Habilyzer: A User-Driven Open-Ended Sensor Kit for Office Workers

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ABSTRACT

Office work presents health and wellbeing challenges, triggered by working habits or environmental factors. While technological interventions gain popularity in the workplace, they often fall short of acknowledging personal needs. Building on approaches from personal informatics, we present our vision on the use of user-driven, situated sensor probes in an office context and how the community might deal with complex yet timely questions around the use of data to empower people in becoming explorers of their own habits and experiences. We demonstrate Habilyzer, an open-ended sensor toolkit for office workers, which enables user-driven explorations in self-tracking their work routines. This research contributes an alternative approach to improving working habits and vitality in the workplace, moving from solution-oriented technologies to inquiry-enabling tools. Through this demonstration, we also aim to trigger discussions on the use of sensors and data in the office context, in the light of privacy, consent and data ownership.

CCS CONCEPTS

• **Human-centered computing**; • **Human computer interaction (HCI); Interaction techniques.**;

KEYWORDS

Office work, Working habits, Sensing technology, Data-enabled design, Inquiry-enabling tools

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1 INTRODUCTION

A myriad of sensor technologies surrounds us in our work environment, collecting data about building performance, human activity, and workers' wellbeing. The majority of design work in this area aims to find novel ways to improve healthy behaviors, productivity or reduce stress through the use of data [3]. Most systems that use automated environmental sensors (e.g., occupancy, climate control) offer limited control to end-users on how these sensing systems are placed, used, or leveraged. Automated data collection through environmental sensors reduces the burden on the user but limits the types of data that can be collected and how much control users have over that data.

Workplace sensor systems data is often translated into actionable interventions for end-users. Over the years, the HCI community has explored an array of workplace health promotion designs, ranging from break-taking interventions [10], integrated health recommendations delivery systems [4], or walking meeting facilities [5]. Many of these interventions rely on researcher-curated or data-driven health promotion messages [2]. As everyday (health-related) behaviors are complex and different for every person, these messages are often either too generic ("take the stairs") [4] or do not match the context of the user [11]. Following Sunstein (2013) this type of prescriptivist approach assumes heterogeneity in a population, or that the researcher can sufficiently personalize to individual situations [12]. In the case of uncontrolled and complex contexts such as everyday office life, a lot of richness is not encapsulated in the data available to the remote researcher.

Self-tracking offers a way for people to gain control over what questions they want to answer, the type of data to collect, and the ability to enrich data with qualitative input. However, while apps [6] are relatively simple ways of collecting a variety of data, they require frequent attention and effort, which can compromise data collection. Wearables (e.g., smartwatches or activity trackers) provide a hands-on solution, offering at-a-glance data, but require the user to continuously wear them, and sensor-capabilities are limited to on-body measurements. Of course, the experience of the workplace goes beyond that; our physical and social worlds are crucial to consider when trying to understand user behaviors. As self-tracking continues to expand into the private sphere, ongoing societal changes shaping the future of work call for timely research on the opportunities, challenges, and risks of tracking technologies in the office context.

Epstein et. al. [8] showed that self-tracking in the workplace often suffers from abandonment due to discomfort and judgment when users reflect on their data. Wannamaker et. al. (2021) experimented with simpler, user-driven, situated trackers that used relatively simple 'button' style probes, but cleverly added e-ink screens to show co-created data visualizations [13]. While indeed a more flexible and less judgmental approach to provide users with the means to explore their own habits, the buttons require a conscious and sustained effort of the user and do not capture detailed patterns over a prolonged period.

Bogers & Van Kollenburg on Data-Enabled Design [9] proposed a design-research methodology that uses data as a creative material in the design process, rather than as a directive solution to a problem. The use of data-enabled probes situated in the everyday life of

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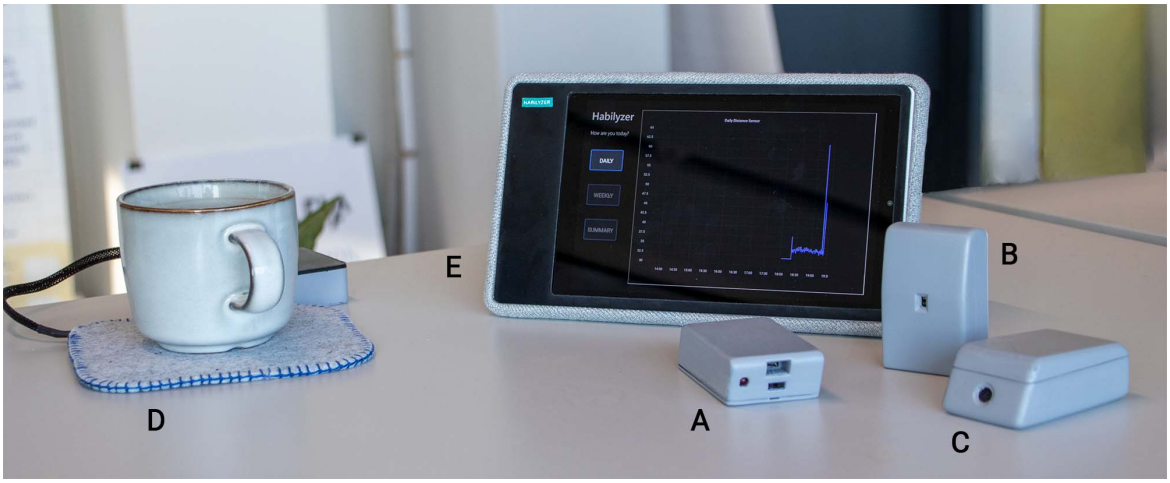

Figure 1: The Habilyzer toolkit with the four sensor modules.

people offers rich insights through a combination of quantitative (eco-)system usage patterns and qualitative nuance by end-users. Their work mostly focused on household contexts, which offer a known social environment and give the users a high degree of control over the probes. Different from Daskalova et al. [6], while the data and thus its probes need a certain fidelity to reliably co-reflect; they don't need to be perfect since we are not looking for explicit causal connections.

We see opportunities to combine the user-driven, situated approach with more complex, automated data collection probes in a more open, uncontrolled context such as the office. While the workplace context is rich in different activities, social interactions, and personal experiences, we also recognize the need for thoughtful discussion in the HCI community regarding privacy, consent, and access to personal data (see also [7]). In this Interactivity contribution, we present our vision on the use of user-driven, situated sensor probes in an office context and how the community might deal with complex yet timely questions around the use of data to empower people in becoming explorers of their own habits and experiences. To this end, we have developed Habilyzer, an open-ended sensor toolkit for the office context that enables user-driven explorations in self-tracking their work routines. This research contributes an alternative approach to improving working habits and vitality in the workplace, moving from solution-oriented technologies to inquiry-enabling tools. Through this demonstration, we also aim to trigger discussions on the use of sensors and data in the office context, in the light of privacy, consent and personal data ownership.

2 THE HABILYZER SENSOR TOOLKIT

Habilyzer is a data-enabled probe kit including a set of 4 distinct sensors and a base display showing data visualizations (Figure 1). It offers office employees a way to become explorers of their own habits. The Habilyzer kit is designed in such a way that it is usable with a minimal understanding of the underlying technology and can easily be placed around the office environment (Figure 2). Participants receive a stand-alone plug-and-play kit along with brief instructions. The sensors can be immediately deployed in any way the user wants to, driven by their areas of interest (e.g., insights into their sitting time, posture, productivity).

The four sensors were designed as rather neutral in their shape and aesthetics to support openness in use scenarios. For the same reason, the sensor kit includes a variety of accessories: depending on the surface they want to place it on, users can attach the sensors using an elastic lanyard, self-adhesive Velcro, clipping straps, or magnets. Except for the sound sensor, the sensors included (movement, distance, and pressure) purposely have no direct link to an environmental factor but need to be linked to another object to gain meaning (e.g., attaching the accelerometer to something that moves). The sensor kit does not currently include input mechanisms (e.g., smart buttons) that could be used for instance to report subjective feelings or events which do not have a physical manifestation. Yet this could be envisioned in future work.

In a preliminary user study [1] we conducted using Habilyzer, the majority of participants investigated a work habit related to bad posture or sedentary behavior (e.g., sitting time, number of breaks during the day). Some of them were also interested in gaining insights into their productivity and what factors could influence it (environment disturbance, type of work). Finally, collaboration with their co-workers was another identified area of interest.

2.1 Technical Realization

The Habilyzer Office Vitality probe kit consists of a base unit that visualizes the data coming from four wireless sensors (Figure 1). The Base Unit (E) contains a Raspberry Pi 4, a Lenovo M8 tablet, and a TP-Link 4G Router. The Raspberry (Figure 3) acts as the main server, hosting the database (InfluxDB) and visualization engine (Grafana). Data from the sensors is being ingested via MQTT (Mosquitto broker) and preprocessed in Node-Red. Processed data is then saved to the database and sent to Grafana-panels that are configured in a Playlist that cycles Daily, Weekly, and Summary data for all sensors. A React app embeds Grafana-iframes and has buttons that allow the user to switch views (Figure 4). The tablet loads the application via a Kiosk app that prevents other interactions with the tablet

Figure 2: Examples of sensor deployment in the office environment

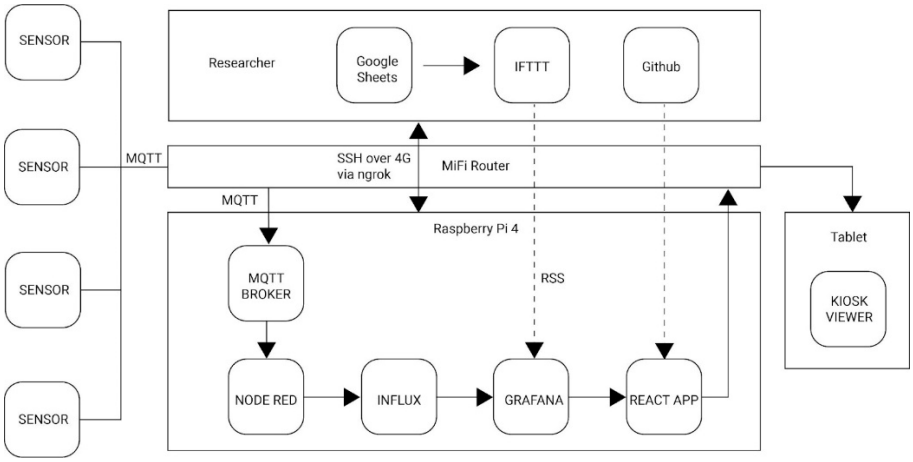

Figure 3: Diagram of the technical architecture of the Habilyzer system.

(e.g., changing settings). The Raspberry Pi hosted services can be accessed via ngrok-secured SSH over 4G. We chose a 4G module, since we do not want to ask for (possibly private) WiFi credentials or unforeseen network issues (such as WPA2-Enterprise encryption or other company-related network rules).

Each Habilyzer kit has four sensors, which are ESP32's (Wemos D32 Pro) with an SD-card for local data-storage and powered by a 2000mAh LiPo battery. The four sensor types are: (A) Movement (MPU6050 9 DoF IMU), (B) Distance (VL53L1X Time-Of-Flight sensor), (C) Sound (MAX4466 microphone module) (D) Pressure sensor (Velostat-based variable resistance sensor encased in a felt-like fabric mat). All sensors have a grey 3D-printed enclosure and come with an on/off switch, USB-port and a status LED. All modules have a deep-sleep function to preserve battery life. WiFi connection is only established after a significant change in measurement values has been observed. Due to the 'always on' nature of the sensors (always actively measuring), battery life is currently around 2-3 days.

3 DEMONSTRATION SETUP

Envisioned On-Site Setup - The demonstration will be organized on-site as a participatory experience. As knowledge workers, CHI attendees are target users of Habilyzer. It will thus be easy to engage with the demonstration. Three Habilyzer kits will be available for people to experiment with. People will first be invited to think of what they are interested to research, and then wander around in the exhibition space around the booth to attach sensors where want. The data captured by each of the sensors will be displayed live. In the case of a large crowd gathering at the booth, the waiting time will mostly consist of participants defining some interesting areas of inquiry and thinking about where to creatively put the sensors to research these specific points of interest. The audience can also find it interesting to adopt a position of an observer, looking at what the three participants using the sensor kits do (perhaps even trying to guess what questions they are exploring), and watching the stream of data live on the dashboard. We envision having the demo also happen during the main conference sessions by deploying our kits with volunteers and making the stream of data and their accounts of experience available.

Figure 4: Data visualizations on the Habilyzer base unit

Envisioned Online Setup - When joining the demo session online (using the video conference system provided by the conference), participants will be briefly introduced to our concept and invited to think about what (working) habits they would be interested in uncovering using Habilyzer. As demo organizers, we will be located in an office, each of us being equipped with a Habilyzer kit. The sensor data captured by each of the sensors will be displayed live to the audience on an online dashboard. Attendees will have the opportunity to send an inquiry assignment to the organizers. For instance, requesting from one of us to position a sound sensor next to the printer or to attach the accelerometer sensor to our office chair. The possibilities are endless, and attendees are welcome to come up with any creative combination. They will see the working situation via the webcam, along with the live sensor data. We will have a chat moderator suggesting debate topics or asking the audience to share their reflections.

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