An ambient communication system that sensitizes for the own loudness in working places

Blank, C.
University of Applied Sciences Osnabrück 49076 Osnabrück, Germany
Christina.Blank@hs-osnabrueck.de

Gimmel, E.
University of Applied Sciences Osnabrück 49076 Osnabrück, Germany
Elena.Gimmel@hs-osnabrueck.de

Winter, S.
University of Applied Sciences Osnabrück 49076 Osnabrück, Germany
Sebastian.Winter.1@hs-osnabrueck.de

Rittmeister, N.
University of Applied Sciences Osnabrück 49076 Osnabrück, Germany
Neele.Rittmeister@hs-osnabrueck.de

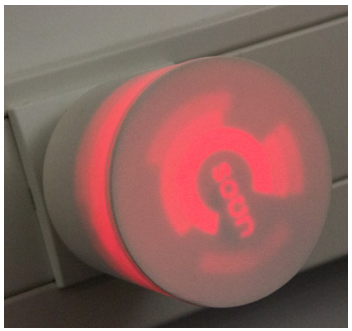
Abstract
Today's office spaces tend to change into a more open working environment to increase collaborations between co-workers. Removing visual barriers to improve communication is also causing acoustic problems making noise pollution a growing problem.
To address this problem, we introduce "Sone", an ambient communication system that aims to reduce noise pollution by controlling the Wi-Fi signal.
Sone is capable of either strengthening or blocking the signal based on the noise that is recorded.
Our intention is to sensitize people towards their own volume at work by affecting something important as the internet access.

Author Keywords
ambient information; ambient communication; ambient interaction; ambient design; public interaction; social design; social behavior; learn from mistakes; open plan office; peer pressure; Environmental sensitivity

ACM Classification Keywords
H.5: Information interfaces and presentation (e.g., HCI): H.5.2. User Interfaces; H.5.m. Miscellaneous

Figure 1: Finished prototype

Figure 2: Normal state



Introduction

"Sone" is an ambient information system that addresses the problem of noise pollution in offices. Noise can be one of the greatest stress factors at work. This permanent stress can also lead to health consequences such as sleep deficit or lack of concentration, … [1]. A major distraction is caused by speech, having a negative effect on the ability to remember and overall performance [3]. There are already various approaches to resolve this problem. A common reaction is to start listening to music in attempted to block out any noise with their headphones [8/9]. Another frequent solution is the use of partition walls to dampen the sound of others [13]. A relatively new approach is sound masking, which counteracts the noise with an unobtrusive background sound to reduce the intelligibility of human speech [4]. "Sone" aims to make people more aware of their own loudness at work and presents a long term solution. Considering that "Sone" teaches the workers to be more aware of the problem and not only scratch the surface. "Sone" is installed at each workstation. Metaphorically the boisterous person is suppressing the digital waves of the Wi-Fi with his analog sound waves. The importance of a stable Wi-Fi Connection is necessary and indispensable at work [5]. By controlling the Signal, it is used as a leverage. Under quiet conditions "Sone" glows white and amplifies the Wi-Fi Signal, as long as the sound level is below the threshold. As soon as the threshold is exceeded, the object closest to the source of interference starts to glow red and sends a disconnect signal to all connected devices. By also changing its color "Sone" visually indicates to the rest of the group who's responsible for the interference. By pointing out his mistake, the boisterous person is made aware of his negligence. In addition, the awareness of one's own loudness is increased by the social pressure caused by the group [6].

Setting

Until recently, office buildings were designed to create a quiet working atmosphere. This was done by installing sound absorbers or by installing partition walls. In modern offices, the visual barriers are reduced to create more open workplaces [3]. This is intended to improve the communication and collaboration between the co-workers [10]. Through the visual connection, open spaces encourage more communication and interaction between various people. However, these open offices cannot ensure the same level of privacy of conversations or important information. At the same time noise is not so well damped [10]. The trend towards more open, larger office spaces is a sign of the large office spaces, the co-worker shares both the office is a social environment in which various psychological factors intertwine. Since Wi-Fi is very important for the whole team to accomplish the work, Wi-Fi disconnection can cause troubles for working people. This increases social pressure created by the group. [7]

Problem

In former times people tended to have their own working space in separate rooms [10]. It used to be that everyone had their own workspace in separate rooms. Nowadays, there is an upcoming trend that is increasingly towards more open, larger offices and shared workplaces. This creates a modern workplace that is more flexible and communicative. One negative side effect when using large spaces by many people is

an increased noise pollution [8]. Being undisturbed is an important requirement for productive work. Employees in public office rooms are often confused by noise, by telephones, conversations between colleagues, co-workers or other ambient noise. Thus, the concentration in open office spaces can be impaired by increased communication between the other employees [14]. In addition to reduced productivity and impaired learning ability, intense noise can even have a lasting impact on physical health. Among others this can be expressed in hearing loss, cardiovascular diseases or sleep disruption [1].

Description & Solution

Description

As outlined above the problem noise pollution has many consequences. Especially the changing workplace situation calls for a long-lasting solution that tries to reduce the causes of the volume. The most common cause is that by concentrating on secondary activities or content of a conversation, the perception of one's own volume is blurred. In order to raise this awareness for our own volume level and educate the people in the long term to a quieter behavior our ambient information system should be used. Ambient information systems transfer informations from the digital world to the physical environment. Often through a subtle change of light, color, temperature or movement. There are different notification levels defined. Our system works on two levels. The red light tries to make aware of the sound pollution. But the device also interrupts the people in using the internet and practicing their tasks through disconnecting the Wi-Fi [2].

Solution

"Sone" directly solves this problem at the root to fix it in the long term. In doing so, the advantages of an open plan office will be maintained. The learning effect is to ensure the long-term success, which motivates the employees to behave quietly. To ensure that all employees are treated equally, everyone is being monitored. Wi-Fi serves as a suitable leverage as it is indispensable in today's office day. The blocking of the Wi-Fi signal is only one part of the punishment. By drawing attention to the cause with the help of a visual feedback, the boisterous person also attracts the annoyance of the other employees.

“Peer pressure is the moral pressure of being judged by one's peers.” [12]

This social pressure is supposed to make him aware of the consequences of his behavior. “Sone” even punishes those who work quietly but also helps them to quickly resolve the disturbance. Therefore “Sone” helps those employees who would have otherwise avoided to address the problem.

“57% of respondents do nothing to address noise problems in the workplace.” [11]

Development

“Sone” can easily be setup around the office, by simply plugging it directly into a power socket. After plugging it in, the device will start to glow white, which indicates that it is ready for use. The amount of devices needed, is based on the range of the microphone. The unit consists of a microcontroller, two Wi-Fi modules, a microphone and a LED strip. The microcontroller is monitoring the sound level. Based on the sound intensity the controller changes the color of the LED

strip and switches between the two Wi-Fi modules. The first Wi-Fi module is connected to the office Wi-Fi and is working as a repeater to strengthen the signal. The second module on the other hand is disconnecting all devices from the Wi-Fi when power on. Visually the device will glow red as soon as the sound intensity is above the threshold. By plugging it directly to a socket the device is not relying on a battery.

Expected Outcomes

"Sone" addresses the problem of noise pollution and aims to provide a long term solution. By strengthening the Wi-Fi Signal, rewarding those who work quietly. On the other hand, it punishes not only those who cause noise, but everyone in the office. With the addition of highlighting the boisterous person we aim to make him more aware of his misconduct. We hope to achieve this goal by educating the co-workers to be more judicious towards one another. By drawing more attention to this matter we hope to create a more sustainable work environment. Without testing this concept there is no certainty that it is going to perform the way we indent it to. There is a chance that blocking the Wi-Fi signal won't be noticed. If they don't need to access anything online, they might not be affected by it. There is also the possibility of "Sone" being abused to intentionally block the internet access. There is also no certainty of how the other co-workers are going to react to the person who caused the interference. This might lead to a conflict between co-workers making the working environment more hostile. The constant monitoring and the fear of being punished, may also increase the stress on the employees.

Conclusion

Taking into account different psychological and design aspects, we developed an ambient communication system, which aims to attract the attention of people at different levels. In order to present the relevance of our concept, we looked at current publications on the growing problem of noise pollution in modern office spaces. We discovered that there was a need for such a solution that would not interfere with the concept of an open space.

To find out whether our concept sensitizes people to their own volume and influences their own behavior in the long term, we looked at publications about peer pressure. Although none of the studies could confirm our thesis, it indicates that the result of peer pressure combined with monitoring could achieve the desired effect. We hope to test our ambiance information system in an appropriate usage scenario, to address and improve existing deficits in the system.

References

1. Lisa Goines, Louis Hagler. 2007.Noise Pollution: A Modern Plague.Southern Medical Journal 2007.
2. Tomitsch M, Kappel K, Lehner A, Grechenig, T. 2007.Towards a Taxonomy for Ambient Information Systems.
3. Stephen A Stansfeld, Mark P Matheson.2003. Noise pollution: non-auditory effects on health.British Medical Bulletin, Volume 68, Issue 1, 1.
4. Goubran Rafik, Botros Radamis.2003. Adaptive sound masking system and method. http://www.freepatentsonline.com/y2003/0103632.html
5. Murugan Anandarajan, Thompson S H Teo, Claire A Simmers.2015.The Internet and Workplace Transformation

6. Corgnet B, Hernán-González R, Rassenti S.2015. Peer Pressure and Moral Hazard in Teams: Experimental Evidence. Review of Behavioral Economics
7. Aram Seddigh, Cecilia Stenfors, Erik Berntsson, Rasmus Bååth, Sverker Sikstrom, Hugo Westerlund.2015.The association between office design and performance on demanding cognitive tasks. Journal of Environmental Psychology Volume 42, June 2015, Pages 172-181
8. Herbig B, Schneider A, Nowak D.2016.Does office space occupation matter? The role of the number of persons per enclosed office space, psychosocial work characteristics, and environmental satisfaction in the physical and mental health of employees. Wiley Subscription Services, Inc.
9. Jahncke Helenaa, Björkeholm Patrikb,MarshJohn E.c, Odelius Johand, Sörqvist Patrike.2016.Office noise: Can headphones and masking sound attenuate distraction by background speech?. Work, vol. 55, no. 3, pp. 505-513, 2016
10. Hesedahl Jeanette, Gray Kathleen.2016.Evolution of Office Acoustics. INTER-NOISE and NOISE-CON Congress and Conference Proceedings, NoiseCon16, Providence, Rhode Island, pages 1-871, pp. 491-494(4)
11. https://de.scribd.com/document/142926011/Office-Acoustics-Infographic
12. Eugene Kandel, Edward P Lazear.1992. Peer Pressure and Partnerships. Journal of Political Economy Vol. 100, No. 4 (Aug., 1992), pp. 801-817
13. Julie Wagner, Dan Watch.2017.Innovation Spaces: The New Design of Work.
14. Iris De Been, Marion Beijer.2014.The influence of office type on satisfaction and perceived productivity support.Journal of Facilities Management, Vol. 12 Issue: 2, pp.142-157,