Your Health in the Mirror: A Critical Analysis of Health and Well-being Monitoring by Smart Mirrors

Ana Patrícia Rocha[1], Inês Águia[1], Pedro Carneiro[1], Rafael Pinto[1], Hugo Senra[1], Nuno Almeida[1], Samuel Silva[1], Florinda Costa[2], and António Teixeira[1]
[1]*IEETA, DETI, University of Aveiro*, Aveiro, Portugal & *LASI*, Portugal
[2]*i3N, Physics Department, University of Aveiro*, Aveiro, Portugal
{aprocha,inesaguia,pedrocarneiro,rafaelpbpinto,hsenra,nunoalmeida,sss,flor,ajst}@ua.pt

***Abstract*—The aging population creates the need to promote and encourage healthy and active lifestyles to help prevent chronic diseases or injuries and consequently alleviate the pressure on healthcare systems. Technological advancements present an opportunity to monitor people more continuously and provide them with useful and relevant information that can indicate potential problems or simply help them to stay or be more active and healthy. Smart mirrors offer the promising capability of monitoring individuals daily, in their own homes, without interfering with their usual routine, a key factor for user acceptance and widespread adoption. To obtain an overview of the state-of-the-art on smart mirrors for health/well-being monitoring, we performed a review of the literature on the topic, focusing on mirrors incorporating sensing capabilities. Relevant information was then extracted from the articles found and a critical analysis was carried out. Based on the results of this analysis, as well as our own experience, we provide recommendations we consider important to take into account in the future development of smart mirrors that monitor people's health and well-being.**

***Index Terms*—health and well-being monitoring, smart mirrors, sensors, smart environments**

I. Introduction

The 2030 Agenda for Sustainable Development prioritizes "Good Health and Well-Being," seeking to ensure healthy lives and promote well-being for all, at all ages [1]. This goal is vital as the global population ages, with those over 60 expected to nearly double from 12% in 2015 to 22% by 2050 [2]. This puts pressure on healthcare systems, as older ages are often associated with chronic diseases [3]. Moreover, by 2030, the global healthcare workforce is projected to fall 15 million short of the 80 million professionals needed [4].

In this context, providing support to older adults is important to help them recover from injuries or diseases in their own homes or simply maintain an active, healthy, comfortable, and independent life for as long as possible. Investing in prevention in both older and younger populations is also important to avoid the onset of some diseases, consequently reducing the need for appointments and treatments and thus easing the burden on healthcare systems.

The present study was developed in the scope of the Project "Agenda ILLIANCE" [C644919832-00000035 — Projeto n.º46], financed by PRR – Plano de Recuperação e Resiliência under the Next Generation EU from the European Union. This work was also funded by national funds through FCT - Fundação para a Ciência e a Tecnologia, I.P., in the context of projects/supports UID/00127, UIDB/50025/2020 & UIDP/50025/2020, and LA/P/0037/2020.

Furthermore, the healthcare professional-patient relationship is currently asymmetric, with professionals dominating knowledge and decisions while patients often remain passive. In addition, health data are commonly limited to the results of occasional medical exams/analysis. Technology offers the potential to change this paradigm by allowing more regular monitoring of health and well-being (both mental and physical) and making health information more accessible to people, thereby promoting a more balanced relationship.

Some health-tracking solutions exist but often require physical contact or user actions (e.g., wearing and charging smart devices), or rely on vision-based sensors (e.g., cameras). This can lead to low acceptance and/or adoption. Moreover, some solutions are tailored for specific conditions, limiting their use to individuals who already have a disease. Many challenges thus persist in creating person-centered healthcare solutions that are convenient, accepted, and trusted.

Some of these challenges can be addressed by leveraging the environments where people lead their lives, including their homes, and giving them greater control over their own health. Furthermore, minimally intrusive health monitoring can provide valuable insights for prevention and leading a healthy, active life without disrupting daily routines.

Within this vision, smart mirrors can – and should – play an important role. Mirrors are already a part of our homes and lives. With suitable sensors, they can enable unobtrusive, long-term monitoring of people during daily routines (e.g., in the morning and before bedtime). Smart mirrors can also offer personalized feedback, possibly contributing to greater user engagement and consequently long-term adherence.

Although there are recent reviews on smart mirrors, they either explore various applications – such as health, fashion, fitness, and home automation – [5], [6] or focus on healthcare but are outdated (i.e., only cover works published until 2018) [7], [8]. To better understand the current state-of-the-art and associated limitations regarding people's health and well-being monitoring using smart mirrors, we carried out a review of the literature on this topic, performed a critical analysis based on the relevant information extracted from the reviewed papers, and defined a roadmap with suggestions for future directions.

II. Literature Review

This section describes the method used for searching and selecting papers on smart mirrors for health/well-being monitoring and presents an overview of the selected papers.

A. Method

The literature review involved the following steps:

1) Search of an initial list of contributions in Google Scholar and Scopus using the queries described below, considering all papers published until 2025;
2) Identification of duplicates and selection of papers considering the exclusion criteria listed below, based on the analysis of the title and abstract;
3) Detailed analysis of the selected works' full text to extract information on relevant aspects;
4) Further paper selection, by excluding those where the mirror itself does not integrate any sensor or does not acquire any data related to health and/or well-being.

For the first step above, the following query was used to search in Scopus, relying on the "Advanced query" option:

TITLE((smart OR intelligent) AND (mirror OR mirrors)) AND TITLE-ABS-KEY(health OR well*being OR medic*)*

In Google Scholar, we used "Advanced search" and the following query (variants were considered by replacing "smart" with "intelligent" and/or "mirror" with "mirrors"):

allintitle: smart mirror health OR healthcare OR healthy OR well OR medical

In the second step, after removing duplicates, the articles that met the following exclusion criteria, based on their title and abstract, were excluded:

- Corresponds to a review, survey, critical analysis, or other type of non-research paper;
- Presents a study aiming at requirement elicitation only;
- Is written in a language different than English;
- In the case of journal papers, the journal is not indexed in Scopus nor Web of Science;
- Full text not available to us;
- Does not involve smart mirrors or health/well-being monitoring.

In the third step, we analyzed the remaining papers in more detail and extracted information on the following aspects:

- Application area(s);
- Sensors or devices integrated into the smart mirror;
- Health or well-being data obtained by the smart mirror;
- Interaction and other relevant mirror's features;
- How the system was evaluated by users (if applicable).

As previously mentioned, the focus of the review is on sensorized mirrors. Therefore, contributions where health/well-being data are obtained using only sensors not integrated in the mirror were also excluded. We consider a sensor to be integrated if it is placed behind or in the frame of the smart mirror, or is attached to it in any way. We further excluded papers focusing on fitness, where users are monitored during physical exercises only. For papers with the same authors or authors in common, if the proposals are the same or very similar, we selected only the most recent one.

B. Results

The searches outlined in subsection II-A were carried out in May 2025, resulting in 43 publications in Scopus and 24 in Google Scholar. After removing duplicates, the initial list comprised 51 papers. The first filtering narrowed it down to 29 papers, which were then reduced to 14 papers in the second selection round.

Figure 1 shows the number of publications (selected and excluded) versus the publication year, as well as the accumulated value for the initial and final paper selections. Apart from one article in 2007, papers on the considered topic started around a decade ago, in 2015. There was a peak in 2021, possibly reflecting the increased interest in home health monitoring solutions during the COVID-19 pandemic, when people were confined to their homes for extended periods and there was more awareness/concerns related to health.

Figure 1 also shows that only around half of the initially selected papers feature mirrors that carry out monitoring themselves (corresponding to the final selection), while the other half relies on external sensors/devices. Despite a decline in publications after 2021, we anticipate an increase in the coming years, driven by a growing interest in non-intrusive sensing and monitoring, particularly focusing on health and well-being, in the comfort of our homes.

Figure 2 presents the word cloud generated from the titles of the final selected papers, after stemming and excluding common and non-relevant words (e.g., "the", "a", "for", "using", "based"), systems' names (i.e., "Lux", "Shapes", "iMirror"), and the two most frequent words (i.e., "mirror" and "smart" with 16 and 15 occurrences, respectively).

The most frequent words are "health", "medical", "monitoring", and "mental", occurring three times each. Other significant words include: "intelligent", "emotion", "posture", and "assistant", which together with the previously mentioned

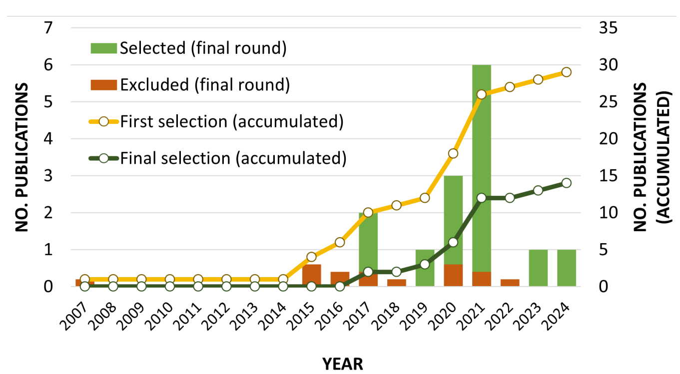

Fig. 1. Number of publications versus the year of publication, considering the first and final selection of papers, as well as the accumulated number.

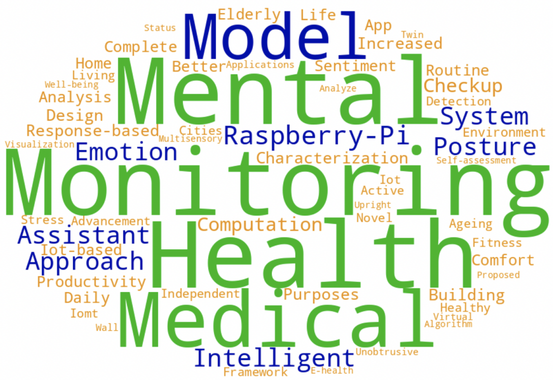

Fig. 2. Cloud of words that appear in the titles of the final selected papers (excluding non-relevant words as well as "smart" and "mirror"), with a larger font size corresponding to a shigher word frequency (different colors indicate different frequency values).

words showcase the main areas of application. Words featured only once, but corresponding to aspects we deem relevant are: "unobtrusive", "multisensory", "daily", "routine", "comfort", "independent", "active", "ageing", and "visualization".

An overview of the final selected articles is given in Table I, including information on each aspect listed in subsection II-A.

1) Areas of Application: As expected, the main areas of application are monitoring of health and/or well-being [9]–[18]. Other applications include daily life management [19], independent living and physical rehabilitation [20], daily productivity improvement [21], and fitness monitoring [22]. Within well-being monitoring and daily life management or productivity improvement, many focus mostly on emotion or sentiment [10]–[12], [18], [19], [21].

2) Sensors Integrated in the Mirror: Half of the works rely on a single sensor type integrated into the mirror for health/well-being monitoring [10], [14], [15], [17], [19]–[21], with only ≈30% using more than two types. Cameras are a common option, with a large majority (≈70%) of contributions relying on one or more camera types: RGB cameras (including webcams) [11], [12], [14]–[19], [21]; depth cameras [16], [20]; multispectral imaging cameras [16]. Microphones are sometimes used together with a camera or alone for emotion monitoring [10]–[12], [18]. Other used sensors include ultrasonic, load cell, temperature, PPG (photoplethysmography), electrode plates, and gas detection (breath analysis device) sensors [9], [13], [16], [22].

3) Monitoring by the Mirror: Concerning the type of health or well-being information collected by the smart mirror, most articles focus on one or two parameters: body mass index (BMI) and body temperature [9]; emotion/sentiment and/or moving speed [10]–[12], [18], [19], [21]; stress level [14]; body pose and orofacial gesture information [20]. Some propose gathering a larger set of three to four parameters: BMI, body temperature, SPO2 (oxygen saturation), and heart rate [13]; BMI, body fat percentage, and body temperature [22]; upper body posture, body swelling, and skin condition [17]. The two remaining contributions either monitor both physical and mental status (based on different parameters) [15] or obtain a wellness index (from physical, emotional, and lifestyle information – the latter provided by the user) [16].

4) Interaction and Other Relevant Features: Regarding interaction between the user and the mirror, most proposed mirrors present information to the user using text and/or graphics output through a display integrated into the mirror [10]–[13], [15]–[17], [19]–[22]. Around half of them (55%) also provide speech output as well as speech input [10]–[12], [15], [19], [20]. Only one proposal offers multimodal input (speech, gestures, and physical button) [17]. Many do not provide information on user input [9], [13], [14], [16], [21], [22].

Additional relevant mirror features were proposed by around 70% of the reviewed works. Most are related to user-mirror interaction: recommendation and/or alert/reminder presentation [9], [10], [19], [20], [22]; users' avatars [12]; voice assistant/chatbot [11], [20]; telemedicine [11]; virtual twin that adapts the conversation to the user's emotional state [15]. User identification/authentication, based on the person's face [15], [17], [19], [22] or both face and voice [12], or RFID technology [20], is a common feature. Other features include home device control/monitoring [17], [20], [22].

5) Evaluation: All but one proposed smart mirrors were evaluated by users. Nonetheless, more than half (≈60%) evaluated specific features only [10], [11], [14], [16]–[19], [22], such as the performance of emotion or stress level classification, user identification, face-related feature detection, or validation of specific measures. Most of the remaining works assessed the system's usability (using System Usability Scale – SUS – or a custom questionnaire) [12], [13], user satisfaction (using a 10-point Likert scale) [21], and/or user's productivity [21]. Other works also evaluated usability or user's experience, but regarding a specific service [15], [20]. Details about participants are not always provided, but the number ranged greatly (from one to 53 volunteers) and they are often young or middle-aged adults [12], [16], [18], [20] (except one study involving older people [11]).

III. Critical Analysis

Based on the review results, we identified several limitations common to most contributions.

A. Application of Smart Mirrors is Narrow

When monitoring the health of a person over time, it is important to adopt a more holistic approach, by considering aspects related not only to health (e.g., presence or absence of a disease) but also well-being (including physical, mental, and emotional). However, our review showed that smart mirrors are typically used to monitor either health or well-being, and, within well-being, most consider emotion monitoring only.

B. Sensing Technology is Limited and Intrusive

Using diverse sensing technology can enhance the richness of the collected information, covering multiple dimensions associated with health and well-being, and thus allowing a

TABLE I
SUMMARY OF PAPERS ON SMART MIRRORS FOR HEALTH/WELL-BEING MONITORING.

Ref.	Year	Application	Sensors/Devices integrated in mirror[1]	Health/Well-being data obtained by mirror	Interaction and other features	Evaluation[2]
[18]	2024	Well-being (mental health) monitoring	**Camera, microphone**, speakers	Sentiment (face- and speech-based)	Speech input and output	Face measures w/ and w/o smart mirror; Number of interactions w/ and w/o notifications
[9]	2023	Health monitoring	**Ultrasonic, load cell, infrared temperature**, temperature/humidity, webcam	Body mass Index (BMI) (from height and weight) Body temperature	Alerts for over/underweight conditions; Face-based gender classification (for BMI interpretation)	None
[19]	2021	Daily life management	**Camera**, microphone, speakers	Emotion (face-based)	Speech input & text/graphics and speech output Face-based user authentication ; Health-related recommendations; Water drinking reminders; Presentation of other info	Performance of face-based authentication and emotion recognition
[10]	2021	Well-being (emotion) monitoring	**Microphone**, speakers	Emotion (speech-based)	Speech input & text/graphics and speech output Wake-up prompt detection; Recommendations according to emotional state	Performance of emotion recognition
[11]	2021	Well-being (emotion) monitoring in older people	**Camera, microphone**, speakers	Emotion (face- and speech-based) Moving speed (based on pose over time)	Speech input & text/graphics and speech output Simple chatbot; Telemedicine	Performance of emotion recognition
[12]	2021	Well-being (emotion) monitoring	**Webcam, microphone**, speakers	Emotion (face- and speech-based)	Speech input & text/graphics and speech output Face and speech-based user identification; Presentation of user's avatar and other info	System usability (SUS) Performance of speech-based user identification
[20]	2021	Independent living and physical rehabilitation	**Depth camera**, radio-frequency identification (RFID) reader, microphone, speakers	Body pose Orofacial gesture information	Speech input & text/graphics and speech output Call service; Voice assistant; Calendar with reminders; Login service (using RFID); Home monitoring	Usability (ICF-US II) of rehabilitation service Smartband data collection; Performance of orofacial gesture recognition; Validation of digital assistant and home monitoring
[21]	2021	Daily productivity improvement	**Camera**	Emotion (face-based)	Text output Presentation of other info	User satisfaction (10-point Likert scale) & productivity (positive or negative)
[13]	2020	Health monitoring	**Ultrasonic, photoplethysmography (PPG), temperature**	BMI (height and weight) Body temperature SPO2 (oxygen saturation) Heart rate	Text output	System usability (custom questionnaire) and validation of measures compared to a reference device
[14]	2020	Well-being monitoring	**Camera**	Stress level (based on eye bags and redness, facial sweat, pupil dilation & forehead frown)	None	Accuracy of face-related feature detection and stress level classification
[22]	2020	Health and fitness monitoring	**Electrode plates, load cell, ultrasonic, infrared temperature**, temperature/humidity, webcam	BMI (weight and height) Body fat percentage (from bioelectrical impedance analysis, height & weight) Body temperature	Text output Face-based user identification; Health/fitness recommendations; HVAC control based on ambient temperature; Presentation of other info	Validation of weight, height, body temperature, and body fat percentage
[15]	2019	Health and well-being monitoring	**Camera**, microphone, speakers	Physical and mental status (based on detection of xanthelasma, acne, depression, and sleep deprivation)	Speech input & text and speech output Face-based user authentication; Virtual twin (suggestions/warnings and conversation adapted to emotional state)	User experience & question answering performance of dialog manager; Accuracy of face recognition and xanthelasma & lip/eye type classification
[16]	2017	Well-being monitoring	**RGB camera, depth sensor, multispectral imaging cameras**, infrared thermometer, breath analysis device	Wellness index (from physical condition data based on 3D face anthropometric quantification, emotional status, and lifestyle information indicated by user)	Graphics output	Validation of face anthropometric quantification, facial skin analysis, emotional & psychometric status, breath analysis
[17]	2017	Health monitoring	**Camera**, steam sensor	Upper body posture Body changes regarding swelling and skin condition	Speech, gesture, and physical button input & text/graphics output Face-based user identification (for personalization); Fan automatic activation; Presentation of other info	Difference between estimated and "perfect" posture for 30-day period (no comparison between estimated and actual posture)

[1] The sensors/devices used to collect health/well-being data from the users are indicated in bold. All contributions additionally include a display except [14].
[2] SUS and ICF stand for System Usability Scale and International Classification of Functioning, Disability and Health, respectively.

more complete picture of an individual. Nonetheless, the majority (≈70%) of the proposed mirrors rely only on one or two sensor types, limiting the variety of acquired information as further discussed below. It is also important that the used sensors are as less intrusive as possible. However, the most popular sensors in our review are cameras and microphones, which can be considered too intrusive due to privacy concerns, especially in spaces such as bathrooms and bedrooms, which can affect the system's acceptance and long-term adoption.

C. Privacy Issues are not Addressed

Besides privacy concerns associated with sensing, there are further privacy dimensions that should be considered when dealing with sensitive and personal information, such as user consent, access control, data anonymization, and/or encryption. Nevertheless, none of the reviewed papers mentions if and how they address these issues, including how/where data are transmitted, stored, and retrieved/processed, and how access by authorized people only is ensured.

D. Obtained Health/Well-Being Information is Limited

Besides covering both health and well-being, the information obtained by the mirror should be as complete and varied as possible. Although a varied set of sensors is sometimes used, the variety of obtained information is typically limited. From the reviewed articles, around 35% detect the person's emotion, sentiment, or stress level only. The remaining ones obtain two or four types of data, mainly focusing on body characteristics (e.g., BMI from height and weight, body temperature, fat percentage, or pose) and/or a few vital signs (SPO2 and heart rate). An exception is the proposal of a wellness index based on physical and emotional information obtained by the mirror (using five sensor types) and lifestyle information manually provided by the user [16].

E. Human-Mirror Interaction is not Given Much Attention

Although interaction between the user and mirror is relevant, most reviewed articles do not provide many details in this regard, which shows the low relevance given to this aspect in smart mirrors' design. Although some mirrors offer multimodal output, most contributions do not mention any or only mention one input modality (speech input in most cases), with only one providing multiple input modalities, which can limit the access to useful information through the mirror. Besides multimodality, another aspect that can contribute to a more natural interaction is adaptivity. It is interesting to note that although user identification/authentication is often proposed, it is not used to adapt the interaction to the user, with two exceptions consisting of personalization of displayed information [17] and adaptation of the conversation with a virtual twin to the user's emotional state [15].

F. Lack of Integration with Healthcare Systems

Almost all articles mention the presentation of information regarding health/well-being (and sometimes other information), alerts to specific changes, and/or recommendations/suggestions based on gathered information. However, communication between users and healthcare professionals is rarely mentioned, with the ability to share the data collected by the mirror not being provided or explored. Empowering people by allowing them to access their own data is crucial, but it is equally important to foster a symmetric relationship between professionals and patients instead of simply reversing the existing asymmetry.

G. Evaluation is not Comprehensive

Evaluating the smart mirrors with users is essential to ensure that they are not only easy to use, but also accepted and trusted. Some of the reviewed articles only evaluate the performance of specific features, not considering aspects of overall usage, including interaction. A few assess the usability of the mirror or the user's satisfaction. However, as with other systems, it is vital to evaluate a wider range of dimensions, including the system's usability and the user's experience, satisfaction, acceptance, and trust.

IV. Roadmap

As our critical analysis shows, the community has already explored and showcased the potential of smart mirrors for health and well-being monitoring. However, several aspects remain unexplored and/or offer room for improvement. As a roadmap for the future, we lay out guidelines and recommendations for the development of smart mirrors that monitoring people over time, focusing on health and well-being.

Firstly, it is important that monitoring is as less intrusive as possible. Therefore, monitoring should rely on sensors that do not interfere with people's routine. For example, sensors that need to be worn by the users (e.g., smart bands or watches) or that can raise privacy concerns (e.g., vision-based sensors, microphones) should be avoided. Instead, less intrusive sensors (e.g., radio-frequency sensors) should be adopted. Sensors should also be positioned in ways that do not force people to change their behavior. For example, users should not be required to get closer to the mirror than usual or stand in front of a specific part of the mirror.

To further address privacy concerns, adequate security measures (e.g., encryption and/or anonymization) should be implemented concerning data transmission, processing, and storage. What data and how they are collected and used should also be transparent to the user.

Concerning health, smart mirrors should not be seen as simple detectors of diseases. Given the privileged position mirrors can have in a person's daily routine, they should play an important role in obtaining a better view over a person's health and well-being. They can be leveraged to enable a more continuous and regular monitoring relying on sensors integrated in the mirror, but also in synergy with sensing across other daily home contexts (e.g., living room, office) (requiring robust data management). For example, the information gathered over time can be used to detect and alert about deviations to a person's "normal" values. This can be beneficial not only for disease follow-up, but also for preventive healthcare in the general population.

Smart mirrors can also enhance the access of people to their own health data, leading to a more balanced relationship between them and healthcare professionals. Nevertheless, it is also important to ensure they have control over the stored data. Users should be able to choose whether they wish to share their data and, if so, with whom. It can be professionals, to help them have a more comprehensive and complete picture and potentially make more informed decisions. It can also be relatives or caregivers, which can be especially important in specific cases, such as an older person living alone or someone with a specific disease that needs to be controlled, to bring them more peace of mind or help them intervene if needed.

Regarding information presentation to the user, besides presenting data in a more automated way, it should also enable the user to request specific data. In both cases, it is crucial that the interaction between the user and the mirror is as natural as possible, being also provided in a minimally intrusive way, and suitable to different people (regardless of their characteristics and capabilities) and contexts. This can be enabled by relying on a rich set of interaction modalities with adaptive capabilities, i.e., that adapt to the user and context.

Smart mirrors, as any solution, should be overall developed with adaptability and adaptivity in mind, considering a wide range of user profiles (in terms of characteristics, capabilities, and needs). This is also important during evaluation, which should involve different types of users (e.g., younger and older people, people with disabilities, people with different cultures). Moreover, evaluation should take into account not only usability but also the whole experience of using a smart mirror. This involves assessing not only its features, but also how they are provided alongside the functions a typical mirror is meant to fulfill.

V. Conclusions

To better understand the current state-of-the-art and existing open challenges regarding smart mirrors for health and well-being monitoring, a review of the literature was carried out focusing on mirrors that integrate sensors to acquire data from the users. We further performed a critical analysis, where different limitations of the smart mirrors proposed so far were identified. Considering those limitations, as well as our own experience, we also presented a roadmap for the development and evaluation of smart mirrors that enable a more continuous monitoring of different aspects of a person's health and well-being, in a minimally intrusive way, and the access to the gathered information using adequate forms of interaction.

We believe these kind of mirrors have the potential of helping people to have more control over their own health data, balancing the relationship between them and healthcare professionals, and contributing to prevention and/or early interventions and, consequently, healthcare costs reduction.

References

[1] United Nations, "THE 17 GOALS — sustainable development goals," Accessed: 5 Jul 2025. [Online]. Available: https://sdgs.un.org/goals

[2] World Health Organization, "Ageing and health," Accessed: 5 Jul 2025. [Online]. Available: https://www.who.int/news-room/fact-sheets/detail/ageing-and-health

[3] K. B. Watson, J. L. Wiltz, K. Nhim, R. B. Kaufmann, C. W. Thomas, and K. J. Greenlund, "Trends in multiple chronic conditions among us adults, by life stage, behavioral risk factor surveillance system, 2013–2023," *Prev. Chronic Dis.*, vol. 22, p. E15, 2025. DOI: 10.5888/pcd22.240539

[4] J. X. Liu, Y. Goryakin, A. Maeda, T. Bruckner, and R. Scheffler, "Global health workforce labor market projections for 2030," *Hum. Resour. Health*, vol. 15, no. 1, pp. 1–12, 2017. DOI: 10.1186/s12960-017-0187-2

[5] D. Divakar, H. M. Bharat, and G. M. Dhanush, "Reflecting on technology: A review of the smart mirror advancements and applications," in *Comput. Sci. Sustain. Technol.*, S. Aurelia, C. J., A. Immanuel, J. Mani, and V. Padmanabha, Eds. Cham: Springer Nature Switzerland, 2024, pp. 438–451. DOI: 10.1007/978-3-031-50993-3_35

[6] D. A. Alboaneen *et al.*, "Internet of things based smart mirrors: A literature review," in *3rd Int. Conf. Comput. Appl. Inf. Secur.*, 2020, pp. 1–6. DOI: 10.1109/ICCAIS48893.2020.9096719

[7] R. Miotto, M. Danieletto, J. R. Scelza, B. A. Kidd, and J. T. Dudley, "Reflecting health: smart mirrors for personalized medicine," *npj Digital Med.*, vol. 1, no. 1, p. 62, 2018. DOI: 10.1038/s41746-018-0068-7

[8] V. M. Soppimath, M. G. Hudedmani, M. Chitale, M. Altaf, A. Doddamani, and D. Joshi, "The smart medical mirror - A review," *Int. J. Adv. Sci. Eng.*, vol. 6, no. 1, pp. 1244–1250, 2019. DOI: 10.29294/IJASE.6.1.2019.1244-1250

[9] R. Mariappan, P. N. Prasanna, S. Tehmeem Sulthana, A. Ramprasad, and P. Charishma Shalini, "Design of smart medical mirror using raspberry pi," *J. Phys.: Conf. Ser.*, vol. 2466, no. 1, p. 012022, 2023. DOI: 10.1088/1742-6596/2466/1/012022

[10] H. Yu, J. Bae, J. Choi, and H. Kim, "Lux: Smart mirror with sentiment analysis for mental comfort," *Sensors*, vol. 21, no. 9, 2021. DOI: 10.3390/s21093092

[11] P. Silapasuphakornwong and K. Uehira, "Smart mirror for elderly emotion monitoring," in *IEEE 3rd Glob. Conf. Life Sci. Technol.*, 2021, pp. 356–359. DOI: 10.1109/LifeTech52111.2021.9391829

[12] S. Bianco *et al.*, "A smart mirror for emotion monitoring in home environments," *Sensors*, vol. 21, no. 22, 2021. DOI: 10.3390/s21227453

[13] S. Halaby, G. Khoury, R. A. Zeid Daou, A. Hayek, and J. Boercsoek, "Novel approach of a smart medical mirror system for medical applications," in *IEEE Middle East Africa Conf. Biomed. Eng.*, 2020, pp. 1–6. DOI: 10.1109/MECBME47393.2020.9265149

[14] L. Rachakonda, P. Rajkumar, S. P. Mohanty, and E. Kougianos, "iMirror: A smart mirror for stress detection in the IoMT framework for advancements in smart cities," in *IEEE Int. Smart Cities Conf.*, 2020, pp. 1–7. DOI: 10.1109/ISC251055.2020.9239081

[15] S. S. Abeydeera *et al.*, "Smart mirror with virtual twin," in *Int. Conf. Adv. Comput.*, 2019, pp. 238–243. DOI: 10.1109/ICAC49085.2019.9103335

[16] P. Henriquez *et al.*, "Mirror mirror on the wall... an unobtrusive intelligent multisensory mirror for well-being status self-assessment and visualization," *IEEE Transactions on Multimedia*, vol. 19, no. 7, pp. 1467–1481, 2017. DOI: 10.1109/TMM.2017.2666545

[17] B. Cvetkoska, N. Marina, D. C. Bogatinoska, and Z. Mitreski, "Smart mirror e-health assistant — Posture analyze algorithm proposed model for upright posture," in *IEEE EUROCON - Int. Conf. Smart Technol.*, 2017, pp. 507–512. DOI: 10.1109/EUROCON.2017.8011163

[18] T. Noguchi, M. Hirokawa, S. Doki, and K. Suzuki, "Computational modeling of mental health checkup with response-based characterization using a smart mirror," in *IEEE Int. Conf. Syst. Man Cybern.*, 2024, pp. 2549–2554. DOI: 10.1109/SMC54092.2024.10831537

[19] S. Sirinayake, D. Dasanayake, T. Rodrigo, W. Perera, M. Hansika Mahaadikara, and S. Kahandawala, "IOT-based intelligent assistant mirror for smart life & daily routine using Raspberry PI," in *21st Int. Conf. Adv. ICT Emerg. Reg.*, 2021, pp. 1–6. DOI: 10.1109/ICter53630.2021.9774788

[20] J. D. Chaparro *et al.*, "The SHAPES smart mirror approach for independent living, healthy and active ageing," *Sensors*, vol. 21, no. 23, 2021. DOI: 10.3390/s21237938

[21] J. Liu and Y. Sun, "Building a smart mirror for the purposes of increased productivity and better mental health, complete with an app," in *CS & IT Conf. Proc.*, vol. 11, no. 14, 2021. DOI: 10.5121/csit.2021.111406

[22] A. Muneer, S. M. Fati, and S. Fuddah, "Smart health monitoring system using IoT based smart fitness mirror," *TELKOMNIKA (Telecommun. Comput. Electron. Control)*, vol. 18, no. 1, pp. 317–331, 2020. DOI: 10.12928/telkomnika.v18i1.12434