

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

HCI group
Human Computer Interaction, M.Sc

June 17, 2016

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...

Contents

Declaration of Authorship	i
Abstract	iii
Acknowledgements	iv
1 Introduction	1
1.1 Introduction	2
1.2 Advertisement performance	3
1.3 Research Questions	3
1.4 Procedures	4
1.5 Methodology	4
1.5.1 Prototypes	5
1.5.2 Evaluations	5
1.6 Research context	5
1.7 Thesis outline	6
2 Background	8
2.1 Advertising	9
2.1.1 History of advertisement	9
2.1.2 Traditional Advertising	9
2.1.3 Online advertising	10
2.1.4 Pervasive Advertising	10
2.1.5 Advertising program	10
2.1.6 Advertisement performance	11
2.2 Public displays	13
2.2.1 History of public display research	13

2.2.2	Auto-active displays	14
2.2.3	Interactive displays	15
2.2.4	Engagement with displays	16
2.2.5	Metaphors	17
2.2.6	Interaction models	18
2.2.7	Technologies	20
3	Conclusion	23
3.1	Summary of research	24
3.1.1	Advertisement development cycle	26
3.1.2	Advertisement performance	27
3.1.3	Attracting attraction	27
3.1.4	Motivation	28
3.1.5	Interaction	28
3.1.6	Passers-by Behavior around display	28
3.1.7	Futur work	29

List of Figures

2.1	Advertising Program, [36]	11
2.2	Conversion Funnel	12
2.3	Three zones of interaction, [75]	18
2.4	Four interaction phases, [75]	19
2.5	A diagram of public interaction flow accross thresholds, [14]	20
2.6	The Audience Funnel, [2]	20

List of Tables

1.1 Thesis Outline	6
------------------------------	---

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 [84] 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” [41], 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 [48, 39]

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 [96], 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 [41]. 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.*”[57] 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 [83].

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 [96], attention is the first phase that can take user to be involved.

Motivation: To be motivated means *to be moved to do something*[54].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.[50].

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.*”[33], 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 [66]. 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

[84].

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 Traditional Advertising

Traditional advertising is a form of advertising that uses the media to send commercial messages to the mass audience or viewers, the media can be in any form like TV, Newspaper, Radio, public displays, bill boards and more and in traditional advertising is “the presentation of content is linear and the consumer is passively exposed to product information” [41], user has no control over the flow of the advertisement.

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

2.1.3 Online advertising

Online advertising or Internet advertising is a form of advertising that uses email, web, applications, or any internet application used in mobile or computer, that drive direct sales via electronic commerce [26], as PWC [32] researched and there are two trends that give online advertising this boost, (1) increase in webpages, and (2) development in targeted advertising format and beside that there are a lot of ways for online marketing [29], (1) search engine optimization, to suggest websites for users, (2) email, (3) video marketing, like YouTube, (4) Blogging , (5) social media, like Facebook, and many other forms.

2.1.4 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 [89] “*Ubiquitous 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 [71] and it is constructed from basic elements [85] (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 [73] 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, “*Pervasive advertising is the use of pervasive computing technologies for advertising purposes.*”[83].

2.1.5 Advertising program

To have and effective and efficient advertising, most big advertising industries follow an advertising program after they have defined the target market and buyer motives, the advertising program is also called as *5Ms* [36], because it is composed of five steps (1)*Mission*,(2) *Money*,(3) *Message*,(4) *Media*,(5) *Measurement*, Figure 2.1 shows these steps.

1. Mission:

Advertising mission (goal) should come from prior decisions on targeted market and location, this goal can be achieved by a fixed communication process in fix duration between advertiser and audience. There are three advertising goals (1) *Informative Advertising*, it is the early advertising stage, which aims to inform target audience about a product which was not in market before, (2) *Persuasive Advertising*, this happens when there are several competitors of the same product, the advertiser persuades people that their product is the best than others, and (3) *Reminder Advertising*, the need of this type is when a product has been in market from long time like *Coca-Cola* and then there is a need to remind people about that product.

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

2. Money:

Decision on advertising budget is very essential for future of company, the company should clearly invest on the advertising of certain product, if the budget is less then the effect will be less, if the budget is higher it could be also a risk of overspending.

3. Message:

The message of the advertising should be very clear and innovative, and generated in a way that can impact on viewers. It should go from four stages, (1) message generation, (2) message evaluation and selection, (3) message execution and (4) social responsibility review.

4. Media:

The media selection is important because it can help to expose the number of desired times an advertisement message to the target audience. The number of exposures of advertisement can define the number of awareness of audience about product. And the effect of exposure depends on, (1)*reach*, how much can the advertiser reach to users, through internet, banners, TV and so on, (2) *Frequency*, How many times that advertisement is going to be shown on those locations, (3) *Impact*, the qualitative value of exposure on audience.

5. Measurement:

The last step is to measure how the advertisement was effective, for a specific defined advertisement goal, location, and target audience within a specific duration of time. The measurement will state the level of achievements and what got accomplished and what not.

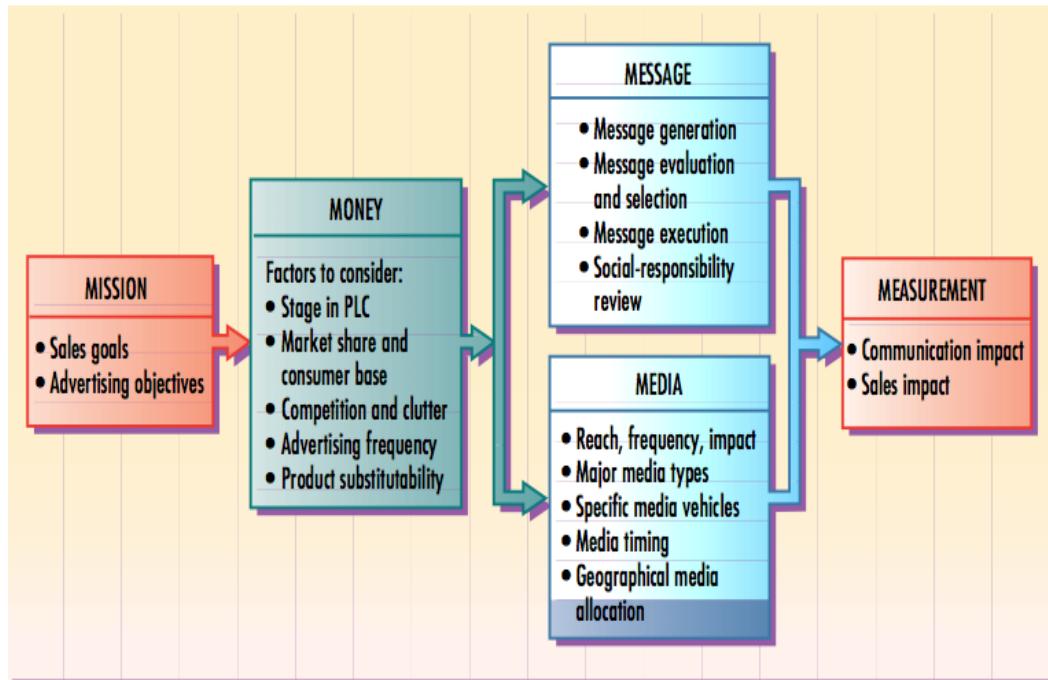


FIGURE 2.1: Advertising Program, [36]

2.1.6 Advertisement performance

Every advertiser is interested in *conversion-rate*, it is “*the percentage of visitors who take a desired action.*”[57], the desired action is to visit a webpage, buy a product, play a game, or

any action which is defined by the advertiser. *conversion-rate* is very important for advertiser to see the efficiency of their advertisements and how to utilize it for mass visitors that could be more effective. In e-commerce, advertisers track user's each step or click, they track users from search engines to webpages, from webpages to contacts, from contacts to subscribers and from subscribers to *Actions* purchase or downloaded of an application, with the help of a technique called *conversion-funnel* [21], all the journey of visitors are described in a funnel like shape, as Saad Kamal [20] describes the conversion funnel in Google Analytics, see figure 2.2 the funnel is composed of four layers, (1) Awareness or attention, (2) interest, (3) Desire and (4) Action, and visitors would have to take these steps to reach the final goal which is purchase of a product.

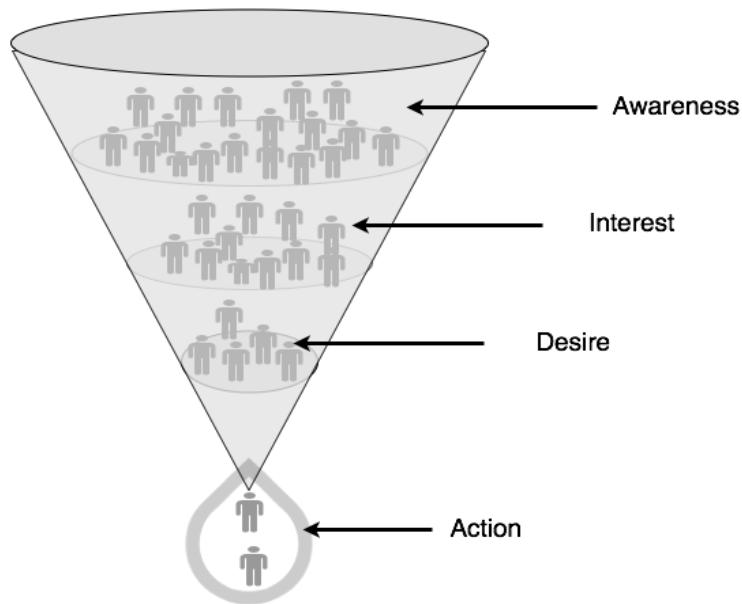


FIGURE 2.2: Conversion Funnel

The funnel shape shows the decrease of visitors in each layer of funnel, because most visitors may be aware but not interested, and people who are interested are subset of the first layer of funnel, and not all interested people desire to buy a product, so people get decrease in the next layer who desire for a product and may read the details, and specifications, but not all people who desire buy the product because maybe the person does not have money to buy or other reasons, and at the end very few people fit to buy the product and reaches the final layer of funnel (purchase). Advertisers can aim different visitors at different layers of conversion funnel, and based on analysis of the funnel advertisers can define where exactly the advertising effort should be invested, [24]

The conversion ratio is defined by *click-through rate* (CTR) metric, it is the ratio of the number of clicks on advertisement to the number of visitors who makes impression (see the advertisement) [21], and advertisers optimize their pages, by analysing that which sections, links of web pages can result in to higher CTR. and to compute the conversion rates the bellow metrics are used.

- CPM (Cost Per Thousand)

It is a benchmarking metric in advertising to calculate the cost of an online advertisement, which defined by showing an ad to thousand of viewers. Advertisers would be charged per impression (thousand of viewers).

- CPC (Cost per Click)

The advertiser is charged, when a viewer clicks on the advertisement message or link, occasionally it is found in search engines, and famous websites.

- CPA (Cost per Action)

Advertisers will be charged if the viewer performs an action, the action could be click, register, subscribe, fill a form or any other action.

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*” [49], 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.

Another research on situated displays that projects content based on location for-example *FLUMP*⁵ [28], 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 [25] 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

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

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.

human activities. The room was kind of augmented space using light, sound and airflow and water movement. Another was *office plant#1* [27], 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 [23] 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* [55], 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 [62] that developed interaction framework for sharable, interactive public ambient displays⁷ it could also support implicit and explicit and multi-user interactions, *Blueboard* [70], which was developed at IBM Research, was a display system for groups to exchange information in a walk-by situation, *IM here* [47] 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* [63] 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 [80] 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., [72, 81]).

Consequently advertising also became a focus for researchers as Krüger and Müller illustrated their design of how to recognize passers-by via Bluetooth [52] 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, *BlueScreen* [31] 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* [53] that developed a display framework that could be configurable and controlled in public, *RunWithUs* [40] a social sport application that motivated people to do sport and share their progress, *Digifieds* [30] 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*[88] at year 1928 made LED display at the front corner of the New York Times building, this display was showing current

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

headlines, in Olympic 1979 the very first large display was deployed, which had video enabled ¹⁰, 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 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 pizzaHut ²³ 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, *JCDecaux*²⁵ 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.

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: 18May2016

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

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

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

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

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 [74] 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 [83] stated from previous researches that the attraction attention could be gained by behavioral urgencies and honeypot effect has also strong impact on attracting attention.

Behavioral urgencies models predicts how much a specific external stimuli can gain attention of someone, for example Franconeri and Simons [79] 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 Rogers [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*[54], 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 [50] 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 [83] summarizes *Flow*[51] 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 [54], 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 [83].

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 [59], 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.

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 [48], and by integrating sensing technologies these posters could be interactive too to increase the user engagement.

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

- **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, for example *Hole-in-Space*[82], 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 [76, 75], 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.

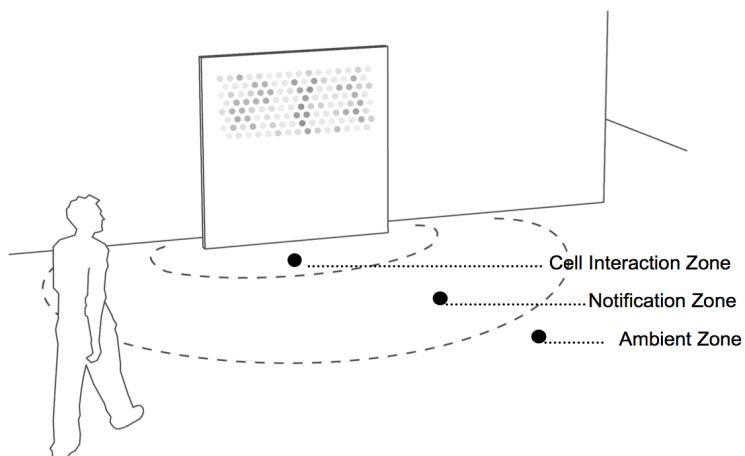


FIGURE 2.3: Three zones of interaction, [75]

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

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 [62] 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.

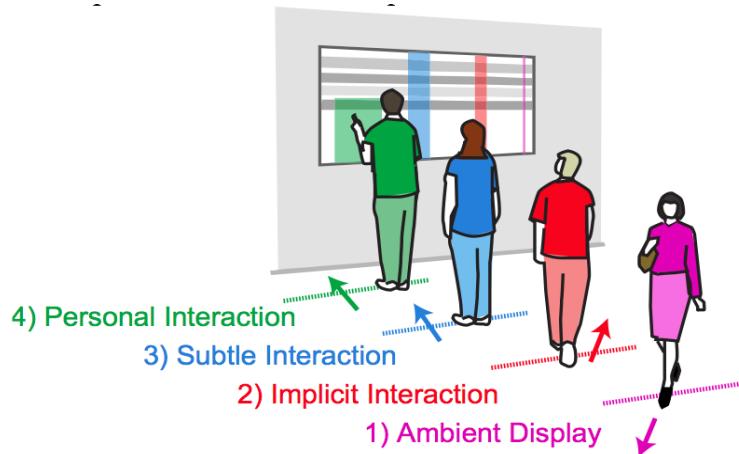


FIGURE 2.4: Four interaction phases, [75]

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 implicit 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.

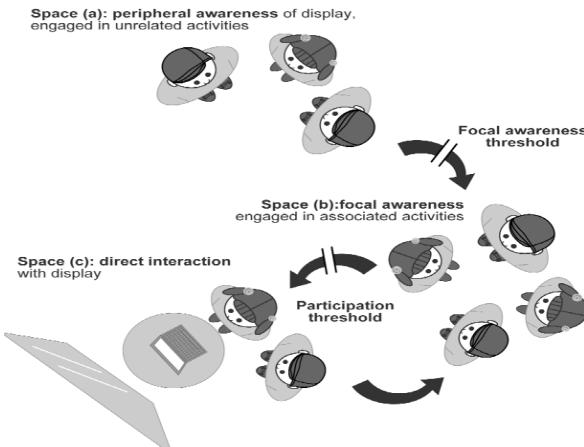


FIGURE 2.5: A diagram of public interaction flow accross thresholds, [14]

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.

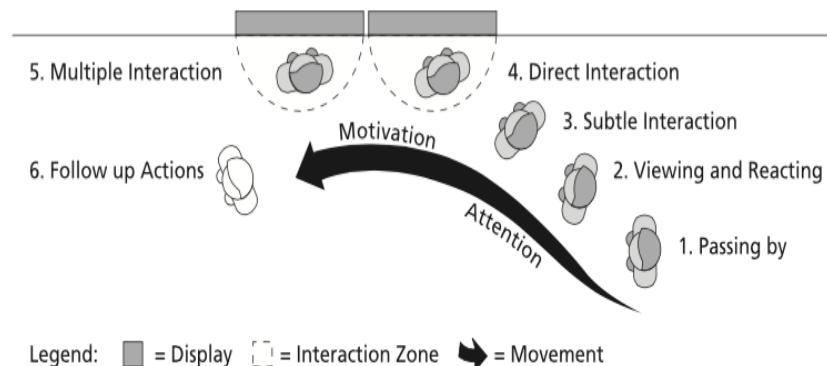


FIGURE 2.6: The Audience Funnel, [2]

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)

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

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 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 Mircosoft Kinect 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:

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

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>

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

- * 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.

3

Attraction attention

3.1 Introduction

Increasingly, displays are now being installed in most of the locations and most of these displays are full of advertisements and passers-by often try ignoring because of various reasons like, first is “*information overload*” that happens on people at some environmental setups, when they enter at place where too much information is delivered and needs to be processed by a single person, and when that is beyond the person capability then they simply ignore them, as Milgram [38] investigated on information overload stated in his paper that “*the concept of overload. This term, drawn from systems analysis, refers to a system's inability to process inputs from the environment because there are too many inputs for the system to cope with, or because successive inputs come so fast that input A cannot be processed when input B is presented*”, therefor there are priorities for each input and low priorities are disregarded, for example, disregarding of low priorities inputs is called “*Banner Blindness*” in the web, Burke et al [39] showed with an experiment using eye-tracking that people tend to ignore banners mostly and have very few number of recalls of the banner contents.

The second reason of ignoring is, that people expect unrelated or uninteresting contents, Huang et al, also investigated and explained that most public displays are ignored and get little glances [37], where at this points Jörg müller and his fellow [48] investigated on similar effect called “*Display Blindness*” they conducted the experiment in university context with two displays first, the iDisplay, that showed information for students, was looked at more often than the other (MobiDiC), that showed coupons for shops.

This chapter focuses on the comparative study of attracting attention methods with a traditional advertisement in public display and explains the study design and findings, this comparative study was conducted in university Mensa, meanwhile this chapter explains the feedbacks and opinions of people about advertisement in general, whom were interviewed during the study. The purpose of conducting this study was to find out appropriate attracting attention method for interactive advertisement, which are discussed on other chapters.

3.2 Attention

Every moment we spend alone, with friends in the crowd, in the concert or party our attention keeps tracks of us and make us aware of the environment and we react differently for different stimuli, so “*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]. Attention is influenced by two different processes (Top-Down & Bottom-Up) [74, 8]. Top-Down process happens when the user has prior awareness (goal) about where to put his/her attention toward, and Bottom-Up process happens when the user has no prior awareness and suddenly by an external stimuli move or change attention toward something. People walking on pathway or walking in a store or waiting in bus station does not have any knowledge or awareness about an Interactive advertisements located there, nor the researchers tend to speak about it for them, at this situation I believe that the attraction of attention should be a Bottom-Up process for the users to drag them to the screens.

The appearance of objects suddenly or moving objects on the screen or contrasting color can capture attention quicker. Yantis and Jonides (1984) demonstrated that the detection of a target in visual search was markedly enhanced when the target was presented as an abruptly[9]. And the type of contrast change on an object influence priority in visual search, “*Both the sudden appearance of an object and sudden changes in existing object features influence priority in visual search.*”[7]

Elaine M. Huang, Anna Koster, and Jan Borchers have researched and discussed on “*When Does the Public Really Look at Public Displays?*”[10], in this paper they argued that glancing and attention at large displays is complex and is dependent on many factors like Brevity of glances, Positioning of displays, Content format and dynamics, Catching the eye, Display size, this paper provided some recommendations for each of the mentioned factors.

3.3 Approaches

As discussed earlier that Interactive advertisement would need to first attract the passers-by, therefor for the initial phase, three different attracting attention techniques were made that were interactive, and compared them with non-interactive (traditional) advertisement to observe how many of passers-by are being attracted.

John Hardy and his colleague classified the attention level in three categories, (1) Glance, (2) Ignore and (3) Watch.

- **Glance:** This happens when the passer-by apparently turn his/her head and stares the screen for less than 3 seconds.
- **Ignore:** This is when the person completely does not look or turn his/her head while passing by the screen.
- **Watch:** This is when the person stares the screen for more than 3 second.

3.3.1 Prototypes

Three interactive attracting attention method prototypes were developed and their screen backgrounds were set to black.

First, was the *Following eye* shown in figure ?? these eyes suddenly pop-up when a person passers-by the screen and follows the person by moving its eyeball. The idea behind this is to check if people would react if something abruptly appear on the screen and starts to follow people, This example has very limited movement it is only constraint with limited eye space, but big object with high contrast.

Second, was the *Firework* shown in figure ??, it shows different colored and sized firework animation, The application will show a random firework for each person on the scene, there are three blocks of fireworks for three persons, the movement of the person changes the location of the firework. In this example there is more object movement and color changes with high contrast.

Third, was the *silhouette presentation* shown in Figure ??, which shows the augmented colored representation of people passing by the screen, the idea is derived from Jorg Müller [11], who has investigated that how passers-by notice the interactivity of the public display by showing different representations of body like Mirrored (1) “*user silhouettes*”, (2) “*avatar-like*”representations and (3) “*real user Image*”, in that paper they concluded that mirroring user image is much more effective to attract users and understand the interactivity of the display, but because of privacy policy and because of social attitude like may be someone does not like to be shown on the screen, only Mirrored silhouettes.



FIGURE 3.1: Attraction attention methods

Non-interactive advertisement prototype was a traditional style advertisement in which five pages, were in loop in a slideshow, the advertisement pages consisted of pictures and mostly texts about some events in Weimar, the sequence of pages of the slideshow were fixed and would switch from one page to other within about each 15 seconds.



FIGURE 3.2: Traditional Advertising

3.3.2 Hypothesis

- **H0:** Silhouette representation method and traditional advertising attract same number of passers-by.
- **H1:** Silhouette representation method attracts more passers-by than traditional advertising.

3.4 Study design

At the beginning, the idea was to conduct some experiment in the lab and investigate about the attention, like doing gaze tracking but it did not suited well for the real life displays in which an already situated display was advertising, therefor that was a nice opportunity to compare our attracting attention methods with the traditional advertising.

3.4.1 Participants

Participants were random from university students or employees, mostly consisted of students and teachers, the participants were observed that passed in front of the display, The participants who passed from the backside of the display were not taken in consideration. None of the participants knew about the attracting attention conditions in advance.

3.4.2 Location

The study was conducted in university Mensa, this location was an ideal location because many students, teachers and university employees go for having lunch and taking coffee breaks and the Mensa gets crowded. 14-inch display, which was previously used for advertisement in Mensa by Kasseturm¹, was used to deploy our methods.

3.4.3 Procedures

The study was conducted for four continuous days, and each day only one method was displayed on the screen for two hours at 14:00 o'clock. The first day of the study was the passive mode of the screen, where traditional advertisement was displayed and the next three days were the interactive mode of the screen, where the attracting attention methods were shown. One person was responsible for observing and noting the glances made by the passers-by and also noting interesting behavior of people toward the screen. The other person was responsible to take interviews from the passers-by that glanced at the screen and get more feedbacks of the advertisement in general.

3.4.4 Data gathering

Data gathering consisted of direct observation of passers-by from 14:00 – 16:00 for each individual day and interviews were taken which was recorded.

Observation

Observation was used to count the number of glances the passers-by make at the screen while pass from the front of the screen. A small pilot study was conducted for the observer to find an appropriate location in the Mensa setup to be able to count people and glances without being noticed by passers-by.

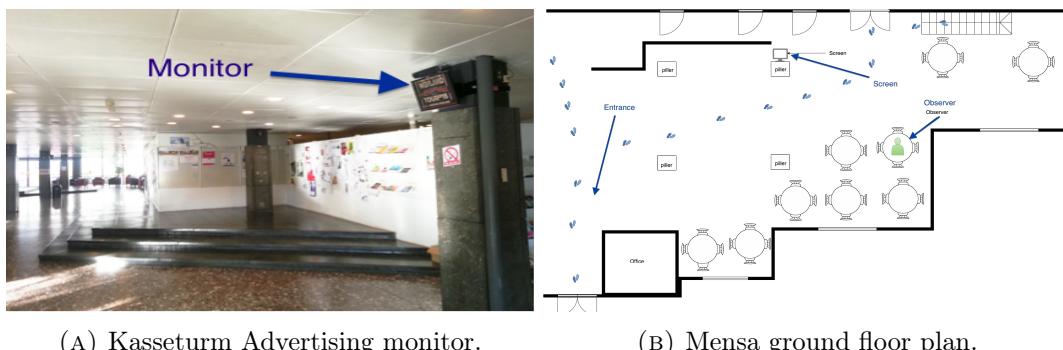
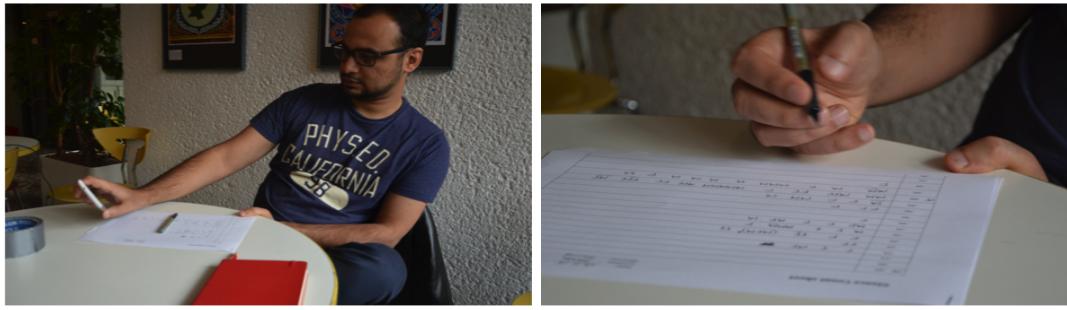


FIGURE 3.3: University Mensa

A sheet was provided to the observer to note each 5 min time stamp for two hours, specific letters were defined to detect Male, Female, Unknown gender and at the same time who were in a group and individual and who glanced to the screen. fix appendix

As stated before that observer did one small pilot study to locate a good location and be able to count and note in the sheet, beside that, he was told to write notes when he observes something interesting during the period.

¹Kasseturm: <http://www.kasseturm.de/>, last accessed: 26 May 2016



(A) Hamid Sabri as an observer. (B) Observer is taking notes on the data sheet.

FIGURE 3.4: Observation method

Interviews

During all four day of the observations, 16 interviews were taken from people inside Mensa to get general opinion about advertisement and people preferences what they like and what they avoid about advertisement. Responders were asked to sign the consent form because the interviews were tap recorded for later analyzing. Each interview took around 6 minute in average. All interviews were transcribed separately for further data analyzing.

See fix appendix

3.5 Findings

The findings are categorized as bellow.

3.5.1 Observation findings

Observational data for attention level of passers-by was collected and summarized as bellow.

TABLE 3.1: Cross tabulation of deployment and attention level

Methods	Glanced (%)	ignored (%)	Total
Traditional	9 (%7.6)	109 (%92.3)	118
Silhouette	22 (%15.82)	117 (%84.7)	139
Following eye	10 (%12.98)	67 (%87)	77
Firework	6 (%10.1)	53 (%89)	59

As can be seen from the table above, Silhouette attention attraction technique received the highest number of glances 22 out of 139 compared to other techniques, Following eye technique was the second most attracted technique probably because of its contrasting color and funny.

To find the statistical significant difference between traditional screen and these three methods Chi-squared test was applied as bellow.

TABLE 3.2: Cross tabulation of Following and traditional attention level

Method	Glanced	Ignored	Total
Traditional	9	109	118
Following eye	10	67	77
Total	19	176	195

Performing the ch-squared test on above table, $\chi^2(1, N=195)=1.522$, $p > .05$ ($p=.21$), it suggests that there is no significant difference to attract passers-by between following-eye method and traditional screen

TABLE 3.3: Cross tabulation of Firework and traditional attention level

Method	Glanced	Ignored	Total
Traditional	9	109	118
Firework	6	53	59
Total	15	162	177

After the ch-squared test, $\chi^2(1, N=177)=0.328$, $p > .05$ ($p=.56$) suggests that there is no significant difference to attract passers-by between Firework method and traditional screen.

TABLE 3.4: Cross tabulation of Silhouette and traditional attention level

Method	Glanced	Ignored	Total
Traditional	9	109	118
Silhouette	22	117	139
Total	31	226	257

After performing the ch-squared test, $\chi^2(1, N=257)=4.046$, $p < .05$ ($p=.04$), it suggests that Silhouette representation attracts more passers-by than traditional advertising screen. Based on this finding, H_0 is rejected because the attention level of traditional advertising and interactive silhouette presentation are not the same, silhouette presentation attracts statistically more passers-by than traditional, as a result H_1 is accepted.

3.5.2 Interview Findings

Interview transcripts were individually coded to generalize the responder's opinions on the advertisements. I created two main sections from the interviews that what makes a Good Advertisement, and what makes a Bad Advertisement and related all responses to these sections a lot of codes were analyzed and grouped together to make sub sections and sub-sub-sections.

Good Advertisement

A lot of categories have been found after coding the interviews the chart in Appendix A, show all the categories and sub categories with the correspondent code from the interviews and

even some codes were directly also placed as a category instance. The bellow list describes some of the important categories retrieved from the diagram. reference the code diagram

1. Content

Responders like to have more funny contents than any other strict informational advertisement; As responders replied like this, “*just make it funny like make a joke or something but something in a very good one that is really difficult*”, “*it should be very not very serious?*”, “*Yeah mostly I like funny things that the main concept is shown in different way like in funny things*”, “*I like advertisement that are somehow have humor*”.

At the same time responders would like to see some useful, true, sensible facts and main idea of advertisement; “*an offer if it is clearly mentions that okay that you save this much or you get this or that, that is like a clear message*”, “*You have to focus on the main things that will happen in the event which will attract people will come*.”

Furthermore, contents of advertisement should be small and understandable; “*the advertisement should be clear too*”, “*when you have too many numbers and too much to read then it is confusing*” “*Add some pictures based on the advertisement what do you want to show*.”, “*Not many text in advertisement*”, “*Have a good design, not too crowded with information*”, “*Well defined subject, and shorter contents, because we don't like reading long things usually no body likes to read*”.

Another important thing was context Based contents, the users liked to see things related to their surroundings; “*if I am standing near a shopping center it should tell me that what kind of shops are there and what I could buy from there*.” “*It should show movies of the actor I like*”.

2. Creativity

People like to see very new and creative things happening in advertisement; “*something that catches your attention in a way that you haven't seen before*”, “*like seeing something out of ordinary*” . Introducing new ideas, artistic; “*as I am musician you know kind of creative person I like if it something special inside not it is just like for example if it is advertisement of milk*” , “*Which can be something un-expectable probably also*” , “*in general I would say yes as long it gets creative*”

3. Style

The style of advertisement plays key role in terms of color and size as stated by responders; “*may be should be more should be more colorful?*”, “*my eyes are attracted to so hard things unless there is something big enough things*”, “*Use the bright color*.” , “*You have to be clever in using colors okay because color mismatch does not attract the eyes*”, “*when it is really just like an art like you have a picture you some impression or illusion*”.

4. Location

Responders like to see advertisement while they are on the way, they don't get annoyed if advertisements comes on their way and some probably take a look to them too, but heavily they do not like advertisement while they are at home or watching program in TV or Internet, ?I think the street is better?

5. Interactivity

Some liked to have some sort of interactivity to experience like playing games; “*it is good like if you have a game, it would better to have a preview of the game on the screen or just like something like even people could interact with it like get an experience of the game*”, “*if the screen will also be interactive so you can interact with the with the something you are advertising*.”

6. Mean

Different means were mentioned like larger screen, sound, banners for good influential advertisement.

7. Motivation

One of the responder pointed that the advertisement should motivate users in a natural way and should be from unbiased point of view; “*I prefer to buy in a natural way. The company should know who are using their product the power users who that have a lot of influence you know if you have good connections with the guitarists who have like actually like you know people listen to his opinion I think you have to reach out to the guitarist but once you know the guitarist is gaining something from that guitar maker then I don’t trust that company, It should be like completely unbiased, I think that is the kind of advertisement I listen to.* ”.

Others suggest that advertisement must motivate for healthy diet and sport; ?if it reminds me to do stuff like do more sport or eat healthier or anything that has a good purpose?

8. Other categories

Many other categories were also extracted for a good advertisement like Goal of advertisement, Audience, Purpose and motivation, for more detail look at appendix A.

Bad Advertisement

The bellow categories were derived from the interviews that make an advertisement feel or look bad, and we should not avoid using in advertisements. reference the code diagram

1. Style

There exist different styles that advertisement makers follow but texts or photos are blinking; “*try not to use anything would be blinking okay because that is really annoying okay because even so if you are not looking at it is still effecting*”. Using of mismatched colors in advertisement is certainly a bad idea; “*color mismatch does not attract the eyes*”.

2. Annoyance

Most of the responders felt annoyed by almost all advertisements because they contain some sort of similar features like repetitions; “*it should not be like repeating itself over and over and over again*”, “*I like advertisement apart from watching it again and again*”, “*Hmm if I see the same advertisement again and again that is annoying.*”.

Other feature is destruction, which does not allow a person on focusing on something; “*Not just like something popping up in front of your face*”, “*for example in middle of the serial or a movie that i am watching and an advertisement that is I don’t like because it makes me destructed now I just can’t focus on things for view minutes you have to leave what ever you were*”

3. Motivation

Advertisement in general motivate people in their own way to attract customers, which people make not like it, for example sudden appearance of something in the screen or what users do not like to see but they are forced to see; “*usually you are forced to see them because you are watching something or doing something and suddenly it comes and it disturbs you*”, “*it is trying to convince me of something only for to consume or buy and then I mean I don’t want*”

4. Content

Some advertisements exaggerate on their products or even say lie; “*it is like magnificent thing and nice pen okay and then it is just a pen, okay*”, “*They are all lies. Showing inappropriate content are heavily disliked;*” “*whenever I go and access the Internet okay A lot of advertisement comes to my face and most of them are inappropriate. Stuffs like that I don’t like them at all for example some perfume ad which would the a woman in a very degrading position or for example mocking someone believe or something just to catch the attention that is probably to offend people that is what would annoy me a lot. The use of ugly and old people is also not welcomed.*”

5. Duration

Long lasting advertisement are always boring and waste of time, most of the responders said that they would prefer short advertisements.

6. Other categories

Many other categories are also extracted from the interviews like location, Confusing advertisement, Controversial ads, amount of ads and types of ads that were not liked by responders. For more information.

3.6 Conclusion

As a result this research takes all the considerations and concerns about the nature of traditional advertisement and what the passers-by think that could be good for the advertisement in terms of attractiveness, content and many other factors described in this chapter. A good advertisement from people points of view is an advertisement that provides most relevant content to the theme and environment, is short and precise, should have creativity and some kind of interactivity. Many other negatives aspects should be avoided like having a bad style, being annoying and putting non-context contents.

Regarding the attracting attention, among other techniques the silhouette representation statistically attract more passers-by because of a higher number of glances, and also based on the findings of J. Müller[11] silhouette representation is a well accepted presentation of people that can be interesting, joyful and obviously more attractive. This technique would be used for attracting attention for coming interactive advertisement both for (mobile and body).

4

Advertisement decision

4.1 Introduction

At the time of industrialization, industries compete on product quality, and modern organizations focused more on delivering services, and now services and products is hardly able to be distinguished because of they provide various offers and consumers lose themselves in it, as Peter van Waart describes in his paper that “*In the last two decades however, economical developments resulted in the experience economy: a new era of marketing and branding, in which traditional advertising is becoming less effective and meaningful experience branding is key*”, [78], therefor economical developments have changed from time to time and is emerging from economical experience and factors like price-reduction for a brand is not so important, but experience factor has become the central part for the development. Any advertisement that explains a product features and why that matters fails to achieve people satisfaction, because people’s experience were not considered in it, as Joško Brakus [92] explains the measurement of brand experience and how it can effect on product loyalty.

Now at this era where the technology is highly advanced and most people especially youngsters are much familiar with them like using smartphones, tablets and now even wearable computers like Apple watch, and also there are many developments in sensing technologies like body tracking, hand recognition, by using these technologies different interactions are possible and very attractive and funny interactive advertisement can be developed so that could engage more participants.

The development of advertisement requires many steps and the initial step is to create content and this happens normally by creating a *Focus group* of stakeholders or producers to be able to fully convey their message through advertisement. Focus group is a small group, usually between six up to ten participants, that joint together in comfortable place, usually a quite room, to discuss on a specific topic domain and share ideas. As described by Jenny Cameron “*Focus groups can be exhilarating and exciting, with people responding to the ideas and viewpoints expressed by others, and introducing you, the researcher, and other group members to new ways of thinking about an issue or topic*”[19]. As Florian Alt [44] talks about the process of how the focus group was conducted for a mobile contextual display systems.

As a computer scientist, there had been no chance to create an advertisement, and this was the opportunity to make one, and after negotiating with University communication department and then discussing with University marketing department, finally the decision was made to make an advertisement for *Bauhaus-Walk*¹, which was conducting tours about Bauhaus for tourists in Weimar, but in-depth goal and motivation of this program was not clear, what kind of advertisement they wanted, what message they wanted to convey through the advertisement was not clear.

Therefor, there was a need to conduct a focus group to do requirement analysis on *Bauhaus-Walk* program and its content. This was mainly meant to understand many aspects of Bauhaus-Walk and collect the required parameters for designing the advertisement (interactive and non-interactive). Because of time limitation in each session two sessions were arranged in two different dates to cover all topics and discussions. This chapter describes the main theme and goal for focus group and reports all the processes that were taken to establish the focus group, how participants were invited and what was being discussed and more focused on each session. How data was gathered and what techniques were used to analyze them. The document presents all the findings and outcomes in details and related discussions and conclusions.

¹Bauhaus Walk: <https://www.uni-weimar.de/en/university/profile/bauhausatelier/bauhaus-walk/>, last accessed 26 may 2016

4.2 Research Questions

To design and create the Bauhaus-Walk advertisement, it was required to collect the bellow information from the Bauhaus-Walk members, so that a very relevant and meaningful advertisement could be developed that could speak by itself for Bauhaus-Walk and at the same time it should be entertaining and funny and fit for both interactive and non-interactive advertisement, so that passers-by remember the experience for long time and as a result be motivated to take the tour. Therefor we would need to understand many aspect of Bauhaus-walk as listed bellow in short.

1. Who is (are) the target group?
2. What are the existing Bauhaus-Walk advertisement medium?
3. What are the peak times in the year and famous locations for Bauhaus-walk tour?
4. What are important aspects of Bauhaus-Walk from their point of view?
5. What could be a suitable advertisement theme and content?
6. What interactions should be integrated in interactive (body & Mobile) advertisement?

4.3 Study design

Focus group was designed in two sessions mainly because the participants could not be present all at the same time or date, and by doing this, there was enough time to analyze the first session and discuss the findings in the second session with new participants and get their point of views, the first session was more related to gathering general information about Bauhaus-Walk program and second session was more in depth discussions on the advertisement decisions.

4.3.1 Participants and Environment

The focus group in the first session consisted of three participants, and in the second session it consisted of two participants. The participants of this focus group were only active tour guides for Bauhaus-Walk, they have been providing tours for more than a year and know the aim and vision of Bauhaus-Walk, They were invited through Doodle², where varieties of date slots were available to select, in which a short introduction of the aim of the focus group was also described to. Both sessions lasted for 90 minutes.



FIGURE 4.1: Focus group sessions

²Doodle: <http://doodle.com/de/>, last accessed: 26 May 2016

The focus Group was held inside the DBL³ building in meeting room, where we had enough space to make a group circle. Participants were offered coffee and biscuits at the beginning or end of the session to feel comfortable and relaxed for discussion.

4.3.2 First session

This session was an exploratory session over Bauhaus-Walk program, and it was a good start for me to investigate thoroughly on related program domains to create the prototypes for the next sessions.

Procedures

Participants were warmly welcomed and asked to feel comfortable by having biscuits and coffee. I introduced myself and asked them to introduce themselves. This helped to understand each others professional background and interests.

1. Introduction

Brief introduction on advertisement and interactive advertisements were given to participants to understand the possibilities of existing technologies and the use of them in advertisement field. Some interactive advertisements were introduced with their relative interaction techniques. The agenda and goal of thesis was also described to have a wide picture of what is going to be done till the end of this semester.

2. Consent Form

Each participant was asked to sign the consent form to make sure they agree to participate and video recorded.

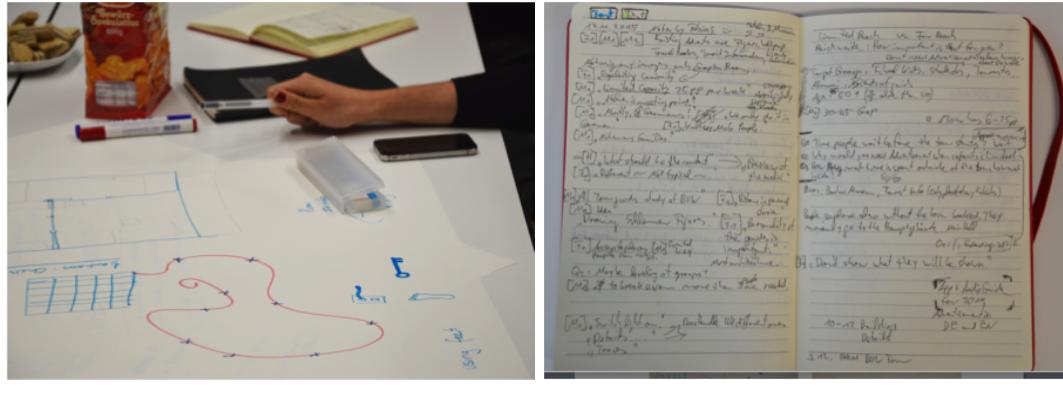
3. Discussion session

After introduction, discussion started on bellow mentioned questions. Because there was limited number of participants I could not divide them in to groups to discuss in detail and do comparative study among the groups. They were given sheet empty big papers to draw and write what come in their mind while discussing to be able to keep track of their thoughts and be easy to generalize the opinions. During the discussion Patrick Tobias Fischer was asked to write notes on the discussion.

- (a) What kinds of advertisements for Bauhaus-Walk are there?
- (b) Who join the Bauhaus-Walk program in general?
- (c) What could be a suitable theme of Bauhaus-Walk for the Interactive advertisement?
- (d) What would be the content of the advertisement?
- (e) How to motivate passer-by to be engaged with the advertisement?
- (f) How to engage passers-by with the advertisement?
- (g) What kind of Gesture and Mobile Interactions should be used?
- (h) How to motivate passer-by to join the actual Bauhaus-Walk tour?
- (i) Is there anything else we need to discuss on Bauhaus-Walk Advertisement? Any new angle?

³DBL: Digital Bauhaus Lab

I was responsible to carry on the entire discussion and Patrick Tobias Fischer was doing the note taking during the discussion. He noted important information extracted from our discussions so that I could later look at them beside that, the entire discussion was also video recorded for analyzing.



(A) Drawing sketches

(B) Observation notes

FIGURE 4.2: Discussion Session

4.3.3 Second Session

Based on the first focus group's discussions and the participant's nice ideas, which are mentioned in finding section, two different paper prototypes of advertisement were made to dig more in detail. The participants were given the prototypes to play with them and explore their own way of designing the advertisement and interaction.

The basic ideas were designed to help the participants to think more and come up with some more ideas and at the same time should be in the context of Bauhaus-Walk program.

Procedures

1. Short introduction was given on Interactive Advertisement thesis.
2. Consent forms were handed to sign for video recording.
3. Short motivational video of interactive advertisement was shown.
4. Two paper prototypes that are mentioned above (Bauhaus chess and Map) were introduced.
5. Possible interactions were shown to them.
6. Participants were asked to comment on prototypes and come up with new ideas and interactions.
7. They were asked to design their own prototype.
8. Integrate some fun ideas with prototypes.
9. What contents should be included in the prototypes.
10. How to gather and collect those contents.

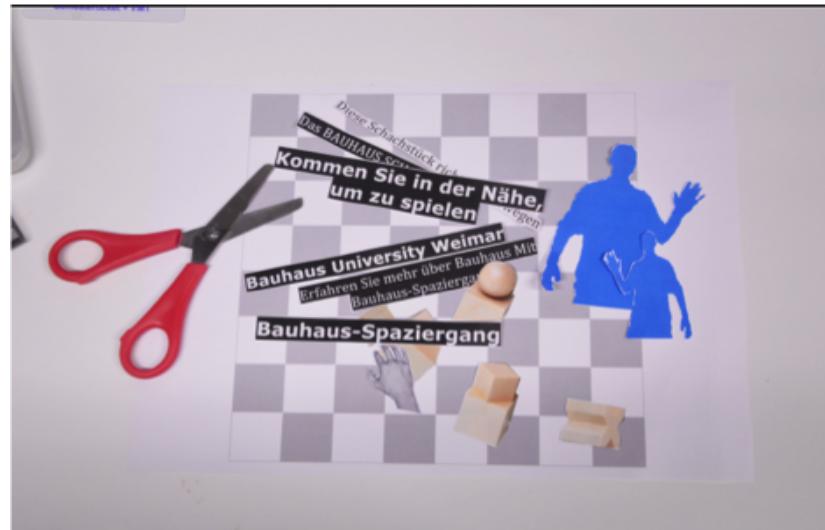
Prototypes and discussion

Two prototypes were explained to the participants, that how the prototype originated from the previous discussions, how the prototype functions, a short glance to these prototype are described bellow.

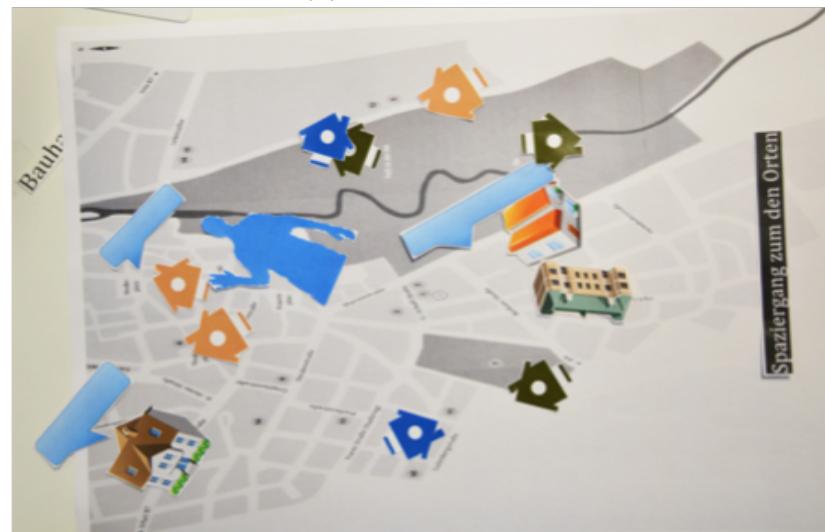
First prototype was Bauhaus-Chess, This prototype was chosen because of the historical background of this amazing chess game that was developed by Josef Hartwig⁴ long time before. The shape of the chess piece defines the movement direction of itself on the chessboard. The goal was to show the chess on the advertisement screen and show one piece at a moment and let users to move the chess in the right direction by some sort of gesture.

Second prototype was to show a city map on the screen with possible interactive famous places of Bauhaus, the interaction idea was to map physical movement of a person or map the cursor movement of a phone to the virtual movement on the city map, and let user to explore the target places by reaching to those locations. Maximum three places were to be explored by one person to finish the interaction.

⁴Josef Hartwig: <http://bauhaus-online.de/en/atlas/personen/josef-hartwig>, last accessed: 26 May 2016



(A) Chess prototype



(B) Map prototype

FIGURE 4.3: Prototypes

After prototype got explained to the participants, they were asked to bring their own ideas and ask questions, find possible issues and how to enhance one of them to be used for the advertisement. The consideration was also that any prototype selected should be valid for non-interactive, body interactive and mobile interactive advertisement.



FIGURE 4.4: Explaining and discussions on prototypes

4.3.4 Data Gathering

The data gathering design of the focus groups were done in a way that could be very easy to be analyzed and generalized in very little amount of time.

- The participants were encouraged to discuss the issues on a piece of chart using drawings and texts this helped the participants to focus on their ideas and build the ideas in a more better way and at the same time that helped the research to have a summary of their opinions and thoughts
- They could make summary of their discussion on the paper so that they and we fully understand the topics.
- Tobias Patrick was taking notes to cover up everything we discussed.
- All the sessions were video recorded for full detailed analyzing.
- Photos were also taken from the participant while discussing ideas, and also from the sketches they drew.

All of the above resources were analyzed by going through each of the sketches they drew and each notes that were written and all the videos were seen many times to check if some ideas were not clear in the sketches or notes and to have a final image of the discussions.

4.4 Findings

4.4.1 First Session Findings

The bellow sections are extracted from the long discussions, and analyzing video and drawn charts.

Bauhaus-Walk

Bauhaus-Walk is a project that is run by university students to show more about Weimar and Bauhaus culture to the world, by giving small tours to group of maximum 30 people. The tour shows studying conditions of the university and students, living style of people and giving excursion to historical places.

Tour guides are from different backgrounds like architecture, urbanism and design and each of them could show various aspect of Bauhaus by their own stories, and interrelate the stories with the facts and then connect them to the places in Weimar. Most important for the guides are not just the buildings, but also the small details inside the building that most people do not focus. The guides want to be the voice of those unspoken stories for the tourists.

Current Advertisements

Current existing advertisements for Bauhaus Walk is through different mean as listed bellow.

1. Web:

Bauhaus Walk is advertised briefly in the Bauhaus University Weimar webpage⁵ and in Weimar tourist information page⁶.

2. Print:

Bauhaus Walk program are advertised in flyers and leaflets at different locations, like they could be found in tourist information center, Bauhaus Museum, calendar of Weimar and in travel leaflets.

3. Books:

Bauhaus Encyclopedia has mentioned this program too.

4. Oral:

Mostly the people who have already taken the program once publicize it and they let their friends, relatives and family know about it.

Tour participants

Most of the people who join the tour are from elder people range between 45-65 years old and others are adults and children. Adults mostly learn about the program trough web and the elders learn from the tourist information centers and books. Most of the participants are German and do not understand English language.

⁵Bauhaus Walk: <https://www.uni-weimar.de/en/university/profile/bauhausatelier/bauhaus-walk/>

⁶Weimar tourist information: <http://www.weimar.de/homepage/>, Last accessed, 4th Jan 2016

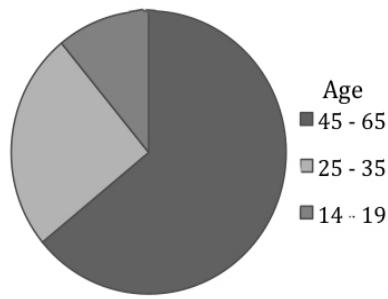


FIGURE 4.5: Tour participant average ages

Peak Tour times

In Average 5000 people take the tour each year. April, May, September and October are the peak months that people take the tour because of the weather condition to be good the amount of people per tour is about 25 people, but in winter there are very few people joining the tour and the amount of people per tour is up to five to six.

Possible advertisement location

1. Tourist Information.

This is a good place to put Bauhaus-Walk advertisement because

- Random visitors from different places and cities come here and want to know about Weimar in general.
- Heavy traffic of people.
- This is the only place to get Bauhaus-Walk tickets in advance.

2. Bauhaus Museum.

This could be another good place, but people have to pay to enter to this museum, so there will be limited people but who

- Are very interested in Bauhaus.
- Likely to go on tours.

3. University main building.

Main university building is a more open place for all visitors; there are many factors as stated bellow.

- People from different background.
- People from different age, more youngsters like students.
- Interested people in Bauhaus.
- It is close to starting point of Bauhaus-Walk tour.

Content of advertisement

Participants pointed on very important things about the content of advertisement, from which the advertisement got clearer and clearer and could be categorized in to many different aspects of Bauhaus-Walk.

1. Objects

There are objects that are introduced during the tour for the tourists; A good idea would be to show those objects on various locations on the map that belong to.

2. Stories

Bauhaus Walk tour guides have many stories to tell about the walk and their own backgrounds as one of them said "*Probably our walk is to sum it up, consists of stories we are actually telling stories, not just talking about history, not just about facts but our own personal stories and stories that were told by former students, so we are kind of raping the history in to personal stories, and we want to say that hay, we are students from different faculties and we want to tell the stories by different ways, and that is not a bad thing, because based on historical fact that there has not been the same Bauhaus in Weimar, there has been so many different teachers and students and they all had a different idea that what Bauhaus could be and I think we still kind of incorporate that the fact that no Bauhaus tour would be the exactly the same like the others before.*"

3. Histories, Facts, Places

The content of advertisement could also be related to history of Bauhaus, how it is known to world, what were and are the innovations and obviously show the historical buildings of Bauhaus.

Interaction of advertisement

Based on the examples that were shown at the introduction for the participants, they liked hand gesture and some other techniques and came to the bellow possible techniques.

1. Hand gesture Interaction.

The bellow two kinds of interactions were discussed each containing different contents.

- Hovering:

By showing the Bauhaus map on the screen with the most important elements on it, the users should be able to look at the items by moving their hands on top of it. The items could change its status when hovering for example if there is a light object shown by hovering it should turn on or something like that. There could be famous places shown on the map that Bauhaus-Walk tour focuses most, and by hovering the hand some more information like a picture or a related to that places should be shown.

- Performing a specific gesture:

There are many objects that have specific characteristics and those details are described in the tour, so the idea was to bring those objects in action and allow users to perform those actions, one idea was to show a 3D environment and the user should be able to perform a gesture, like opening door handle, lighting up a lamp, opening a lock by a key or play with Bauhaus *Bauhaus-Schachspiel*⁷(chessboard) to navigate the correct movement of the chess piece on to the screen, or other different gestures for specific tasks.

2. Body Interaction

Bauhaus-Walk is known from its name that it is all about walking to different historical places, therefor there was the idea of giving short virtual walk on the screen by moving the user's body in front of the screen and exploring some sights.

⁷Bauhaus-Schachspiel: <http://www.markanto.de/Markanto-Store/Entwurfsjahr/1920-1929/Bauhaus-Schachspiel-165.html>, last accessed: 27 May 2016

4.4.2 Second Session Findings

The second session was held after a week and half, with only two participants other participants could not come because they were busy with their studies.

Prototype discussion

After lengthy discussion on both prototypes, that how could they fit for both mobile and body interactions and at the same time for non-interactive advertisement and whether or not these prototypes could be ideal for Bauhaus-Walk theme and could convey their message through it or not. The bellow are their final summarized comments on both prototypes.

1. Chess-Game

- Positive points:

- The idea is very nice, because many of the visitors are above the age of 40 and they may be familiar with this game.
- Easily understandable by looking at the shape, because shape defines the movement.
- Suites best for Bauhaus Museum because, there is the original chess board of Bauhaus but people are not allowed to touch the game, by bringing this type of interaction, people will have a live experience with the chess board and play around with it and understand it.

- Negative points:

- Very difficult to understand by people who have not played chess before or have not seen this special type of chess.
- Players could make a lot of mistakes while moving the chess piece.
- The idea does not really fit to the Bauhaus-Walk program.
- It does not fit the places that are being shown in the tour.

2. Map-Game

- Positive points:

- Map game idea fits a lot to Bauhaus-Walk tour.
- Portraits the idea of walking action.
- Easy interaction just by moving body or a cursor in mobile phone and navigate inside the screen.
- Understandable concept by moving on to different places and exploring them.

- Negative points

- Possible moving difficulties in a given space.

4.5 Conclusion

The conduct of the two sessions of focus group was very helpful in a way that it was held very intensive that helped to understand in general the whole about Bauhaus-Walk program tour and especially about the tour guides that what they think about Bauhaus-Walk and what are the most important things that could be discussed and advertised for Bauhaus-Walk. All the relevant mentioned questions for the design and interaction of advertisement were answered and discussed. As a result of this focus group, one interactive advertisement prototype would be purposed, that should be able to cover all the aspects of advertisement and concept of Bauhaus-Walk that was discussed in this focus group.

Based on the opinions and discussions, participants chose the Map-Game prototype to be developed for Bauhaus-Walk advertisement and this prototype would suite better in Tourist Information center than Chess-Game prototype. Along with the prototype decision, participants suggested more features were to be integrated with prototypes, like (1) Content of the game should be very clear and accurate and they should show the places where we provide tour. We do not have many places to show and there may be maximum three places. (2) Integrating some fun factor to the game and interaction like by showing a famous character face on top of the silhouette head position. And giving a kind of funny movement. (3) Giving opportunity for multiusers to play interactive game, like for example if there are two people standing in front of the screen, the tasks will be divided among them by locking one's silhouette or interaction and allowing the other to perform the task. (4) Defining the task by the defined character or by color of the body or by random. (5) Showing funny map, which was made many years back of Weimar city. (6) Popping up interactive objects (houses) on the screen so the users understand that they are interactive.

5

Advertisement Low fidelity prototype

5.1 Introduction

This chapter conducts formative studies, which help the design process of application and how to investigate problems with the various prototypes, as Charles M. Reigeluth [93] says “*Formative evaluation (sometimes called field testing or usability testing) is a methodology for improving instructional resources and curricula*”. Evaluating the paper prototype of a system can be efficient [67] and can be very effective as Robert A [46] conducted usability testing using Low- and High-prototypes of the same system, where one group of subjects were confronted with a paper prototype and the other group of subjects with high-fidelity prototype (real functional system) and both groups were give the same set of tasks, and stated that “*In both experiments, substantially the same sets of usability problems were found in the low- and high-fidelity conditions. Individual problems were detected by a similar proportion of subjects in both the low- and high-fidelity conditions*”, therefor it is better at early stage to conduct such paper based evaluations.

There have been many evaluations on public display prototypes like Scott Carter [43], where three different prototypes were created for Ubicomp systems and were evaluated at different stages inside office places, during the early phases the 16 paper prototype technique was used, the evaluator was simulating the computer’s reactions, and even he involved five of his friends and employees to play the part of network that could update content in the display and the analysis was mostly qualitative like by taking interviews.

Evaluation of computer and mobile application paper prototypes are very common and it is easy to be conducted because there is only one interface and the interaction happens on the same interface, but as far as public non-touch displays are concerned, they seem to be slightly different because the interaction is happening outside maybe with a smartphone or without any input device like body interaction, at this point the moderator should be monitoring the interaction interface and simulate the effect in the display, most of this kind of testing is done with using think-aloud method as Robert .A [46] conducted the evaluation of electronic book player where the keyboard and the screen were simulated on paper and participants were told to call loud when pressing a key and the evaluator was doing the action on the screen.

This chapter describes the study design, evaluation process and findings of Low-Fi advertisement prototype, the *map-game* prototype, which was chosen by Bauhaus-Walk members in focus group discussions in chapter 4. The *map-game* prototype consisted of two different interactions (1) body interaction and (2) mobile interaction. The reason to conduct this study was to exploit usability issues of prototype and find out the appropriate and meaningful elements and what elements were confusing and not understandable. This document also describes the advertisement application requirements, lists all functionalities, and defines the target group that this application was going to be made for.

5.2 Advertisement paper Prototypes

The prototype was to show a city map on the screen with possible interactive famous places of Bauhaus, the interaction idea was to map physical movement of a person or map the cursor movement of a phone to the virtual movement on the city map, and let user to explore the target places by reaching to those locations. Maximum three places were to be explored by one person to finish the interaction.

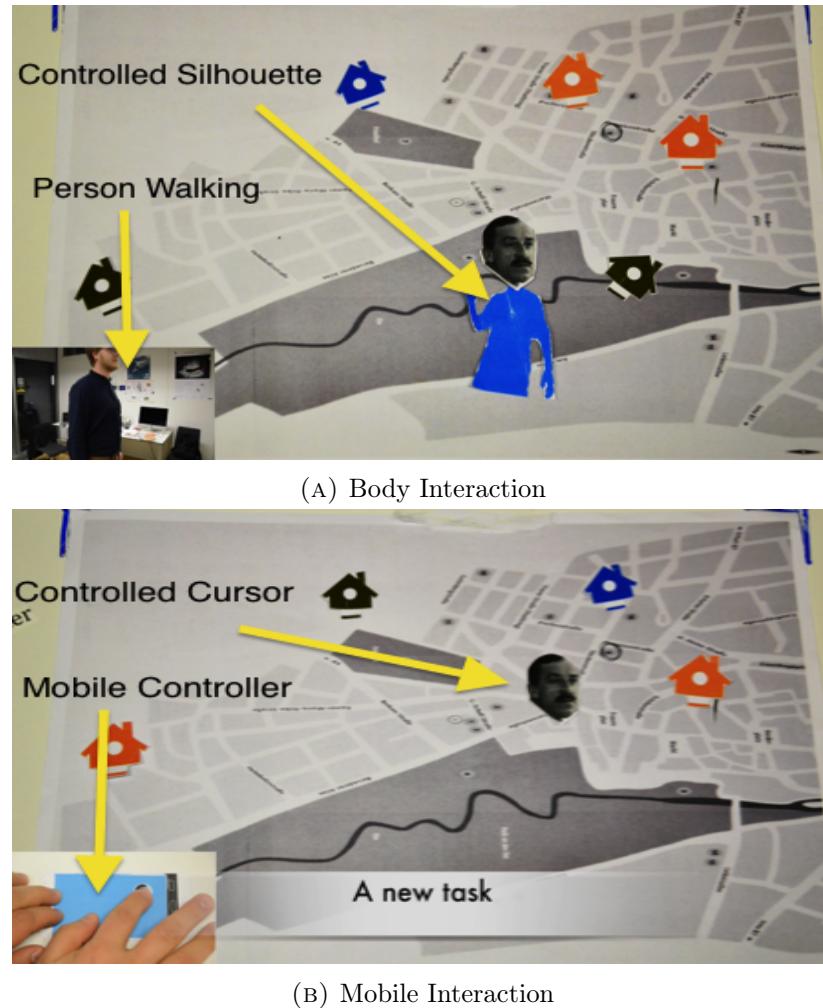


FIGURE 5.1: Bauhaus-Walk Advertisement Prototypes

As can be seen in picture (A), the person, in the left corner, is physically walking and his blue silhouette in the screen is changing its location on the map. and in mobile interaction in picture (B), the person is changing the cursor in the phone screen and the movement is shown on the display on the map. To have a look the entire paper prototype interaction sequence both with body and mobile, watch the prototype video¹ for all the process.

5.3 Requirement gathering

The bellow mentions a generalized form of Bauhaus-Walk advertisement's functional, non-functional requirements. These requirements were the result of the fouscs-group and discussions.

5.3.1 Functional Requirements

1. Detect multi User.
2. Assign a character to the user.

¹ Ad Low-fi:<https://youtu.be/XGBgeSGeUwQ>, Last accessed 27th May 2016.

3. Assign a task to the user.
4. Respond to each user interaction.
5. Show advertisement text.
6. End the interaction.

5.3.2 Non-functional Requirements

1. Performance

This is a very important requirement that should be wisely done. Response time should be very fast in both gesture and mobile interaction so the user could see the reaction quickly on the screen.

2. Scalability

The interaction is scalable for multi-users at the same time for body interaction and mobile interaction.

3. Availability

Kinect camera should be functional during the experiment for people detection, Access point should be running so that it could provide network access to users.

4. Usability

The advertisement interaction both mobile and body should meet all criteria of usability.

5.3.3 Personas

The bellow personas are made based on focus group findings that most of people taking tour are elder people, which builds up our primary type of persona and secondary type persona would be young age girl as described bellow.

TABLE 5.1: First persona

Type	Primary
Name	Andreas Müller
Background	History teacher
Demographics	Age:.....50 Height:.....1,6 m Martial status:.....Married Kids:.....Two Profession:.....School teacher Language:.....Deutsche Computer experience:.....None Smartphone experience:.....None
Goal and Task	Experience goals: 1.Likes to learn about places in Weimar 2.Likes to have fun. 3.Does not like to feel alone and likes his wife or friend to also join. End goals 1.Wants to see his body moving in the screen. 2.Wants to explore the character's location. 3.Want to learn about Bauhaus-Walk program.
Environment	He and his friends want to learn about some good places in Weimar and explore other famous culture events. He does not use technology.

TABLE 5.2: Second persona

Type	Secondary
Name	Anna Weber
Background	Media art student
Demographics	Age:.....25 Height:.....1,6 m Martial status:.....Single Kids:.....None Profession:.....Designer Language:.....Deutsche, English, Spanish Computer experience:.....Yes Smartphone experience:.....Yes
Goal and Task	Experience goals: 1.Avoid feeling stupid. 2.Likes to try and error. 3.Likes to have fun and laugh. End goals 1.To complete the task. 2.Learn about Bauhaus-Walk program
Environment	She is a student in Bauhaus University; she is very interested in art and design and wants to find out more about Weimar art. She loves using technologies like smartphone.

5.4 Goal

The goal of this evaluation is to find possible issues as listed bellow with interactive advertisement.

1. Confusing and unclear events or interactions.
2. Misconception of a function.
3. Task confusion.
4. Understandability of advertisement goal and contents.

5.4.1 Questions

The questions are divided for each individual interactions (mobile and body).

Body Interaction

- Do users understand and react to the Call-to-Action approach?
- Do users recognizes the character assigned to them?
- Do users understands the tasks assigned to them?
- Do users can explore locations by moving their body in physical space?
- Does application raise alerts to specific user actions?
- Does application motivates participants to continue playing?

5.4.2 Mobile Interaction

- Do users understand the access-information shown on the board?
- Do users open the controller website by scanning QR-Code?
- Does Webpage application produce alerts with incorrect user input?
- Do users rotate the mobile phone to start game?
- Do users understand the task?
- Can users navigate the character by moving the face in mobile?
- Does application produce alerts for incorrect location?

5.5 Study Design

Bauhaus-Walk interactive advertisement consisted of two elements, (1) the screen that the users see the reaction of their action and advertisement content, (2) was the mean of interaction, which was body or mobile. To design the evaluation, first of all, this paper prototype should be capable to mimic both of these elements as real life scenario. As result the actual advertisement screen paper prototype was made, in which the experimenter simulated the output of all user action even small actions like, movement of silhouette or character face, on a display board, which resembled a display.

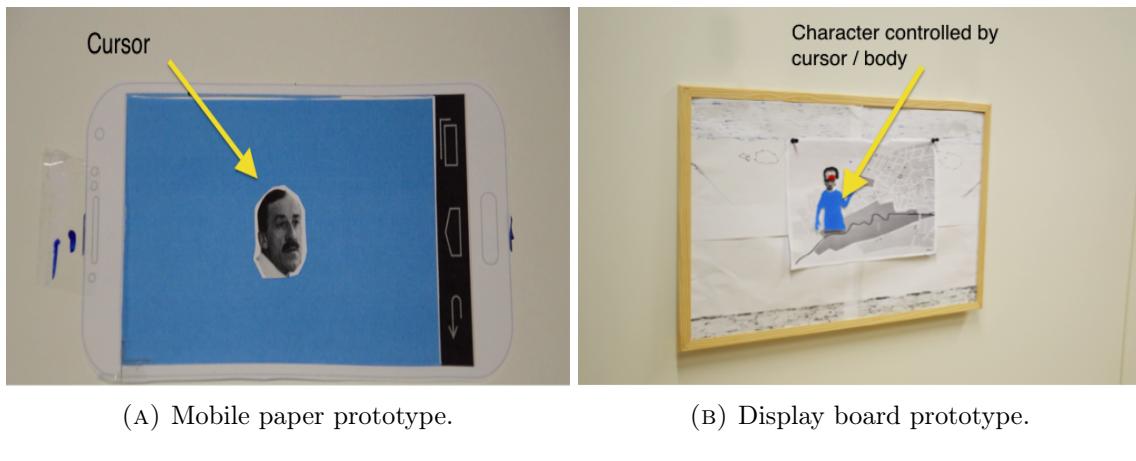


FIGURE 5.2: Paper prototypes

5.5.1 Subjects and location

The prototype testing was limited to five participants; they were from different background, like Media Art, Media architecture and computer science. Participants were invited in Digital Bauhaus Lab ground floor.

5.5.2 Procedures

The bellow procedures were followed.

1. Participants were handed the information sheet and consent form for film recording.

2. Short introduction was given about the goal of thesis and this evaluation in particular. But they were not given any clue about the interactive prototypes.
3. The task for participants were to explore the paper prototype until the game finishes and advertisement content is shown.
4. Participants interacted with both prototype one after another.
5. They were instructed to think-aloud during interaction to help the experimenter imitate the reactions on the board.

5.5.3 Display output simulation

The moderator, as a computer between display and the user, would receive (watching or listening) the user's action and compute the result and show it on the display. All the interactive elements for the display were separately cut and put a side and each had a sticker at backside, and whenever the user wanted to do something like for example visiting a location, moderator would stick the picture of that place on display and also move the character based on the user's physical movement.



FIGURE 5.3: Participants interactions

As can be seen in the left picture, the user is interacting with body and the moderator is holding the blue silhouette on the board and would change if user changed her position. The picture on the right shows the mobile interaction, the user is interacting with phone prototype and sees reaction in the display board (The display board had not come in the picture frame).

5.5.4 Data gathering

The process of data gathering was as bellow, the methods are designed in a way to fully answer the research questions.

1. Video Recording

Each participant was video recorded for both body and mobile interactions for later observation and analyzing purpose.

2. Direct observation

Participants were observed during the interaction and also asked about what they thought at that moment while interacting. When participants could not perform a task then they were asked exploratory questions on how would they do the task naturally.

3. Think aloud

Participants were asked to read their mind while interacting with the prototypes. This helped to understand what they thought about a specific interaction at that moment.

4. Interviews

After both paper prototype interactions were finished, a brief interview was taken to further learn about the interactions they did and get other user comments and feedbacks for the prototypes.

5.6 Findings

The important part for analyzing the data is shaped based on the defined hypothesis at the beginning; the bellow procedure was followed to best answer our open questions and to be able to evaluate both paper prototypes. For interview codings see Appendix fix the appendix

5.6.1 Body Interactions issues

1. Confusions

- (a) user was confused of how should to walk, because it felt that there is not enough space.
- (b) User thought that if he/she moves to the location names or the icons, someone would guide her.
- (c) User was confused on the new character photo labeled on the top of his silhouette; he thought that the new character is trying to interact with his silhouette. *“Is it like people approaching you and say hi and hello, and then ask me if I can visit his places”*
- (d) User did not know his places (the character’s places).
- (e) Could not understood the word move or walk, he taught that it is not applicable at the moment.
- (f) Raise one hand to see if the blue reacts or not.
- (g) Did not recognize the person.
- (h) Did not understand the task partially.
- (i) Did not understand what is the blue silhouette.

2. Frustrations

- (a) When the wrong house was explored, and she said “(Ohh No)”.
- (b) Waiting for the houses to load on the screen.

3. Mistakes

- (a) Entered to the wrong location.
- (b) Did not know how to navigate to the places. Even he was told that the silhouette is his body.
- (c) Navigating the silhouette was a problem for her; she wanted to go on top of the map in the screen but physically moved back. And after seeing the reaction she corrected herself.

4. Comments

- (a) There should be very clear instruction in the application on what to do, what it is about and how to do it.
- (b) I did not understand the person; maybe do not use it anymore.

5.6.2 Mobile usability

The bellow chart lists all the possible issues with mobile interaction.

1. Confusions

- (a) The idea of the application was not clear for her because she taught that the mobile application could be used when she goes out in the city. But later she found out that the screen and mobile are both of them used at a place.
- (b) Navigation was a big confusion for him; he was touching the character on the mobile screen.
- (c) The turning phone as shown in arrow, since she could not turn the phone.
- (d) Did not understood what happened after the interaction was over. She did not read the texts or she did not understand why those were about.
- (e) The face in the mobile.

2. Frustrations

- (a) Entering IP address.
- (b) Visiting to all locations to finish the interaction.
- (c) Not enough things when visiting to a location.
- (d) She felt frustrated when visiting the wrong location and find the right location.
- (e) He had to re-login because he accidentally pressed cancel button.
- (f) Visited to the wrong location.
- (g) Waiting for the houses to load on the screen.

3. Mistakes

- (a) Did not understand to scan QR code.
- (b) Took longer time to use the phone prototype.
- (c) Did not understand to rotate the mobile. As the instructions were shown on the phone.
- (d) Took longer time to navigate the person on the screen.
- (e) She tried to continue without putting any name in the form.
- (f) Did not understand how to turn the phone, she touched the arrow on the screen many times. But nothing happened. Later she knew to turn the phone, but did not do it because she thought that the paper prototype should not be moved from its place.
- (g) Could not navigate the person on the screen.
- (h) Entered the wrong IP address, but then changed his mind and scanned the QR code.

- (i) Accidentally pressed cancel.

4. Comments

- (a) There is no enough information about the locations; it would be good to show a short description of the place.
- (b) There could be like choices like when the opening time is for these locations.
- (c) How far are they from my current location, the distance?
- (d) View the transport possibilities to the selected locations.
- (e) It would be good to have more information about the locations.
- (f) And I would like to see the entire map on the phone too.
- (g) I like to see some more information in my phone.
- (h) There should be more guides when I use the phone, like there should be like Samsung, when you turn it on for the first time, it shows how to use what or it should have a finger picture to swipe on the face.

The bellow chart lists all the number of usability issues as, confusions, frustrations, and errors for each of the interactions carried by participants.

TABLE 5.3: Number of usability issues

Prototype	Confusion	Frustration	Errors
Body	9	2	3
Mobile	5	7	9

5.6.3 Summary of findings

The questions, which were defined in the design study, from which some of them are accepted and rejected based on the above findings.

Body Interaction

- Users understood and react to the Call-to-Action approach.
All of the participants understood call-to-action and reacted to it quickly as soon they read it.
- Users did not recognize the character assigned to them.
All the participants did not understand the character which was assigned to them, This happens when the participants do not have background to the related history that should know the character, It would be better to use someone who is very famous and is known to most of the population and different cultures, using very specific character is a bad idea. Users gets confused. At one occasion even an architect student who must know that face, but unfortunately did not recognized him.
- Users did not understand the tasks assigned to them.
Most users did not understand the task in the sense of the defined character, but they did understand that they should walk and explore locations.

- Users could explore locations by moving their body in physical space.
As soon as users understood that the silhouette shown are theirs then they did the task by moving them selves physically, except one participant who did not understand until the observer gave him hint to move his self physically in right or left.
- Application did not raise alerts to specific user actions.
The application did not raised error for user's specific interactions like if the user was out of the screen or very close to the screen. Most of the participants raised their hand up, or turned around, there was no alerts for the participants.
- Application did motivate participants to continue playing.
When the users explored the first location, they were excited and tried to see the other places, but all the locations action was predictable by the participants and nothing new was happening, participants expected more from their interactions to be more excited to play the whole game. They did finish the game because they were told so.

Mobile Interaction

- Users understood the Access Information shown on the board.
The participants were not shown the phone prototype at first, they were only shown the display and were asked to react based on the messages or what ever the users comprehend, after reading the Access information they asked for the phone prototype and then the phone prototype was shown to them to interact.
- Users opened the controller website.
Four of the participants understood the use of QR-code and from which two of them scanned it and other two typed the IP address, and one participant did not understand the use of QR-code.
- Webpage application did not produce alerts with in correct user input.
The webpage did not produce error at many occasions while filling the form like, what happens when cancel button is pressed, or when the game finishes the application does not alert user to replay or leave webpage.
- Users did not rotate the mobile phone to start game.
Only two of the participants rotated the phone but the rest of the participants tapped on the icon and tried to rotate the icon in the screen instead rotating the whole phone.
- Users did not understand the task.
This happened because all of the participants did not recognized the face and did not know where are his locations.
- Users could not navigate the character by moving the face in mobile.
Four of the participants touched and tapped the face shown on the mobile phone many times, they expected that something will happen after they touch the character like a dropdown list would appear to edit it, but one of the users drag it and saw the reaction on the screen.
- Screen application produced alerts for incorrect location.
The incorrect locations that were explored by the participants were given an alert message.

5.7 Conclusions

Evaluation of low-fidelity prototype of advertisement was very helpful to understand possible design problems and interactions that could have been a headache if had been identified at high-fidelity version.

First, the body interaction was easily understood by most of the participants, this type of interaction is more natural and can be done by any kind of participant without having any technical expertise. Two most important interactions in this technique was the call-to-action which approached participants to come near to the screen and other was to explore the locations using their body position in physical space. This low-fidelity usability testing suggests bringing changes for the next high-fidelity version of the advertisement. The changes would be to remove the character assigning for individuals, improving alert messages for different user actions, improving task description and integrating features to increase interest rate for participants to be engaged with the advertisement.

Second, participants also appreciated the mobile interaction, but they were not so convinced for the usage because of many issues like logging in web application first, then navigating the face character. There was no clear instructions for how to navigate the character, and what will happen if there are many participants playing at the same time, where all of the participant would have the same face and they would get confused that which one is being controlled by their controller, and lastly, it was unclear that what happens in web application when the interaction is over. This usability testing helped me to identify the mention usability problems and would bring changes for the new high fidelity version that would solve the current issues.

Third, The advertisement text, which was shown at the end of interaction, did not brought user's attention, it would be better to make a short video for the next prototype that could bring users attention to see the advertisement. After the video advertisement gets over the attraction phase starts again.

Finally, all usability related questions were taken in to account from which new decisions for the high fidelity version would be taken, the new version would overcome all the issues discovered until this stage. Participant's recommendations and feedbacks had also much value and would be considered in the development phase.

6

Advertisement High Fidelity prototype

6.1 Introduction

A follow up study is conducted when a final version of a prototype is developed, this is called *summative study*, [69] “*it is used to evaluate how well the design meets the usability requirements*” it is to make some final decisions on the prototype, there have been studies like “*Sweep and point & shoot*” [42] that evaluated prototypes of interaction of personal computing device with large public displays, another was an evaluation of “*mobile interaction with live video*” [45], which was a with-in subject design, the participant’s performance were measured for automatic zooming and temporary image freezing. Sebastian .D [60] assessed the general performance of drag and drop interaction on large displays and compared it with a traditional drag and drop. Jorg Müller [11] did pre-studies (lab and field) on noticing interactivity of a display in which the time required for recognizing interactivity by participants were measured.

Based on the feedbacks from the low-fidelity evaluation in previous chapter, I developed the hi-fidelity version of interactive advertisement both (body, mobile), which was at a functional level. This chapter explains the evaluation process of Hi-fidelity prototypes of interactive advertisement both body and mobile. The evaluations were more on user performance, user acceptance; it also focused on the possible usability issues. As the application would be in public, where many people would interact, therefore this study also tested the application performance with single and multi-users to ensure application stability.

6.2 Advertisement prototypes

The prototype was to show a city map on the screen with possible interactive famous places of Bauhaus, the interaction idea was to map physical movement of the user, or map the cursor movement of a phone to the virtual movement on the city map, and let user to explore the target places by reaching to those locations. Three to five places were to be explored by one person to finish the interaction.

There are mainly three hierarchical levels of interfaces, (1) *call-to-action*, (2) *Game interaction*, and (3) the advertisement video interface.

- Call-to-Action interface:

This interface invites participants to interact with the application, this method was first proposed by Bill Kules [68], in which the immediate usability of public accesses to a system was designed. *call-to-action* of body and mobile are designed differently, which are shown in below sections.

- Interaction interface:

This interface activates when the user follows the instructions of the first interface, the interface shows the interactive map with the hotspots to be explored by participants.

- video advertisement:

After the interaction finishes then a silent video advertisement is shown for 20 seconds. The advertisement video was created in powtoon¹ with a free version account, to see the full advertisement video visit below link.

Old video version: <https://www.youtube.com/watch?v=GrWtOyjNcQ0> New video version: <https://www.youtube.com/watch?v=-y1Dbz6E6bU&feature=youtu.be>

¹Powtoon: <https://www.powtoon.com>, last accessed: 21 April 2016

6.2.1 Body prototype

This section introduces the interfaces of the body interactive prototypes and the processes that how a user can start interaction.

[make the video demo](#)

1. call-to-action interface:

This interface is basically the attraction attention and call-to-action interface, as you can see bellow there is someone standing in front of the screen and the interface calls him to come near. This area also has alert message on the top right area of the screen and alerts the participant if they move away from the camera range, in this example the person is standing but there is also the second person but got immediately untracked and the system pops that message to raise his hand to be tracked again.

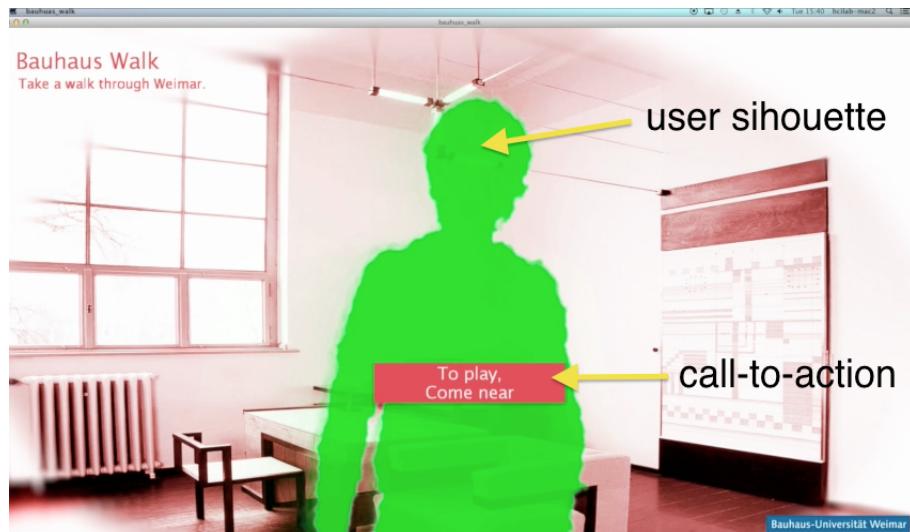


FIGURE 6.1: call-to-action interface

When the person steps in the range of the Camera, his silhouette is projected on the screen with a different color, the application calls the person to come near in order to trigger the game.

2. Transition to interaction interfaces:

The transition happens when the person stands close to the screen for more than 3 seconds and the bellow things happen.

(a) Loading animation:

The loading animation is a reaction to the action of the participants, and at the same time participants waits for something to be loaded.

(b) Scaling down the silhouette:

To walk freely on the map and to give the participant the feeling of walking, the participant's silhouette is scaled down, the scaling happens smoothly frame-by-frame.

(c) Show task instruction:

Every interaction has instructions, the instruction is fairly very easy and it is simplified in one sentence to explore locations on the map.

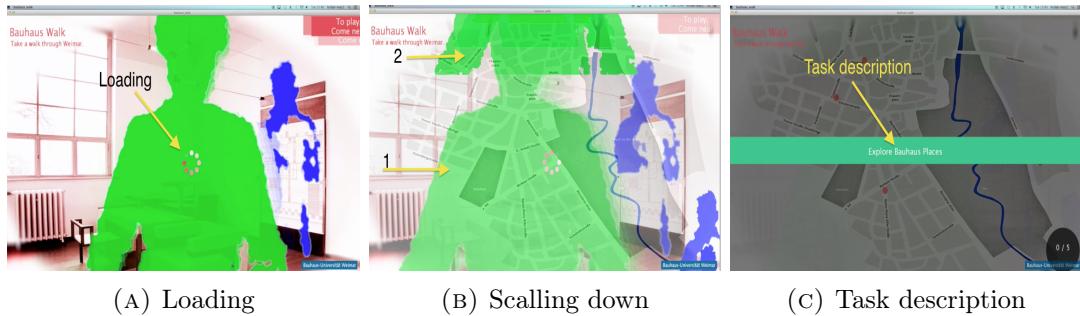


FIGURE 6.2: Transitions of interfaces

3. Interaction interface:

In this interface participants can interact with the elements on the map. As shown in picture bellow, the silhouette has visited four locations therefor has 4/5 score, to finish the interaction he needs to visit the last one location.

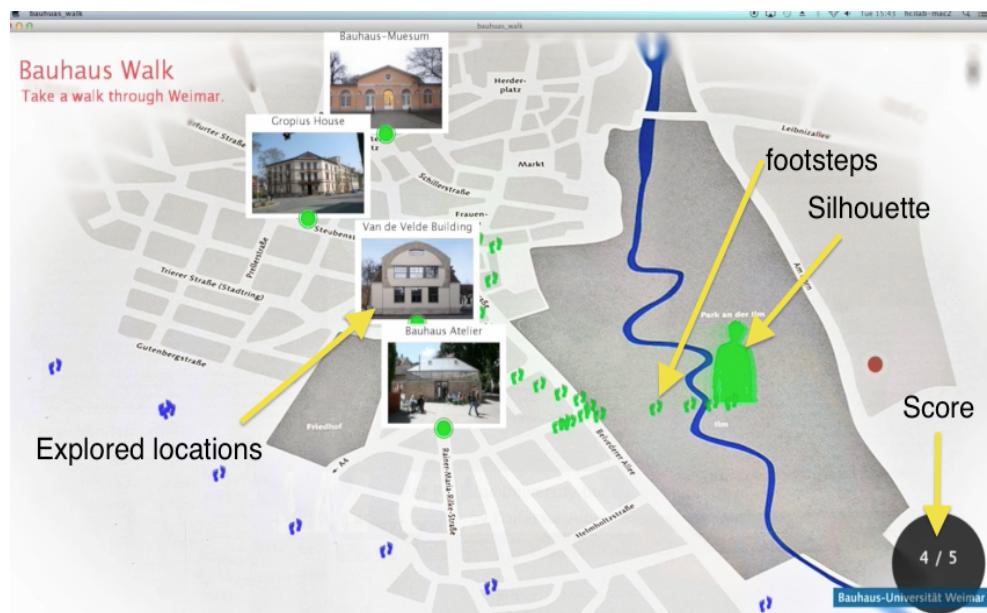


FIGURE 6.3: Second Interface

6.2.2 Mobile

Mobile interaction is possible by using a smartphone and a Wi-Fi connection to the advertisement network, the user should open the mentioned IP address in his / her mobile browser and enter a name to login. [make the video demo](#)

1. call-to-action interface:

This interface is designed in such a way to attract passers-by and also guide the participant on how to use their smartphone to access the advertisement application. The attraction is again the same method that was used for body, the passers-by silhouette is projected at the back of Access information. The interface has QR code that could be easy to be scanned instead of typing the whole IP address, and there is an alert area, that gets activated when a logged in person has not turned their phone in landscape orientation.



FIGURE 6.4: Mobile interactive interface:

2. Transition to interaction interfaces:

The transition happens only when the user connects to the WiFi, open the controller and physically hold the phone in landscape.

(a) Loading animation:

The loading animation is a reaction to the action of the participants, and at the same time participants waits for something to be loaded.

(b) Creating Colored cursor:

A colored circle will be created for the participant in the center of the screen; each participant would have different colors matching to their controller interface in their phone.

(c) Show task instruction:

The instruction is fairly very easy and it is simplified in one sentence to explore locations on the map by using their phone.

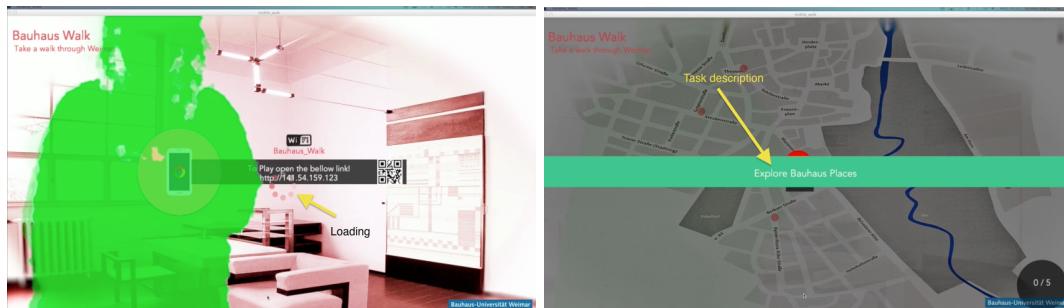


FIGURE 6.5: Transitions of interfaces.

3. Interaction interface"

Second screen is the interaction screen for the participants, participants can navigate the cursor using their phone controller page. As can be seen in bellow picture, the user is controlling the cursor and has explored one location, the user's defined name is also shown on the cursor, to provide a hint that they have reached an interest point a small

circle is shown to determine the area of that interest point. The interaction will finish when all the locations are explored or the interaction time finishes.



FIGURE 6.6: Mobile interactive interface

4. Mobile interface:

After opening the web page in smartphone, and entering name, the bellow interface would appear. The interface is very simply designed and has two elements, the cursor and the select button, with cursor the user can navigate inside the map for interest points and when reached on an interest point the participant presses the select button to explore that location, see the picture bellow.

Florian Echtler's student projects!



FIGURE 6.7: Mobile controller interface: The left side is the cursor and the right side is the select button.

6.3 Research questions

1. How fast do users understand call-to-action?
2. How fast participants react to the call-to-action?

3. How easy participants understand the interaction task?
4. How long participants take to finish the interaction or visit all target locations?
5. What are the major usability flaws that prevent users from advertisement interactions?
6. What is the difference between mobile and body performance.
7. How the applications would perform in single user interaction and in multi user interaction?

6.3.1 Video advertisement

1. Do participants understand about the content of advertisement?
2. How many elements of display can participants recall after their first interaction?

6.4 Test Design

This study used a within subject design, in which each participants were asked to experience with both body and mobile interactions, the interaction sequence was interchanged for participants in order to counterbalance the learning effect.

6.4.1 Participants

12 participants were invited for the usability testing; from which five participants were female and seven were male, most of the participants had computer science background and were familiar with mobile and had seen or worked with body sensing technologies, one participant was not familiar with QR-code.

6.4.2 Task

Participants were not told about any specific task, they were told to explore the system by their own and understand what to do, to avoid different outcomes participants were told to continue interaction until they encounter the very first stage of the application. So the tasks for participants were to start from initial stage of the interaction (body /mobile) and continue until reach the initial stage again.

As for body interaction no extra device was required to accomplish the task, but for mobile interaction a mobile phone was required, participants were not told that the use of mobile is required unless participants used their own phone or asked for it from me.

- Task understandability:
Participants were told to think-aloud that what task will they perform at each stage.
- Performance measurement:
 - call-to-action understanding duration
The time from when the user saw his/her silhouette until he/she understood / approached to start the interaction. For body call-to-action, if the person intentionally moved toward the screen and for mobile call-to-action, when the person pulled the phone out.

- Triggering game duration
This time is measured from the time the user understood that how to start the interaction, until the user actually starts the interaction. for example in case of mobile interaction, the time is measured from the time the user takes out the mobile until he logins and opens the interaction controller.
 - Task understanding duration
This time is measured when the users starts the game until he/she understands what to do. or how to explore locations.
 - Task completion duration
Task completion time is measured from the time interaction starts until the interaction ends.
- Content recall:
After the first interaction with the advertisement, immediately participants were given paper and pen to write down the name of anything that they could recall. The interactions (mobile and body) were counterbalanced between the participants.
 - Usability issues:
Each participant was given five minutes to interact with advertisement for both mobile and body and then follow up questions were asked regarding the issues they faced. The usability issues like (confusing, unclear events and mistakes) were all observed by the moderator at the scene and later while watching the recorded videos. To understand better each interaction was separately listed as bellow.

6.4.3 Data Gathering

The bellow data were gathered.

6.4.4 Performance data

Check for performance measurements, which were discussed in the previous sections. Each individual's performance with both mobile and body interactions were created in bar chart, this data could also be used to check for efficiency of the interactions techniques too, then to get an overview of performance in general the mean duration of the performance data were computed.

Preference data

The preference data, which is the measures of participant opinion or thought process, like the think-aloud each participant performed, or the answers for the interviews and their feedbacks.

- Think aloud quotes
Think-Aloud quotes were noted during the video observation, these quotes were important to check at which point in time users understand about the interaction and tasks. It also helped to analyze their reaction and feedbacks toward the tasks being done.
- Interview transcripts
All the interviews were transcribed and color-coding technique was applied to analyze and comprehend different aspects and categories from the defined questions.
attach the color code chart

- Recordings

There were two different recordings done during the session, first was video recording using camera at the backside that could record user actions and computer screen, the second recording was the screen recording of the application using QuickTime screen recorder. These recordings were used to analyze behavior, application performance and listen to the things participants said during interaction.



(A) Participant in body interaction mode. (B) Participant in mobile interaction mode

FIGURE 6.8: Participant's video recordings

6.5 Findings

6.5.1 User performance

- Mobile Interaction performance:

The bellow chart shows the performance data when the mobile interaction happened for participants. The y-axis shows duration in seconds and x-axis shows the aspects as bellow. You can see performance chart for each individual in Appendix [put number](#)

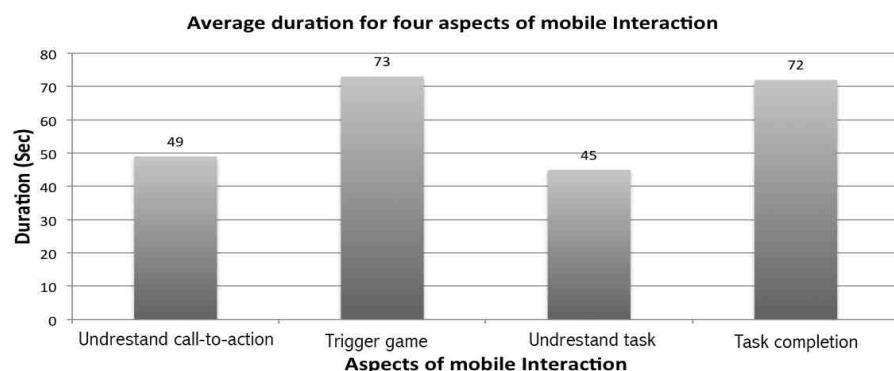


FIGURE 6.9: Chart that shows each aspect with respect to duration.

Participants took 49 seconds in average to understand how to access the system (call-to-action), After participants understood what to do it took 73 seconds in average from taking their phone, opening the web page, logging and starting the game, it took 45 seconds in average to figure out how to do the task and 72 seconds to complete the task, as a result in average 240 seconds were taken for whole interaction time.

- Body Interaction performance:

This also shows four different aspects of the body interaction in the bellow chart. To see all participant's interaction see Appendix. [put number](#)

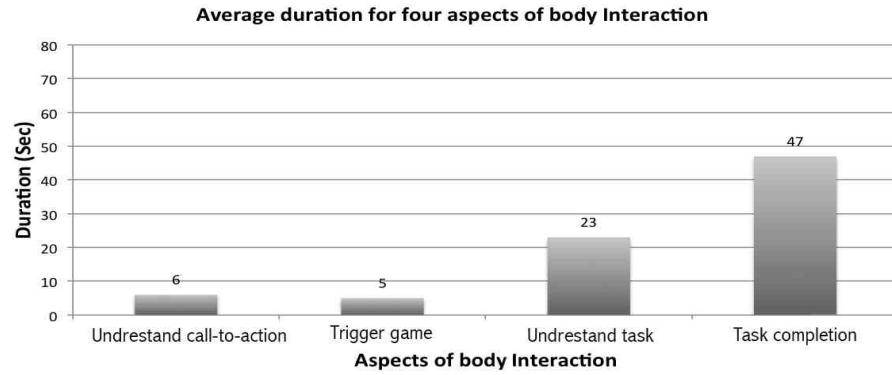


FIGURE 6.10: Chart that shows each aspect with respect to duration

As can be seen above most of the participants finished the whole interaction in approximately 81 seconds, which is much better than mobile interaction. It took 6 seconds to understand call-to-action, 5 seconds to trigger and start the game, 23 seconds to understand the task and 47 seconds to complete the tasks.

- Body Vs. Mobile performance:

As can be seen below body interaction seems to be much better than mobile interaction in terms of performance. The whole interaction time of body is less than the half of the time of mobile interaction.

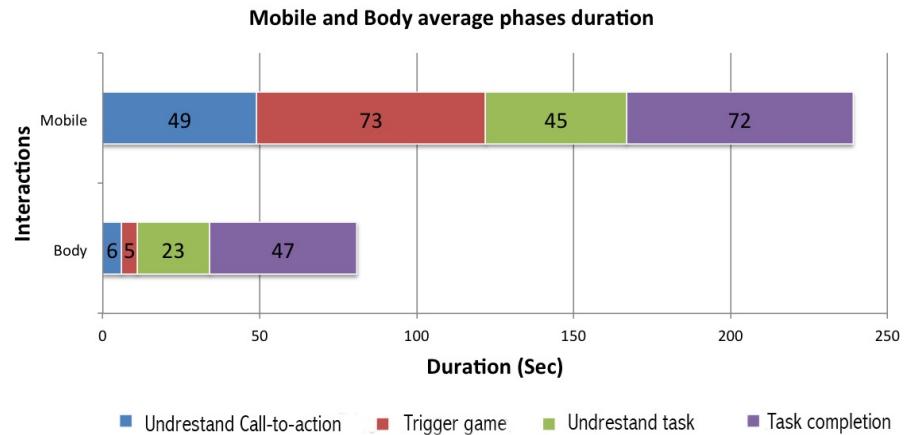


FIGURE 6.11: Comparison of body and mobile interaction performance

81 second is the mean value of the all participants with body interaction and 240 seconds is the mean value of the same participants with mobile interaction. The bellow chart shows other comparison of aspects as described.

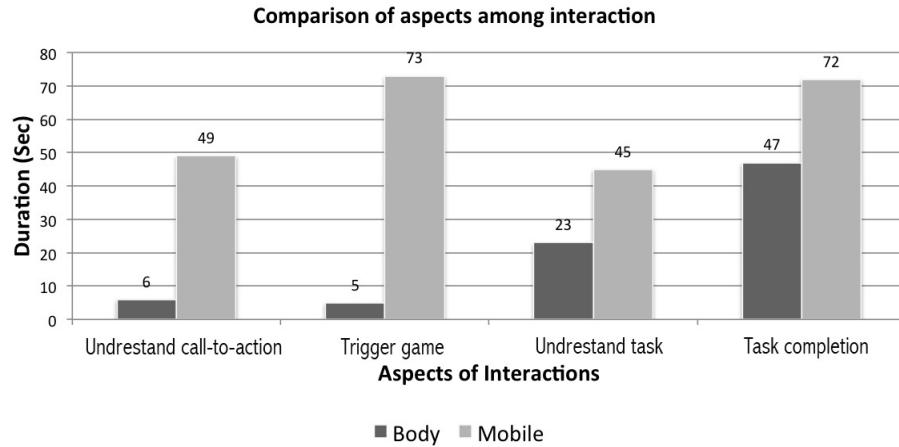


FIGURE 6.12: Comparison of the aspects of interaction among body and mobile

As can be seen in the chart mobile interaction took much longer than body interaction for each phase or aspects, ANOVA reveals a significant effect of call-to-action of (body vs. mobile) ($F_{1,11}=22.4758, p < .001 (p=.0001)$). A post-hoc tukey test shows that participants understood very quickly the call-to-action of body interaction compared to mobile interaction technique, maybe because it is very easy and understandable by any person because of the action “*to play come near*” is very usual and easy compared to using mobile phone, which is not expected at that moment and the users should read and see the information text to understand, all those steps requires more cognitive load than simple action of body interaction.

ANOVA reveals a significant difference of triggering game between (body vs. mobile) ($F_{1,11}=124.1066, p < .001$). post-hoc tukey test shows that in body interaction the triggering happens much faster than mobile interaction, This is because mobile technique has many steps to follow in order to trigger the game (like connecting to WiFi, logging to website).

ANOVA reveals a significant difference of task understandability between (body vs. mobile) ($F_{1,11}=7.1340, p < .05 (p=.0147)$). A post-hoc tukey test shows that participants understand the task very faster compared to mobile technique, one hint could be the body representation itself and in mobile an abstract circle is shown and the interface that takes time to try and error and find what to do.

Interaction time is also significantly different as ANOVA test suggests a significant difference between the game interaction ($F_{1,11}=19.7000, p < .001 (p=.01)$) post-hoc tukey test also strongly recommends that body interaction takes less time to complete the interaction compared to mobile.

6.5.2 Usability issues

The bellow usability issues are gathered from participant while observing them during the interactions.

- Mobile Interaction:

1. Call-to-Action

- (a) At the first glance and moment most participants did not try to read the text on the screen, despite they were expecting other way to get quick information, but after many try with their body they had to read the information text. This could be because of many issues like (amount of text, text size and used icons). And most importantly the text information was being covered by the silhouette, if participants were far the text was readable but when participants would get near to the screen to scan the QR-code or read the IP address, the silhouette drawn by the Kinect camera would occlude part of the information text, which resulted that participants should move a side to scan while facing toward the screen.
 - (b) Participants did not understand about the phone icon or the browser animation on top of it until they figured by themselves.
 - (c) Frustration of typing the IP address.
 - (d) The size of QR code was small.
2. Use of mobile phone.
 - (a) Participants did not expect at the beginning that they would use their own phone for the interactions; many times participants asked, "*Should I use my phone?*"
 - (b) Most participants did not read the instruction to tilt their phone and even if they accidentally had tilted the phone, it would have not effected because by default the tilt-sensor of the phones were off because of power saving settings.
 - (c) There was no instruction to turn-on the tilt-sensor in mobile phone.
 3. Login page
 - (a) Some of the participants were confused with the word Login, Participants thought that they would have to provide some sort of username and password to the system, and one participant reacted to this strictly and refused to login to the webpage using his phone.
 4. Task description
 - (a) The task description was shown after the participants login to the system despite of whether the phone is tilted or not, Most participants missed to read the task description because they were busy with their phone to tilt it and by that time the description on the screen was gone.
 5. Controller
 - (a) Participants did not read and saw the instructions for phone.
 - (b) Many participants complained about the elasticity (automatic centering feature) of cursor. They had to reposition the cursor for another location to explore.
- Body Interaction:

1. Call-To-Action

The silhouette is projected in the largest scale for attraction attention, but the silhouette scales down (mini-silhouette) and adjusts to person position (x, z) on the display, when users triggered the interaction by coming close to the screen, then participants could not see themselves, because the mini-silhouette would adjust outside at top of the display, if participant moved back then they could see the silhouette back.

2. Silhouette controlle
There was no instruction on how to move the body physically to perform the tasks, but participants tried themselves to find a way to interact.
 3. Alert image
Alert image that shows a Hands-Up person lead to confusion at the moment where users were much closer to the system.
- Advertisement video:
 1. The slides were switching fast.
 2. Some did not liked the colors and theme.

6.5.3 Advertisement goal

- Did users understand about advertisement?

The criteria for recalling the advertisement was that participants should recall “*Bauhaus-Walk*” word and explain what does it do or if the interaction technique gave them an idea what could be the advertisement about, At best users can recall the date, timing and location of the tour program.

1. Ad goal description

Therefor to find out this, when all participants experienced with the very first interaction technique mobile or body, they were immediately asked about the goal of advertisement, we wanted to know if the participants would understand about the advertisement at their very first try. All of the participants were speaking in English language and the advertisement interaction and the entire participants responded as they finished the interaction. 9 participants accurately described the goal of the advertisement and 2 participants generally described about the goal, the reason behind that was advertisement video, which was shown was in German language, later the video was changed to English for the rest of participants and they responded precisely.

put two example sentence by participants

2. Ad-related elements recalled

After the participants described the goal, they were given a piece of sheet to draw and write any element related to the interaction and advertisement with in five minutes. All the sketches drawn and keywords written by the participants were manually analyzed and counted

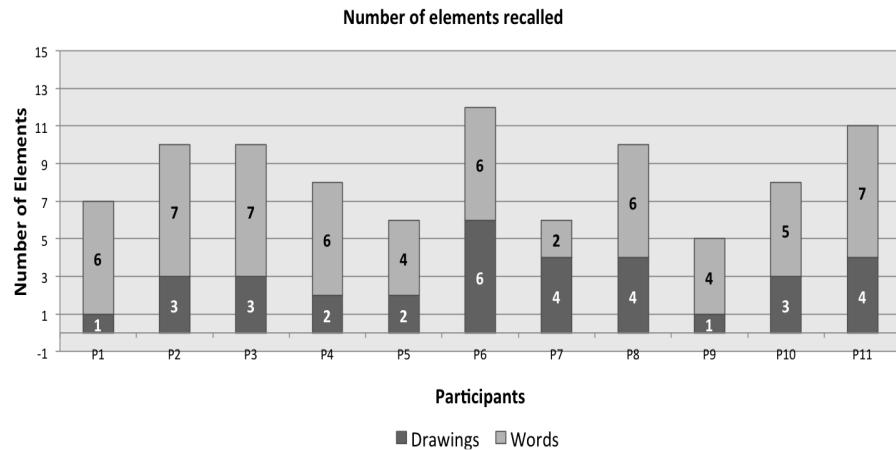


FIGURE 6.13: Number of words and drawings of the advertisement elements

- Word cloud (Wordle):

All the keywords written in the papers by participants were collected in one text file and visualized in word cloude technique by using an online tool² the bellow word cloud was generated.

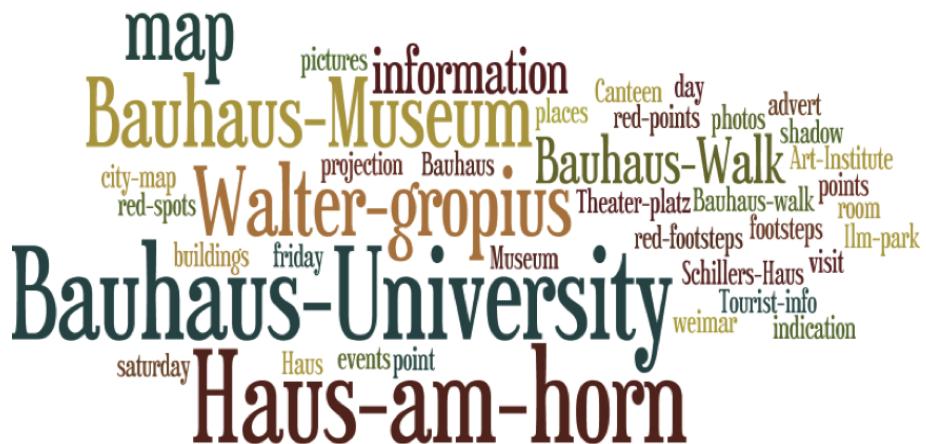


FIGURE 6.14: Word cloud representation of the keywords

As can be seen, most key words that has high frequency are the ones actually related to the advertisement it seems most location names that participants interacted with are recalled a lot like “*Bauhaus University*”, “*Haus-am-horn*” and others, The program name “*Bauhaus-Walk*” is also in high frequency, and even the day of the event is mentioned too.

- Key factors for advertisement understanding:

²Wordle: <http://www.wordle.net/create>, last accessed: 10 May 2016

1. Game environment

The game environment designed for the interactions had a major impact for understanding the advertisement goal, for example one of the participants replied “*I saw a map and different places, so I guess touristic places that I can visit in Weimar.*” Beside the map the blinking points on the map, which more people are familiar that shows interest regions of a city, one participant replied “*I think it was about tourist places in the city, at first I saw the map, and there were points on the top*” By analyzing their reply, they already linked the points with the touristic places.

2. Interaction technique

The interaction technique especially with the body interaction where walking is involved, participants got clue about the advertisement indirectly only by walking and linked walking as visiting locations, like one of the participants replied “*Discovering Weimar. The Bauhaus-Walk. It was the advertisement about those locations that the people can visit in the tour.*” It is very fascinating to read that answer from which the whole goal of the advertisement can be derived.

3. Advertisement video

The advertisement video had an impact on the participants to be able to recall the advertisement, one of the participants replied that “*I saw many pictures coming about Bauhaus and the program times and day*”, despite that the users understood a little about the advertisement they also complained about the video for being fast.

6.5.4 Interview Findings

All the interviews transcripts were coded for better analyzing and finding appropriate connections to categories and these categories are shown as a big diagram attached to appendix B. Each category is discussed separately

fix the appendix

- Mobile Categories:

Many important categories were created from the responder’s codes; these categories reflect the functionality, nature, issues and complications of mobile interaction technique. Most of them points out negative concerns and some positive feedbacks too about the interactions, which is discussed bellow.

1. Comfortable

Mobile interaction is comfortable in the context of public environment, users do not feel shy to work with their phone, they have more privacy as one user said “*I think for people moving in public could be more embarrassing if you just use your phone the people passing by will not pay attention*”. Users can also work with the display from a far location rather than standing in front as one participant said, “*you can comfortably set far away see the screen and start interacting*”.

2. Activity

This method has less Activity, participants do not have to move their body to reach certain points in the map, instead they can use their phone and stand or sit steady and with the tip of their finger can easily explore locations, as one of the user said “*I could go with the tip of my finger and it helped me all the places I visited*”.

3. Dependency

On the other hand, this interaction is dependent to many things like obviously a mobile phone, if the user does not have a mobile phone the interaction cannot

happen, a participant asked, “*How would I have played if I have not brought my mobile phone?*” Another dependency is the WIFI connection, one participant pointed out “*And then the fact that I had to be connected to a WIFI, that was because I did not understand do we have to be in the same Internet (Network)?*”

4. Complicated

The process seemed also complicated like first entering the IP-Address or scanning the QR-code, then looking at the instructions and logging with a name, then tilting the phone and finally interacting with the controller elements like the button and cursor, most of the participants complained about this stating like, “*Because it is a headache for me to take out my phone and use all this login, and waste my time.*” another commented like “*for exploring you have to push that red button, that was a bit confusing.*”

5. Annoying

One of the annoying things pointed out by the participant was the QR-Code was being covered by the person silhouette standing in front of the display the user said “*QR-Code was small and when I was coming near the screen to scan the code, my body was covering it*”.

6. Clarity

There were many instructions like Access-information, mobile instruction and task instruction, but these instruction was also not clear to them as one of the participant mentioned, “*that controller was also not clear, because I though the red areas is the touch area that I can scroll and the red button was a click*” another participant replied like “*there were very few descriptions, I guess the word login was miss-phrased, it was not really a login it was just chose a name*”. Another participant was not sure if to use mobile phone or the screen has touch capability as he replied “*at first I saw the map, and there were points on the top first I tried to touch*”.

- Body Categories:

Body interaction was more appreciated by the participants; from the interview transcripts the bellow positive and negative opinions were derived and categorized.

1. Enjoyment

Participants had the sense of enjoyment and fun, as one of participants said, “*I liked the second one because it seemed more involving and I think it was more fun*”, another user said “*I liked this interaction; it was more good and fun.*” ,

2. Easy

Users found the interaction to be very easy, simple and smooth, a user said, “*The body movement was good it was smooth*” another user said, “*It was much easier than the previous one, it was much better, umm it was not confusing*”. The call-to-Action seemed much easier, one user said, “*I saw saying me to come near, and when I came the game started, that was very easy to use*”, and the interaction with the game elements was also easy to understand, one participants said “*it was easy to come near to the screen and first I did not understand how to play the game but when I saw my avatar that is moving with me then I realized and did the tasks*”

3. Immersion

Some participants said they were some how immersed with the game, like one said, “*I felt that I was really part of it*”, another said, “*With the body you look your own avatar in the map and you feel that you are in the map.*”

4. Engaging

The body technique seemed also very engaging and users wanted to play more and more, one said, “*It is so engaging and it is like that it needs you*”, another said, “*it is like you want to put the footsteps exactly on the street*”, “*it seemed more involving*”.

5. Issues

On the other hand, body interaction had also some issues, like one of the participants pointed out that the interaction would be difficult if it is in crowded area, one said, “*If two people interact then they can crash at each other*”. Participants complained about physical space “*I felt was the space there was not enough space in here*”. Bad tracking of the body and unexpected locations were triggered by fast movement like, one participants said, “*I guess the application was tracking me really bad*”, “*when I was moving to some areas fast suddenly that point was being triggered*.”

6. Embarrassing

Some participants said that they would not try at public because it could be shame or embarrassment for their selves, ?moving in public could be more embarrassing?

7. Confusion

The projection of silhouette on the advertisement also made some participants confused and that was also distractuve, like one said, “*I saw my silhouette at the last time I was playing, because I was curious that why is it there*”.

- Others:

1. Interface

The interface was appreciated by all the participants, as one said, “*I really liked the map*”, another user said, “*the footsteps were cute*”.

2. Non-controllability

The flow of the interaction was also observed by the users, which they found annoying like, one participants noticed that “*I do not want to be forced to see all the places and then see the advertisement*”, the video advertisement was also not in the control a user said, “*There was nothing to answer, it gave me the impression that okay; this was an advertisement someone did it and I could not change the flow of it*.”

3. Distraction

The projection of silhouette after the interaction body or mobile technique was a distraction factor, because participants would not notice the video advertisement but would notice themselves.

4. Speed

The pictures for the locations and the advertisement video were fast, a user said, “*The description of the places were very fast, when I was trying to read it, it disappeared*.”,

6.5.5 Application Performance

Application performed quite well for both single and multi-user interactions, it did not crashed nor hanged in the middle of interaction, but in multi-user interaction, application faced some delay in both body and mobile because of many participants 5-7 at the same time, this issue

got solved by changing the JRE version from 32bit to 64bit and along with this the processing version was also changed from 32bit to 64bit and increased the maximum usage memory to highest in processing.

Maybe put some system specifications that run the applications



(A) Group body interaction.

(B) Group mobile interaction.

FIGURE 6.15

6.6 Conclusion

This chapter concludes that with body interaction technique, users performed better than mobile technique and preferred the use of body interaction than mobile in public environment, but at the same time mobile interaction was also preferred by some participant.

Body interaction was more natural and convenient for participants. This interaction had no dependency to any preferable device like mobile phone, the call-to-action was very understandable and performing this call-to-action (come near), was very natural. Body representation on the map provided a strong clue of “*walking*”, this clue had two major benefits, (1) understanding the task and performing it, (2) understanding the goal of the interactive advertisement. Participant felt enjoyment, immersion while interacting using their body. Despite the positive feedbacks, there were some usability issues like incorrect mapping of the silhouette when user was standing near, and some alert messages were not implemented, and also the interaction was difficult if there were multi-user because the users were colliding to each other, but the overall performance and acceptability of this technique was very convincing compared to mobile interaction.

Mobile interaction had various usability issues and especially with the accessibility to the advertisement system, participants took very long time to understand what was required to access because of (unclear access-info text, unfamiliarity with QR code or phone icons, inserting name), and then took longer time to follow the steps to login to the system. Task completion time was also significantly low than body interaction. Beside all these major issues some participants found it more comfortable to use it in public display because it will not cause the sense of embarrassment for them, and while interaction it did not require more physical body movement but only required cursor movement, and also participants understood the goal of advertisement.

Considering the above issues, the next step would be to refine both prototypes and make it ready for evaluation on public space.

7

Advertisement application

7.1 Introduction

The use of technology in advertisement plays a major role in advertisement industries, it would have been much difficult to reach to their customers without technologies, and technology enhances the two-way communication with client and customers. The companies can now easily express their thoughts and vision to their customers with the use new technologies. Advertisement are everywhere like in websites, in your smartphone, in television and radio and especially from past decade it is more common on the streets, supermarkets, airports and areas where is crowded, so for every context or setting there are set of technologies that are being used to make the advertisement more appropriate, and when it comes to interactive advertisement the use of right technology plays another major role in terms of usability and understandability, interactive advertisement in websites are usually interactive using keyboard and mouse, in smartphone they are using the capability of the touch or other sensors to make the interaction easy, and interactive advertisement in public space has again another bunch of technologies that could make the interaction usable like using face recognition, body and position recognition, hand gesture recognition and also touch sensors, proximity sensors and much more.

This chapter explains all the technical aspects of advertisement system that were developed during the thesis work for attracting attention application and main advertisement application, it discusses what technologies and hardware had been used and what algorithm and methods were implemented to accomplish the goals. Beside the technical details it describes the interaction design of interactive advertisement display.

7.2 Applications

7.2.1 Silhouette representation

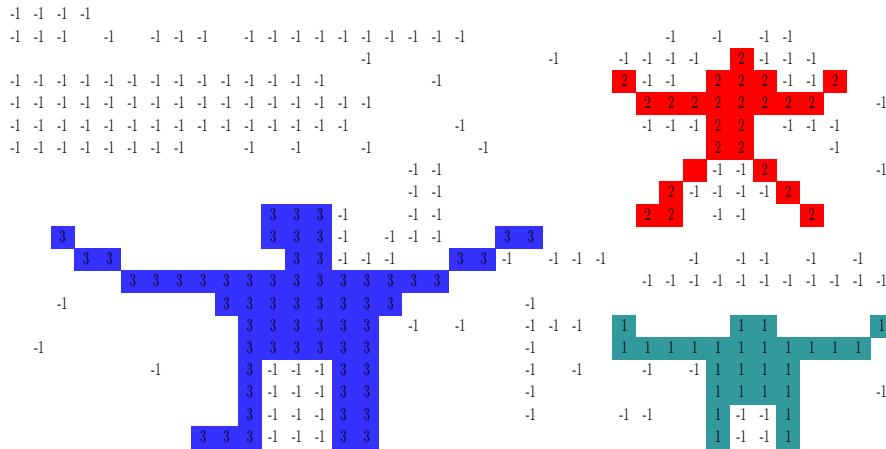
The reason behind silhouette representation of passers-by was to attract their attention toward the display. There are a lot of body sensing technologies, and the most easy way was to use Microsoft Kinect camera¹, that has built-in algorithm to track people, the camera has a resolution of 640x480 pixels. I created the colored silhouette representation from the *UserMap* array sent by camera, which is a 1xD integer array that corresponds to the pixels of the image, the array looks like bellow

```
Int upix = context.userMap();
upix = [1,1,1,1,1,1,2,2,2,2,2,2,-1,-1,-1,-1,-1,2,2,2,2,...]
```

The above example shows the structure of the array, the index of the elements of array correspond to the pixel number of image and the element values correspond to the user id standing in front of the camera, the user id is always above zero, any value which is not above zero in fact could be background or non-user pixel, the example shows that there are at least two people standing in front of the camera, which has user id (1 and 2) the -1 value is a non-user pixels. So the application iterates to this array and assigns specific color to each of the pixels of the user image and does not give color to the non-user pixels, and after assigning the color value to each index of the user in the picture and leave out the background as null, the bellow picture will be created.

¹Microsoft Kinect: <https://developer.microsoft.com/de-de/windows/kinect>, last accessed 5 jun 2016

TABLE 7.1: UserMap and application color mapping



The above picture has very limited pixels; it is not an original picture but is made to clear the idea of how the coloring of silhouette works. As you can see from above picture, the white areas or the -1 values are background and non-user and the remaining positive number represent the pixelse related to the user. Check the Silhouette video² and For more information about the source codes, please refer to the DVD.

7.2.2 Main advertisement application

In this section the main advertisement applications are being discussed. According to the plane there was a need to develop three-advertisement application (non-interactive, body interactive and mobile interactive), which had the same functionality but were different in terms of interactivity and control.

The advertisement application was designed to show important places of Bauhaus that were included in Bauhaus-Walk tour, the pictures of these places are attached on top of the Weimar map with a name on top and a small description at bellow this technique helps participants to build a relationship of location and the map, only five locations are randomly chosen by the software to be shown on the map, each come one after another and when all the locations are explored then the advertisement video will be played and after that the application will repeat it self.

Non-Interactive application

As can be understood from the name, the application is not influenced by the passers-by but triggers automatically, it automates through whole three hierarchical levels of interfaces, (1)Initial interface, (2) Map interface, and (3) the advertisement video interface, all the interfaces have a fixed time in which it will switch from one to another, see the bellow figure.

²Attraction attention method: <https://www.youtube.com/watch?v=1EtHVqS412M>, last accessed 5 jun 2016

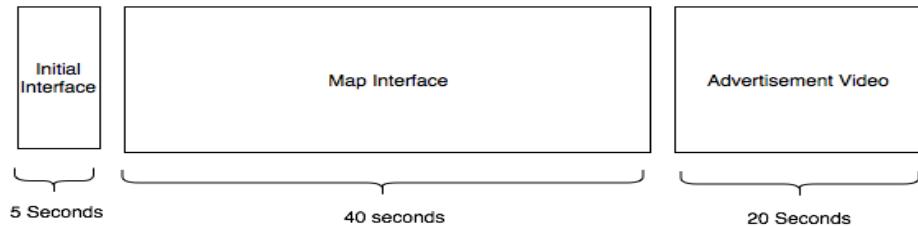


FIGURE 7.1: Interface flow

1. Initial Interface:

Initial interface of advertisement shows is the *Gropius walter* room, and the Bauhaus-Walk name on the upper left side, and the Bauhaus University logo at the bottom right.



FIGURE 7.2: Initial Interface

2. Map Interface:

This is the city map of Weimar that has some interest regions shown on the top of the map. Those regions are blinking to signal the users.



FIGURE 7.3: Map Interface

The location pictures are animated randomly and they are first enlarged, and then resized back to fit on the map region.

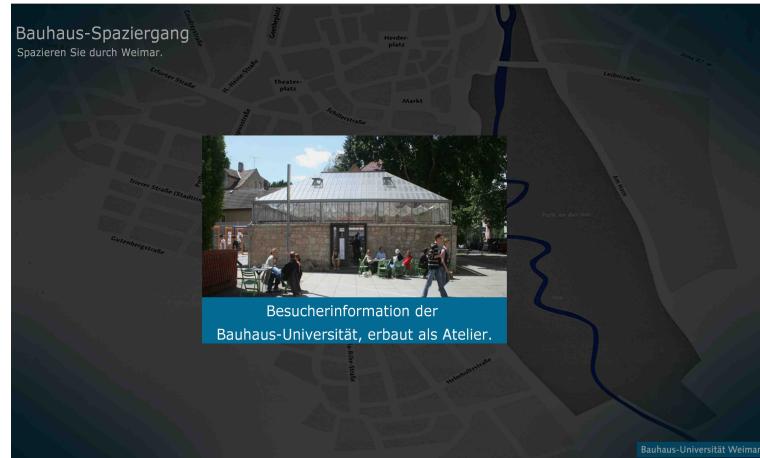


FIGURE 7.4: Enlarged picture

The resized pictures on the map looks like bellow.



FIGURE 7.5: Pictures on the map

3. Advertisement video:

In this interface the video is being played, this picture is a screenshot of one of the frames of the video.



FIGURE 7.6: Advertisement video

This is the last frame of the video that shows information about how and where to join the Bauhaus Walk.



FIGURE 7.7: Advertisement video last frame

The advertisement video was created in PowToon³ with a free version account, visit this video⁴ that shows the advertisement video or browse the animation from the DVD.

To see the full non-interactive advertisement flow of interfaces and its animations visit this video⁵ or browse the video from DVD.

Body Interactive application

As discussed earlier there are three interfaces or phases (initial interface, map interface and advertisement video) of the application, and in body interaction the same interfaces are used, but with a difference of interactivity, the first two interfaces are interactive and allows participants to interact with using their body with the advertisement, in this case exploring the interest points on the map by moving physically (forward, backward, right and left) in front of the screen. Kinect camera is used to track user's body position.

1. Initial Interface (Call-to-Action) :

This interface is basically the same interface as non-interactive but with a difference, that it projects passers-by silhouette on interface, this interface is also called *call-to-action* interface because it calls passers-by to interact with the screen, as you can see below there is someone standing in front of the screen and the interface calls him to come near. This interface also has alert messages on the top right that alerts the participant if they move away from the camera range, in this example a second person had got untracked from the camera and the system pops that message to raise his hand to be tracked again.

³PowToon: <https://www.powtoon.com/index/?gclid=CJqSqr5180CFesV0wod1u8IEQ&edgetrackerid=10083804111572>, last accessed 5 jun 2016

⁴Advertisement Video: <https://www.youtube.com/watch?v=-y1Dbz6E6bU&feature=youtu.be>, last accessed 5 jun 2016

⁵Non-interactive Ad: <https://www.youtube.com/watch?v=ZLszzfbZJgI>, last accessed: 5 Jun 2016

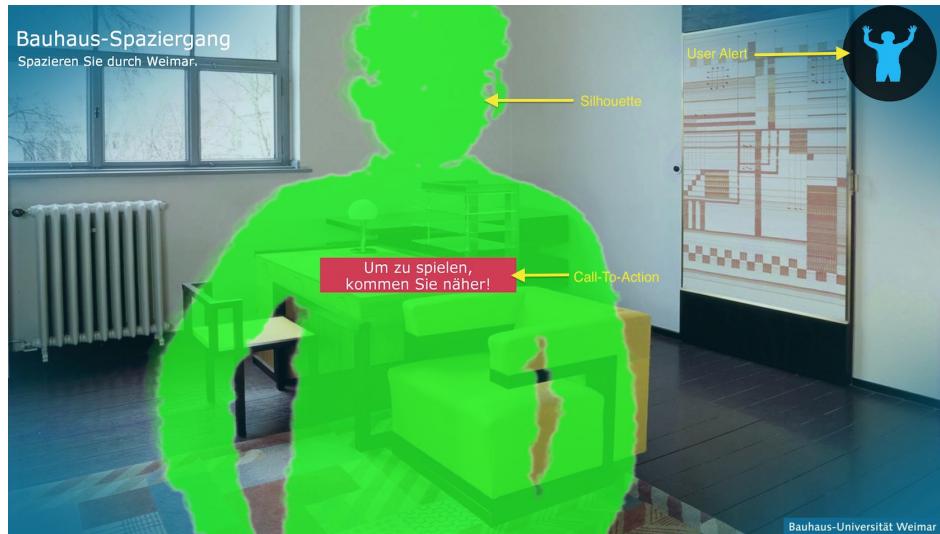


FIGURE 7.8: Initial interface

2. Transition to Map Interfaces:

The transition happens when the person stands close to the screen for more than 3 seconds and the bellow process happen.

(a) Loading animation:

The loading animation is implemented to show reaction to the action of the participants, and at the same time participants waits for something to be loaded.

(b) Scaling down the silhouette:

To walk freely on the map environment and to give the participant the feeling of real walking, the participant's silhouette is scaled down, the scaling happens smoothly frame-by-frame.

(c) Show task instruction:

Every interaction has instructions, the instruction is fairly very easy and it is simplified in one sentence to explore locations on the map.

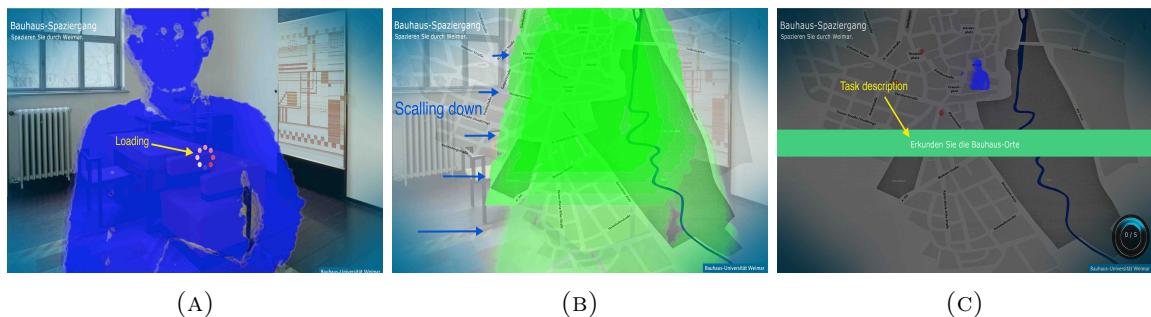


FIGURE 7.9

As can be seen in picture A, the person is close to the screen and the loading animation is started, in picture B the person silhouette is being scaled down (in this example the silhouette color is green) and in picture C the instruction is shown.

3. Map Interface (Interaction):

In this interface participant can interact with the elements on the map. In bellow

picture, the silhouette has visited two locations therefor has 2/5 score, to finish the interaction he needs to visit all the location or the timer(40 seconds) on the corner right will be over.



FIGURE 7.10: Map Interface

4. Advertisement video:

The same advertisement video, which was for non-interactive, is shown after the interaction is overed.

Mobile Interactive application

In this application, the display interface is absolutely the same as the other two applications; the only different is that a user carries out the interaction with a smartphone. The mobile interaction technique and platform was adapted from the Bauhaus University *MMM Ball*[12] project under Mobile Media Group⁶ department.

1. Initial Interface (Call-to-Action) :

This interface is designed in such a way to attract passers-by and also guide the participant on how to use their smartphone to access the advertisement application. The attraction is again the same method that was used for body, the passers-by silhouette is projected at the back of Access information. The interface has QR code that could be easy to be scanned instead of typing the whole IP address, and there is an alert area, that gets activated when a logged in person has not turned their phone in landscape orientation.

⁶Mobile Media Group: <https://www.uni-weimar.de/de/medien/professuren/mobile-media/>, last accessed 5 jun 2016

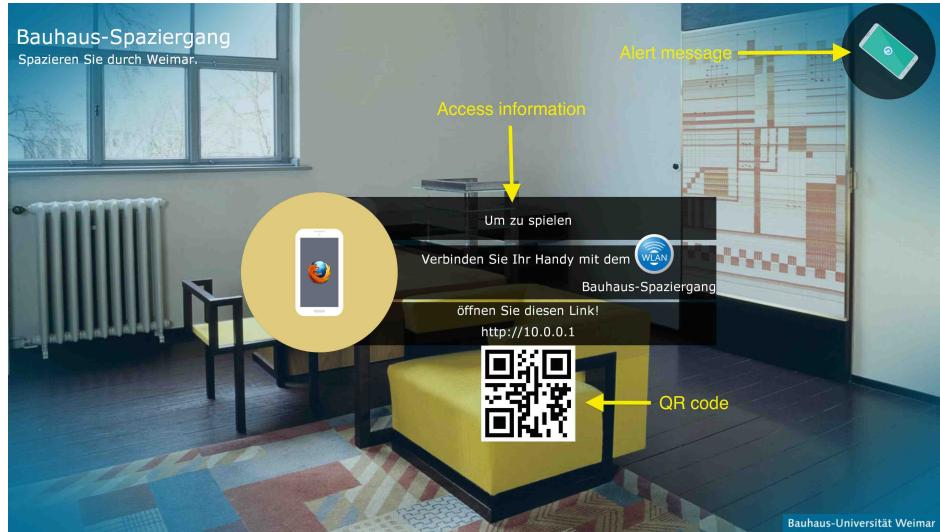


FIGURE 7.11: Initial Interface

2. Transition to Map Interface:

The user should login to the advertisement system and open the interaction controller and hold the mobile in landscape mode and then the bellow process will be triggered.

(a) Loading animation:

The loading animation is a reaction to the action of the participants, and at the same time participants waits for something to be loaded.

(b) Creating Colored cursor:

A colored circle will be created for the participant in the center of the screen; each participant would have different colors matching to their controller interface in their phone.

(c) Show task instruction:

The instruction is fairly very easy and it is simplified in one sentence to explore locations on the map by using their phone.



FIGURE 7.12: Transition of interface

In picture (A) a user has logged in and the screen is loading, in picture (B) the task description is shown.

3. Map Interface (Interaction):

Map interface is interactive for the participants; participants can navigate the cursor using their phone controller page. As can be seen in bellow picture, the user is controlling the cursor and has explored one location, the user's defined name is also shown on the cursor, to provide a hint that they have reached an interest point a small circle is shown to determine the area of that interest point. The interaction finishes when all the locations are explored or the interaction time (40 seconds) gets over.

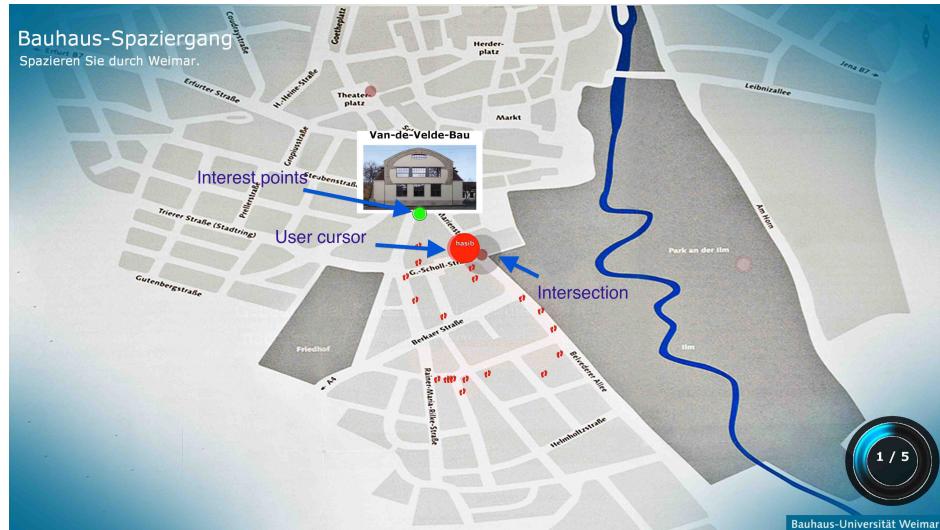


FIGURE 7.13: Map interface

4. Advertisement video:

The same advertisement video, which was for non-interactive, is shown after the interaction is overed.

5. Mobile interface:

The interaction controller in smartphone is shown in bellow picture, the interface is very simply designed and has two elements, the cursor and the select button, with cursor the user can navigate inside the map for interest points and when reached on an interest point the participant presses the select button to explore that location, see the picture bellow.



FIGURE 7.14: Mobile controller

7.3 Interaction Design

The body interaction model is designed based on *Audience funnel*, because it suites well for public setup like Tourist information center and advertising, with the design of this interaction model different levels of interactions and phases can be observed. Based on this model the three phases of the applications were designed (Call-to-Action, Interaction interface and ad video), this model attracts passers-by and gradually motivates them toward display for interaction to be engaged and at the same time it is convenient for passers-by to avoid the display.

7.3.1 Body Interaction Design

As can be seen in bellow diagram, that shows the display on top, the body-tracking area illustrated by a triangle, which is divided in two sections that is separated by dashed lines, (1) gray region defines the least interest regions, because in this area it is assumed that people maybe busy with other things around display, and people in this region can easily avoid the display and display will not motivate them for interaction, and (2) the highest interest region that it is assumed that people are aware of display and display would motivate them for interactions only if they are facing toward display.

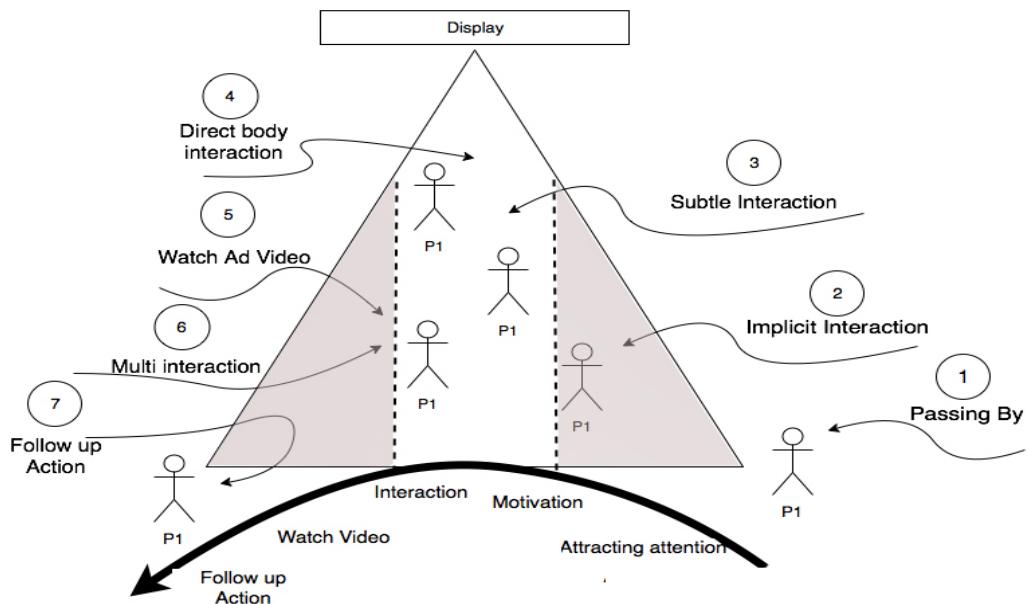


FIGURE 7.15: Body interaction design.

The model consists of seven phases, (1) Passing by phase, which demonstrates passers-by who are not in display tracking range, (2) Implicit Interaction phase, when passers-by are in the gray region of display tracking range but are far or at the side of the display, (3) Subtle interaction phase, where the user is in near and center area of tracking range and facing toward display, the system motivates the user for direction interaction with the call-to-action feature “*To play, Come near*”, (4) Direct body interaction phase, is when the user has actively started the game interaction and is playing, at this phase the whole tracking range (gray and white) could be used for direct interaction until the end of interaction phase. (5) Watch ad video phase, happens when the interaction is over and a short advertisement video is shown,(6)multi interaction phase, demonstrates that the user can perform interaction multiple times, and (7) follow up action phase, demonstrates that the user can interact again.

Follow up action phase, is when the user leaves the display's tracking range and performs other actions.

The Black curve bellow the diagram shows the transition of user between each phase and shows the flow of the attention, motivation, interaction and other phases. The attention is captured mainly in implicit interaction phase, the motivation occurs when the user is in subtle interaction phase and the interaction is when the user is directly playing with his/her body in the entire tracking coverage area, after the interaction and watching ad video the curve changes direction to down which illustrates that the user would likely leave the interaction area and follow other actions unrelated to the screen.

- Attention:

A bottom-up approach was used to achieve the passers-by attention because the approach can help get attention by showing a sudden object, or by contrasting various colors. To do so, the silhouette representation of passers-by were projected on the screen, this representation can bring higher level of attraction because it is responsive on user movements, and has different contrast colors in relation to background. In chapter 3, this method was compared with other forms of representation and attracting attention and the silhouette was the top candidate.

- Motivation:

The motivation is done by bring joy, fun, curiosity and challenge[50] to the users who are attracted toward display. In body interaction design the use of passers-by's silhouette presentation would be a good motivational force to bring passers-by near the display, because this technique can become a source of fun and entertainment and can give a sense of connectedness with the display, and at the same time it also motivates passers-by by showing a *call-to-action* message like “to play! Come near”, which is responsive to user movement and gives confident to them to play.

- Interaction and follow up actions:

When the user starts the interaction, the interaction carried out should be meaningful, understandable and easy else the user will leave immediately after some tries. Therefor many focus groups and evaluations of many prototypes were conducted to assure the usability of the body interaction. The interaction is explained in detail in the previous sections. After the end of interaction the advertisement video is shown and then the user can start again interaction or leave the screen.

7.3.2 Mobile Interaction Design

The bellow diagram shows the mobile interaction design; the diagram shows the display on top, and the triangle, which is body-tracking range for passers-by. The design has 8 phases. (1) Passing by phase, which demonstrates passers-by who are not in display tracking range, (2) Implicit Interaction phase, the mobile version also has the implicit body interaction for attracting attention only and it is not limited to a certain region, but the whole the tracking area could be used for this purpose, and no further direct interaction is possible, (3) Read Access info, after the user is attracted toward the screen, the user reads how to use his/her mobile phone to connect to the display, (4) connect to system, in this phase the user connects to Wi-Fi and opens the controller, (5) direct interaction phase, is when the user actively interacts using smartphone with the display, (6) Watch ad video, this phase is triggered when the interaction is over, (7) multi interaction phase, demonstrates that the user can perform interaction multiple times, (8) Follow up action phase, is when the user leaves the display's tracking range and performs other actions.

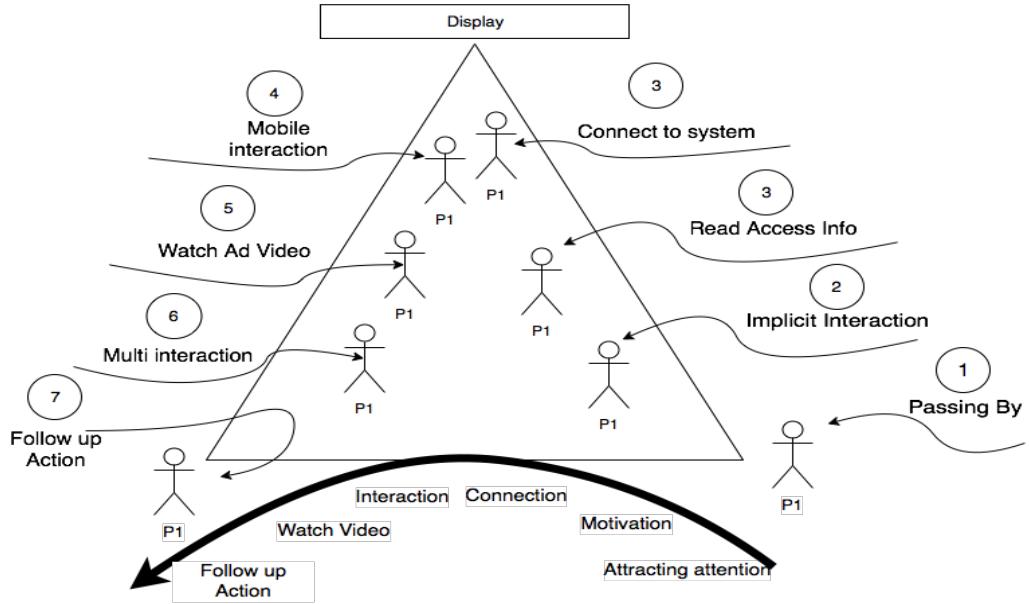


FIGURE 7.16: Body interaction design.

1. Attention:

Technologies like Bluetooth, infrared and NFC⁷ of mobile devices in fact could be used for attracting attention of passers-by, but these technologies have their limitations and limited usage and not all mobile phones support all of the technologies and at the same time it is possible that the passers-by have not switched on these technologies because of battery consumption or other purpose. Therefor to attract all the passers-by without any limitation, the silhouette representation was used as it was used for body interaction design.

2. Motivation:

The motivation is also similar to the body interaction, because of the silhouette that bring curiosity and joy, and beside that an Info text is shown on the screen to give sufficient information on how to access the advertisement system and play the game.

3. Interaction and follow up actions:

The interaction with the game element is only possible with the use of a smart phone, the interaction usability is important in order to keep the passers-by engaged with the display. Therefor two prototype versions of mobile interactions were evaluated to remove any possible usability issue. After the interaction is over the advertisement video and other follow up action is taken by user.

⁷NFC: Near Field Communication

8

Interactive and non-Interactive Advertisement field study

8.1 Introduction

Norman [90] 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 [96], and would increase involvement of both users and product that is believed to have an effective advertising to convey the advertiser message [95]. 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 [87], 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 [61] 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 [22] 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* [61] 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 [35, 58], (2) among passers-by how many glanced [35, 37, 48] to display, (3) how many started interacting [11, 35] 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.

8.2 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.

8.2.1 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

8.2.2 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[96] 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[94], and the strength of relationship can moderate the effectiveness of advertisement message [95], 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.

8.3 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?

8.4 Study design

8.4.1 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 8.1: Weimar Tourist Information Center Top-view picture, The locations are marked with yellow arrows.

8.4.2 Duration

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

TABLE 8.1: Week sequence

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

8.4.3 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.

8.4.4 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.

8.4.5 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 [34] 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 [35] 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).

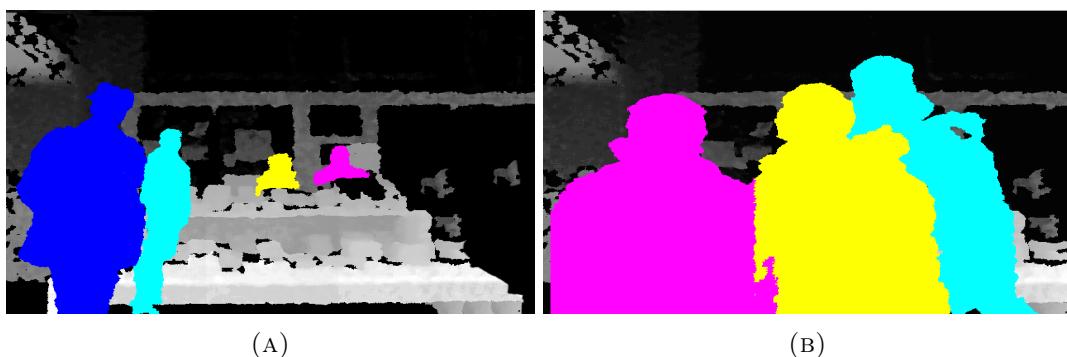


FIGURE 8.2: Depth recording examples

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

8.5 Data Analysing

8.5.1 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

8.5.2 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

8.5.3 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.

8.5.4 Honeypot and landing effects

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

8.5.5 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.

8.6 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.

8.6.1 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.

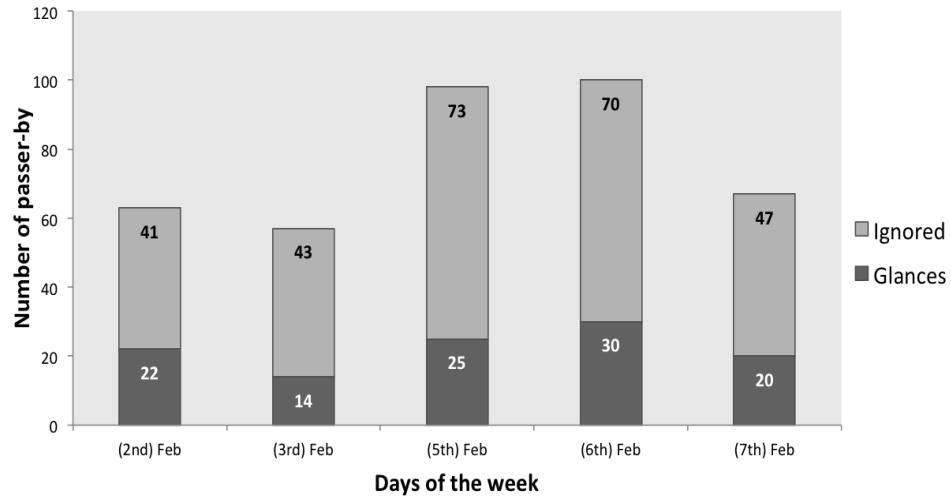


FIGURE 8.3: Non-interactive attention level chart

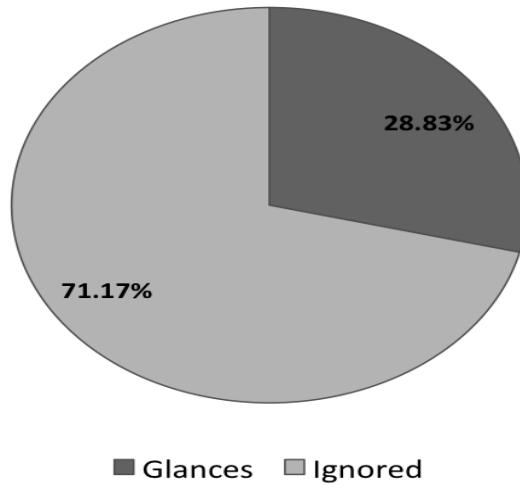


FIGURE 8.4: Non-interactive Attention level percentage

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.

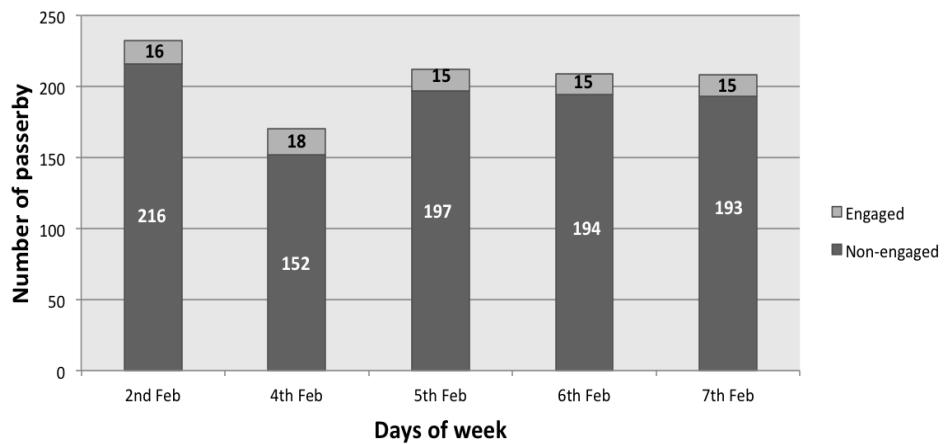


FIGURE 8.5: Non-interaction Number of engaged and Non-engaged passers-by

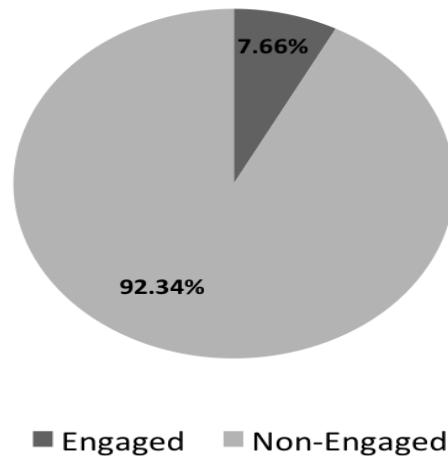


FIGURE 8.6: Percentage of engaged and Non-engaged passers-by

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 8.7: Landing effect

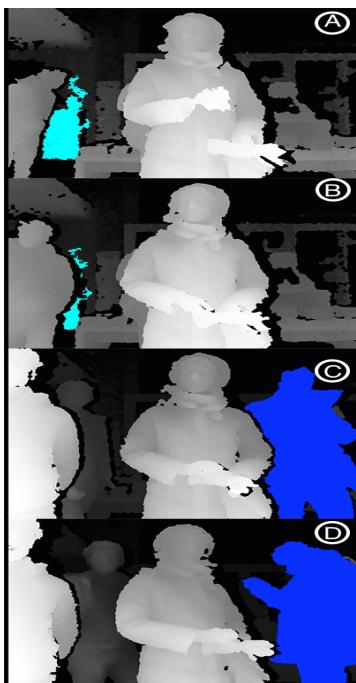


FIGURE 8.8: Honeypot effect

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 8.2: 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.

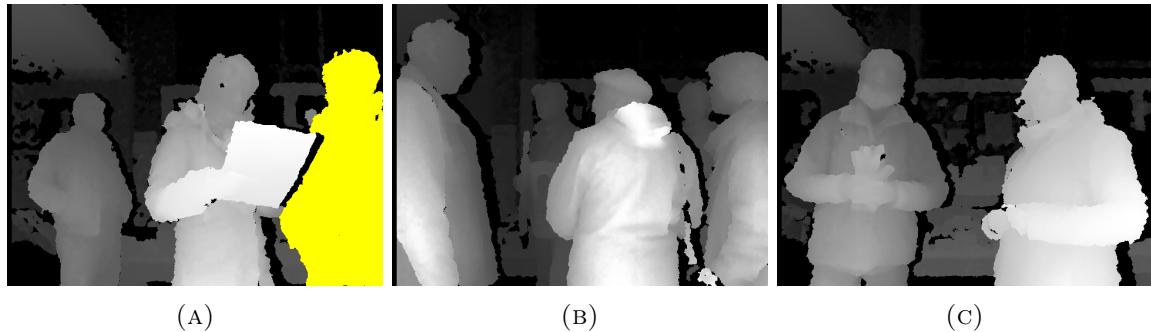


FIGURE 8.9: Passers-by Behaviors

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.

8.6.2 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.

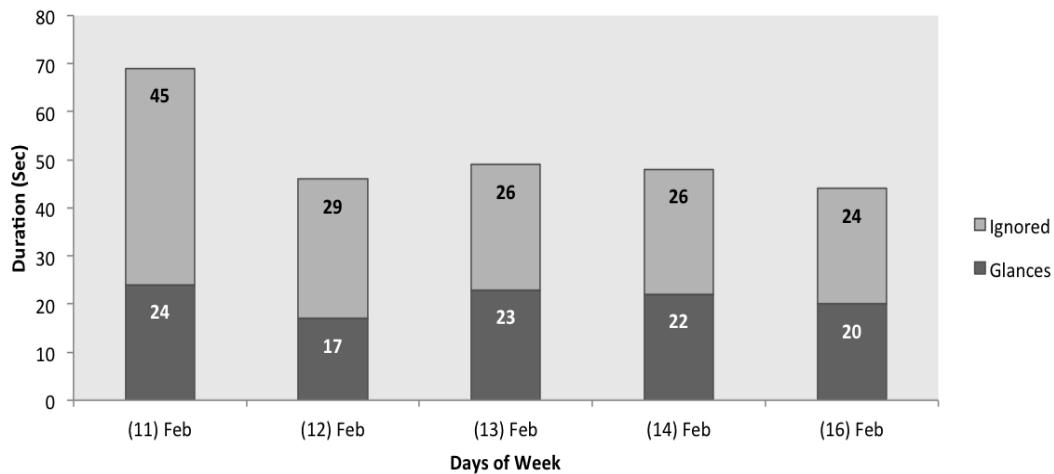


FIGURE 8.10: Attention level chart

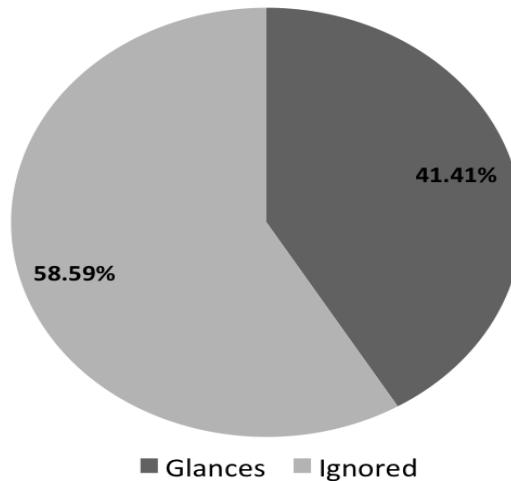


FIGURE 8.11: Body interactive Attention level percentage

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.

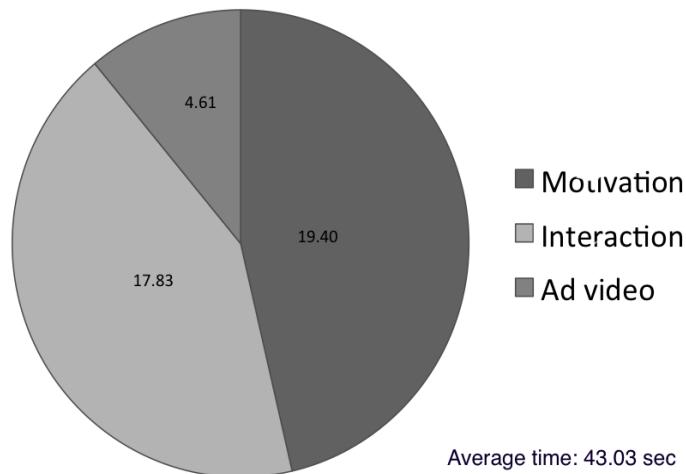


FIGURE 8.12: Average time for each phase

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.

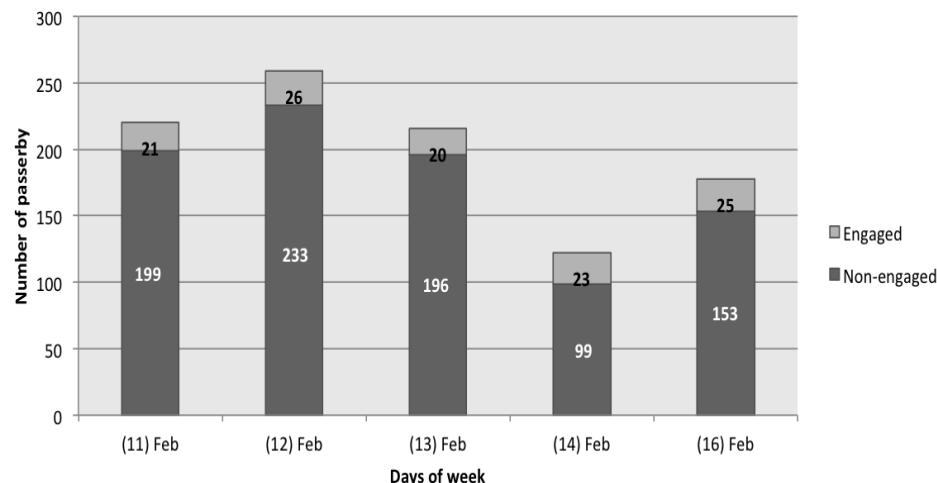


FIGURE 8.13: Body interactive Number of engaged passerby

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.

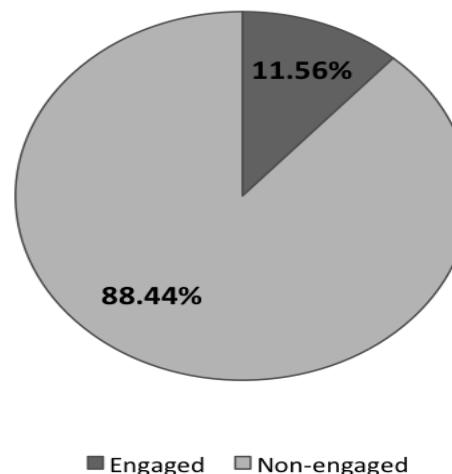


FIGURE 8.14: Percentage of engaged and non-engaged passers-by

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).

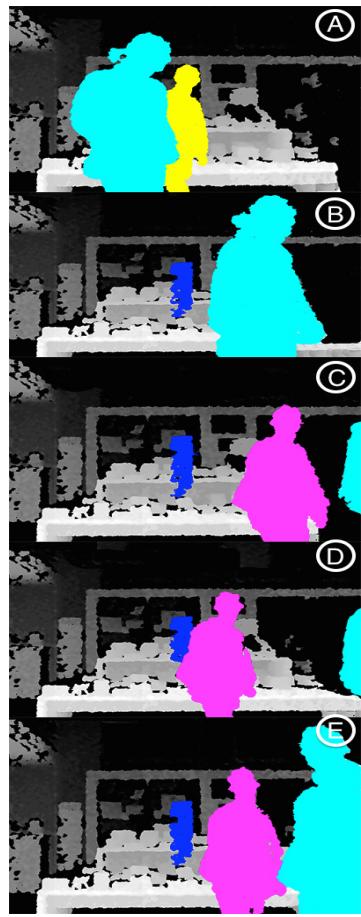


FIGURE 8.15: Landing effect

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

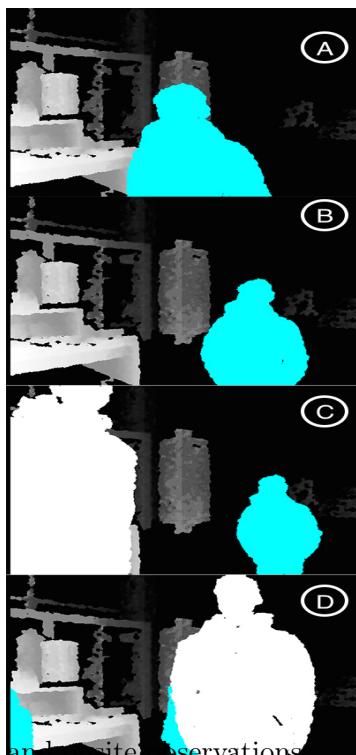


FIGURE 8.16: Honeypot Effect

TABLE 8.3: 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).

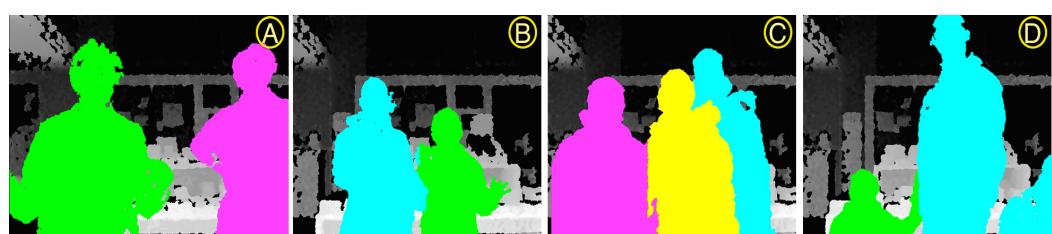


FIGURE 8.17: Group interactions

- 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.

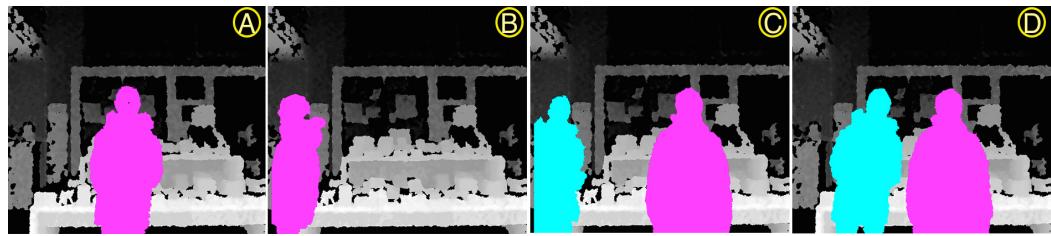


FIGURE 8.18: Calling others

- 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.

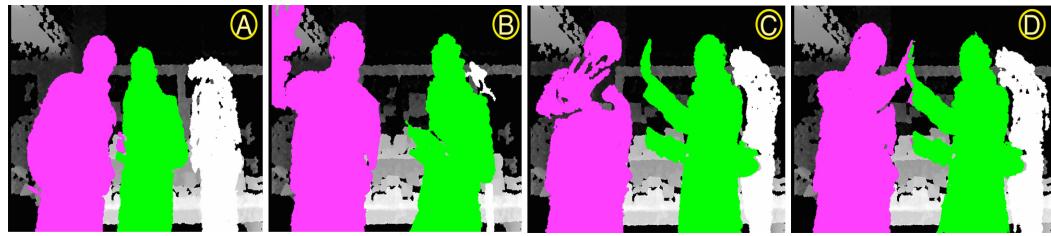


FIGURE 8.19: Playing with silhouette

- 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).

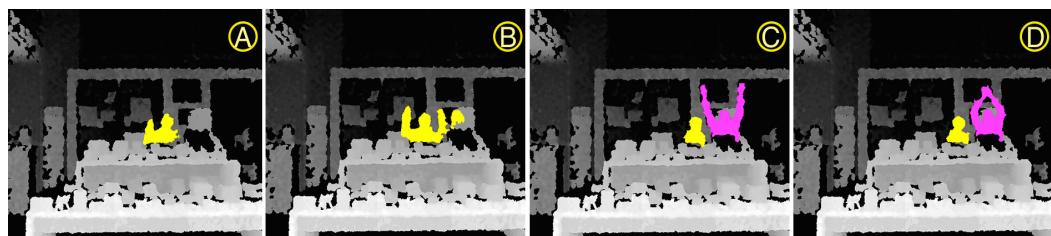


FIGURE 8.20: Noticing interactivity

- 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 8.21: 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.

8.6.3 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.

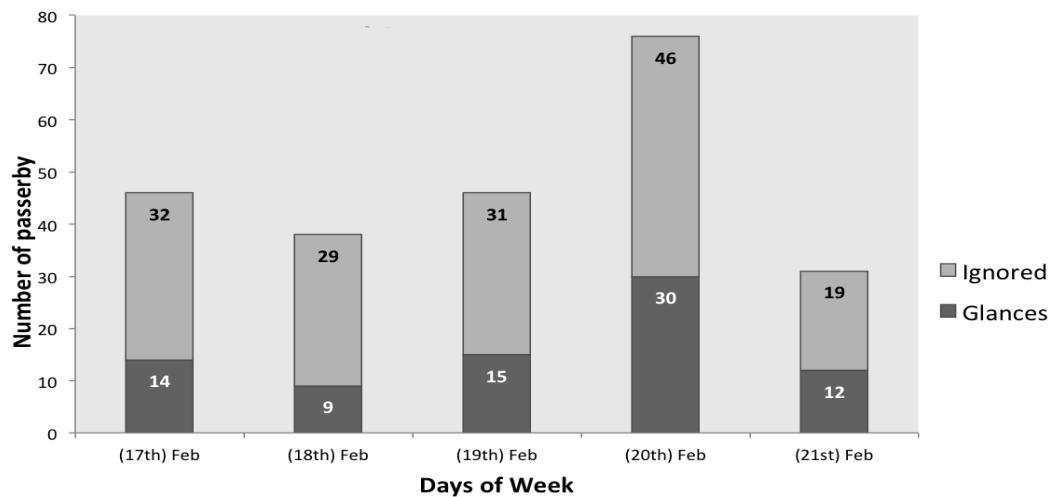


FIGURE 8.22: Mobile interactive attention level chart

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.

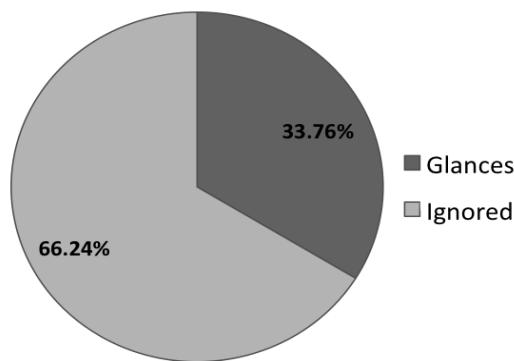


FIGURE 8.23: Attention level percentage

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.

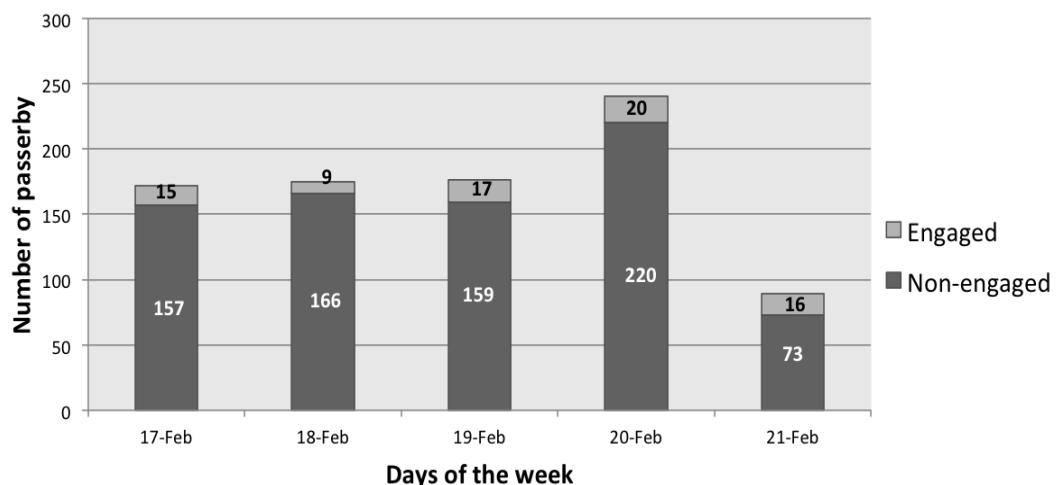


FIGURE 8.24: Mobile interactive Number of engaged passerby

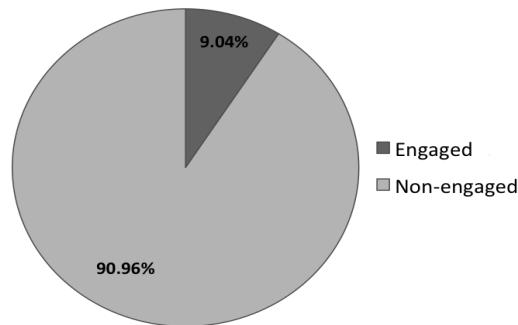


FIGURE 8.25: Percentage of engaged passerby

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).

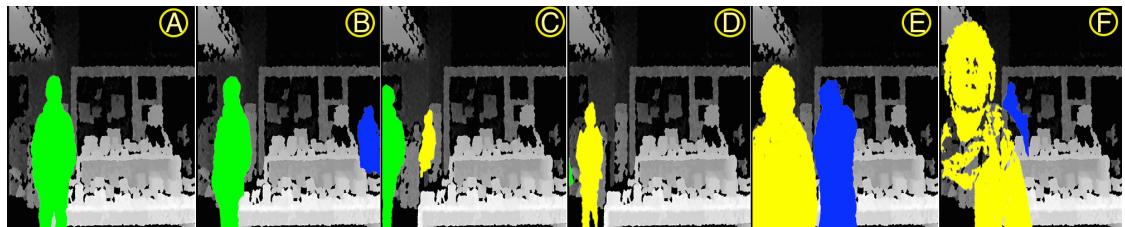


FIGURE 8.26: Honeypot effect

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 8.27: Landing effect

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

TABLE 8.4: 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.

8.6.4 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 8.5: 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.

To find how small was the difference between the weeks, the eta squared(η^2), which is an effect size index for ANOVA, in which the SS_{effect} (sum of squared) between conditions is divided by SS_{total} (sum of total) as below.

$$\eta^2 = \frac{SS_{effect}}{SS_{total}} = \frac{7293.3332}{42506.9332} = 0.1716 \approx 0.18$$

The 0.18 value means that %18 was the difference between the weeks, which is relatively small amount of percentage and is not a matter of concern, and as a result there was no statistically difference between numbers of passers-by of each conditions between the weeks.

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 8.6: 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 $H0$ is rejected and $H1$ 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.

$$\chi^2(1, N=641)=10.863, p < .05 (p=.00437653)$$

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 8.7: 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

To determine that whether there were any significant differences between the means of these three conditions (groups), I conducted *one-way ANOVA* test, and it strongly suggests that there was a significant differences 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, *Post-Hoc* test was carried out, the Post-Hoc Tukey's HSD would likely identify which of the pairs of conditions were significantly different from each other. The critical value of the Studentized Range Q statistic was computed as, $Q_{critical}^{\alpha=0.01,k=12} = 5.0430$, and the significance can be determined if each pair's critical value(Tukey HSD Q statistic) is bigger than Studentized Range Q statistic. $Q_j^i > Q_{critical}$, and the strength of difference is determined by the P value as shown bellow.

TABLE 8.8: 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 because the critical value is not bigger than 5.0430 and also the p value is bigger than 0.5, but group B shows a significant difference between A and C because the critical value is higher than 5.0430, and the p is smaller than 0.01. It shows that the body interactive advertisement engaged significantly more passers-by than other two types of advertisement.

To find out how big is the difference between engaged passers-by in non-interactive and body interactive conditions, the eta squared(η^2), which is an effect size index for ANOVA, in which the SS_{effect} (sum of squared) between conditions is divided by SS_{total} (sum of total) as bellow calculated by online tool *Easycalculator*⁴.

$$\eta^2 = \frac{SS_{effect}}{SS_{total}} = \frac{129.6}{162.4} = 0.798 \approx 0.8$$

The 0.8 means that %80 of total variance is accounted for by the conditions (body interactive, non-interactive) effect.

⁴easycalculator: <https://www.easycalculation.com/statistics/eta-square-calculator.php>, last accessed 15 jun 2016

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 8.9: 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, ($F_{2,5}=7.5294$, $p < .05$ ($p=.0076$)). So I reject the Null hypothesis and state that one or more of the above conditions were statistically different from the others,

To confirm that which of the pairs were different significantly, I run Post-Hoc Tukey's HSD test, the critical value of the Studentized Range Q statistic was computed as , $Q_{critical}^{\alpha=0.05,k=12} = 3.7711$, and the significance can be determined if each pair's critical value(Tukey HSD Q statistic) is smaller than Studentized Range Q statistic. $Q_j^i > Q_{critical}$, and the strength of difference is determined by the P value as shown bellow.

TABLE 8.10: 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.

To find out how big is the difference between number of landing effects in non-interactive and body interactive conditions, the eta squared(η^2), which is an effect size index for ANOVA, in which the SS_{effect} (sum of squared) between conditions is divided by SS_{total} (sum of squared)total as bellow calculated by online tool Easycalculator⁵.

$$\eta^2 = \frac{SS_{effect}}{SS_{total}} = \frac{5.12}{7.84} = 0.6531 \approx 0.66$$

⁵easycalculator: <https://www.easycalculation.com/statistics/eta-square-calculator.php>, last accessed 15 jun 2016

The 0.66 means that %66 of total variance is accounted for by the conditions (body interactive, non-interactive) effect.

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 8.11: 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 from that I reject the null hypothesis and accept that there was a statistical difference between one of the conditions in the number of honeypot effects. To find which of the pairs were significant different the Post-hoc Tukey test was applied as bellow.

TABLE 8.12: 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	** $p < 0.01$

Group A, B and C refers to (Non-interactive, body interactive and mobile interactive) advertisement accordingly. Post-hoc Tukey computed the critical value (Studentized Range Q statistic) for A and B as, $Q_{critical}^{\alpha=0.05,k=12} = 5.0430$ for and another value for B and C as, $Q_{critical}^{\alpha=0.05,k=12} = 3.7711$ and the significance can be determined if each pair's critical value(Tukey HSD Q statistic) is bigger than Studentized Range Q statistic. $Q_j^i > Q_{critical}$, and the strength of difference is determined by the P value as shown above. From the diagram above it is very clear that non-interactive with mobile interactive is insignificant, but the non-interactive with body is significant and body and mobile is strongly significant too.

To find out how big is the difference between number of honeypot effects in non-interactive and body interactive conditions, the eta squared(η^2), which is an effect size index for ANOVA,

in which the SS_{effect} (sum of squared) between conditions is divided by SS_{total} (sum of total) as bellow calculated by online tool *Easycalculator*⁶.

$$\eta^2 = \frac{SS_{effect}}{SS_{total}} = \frac{6.4}{13.6} = 0.4706 \approx 0.47$$

The 0.47 means that %47 of total variance is accounted for by the conditions (body interactive, non-interactive) effect. Even though they are statistically significant but the effect size is low, which makes this effect not very significant, that is why only one (*) is given in above inference column. But the comparison of body and mobile has two (*) which means that body performed much more better than mobile and is assumed to have a larger effect size.

discusse on effect size

8.7 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

⁶easycalculator: <https://www.easycalculation.com/statistics/eta-square-calculator.php>, last accessed 15 jun 2016

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. **to play come close, is misleading**

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, therefor 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.

8.8 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 bellow.

Non-interactive advertisement in tourist information was very quite, 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.

9

Advertisement enhancement

9.1 Introduction

The very first phase to get passers-by engaged with the display is the getting their attention. 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 a short amount of second and that is not enough for passers-by to understand interactivity quickly, if the screen is large and placed in front it takes about 1.2 to understand interactivity [11], but my display was in sideways and small, so i assume that it takes longer than 1.2 seconds to understand interactivity and by that time the passers-by has passed the screen, (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 and even did not see the display.

In existing real scenarios like in the tourist information center, where I conducted the study, the display was placed at sideways, and there was no other way to change the location of display to be more in front of passers-by to have more attention of people, therefor I took this real time scenario and proposed an 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.

9.2 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 not perceivable by passers-by. Kinect cameras were tracking individually the users, so the user in the first Kinect was not the same user in the second Kinect and as a result Kinect would give different colors to the same user while passing by each camera, therefor only one color was chosen for all users so that they do not see the shift from camera to other.

See the diagram bellow that shows the physical setup including Kinect camera and their ranges, the diagram shows three different person standing at each camera range and the system has mapped their silhouette representation that all have the same color on the screen sections relative to their distance to the screen.

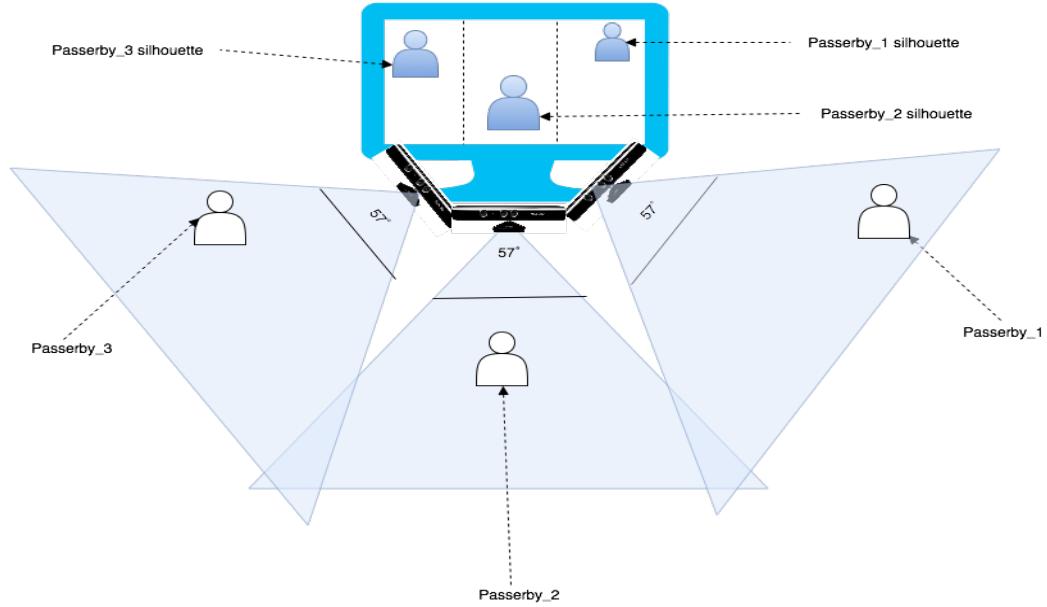


FIGURE 9.1: Attracting attention extended version.

9.3 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.

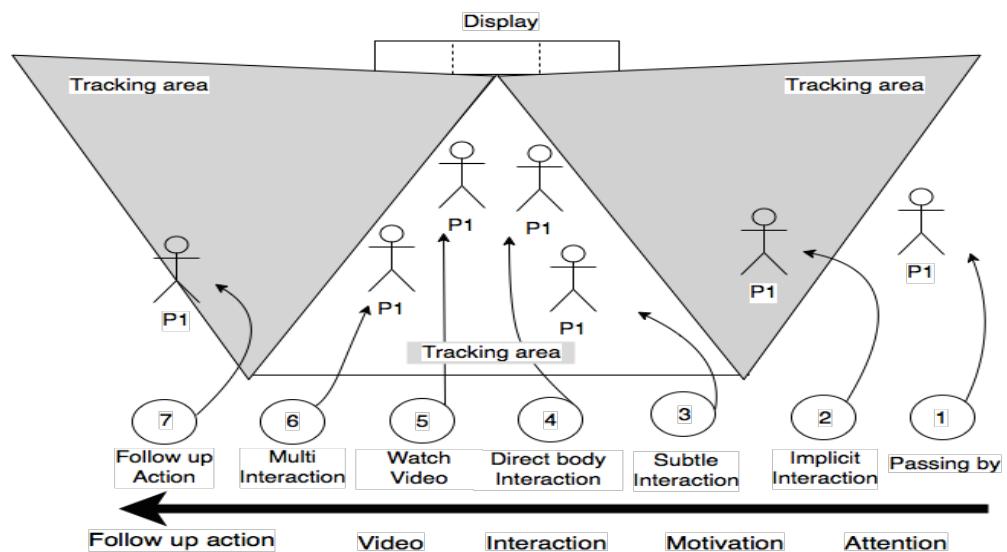


FIGURE 9.2: Extended Interaction design

9.4 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?

9.5 Study design

9.5.1 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.

9.5.2 Duration

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

9.5.3 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.

9.5.4 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 in 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.

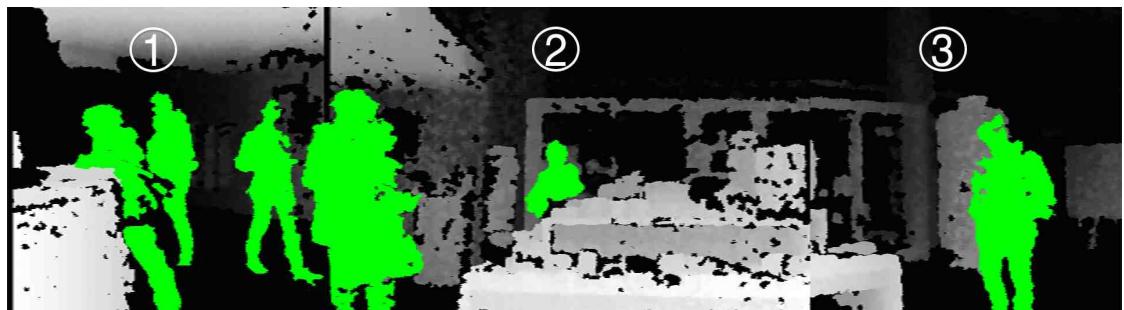


FIGURE 9.3: Three Kinect images

9.6 Findings and results

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

9.6.1 Attention Level measurements

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

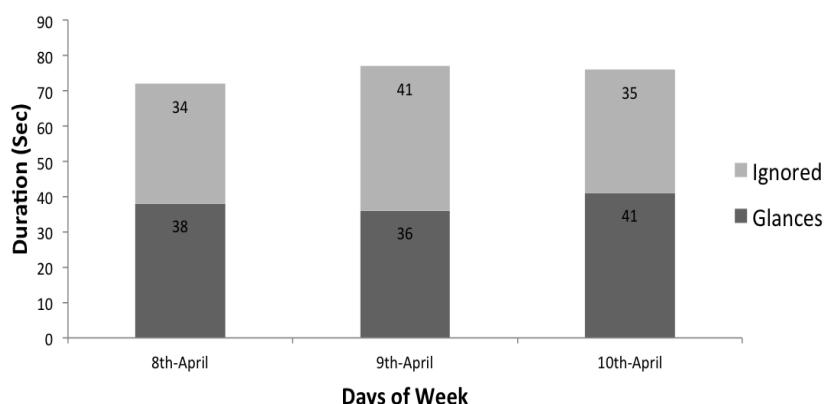


FIGURE 9.4: Attention level chart

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.

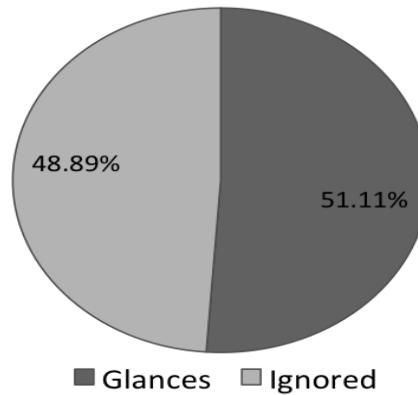


FIGURE 9.5: Attention level percentage

9.6.2 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.

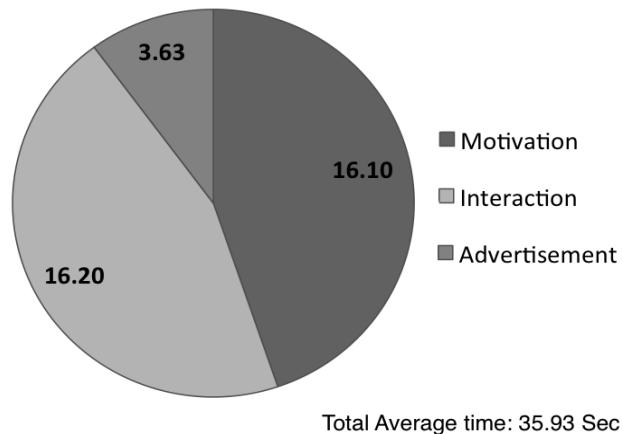


FIGURE 9.6: Average time for each phase

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

9.6.3 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.

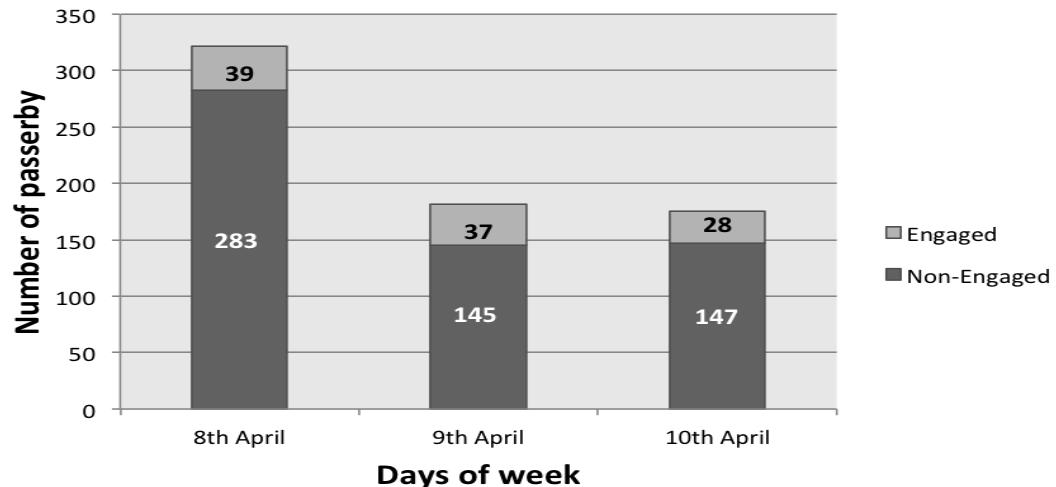


FIGURE 9.7: Number of engaged passers-by

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.

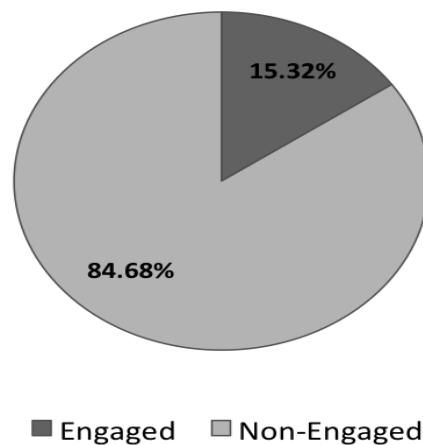


FIGURE 9.8: Percentage of engaged and non-engaged passers-by

9.6.4 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).

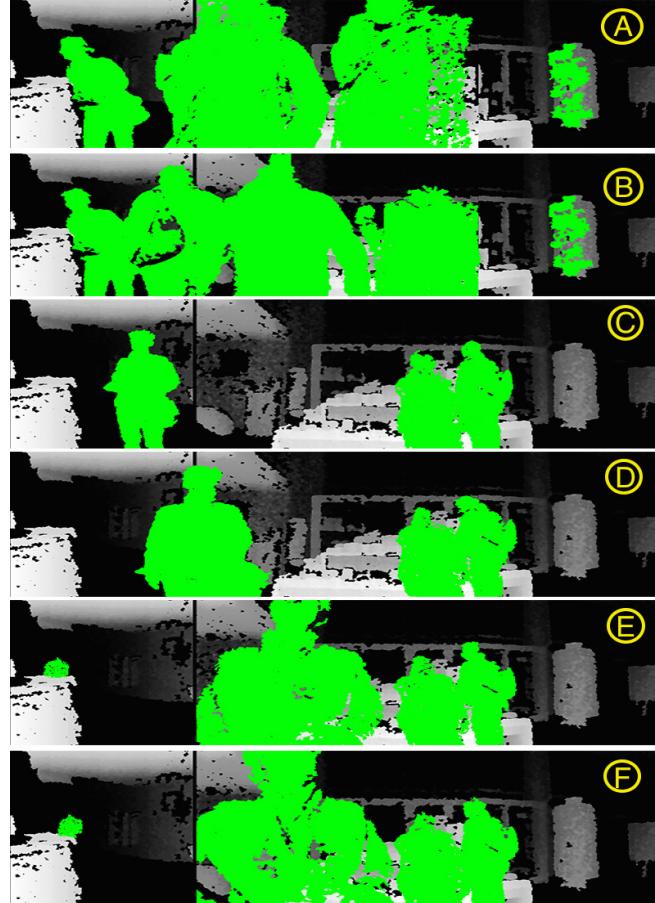


FIGURE 9.9: Honeypot effect

- 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.

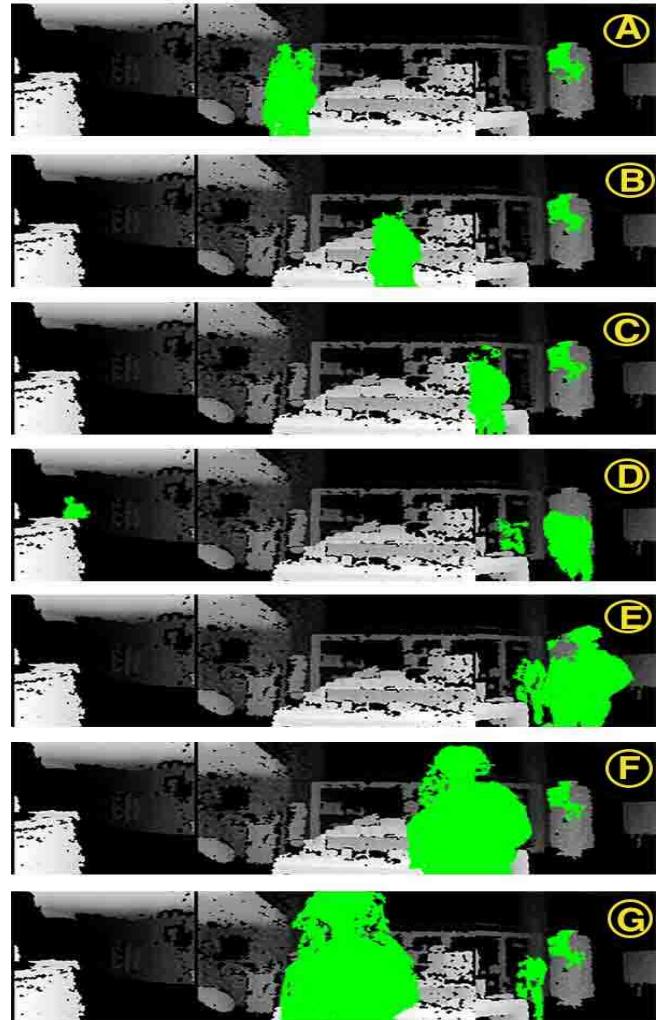


FIGURE 9.10: Landing effect

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

9.6.5 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).

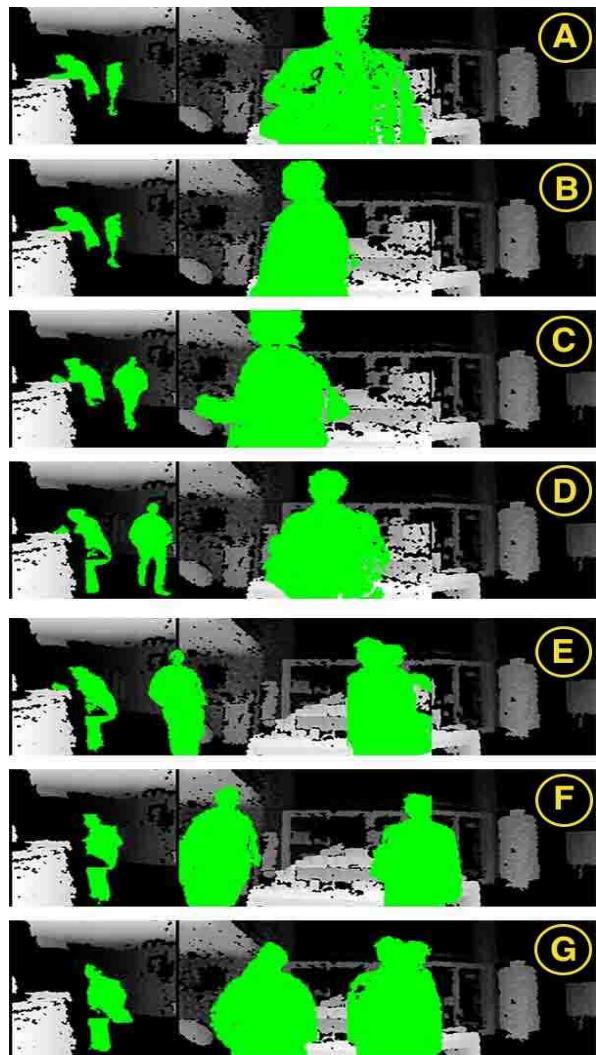


FIGURE 9.11: Calling others

- Noticing Interactivity earlier:

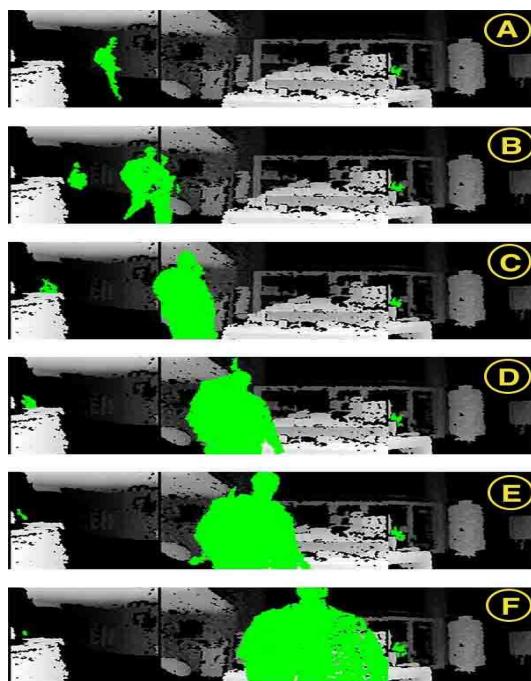


FIGURE 9.12: Noticing interactivity earlier.

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.

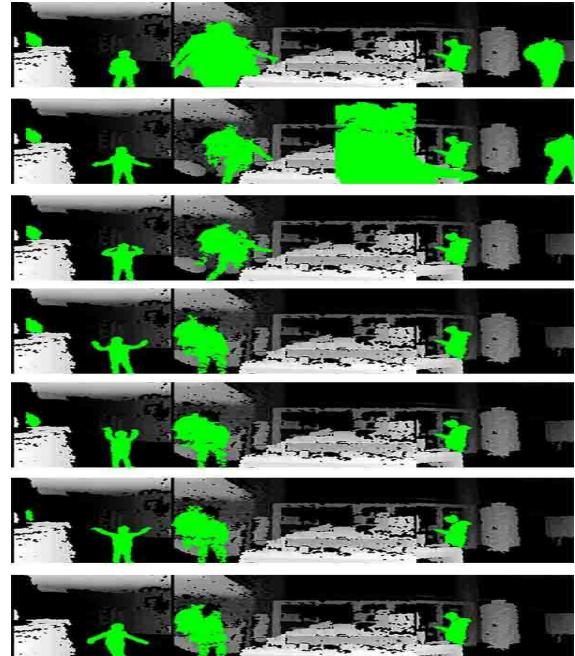


FIGURE 9.13: Side interaction

9.6.6 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 9.1: 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 9.2: 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
Enhanced 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. Engaged and Non-engaged passers-by

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

TABLE 9.3: 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 to confirm that which of the pairs were different significantly, I run Post-Hoc Tukey's HSD test as bellow.

TABLE 9.4: 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

Group A, B and C refers to (Non-interactive, body interactive and enhanced body interactive) advertisement accordingly. Post-hoc Tukey computed the critical value(Studentized Range Q statistic) for A and C as, $Q_{critical}^{\alpha=0.01,k=6} = 6.3250$ and another critical value for B and C as, $Q_{critical}^{\alpha=0.05,k=6} = 4.3341$ and the significance can be determined if each pair's critical value(Tukey HSD Q statistic) is bigger than Studentized Range Q statistic. $Q_j^i > Q_{critical}$, and the strength of difference is determined by the P value as shown above.

From the diagram above it is very clear that non-interactive with body interactive is insignificant because their critical value is smaller than 4.3341 and $p > 0.05$, the result was significant in the previous chapter because of five days together but became

insignificant with little number of days. On the other hand, the non-interactive with enhanced body interactive is strongly significant because their critical value is bigger than 6.3250 with $p < 0.01$, the result of enhanced body compared to body interactive is also significant with $p < 0.05$. As a result the enhance body interactive has strongly increased the number of engaged passers-by compared to non-interactive advertisement, and the effect size between them are measured as bellow.

To find out how big is the difference between number of engaged passers-by in non-interactive and enhanced body interactive conditions, the eta squared (η^2), which is an effect size index for ANOVA, in which the SS_{effect} (sum of squared) between conditions is divided by SS_{total} (sum of squared) total as bellow calculated by online tool *Easycalculator*¹.

$$\eta^2 = \frac{SS_{effect}}{SS_{total}} = \frac{580.1687}{648.8354} = 0.8942 \approx 0.89$$

The 0.89 means that %89 of total variance is accounted for by the conditions (enhanced body interactive, non-interactive) effect.

4. Landing effect comparison

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

TABLE 9.5: 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, ($(F2,3)=1.857$, $p > .05$ ($p=0.236$)).

5. Honeypot effect comparison

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

TABLE 9.6: 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. ($(F2,3)=1.667$, $p > .05$ ($p=0.266$))

¹easycalculator: <https://www.easycalculation.com/statistics/eta-square-calculator.php>, last accessed 15 jun 2016

9.7 Discussions

The increase in attention level, which was higher than old body advertisement version could have many reasons, (1) *Wide angle tracking*, 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 (2) *Exposure time*, the time passers-by were exposed to their silhouette in three cameras facing (left, center, right), was longer than exposure time with only one camera, normally it takes around 1.2 seconds to understand interactivity with silhouette with large screen that is in front of passers-by [11].

Honeypot effect in the previous body interaction experiment and in this experiment did not seem to be more strong, 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 himself 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.

9.8 Conclusion

In conclusion, this enhanced body interactive version performed significantly better than body interactive technique, it has increased the attention level of passers-by and dramatically raised the number of engaged people in front of display, but the number of landing and honeypot effects were not significant compared to body interactive.

In enhance version, the number of glances was %51 against the number of ignores, it was very effective in attention level than other two conditions (non-interactive and body interactive), because the number of glances was almost double than non-interactive and %10 increase than body interactive. The findings show that for a display positioned in a sideway, this technique can increase the attention level significantly than non-interactive display.

The enhanced version also increased the number of engaged people up to %15 of whole passers-by during three days, which the body interactive could not achieve in five days (%12) and the findings state that the enhanced version significantly engaged people than body interactive, but the significance was not as strong as compared to non-interactive (%7), which was above the double of percentage of engaged.

The above percentages might would have increased if the silhouette color was not the same for all passers-by, various silhouette color has an effect on the attention level and the motivation on passers-by, it would be very effective if this problem gets fixed in future.

10

Conclusion

10.1 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[91] 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 ways, 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 [65]., 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 into account, in which the main study was conducted in Tourist information center, and the 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 below.

- **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.

10.1.1 Advertisement development cycle

The advertisement development cycle should mainly follow the advertising programs[84] 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.

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.

10.1.2 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 [83], 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.

10.1.3 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 [38], they think they are irrelevant, boring and distractive to them [39, 48]. 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.

10.1.4 Motivation

To be motivated means *to be moved to do something*[54], 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 [50].

- **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.

10.1.5 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[78], 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.

10.1.6 Passers-by Behavior around display

Passers-by behave differently for certain types of display[61] and certain physical setup or environment [64, 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.

10.1.7 Futur work

Data gathering

The data gathered in this thesis was more from direct and indirect observations, which involved manually going through all depth images frame by frame to refine the data logs for accurate measurement. It would be more effective to create advanced techniques for data gathering in public spaces in real time with high accuracy and less errors, there have been works on this as bellow.

Quantifying attention, there are many applications that count glances, like *IntraFace*¹[34], this can detect gaze direction by obtaining head orientation, extracting eye corners, detecting pupils and then finds out where the person's gaze direction, but the application was meant for single users or a controlled environment with multi users. Another application was introduced in 2011 about the real world application of glance counting by F. De la Torre [35] that could measure the person glance toward display, record passers-by speed and emotions, but I still personally doubt on these sort of applications in terms of accuracy and handling large amount of people glances and repeated glance of the same passer-by, but with the use of new technologies in future these gaze detections would be more precise and stable.

In online marketing, measuring the *duration of engagement* with interactive advertisement and how often the person interacts during day, week or month in Internet is very easy

¹Intraface: <http://www.humansensing.cs.cmu.edu/intraface/>, last accessed 12 jun 2016

because the individual computers can be traced using their IP or Mac addresses or even user accounts in social medias, but in public displays the situation seems a bit difficult because many people pass by the display and start interacting too, but it is very hard to track the person during the day or week to measure the duration of engagement, there are applications [35] using face detection algorithms that count the durations but it is only for one time, the second time the person come is treated as a new person, or even there are a lot of false detection of faces and makes it hard to measure accurately, in future technologies I believe there will be more stable tracking applications to track users, but the display owners should deal with legal issues if people would allow to be tracked or not.

Impact of Advertisement types

This thesis compared the non-interactive and interactive advertisement in terms of performance and effectiveness, but has not quantified the amount of impact of advertisement on passers-by, *Attitude* toward a the product, or *buying decision*, a very clear and precise evaluation techniques should be developed to assess the impacts of interactivity and non-interactivity of advertisement from various viewpoint and angles.

Advertisement interaction design

The *Audience funnel*[2] interaction model consisted of 6 phases *Passing by, Implicit interaction, Subtle interaction, direction interaction, multiple interaction and follow-up actions*, but in this thesis the body interaction model design had one extra phase called *Ad video phase*, which was after the *direct interaction* phase. The findings show that people do not stay longer than 4 seconds in average to watch the advertisement video and this feature is a disturbance for the people who were interacting and were engaged with the display. This feature leads to a point that people would not be engaged anymore and future interaction designs should not include this phase in interaction design. A better solution would be to integrate short video clips inside the interaction phase, so that the people do not feel disconnected with the application and can still continue interaction and watch video.

Enhanced silhouette color in 3 kinect

The extended version was in fact a good solution to attract attention in side way public display. The integration of multiple Kinects extended the range but the problem was the silhouette colors, all the passers-by had the same color, because to have a seamless transformation of one person from one camera to other camera the color should had been consistent, but if there were different colors the person would see the shift in color in another next camera. An algorithm is required to keep track of passers-by in all three cameras and give one consistent color to each individual; in this case every person will have their own dedicated color.

Mobile interaction improvement

The usability testing, which was conducted in the thesis showed that the mobile phone had performed extremely worst than body interaction technique, and this is a major issue for public displays that use mobile phone interaction, and there is a need to research in this field from different perspectives like, (1) *usability issues*, the usability issues are shared with mobile device and public display at the same time, there is a need to create usability evaluation techniques to tackle usability issues on both devices simultaneously, (2) *Interaction technique*, create and develop interaction techniques that could be as easy as body interaction technique

with less amount of cognitive load to user, and (3) *Technology support*, the use of technology should be in a way that could support most famous platforms and at the same time it should be secure and reliable.

As stated before, the finding in tourist information center shows that no one interacted with mobile devices during the five-day deployment, which was a serious issue that why passers-by did not interacted, and some of the apparent issues were *Physical setup, security, limited technology knowledge, lack of smartphones*, this raises questions that how to design a space for mobile interaction and increase trust between advertiser and passers-by to allow them interact without any doubt.

Bibliography

- [1] J. Müller, Florian Alt, Albrecht Schmidt, Daniel Michelis, 2010 *Requirements and Design Space for Interactive Public Displays*, In Proceedings of the SIGMM Conference on Multimedia (MM '10), 1285 - 1294
- [2] Michelis and J. Müller. *The audience funnel: Observations of gesture based interaction with multiple large displays in a city center.* 2011.
- [3] Elizabeth F. Churchill, Les Nelson, Laurent Denoue. *Multimedia Fliers: Information Sharing With Digital Community Bulletin Boards.* In proceedings of Communities and Technologies (2003)
- [4] Florian Alt, Stefan Schneegäß, Albercht Schmidt, Jörg Müller, Nemanja Memarovic *How to evaluate Public Displays* Proceeding PerDis '12 Proceedings of the 2012 International Symposium on Pervasive Displays Article No. 17
- [5] H. Ishii and B. Ullmer. *Tangible Bits: Towards Seamless Interfaces Between People, Bits, and Atoms.* In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (Atlanta, GA, USA), CHI'97, pages 234–241, New York, NY, USA, 1997. ACM.
- [6] Gosling, Peter. (1999). *Scientist's Guide to Poster Presentations.* New York: Kluwer. ISBN 978-0-306-46076-0.]
- [7] James T. Enns, Erin L. Austen, Vincent Di Lollo, And Robert Rauschenberger and Steven Yantis *New Objects Dominate Luminance Transients in Setting Attentional Priority.* (Journal of Experimental Psychology: Human Perception and Performance 2001. Vol. 27. No. 6, 1287-1302)
- [8] Standford, Attention, Chapter 3, <http://www-psych.stanford.edu/ashas/Cognition20Textbook/chapter3.pdf>, last accessed 1:46 PM january 2016 Page 103,
- [9] John Jonides, Steven Yantis, *Uniqueness of abrupt visual onset in capturing attention.,* (perception & Psychophysics 1988, 43 (4), 346-354)
- [10] Elaine M. Huang, Anna Koster, and Jan Borchers. *Overcoming Assumptions and Uncovering Practices: When Does the Public Really Look at Public Displays?,* (J. Indulska et al. (Eds.): Pervasive 2008, LNCS 5013, pp. 228?243, 2008. Springer-Verlag Berlin Heidelberg 2008)

- [11] J. Müller, R. Walter, G. Bailly, M. Nischt, and F. Alt. *Looking Glass: A Field Study on Noticing Interactivity of a Shop Window.*, In Proceedings of the 2012 ACM Conference on Human Factors in Computing Systems (Austin, TX, USA), CHI'12, pages 297–306, New York, NY, USA, 2012. ACM.
- [12] Tim Weißker, Andreas Berst, Johannes Hartmann, Florian Echtler. *MMM Ball: Showcasing the Massive Mobile Multiuser Framework* CHI EA '16 Proceedings of the 2016 CHI Conference Extended Abstracts on Human Factors in Computing Systems Pages 3796-3799
- [13] R. Borovoy, F. Martin, S. Vemuri, M. Resnick, B. Silverman, and C. Hancock. *Meme Tags and Community Mirrors: Moving from Conferences to Collaboration*. In Proceedings of the 1998 ACM Conference on Computer Supported Cooperative Work (Seattle, WA, USA), CSCW'98, pages 159–168, New York, NY, USA, 1998. ACM.
- [14] H. Brignull and Y. Rogers. *Enticing People to Interact with Large Public Displays in Public Spaces*. In M. Rauterberg, M. Menozzi, and J. Wesson, editors, Proceedings of the IFIP TC13 International Conference on Human- Computer Interaction (Zürich, Switzerland), Interact'03. IOS Press, 2003.
- [15] J. M. Heiner, S. E. Hudson, and K. Tanaka. *The Information Percolator: Ambient Information Display in a Decorative Object*. In Proceedings of the 12th annual ACM Symposium on User Interface Software and Technology (Asheville, NC, USA), UIST '99, pages 141–148, New York, NY, USA, 1999. ACM.
- [16] Junko Ichino, Kazuo Isoda, Tetsuya Ueda and Reimi Satoh *Effects of the Display Angle on Social Behaviors of the People around the Display: A Field study at a Museum*. Proceedings of the 19th ACM Conference on Computer-Supported Cooperative Work & Social Computing ACM New York, NY, USA ©2016
- [17] Junko Ichino, Kazuo Isoda, Ayako Hanai and Tetsuya Ueda *Effects of the Display Angle in Museums on User's Cognition, Behavior, and Subjective Responses* Proceedings of the SIGCHI Conference on Human Factors in Computing Systems Pages 2979-2988 ACM New York, NY, USA ©2013
- [18] A. Chew, V. Leclerc, S. Sadi, A. Tang, and H. Ishii. *SPARKS*. In CHI'05 Extended Abstracts on Human Factors in Computing Systems (Portland, OR, USA), CHI EA'05, pages 1276–1279, New York, NY, USA, 2005. ACM.
- [19] Jenny Cameron,
Focusing on the Focus Group. School of Environmental Planning, Griffith University Australia.2005
- [20] Saad Kamal *Conversion Funnel in Google Analytics* <http://www.saadkamal.com/sales-funnel-in-google-analytics/> Last accessed 17 Jun 2016
- [21] Abraham Bagherjeiran, Andrew Hatch, Adwait Ratnaparkhi. *Ranking for the conversion funnel* In SIGIR '10 Proceedings of the 33rd international ACM SIGIR conference on Research and development in information retrieval Pages 146-153
- [22] Anthony Tang, Mattias Finke, Michael Blackstock, Rock Leung, Meghan Deutscher, Rodger Lea
Designing for Bystanders: Reflections on Building a Public Digital Forum. Proceedings of the SIGCHI Conference on Human Factors in Computing Systems Pages 879-882

- [23] S.Greenberg, M.Boyle, and J.Laberge. *PDA sand Shared Public Displays: Making Personal Information Public, and Public Information Personal.* Personal and Ubiquitous Computing, 3(1):54–64, 1999.
- [24] Bernard J. Jansen, and Simone Schuster *BIDDING ON THE BUYING FUNNEL FOR SPONSORED SEARCH AND KEYWORD ADVERTISING* Journal of Electronic Commerce Research, VOL 12, NO 1, 2011
- [25] Borovoy, R., McDonald, M., Martin, F., and Resnick, M. *Things that blink: Computationally augmented name tags.* IBM Systems Journal 35, 3&4.
- [26] Vangie Beal *Internet Marketing:* http://www.webopedia.com/TERM/I/internet_marketing.html Last accessed: 15 Jun 2016
- [27] M. Böhlen and M. Mateas. *Office Plant# 1: Intimate Space and Contemplative Entertainment.* Leonardo, 31(5):345–348, 1998.
- [28] J. Finney, S. Wade, N. Davies, and A. Friday. *Flump: The Flexible Ubiquitous Monitor Project.* In Proceedings of the 3rd Cabernet Radicals Workshop, 1996.
- [29] Tommy Walker *The 14 types of online marketing* <http://tommy.ismy.name/14-types-of-online-marketing/#.V2F0OK6yAsk> Last accessed 15 jun 2016.
- [30] F.Alt,T.Kubitz, D.Bial, F.Zaidan, M.Ortel, B.Zurmaar, T.Lewen, A.S. Shirazi, and A. Schmidt. *Digifieds: Insights into Deploying Digital Public Notice Areas in the Wild.* In Proceedings of the 10th International Conference on Mobile and Ubiquitous Multimedia (Beijing, China), MUM’11, pages 165–174, New York, NY, USA, 2011. ACM.
- [31] M. Shari , T. Payne, and E. David. *Public display advertising based on bluetooth device presence.* In Mobile Interaction with the Real World (MIRW 2006)in conjunction with the 8th International Conference on Human Computer Interaction with Mobile Devices and Services, Espoo, Finland, September 2006.
- [32] Study conducted by PwC for IAB France and the SRI *Measuring the effectiveness of online advertising* 2010
- [33] Emotion difination, <http://www.dictionary.com/browse/emotion>. last accessed 4 jun 2016
- [34] F. De la Torre, W.-S. Chu, X. Xiong, F. Vicente, X. Ding, and J. F. Cohn *IEEE International Conference on Automatic Face and Gesture Recognition (FG)*, Ljubljana, Slovenia.,2015.
- [35] John Hardy,Enrico Rukzio and Nigel Davies *Real World Responses to Interactive Gesture Based Public Displays* MUM’11, Dec 7–9, 2011, Beijing, China.2011 ACM 978-1-4503-1096-3/11/12
- [36] P.Kotler *Marketing Management. Pearson one series. Pearson Prentice Hall, Upper Saddle River, NJ, 13th Edition, 2009*
- [37] E. Huang, A. Koster, and J. Borchers. *Overcoming assumptions and uncovering practices: When does the public really look at public displays?* In Proc. of Pervasive 2008, 2008.
- [38] S. milgram. *The experience of living in cities.* Science, 13 March:1461–1468, 1970.

- [39] M. Burke, A. Hornof, E. Nilsen, and N. Gorman. *High-cost banner blindness: Ads increase perceived workload, hinder visual search, and are forgotten.* ACM Trans. Comput.-Hum. Interact., 12(4):423–445, 2005.
- [40] F. Gil-Castañeira, A. Fernández-López, C. L. Bravo, N. Cid-Vieytes, D. Conde-Lagoa, E. Costa-Montenegro, and F. J. González-Castaño. *Runwithus: a social sports application in the ubiquitous oulu environment.* In Proceedings of the 10th International Conference on Mobile and Ubiquitous Multimedia (Beijing, China), MUM ’11, pages 195–204, New York, NY, USA, 2011. ACM.
- [41] Bezjian-Avery, A., Calder, B., & Iacobucci, D. (1998). *New media interactive advertising vs. traditional advertising.* Journal of Advertising Research, 38(4), 23-32.
- [42] Ballagas, R., Rohs, M., and Sheridan, J. G. Sweep and point and shoot: phonecam-based interactions for large public displays. In CHI ’05 EA, ACM (NY, USA, 2005).
- [43] Scott Carter, Jennifer Mankoff *Prototypes in the Wild: Lessons Learned from Evaluating Three Ubicomp Systems* Journal IEEE Pervasive Computing archive Volume 4 Issue 4, October 2005 Page 51-57
- [44] Alt, F., Schmidt, A., and Evers, C. *Mobile contextual display systems.* In Adj. Proc. of HotMobile’09 (2009).
- [45] Boring, S., Baur, D., Butz, A., Gustafson, S., and Baudisch, P. *Touch projector: mobile interaction through video.* In Proc. of CHI’10, ACM (New York, USA, 2010), 2287–2296.
- [46] Robert A. Virzi, Jeffrey L. Sokolov and Demetrios Karis *Usability Problem Identification Using Low- and High-Fidelity Prototypes* In Proceeding CHI ’96 Proceedings of the SIGCHI Conference on Human Factors in Computing Systems Pages 236-243
- [47] E. M. Huang, D. M. Russell, and A. E. Sue. *IM Here: Public Instant Messaging on Large, Shared Displays for Workgroup Interactions.* In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (Vienna, Austria), CHI’04, pages 279–286, New York, NY, USA, 2004. ACM.
- [48] J. Müller, D. Wilmsmann, J. Exeler, M. Buzeck, A. Schmidt, T. Jay and A. Krüger *Display Blindness: The Effect of Expectations on Attention towards Digital Signage* In Proceedings of the 7th International Conference on Pervasive Computing (Nara, Japan), Pervasive’09, pages 1–8, Berlin, Heidelberg, 2009. Springer-Verlag.
- [49] M. Weiser. *The computer for the 21st century.* Scientific American, 265(3):94–104, 1991.
- [50] T. Malone. *Toward a Theory of Intrinsically Motivating Instruction.* Cognitive Science, 5(4):333–369, 1981.
- [51] M. Csikszentmihalyi, C. Kolo, and T. Baur. *Flow: The Psychology of Optimal Experience.* Australian Occupational Therapy Journal, 51(1):3–12, 2004.
- [52] J. Müller and A. Krüger. *Towards Situated Public Displays as Multicast Systems.* In Proceedings of the Workshop on Ubiquitous User Modeling UbiqUM’06, 2006.
- [53] B. Congleton. *Prospero – A “Visual Commons” Framework for Public Displays,* 2007. http://dlc.dlib.indiana.edu/dlc/bitstream/handle/10535/3816/prospero_wrap_up.pdf?sequence=1, last accessed 15 May 2016.
- [54] E. Deci and R. Ryan. *Intrinsic Motivation and Self-Determination in Human Behavior.* Springer, 1985.

- [55] J. E. Bardram, T. R. Hansen, and M. Soegaard. *AwareMedia: a Shared Interactive Display Supporting Social, Temporal, and Spatial Awareness in Surgery*. In Proceedings of the 2006 20th Anniversary Conference on Computer Supported Cooperative Work (Banff, AB, Canada), CSCW '06, pages 109–118, New York, NY, USA, 2006. ACM.
- [56] A.Bulling, F.Alt, and A.Schmidt. *Increasing The Security Of Gaze-Based Cued-Recall Graphical Passwords Using Saliency Masks*. In Proceedings of the 2012 ACM Annual Conference on Human Factors in Computing Systems (Austin, TX, USA), CHI'12, pages 3011–3020, New York, NY, USA, 2012. ACM.
- [57] Conversion Rate: http://www.marketingterms.com/dictionary/conversion_rate/, last accessed 3 June 2016
- [58] Müller, J., Exeler, J., Buzeck, M., and Krüger, A. *Reflectivesigns: Digital signs that adapt to audience attention*. In Proc. of Pervasive'09, Springer (Berlin, 2009), 17–24.
- [59] A. Blackler, V. Popovic, and D. Mahar. *The Nature of Intuitive Use of Products: An Experimental Approach*. Design Studies, 24(6):491–506, 2003.
- [60] Collomb, M., Hascoët, M., Baudisch, P., and Lee, B. *Improving drag-and-drop on wall-size displays*. In Proc. of GI '05 (2005), 25–32.
- [61] Beyer, G., Alt, F., Müller, J., Schmidt, A., Isakovic, K., Klose, S., Schiewe, M., and Haulsen, I. *Audience behavior around large interactive cylindrical screens*. In Proc. of CHI'11, ACM (New York, USA, 2011), 1021–1030.
- [62] D. Vogel and R. Balakrishnan. *Interactive public ambient displays: Transitioning from implicit to explicit, public to personal, interaction with multiple users*. In Proceedings of the 17th annual ACM Symposium on User Interface Software and Technology (Santa Fe, NM, USA), UIST'04, pages 137–146, New York, NY, USA, 2004. ACM.
- [63] K. Miyaoku, S. Higashino, and Y. Tonomura. *C-blink: A Hue Difference- based Light Signal Marker for Large Screen Interaction Via Any Mobile Terminal*. In Proceedings of the 17th annual ACM Symposium on User Interface Software and Technology (Santa Fe, NM, USA), UIST'04, pages 147–156, New York, NY, USA, 2004. ACM.
- [64] Maurice ten Koppel,Gilles Bailly, Jörg Müller and Robert Walter *Chained Displays: Configurations of Public Displays Can Be Used to Influence Actor-, Audience -,and Passer- By Behavior* Proceedings of the SIGCHI Conference on Human Factors in Computing Systems Pages 317-326ACM New York, NY, USA ©2012
- [65] Elaine M. Huang, Elizabeth D. Mynatt *Semi-Public Displays for Small, Co-located Groups* In proceeding of CHI 2003, pp 49-56 (2003)
- [66] H. Meffert, C. Burmann, and M. Kirchgeorg. *Marketing: Grundlagen Marktorientierter Unternehmensführung. Konzepte-Instrumente Praxisbeispiele*. Gabler, 2011.
- [67] Virzi, R. *What can you learn from a low-fidelity prototype?* In Proc. of the Human Factors Society 33rd Annum Meeting, HFES: Santa Monica, CA(1989), pp. 224 - 228.
- [68] Kules, B., Kang, H., Plaisant,C., Rose,A. and shaneiderman,B. *Immediate usability: a case study of public access design for a community photo library*. Interactiing with Computers, 16, 6 (2004), 1171 - 1193
- [69] Quesenbery, W. (2004). *Defining a summative usability test for voting systems - A report from the UPA 2004 workshop on voting and usability* <http://www.slideshare.net/whitepapers/defining-a-summative-usability-test-for-votingsystems>

- [70] D. M. Russell, J. P. Trimble, and A. Dieberger. *The Use Patterns of Large, Interactive Display Surfaces: Case Studies of Media Design and Use for BlueBoard and MERBoard*. In Proceedings of the 37th Annual Hawaii International Conference on System Sciences HICSS'04, Washington, DC, USA, 2004. IEEE Computer Society.
- [71] Nieuwdorp, E. (2007). *The pervasive discourse*. Computers in Entertainment 5 (2): 13. doi:10.1145/1279540.1279553.
- [72] N. Davies, A. Friday, P. Newman, S. Rutledge, and O. Storz. *Using Bluetooth Device Names to Support Interaction in Smart Environments*. In Proceedings of the 7th international Conference on Mobile Systems, Applications, and Services (Krakow, Poland), MobiSys'09, pages 151–164, New York, NY, USA, 2009. ACM.
- [73] M. WEISER: *The Computer of the Twenty-First Century*. Scientific American, pp. 94–100, 1991.
- [74] L. Itti, C. Koch, and E. Niebur. *A Model of Saliency-Based Visual Attention for Rapid Scene Analysis*. IEEE Transactions on Pattern Analysis and Machine Intelligence, 20(11):1254–1259, Nov. 1998.
- [75] N. Streitz, C. Röcker, T. Prante, R. Stenzel, and D. van Alphen. *Situated Interaction With Ambient Information: Facilitating Awareness and Communication in Ubiquitous Work Environments*. In Proceedings of the 10th International Conference on Human-Computer Interaction (Crete, Greece), HCI International'03, 2003.
- [76] T. Prante, C. Röcker, N. Streitz, R. Stenzel, C. Magerkurth, D. van Alphen, and D. Plewe. *Hello.Wall –Beyond Ambient Displays*. In Adjunct Proceedings of the 5th International Conference on Ubiquitous Computing (Seattle, WA, USA), Ubicomp'03, pages 277–278, 2003.
- [77] J. Müller, F. Alt, and D. Michelis. *Introduction to Pervasive Advertising*. In J. Müller, F. Alt, and D. Michelis, editors, *Pervasive Advertising*. Springer Limited London, 2011
- [78] P. van Waart, I. Mulder, and C. de Bont *Meaningful advertising: pervasive advertising in the experience economy* In J. Müller, F. Alt, and D. Michelis, editors, *Pervasive Advertising*, pages 57–81. Springer Limited London, 2011.
- [79] S. Franconeri and D. Simons. *Moving and Looming Stimuli Capture Attention*. *Attention, Perception, & Psychophysics*, 65(7):999–1010, 2003.
- [80] A. S. Shirazi, C. Winkler, and A. Schmidt. *Flashlight Interaction: A Study on Mobile Phone Interaction Techniques with Large Displays*. In Proceedings of the 11th International Conference on Human-Computer Interaction with Mobile Devices and Services (Bonn, Germany), MobileHCI'09, pages 931–932, New York, NY, USA, 2009. ACM.
- [81] K. cheverst, A. Dix, D. Fitton, C. Kray, M. Rouncefield, C. Sas, G. SaslisLagoudakis, and J. G. Sheridan. *Exploring Bluetooth-based Mobile PPhone Interaction with the Hermes Photo Display*. In proceedings of the 7th Internaltional Conference on Human Computer Interaction with Mobile Devices & Services (Salzburg, Austria), MobileHCI'05, pages 47-54, New York, NY, USA, 2005. ACM
- [82] K. Galloway and S. Rabinowitz. *Hole-in-Space, 1980*. <http://www.eafe.com/getty/HIS/>, last accessed May 15, 2016.
- [83] J. Müller, F. Alt, and D. Michelis. *Pervasive Advertising*. Springer London Limited, 2011.

- [84] P. Kotler. *Marketing Management. Pearson one series.* Pearson Prentice Hall, Upper Saddle River, NJ, 13th edition, 2009.
- [85] Alois Ferscha *What is Pervasive Computing?* Johannes Kepler Universität Linz, Institut für Praktische Informatik,
- [86] Greenfield, Adam (2006). *Everyware: the dawning age of ubiquitous computing.* New Riders. pp. 11–12. ISBN 0-321-38401-6.
- [87] Laurie Kantner, Timothy Keirnan *Field Research in Commercial Product Development* Reprint of paper delivered at UPA 2003, sponsored by the Usability Professionals' Association
- [88] L. Brill. *Led electronic message reader boards: Watching the world go by in streaming headlines.* signindustry.com, 2008.
- [89] Mark Weiser, *Some Computer Science Problems in Ubiquitous Computing* Communications of the ACM, July 1993.(reprinted as “Ubiquitous Computing”. Nikkei Electronics; December 6, 1993; pp. 137-143.)
- [90] D. A. Norman. *Emotional Design: Why We Love (or Hate) Everyday Things.* Basic Books, 1st edition, 2003.
- [91] Andreas Ernst, Tobias Ruf, Chritain Kueblbeck. *A modular Framework to Detect and Analyze Faces for Audience Measurement Systems.* In proceedings of the 2nd International workshop on pervasive advertising (Lübeck, Germany), PerAd'10, 2010
- [92] Brakus, j.j. Schmitt, B.H. & Zarantonello, L. *MBrand Experience: What Is It? How Is It Measured? Does It Affect Loyalty?* In: Journal of Marketing. Vol. 73, May 2009, p. 52–68.
- [93] Charles M. Reigeluth and Theodore W. Frick *Formative Research: A Methodology for Creating and Improving Design Theories* In C.M. Reigeluch (ed.), Instructional-Design Theories and Models: A New Paradigm of Instructional Theory. (Volume II). Hillsdale, NJ:
- [94] J. Zaichkowsky. *Measuring the Involvement Construct.* Journal of Consumer Research, 12(3):341–352, Dec. 1985.
- [95] A. G. Greenwald. *Audience Involvement in Advertising: Four Levels.* Journal of Consumer Research, 11:581–592, 1984.
- [96] R. Heath, D. Brandt, and A. Nairn. *Brand Relationships: Strengthened by Emotion, Weakened by Attention.* Journal of Advertising Research, 46(4):410, 2006.