Artificial Conscience

JONAS KEPPEL, University of Duisburg-Essen, Germany
ALPER ÖZTÜRK, University of Duisburg-Essen, Germany
STEFAN LEWIN, University of Duisburg-Essen, Germany
JEAN-LUC HERBST, University of Duisburg-Essen, Germany

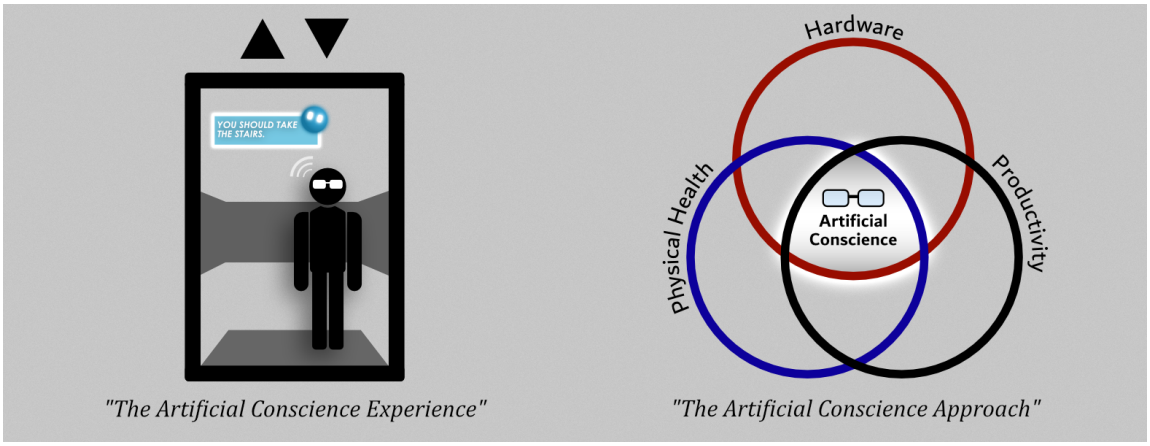

Fig. 1. The Artificial Conscience. Left: Example application scenario of the Huawei Eyewear. Right: Venn diagram visualizing the overall approach. The smart glasses can be used for intervention strategies regarding health recommendations and to improve productivity in everyday life.

The Artificial Conscience concept aims to improve the user's quality of life by giving recommendations for a healthier lifestyle and reacting to possibly harmful situations detected by the various sensors of the Huawei Eyewear. But autonomous reactions to situations that pose an immediate danger to the user's health as well as methods for habit-forming and other supporting functions are only representing a subset of the possible design space. All functions of this concept are described and evaluated individually, both under the assumption of autonomous operation of the Huawei Eyewear and with the inclusion of other data sources and sensors (smartphone, smartwatch). In addition, an outlook is given on additional features for the Huawei Eyewear that could be implemented in future versions of the glasses.

CCS Concepts: • **Human-centered computing** → *Human computer interaction (HCI)*; *Ubiquitous and mobile computing*; • **Applied computing** → *Consumer health*; *Health informatics*.

Additional Key Words and Phrases: eHealth, behavior change, health recommendations, reminders

ACM Reference Format:
Jonas Keppel, Alper Öztürk, Stefan Lewin, and Jean-Luc Herbst. 2022. Artificial Conscience. In *MobileHCI '22: The ACM International Conference on Mobile Human-Computer Interaction, September 28–October 01, 2022, Vancouver, Canada.* ACM, New York, NY, USA, 4 pages. https://doi.org/XXXXXXX.XXXXXXX

Manuscript submitted to ACM

1 INTRODUCTION

With a stressful daily routine, it often happens that both professional and private tasks are not completed, which is why many people not only have problems organizing their daily routine but also endanger their health due to a lack of work-life balance. Personal assistants like Google Assistant and Apple's Siri are used to assist the users in managing their daily tasks, but they are often limited in their functional scope. Since personal assistants are mostly tied to the smartphone, which is usually carried in the pocket, some drawbacks arise in terms of usability and privacy, for example, many sensors are blocked, the microphone and speakers are muffled, the phone is nearly unusable in the pocket and the speaker outputs are not private. Our Artificial Conscience approach in combination with the Huawei Eyewear has the goal to assist the user in daily tasks like 'focus assist', reminders, etc., while also supporting the health of the user with workout notifications or warnings when the user enters a dangerous situation. The implementation aims to use the full potential of all available sensors and input/output devices provided by the Huawei Eyewear to assist users in as many life situations as possible. The data of the built-in 6-axis sensors is used for interpreting the user's body and head position, while the built-in speakers near the head, for example, allow the system to play back private information without privacy concerns. In this use case, the user is encouraged to wear the Huawei Eyewear as often as possible to realize the full potential of the Artificial Conscience, until the glasses are seen as an extension of the user itself and the interaction becomes mostly implicit.

2 GENERAL APPROACH

2.1 Feature Categories and Levels

The project contains various features regarding eHealth. This is why we assigned the features to six different categories: Warnings, Smart Assistant, Sports Companion, Haptics & UX, and Potential Next-Gen Features. After categorizing, it was obvious that certain features cannot be based solely on the Huawei Eyewear. Some functions only make sense if they are implemented in conjunction with an app or require additional sensor technology that the Huawei Eyewear does not offer out of the box. For these reasons, we organized the features in four different levels as seen in Table 1.

Table 1. Descriptions of the four different levels of Artificial Conscience features for the Huawei Eyewear.

Level	Description
Level 1 - Eyewear only	All features at this level can be implemented without a smartphone app. The I/O interfaces of the Huawei Eyewear are sufficient to make these functions operational.
Level 2 - Companion App	Features, which are intended to support the user in carrying out activities of everyday life. For this level, a Companion App is installed on the user's smartphone.
Level 3 - Sensors and APIs	All features on this level require either additional sensors or external APIs.
Level 4 - Additionals	All features at this level are not mandatory and may exceed the scope of the project idea. Nevertheless, these features could act as an appealing addition to the project.

2.2 Feature Overview

In the following, we provide a more in-depth description of the most interesting features. An overview of all possible features of the Artificial Conscience organized by level and category can be found in Table 2.

Table 2. Overview of possible Artificial Conscience features for the Huawei Eyewear.

Level 1	*Level 2*	*Level 3*	*Level 4*
Warnings: Fall detection; Volume warning **Habit Forming:** Hydration Check; Neck Exercise; Focus Assist **Smart Assistant:** Timer, Alarm	**Habit Forming:** Sleep Tracking; Pomodoro Mode **Smart Assistant** Reminders; Daily Report **Sports Companion:** Workouts	**Smart Assistant:** Speech Assistant **Sports Companion** Heartbeat; Workouts Extended	**Warnings:** Temperature Warning; Screen Brightness Warning **Haptics & UX:** Vibration **Next-Gen Features:** Iris Sensor

Fall detection: The gyroscope and acceleration sensors provide data to detect unexpected movements that could indicate a fall. In the event of an emergency situation, either an individual emergency number or an emergency call is dialed. A more medical approach is explored by T. Shany et al. [5], with the goal to reduce the risk of falls through the use of wearable sensors like accelerometers and gyroscopes and to predict the risk of falling.

Volume warning: Whenever the microphones measure an environmental sound level that may cause long-term hearing damage, the user gets notified. Thus, the user can initiate countermeasures.

Hydration Check: Hydration is an often overlooked aspect of a healthy lifestyle and there are a number of approaches to tackle that problem. Henry Griffith et al. explored hydration-level tracking through a smart container with a triaxial accelerometer [3]. Artificial Conscience addresses that problem by checking the user's head movement. If no movement indicating drinking was detected for an extended time period, the users will be reminded.

Neck Exercise: In 2015 Katsuna Tanaka et al. showed how smart glasses with similar capabilities to the Huawei Eyewear can be used to analyze a user's neck position and give feedback about the user's posture [6]. In our project after pre-defined time intervals have elapsed, the user will be instructed to perform light neck exercises. The Huawei Eyewear will guide the user through the instructions and detect whether the exercise has been performed correctly by using the built-in gyroscope and accelerometer.

Focus Assist: When Focus Assist is activated, the Huawei Eyewear detects whether the user is concentrating on a task or is easily distracted, by interpreting the user's head movements. The user can be directed back to the task with certain audio outputs. Additionally, to help the user to stay focused, our project plans to use the Pomodoro technique outlined by Francesco Cirillo et al. which touches on predefined focus and break intervals [2].

Alarm: An alarm time can be set via touch and voice input. The alarm deactivates automatically after the glasses are picked up. The wear detection, accelerometer, and gyroscope should then detect whether the user has actually put on the glasses and moved away from the bed. If the glasses are only moved briefly so that the alarm clock is deactivated, but the user then puts them down again, the alarm tone is supposed to play again after a certain time.

Reminders: Appointments and individual reminders can be set via the app's GUI or via voice commands. If desired, the Huawei Eyewear will remind the user of these events. It could also be possible to send self-recorded reminders via voice commands directly to a friend's or colleague's schedule in case they also own a pair of Huawei Eyewear.

Daily Reports: The daily report builds on the appointments and reminders. The user can request the daily report via voice input and the Huawei Eyewear dictates the entered appointments for the current day.

Workouts: The app will provide a number of predefined sports exercises that the user can perform. The sensors of the Huawei Eyewear are able to detect the user's repetitions and will count them. This could be expanded by the

Huawei Eyewear playing motivational statements if the user should perform the repetitions more slowly when they are on the verge of exhaustion. (Extended in Level 3)

Speech Assistant: Extensions of the speech assistant enable many interesting features. What if there is no artificial computer voice accompanying the user through their journey of life? But instead, the voice of a loved one, or even a celebrity [1]? Another form of extension can be the integration of an external voice assistant API such as "Google Assistant" or "Amazon Alexa", which extend the functionality of the voice assistant immensely.

Extended Workouts. The Workout feature can be extended with additional sensors the user might already have at hand. The smartphone strapped to one leg or simply put in the pocket and a smartwatch on one wrist can provide additional sensor data. This allows for a wider range of exercises, the app can provide and track.

Iris Sensor: An extension for authentications. Instead of looking for a laptop model with Windows Hello, authentication happens via the glasses. This feature could also replace authentications for smartphones and would be interesting since the glasses always sit in the same position on the head. In accordance with this idea of user authentication with smart glasses, Stefan Schneegass et al. investigated the possibility of authentication using bone conduction through the skull [4]. But to implement bone conduction for the Huawei Eyewear, additional sensors would most likely be needed.

3 CONCLUSION

The concept of Artificial Conscience aims to react passively (by gathering data for later evaluation) and actively (by communicating with the user or awaiting input) to both unexpected events and planned events, to support the users with this data in their daily routine and health management. Features such as fall detection, drink reminders, and the sports companion functions support the user's overall physical health. Other features such as to-dos, reminders, and Pomodoro/Focus assist the user's productivity and achievement of daily tasks.

The demand for apps that support users' productivity or physical health can be measured by the number of apps and their download counts. For example, there are numerous drink reminder apps, some of which have been downloaded over 10 million times. But productivity and physical health apps are rarely combined and there are little to no implementations, which use a wearable for continuous tracking and support. Implementing Artificial Conscience will not only improve productivity or health exclusively but increase the user's overall life quality. Combining this concept with the Huawei Eyewear offers multiple benefits: The user is enabled to focus on achieving their tasks because the device is always available and ready to interact with. Privacy is another major factor, which is achieved using the Huawei Eyewears private speakers and data being processed on the local device only.

REFERENCES

[1] Sercan Arik, Jitong Chen, Kainan Peng, Wei Ping, and Yanqi Zhou. 2018. Neural voice cloning with a few samples. *Advances in Neural Information Processing Systems* 31 (2018).

[2] Francesco Cirillo. 2006. The pomodoro technique (the pomodoro). *Agile Processes in Software Engineering and* 54, 2 (2006), 35.

[3] Henry Griffith, Yan Shi, and Subir Biswas. 2019. A Container-Attachable Inertial Sensor for Real-Time Hydration Tracking. *Sensors* 19, 18 (2019).

[4] Stefan Schneegass, Youssef Oualil, and Andreas Bulling. 2016. SkullConduct: Biometric User Identification on Eyewear Computers Using Bone Conduction Through the Skull. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems* (San Jose, California, USA) *(CHI '16)*. Association for Computing Machinery, New York, NY, USA, 1379–1384. https://doi.org/10.1145/2858036.2858152

[5] T Shany, SJ Redmond, M Marschollek, and NH Lovell. 2012. Assessing fall risk using wearable sensors: a practical discussion. *Zeitschrift für Gerontologie und Geriatrie* 45, 8 (2012), 694–706.

[6] Katsuma Tanaka, Shoya Ishimaru, Koichi Kise, Kai Kunze, and Masahiko Inami. 2015. Nekoze!-monitoring and detecting head posture while working with laptop and mobile phone. In *2015 9th International Conference on Pervasive Computing Technologies for Healthcare (PervasiveHealth)*. IEEE, 237–240.