Improving user attention by using adaptive content on public displays

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ABSTRACT
This paper describes our research into whether the user attention towards public displays increases if adaptive content is provided. We will use a gender detection software to identify male and females, using this data we will provide gender orientated content on the display to see if the attention time increases. We will also provide non-adaptive content and compare both data. At the end it proved that there were no significance statistical difference, but most users liked the idea of adaptive content and future researches might have greater breaktroughs.

ACM Classification Keywords
Category: I.4.0 – Computing Methodologies/Image Processing and computer vision/General: Image processing software

General Terms
Measurement, Experimentation, Human Factors

Keywords
Face recognition, Attention time, Dwell time, In-view time, Public displays and Computer vision

1. INTRODUCTION
Public displays are getting more common in a variety of contexts. The fact that they are becoming cheaper and more robust makes them ideal for commercial, social and information purposes. However the effectiveness of such displays is not always as straightforward as it appears [1] [2]. That is because the user[1] does not always pay attention towards the display. People nowadays are so used to finding commercial ads on these public displays that they unconsciously tend to ignore them. This research focuses on increasing the user attention towards a display by using adaptive content. R. Ravnik and F. Solina already proved that providing dynamic content on a display will improve the users' attention towards it [4]. We wanted to improve on this research by proving that if providing adaptive content based on gender recognition, would or would not improve the user attention even more. In order to do that we used software provided by VANturelabs[2]. This software can measure audience flow, determine a persons' gender and measure the amount of time a user is looking towards the display (attention time). We build a system that used the information provided by the software to dynamically adapt the content on the display. The system did this based on whether the user was a male or a female. At the end we compared the attention time on both adaptive and non-adaptive content to see if the user attention increased if adaptive content was provided.

2. RELATED WORK
There were many researches done on this subject, some to improve the technology and some for commercial purposes. An obstacle we had to overcome during this research was screen blindness [1]. This is an emerging phenomenon where users expecting to find advertisement on public displays, unconsciously ignore them. We also had to take in consideration the room dynamics and how social interactions took place in the building. We also had to find out how to attract the users' attention towards the display. The research done by D. Michilis and H. Send describes how to tackle this problem [3]. They based it on three frameworks which can be used to model a users' attention and engagement towards public displays. In order to keep the users' attention we had to know what type of content attracts most users. In this case R. Ravnik and F. Solina have researched the users' attention with different types of content on public displays [4]. They used computer vision to get quantitative results on the users' dwell time, in-view time and attention time while providing both static and non-static content. They proved that non-static content gets more attention from the user than static content.

Another research we took into consideration was the one done by Harry Brignull and Yvonne Rogers about: Enticing people to interact with large public displays in public spaces [5]. Although their concept consisted of a screen that interacted with the user by means of user interaction, they also had to overcome the screen blindness concept. In their research they attribute the screen blindness with the user being embarrassed to use the screen in a public space. They had to take into consideration the flow of people in an area, to design a screen in such way that the user is not obligated to use it. Also it had to be socially acceptable so the user would not feel embarrassed or overcommitted to use it. In our research our screen must also attract the attention in such way that the user does not feel obligated to watch if he does not want to.

Another concept that was useful for us was that of creating conversation opportunities in urban spaces through public displays and personal devices [6]. Here the concept of enticing people to play a game on a public display versus or with each

[1]A person who passes in front of the display who may or may not look at the display.

[2]http://vanturelabs.com/ (May 2013)

other, made it possible for total strangers to interact with one another by means of the public display. For our research providing the right content may increase the attention time towards the display, but may also trigger a user to let others notice the screen thus improving the attention time even more.

3. RESEARCH SETUP

In this section we describe the preliminary researches we had to perform. This was needed in order to find out what kind of content users wanted to see on the display. We also had to figure out what research location would be the best for us. These were important in order to get the best results for the research.

3.1 Technology

For this research we used a screen, a webcam and a PC. The software used the webcam to "scan" the environment and then determine whether the users where male or female. It also used the webcam to determine the attention time and how many male or female users are present. This data was then pushed online to a server whose role was to store it in a database and determine what video had to be shown on the screen. The video was accessed by means of a webpage which was shown on the display so the users could only see the videos.

3.2 Screen content

Before we started testing with the software, we held a questionnaire to get a sense of what content was most appealing for the potential users. The questionnaire had a list of 20 themes ranging from babies, cars, flowers, cute pets to cooking and movie genres. These themes where chosen based on the amount of "Vine[3]" videos available. The fact that Vine was a very new application at the time, made the amount of videos for certain themes less than others. The potential users who took the questionnaire had to mark down all the themes they found interesting. The potential users ranged from students, teachers and employees of the Amsterdam University of Applied Sciences. This was done in order to get an as diversified pool of users as possible, which helped get a better sense of what everybody liked. Of the results gathered we chose the topics that had the biggest difference in liking between the genders. Then for every video theme we selected a set of Vine videos. When the software determined a users' gender, the server would then choose random video of that genders video list. The reason we have chosen for Vine is because of the fact that the videos have neither a beginning nor an end, so the user won't notice that the video was cut in the middle if it suddenly changed. The videos chosen were specifically selected so that it wouldn't contain sexual contents of course, but it also served a purpose in selecting videos that were not going to be annoying. Vine is used by everybody so it will provide the usual amateurish shaky videos. Also due to the fact that the videos must be a maximum of 6 seconds, some of them are a series of captures which turn out to be quite annoying. These are at times unpleasant to watch and may influence the attention time. This is why we screened and selected the videos that were going to be shown on the display.

3.3 Location

Our first research location was at the Computer Science dependence of the Amsterdam University of Applied Sciences (See figure 1). During our preliminary measurements we noticed that there were more male than female users present at this location. So in order to have a more balanced pool of users we choose **to** setup at a second location, which was at the Media, Creation and Information dependence of the Amsterdam University of Applied Sciences (See figure 2). At that location we had a more balanced pool of male vs. female users and the amount of potential users that passed by the display is greater than at the first location.

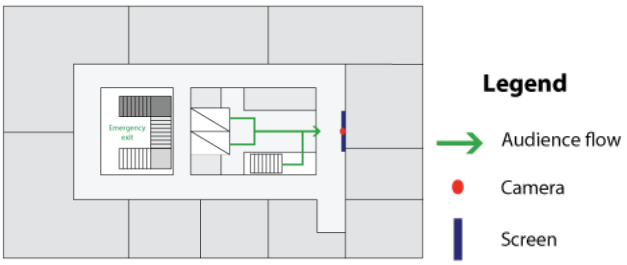


Figure 1. Test Setup first location

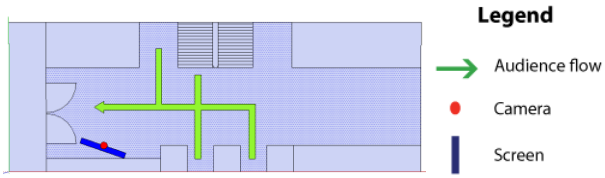


Figure 2. Test Setup second location

4. RESEARCH METHOD

Our research was based on whether the user paid more attention towards a public display if adaptive content was provided. We did this in two stages. In the first stage, the system provided only non-adaptive content on the display. It then gathered information about the users' gender and it measured the attention time towards the display. In the second stage, the system provided adaptive content on the display based on the users' gender. It also took into consideration how many users of one certain gender stood in front of the display. This meant that if there were more female than male users present, the system would provide female oriented content on the screen. During this stage the system also measured the attention time. To prevent that the users got accustomed to the system we toggled between stages so the users did not know when adaptive or non-adaptive content was provided. This way we could gather data that was not influenced by the fact that the users had gotten used to the system. Finally we compared the data of both stages. Data was gathered for 3 weeks, during which adaptive and non-adaptive content was provided. The data that we received from the software was: Timestamps of the data entries; How many users are in view[4]; How long a user was in view; How long was a user looking at the screen; Was the system in adaptive or non-adaptive mode; What content was provided; Was the content adapted or not regarding to the adaptive or non-adaptive mode; Start and end time of the content. In figure 3 get a view of the setup in both locations and in figure 4 you get a view of the systems' process.

Figure 3. Research setup of both locations.

[3] https://itunes.apple.com/app/vine-make-a-scene/id592447445 (May 2013)

[4] The area in front of the screen where the software can recognize you as a user.

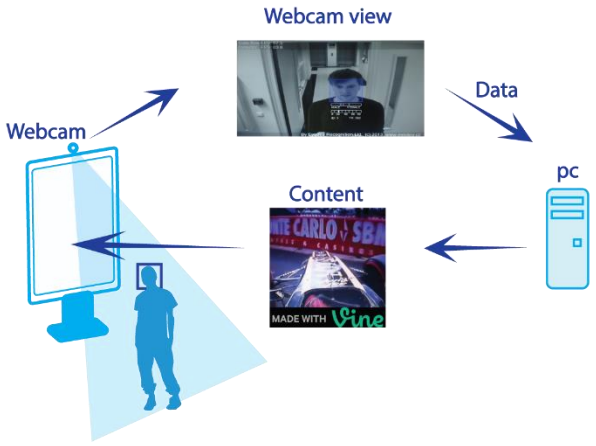


Figure 4. System process.

5. RESULTS

As described in Research Setup we split the research into researching the screen content and providing the adaptive and non-adaptive content. Here are the results of these researches.

5.1 Questionnaire results

The questionnaire gave us an insight of what the potential users would like to see on the display. A total of 97 potential users took the questionnaire, 37 male (M = 24.2 – SD = 5.8) and 60 female (M = 21.7 – SD = 3.1). The youngest male and female to take the questionnaire were both 18 years of age. The oldest male and female were 53 and 38 years of age. As described in the research setup we selected the themes that had the biggest difference in liking. As a result we found that males opted for sports and video games themes, while females opted for fashion and romantic movies. For Males we have choose the following video themes: Sports; Video games; Comics; Action Movies; Cars; Weight lifting; Motorcycles; Space. For females we have chosen the following video themes: Fashion; Romantic Movies; Flowers; Pets; Ballet; Street Dancing; Babies. In figure 5 you have an overview of all the results gathered from the questionnaire.

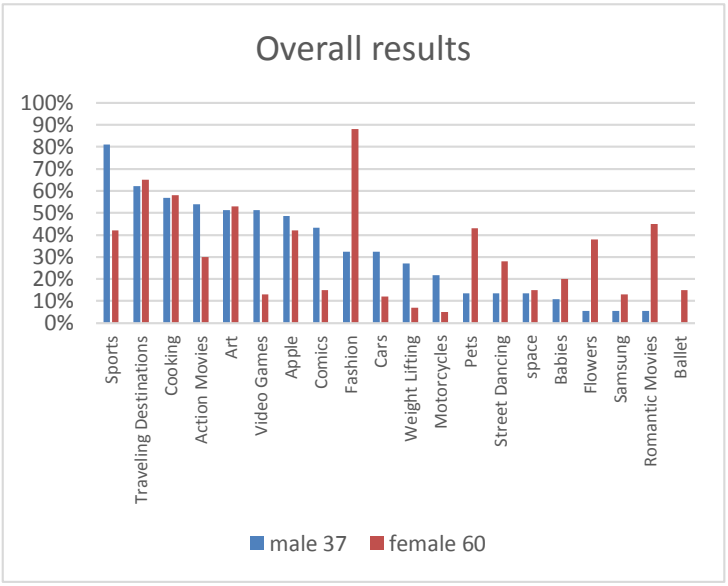
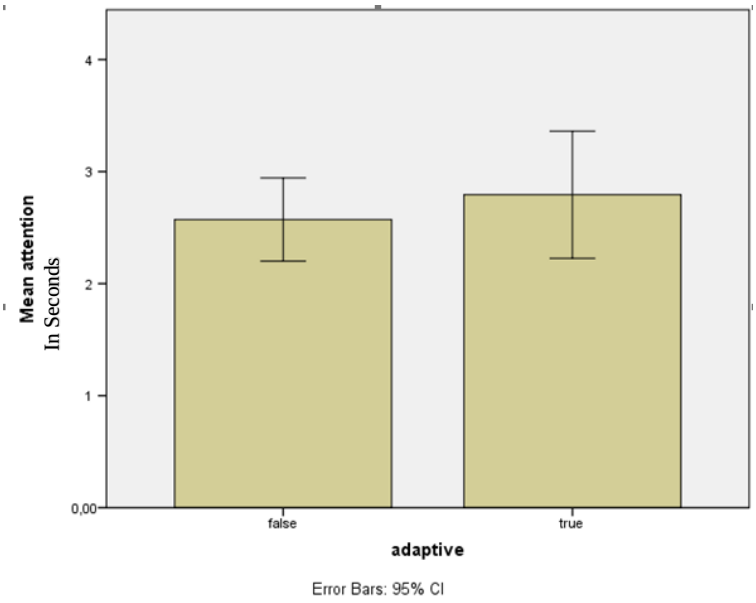


Figure 5. The overall results of the questionnaire.

5.2 Overall research results

During our research a total of 491 people were captured standing in front of our system. Out of that total 197 people were captured when the system was adaptive and 294 people were captured when the system was non-adaptive. The adaptive results showed people looking at the screen for a longer period (M = 2.794 - SD = 4.037) than the non-adaptive results (M = 2.572 - SD = 3.233), $t(489) = .416 \geq .05$. (See figure 6) So we can conclude that is no statistical significance.

Figure 6. Attention time difference.



6. Discussion

Even though the data did not indicate a statistical significance we did see an improvement in average attention time of 13%. On top of that we have gotten a lot of very positive responses from users because of the adjusted content, this because it was a lot less general than content normally found on public displays. This is why we feel that if more research in this field is done, the significance of an adaptive system can be improved a lot. Our research was based on the fact that if adapted content was provided for a user on a public display, that it would increase the attention time. We did not focus on what kind of content because this would be a whole research on itself. There are different aspects on the type of content that should be provided. In the research done by Frédérick F. Brunel and Michelle R. Nelson proved that message order affects the way people remember them [7]. They also researched how males and females would react and think of certain content. This would help in segmenting the content even more towards a specific gender. Although in our research we found the use of vine videos helpful, but it required more work. Because of the screening we had to manually select the videos every time we wanted to change the content list. So having a set of videos that are already specifically made for this system would be a lot easier and efficient to use.

7. Follow-up researches

For future researches we propose researches that focus on the difference in advertisement and entertaining content. In our research we used mainly entertaining content due to school policies. But an in-depth research on advertisement vs. entertainment content would provide more results on getting the user attention. Another research concept is to determine what a content system should adapt itself to when a crowd is standing in front of the display for different durations. In this concept one can also take in account more complicated segmentation as families and couples. How to identify them and what content to provide to them based on computer vision. We also think that there may be some improvement by using sound in conjunction with adaptive content. This concept may improve the user attention even more by attracting the users' attention faster. Attention should be paid on how to implement this however in order to avoid that it becomes an annoying additive.

8. ACKNOWLEDGMENTS

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