Social Acceptance of Nomadic Virtual Reality

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ABSTRACT

The following paper provides an overview on the reviewed social acceptance of nomadic virtual reality devices in a university environment. Within the scope of a field study data regarding fears and desires was collected via a questionnaire and the results of its examination the so-called WEAR scale. Three different cases (Smartphone, Oculus Rift without gesture control, Oculus Rift with gesture control) have been reviewed. In this case the smartphone served as a comparative. Considered given is the fact that a smartphone is already accepted as an everyday object because of its widespread use in society. An actor and an actress that both created situations with using all of the three cases, became rated by overleaf passerbys based on above-mentioned scale in form of questionnaires. The evaluation shows that virtual reality devices in general are accepted. A difference can be found in the contemplation between smartphone and the usage of a VR device in combination with performing gestures with a VR controller. It shows that gesture control in this context is still less familiar and something that makes people feel more uncomfortable compared to the handling of ordinary wearables.

CCS CONCEPTS

• **Computer systems organization** → **Embedded systems**; *Redundancy*; Robotics; • **Networks** → Network reliability.

KEYWORDS

virtual reality, social acceptance, nomadic, field study

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1 INTRODUCTION

New presentation forms such as VR experience are a growing trend as alternatives to conventional displays in different end devices e.g. tablets or mobile phones. Although the latter can double as a VR-Device with extra parts to hold it in place etc.. This was disregarded here due to the major difference in looks and usage to a mobile phones common usage. These devices are always improving in size, functionality, and appearance, to support the mobility of todays life and constant availability. Due to this development process never standing still VR devices might be prospectively used in the same way we already use mobile phones today, at any time and everywhere. To achieve a broad utilization, it is not only important to focus on the unique user and establish hardware with high usability for the users themselves, but also something that fits all the tangentially involved people and their needs for well-being, comfort, and privacy. The fear of interfering with your own privacy and also data theft makes the question about the current state of social acceptance of VR devices in public spaces an important issue to examine. Before spreading out this type of gear and gaining the possibility of high sales output it is essential to find out if those devices are already accepted by society and what impact they have on society.

Several researchers already tried to investigate this potential issue regarding the social acceptance. Under laboratory conditions they tried to find out more about their test persons opinions, feelings, and reactions about being confronted with pictures and videos of users wearing VR devices in public spaces [4]. By only looking at pictures, people will always keep a certain emotional distance to the context shown. The spontaneous and direct confrontation with a previously completely unexpected situation in daily life might change the view of things and the way people accept certain circumstances under different conditions. VR devices might be fully accepted by society, but it can also

be, that they evoke discomfort because people are not used to not seeing each other's eyes while passing by, or sitting next to them on a park bench. Although Sunglasses act similar, todays VR glasses still cover almost half of the wearers face which is why it cannot be generalized and needs to be examined more accurately. In this paper, we examined the topic of social acceptance of VR devices using a field study to achieve a high external validity.

2 RELATED WORK

Previous work already dealt with social acceptance and mobile devices. Gesture control has also been investigated. In the following, three papers will be analyzed that already tried to gather information about how devices of that kind are accepted in a social context.

One work dealing with gesture control and mobile devices and their social acceptance is a work by J. Rico and S. Brewster [2]. They mainly observed the extent to which social acceptance can be measured. They found out that the social acceptance of technology use depends on embarrassment or politeness and a combination of factors ranging from appearance and social status to culture. It was also stressed that gesture-based user interfaces face acceptance problems as they require users to evaluate a range of new actions. This would require the user to define new standards for social acceptance. In a survey, they found that location and audience have a significant impact on whether a user wants to perform gestures. They conclude that users would be more likely to use gesture-controlled mobile devices at home. Two other areas that were defined were the semi-public space, i.e. with a restricted but not necessarily familiar audience, and the public space, i.e. the sidewalk. They then carried out another experiment to see how participants behave when they make gestures on a busy street.

In this context another paper criticized that there was no robust model to explain the underlying factors why a device was socially acceptable [3]. Therefore, the devices were regarded as social objects and it was examined whether the stereotypical content model (SCM) could be applied to them. The focus of this work was whether mobile applications themselves are stereotypically perceived. This has been investigated in two studies. In the first study it was shown that different devices have a different impact on the person wearing them. LED glasses, for example, were reviewed negatively. In the work, this was associated with low warmth and low competence. Medical devices, on the other hand, were rated more positively or warmer. VR headsets were rated well in terms of being more competitive, but they overall were received as contemptuous. It was also found that devices systematically trigger emotions when people use them. This may allow the SCM to explain the results of older work, as the social acceptance of highly competitive devices such as smart glasses depends on the stereotype of the person wearing the device. Here the comparison was made between older people wearing a VR headset and other people. A weaker attraction in terms of the SCM was also measured for VR glasses than for other devices. This revealed that the SCM can be used to measure the social acceptance of a mobile device. These assumptions were supported in a second study. In this study no images of human stereotypes were used and since it showed no significant difference to the stereotype device combinations of the first study, it was assumed that a possible effect of human stereotype images is negligible. In addition, it was supported once again that VR glasses are assigned a certain competence and that they are perceived more competitively.

Schwind et. al. investigated the acceptance of VR glasses [4]. It was assumed that mobile VR glasses are less frequently used in public because they are not socially accepted. To investigate this, an online experiment was conducted to investigate the acceptance of VR glasses in six different contexts. Prior work worked out that it depends on the environment the device is used in. It seems to be more acceptable to use VR glasses in bed, a train or the subway. In public places, on the other hand, or when the user is supposed to interact with a person in the environment, they are less acceptable. In the online experiment, the test person was shown pictures of people wearing VR glasses. They were asked to answer a number of questions. In addition, different places and persons of different sexes were shown with VR glasses. Subsequently, the subjects were asked to assign one of eight statements, which stood for Awkward, Normal, Appropriate, Rude, Uncomfortable, Distracting, Useful and Unnecessary, to the respective images.

If a gesture is performed in a public place, this would be seen as less appropriate. One should also assume that more inappropriate the usage of VR glasses in a certain context is the less comfortable people feel while performing gestures with this type of device. The SCM can be used as a classification. The VR glasses are assigned competence but also a certain coolness, i.e. separation.

3 STUDY: ACCEPTANCE OF NOMADIC VIRTUAL REALITY

The specific goal of this study was to examine more about the current state of social acceptance in the open field by confronting unprepared bystanders with this topic in different real-life scenarios. This was done with the help of a field study because of our research question if VR devices will be accepted by society in public spaces due to direct confrontation and missing emotional distances.

Study Design

The design of the study is a two-factorial within-subject design and conducted with the independent variable CASE which included three different peculiarities (Using a smartphone, wearing VR glasses without performing gestures and wearing VR glasses with performing gestures). Since VR devices often rely on some level of gestures for interaction, gesture control of connected controllers is essential for the use of most common VR devices. This is due to a lack of other controllers apart from the direction of the users gaze. This includes the Oculus Rift which is used to perform this study. Since performing those gestures might have a big impact on the acceptance, this also was an important issue to test to find out more about the general acceptance and how people react when being confronted with this situation. For the investigation, it is important to choose an experimental group with almost equal gender distribution in order to exclude potential gender effects. For the same reason two actors were asked to play the part of the devices wearer, one male and one female. The questionnaire used was the 14 item WEAR-Scale [1], a questionnaire to quantify how acceptable a device is with regard to e.g. aesthetic, personal attitude and the wearers impression on the participant. We used this scale with a 5-point Likert scale translated for ease of use and the avoidance of language barriers in a german university setting (translations: strongly agree="sehr"=5, somewhat agree="ziemlich"=4, neither agree nor disagree="mittel"=3, hardly agree="kaum"=2, don't agree="gar nicht"=1) instead of the, for this questionnaire normal 6-point Likert scale, due to an oversight.

Conditions

In earlier research pictures and videoclips have been used for probing [4]. Since we wanted to extend those results and test their external validity we used confrontations in real life situations in the open field rather than representations of it.

We tested the glasses in combination with controllers and gesture controls which is our stimulus. In this study we combined those three peculiarities to receive as much information as possible about peoples reactions on different types of situations.

Survey Procedure

After handing out the informed consent, the randomly chosen participants answered a short demographic questionaire in which we request allegations to gender and age. Afterwards we handed out another Questionaire to measure the acceptability of wearable devices [1]. After going over the questionnaire with the participants each of them received a little thank-you gift.

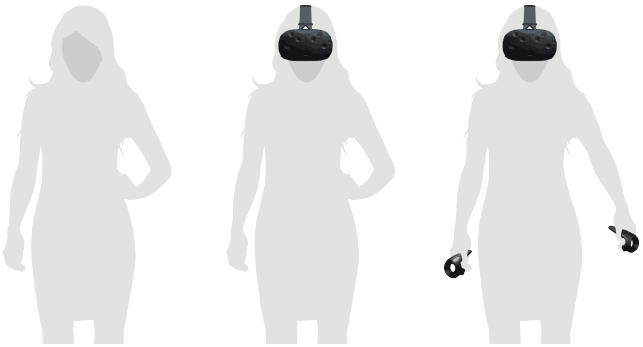

Figure 1: Three different female stimuli

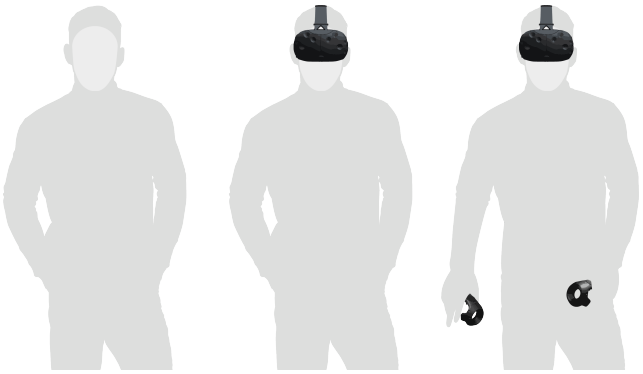

Figure 2: Three different male stimuli

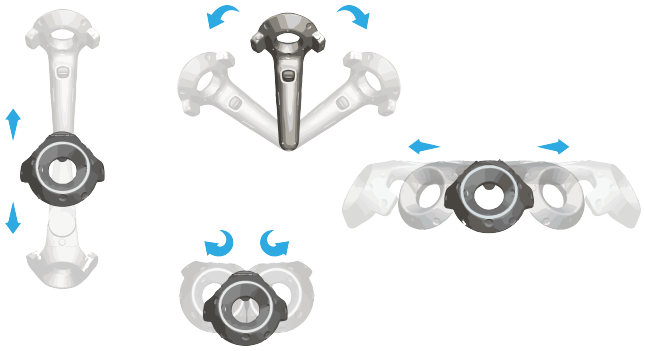

Figure 3: Used VR gestures

Participants

We examine this Acceptance Rating by collecting real life reactions and the opinions. For this type of field study it was essential to acquire unpremeditated pedestrians in their daily life to receive an unbiased output. We acquired 60 Participants (33 female, 27 male) for the study. Their age ranged from 19 to 28 (M = 22.65, SD = 2.92).

4 RESULTS

An analysis of variance (ANOVA) was conducted to determine the effects of the CASE (mobile phone as control, VR Glasses no gestures, VR-Glasses with gestures) on the ACCEPTABILITY. Statistically significant effects of CASE on DESIRES, a part of the WEAR-Scales overall metric, $F = 5.714$, $p < 0.00561$, were found. In contrast effects of CASE neither on FEAR nor WEAR revealed any significant results (FEAR: $F = 0.341$, $p > 0.712$; WEAR: $F = 3.048$, $p > 0.0557$). The effects of the actors gender has also been analyzed and showed no statistically significant effects either (DESIRES Actor: $F = 1.525$, $p > 0.22221$; FEAR Actor: $F = 1.869$, $p > 0.177$; WEAR Actor: $F = 2.917$, $p > 0.0934$). Due to this t-tests were conducted in pairs between the three CASEs, showing a significant difference between the acceptance of mobile phones and VR-Glasses with the usage of gestures, $t = -3.3343$, $df = 36.391$, p-value = 0,001976. Between wearing a mobile phone and wearing VR glasses the results where: $t = 0.7791$, $df = 36.82$, p-value = 0.4409. The results of the t-test between wearing VR glasses and wearing VR glasses while making gestures are: $t = -2.3739$, $df = 37.96$, p-value = 0.02276. Solely on DESIRES the CASEs have a significant effect. Significant differences in ACCEPTANCE only exist between smartphone and the wearing of VR glasses while performing gestures.

5 MAPPING AND MODEL

Using the WEAR scale, data to research acceptance on different wearables can be determined by their relative locations on a 2D map with the dimensions DESIRE and FEAR.

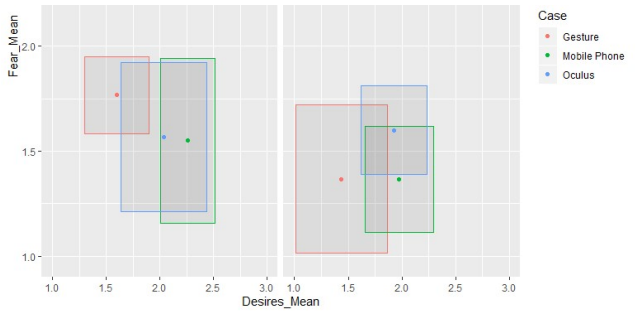

Figure 4: Desire-Fear-Plot by CASE and GENDER, Male actors results on the left, female actress' resulrs on the right. The colored boxes represent the three different cases (mobile phone as control, VR-Glasses no gestures, VR-Glasses with gestures). The dot in the middle of each square locates the mean of the particular case. The box itself shows the horizontal (DESIRES) and vertical (FEARS) variance of the measurements.

As the plot shows the genders show only minimal differences in the acceptance of the three CASEs they tested. Looking at the x-axis you might realize that both the means and the variances differ only minimally. Only when looking at the y-axis with represents the FEARs, you can see strong distinctions between the two sexes regarding using the Oculus Rift with gestures and without.

Figure 5: Female actress - Oculus Rift - without gestures

As long as our female actress only wore the VR glasses without performing any gesture the interviewees were quite agreed about their FEARs. In contrast the results for the male actor were exactly the opposite. This might have psychological and social reasons. Even if this is still more of a cliché nowadays and no longer corresponds to the truth, men of known dimensions are still considered to be technically more affine than women. This could explain why the variance of the acceptance of using gestures with VR devices in public spaces with a male actor less scatters. Overall the results show that VR-Glasses are, when not gesture controlled, comparable to a mobile phone in social acceptability, leading us to thinking that should they be more prevalent atleast in this setting people would get used to seeing them, possibly increasing the social acceptability further.

Considering only the case of wearing, the differences could be explained by the fact that men are quickly considered to be

Figure 6: Male actor - Oculus Rift - with gestures

a freak when using uknown and technically looking objects in an unusual context whereas the observer might pay more attention to looks in women, which could simply distract from such details like VR glasses.

6 DISCUSSION

The results show only that VR-GLASSES WITH PERFORMING GESTURES reduces the desire of bystanders to be like the user compared to the smartphone using actor, which leads us to the conclusion that there is less bias towards VR-Glasses than one might casually suspect, at least measurably in a University environment. The significance of these results can be debatable due to the lack of personal background in the form of major or occupation in this study, in our opinion it is still a proof of concept, showing that in a neutral public to semi-public environment VR-Glasses can be accepted if no social interaction is expected of the user. The lack of other statistically significant results supports that, though a bigger sample size could reveal different results, if so it stands to reason that the differences in the acceptability of a CASE to the baseline grow more distinct and pronounced, especially with a higher age range, as this study had a rather limited reach there with the ages between 19 and 28. Different levels of education and age groups, as well as differences in experimental setup in terms of location and time, have a major impact on the outcome of this or similar studies, be it in the field or in a laboratory, so repeats of this study in a different setting might lead to completely different results. Specifically the performing of gestures warrants extra attention, as this lead to the only significant difference in our study, though not for reasons of social anxiety or simply accidents that could happen when moving your arms and hands in a public environment without seeing, but more from the concept of DESIRE, which leads us to believe that it is the self-image of the people that would play the biggest role in this regard.

7 FUTURE WORK

Any future work building on this should prevent the mistakes that were made here first and foremost, the lack of a background in the form or occupation or major in case of students and the proper scaling for the questionnaire just to be comparable with other results delivered by this scale. Past that, a change of setting or variables could deliver a lot more interesting information, be it in a more social setting like a restaurant or cafe, or a more cramped space like most public transport which are both examples of places VR-Devices could get more and more prevalent given time and social acceptance. Even a repeat of this study in a setting thats not a university could warrant very different results, though we were unable to do that due to issues with permissions a mall would be probably the best space to get sample of most social groups. [1]

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List of Figures

[1] GitHub Repository with all data for any future work or more details: https://github.com/tomNedorost/MMI

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