Evaluation of a gamification approach for increasing interaction with public displays

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ABSTRACT

In this paper we present the results of an experiment to increase the attraction of a public display. To do so, we added a gamification component to improve the frequency of interaction and did an in-the-wild evaluation of the changes by analyzing the automatically logged data in combination with conducting a survey of the staff. We compare interaction data gathered before and during the experiment, and highlight the differences in these two data sets and explain their significance in prospect to the experiment. First, we discuss whether we achieved our goal of increasing the attraction or not based on the interaction data. Second we evaluate the results of our survey in which we asked people that work near the public display and possibly interacted with it, to gather some more information. The combination of both information sources allows us to further answer a question regarding intrinsic and extrinsic motivational factors to interact with smart screens.

KEYWORDS

Gamification, evaluation, (semi-)public display, information radiator, display network

1 MOTIVATION

Since public displays are used more often in public spaces, it is important to try and maximize the attention the display gets as it is used to share important information regarding the department of software-technology.

A public display in an academic environment, such as the one used in this experiment, should be able to provide relevant information to all scientific staff, bus schedules and beyond. In addition to that scientific work is often based on being acquainted with people that have knowledge about a certain field of interest to oneself. See Koch et al. [2] for more information about the CommunityMirror Network setup.

We have added a simple gamification approach to the basic implementation of the CommunityMirror Network setup. In this work we are going to analyze the effect of our gamification approach on the usage of the smart screen.

The public display already automatically gathers interaction data such as touches and dragging of information objects which provide valuable information. Thus the approach of evaluating our gamification element that is supposed to increase the amount of interactions with the display revolves around comparing interaction data from before the experiment with data during its operation.

After a short review of related work we present the setup and the data collection. Then we analyze the data and discuss the results. First, we discuss whether we achieved our goal of increasing the attraction or not based on the interaction data. Second we evaluate the results of our survey in which we asked people that work near the public display and possibly interacted with it, to gather some more information. The combination of both information sources allows us to further answer a question regarding intrinsic and extrinsic motivational factors to interact with smart screens. To conclude the paper, we give a brief summary of the whole project and the outcome of the experiment. In addition, we will present an outlook that describes what our studies could lead to in the future.

2 RELATED WORK

When looking for related work we tried looking for gamification used in public displays, but the research in this special field of human-computer interaction is rather underexplored. Therefore, we tried to include ideas using elements of gamification from different fields and tried to adapt the approaches to our experiment.

Oliveira et al. [5] propose a way of making procedural tasks, meaning repetitive, monotonous tasks, more enjoyable for a user by using elements of gamification. In this specific case it is about maintenance work of airplane turbines. By offering a more fun way of work and giving rewards to the maintenance worker, motivation and therefore productivity can be improved, if applied correctly.

Raising interest in a public display while avoiding a superficial "feel" requires a balancing act of implementing intrinsic and extrinsic motivational factors. The behavioural effects of any "funware" introduced into a purely informative and academic ecosystem have hardly been studied. Some progress has been made which indicates that "to raise motivation and engagement, gamification should combine intrinsic with extrinsic motivation in a workplace environment" [1]. Our study revolves around introducing an intrinsic motivation to interact with the public display. While the main goal is to find out whether an element of gamification increases participation and engagement, it is also of interest to see if extrinsic motivational factors introduce themselves through factors such as word of mouth.

Zaharias et al. [7] present an experiment to compare traditional learning experiences with virtual learning via multi-touch screens. In their paper they set up an experiment for students who visited the Leventis Municipal Museum in Nicosia to learn about the "Walls of Nicosia." The first group learned about the topic in a traditional

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Figure 1: The smart screen that was used to conduct the experiment

way by having a guided tour through the museum. The second group learned about the Walls of Nicosia by interacting with the multi-touch application on the multi-touch table. In this experiment scientists found out that the learning effectiveness is nearly the same for both groups. However, they did notice that the group who learned in a traditional way was just passively listening to what the guide was telling them, while the virtual group was very enthusiastic and actively engaged in the whole process.

The paper "Gamification and serious games for personalized health" [4] describes how gaming in general has reached the mainstream media and is no longer a niche topic. Gamification elements have been successfully used in the military, by educators, the government and health providers. The approach of gamifying an activity appears to have no magic formula that guarantees success. In that regard it seemed related to our work as we had to choose one element of gamification that would lead to the highest increase in usage of the public display.

3 THE SETUP

For this experiment a public display in the building of the department of software technology of the University of the Bundeswehr in Munich was used. It displayed information about the department for software technology, such as its employees and current events, in form of bubbles floating across the screen. See Koch et al. [2] for more information.

The choice of a gamification element fell on a basketball hoop because it was deemed to be a highly recognizable part of a sport. To maximize the effect our gamification approach would have on passersby it had to be something easily distinguishable as new and irregular for the smart screen. In combination with the floating information bubbles on the display it indicates that the user should be able to "throw" a bubble into the basket. It serves as an ice breaker for passersby to interact with the feature and thereby engage with the smart screen.

To include elements of gamification a physics library for Java is utilized. A basketball hoop and the possibility to drag the bubbles and launch them into the basket were implemented. By doing so the user can make specific bubbles disappear until they float back on the screen from either the left or the right. By using this technology, the number of interactions with the screen is expected to increase. The experiment ran from the 22nd of May 2023 to the 9th of June 2023 which adds up to 19 days in total including the days cut off for the novelty effect. The total duration of three weeks was chosen to maximize the limited time this project had to conduct the

experiment. The removal of three days for the novelty effect thus leads to a total of 16 days with data collected. Less than the chosen duration would have delivered less significant data. This shorter time frame could possibly have led to a misleading evaluation of the gathered data.

4 DATA COLLECTION

The screen itself offers a functionality to log interactions. These interactions are then displayed in an online tool called "Elastic" which allows administrators to display and visualize statistics about certain events and activities [6].

The events important for this experiment are called "ACTIVITY:TOUCHPRESSED" and "ACTIVITY:DRAGGED" - i.e. direct user activity by touching the screen or by dragging an element displayed on the screen.

The experiment was installed for three weeks. As we only had a limited amount of time to plan and conduct this experiment the first three days were chosen to be removed from the data set to account for the novelty effect [3]. We also decided to remove weekends and holidays from the data set since the display is located in a workplace, where those days would not deliver any significant data. Furthermore we ignored significant spikes of activity in the data set, meaning days where at least 400 interactions took place. Those amounts of touching and dragging across the display were deemed unrealistic for normal usage and might have appeared due to demoing the display or due to technical problems with the log management. The collected data was then compared to data collected beforehand, when there was no experiment running. By doing so it is possible to evaluate whether the number of interactions has increased. To further validate the collected data, members of the department were questioned after the experiment. The questions were concerning the reason for interacting with the display, their opinion on the gamification element, whether the new function influenced the time they spent at the screen and recommendations for improvement.

5 ANALYSIS

The data collected during the experiment was compared to the data collected before the experiment, when the display was running in its normal mode (without gamification). It was collected from the installation of the display, meaning the 1st of March 2023 to the day before the experiment began, the 21st of May, which amounts to 82 days in total. The amount of days actually examined differed from this number because certain days were ignored. This sums up to 51 days being analysed before the experiment took place. During the experiment only 12 days delivered relevant data, including the 3 days calculated to account for the novelty effect. Since the interval before the experiment is far longer than the one the experiment was carried out, a daily average for the interactions had to be calculated for it to be comparable.

The data from the interaction logs have been analyzed to retrieve quantifiable results. That is in contrast to the survey which was analyzed to get a better understanding of the collected data, especially considering our secondary focus on the possibility of having extrinsic motivational factors being the driving force behind the increase of interaction with the display. The questions of the survey were not influenced by the collected data. In addition to that we wanted to find out whether spikes in usage of the public display could be traced back to a "word of mouth" event, in which multiple people influenced each other to test the new feature after talking about it. Therefore the goals of the survey were first applying certain qualities to our quantitative data collection approach such as the reason behind the increases in interactions and second addressing possible outliers within our data set.

The collected data from automatic log generation by the public display shows a significant increase in display interactions. The main points of focus lie on the touching of the display and the dragging of elements on the display. The first 3 days of the experiment were deemed as statistical outliers and counted towards the novelty effect affecting overall interactions with the smart screen. Thus the data from those days was removed from the overall evaluation to rely on a more realistic daily interaction pattern and to not overstate the impact of this experiment.

Even with the novelty effect having worn off the increases in the activity of touching the display on a daily average increased from 48.94 before the experiment to 68.5 for the duration of our experiment.

As a contrast the data following the end of our experiment averages out to a daily 89.58 for the next 12 days, from the 10th of June to the 6th of July without the previously mentioned deletion of specific data entries. While the statistical significance of an experiment of three weeks could be debated, the remarkable increase in display touches seems to indicate a new motivation to engage with the smart screen. Furthermore the more significant increase in interactions with the public display stems from the activity of dragging of elements on the screen. There the average amount of daily interactions increased from 12.94 to 21.58. After our implementation of the gamification element was removed, the amount of dragging on a daily average totalled 22.08. As our experiment was based on the dragging of elements the increase appears to be directly related to our implementation of the gamification element. Considering the low average amount of element dragging of 12.94 activities per day before the experiment, we affirm our assumption about introducing gamification on public displays to motivate passers-by to engage with smart screens to be confirmed.

In addition to the automatically gathered data from the smart screen we conducted an anonymous survey with 13 participants on the last day our experiment was active by asking people who work in close vicinity and pass the display on a daily basis. From 10:30am to 11:30am on Friday, the 9th of June we conducted the survey. To contextualize this interview study our group of participants would best be described by consisting of two professors, nine scientific staff and one administrative staff. To not falsify results we specifically interviewed the participants while not directly standing in front of the display but rather by engaging them on the floors and in their offices within the same building where the public display is placed. Only 4 out of 13 interviewees realized there was a change on the smart screen at all. The main reason of the low recognition and therefore participation with our gamification element appears to be of visual nature.

Our implementation of the basket in a black color was hardly visible on the display that is of low brightness itself. Moreover 8 of 13 interviewed persons mentioned the fact that they hardly interact

Activities	Before experiment - 51 days	During experiment total - 12 days	During experiment - first 3 days	During experiment - from day 4
"TOUCHPRESSED"	2496	822	228	594
"TOUCHPRESSED" daily average	48,94	68,5	76	66
"DRAGGED"	660	259	62	197
"DRAGGED" daily average	12,94	21,58	20,67	21,89
Total value of interactions (daily average)	3156 (61,88)	1081 (90,08)	290 (96,67)	791 (87,89)

Table 1: Comparison of collected data

with the display at all as they see no reason to do so. Which, based on the type of information being conveyed on the smart screen, may be interpreted as the information having gone "stale" after a few months of operation of barely changing output and visualization. The intrinsic motivation to use the new element and thus increase overall engagement with the display has been hampered by a poor visualization choice. However four out of four people that saw the change have engaged with it. In addition to that an extrinsic motivation seemed to have been a factor as well as all four persons that saw and tried the element also talked to colleagues about it. The evaluation of the interview also showed that the average amount of interactions with the element was two to five per person. There was no reduction in the perception of information based on the answers of the interview.

Our assumption for the changes of the daily average of touches and dragging from before the experiment, during the experiment and after the experiment is that our experiment may have increased the awareness of the public display in question and the possibility of changes on the screen. While those 8 of 13 interviewed people mentioned that they barely interact with the display on a daily basis our interview could have led to a change in this regard. Furthermore we assume that the possibly increased awareness may have caused more discussions in the work place about the smart screen and the fact it is being experimented with.

6 SUMMARY AND OUTLOOK

We conducted our evaluation by comparing automatically gathered data from logs that our smart screen provides and interviewing people that work in the same building in which the public display is set up. Our experiment, with three days removed to reduce the novelty effect, showed remarkable improvements in overall interaction with the smart screen of 34.86% more touches and 69.17% more dragging of elements on a daily average.

The goal to provide a reason to engage with the public display was reached. The comparison between gathered data from before our experiment and during the experiment shows an overall increase in average daily interactions in form of display touches and dragging of elements of 42.03%. In addition to that 13 people were interviewed that work in close proximity to the public display and go past it at least once daily. The answers to our questions however revealed a flaw in the visualization of our gamification element as only 4 out of 13 interviewees even recognized a change on the display. All those that realized something new had been added interacted with it and all four people talked about it with colleagues. In conclusion the intrinsic and extrinsic motivational factors in our relatively short and basic experiment showed the willingness and interest to engage with such elements and suggests that gamification could be a driving factor for improving the engagement with public displays.

The outlook on the future of improving the engagement with smart screens in an academic setting could involve a more sophisticated and thought out approach to gamification elements. Moreover the currently stale and static environment of the public display and barely any changes in the past few months brought up many suggestions for improvements by interviewees. Changes such as a more intuitive design, more and different, specifically directly relevant information like the availability of electric scooters in the close vicinity were recommended.

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APPENDIX - INTERVIEW QUESTIONS

(1) Did you notice any changes on the semi-public display?
(2) Have you tried to interact with the new element?
(3) Did you interact with the display more often in total?
(4) Would you rate this gamification element more negatively or positively?
(5) Did you talk to colleagues about this change?
    - Have you been told about it by colleagues?
    - Have you told colleagues about it?
(6) Did you still perceive the information displayed while interacting with it?
    - Because of it
    - Neutral
    - Still although
    - Less or not at all

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