Electrosmog Visualization through Augmented Blurry Vision

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ABSTRACT
Electrosmog is the electromagnetic radiation emitted from wireless technology such as Wi-Fi hotspots or cellular towers, and poses potential hazard to human. Electrosmog is invisible, and we rely on detectors which show level of electrosmog in a abstract warning such as numbers. Our system is able to detect electrosmog level from number of Wi-Fi networks, connected cellular towers and strengths, and show in an intuitive representation by blurring the vision of the users wearing a Head-Mounted Display (HMD). The HMD displays in real-time the users' augmented surrounding environment with blurriness, as though the electrosmog actually clouds the environment. For demonstration, participants can walk in a video-see-through HMD and observe vision gradually blurred while approaching our prepared dense wireless network.

Categories and Subject Descriptors
H.5.1 [**Multimedia Information Systems**]: Artificial, augmented, and virtual realities. K.4.1 [**Public Policy Issues**]: Human safety.

Keywords
Visual Augmentation; Electrosmog Detection; Wearable Augmentation; Visualizing Unseen

1. INTRODUCTION
Wireless technology has progressed over the years since the debut of Internet. Nowadays, we are always "connected", due to the wide range of devices (mobile phones, tablets) and communication technology (GSM, UMTS, LTE, Wi-Fi) available. However, with this convenience of wide coverage of networks comes a potential hazard, which is the electromagnetic radiation that devices in the networks emit in order for communication, commonly called electrosmog. These radiations are invisible to the eyes of the human and are therefore frequently neglected by general public.

Invisible electromagnetic radiations are regulated by international standards [3] in order to limit human exposure. Manufacturers of wireless devices also have to conform to standards that limit the specific absorption rate (SAR), defined as the measurement of energy absorbed by human tissue. However, we should still be cautious as we are more and more exposed to the growing dense network of wireless antennas and access points. Efforts of reducing SAR by using resistive sheets [1], configuring networks with cooperative meta-heuristics [2], and selecting optimal wireless connections [7] have been investigated. However, there lacks an intuitive approach to raise an everyday user's inherent awareness to electrosmog, so that we may encourage spending more effort targeting this issue.

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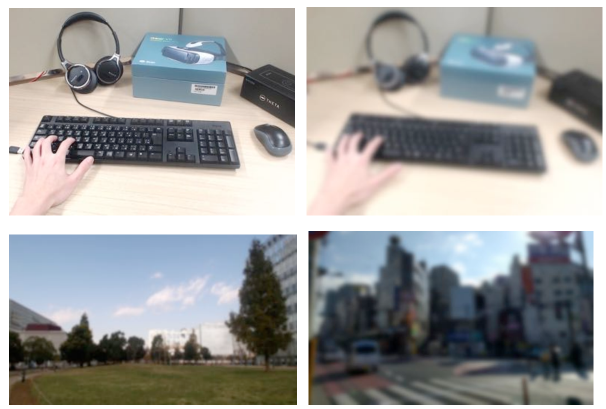

Figure 1. Visualizing detected electrosmog level by blurring HMD vision: normal (left), electrosmog (right), rural park appears less blurred than street.

Our vision, therefore, is to augment human's perception of invisible radiation with Augmented Reality to raise awareness of dense network. We suggest visualizing the "unseen" electrosmog surrounding an everyday user's environment by augmenting a user's vision. We chose visual as our modality of augmented feedback as it is often regarded as the most dominant sense [5]. Also, Rather than showing detected electrosmog level as abstract numbers or charts, we choose to blur a user's vision as though the radiation actually "pollutes" the environment (Figure 1), as we are accustomed, unfortunately, to see in air pollutions. Consequences of blurring a person's vision has been investigated in driving situations where downgrading of performance is observed [4]. We believe our visualization method, which is intuitively related to how air pollution is visualized, can stimulate the subliminal tension of humans towards hazardous environment, as subliminal visual stimulations have been observed to induce anxiety [6].

2. DESIGN AND IMPLEMENTATION
Our system can be divided into two modules (Figure 2): a module which detects potential electrosmog level, and a module which visualize the detection intuitively by blurring a user's vision.

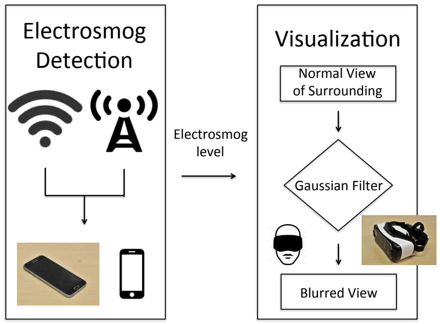

Figure 2. System Structure.

2.1. Electrosmog Detection

There are a wide variety of wireless network technologies that may be sources of electromagnetic radiation, ranging from commonly used Wi-Fi, to cellular networks such as UMTS and LTE, to close range Bluetooth [7]. While commercial handheld electrosmog detectors are available, since our focus is augmenting everyday user's perception of electrosmog, we choose the smartphone, which most public has prolonged exposure to, as the detection device.

Wireless networks available to common mobile phones are Wi-Fi, cellular networks (2G/3G/4G), and Bluetooth. Bluetooth emits comparatively less radiation and is also used less frequently; therefore we omit Bluetooth detection. Wi-Fi networks are a concern since there are an extensive number of access points in our work place and public venue. We devised an Android application that continuously detects the number of Wi-Fi access points and associated signal strength (RSSI) using Android SDK. Since access points emit electrosmog regardless of actual connection from the smartphone, a higher number of access points and sum of RSSI would mean a higher exposure to radiation for the user in the envrionment. Similarly, for cellular networks we detect the RSSI of nearby cell towers. However, in this case we consider the attenuation of signal caused by distance to the connected cell tower, as indicated by RSSI. A weaker signal from the connected cell tower would cause the smartphone to emit more power in order to transmission, which increase radiation from the phone [7]. We calculate attenuation factors from detectable range of RSSI from Android.

2.2. Visualization

We opt for an augmented visualization of electrosmog directly to the user's view by blurring the user's vision in real time, as though the electrosmog actually "clouds" the environment. To actually augment the user's whole vision, a video-see-through HMD is required. Recently a number of smartphone converted video-see-through HMDs are available as well as normal HMD, converted to video-see-through by integrating cameras. Smartphone headsets suit our system well since our concept is the lightweight usage of using smartphone to detect and display. Since the focus of our work is on detection and blurring user view caused by electrosmog, we neglect the slight viewpoint shift and narrow field of view of smartphone headsets; however, our system can be easily applied to a camera video-see-through HMD.

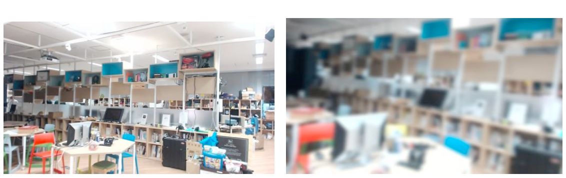

Figure 3. HMD Vision gradually blurred as approaching dense wireless network.

Users are able to view their surroundings by wearing HMD. To blur the images that users see, we use a Gaussian filter to smooth the camera frames. By changing the kernel coefficient of the Gaussian filter, we can change the degree of blurriness, which intuitively reflects how much electrosmog is present, as calculated from detection module. For example, the view in an office would be much blurrier than that in a rural area (Figure 1). We arbitrary choose an electrosmog level with few numbers of Wi-Fi access points and cell tower as reference level 0 of electrosmog severity

3. DEMONSTRATION

Participants will wear video-see-through HMDs and will be able to explore around with clear vision. We will provide hidden dense wireless networks. As participants seek and approach the network, their vision will be gradually blurred (Figure 3).

4. CONCLUSION

We present a demonstration which augments user's perception of invisible electrosmog. Our system has two main features: 1) we devise a method for detecting relative electrosmog level using available mobile phone, and 2) we suggest a intuitive method for augmenting a user's perception of electrosmog by blurring user's view of environment. Since we only detect electrosmog levels from wireless networks of a smartphone, potential future work include targeting more sources of electrosmog such as wireless baby monitors that could be of even more hazardous impact.

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