer, G [54] in which the user behavior and user experience was compared between flat and cylindrical displays, and Müller, J [11] did a study on how passers-by notice interactivity of public displays, another study conducted by Anthony Tang [20] that focused on consequences of the design choices with respect to encouraging *bystanders* to interact with the public displays, and classified *bystanders* who may never engage with the displays but contribute to interaction at some level. Junko Ichino [16] researched on how different display angles could impact social behaviors of people around displays and also in one of his another paper [17] investigated on User's cognition and subjective responses in relation to different display angles.

Audience behavior is an important research question in most of the public display evaluations; audience behavior is how a person or user(s) react around a situated display, these behaviors can result in higher attentions, for example the (1) *honeypot* [14] that is the effect that people who are already involved in interaction with display, attract other people around, it is also called “*sociable buzz*” by the author, in public displays this effect can even create multiple rows of people interacting [11]. Another audience behavior is (2) *landing effect* [11], where the passers-by realize the interactivity of the display after they passed the display and they tend to walk back for confirmation or for interaction. Another audience behavior is (3) *sweet spot* [54] where is a location that most people stand in relation to the display.

Effectiveness is another important area for public display and advertisement evaluation, which is defined by many factors (also discussed on chapter 3) like (1) Number of passers-by [29, 51], (2) among passers-by how many glanced [29, 30, 41] to display, (3) how many started interacting [11, 29] and (4) how long passers-by were engaged with display.

This chapter describes all the processes of the field study, in which the interactive and non-interactive advertisements were compared. The comparisons were on the attraction, effectiveness, passers-by different behaviors and their feedbacks on these advertisements. This research want to find out how much the interactive ads would change the attention level of passers-by, how much passers-by would be engaged and how their behaviors would be different compared to non-interactive, and if it does change how significant are these changes and what could be done to enhance these interactive displays to increase effectiveness of advertisement in public displays. In this study, two different interactive advertisements (body and mobile) and one non-Interactive advertisement displays were installed one after another each for one

week, and direct and indirect observations along interviews were carried for data gathering.

3.2 Advertisement

An advertisement for Bauhaus-walk¹ was developed after several small to medium user studies, to be the most meaningful and attractive advertisements for passers-by, and at the same time be same in all three conditions except the difference be in interaction and non-interaction.

3.2.1 Interactive and Non-interactive Ads

- **Non-interactive Advertisement**

This technique is composed of three phases, each of them is triggered automatically without the influence of passers-by, i also call it auto active advertisement. The first phase shows only the screen with the Bauhaus-Walk title and after few seconds switches to the second phase, in second phase the locations are automatically explored in random sequence and has expiration time of 40 seconds, after that the ad video is shown for about 20 seconds and switches back to the first mode. The entire cycle of the phases is around 60 seconds. Check phases sequence Demo Video²

- **Interactive advertisements**

Two interactive advertisement was developed, first Body interactive and second the mobile interactive. Both of them are designed to have three phases as non-interactive, (1) First phase, which is also called call-to-action³ phase, (2)interaction phase and (3) the advertisement video.

Please read chapter 7 for complete interface and interaction space design.

1. Body Interactive:

The body interactive advertisement has the ability to detect up to seven people at a time and project their silhouette in the screen each with different colors, the Call-to-Action feature asks viewers to come near to the screen to start the interaction, when the interaction starts participants are given a short instruction on how to play the system, participants should walk physically in front of the screen in order to move the silhouette on the map to explore the regions. The interaction finishes if all the regions are explored or the 40 second time gets over and the Ad video is shown.

2. Mobile Interactive:

As you already got the idea that this technique works with smart phone, the system also shows partially passers-by silhouette for attracting attention, but the Call-to-Action is done through using a mobile phone, the screen gives instruction on how to access the system. Passerby should connect to the wireless local area network and browse the controller website from their phone, and the control opens in their phone to use navigate to different regions on the map to explore interest locations. The interaction is also constraint to 40 second time and after that the Ad video is shown.

¹Bauhaus Walk: , last accessed 30 May 2016

²Non-interactive sequence video: <https://www.youtube.com/watch?v=ZLszzfbZJgI>, last accessed 31 may 2016

³Call-to-action: A function of the system that invites participant for interaction

3.2.2 Advertisement Effectiveness

All the public advertisements like poster, banners and displays want passers-by attention and want them to stay longer and be involved because these factors enhance advertisement effectiveness.

1. Attention

If an advertisement has higher attention then it can be an effective advertisement[89] and in public displays the attention is considered in

- Number of glances.
- Number of Honeypot effects.
- Number of Landing effects.

2. Involvement / Engagement

Involvement describes the relationship of audience to a product or service and how strong or weak the relationship could be[87], and the strength of relationship can moderate the effectiveness of advertisement message [88], Engagement is one of the form of involvement for public displays. In this study the engagement was quantified as how long audience are involved with the advertisement screen.

3.3 Research questions

1. For which of the three conditions (body, mobile and non-interactive) advertisements passers-by
 - (a) Are more attracted?
 - (b) Perform Honeypot and Landing effects?
 - (c) Are engaged with the screen?
 - (d) Watch the advertisement video after interaction?
2. What are passers-by feedback about theses advertisement techniques?
3. What are other passers-by behaviors around this display?

3.4 Study design

3.4.1 Location

The screen was installed in Weimar Tourist Information center. This center is one of the famous tourist information in Weimar where a lot of tourists visit. Most importantly this location was chosen because the target audience (tourists) visit here.



FIGURE 3.1: Weimar Tourist Information Center Top-view picture, The locations are marked with yellow arrows.

3.4.2 Duration

Each of advertisement condition was installed for five days in the following three weeks.

TABLE 3.1: Week sequence

Advertisement	1st Week	2nd Week	3rd Week
Non-Interactive	X		
Body Interactive		X	
Mobile Interactive			X

3.4.3 Internal Validity

To be confident that the change in the weeks would not effect the findings, extra effort was done to make all the week environmental conditions the same as much as possible. The screen was installed in the same location, had the same screen brightness, height and also the surroundings of the screen were not altered, we asked the responsible person in tourist information center not to change anything in the surrounding. The luck was also with us that almost the weather conditions were the same too, but the only thing we could not control was the number of passerby; The flow of passers-by were also be nearly the same.

3.4.4 Participants

The participants were the ones who pass by the screen, none of the participants were informed about this study nor any notes were put at the entrance. Roughly %60 of the participants were elder aged between 30-60, %25 were young and the rest %15 were children.

3.4.5 Data gathering

Several types of data from different aspects were gathered for each individual week to be able for analyzing and also be able to answer new arising questions after the onsite evaluation, the bellow types of data were gathered.

1. On-Site Observation

Observation periods were arranged in two different time slots per day, the first time slot was from 10:00 – 12:00 and the second was from 14:00 – 16:00, except for Saturday and Sunday where the tourist information center was open only until 14:00, then the observation period was from 10:00-12:00 and 13:00-14:00. During these two time slots the bellow observations were made and to remove the effects of specific time order, the orders were counterbalanced.

(a) Attention Level measurement

Attention level is how much a person gives attention to the display, which consist of number of glances and number of ignores and how long a person is standing in front of the display. At the beginning gaze-tracking method was considered for accurate measurement of attention level, a very impressive work have been done from Intraface [28] that can not only detect glances but also human emotions at the time, but because of high flow rate that method was not used and instead the glance counting which was proposed by [29] that has formalized a ranking system from which glance is considered if a person reacts to the display by turning his/her head toward it that last less than 3 seconds.

One hour attention level counting for each time slot was conducted, in which the observer was writing the number of people passing by and how many of them glanced and ignored the screen. see the glance counting sheet in Appendix: ??.

(b) Passers-by behavior and Interviews

During one hour per time slot per day the passerby behavior were observed like how they approach to the screen, how do they react, and what are they looking for and even how they ignore the display and after they are done with the display engagement a very short interview was taken from them.

Interviews were taken from the passerby that had some sort of engagement with the display like for non-interactive advertisement the people were interviewed that they stood for a while and saw the advertisement and for the interactive advertisement the people were interviewed that interacted or tried to interact with the system. A leaflet, that describes the thesis goal and interview consent form was handed to the participants and after signature the interview was conducted. All the interviews were audio recorded and later transcribed for analysis, all interviews took in average 4 minutes, the reason we took short interviews was that most of the people were tourists and had little time to stay and even some of them rejected interview because of shortage of time. Each week there were some variation in the questions dependent to the type of advertisement. fix the appendix

2. System Logs

The Advertisement application can generate the bellow logs.

(a) Non-Interaction application

Only duration(seconds) spent in front of the display is logged for each individual person.

(b) Interaction application

For this type the system can detect

- Time user joins.
- Interaction completion time.
- Number of tasks (locations) explored.
- Whole duration spent(sec).
- If the user has seen advertisement or not.

3. Colored-image recording

Colored-image recording from Kinect camera was done during entire three weeks for non-interactive and interactive advertisement for many reasons.

• Passers-by engagement measurement

As discussed earlier, engagement was defined as involvement of audience with the display. The passers-by were considered as engaged if they had stayed longer than 3 seconds, in this sense two types of data were gathered for engagement.

- Number of engagements.
Meaning how many people were engaged.
 - Engagement duration.
How long audiences were engaged with the system.
- Count the number of Honeypot effects and landing effects.
 - Match the log data with the video data for accuracy.
 - Observe passerby behavior in detail.

Because of limited space and processing power, the actual depth information (x,y,z) for individual points was not stored but a 2D colored image was taken per second and after the image recording was done, in lab another post processing script was applied to integrate a static background using Adobe Photoshop application. To match the data logs and the image frames each image name consisted the date and time as (10.12.43.21.png).

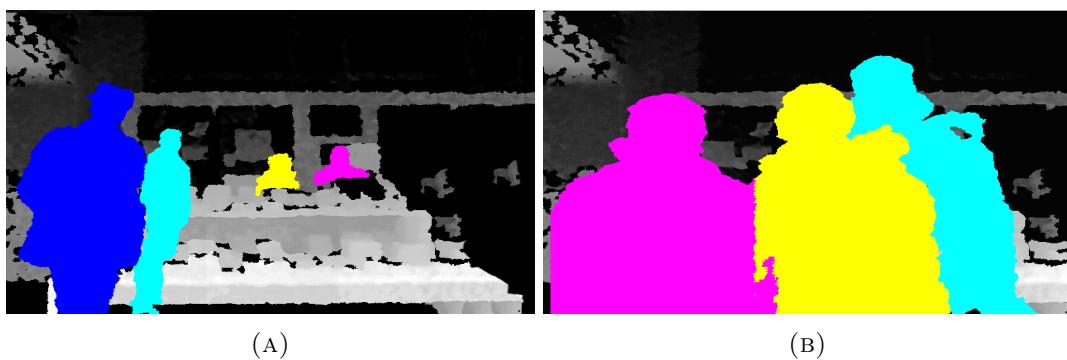


FIGURE 3.2: Depth recording examples

Other pictures were also taken using mobile phone from the scene, verbal permission were taken before the photographing them.

3.5 Data Analysing

3.5.1 Glance counts

The glance counts were transformed from paper to spreadsheet in which number of glances and ignores were recorded individually and then combined from which mean value and percentages are extracted. [fix appendix](#)

3.5.2 Interviews

All the interviews were transcribed and color coded from which interesting categories had emerged, each code is separately discussed in the finding section, To see color coded diagram see Appendix [fix appendix](#)

3.5.3 Display Engagement phases and time

Log files along depth images were seen and compared to have accurate values for each engagement phases and the whole interaction phases. depth frames were manually frame-by-frame analysed and the logs were cleared from any possible mistakes.

3.5.4 Honeypot and landing effects

These two effects were observed mainly from the depth frames and also partially from onsite observation.

3.5.5 Other observations

The observations were done onsite, the observer wrote down any important event happened at that moment, These notes also include observer own point of view of understanding the scenario during the entire day and week. Most of the notes have time stamp. See Appendix [fix appendices](#) The depth recordings were also observed frame-by-frame to see anything that was missed when the observer was not present at the center. Different behaviors are extracted from the observation, which you will find in findings.

3.6 Findings

To be more precise and structured, I have divided the finding sections in two separate sub sections, the first section describes the findings from each condition (Non-interactive, Body interactive and mobile interactive) separately and the second section compares the findings of these conditions among each other.

3.6.1 Non-Interactive findings

1. Attention Level measurements

The number of glances and ignores were measured for the five consecutive days as shown bellow, each day (bar) has less than half number of glances compared to number of ignores and in total the average glance is %28, which slightly corresponds above (1/4) portion of passers-by.

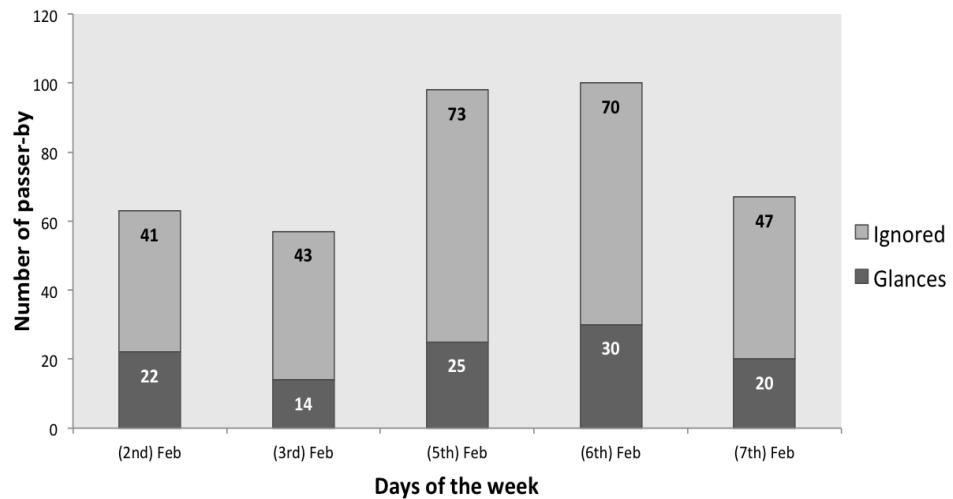


FIGURE 3.3: Non-interactive attention level chart

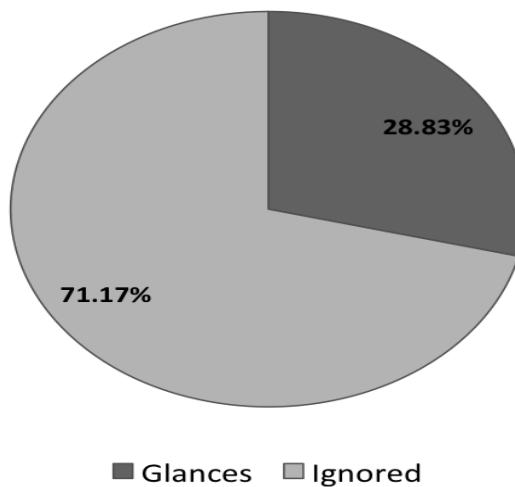


FIGURE 3.4: Non-interactive Attention level percentage

2. Engagement Time

Not all people would take time to see the advertisement, some participants took very

little time like 4-5 seconds and some also saw the ad for about 100 seconds, which is almost twice of the advertisement time, so dependent to the interest, people were engaged in different durations and in average it took about 34 seconds to be engaged.

3. Number of engaged passers-by

Counting the entire passers-by was a challenge and there was not accurate and automated method to do, therefor each day's recordings were watched and the numbers of passers-by were counted manually, this intense work was carried out with a couple of computer science students who voluntarily participated. The bellow chart shows all the count of passers-by and out of those the people who were stood in front of the screen for more than 3 seconds were flagged as an engaged passer-by.

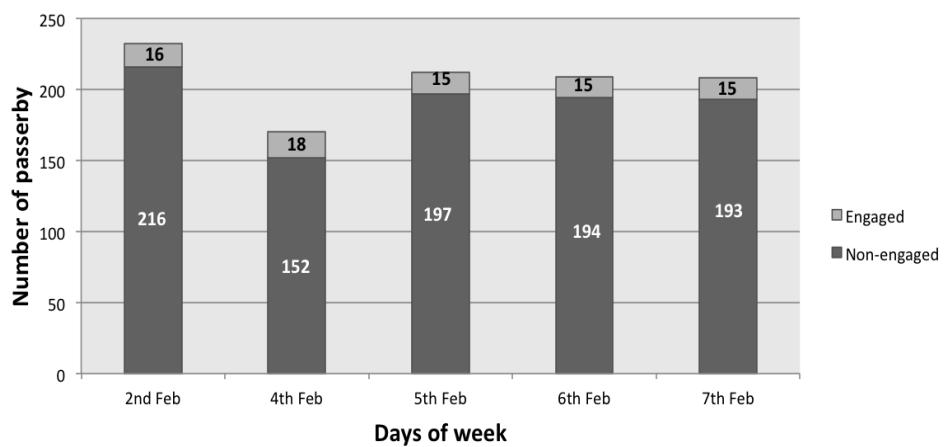


FIGURE 3.5: Non-interaction Number of engaged and Non-engaged passers-by

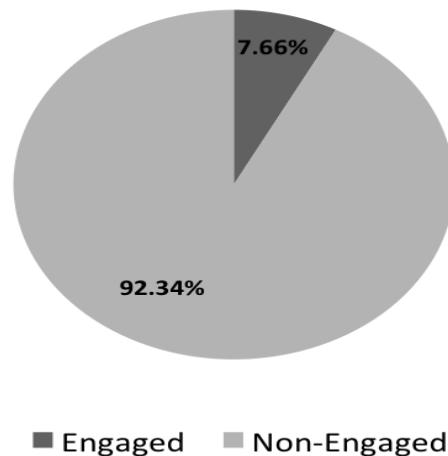


FIGURE 3.6: Percentage of engaged and Non-engaged passers-by

As can be seen in above chart it shows the number of passers who were engaged and number of passers-by who did were not engaged. The chart shows very few engaged people for each day and as an average %7.66 of the whole population was engaged within 5 days.

4. Landing and Honeypot effects

Some might argue that Landing[14] effect do not exist in non-interactive displays because the displays do not react suddenly when a user pass by the screen, but at the same time users may react to the visual stimuli that generated by the non-interactive advertising by showing random contents, which is by its nature independent to the people around.

In non-interactive the silhouette is not projected and the passers-by do not see themselves in the screen, but still for some other reasons passers-by turned back from the end of the screen to the middle of the screen, there could be many reasons behind this, (1) maybe the screen was showing the advertisement video in which pages are changing after one another, (2) maybe the screen was showing city map in which interest locations are animated, (3) beside visual any other personal interest has dragged passers-by toward the screen.

As can be seen in the figure in the right, in frame (A) a person passes-by the display and is almost crossing the display, but suddenly in frame (B) he notices something and he stops, in frame (C) he explicitly shows his reaction by turning back toward display and in frame (D) he comes closer to the screen and starts to see or read advertisement content.



FIGURE 3.7: Landing effect

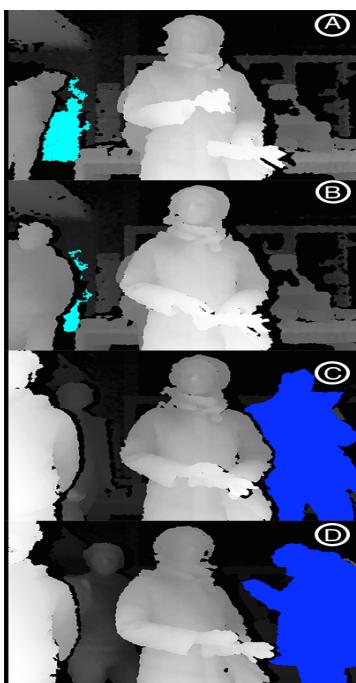


FIGURE 3.8: Honeypot effect

Honeypot[11] effects in non-interactive displays are rare because they do not make passers-by become curious about themselves, and passers-by do not perform any interaction or react differently, that could be noticed by other passers-by, therefore most of the observations on this effect seemed to be more passive and this effect could be due to that a friend was watching the screen and another friend of him / her got attracted or attracted person might just had another intension for-example to talk him. The scenarios seemed to be very personal.

As can be seen in the picture in the left, In frame (A) a lady is standing in front of the monitor and reading the content and after a while in picture (B) another person is approaching the monitor to see what was happening and immediately another person in picture (C, D) was also attracted to come close and see what was going on.

The below the number of effects that occurred for each day is recorded.

TABLE 3.2: Landing and honeypot effects

Days	Landing effect	Honeypot effect
2nd Feb	1	1
4th Feb	0	1
5th Feb	2	3
6th Feb	0	3
7th Feb	1	1

5. Interview

(a) Likes

Many things from the advertisement were interesting, like the concept of map and the design. As one stated that, “*I find the idea good, it is nice to see the pictures of the places on the map*”, “*it is very nice idea because it will be remembered and when I go to the city I will remember*”

(b) Dislikes

Most of the respondents complained on the speed of the advertisement that how fast the image changes as one said “*But the pictures were changing very fast*” other said, “*advertisement is a little fast*” They mentioned that why speed is an issue as stating, “*we wanted to see the map*”, “*Could not read the text*”. Many things were disliked by some of the respondents like the advertisement theme, one said, “*It did not have Bauhaus Theme, the color and that design*” One respondent also disliked the blinking points.

(c) Participation

Respondents mentioned the same excuses that were given at body interactive advertisement, one said, “*I will join if I am free*”, other said, “*I have no time*”, or “*if the weather is good*”.

(d) Advertisement recall

People could recall the ad, as one mentioned, “*It is for a tour of Bauhaus in Weimar*” other said, “*People can visit the city*” and some mentioned directly the name of the program “*Bauhaus-Spaziergang*”.

(e) Recommendations

There were many recommendations proposed by the responders, which was on content, speed, design. Content related recommendations was that one said, “*If the prices are mentioned it would be good so that they can decide if they want to take it or not*” other said on timing, “*how long does this tour take so people arrange their*”. Another mentioned on speed like “*it must be little slow*”.

6. Audience behaviors

Note taking technique and video observations helped to analyze the environment and behavior of people around the display. See appendix fix this appendix

- Passive:

The behavior toward non-interactive during the 5 days observation seemed to be very calm and passive, passers-by selectively came to watch the screen there was no curiosity nor attractiveness that had driven their attention. It was thread as a source of information and whenever they approach the screen the participants would normally stand for a very short time and after looking for 1-2 pop-up pictures on the screen they would leave, except for participants that was looking for some events that stood for the complete duration of the advertisement. There was an interactive object in front of the display on the table, which many people tried to play.

- Display negligence

At most of the occasions the display was neglected and passers-by were busy with their own personal activities and discussions even though they were standing in front of the display facing toward it.

- Display blindness

Passers-by also ignored and passed by the display because they did not expect to be something special related to them.

- Display as information board

Some of the passers-by expected the display to be a source of information, for example some tourist stood in front of the display to see the map and find out locations by reading the street names on the map.

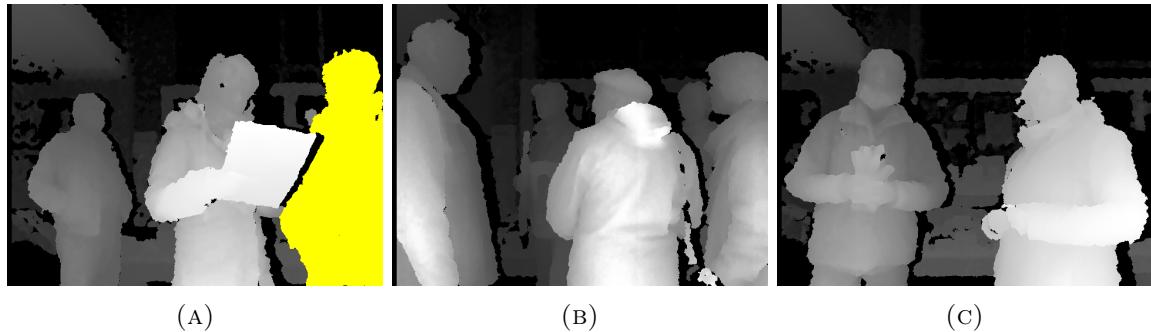


FIGURE 3.9: Passers-by Behaviors

As can be seen above, the first two pictures show that the display is completely ignored and people are busy with themselves. Picture C shows two couples are reading the screen.

3.6.2 Body Interactive findings

1. Attention Level measurements

The bellow chart shows the observation number of glances and ignores of passers-by for two distinct hours of five days. As can be seen the in most days the number of glances and ignores are almost near but not still ignores percentage is higher, as can be seen in the pie-chart %41.41 are the number of glances and around %59 is the number of ignores.

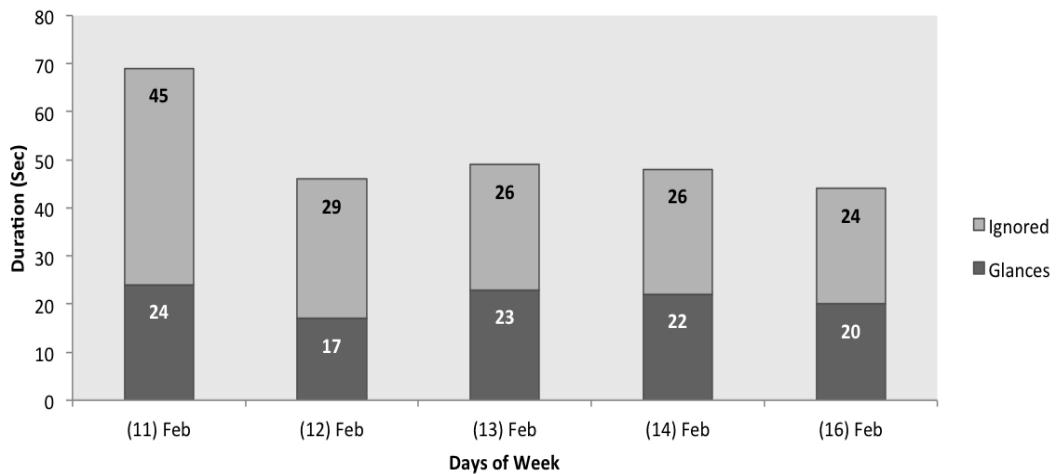


FIGURE 3.10: Attention level chart

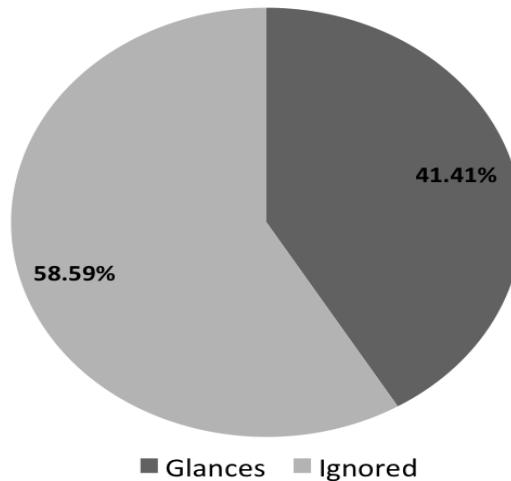


FIGURE 3.11: Body interactive Attention level percentage

2. Engagement phases and time

take average of single and group interaction time

There were passers-by who were very interested in the interaction that played the game even three times, some people triggered the game and left in the middle and some people were just staring at the screen and did not trigger the game, therefore people were engaged in different stages of the game and spent between (10, 200) seconds, and in average passers-by spent around 42 seconds.

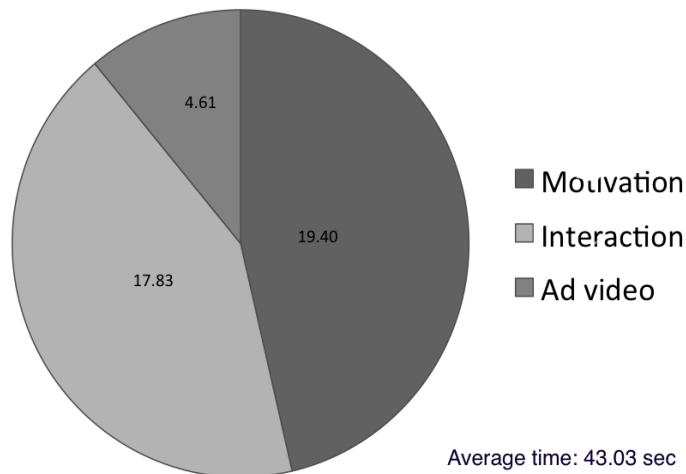


FIGURE 3.12: Average time for each phase

The advertisement was divided in three main sections (1) Attention / Motivation, which is the pre-interaction phase that the participant has not started the game and just playing with body or looking to the screen or reading call-to-action text, in this stage some people by just looking to the screen approached and started the interaction less than 5 seconds and some people took longer time to think and then triggered the game, at some occasions participants just left without triggering the game so in average it took around 20 seconds for this stage. (2) The interaction part in which people again took different times, some people played more than two or three times and some played the first element and left so in average it took about 18 seconds for this stage. (3) The advertisement video which had the least time spent most of the participants left the

screen after they saw the advertisement video in 2 seconds and some were excited to play again so they waited for a while In front of display until the end of advertisement video this was very rare among participants, so in average it took around 4.5 seconds for advertisement video.

3. Number of engaged passers-by

As mentioned before, for non-interactive the entire day's recordings were manually analyzed frame by frame from which the number of passers-by were counted. The bellow chart shows all the count of passers-by and out of those the people who stood in front the screen for more than 3 seconds were flagged as an engaged passer-by.

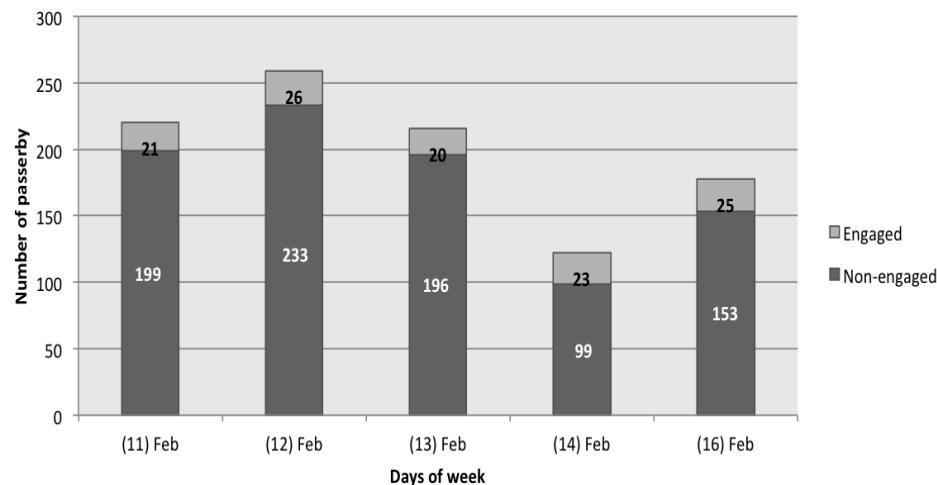


FIGURE 3.13: Body interactive Number of engaged passerby

As can be seen from the chart bellow the number of them are shown in bar chart for each of the day. And in average around %12 of the passers-by were engaged with the screen.

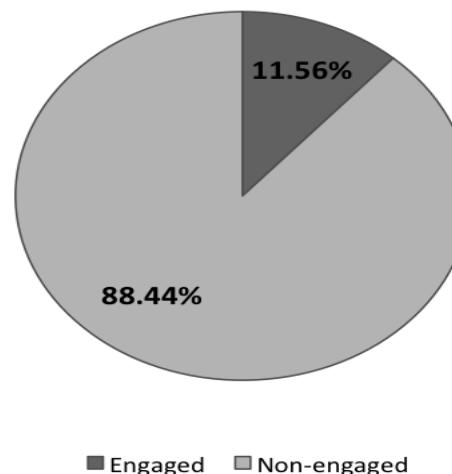


FIGURE 3.14: Percentage of engaged and non-engaged passers-by

4. Landing and Honeypot effects

Interactive displays are known from the most well known user behaviors, (1) honeypot effect and (2) landing effect because they drag passers-by attention significantly so that the passers-by be involved. In body interaction both of these effects were observed while direct observation and while depth recording analyzing. This was the most time consuming task ever and took about a week to analyze and document them.

As before landing effect was discussed, that a person recognizes the interactivity after he /she has already passed by the screen and as a result walks back to confirm if the interactivity is there and check what the display is about, and how to interact. In body interaction all of the landing effects has happened by noticing their silhouette on the screen and has turned back, these effects were observed for individual and group passers-by.

As can be seen in the picture in the right, in the first frame two persons are passing by the screen and one of them has not seen his self in the display even his silhouettes was projected, but the second person who has yellow color (A) notices the interactivity while his friend is still continuing to pass (B, C), but this guy who has noticed stops (colored changed by Kinect camera) in frame (C, D), his stopping drags his friend attention and at this point his friend notices the display and walks back to see his self in the screen (E).

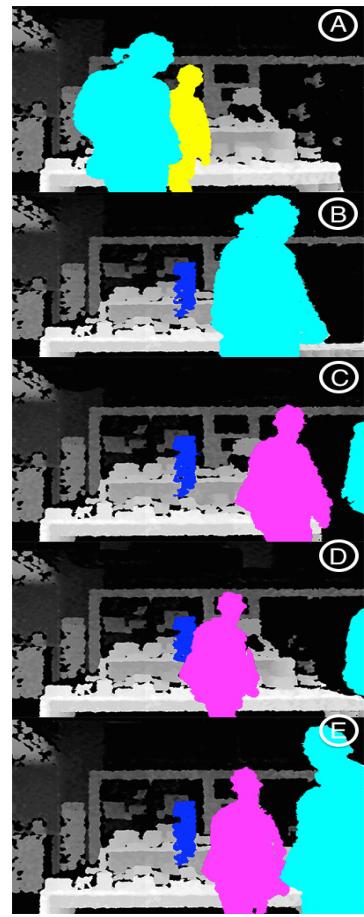


FIGURE 3.15: Landing effect

The honeypot effect is the effect, which other people are attracted by noticing the current people that are somehow involved (interacting) with the display. The people by whom the honeypot effect had occurred, were different, some people might have been in the initial interface by just playing with their silhouette, or they were actively interacting with the game or they were watching the advertisement video, that dragged the people's attention. The engagement duration was higher, as a result participants stood longer, which results in higher number of honeypot effects.

As can be seen in the picture on the left, a boy is interacting with the system in frame (A), the body moves a bit behind from the display in frame (B) at this time another random person who does not know him or has noticed before, tries to approach to the screen in frame (C) and then when the person sees his silhouette then he tries to actively to take control of the interaction by coming in the center of the screen in frame (D) and the other active person was left behind the scene.

The bellow chart lists all the frequencies of honeypot effect and landing effects that was recorded from the depth recordings

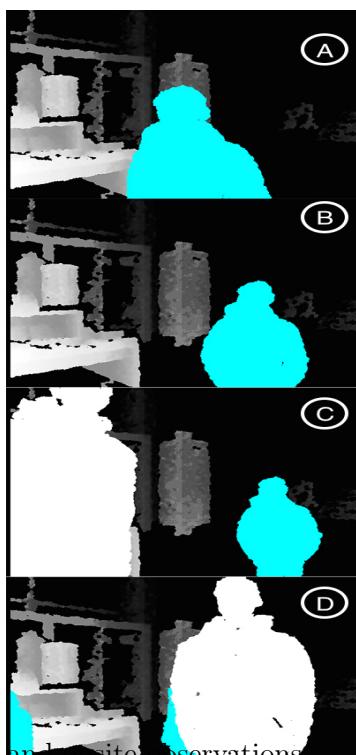


FIGURE 3.16: Honeypot Effect

TABLE 3.3: Landing and honeypot effects

Days	Landing effect	Honeypot effect
11 Feb	2	2
12 Feb	3	3
13 Feb	2	2
14 Feb	2	5
16 Feb	3	3

5. Interviews

The interviews were coded each individually and as a result the bellow categories are extracted, these categories are mainly taken from the questions and others are from the replies of the participants.

(a) Noticing

Different people had their different experience and reaction when they noticed themselves in the display for the first time. Some of the people were standing and looking some books for long time when they saw themselves and for confirmation they waved toward the screen, as one said “*Yes at first I thought that it is not me. I waved my hand and came near.*” Other said, “*Yes I saw my blue color body*”. Other participants noticed at the time of passing from front of the screen, “*when I was passing I saw myself in the screen.*” Other people saw their friend first then noticed themselves like one said, “*I saw my friend in the screen and came near and I was also there with blue color.*” One participant who usually comes to the center every week said that because the screen was newly installed I came near to the screen to see what is new inside.

(b) Ad recall

Respondents responded accurately the content and goal of the advertisement as one said, “*It was about a tour of Bauhaus, Bauhaus Spaziergang.*” “*It was about tour in the city.*” And other said, “*It was about Bauhaus-Walk. City tour.*” And other said, “*it is something to do with Bauhaus city walk*”.

(c) Interest

People find this type of interaction very interesting, funny and motivative, one participant mentioned that, “*I liked to see myself in the screen, it was funny.*” Other says the use of media is very interesting and comfortable for people, “*I think that the people with the use of media is comfortable*”. The use of this type of interactive advertisement give people some sort of good feeling toward Bauhaus-Walk event like one said, “*Bauhaus is very interested to me and it sounds fun*”. People also liked the way content was inside the advertisement like one said, “*It is very interesting to see the pictures*” and even one participant exactly mentioned the goal of the advertisement interaction, “*it was a very interesting idea and it is like a small interactive tour for the people who want to take Bauhaus-Walk.*”

(d) Event participation

Respondents showed sign of interest to join the program in future but are not able to join quickly because of many reasons like they are here for short visit as one said, “*We are here in Weimar for short visit*”, others said they are busy with many other programs like one said, “*Now we are going to Weimar Museum*”.

(e) Confusions

There was some confusion during interaction, like the interaction seemed unclear, one said, “*I did not understand how it works*” other said, “*I left because I did not*

understand" and some people also experienced this by coming very close to the screen and nothing is shown to them at that time, "*when I was standing I saw that it says come near, and I came near to the screen and the map came but I left after standing for a short time because I did not understand it.*"

(f) Dislikes

When a person hovers on a location in the map, a related picture is shown on the screen and deems off after a while, some participants complained about time and said, "*Pictures goes very fast*", one person complained about the rendering speed and said, "*Pictures come very late*".

(g) Recommendations

Respondents recommended that the advertisement should be able to hint users on how to use it, as one said, "*It would be good to put some more information that how we can use it.*" Other said that "*Maybe explain how someone can walk with these body figures*". One person even said, "*It is good that here someone stand and describe it to the people who come near to the screen.*" Some of the participants also recommended to slow down the picture changing of the advertisement.
fix the appendix

6. Other observations

During the body interactions despite honeypot and landing effect other different kinds of behaviors have been observed and how passers-by reacted when there was an interactive display, the behavior with the display was much different compared to non-interactive as listed bellow.

- Group and individual interactions:

Passers-by interacted both in groups and individual, the groups ranged from two to four people. %49 of engagement happened by individuals and %51 engaged were done in groups. The bellow pictures show different group interactions happening between friends as in picture (A, B) and another three persons interacting in picture (C, D).

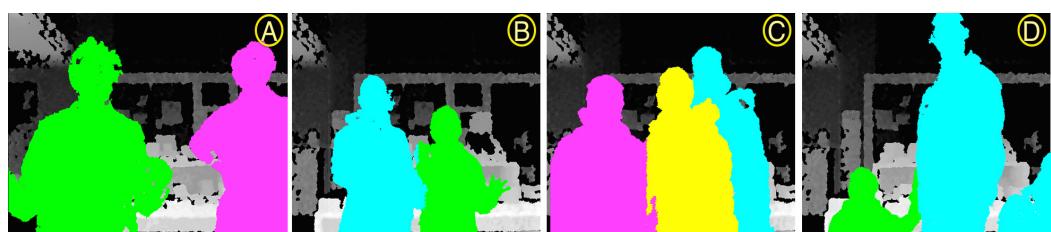


FIGURE 3.17: Group interactions

- Calling others:

People were getting really excited and liked to call his / her friends to come and join and have fun with the interaction, most of this reaction was seen between children and parents and couples. As can be seen in frame (A) a person is watching the display and then moves out in frame (B) and in frame (C) calls a friend of him/her and in frame (D) both of them are in center of the screen and watching themselves in it.

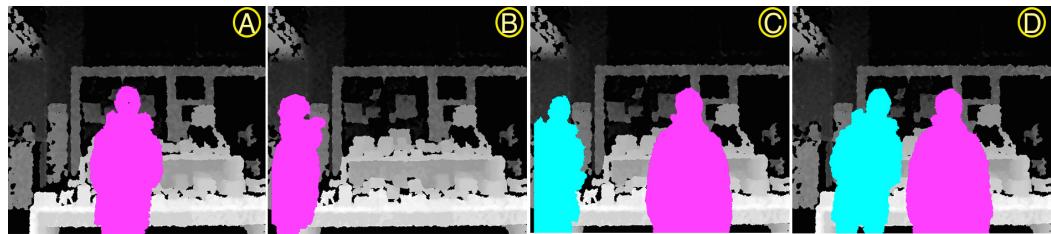


FIGURE 3.18: Calling others

- Playing with silhouette:

Passers-by liked the different colors specially when they were couples or children before they triggered the interaction. As can be seen in bellow picture there is a couple that likes to play with the different colors of their silhouette.



FIGURE 3.19: Playing with silhouette

- Interactivity confirmation:

People who saw their selves from far distance were not sure if the screen was interactive so they started waving their hands, body or their heads to see if their silhouette reacts to their movements. Some of the people did not apparently acted but progressively came near to screen like (spying) and then left. As can be seen in bellow frames, in (A) a person notices his/her silhouette and immediately raises hands in frame (B) and his fellow friend also notices and raises hand up in (C and D).

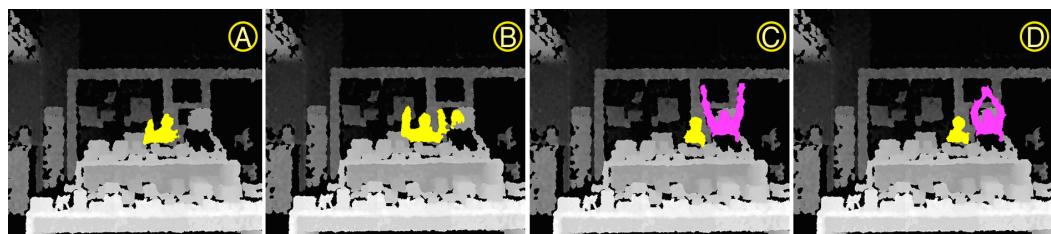


FIGURE 3.20: Noticing interactivity

- Raising hands up:

During the interactions some of participants raised their hands up mainly because of the alert message that was shown on top right corner of the screen if they were undetected by Kinect camera. As can be seen in the pictures that shows different frames people during interaction and prior to interaction are raising their hands up.



FIGURE 3.21: Raising hand

- Physical space domination

The people in front of the display were either interacting or either leaving the space by walking away or turning their face back from display, people felt some sort of influence of their presence in front of it.

- Call-to-action reaction

Most people came very close to the screen when approached by the application, this lead to confusion later in interaction because the camera could not longer track them.

- Interactions behaviors

The movement of silhouette during interaction is by moving forward / backward or left / right, some at early interaction leaned down or jumped higher to go forward or backward on the map.

- Incorrect expectations

Some passers-by who started the interaction using their body, expected that the screen should be working using touch, they tried many times to touch the elements, one of the main reason of this behavior seemed to relied on the fact that they were called to come near, and they felt became more personal with the display and the display which was small in dimension also provides the hint of being personal. Touch interaction is know to be more personal action than using body or other gestures.

- Interaction negligence (technology skeptical)

Some of the elder participants ignored the interaction even after understanding the call-to-action, and after interviewing them they responded that they did not know how that thing works, and after interviewing an employee of the tourist information, he said that the elders are a bit skeptical about the use of technology.

3.6.3 Mobile Interactive findings

1. Attention Level measurements

Attention attraction technique was quite similar to body interaction technique, which was projection passers-by silhouette but with a difference of access information text rendered on top, people would partially see their silhouette but still it was an attention mechanism, the measurement was done for five days each day for only two hours of direct observation.

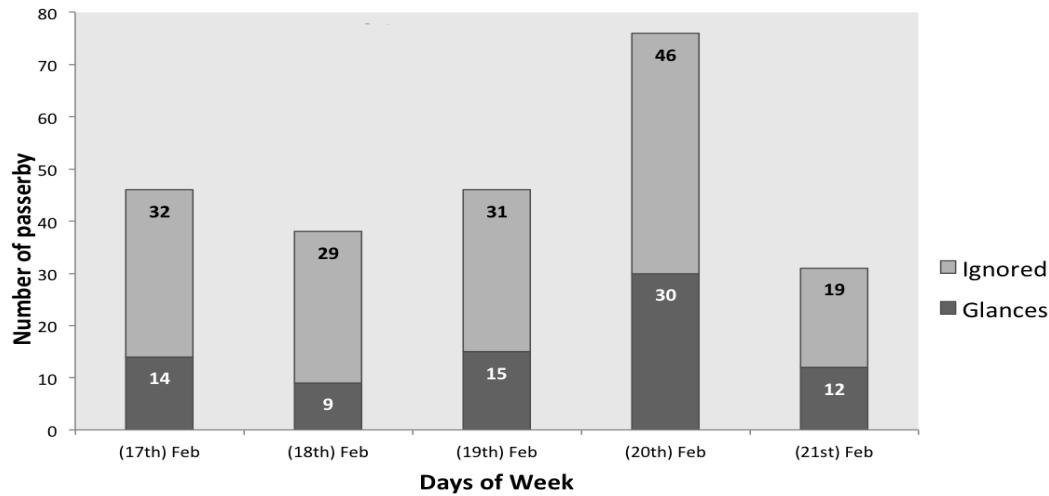


FIGURE 3.22: Mobile interactive attention level chart

As can be seen the number of glances have decreased compared to body interaction, since other things were not changed except for the access information so it could be the result of that, that people have not fully seen themselves or recognized.

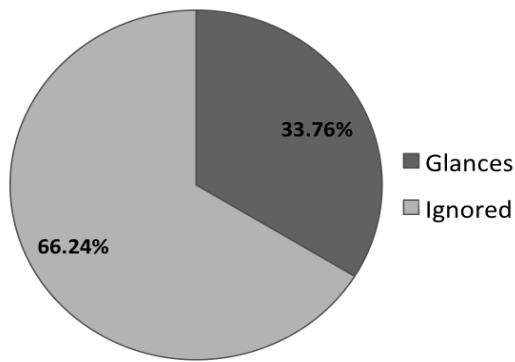


FIGURE 3.23: Attention level percentage

The percentage of the whole week of glances was around %34 and %66 of the cases the screen was ignored.

2. Engagement time

Although no passers-by interacted with the system, all of the participants were in the first screen of the advertisement that showed the Bauhaus-walk name and their silhouette. It took in average around 22 seconds to be engaged passively with the screen, which is less than non-interactive and body interactive applications.

3. Passerby and engagements

The entire five days were observed using the depth recordings and manually the number of passers-by were counted and from which the passers-by who stood for more than 3 seconds were flagged as engaged, as can be seen below in pie chart that shows one day each. Most of the passers-by stood for a very short time.

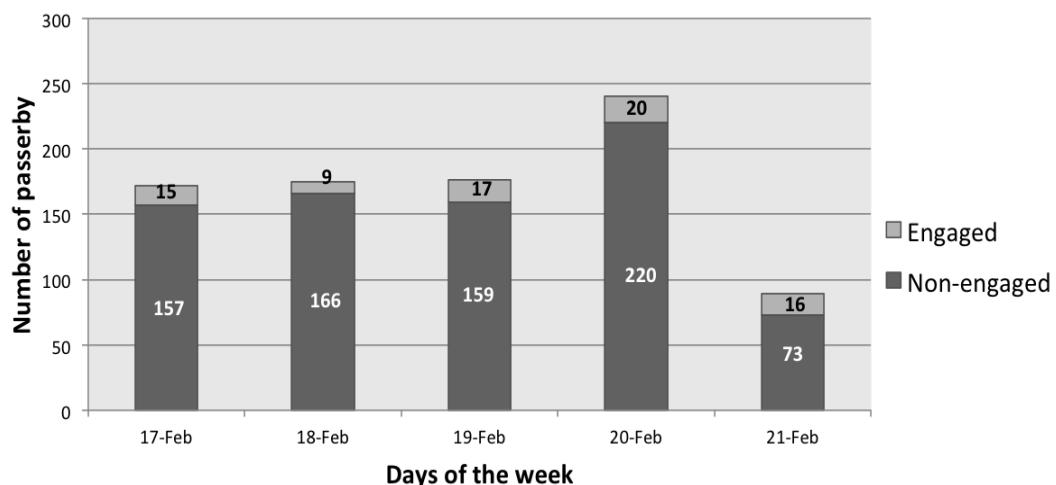


FIGURE 3.24: Mobile interactive Number of engaged passerby

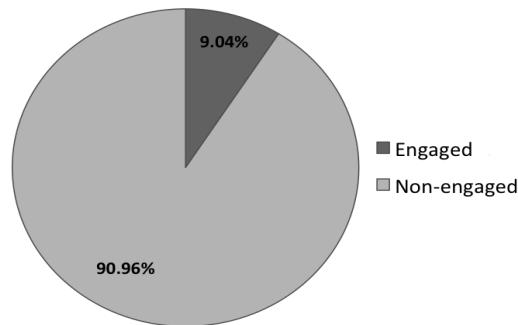


FIGURE 3.25: Percentage of engaged passerby

The pie chart above illustrates that only 9.04% of the passers-by were engaged with the system.

4. Landing and Honeypot effects

Landing and honeypot effects in this technique were very not strong enough mainly because no passers-by interacted with the system.

Honeypot effect was mainly because of the silhouette representation as said before this effect was very weak because of info-screen showed partial body representation, passers-by rarely noticed the text. Only two times honeypot effect occurred and people did not get

engaged with the system afterward. This effect could have been improved if passers-by had actively participated to play game. The picture bellow shows a green colored person at frame (A) at this point he was watching the screen for a while and when he moves out of the screen (B, C) another yellow colored person appears from the back side (C) and walks toward the screen (D, E) and gets close very close at frame (F).

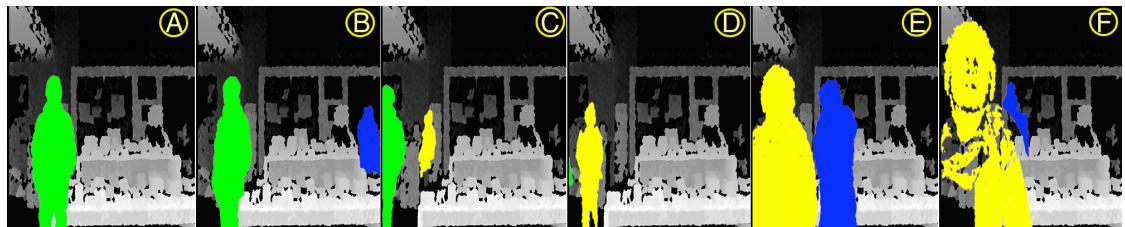


FIGURE 3.26: Honeypot effect

Landing effect was also recorded in some occasions and happened because they saw their silhouette, very less people noticed and most ignored. As shown in the picture from right to left a person is crossing the screen (A – E) but on frame (F) stops and move a little back to see what is on the screen. The person does not entirely come in the center of the screen. The passers-by left after standing in front of the screen without any interaction.



FIGURE 3.27: Landing effect

The bellow table shows the number of honeypot and landing effects that happened during the five days.

TABLE 3.4: Mobile Interactive Landing and honeypot effect

Days	Landing effect	Honeypot effect
17 Feb	0	1
18 Feb	1	0
19 Feb	2	0
20 Feb	0	0
21 Feb	1	1

5. Interviews

complete the interview report

6. Other observations

fix Appendix and put some picture frames

Passers-by were attracted to the system when they saw their silhouette, which was kind of similar to the body interaction technique. The below are behaviors people had with the system.

- Curiosity

Passers-by who noticed showed curiosity and tried to come near to the screen or started waving their hands toward the screen.

- Playful

Most of the kids that noticed, felt excited only to see their different colored silhouette and even at some point started to dance in group.

- Interaction ignoring

All the people who were attracted ignored to interact, that could have many different reasons, like the lack of enough knowledge of how to do, or not having mobile phones or not interested to play, as one of them were interviewed he said that he does not use phone in public he only uses it for calling.

- Scanning code

During five days only two persons tried to scan the QR-code and after scanning they just left.

3.6.4 Comparison of advertisements

This section compares different findings of each condition as listed below one by one.

Number of passers-by

Advertisements techniques were not conducted in the same days, this could ruin comparison of them in between because maybe different number of passers-by have passed in those weeks, therefore, there was a need to first compare the number of passers-by and prove that they were not statistically different in between.

Hypothesis:

- **H0:** There was no difference between numbers of passerby of each conditions.
- **H1:** There was a difference between numbers of passerby of each conditions.

The below is the table of passerby for three weeks.

TABLE 3.5: Number of passerby in three weeks

Days	Non-interactive	Body	Mobile
Day 1	232	178	172
Day 2	170	220	175
Day 3	212	259	176
Day 4	209	216	240
Day 5	208	122	89
Total	1031	995	852

ANOVA test revealed that there is no significant different of passers-by between each of the conditions. ($F_{2,5}=0.8873$, $p > .05$ ($p=0.437$) So based on this the H_0 hypothesis is being accepted and H_1 hypothesis is being rejected. This gives us confidence to proceed our comparisons.

Attention Level Comparison

As can be seen Non-interactive had %28.83 number of glances, the Body-interaction had almost %10 high number of glances (%38.70) than non-interactive, The mobile Interaction had higher glances (%33.75) from non-interactive but still less than body interaction. With this I can not conclude that body interaction had higher until it statistically proven.

To compare which of the three methods drove more passers-by attention, the data of number of glances for each of the weeks were gathered as below and first Chi square test were applied to find if they were statistically different or not.

Hypothesis:

- **H0:** There was no difference between numbers of passerby of each condition.
- **H1:** There was a difference between numbers of passerby of each condition.

TABLE 3.6: Cross tabulation for each week attention level

Methods	Glanced (%)	Ignored	Total
Non-interactive	111(%28.83)	274	385
Body interactive	106 (%41.41)	150	256
Mobile interactive	80 (%33.75)	157	237
Total	297	581	878

The Chi-squared test reveals that $\chi^2(2, N=878)=10.863, p < .05 (p=.004376)$, meaning that there is a difference so H_0 is rejected and H_1 hypothesis would be accepted. To find that where actual difference was, each pairs were tested in between using again Chi-squared test.

1. Non-Interactive Vs Body Interactive

The finding shows that body interactive advertisement had significant number of glances than non-interactive advertisement.

$$\chi^2(1, N=641)=10.8581, p < .005 (p=.000984)$$

2. Non-Interactive Vs Mobile Interactive

The finding suggests that there was no significant difference between Non-interactive and mobile in this case.

$$\chi^2(1, N=622)=1.6716, p > .05 (p=.196039)$$

3. Body interactive Vs Mobile Interactive

As can be expected the glances was not statistically significant among the body and mobile interactive advertisement too.

$$\chi^2(1, N=493)=3.0663, p > .05 (p=.07993)$$

Engaged and Non-engaged passers-by

This test is to compare if there was a difference between number of Engaged passers-by or not between the conditions.

Hypothesis:

- **H0:** There was no difference between the numbers of Engaged passers-by between the conditions.
- **H1:** There was a difference between the numbers of Engaged passers-by between in each conditions.

The bellow table lists all number of engaged and non-engaged passers-by for three weeks.

TABLE 3.7: Number of engaged passers-by in three weeks

Days	Non-interactive	Body	Mobile
Day 1	16	25	15
Day 2	18	21	9
Day 3	15	26	17
Day 4	15	20	20
Day 5	15	23	16
Total	79	115	77

The ANOVA test strongly suggests that there was a significant difference of the number of Engaged passers-by between these three conditions.

$$(F_{2,5})=11.20, p < .05 (p=.002)$$

To find where were the main difference between them, the Post-Hoc Tukey's HSD test was conducted on each three pairs of the conditions to point out which of them exhibit statistically significant difference.

TABLE 3.8: Post-Hoc Tukey's HSD

Methods	Tukey HSD Q statistic	Tukey HSD p-value	Tukey HSD inference
A vs B	5.6337	0.0047509	** p<0.01
A vs C	0.3130	0.8999947	insignificant
B vs C	5.9467	0.0032197	** p<0.01

Method A, B and C refers to (Non-interactive, body interactive and mobile interactive) advertisement accordingly. As can be seen from the above chart, there is no significant difference between group A and C, but group B shows a significant difference between A and C. it shows that the body interactive advertisement engaged significantly more passers-by than other two types of advertisement.

explain HSD Q statistic value

Landing effect

The bellow table shows how many landing effects were recorded from the depth observation video for each of the weeks.

Hypothesis:

- **H0:** There was no difference between the number of landing effect of Passers-by for each condition.
- **H1:** There was a difference between the number of landing effect of Passers-by for each condition.

TABLE 3.9: Number of Landing effect in three weeks

Days	Non-interactive	Body	Mobile
Day 1	1	2	0
Day 2	0	3	1
Day 3	2	2	2
Day 4	0	2	0
Day 5	1	3	1

ANOVA test reveals that there was a significant difference between one or two above conditions, ($F_{2,5}=7.529, p < .05 (p=.008)$). So I reject the Null hypothesis and state that one of the above conditions were statistically significant from the others, to confirm this I again run Post-Hoc Tukey's HSD test on the above data to find out exactly which one was different.

TABLE 3.10: Post-Hoc Tukey's HSD results

Methods	Tukey HSD Q statistic	Tukey HSD p-value	Tukey HSD inference
A vs B	4.7527	0.0144554	* p<0.05
A vs C	0.0000	0.8999947	insignificant
B vs C	5.9467	0.0144554	* p<0.05

Group A, B and C refers to (Non-interactive, body interactive and mobile interactive) advertisement accordingly As can be seen the test shows that the condition A and C were insignificant but condition B is significant from A and C, which means that body interactive advertisement has statistically higher landing effects than other two conditions.

Honeypot effect

The bellow table shows how many honeypot effects were recorded from the depth observation video for three conditions.

Hypothesis:

- **H0:** There is no significant difference between the numbers of honeypot effect for the conditions.
- **H1:** There is significant difference between the numbers of honeypot effect for the conditions.

TABLE 3.11: Number of Honeypot effect in three weeks

Days	Non-interactive	Body	Mobile
Day 1	1	2	1
Day 2	1	3	0
Day 3	2	2	0
Day 4	2	5	0
Day 5	1	3	1

ANOVA test reveals that there is a significant different between the conditions, ($F(2,5)=12.29$, $p <.05$ ($p=.001$)), and after doing Post-hoc Tukey test it revealed that there was significant difference of Honeypot between Body Interactive and Mobile interactive advertisement, but less statistical different between Non-interactive and body interactive as the online tool gave one star for A and B and two stars for B and C.

TABLE 3.12: Post-Hoc Tukey's HSD results

Methods	Tukey HSD Q statistic	Tukey HSD p-value	Tukey HSD inference
A vs B	4.2762	0.0264780	* p<0.05
A vs C	2.6726	0.1836687	insignificant
B vs C	6.9488	0.0010053	** p<0.01

3.7 Discussion

As in non-interactive, the phases were automatically triggered one after another in sequence of time, and passers-by might have encountered to different phases in different occasions and this could have influenced the attention level because not all the phases had the same interfaces, in the first phase the screen did not have enough movement and the other phases had more pictures, movements and colors, but there was a higher chance of encounters of passers-by with the second two interfaces because of the durations they were shown like, the first phase was only for 5 seconds and the others were for 20 to 40 seconds. While on other hand in interactive advertisements, passers-by had more encounters with the first phase because of the silhouette representation, this phase did not have any time limitation until the game interaction was not started.

Engagement of passers-by with the system were also different in three conditions, in non-interactive people might be engaged in watching the two phases (map and video phases) and in body-interactive in the first two phases (attraction, map phases) and in mobile interaction, the engagement was only in the first phase (attraction). Despite these difference in all the phases the Bauhaus-Walk logo and goal of the event was mentioned, people still could understand that what was the advertisement about.

Honeypot effect was more seen in interactive advertisement compared to non-interactive one of the reasons could be, *Interaction movement*, passers-by perform interactions that involve body movement and the movements can attract other nearby, while in non-interactive there were very limited movement. The landing effect was also significant in interactive compared to non-interactive. One of the main reasons could be that in non-interactive passers-by could have encountered in different phases of display and some of the phases might have been interested or more attractive and they performed landing, and in other phases they might have not performed landing effect at all, while in interactive advertisement, passers-by had performed landing effect in the first phase (silhouette representation) and in this case also not all had landed back to screen some people might have liked it and some might not.

In body interactive advertisement, People did not stay longer than 4.61 seconds to watch the video, which is very less compared to the interactive phases (game, silhouette). There could be many reasons for this, (1) *interaction disturbance*, The video phase is a disturbance to participants interaction and I believe that no one likes to be disturbed while they are busy with something, (2) *End of Fun*, by showing the ad video, the participant loses that interest and enjoyments while he/she had during the interaction, (3) *dis-connectivity*, the person feels disconnected to the screen and there is no more place for him/her in display, (4) *Force to watch*, the person feels the direct force to watch the advertisement video, (5) *Time consuming*, participant might think that it will take time to watch till the end of video (6) *Traditional ad effect*, it has the feeling of traditional TV or radio advertising like, in the middle of a movie an advertising video is shown, which people often do something else till the movie start again.

In Mobile interactive advertisement no one interacted with the game using their mobile phone, this could have many reasons, (1) *feel of Insecurity and trust*, smartphones are used by people for calling, messaging, note-taking, emailing, videoing, photographing and for other personal usages, therefore people feel insecure to use their smartphones in public spaces so that their personal belonging might not be theft by other people, in this case the owner of the advertising screen, (2) *Limited technical knowledge*, not all people have technical knowledge about the use of smartphone, specially the elder people, who can only use it for calling or texting, but not connecting to internet or playing games, (3) *Lack of smartphones*, elder people still use their old mobile phones, which does not have Wi-Fi or browser capabilities,

(4) *Physical setup*, the screen was placed in pathway, where people walk often, there is not a comfortable area to sit, connect to system and interact with the game, (5) *Time consuming*, the use of phone and specially a game is considered to be time consuming process, and people in Tourist information center do not have that much time to take their phone and play, (6) *Confusion*, the attraction method was with the use of body silhouette representation, and the interaction was with mobile phone, which might have confused passers-by.

3.8 Conclusion

This chapter concludes the findings and observations of three different advertisement techniques from which one was non-interactive and two of the others were interactive as described below.

Non-interactive advertisement in tourist information was very quiet, people reacted normally, the sense of joy and excitement was not felt with display, participants selectively stood and read the advertisement for a short period of time and most of others ignored the displays, around 1/4 passers by glanced in each two hours of observation, %7.6 passers-by were engaged among all the passers-by in the entire days of week and spent 34 seconds in average, people liked the design of the interface, but also complained about the speed and theme of content.

Body interactive advertisement started with joy and fun, the behavior toward the screen was different from the non-interactive, attention level was about %41.41 that passers-by glanced toward display, and people among all passers-by during the week %12 of them were engaged that took 42 seconds in average.

Many landing effects and honeypot effects were observed and beside that, people reacted differently to notice the interactivity and approached toward the screen, the interactions happened individually and in groups, the attraction attention method was appreciated and participants understood how to trigger the interaction mode. In this technique a lot of passers-by seemed to be active at front of the monitor, the physical space around the screen directly had influenced the people behaviors, people called other friends to join the interaction and raised a sense of awareness around.

Mobile interaction technique was one of techniques that did not really find its value in the environment, except for the attraction attention area, no one interacted with the system and no one were motivated to try at-least for one time, but still people were interested to see their silhouette and spent a little time in front of the display. %33 of passers-by glanced and among all passers-by during the week only %9 of them were engaged within 22 second in average.

At the conclusion from the findings and observations and comparisons of all three different techniques body interaction technique was the most statistically attractive, which received higher number of glances, increased the number of whole passers-by to be engaged, increased the duration of engagement and raised number of honeypot and landing effects. This technique was one of the most acceptable and preferred techniques for interaction in the area by participants. The use of ad video after body interaction is not suitable for interaction design, else participants would leave the interaction quickly, The video could be embedded inside the interaction phase for a short period of time should not occlude the silhouette so that the person do not feel disconnected with the advertisement. The non-interactive and mobile interactive findings were not significant and I believe that mobile interactive advertisement would be significant if it is installed in a location that is comfortable for people to sit and take time to interact and the target audience should be more from young generation, who are more familiar with the technologies.

4

Advertisement enhancement

4.1 Introduction

The very first phase to get passers-by engaged with the display is the getting their attention first. In previous experiment during the course of five days, only %12 of the entire of passers-by were attracted and engaged, there could be many reasons, (1) the passers-by could not see their silhouette until got very close to the display and camera and by that time the passers-by might have turned his/her face from the display without looking to their silhouette, (2) Passing by the screen happens within 2 or 3 seconds and that is not enough for passers-by to understand interactivity quickly. [get the quotation](#), (3) from the observations made during three weeks, most passers-by turned their faces toward the table, which was located in front of the display, and walked around the table to look for books.

Because of the mentioned main issues and the attraction of less number of passers-by, this chapter discusses on the extended version of attracting attention design to enhance the attention level of passers-by who were far or at corner of display and still could be tracked by display. The chapter also discusses on the study design and evaluation of this technique and meanwhile compares this technique with the previous technique to see the effectiveness and advantages.

4.2 Enhanced attracting attention

The change in the new version was to extend the tracking area about 180 degree around display, this would over come the issues pointed before, because when passers-by walk from the sides the camera can track them and the application can project their silhouette, by doing this there will be enough time for passers-by to get attracted while coming toward display.

To achieve this, three Kinect cameras were integrated in the sides and in the center of the display and the tracked passers-by silhouette images were stacked together and shown on the display, a person passing from the side could see his self at the side of the screen and when moving to the middle of the screen the application could smoothly transition the person from side camera to the center camera by having the same silhouette color, physically the cameras were positioned side-by-side, therefor there was a small gap for each camera range, which was also not perceivable by passers-by. See the picture bellow to have a glance to the design.

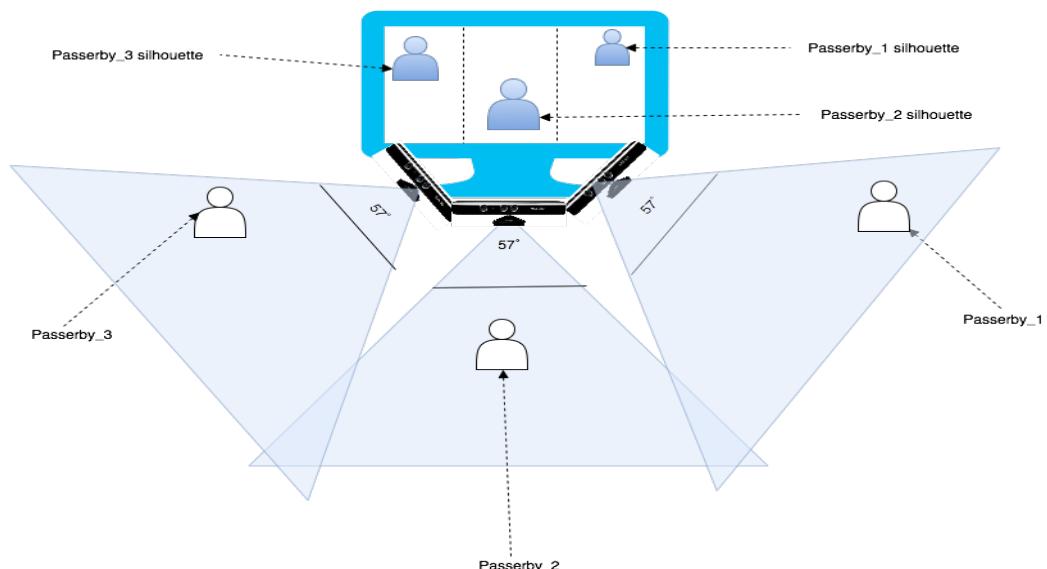


FIGURE 4.1: Attracting attention extended version.

4.3 Interaction design

The interaction design for the extended version is completely the same as the body interaction design that was introduced in chapter 7, it consists of seven phases, (1) Passing by phase, (2) Implicit interaction phase, (3) Subtle interaction phase, (4) Direct body interaction phase, (5) Watch ad video phase, (6) multi interaction phase, and (7) Follow up action phase. The range for implicit interaction phase is extended in both sides shown in gray color, which attracts passers-by from the sides of the display and also allows participants to do implicit interaction like playing with the body silhouette, and whenever users enter in subtle interaction zone shown in white color, then the display motivates users with call-to-action feature toward display for direction interaction and after interaction a short video is shown and then again participants can follow the interaction or be involved in other activities.

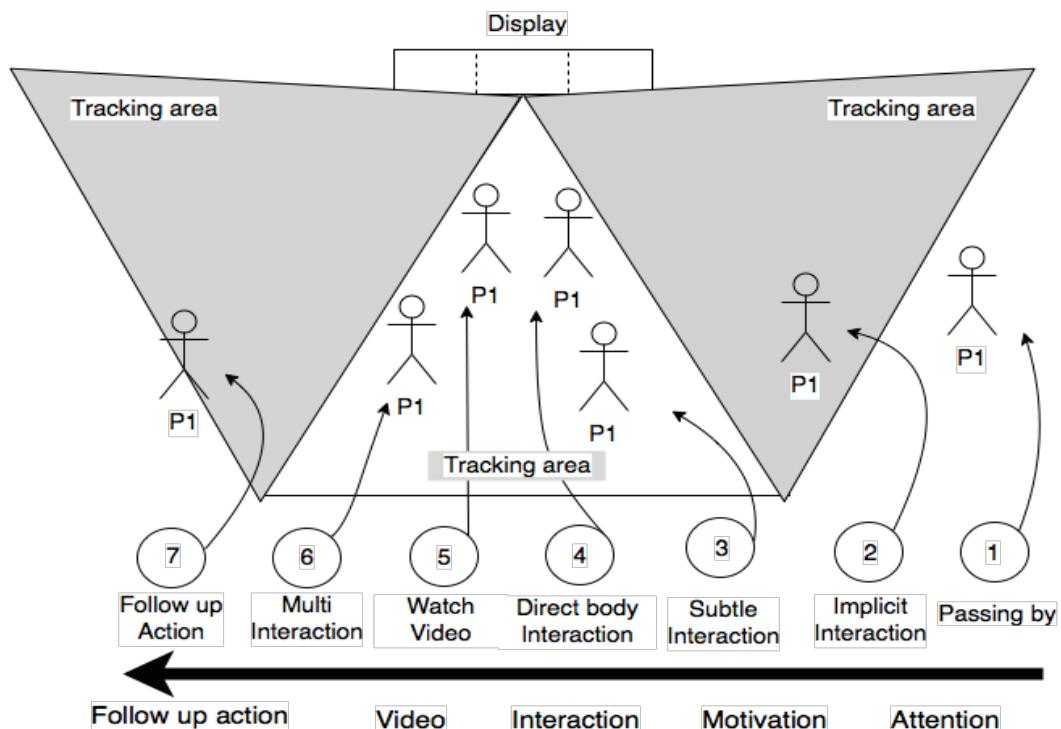


FIGURE 4.2: Extended Interaction design

4.4 Research question

This experiment was conducted to find out that what are the major effects when the coverage area is expanded in both right and left side of the screen, compared to the previous body interaction.

1. Would the attention level change?
2. Would the number of engaged passers-by increase?
3. Would the average engagement time rise?
4. Would there be any changes in number of Honeypot and landing effect?
5. What would be the passers-by behaviors to the display?

4.5 Study design

4.5.1 Location

This experiment was conducted in the same location that was chosen in previous location, it was positioned in the same pathway of passers-by with the same height and screen brightness. The surrounding of the display was also kept similar like the previous.

4.5.2 Duration

This experiment was conducted only for three continues days at end of the week, Friday, Saturday, Sunday.

4.5.3 Participants

The participants were from Tourist information center; they were not informed that there is an interactive screen. Most of the participants were of old age, and the rest were middle aged and young aged participants.

4.5.4 Data gathering

The bellow types of data were gathered during three days.

1. On-Site Observation

Observation periods were selected the same as the previous study, from 10:00 – 12:00 and the second was from 14:00 – 16:00, During these two time slots the bellow observations were made.

(a) Attention Level measurement

Number of glances and number of ignores were counted by observing the passers-by from a fixed location, anyone who turned his/her face toward the display for less than 3 seconds were counted as glance, and those who had not turned their faces at all where selected as ignored. see the full report of glances in Appendix.
fix the appendix

(b) Passerby behavior

The behaviors of the passers-by were observed by direct observation onsite and also from the Camera depth recorded frames. From the observation two important effects were taken in consideration (honeypot and landing effect).

2. Colored-image recording

A 2D colored image was taken per second from each of three cameras, and meanwhile were joint together side-by-side and after the image recording was done, in lab another post processing script was applied to integrate a static background using Adobe Photoshop application. To match the data logs and the image frames, each image name consisted time as (12.43.21.png). Below three Kinect images stacked together, as can be seen that people's colored images was rendered on the images (1,2 and 3) these images are stacked together so that the transition of one person be smooth from one camera to the other.

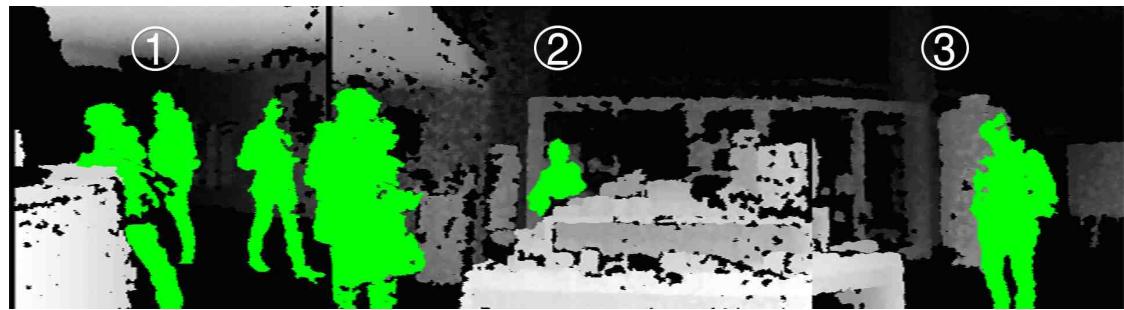


FIGURE 4.3: Three Kinect images

4.6 Findings and results

This section first lists all the findings for enhanced version of advertisement then it compares it with the previous interactive advertisement.

4.6.1 Attention Level measurements

The bellow chart shows the number of glances and ignore for the following three days.

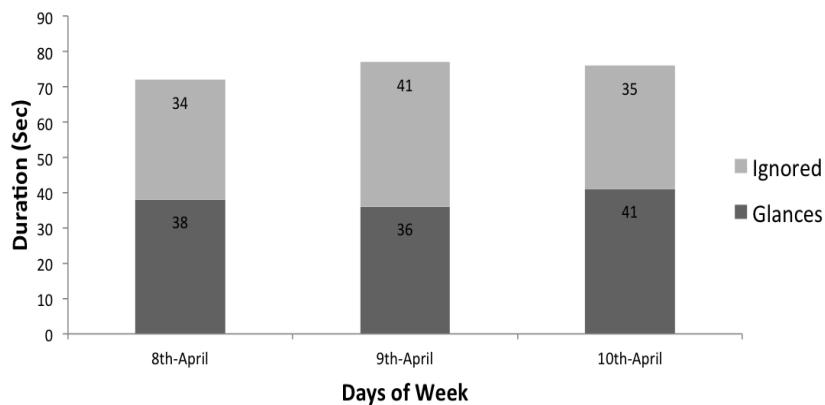


FIGURE 4.4: Attention level chart

As can be seen from the above chart every day has almost similar number of glances and ignores and in average it makes about %51 glances and %49 ignores.

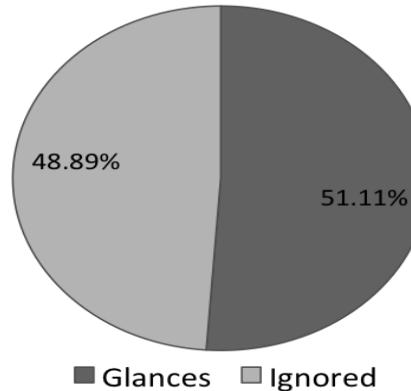


FIGURE 4.5: Attention level percentage

4.6.2 Engagement phases and time

The engagement time for phases were measured from system logs and depth recording manually and in which people spent 16.10 seconds in average for the Attraction/Motivation phase some people took longer and some shorter, and some of them may have left without switching to the rest phases. 16.20 seconds in average was spent for interaction phase, which was different from person to person, and only 3.63 seconds in average was spent for video advertisement.

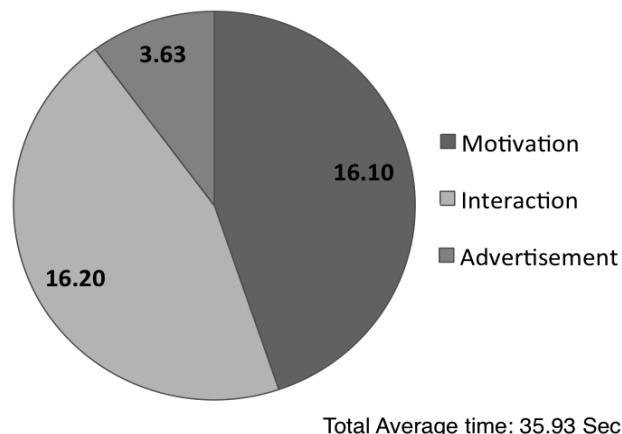


FIGURE 4.6: Average time for each phase

The entire average engagement duration for all these three phases together, was around 36 seconds.

4.6.3 Number of engaged passers-by

The entire three day's recordings were manually analyzed frame by frame from which the number of passers-by were counted. The bellow chart shows all the count of passers-by and out of those the people who stood in front the screen for more than 3 seconds were flagged as an engaged passer-by.

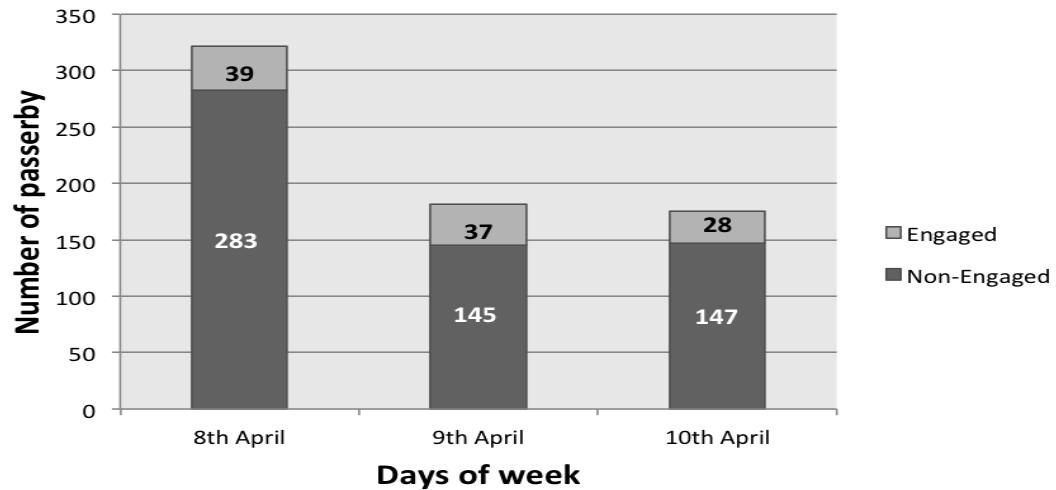


FIGURE 4.7: Number of engaged passers-by

From entire passers-by %15.32 of them were engaged with the display and the rest might have only glanced or simply ignored as shown in the chart bellow.

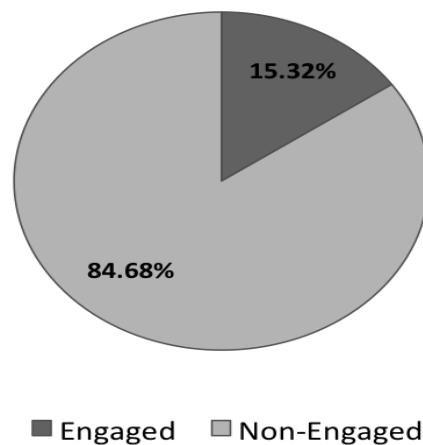


FIGURE 4.8: Percentage of engaged and non-engaged passers-by

4.6.4 Landing and Honeypot effects

Although the number of days were only for three days, but Landing effects [11] and Honeypot effects[14] were observed for this type of technique and they were not as strong as in previous interaction technique. See the example frames bellow.

- Honeypot Effect:

As can be seen from the picture in the right, which is composed of three kinect images that has covered right and left and the center of the display. In first frame (A) in the middle of the screen two persons are engaged and interacting for some time and a women at the left is busy with the help desk, but she is curious about the screen and has got attracted toward the screen, and she has looked many times in previous frames, in frame (B) the two guys leave the interaction and walk away from the screen and the application is left alone, and in frame (C) that women is left alone and is watching her self in the screen, and then approaches toward the screen in frame (D), she is near to the screen and I guess realizes that the screen is in fact interactive and in frame (E) she comes closer and starts actively interaction in frame (F).

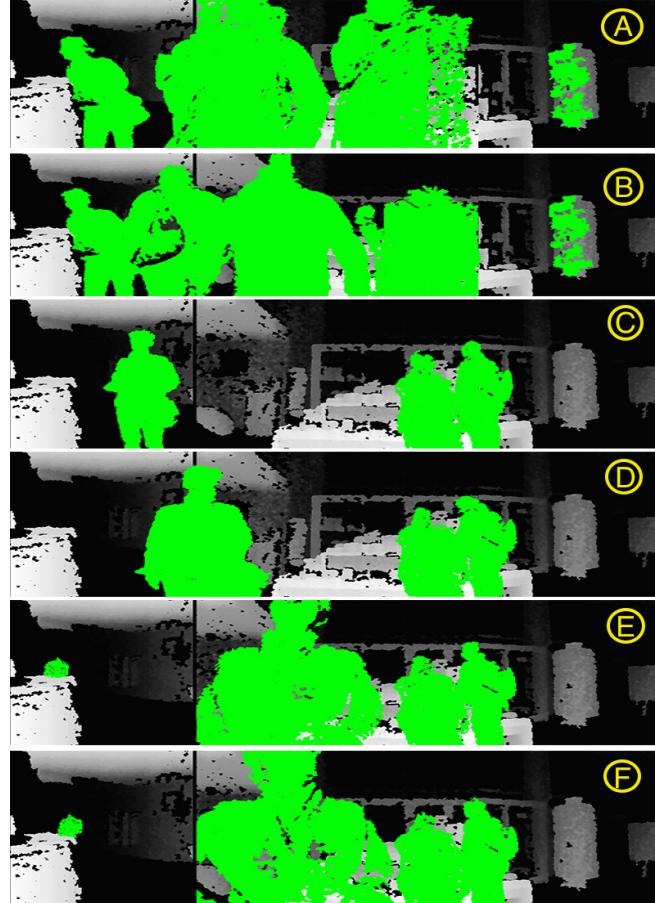


FIGURE 4.9: Honeypot effect

- Landing Effect:

Few landing effects had also happened, which were similar to the previous experiment with one camera. The landing effect has happened differently like, some noticed the interactivity in the middle and stopped by the display, and some noticed the interactivity at the very corner of the display and then moved back toward. As can be seen in the picture in the right, there is a lady (the camera could not capture the entire body of her, maybe because of the sun light), the lady is passing by the screen from frame (A – D) continuously and notices the screen interactivity in frame (E) and stops at her position and when she realizes then she moves gets closer to the screen in frame (F) and reaches the middle of the screen at frame (G) and starts to explore the interaction and game.

- Numbers of Honeypot and Landing Effects:

The chart bellow shows the frequencies of landing and honeypot effects for three days.

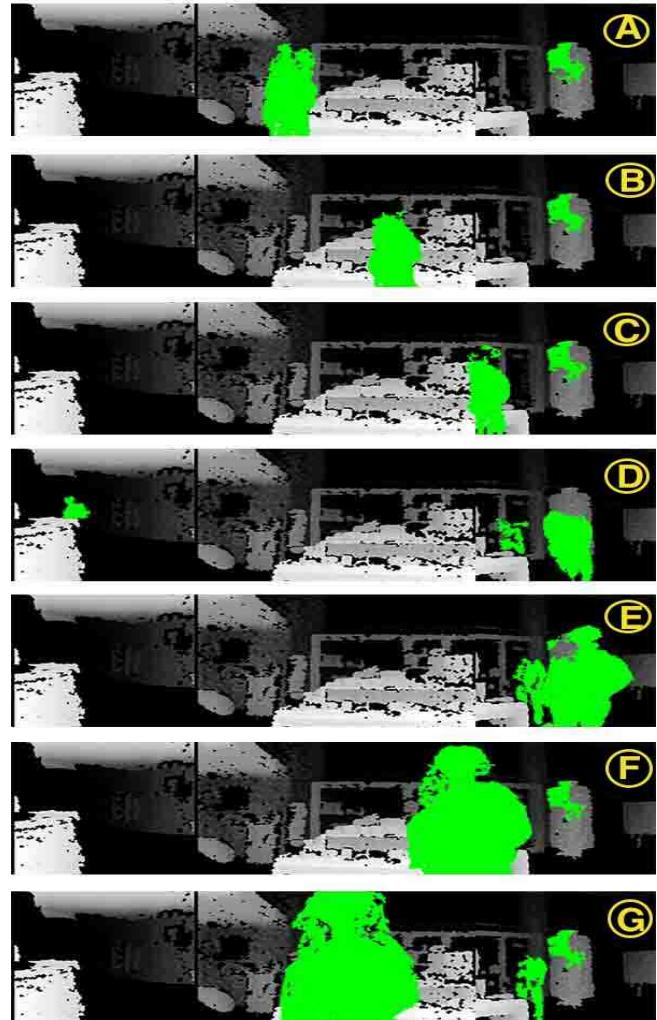


FIGURE 4.10: Landing effect

Days	Landing effect	Honeypot effect
8th April	3	3
9th April	2	5
10th April	1	2

4.6.5 Other observations

Beside the above behaviors there were other observations recorded too as they are listed bellow.

- Calling Others:

When a person is engaged with the display and is more excited about it, the person will most likely call his / her friend or family to see and give it a try.

Few of this calling effect have occurred in this enhanced version too, as you can see the picture in the right, in frame (A) a lady was engaged with the screen for a while and is standing in the middle of the screen, and then she calls his friend who is standing very far from the display and is busy with looking to some books, she turns her self toward her friend in frame (B) and seems to be talking to him in frame (C) and her friend leaves his work and starts to look at her in frame (C) and moves toward the screen in frame (D) while the lady is back busy with the screen, when her friend comes closer to the screen in frame (E) she gives a bit space for him to let him see by moving a bit back in frame (F), and finally her friend is also attracted and experiencing with the advertisement in frame (G).

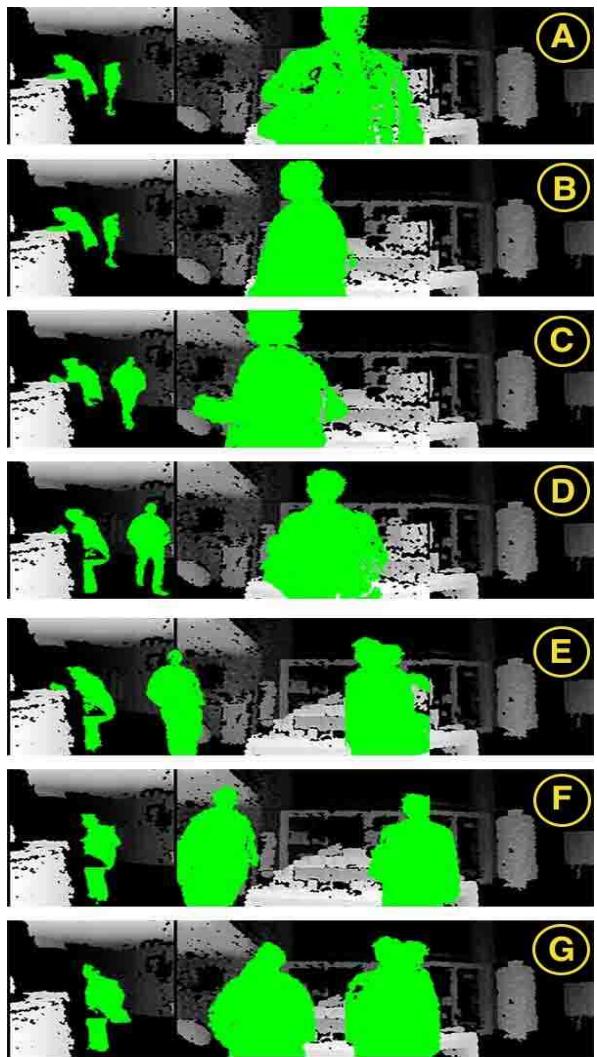


FIGURE 4.11: Calling others

- Noticing Interactivity earlier:

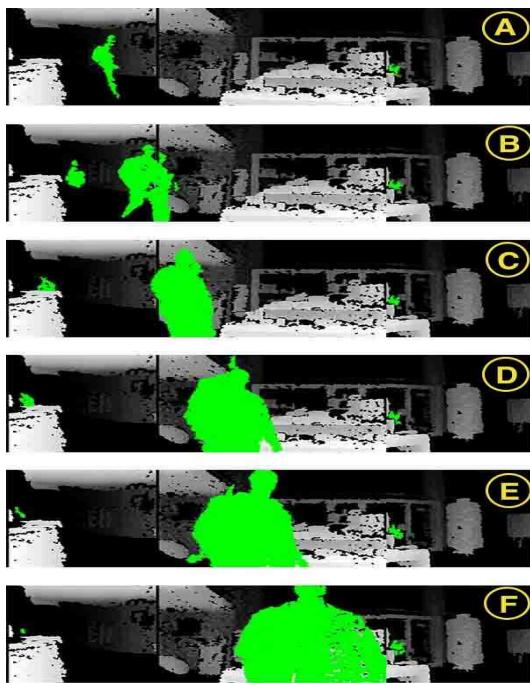


FIGURE 4.12: Noticing interactivity earlier.

Passers-by also directly came from the corners of display without showing any landing effect toward the screen and started interacting, this effect might be because of when they were passing by the screen had noticed themselves on the screen from the first camera, which was faced toward the side of the display, so it is assumed that they understood the interactivity and then came in the center of the display and started interacting. As can be seen from the image at the left side, a person is walking by from the left side in frame (A) and continues his walking toward the screen and gets closer and closer toward the middle of the screen, he is not passing by the screen by he intentionally

stops in the middle and starts interacting.

- Side interaction:

The integration of Kinect cameras at the side provided passers-by or people who were standing at the side of the display and did not or could not come close to the screen, were still able to have some sort of bound or connection with the system, this feature provided a sense of safety comfort zone for them to stay back and still be able to interact passively.

As can be seen in the picture in the right, there is a girl standing at the left side of the picture, she was standing with her parents in the information desk, and she recognizes herself in the screen and waves her hand first to see if it is actually her, and then starts to play with her silhouette on the screen and have fun.

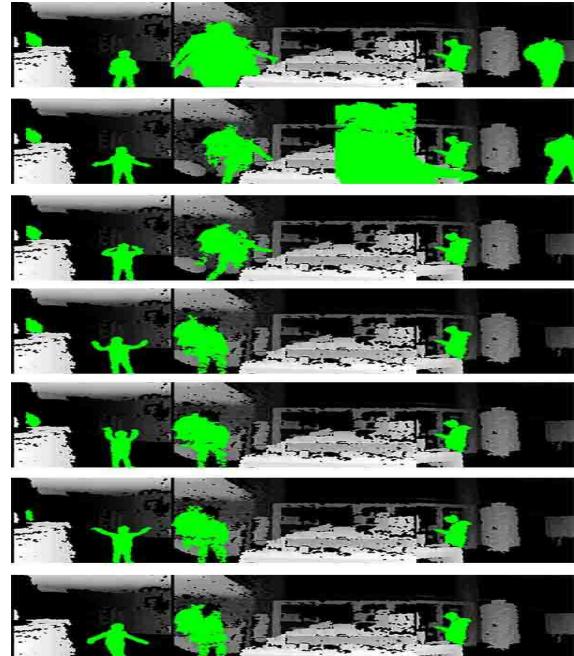


FIGURE 4.13: Side interaction

4.6.6 Comparison

This section compares the results and findings of the enhanced version of advertisement version with the previous advertisement, which could only track the middle screen of the display.

1. Comparison of number of passers-by

To be on safe side that the number of participants were statistically the same, the below computation has been applied on three similar days, which provides the base for further evaluations.

TABLE 4.1: Number of people for three conditions

Days	Non-Interactive	Body Interactive	Enhanced body Interactive
Day 1	212	259	322
Day 2	209	216	182
Day 3	208	122	175
Total	629	597	679

ANOVA test revealed that there was no statistical significant difference between the passers-by in each of the conditions ($(F_{2,3})=0.1449, p > .05 (p=0.868)$)

2. Attention Level comparison

The number of glances and ignores for both body interaction and enhanced body interaction were collected as below.

TABLE 4.2: Cross tabulation for each condition attention level

Method	Glanced (%)	Ignored	Total
Non-interactive	111(%28.83)	274	385
Body Interactive	106 (%41.40)	150	256
New body Interactive	115 (%51.11)	110	225
Total	332	534	866

As can be seen the enhanced body interactive advertisement has a higher percentage about %51 of the glances compared to the old body interactive advertisement, this means that there is a rise of %10 increase. To test if these are statistically significant different, the Chi-square test was applied on them and revealed $\chi^2(1, N=481)=4.5413, p < .05 (p=.033086)$ that they are statistically different and the enhanced body attraction technique does have higher effect on the attention level.

The non-interactive advertisement was about %28 percentage in attracting attention, but the enhanced version had about %23 higher attention level than non-interactive, Chi-square reveals $\chi^2(1, N=610)=30.2247, p < .001 (p=.0)$, which strongly suggests that the enhanced version has dramatically increased the attention level than the non-interactive one.

3. Landing effect comparison

The landing effects were recorded for non-interactive, body interactive and enhanced body interactive in bellow table.

TABLE 4.3: Cross tabulation for each condition Landing effect

Method	Non-Interactive	Body Interactive	Enhanced body Interactive
Day 1	2	2	1
Day 2	0	2	2
Day 3	1	3	3

After conducting ANOVA test, it states that there is no significant different between three days for all of the conditions, ($(F2,3)=1.857, p > .05 (p=0.236)$).

4. Honeypot effect comparison

Honeypot effects were also gathered from those days as bellow in table.

TABLE 4.4: Cross tabulation for each condition Honeypot effect

Days	Non-Interactive	Body Interactive	Enhanced body Interactive
Day 1	2	2	3
Day 2	2	5	5
Day 3	1	3	2

ANOVA reveals that there is also no statistical difference between these conditions. ($(F2,3)=1.667, p > .05 (p=0.266)$)

5. Engaged and Non-engaged passers-by

The numbers of engaged and non-engaged were recorded for all three conditions as bellow.

TABLE 4.5: Number of engaged passers-by in three weeks

Days	Non-Interactive	Body Interactive	Enhanced body Interactive
Day 1	15	26	39
Day 2	15	20	37
Day 3	15	23	28
Total	45	69	104

ANOVA reveals that there was statistical difference between these conditions, ($(F_{2,3})=20.3154$, $p < .05$ ($p=0.0021$)), and might be one or two of the conditions be of big difference, to find out which of them actually are statistically significant, the post-hoc Tukey HSD test was applied as shown in the table bellow.

TABLE 4.6: Post-Hoc Tukey's HSD

Methods	Tukey HSD Q statistic	Tukey HSD p-value	Tukey HSD inference
A vs B	3.6459	0.0920761	insignificant
A vs C	8.9627	0.0017440	** p<0.01
B vs C	5.3169	0.0218582	* p<0.05

In the table above (A,B and C) are non-interactive, body interactive and enhanced body interactive respectively, and they are compared among each other, as you can see that post-hoc tests shows that non-interactive and body interactive were not statistically significant in those three days, but there results were strongly significant for non-interactive and enhanced body, and body interactive and enhanced body only just significant different among in between.

4.7 Discussions

The enhanced version of advertisement seemed to be more effective than other two conditions in terms of attracting attention. The number of glances was dramatically increased up to %51, this was higher than old body advertisement version, one of the main reason could be the wide angle of display tracking, in which participants could see themselves from different angles (left, center and right) if they had missed the left, there was still chance to see the center or vice versa, and the second reason could be the time they were exposed to their silhouette, for normal passing by the screen it takes around 2 to 3 seconds and if there was one tracking camera, then the silhouette was projected for 2 to 3 seconds only, and if there are three cameras facing (left, center, right) then for all region minimum it would take 6 – 9 seconds, this time is enough to get user attention.

The number of engaged people were also increased from %12 to %15, which was scientifically more than body interactive, and it was double in the compared to non-interactive (%7) of the engaged passers-by.

Honeypot effect in the previous body interaction experiment and in this experiment did not seemed to be more strong (meaning not more than 2 people were attracted at a time), there could be many reasons for this, (1) *Environment*, the display is situated in a touristic place, where people do not stay longer than staying in restaurant or some other gatherings, people move in and out often times, (2) *unfamiliarity*: people are not familiar with each other to wait or come near to the shoulder of other person to look what is going on, therefor they tend to ignore, (3) *Personal interaction*, the interaction seemed more personal and single user,

and was not vast to be observed by others quickly, (4) *display size*, screen size was also small and passers-by might have not noticed the interactions of people.

As mentioned before, landing effect happens, when the user notices interactivity after he passes by the screen, but in this enhanced version few honeypot effects happened, one of the reasons could be that, when the passer-by is walking from a far side of the display, he is noticing the interactivity before hand because he can see him self in the screen, and when he reaches near to the screen, he is aware of the interactivity for sure and would not perform landing, but by that time he would have two options (a) start interacting, or (b) ignore the interaction and pass by the screen.

4.8 Conclusion

In conclusion, this enhanced attracting attention technique for display would perform better than the technique that uses only one camera, the findings and comparison reveals that the technique has increased the attention level significantly, and consequently increased the number of engaged passers-by. Landing effect was decreased because of the tracking 180 degree coverage and passers-by early understood the interactivity and did not performed landing often.

As a future work, the silhouette color for individuals should be different and consisted to all cameras, when passing by from one side of display to other side.

5

Conclusion

5.1 Summary of research

Public displays are in fact very complex research areas, and there are many reasons that could make the research at risk, like different backgrounds of passers-by are, display locations, display sizes, display orientation, physical setup and no commonly accepted method for evaluation. Human emotions provides important feedbacks about a display, and there exists technologies that can track the human emotions and state of their conditions[84] The location of display also has influence on the attention level and motivations, if the displays are placed in front of the passers-by, could have different attention level compared to sideway or if the display is placed in a higher compared to placed in lower place or even at eye distance [10]. Displays are found in various sizes and based on sizes they are used for various purposes, small sized displays are mostly used for single users and large displays would be suitable for more multi user interactive applications, and the size can also influence on the attention level [10]. Orientation also influences the behavior of people in various was, how display are angled, horizontal or vertical conditions will produce different results[16]. Environment also has influence, if a display is installed in a cafe or train station[3], or installed in a library or workplace [3], would produce different outcomes [58]., or if one is installed in a party compared one installed in formal meeting. Because of the problems mentioned above, most researchers limit all their findings to a fixed environment and conditions, and can not generalize their study design and findings to whole the displays, therefor there is no commonly acceptable technique of evaluation for public displays [4]

Consequently, public display advertising also inherit the above issues in research field, therefor in this study also specific conditions were taken in to account, in which the main study was conducted in Tourist information center, and the an interactive and non-interactive advertisements were developed for Bauhaus-walk and the activating components of the *conversion* (action) of the advertisements were measured and compared against each other, there are various activating components like emotions, motives, attentions and engagements of passers-by, which would eventually lead to actions like participation in Bauhaus-Walk program. The study compared the attention, engagement and other behaviors of the conditions and briefly answers the research questions bellow.

- **Which method is better to attract passers-by's attention?** To design an attracting attention method for interactive advertisements, an intense background study was done on attention and based on that three methods (moving eye, firework and silhouette) were proposed and compared against non-interactive advertisement, and among the three, the silhouette representation attracted more passers-by than other two, and beside that this method was a more widely acceptable method for interactive displays from the literatures. As a result the silhouette representation was used for the rest of interactive advertisements.

- **How is the attention level in interactive (body and mobile) and non-interactive advertisement?**

Glance is when a user look at display for less than 3 seconds in an observable manner by moving the head orientation toward display.

In non-interactive advertisement %28, in body interactive %41.41, and in mobile version %33.76 of the passers-by glanced toward the display, among which body interactive showed higher amount of glances. Enhanced interactive advertisement strongly increased the number of glances by %50 compared to non-interactive and body interactive.

The studies suggest that interactive advertisement in all the conditions like body, mobile and enhanced body version had higher attention level compared to non-interactive advertisement.

- **How many passers-by are engaged in interactive (body and mobile) and non-interactive advertisement?**

Involvement of passers-by with the display in some form, defines the effectiveness of advertisement, this can be achieved if the passers-by engage by viewing the screen, reading or interacting with the advertisement display. In this study a person was marked engaged if stood for more than 3 seconds in front of display.

In non-interactive advertisement people were reading or viewing the content of advertisement and only %7.66 of the whole passers-by were engaged, and the average duration for engagement was 34 seconds.

In body interactive advertisement, users were reading the content and at the same time they were motivated to play with the silhouette and start the game interaction and let them explore the locations with their body. From the whole passers-by %11.56 of them were engaged with the display and the average interaction was about 42 seconds, in which 19 seconds were spent in attraction/motivation part, 18 seconds in interaction and 4.6 seconds in advertisement video.

In mobile interactive advertisement, users were only reading or viewing the display, they had little interaction with their silhouette, but no interaction with the mobile devices, and %9 of the passers-by were engaged and took 22 seconds in average for the engagement duration.

In the enhanced advertisement version, passers-by were also engaged with reading, playing with the silhouette and interacting with the game element, and %15 passers-by were engaged with the average duration of 32 seconds.

This recommends that enhanced and body advertisement version engaged more participants than other advertisement techniques.

- **What are passers-by behavior toward interactive (body and mobile) and non-interactive advertisement?**

In non-interactive advertisement, the behavior of passers-by toward display was more passive, calm and natural, passers-by selectively came near the display and used it as a source of information, and at the same time neglected it easily. There was no influence of display on the environment around.

On the other hand, in body interactive advertisement, passers-by were attracted quickly toward display, passers-by were curious about their silhouette representation; they were waving hands or moving their body explicitly and learning about the interactivity, they felt the sense of joy and fun and reacted according to the call-to-action, they explored the interactions and played the game, the interaction was in groups and individuals, and the people were calling other friends to join. When the game was over, the advertisement video was shown but people tried to ignore that by leaving the display or standing one side until the video was over and start over the interaction. The dominance of the display over the area was felt if a person noticed the screen, the person had to leave the area or start the interaction.

In mobile interactive advertisement, the passers-by had some similar behaviors like, they were being curious about their silhouette representation, they were waving their hands to confirm interactivity and coming closer to the screen to understand the interactivity of the system, but quickly left the display, maybe because of being skeptical about

technology usage like using phone in public, and not understanding the connectivity to system, feeling unsecure or feeling inappropriate interaction in that space.

In the extended advertisement version, the behaviors were very similar to body interactive advertisement, in which people felt the sense of joy, fun and play, passers-by played the game and started exploring the locations, group interactions and individual interactions were also seen, in this extended version people noticed the interactivity earlier and came toward display with very less landing effects. Side interactions were also observed, in which the people stood at side of the screen and were still playing with their silhouette.

5.1.1 Advertisement development cycle

The advertisement development cycle should mainly follow the advertising programs[77] and evaluate advertisement development with the use of HCI methods. The advertising program is defined with series of steps to take, (1) *Mission*, define the advertising objectives and goals, (2) *Cost*, define the budgets for advertising location, medium, duration etc, (3) *Message*, create advertising content, and evaluate the contents, (4) *Media*, select an advertising medium for advertising campaign, and finally (5) *Measurement*, to answer how the advertisement was effective. This thesis also partially followed this program for advertisement development and evaluations, which are discussed as bellow. take the diagram of advertisement program

First and foremost, after many trials with university, I found *Bauhaus-Walk* program that provides short tours for tourists in Weimar, this program became the advertiser and this was the start of communication process with them. By conducting focus groups with *Bauhaus-Walk* team members, we decided various things like, target group, location, duration of advertising, advertising message, and a complete discussion on two advertising prototypes and interactions techniques, which covered two essential programs (*Mission, Message*).

Secondly, the *Cost* was another issue, and on many things money needed to be invested like, (1)*advertising location*, but with the support of *Bauhaus-Walk* and Weimar tourist information center and university management, we could get the advertisement deployment for free which was for more than three weeks, and (2) *Devices*, I needed a large LCD monitor, computers, Kinect cameras and other electronic devices for implementation, and I managed to get them from the University different departments, but if the advertising were meant for long time and multiple locations, then it would have been expensive.

Thirdly, the advertising prototypes were evaluated using usability and HCI methods, in which the advertising message, interaction and usability issues were evaluated. This consisted two evaluation, (1) Low-Fi prototype evaluation and (2) Hi-fi prototype evaluation. These evaluations were very helpful to decide for the correct *Media, Message* and as a result three advertisements were developed which were same but different in interactivity, (1) Non-interactive, (2) Body interactive, and (3) mobile interactive.

Eventually, three of advertisements were deployed in Weimar Tourist information center each for one week, during these weeks different data gathering techniques were used like, direct observation, interviews of passers-by, depth recording and system logs. After that based on some observations on attention another extended advertisement application was developed and deployed again in tourist information and followed the same data gathering techniques, which helped me to later asses the advertisement performance for each of the conditions.

5.1.2 Advertisement performance

The advertisement can perform better if the *conversion rate* is higher. The *Conversion rate* for Bauhaus-walk advertisement would be that, how many people participated in the walk after the advertisement campaign. The comparison of interactive and non-interactive advertisement of Bauhaus-Walk was not to measure the final *conversion rate*, because of many reasons, (1) there were already other existing advertising campaigns for Bauhaus-Walk, (2) the duration of advertisement was limited to five days each, (3) limited reachability to wide range of people in city, (4) you may never know the reason of a person joining the walk, it could be because of interactivity of advertisement or because someone has told the person a month before the advertisement campaign even started, (5) or might that person is motivated by the advertisement but does not have time to join this week and might join the other week.

Instead of measuring the conversion-rate, the reasons that the conversion happens should be considered more, and if those reason are tackled then an effective and efficient advertisements can be developed, those main reasons are the level of attention, motivations, involvement and emotions of people toward advertisement [76], that can positively change people perception and attitude toward the product. This thesis compared these factors between Non-interactive, body interactive, mobile and extended body interactive advertisement, as discussed bellow.

5.1.3 Attracting attraction

Attracting attention of passers-by is the most crucial phase for the public display advertising, while most of the passers-by ignore the displays because of many reasons like, information overload [31], they think they are irrelevant, boring and distractive to them [32, 41]. There are two approaches of influencing the attention top-down and bottom-up, in top-down approach the passer-by has prior awareness of the display and change attention toward display, and in bottom-up the passer-by is unaware of the display and change attention toward display in case of an sudden external stimuli like color [7] or position [9] change of an object in display.

The Top-Down approach cannot work for public display even if passers-by know about display because passers-by have those negative thoughts about displays, therefor bottom-up approaches suites best in public display scenarios, but non-interactive advertisement can not use this approach because it can not sense passers-by and does not change anything related to the passers-by. Interactive advertising can use this approach and react based on passers-by and drag their attention toward it.

- **Silhouette representation**

Silhouette is a colored 2D shape of a person standing in front of a camera, many researcher prefer the use of this representation in public display because of many reasons that are linked to attraction, (1) sudden appearance of the silhouette when the person gets closer to display, (2) color contrast of silhouette in relation to other silhouettes and background, and (3) responsiveness of silhouette, so by combining all these elements this representation is the most attractive methods for body interactions [11]. The Bauhaus-Walk interactive advertisement used this silhouette representation of passers-by to get their attentions the most.

- **Extended silhouette representation**

This method was used to get passers-by attention before they reach near the display; the method is using three cameras in the sides (right, left) and in the center to cover 180 degree in front of the display. This method increased the attention level dramatically then the previous method.

5.1.4 Motivation

To be motivated means *to be moved to do something*[47], if someone does something like interacting with the display, it is because something else has moved or peacefully forced him to do so. Various forms of motivation exists and affects differently it depends on person to person, something like (1) Fun, (2) interesting, (3) captivating, (4) appealing, or a system that has (5) challenges, (6) fantasy or even (7) curiosity [43].

- **Silhouette representation:**

The silhouette representation was not just meant for attracting attention but also for motivation for many reasons, (a) it can become a fun and interesting factor for people, because it is not a common thing to see a colored image instead of a full video image, and the different color of partner would become more interesting and playful, (b) it triggers curiosity among people and they would question that why are they shown in the display, or what is more to explore from the display.

This representation was used in all interactive advertisement like in body, extended body and even mobile interaction techniques.

- **Call-to-Action:**

Even if passers-by got motivated with silhouette representation, but they might still leave the display because they fear if they do something wrong or awkward, therefor to give them confidence and trust, call-to-action feature was developed. This is a responsive feature that follows with the silhouette of the person together and shows this text “*To play! Come near.*”, this text gives the user a goal for staying in front of display and at the same time it is a challenge for him/her to complete the task.

5.1.5 Interaction

When the passers-by encounter with the interactive display for the first time, then there are many things that the display application should be ready for in terms of interaction, (1) Meaningful content for interaction[71], if the user does not feel comfortable with the content with which he/she is interacting, the user will ignore, (2) Meaningful interaction, it is not a good practice to create interactions that does not fit to the advertisement content and goal and make the interactions in a way that it makes the user feel shy or embarrassment in public [14], and (3) the application usability, The application should be able to provide an easy to use interaction, so that the users has full control and be able to complete the task, the use of right technology and technique is required to achieve this.

Based on many Focus group discussions and prototype (low-fi and high-fi) evaluation, I decided to create interactive advertisement for Bauhaus-walk, in which i developed two different interaction techniques, (a) body interaction and (b) mobile interaction, and both of them fit on the theme and goal of Bauhaus-Walk, the body & mobile interaction techniques resemble the virtual walking of users in Weimar city and exploring Bauhaus locations, read chapter 7 for complete description of the interactions.

5.1.6 Passers-by Behavior around display

Passers-by behave differently for certain types of display[54] and certain physical setup or environment [57, 11], and it is very crucial for advertisers to understand and know how the people react in front of their advertising displays and to develop an engaging and entertaining advertisement that could positively affect passers-by perception and attitude toward their

products and services. In this thesis I compared the behaviors of people in front of non-interactive advertisement and interactive advertisement in Tourist information center. The bellow two effects were investigated in depth for all the advertisement conditions.

Landing Effect

In non-interactive from 79 people, who were engaged only 4 (%5) events were because of landing effect were observed during the entire week, and same amount was observed in mobile interactive, which even had used body silhouette, this was because of the access information page shown on top of the screen that might have caused less amount of landing effect, but in body interactive 12 (%10) events of landing effects were observed which is 2 times higher than non-interactive, this is considered because of the clear silhouette representation and the call-to-action text that made passers-by to land back. The comparison between the conditions was significant, and it concludes that silhouette can introduce more landing effects. On other hand the extended silhouette representation, which was in extended interactive advertisement, could not bring more landing effects (5 times), because people might have noticed themselves before they reach the end of display.

Honeypot Effect

The honeypot effect increases the attention level of the people toward the display, this effect in non-interactive display was weak (7 times) compared to body interactive display (15 times), which almost was double, the statistical analysis revealed that they are different significantly and it can conclude that the interactivity can increase the number of honeypot effects, but this effect was not statistically higher in extended body interaction (10 times) during 3 days, and it could be because of little number of days during the comparison, but it is certainly higher than non-interactive advertisement.

5.1.7 Futur work

Change the advertisement flow

Mobile improvement

Better data gathering

Better evaluation

Enhanced silhouette color in 3 kinect

New interactions

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