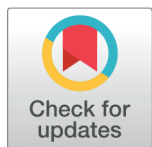


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IntelliMirror: User Evaluation of an IoT Smart Mirror for Health Awareness and Mood Tracking

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Abstract

Objectives: Integrating Internet of Things (IoT) technologies in healthcare creates opportunities to develop intelligent, non-invasive, and user-friendly systems for continuous health monitoring. These advancements can simplify healthcare-related tasks, improve patient monitoring, and enable more personalized healthcare services. This study presents IntelliMirror, an IoT-based smart mirror for mood and health monitoring, which provides an interactive platform for accessing health-related information and mood-related conditions. **Method:** The experiment is conducted in three phases, comprising a baseline pre-survey, active IntelliMirror design and development, and interaction. Finally, the post-implementation evaluation. The experiment aims to incorporate user's needs into the design to increase the system's trust and usability. Fifty participants completed the survey-based evaluation. The baseline survey identified user's perceptions of the system before development, focusing on perceived health benefits, interest in mood monitoring, technological comfort, trust in data handling, and willingness to use the technology. **Findings:** The evaluation results show that 60% of participants perceived potential health benefits, 70% expressed interest in mood monitoring, and 62% were willing to use an intelligent mirror in a healthcare environment. The evaluation demonstrated generally favourable user perceptions, with positive responses exceeding 80% across the evaluated system features. The results indicate that IntelliMirror has promising potential as a user-centered IoT platform for integrating health and mood monitoring into an interactive smart-mirror environment. **Novelty:** This study explores user's perception of an Intelligent Mirror before and after development. Based on pre-survey findings IntelliMirror was designed as a user centered IoT platform integrating healthcare and mood monitoring into a smart mirror environment. Post-development result indicates potential for smart technology adaptation in personalized healthcare. However, the research needs to include technical validation, clinical comparison, and long-term evaluation to ensure reliability and clinical applicability.

Keywords: IntelliMirror; Smart Mirror; Internet of Things; IoT Healthcare; Mood Monitoring; Health Monitoring; User Acceptance; Smart Healthcare; Human-Computer Interaction

1 Introduction

The rapid advancement of the Internet of Things (IoT), artificial intelligence (AI), embedded systems, and smart sensing technologies creates opportunities for developing intelligent solutions that enhance everyday life. More specifically, these technologies can transform healthcare by enabling convenient, continuous monitoring of an individual's health and well-being⁽¹⁾. Conventional healthcare monitoring often depends on dedicated medical equipment and periodic clinical trials. Although these approaches remain important, they may not always provide continuous awareness of changes in an individual's health and emotional state. So, there is increasing interest in non-invasive and user-friendly technologies that can integrate monitoring capabilities into everyday environments⁽²⁾.

A smart mirror is an emerging approach for integrating digital information with a familiar household item⁽³⁾. By combining a conventional mirror with sensors, displays, embedded computing, and IoT connectivity, a smart mirror can provide information without requiring users to interact with a separate computer or mobile device. This makes the smart mirror concept particularly suitable for applications in which information needs to be presented naturally during everyday routines⁽⁴⁾. When combined with health and mood monitoring capabilities, such a system can potentially provide users with greater awareness of selected health-related parameters and emotional states⁽⁵⁾. However, technology-based mood monitoring also faces issues of accuracy, privacy, acceptance, and interpretation of mood signals⁽⁶⁾. Likewise, health monitoring systems must present information, such as health statistics, in a way that is understandable and usable for users, without making them feel the system may substitute for diagnosis by health professionals⁽⁷⁾. Therefore, an intelligent mirror that monitors health and mood must address both functional and human aspects.

According to a Grand View Research analysis, the global wearable technology market is projected to grow at 13.6% between 2025 and 2030.⁽⁸⁾ This section presents research on smart mirror-based applications. Wani *et al.*⁽⁹⁾ presented a smart mirror that integrates everyday functionality with convenient, interactive, and secure personal services. The system displays weather, date and time, important emails, and an activity list in the mirror interface using a Raspberry PI 3 and a network connection. To provide authenticated access, the proposed mirror includes a face recognition system.

Gupta *et al.*⁽¹⁰⁾ presented the design and implementation of a smart mirror using a Raspberry Pi, a 2-way mirror display, and a microphone and speaker to provide interactive services. The system provides weather updates, news, maps, calendar, reminders, music, and personalized greetings, which enhances the capabilities of a smart mirror. The study also highlights the need to integrate AI capabilities to provide more personalized services. Dabiah *et al.*⁽¹¹⁾ reviewed mirror-based smart applications. The research paper examines how smart mirrors combine traditional reflective surfaces with interactive digital displays for applications such as medical education, smart homes, and virtual fitting rooms. Uddin *et al.*⁽¹²⁾ proposed a smart mirror application that integrates face recognition and voice input to provide secure, interactive access to features such as weather, time, calendar events, news, traffic, and COVID-19 updates. The system achieved 87% face-recognition accuracy, and the voice integration demonstrates its potential for practical, secure use.

Bianco *et al.*⁽⁴⁾ present a smart mirror that tracks and detects emotions using deep learning. The system provides a variety of functions, which include news and reminders. By accessing users' emotional states and offering personalized feedback, the mirror seeks to promote emotional well-being. Silapasuphakornwong *et al.*⁽¹³⁾ introduced an IoT-based smart mirror designed to detect emotional changes in elderly users and identify early signs of depression. It combines facial, voice, speech, and posture recognition with chatbot technologies and daily information services to continuously monitor users' mental well-being. The system also supports telemedicine, enabling doctors and caregivers to remotely track, diagnose, and provide long-term care for elderly patients. Kasno *et al.*⁽¹⁴⁾ presented a real-time smart mirror that integrates facial emotion and age analysis, webcam-based rPPG for heart rate and SpO₂ monitoring, and a bilingual GPT-4o conversational AI chatbot. The system converts the MA-rPPG model into a continuous real-time framework and combines multimodal sensing with voice-enabled interaction through a touchscreen mirror interface. Viswanatha *et al.*⁽¹⁵⁾ proposed a smart mirror-based home monitoring and security system that displays news, weather and security monitoring information. Miotto *et al.*⁽¹⁶⁾ presented a smart healthcare mirror that monitors changes in appearance, posture, movement and other health indicators and providing corrective feedbacks. Kumar *et al.*⁽¹⁷⁾ proposed smart mirror perform face and skin analysis to detect skin health and emotional state. The proposed model achieved 92% accuracy and 87% user preference rate. Santofimia *et al.*⁽¹⁸⁾ presented a smart mirror called sara, to support personalized healthcare and healthy ageing through AI. The authors highlighted key factors such as personalisation, privacy, accessibility, and user engagement as essential aspects aspect for designing smart mirror for healthcare applications.

Existing smart mirror research mainly emphasizes technical functionality, with limited focus on user acceptance, satisfaction, trust, ease of use, and willingness to adopt health-related smart mirrors. Therefore, researchers need to evaluate user acceptance, usability, trust, and perceived usefulness of integrated emotion and health monitoring in smart mirrors for healthcare settings. Based on study, this paper proposes an IntelliMirror, an IoT-embedded smart mirror that can monitor mood and health. The proposed system provides a convenient interface through the mirror that delivers mood- and health-related information.

Rather than focusing on technical implementation, the study adopts a user-centered development approach, identifying user perceptions and requirements before system development and evaluating them after interaction with the developed prototype.

The research study followed a three-phase experimental pipeline: a baseline pre-survey, an active IntelliMirror interaction phase, and a post-implementation evaluation. Initially, a pre-survey of 50 participants identified baseline perceptions of health improvement, interest in mood monitoring, technological comfort, trust in data handling, and willingness to use an intelligent mirror in healthcare environments. These findings helped identify user requirements and guided the development of IntelliMirror. Participants subsequently interacted with the developed prototype and completed a post-implementation evaluation assessing ease of use, health-information usefulness, mood-monitoring usefulness, information clarity, and acceptance. The study therefore contributes from both system-development and user-evaluation perspectives. Pre- and post-survey responses are then analyzed using descriptive and inferential statistical methods to examine changes in participant perceptions. This study demonstrates the feasibility and user acceptance of IntelliMirror as an IoT-enabled smart healthcare interface rather than its clinical accuracy and diagnostic effectiveness.

Table 1 compares the existing studies with the proposed study highlighting the key technical and user-centered aspects and clearly indicating the contribution.

Table 1. Comparison of existing and proposed study

Study	Technical aspects considered	User acceptance	User satisfaction	Trust / Security	Ease of use	Willingness to adopt
(10)	Smart Mirror display weather, news, maps, calendar, reminders, music, personalized greetings.	Not explicitly evaluated	Not explicitly evaluated. Personalization may potentially improve satisfaction.	Not explicitly evaluated	Potentially high, due to voice and interactive services, but no formal usability assessment reported.	Not explicitly evaluated
(12)	Smart mirror with face recognition, voice input, weather, time, calendar, news, traffic, COVID-19 information	Partially implied, through practical/secure interaction, but no comprehensive acceptance model reported.	Not explicitly evaluated	Strong technical focus on secure access through face recognition.	Potentially high because of voice-based interaction, but not formally measured.	Not explicitly evaluated
(4)	Smart mirror with facial/emotion recognition, news, reminders, personalized feedback.	Not explicitly evaluated	Potentially positive, due to personalized emotional feedback, but no formal satisfaction measure reported.	Not explicitly evaluated. Emotional-data privacy could be relevant.	Potentially high through automated interaction, but not formally assessed.	Not explicitly evaluated
(13)	Smart mirror with facial, voice, speech, and posture recognition, chatbot, daily information services, telemedicine, remote monitoring and healthcare support.	Potentially important, particularly for elderly users, but formal acceptance results are not specified.	Not explicitly evaluated	High importance because of sensitive mental-health information and remote health-care. formal trust assessment not reported.	Potentially challenging for elderly users because of multimodal technologies; formal usability assessment not reported.	Potentially high for continuous elderly care, but not formally measured.

Continued on next page

Table 1 continued

(14)	Smart Mirror with facial emotion and age analysis, webcam-based rPPG, heart rate and SpO ₂ monitoring, MA-rPPG, GPT-4o chatbot, touchscreen and voice interaction, bilingual interface.	Not explicitly evaluated in terms of a formal acceptance model.	Potentially high due to real-time, personalized, and conversational interaction; not formally quantified.	Important but not explicitly evaluated; health data and AI interaction raise privacy/trust considerations.	Potentially high through touch-screen, voice, and conversational AI; formal usability evaluation needed.	Not explicitly evaluated
(15)	Smart mirror displays news, weather and security monitoring.	Not explicitly evaluated	Not explicitly evaluated	Relevant, particularly because of home/security monitoring, but formal trust measurement not reported.	Potentially high due to information presented through the mirror, but not formally measured.	Not explicitly evaluated
(16)	Monitoring of appearance, posture, movement, and other health indicators; corrective/health feedback.	Potentially relevant, particularly for healthcare use, but formal acceptance results are not specified.	Potentially positive because of personalized corrective feedback; not formally evaluated.	Highly relevant because health information is collected, although formal trust assessment is not reported.	Potentially high due to passive/continuous monitoring, but formal usability evaluation is needed.	Potentially high for preventive and personalized healthcare, but not explicitly measured.
(17)	Monitoring face skin health and detect emotions.	Achieved 87% user preference rate	Improved engagement and satisfaction compared with traditional mirrors.	Not explicitly evaluated.	Real-time analysis and interactive features support convenient and engaging use.	High potential for adoption due to personalized wellness and self-care features.
(18)	AI and machine learning for personalized health monitoring	Not explicitly evaluated; user engagement is identified as important.	Not explicitly evaluated; personalization may improve the experience of older adults.	Privacy is highlighted as an essential requirement	Not explicitly evaluated. Improved interfaces and accessibility are proposed.	Not explicitly evaluated.
Proposed Study	Intelligent mirror provides an interactive platform for accessing health-related information and mood-related conditions,	Explicitly evaluated	Explicitly evaluated	Partially evaluated	Explicitly evaluated	Explicitly evaluated

2 Methodology

The proposed IntelliMirror system is designed as an IoT-enabled smart mirror that integrates physiological sensing, camera-based facial analysis, local processing, and an interactive smart-mirror interface. The architecture follows a three-layer structure as depicted in Figure 1: (1) Input Layer, (2) Processing Layer, and (3) Output Layer. This modular architecture facilitates the collection of sensor data and visual information, which are subsequently processed using computational and deep learning techniques and presented through the smart mirror display.

2.1 Input Layer

The input layer collects physiological and visual data from the user. A camera captures visual information, while sensors measure physiological parameters such as body temperature and heart rate. A proximity sensor detects the user's presence in front of the mirror. The IR temperature sensor (MLX90614) is used to measure the user's body temperature. The heart rate sensor

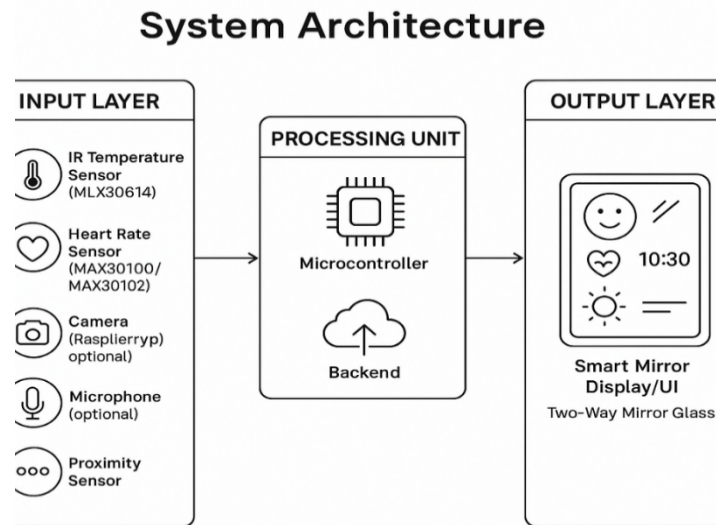


Fig 1. System Architecture

(MAX30102) measures pulse rate and blood oxygen saturation (SpO_2) measurements. The data collected from these sensors serve as input parameters for the system and are subsequently processed.

2.2 Processing Layer

The processing layer forms the central computation component of the proposed IntelliMirror architecture. It receives, processes, and interprets the physiological and visual data collected through the input layer. Raspberry PI 5 serves as the primary processing unit. It interfaces with the connected sensors and camera to acquire raw input data, performs the required pre-processing and analysis, and communicates the results to the user interface.

The collected data, including body temperature, heart rate, proximity status, and facial images, are pre-processed through filtering and normalization before analysis. The OpenCV package handles image acquisition, face detection, and facial processing, while Keras-based models (ResNet50) support facial analysis and emotion recognition. Physiological measurements can simultaneously be evaluated using threshold rules to derive meaningful information. The resulting information is then processed by the Flask backend, which manages communication between the processing layer and the frontend interface and displays the analyzed results on the smart mirror display.

2.3 Output Layer

The output layer serves as the primary interface for interaction between IntelliMirror and the user. It integrates a two-way mirror with a display panel positioned behind the mirror surface, enabling information to be presented while preserving the mirror's reflective functionality. The two-way mirror glass provides the reflective appearance while allowing the underlying display to remain visible. The display panel presents health measurements, mood-related information, notifications, and system feedback. The user interface organizes the processed information in an accessible format. Key parameters including body temperature, heart rate, SpO_2 , and detected facial emotion information are displayed through the interface and preserving the conventional mirror experience.

2.4 Data Description

2.4.1. Participants

The study involved 50 participants selected to assess users' perceptions, requirements, and acceptance of the proposed IntelliMirror system. All participants completed both the baseline pre-survey and the subsequent post-implementation

evaluation. This allowed comparison of individual responses before and after interaction with the developed system. Participants' demographic characteristics were recorded based on three variables: gender, age group, and occupational status, as presented in Table 1. These variables were collected during the pre-survey to describe the composition of the study population and to provide contextual information for interpreting the survey findings.

2.4.2. Gender Distribution

The sample included 28 females (56%) and 22 males (44%), indicating a fairly balanced gender distribution. Including both genders enriched the data and broadened understanding of participants' perceptions, acceptance of the technology, and trust in the IntelliMirror system.

2.4.3. Age Distribution

The experiment included users across 4 age groups to maximize variation among potential IntelliMirror users. Young adults made up the largest group, with 33 participants (66%). Adults followed with 12 users (24%). However, only 3 subjects (6%) were aged over 60 and 2 were teens (4%). Consequently, the IntelliMirror received a variety of opinions on usability, acceptance, and relevance.

2.4.4. Occupational Status

Table 2 indicates the respondent's demographic characteristics. It shows that, among the respondents, there were 30 students (60%), 15 employed persons (30%), and 5 persons in other occupation groups. The broad representation of students, employees, and other professions added diverse viewpoints on the usability, acceptance, and application of the IntelliMirror system. Students provided data from a technically driven user group, whereas those from other sections provided general user views.

Table 2. Demographic Characteristics of the Study Participants (N = 50)

Variable	Category	Count (n)	Percentage (%)
Gender	Female	28	56
	Male	22	44
Age Group	Teenager	2	4
	Young Adult	33	66
	Adult	12	24
	Senior	3	6
Status	Student	30	60
	Employee	15	30
	Other	5	10
Total		50	100

2.5 Pre-Survey Instrument and Baseline Assessment

The pre-survey (baseline) measured people's pre-existing views on, expectancies of, and acceptability of a health and mood monitoring smart mirror for a general population without prior exposure to the IntelliMirror system. Based on these baseline findings, some key functional and human-centered design requirements were identified for the prototype system.

It consisted of 5 main questions (Q1 to Q5) about potential health benefits, desirability of the mood-monitoring function, satisfaction with the technology in a smart-device environment, data privacy/security concerns, and willingness to use a smart mirror in the healthcare system. Table 3 describes the questionnaire questions in more detail. Participants chose their opinion from the provided response choices.

The responses given in the pre-survey can serve as initial benchmarks to compare with the post-survey answers. The post-survey had 50 respondents. All 5 central questions were answered by all respondents, and no cases of missing answers were found in the data. Table 4 presents the baseline responses of pre-survey and it shows a strong attitude toward using an Intelligent Mirror. For Q1, 30 participants (60%) believed an Intelligent Mirror could enhance their lives, but only 10 people (20%) believed it could positively impact their health, and 10 others thought otherwise (20%). For Q2, interest in mood monitoring was high, with 35 participants (70%) expressing interest, compared with 5 (10%) who were unsure and 10 (20%) who were not interested. Regarding Q3, 35 participants (70%) reported being very comfortable with intelligent or IoT-based technologies, while 10 (20%) were somewhat comfortable and only 5 (10%) were uncomfortable. For Q4, participants showed a generally positive level of

Table 3. Pre-Survey Questions

Code	Survey Dimension	Question	Response Options
Q1	Perceived Health Improvement	Do you believe an intelligent mirror could contribute to improving or supporting your health?	Yes / Not Sure / No
Q2	Interest in Mood Monitoring	How interested are you in mood monitoring using an intelligent mirror?	Interested / Not Sure / Not Interested
Q3	Technology Comfort	How comfortable are you with using intelligent/IoT-based technology?	Very Comfortable / Somewhat Comfortable / Not Comfortable
Q4	Data Trust	How much would you trust an intelligent mirror to handle your health and mood-related data?	Full Trust / Some Trust / No Trust
Q5	Healthcare Applicability	Would you be willing to use an intelligent mirror in a hospital or healthcare environment?	Yes / Not Sure / No

trust in data handling: 10 (20%) expressed full trust, 38 (76%) expressed some trust, and only 2 (4%) reported no trust. Lastly, for Q5, 31 participants (62%) indicated that they would be willing to use an intelligent mirror in a hospital or healthcare setting, while 7 (14%) were unsure and 12 (24%) were unwilling.

Table 4. Pre-Survey Baseline Response Distribution (N = 50)

Question	Response	Count (n)	Percentage (%)
Q1	Yes	30	60
	Not Sure	10	20
	No	10	20
Q2	Interested	35	70
	Not Sure	5	10
	Not Interested	10	20
Q3	Very Comfortable	35	70
	Somewhat Comfortable	10	20
	Not Comfortable	5	10
Q4	Full Trust	10	20
	Some Trust	38	76
	No Trust	2	4
Q5	Yes	31	62
	Not Sure	7	14
	No	12	24

The pre-survey findings formed the basis for identifying the requirements of the IntelliMirror system. The design and implementation of IntelliMirror incorporated the needs and expectations identified through participants' pre-survey responses. Table 5 presents the pre-survey findings and the corresponding requirements identified for developing the IntelliMirror system.

The relatively high interest in mood monitoring indicated the need for dedicated mood-monitoring functionality. Similarly, the proportion of participants who perceived potential health benefits supported including health-related monitoring features. The technological comfort results suggest that the system can include an interactive digital interface, and the trust responses suggest that data protection and privacy are important considerations.

3 Results and Discussion

After this active phase, participants completed the post-implementation survey. The first five questions retained the same constructs as the original baseline survey so a pre/post comparison could be easily carried out. Further questions were added to explore evaluation of the IntelliMirror prototype as developed, such as ease of use, usefulness of health information provided, usefulness of the mood information presented, whether or not the user found the information clear, and recommendations to others, as illustrated by Table 6. The questionnaire was intended to perform two evaluations at the same time: the effect on the user's opinion of the system after exposure, and how they rated the resulting system.

Table 5. Pre-Survey Findings and Corresponding IntelliMirror Requirements

Survey Finding	Observation	Derived Requirement	IntelliMirror Design Consideration
Q1: 60% answered Yes	Users perceived potential health benefits	Health-monitoring capability	Display relevant health information
Q2: 70% were Interested	Strong interest in mood monitoring	Mood-monitoring capability	Integrate mood/emotion monitoring
Q3: 70% were Very Comfortable	Most users were comfortable with technology	User-friendly digital interface	Provide simple and accessible interaction
Q4: 96% expressed Some/Full Trust	General acceptance of data handling	Privacy and secure data management	Protect health and mood-related information
Q5: 62% answered Yes	Majority showed healthcare acceptance	Healthcare applicability	Design for potential healthcare environments

Table 6. Post-Implementation Evaluation Dimensions

Dimension	Purpose of Evaluation
Health-support perception	Determine whether users perceive IntelliMirror as useful for health awareness
Mood-monitoring interest	Assess acceptance of the implemented mood-monitoring capability
Technology comfort	Determine ease and comfort of interacting with the system
Data trust	Assess confidence in handling of health and mood-related information
Healthcare applicability	Evaluate willingness to use the system in healthcare environments
Usability	Determine whether IntelliMirror is easy to use
Information usefulness	Assess the usefulness of displayed health information
Mood feature usefulness	Evaluate the perceived usefulness of mood monitoring
Information clarity	Determine whether displayed information is understandable
Recommendation intention	Assess overall acceptance of IntelliMirror

The pre-survey included data from 50 respondents and 9 variables, with no missing values or repeated IDs. Identical quality-check measures were undertaken on post-survey data, and respondent IDs were preserved to enable a valid comparison between the measures.

3.1 Descriptive Statistical Analysis of the Pre and Post-Surveys

Descriptive statistical analysis was conducted to summarize and compare participant data before and after interacting with the developed IntelliMirror system, as shown in Table 7. The analysis used the 50 participants who completed the survey evaluation, with the pre-survey representing the baseline measurement and the post-survey representing participants' perceptions after interacting with IntelliMirror. For each common survey question (Q1–Q5), we calculated the frequency and percentage of responses in each category separately for the pre- and post-surveys. This approach enabled examination of the distribution of participant perceptions and provided an initial indication of changes following exposure to the developed system.

The pre- and post-survey comparison in Table 7 indicates a positive shift in participants' perceptions after interacting with the developed IntelliMirror system. The most notable improvement was observed in data trust, where the proportion of participants reporting full trust increased from 20% to 50%, representing a 30-percentage-point increase. Participants' technology comfort also improved considerably, with the "Very Comfortable" response increasing from 70% to 84%. Perceived health improvement increased from 60% to 70%, while willingness to use IntelliMirror in a hospital/ healthcare environment increased from 62% to 68%. Interest in monitoring mood remained persistently high, with a modest increase from 70% to 72%. At the same time, negative attitudes tended to decline over the measured attributes. The findings indicate that hands-on interaction with IntelliMirror positively influenced user trust, system credibility, and perceptions of health benefits and usefulness. The pre- and post-survey result show improved user perception and acceptance of smart mirror which indicates its potential to support personalized healthcare and technology based health monitoring in hospital and wellness settings.

Table 7. Pre- and Post-Survey Descriptive Comparison (N = 50)

Question	Response	Pre-Count	Pre-%	Post-Count	Post-%	Change (pp)
Q1 Health Improvement	No	10	20%	1	2%	−18
	Not Sure	10	20%	14	28%	+8
	Yes	30	60%	35	70%	+10
Q2 Interest in Mood Monitor	Not Interested	10	20%	6	12%	−8
	Not Sure	5	10%	8	16%	+6
	Interested	35	70%	36	72%	+2
Q3 Technology Comfort	Not Comfortable	5	10%	4	8%	−2
	Somewhat Comfortable	10	20%	4	8%	−12
	Very Comfortable	35	70%	42	84%	+14
Q4 Trust in Data	No Trust	2	4%	1	2%	−2
	Some Trust	38	76%	24	48%	−28
	Full Trust	10	20%	25	50%	+30
Q5 Hospital Use	No	12	24%	10	20%	−4
	Not Sure	7	14%	6	12%	−2
	Yes	31	62%	34	68%	+6

3.2 Wilcoxon Signed-Rank Test

The Wilcoxon signed-rank test was used to determine whether participants' pre-survey and post-survey responses differed significantly after interacting with the developed IntelliMirror system. For each question, the response categories were numerically encoded according to their ordinal direction, with higher scores representing more favorable perceptions toward IntelliMirror. The pre-survey and post-survey scores were then paired by participant ID.

The null and alternative hypotheses were defined as follows:

H0: There is no significant difference between the pre- and post-survey responses.

H1: There is a significant difference between the pre- and post-survey responses.

A significance level of 0.05 was used; therefore, $p < 0.05$ indicated a statistically significant difference between pre- and post-implementation measurements. Table 8 presents the results of the Wilcoxon signed-rank test.

Table 8. Wilcoxon Signed-Rank Test Results

Question	Pre-Mean Score	Post-Mean Score	Mean Change	Wilcoxon Statistic	p-value	Significant at 0.05
Q1 Health Improvement	2.40	2.68	+0.28	0	0.00018	Yes
Q2 Interest in Mood Monitoring	2.50	2.60	+0.10	0	0.02535	Yes
Q3 Technology Comfort	2.60	2.76	+0.16	0	0.00468	Yes
Q4 Trust in Data	2.16	2.48	+0.32	0	0.00006	Yes
Q5 Hospital Use	2.38	2.48	+0.10	0	0.02535	Yes

The Wilcoxon signed-rank analysis, as presented in Table 8, showed statistically significant pre–post changes across all five constructs ($p < 0.05$). Trust in data handling recorded the largest mean increase (+0.32; $p = 0.00006$), followed by perceived health improvement (+0.28; $p = 0.00018$), technology comfort (+0.16; $p = 0.00468$), and both interest in mood monitoring and willingness to use IntelliMirror in a hospital (+0.10; $p = 0.02535$ each). The results indicate more favourable post-interaction responses across the measured areas including perceived health benefits, interest in mood-monitoring, technology comfort, trust and potential use. The analysis result suggest that the system positively influenced participant's perceptions.

3.3 Post-System Evaluation (Q6–Q10)

After comparing the pre- and post-surveys, the post-system analysis examined participant's experience with the developed IntelliMirror prototype. To capture participant's thoughts and feelings toward the implemented system. The questions were

analyzed in terms of how easy the system was to use, how useful the health information displayed by IntelliMirror was, how useful the mood-monitoring feature of IntelliMirror was, how clear the information presented was, and, finally, how useful the health recommendations were. The responses to these questions were answered on a five-point Likert scale (1=Strongly Disagree - 5=Strongly Agree). The main reason for analyzing the post-system data was to determine whether the constructed IntelliMirror system was deemed usable, useful, understood, and applicable to health. The results reflect a positive user attitude towards the system. Ease of use (Q6) received the highest affirmative responses (86%), indicating that users perceived the system interface as easy to use. Information usefulness (Q7), related to health information, received a high 84% positive responses, indicating that users found the health data useful. Mood Monitoring usefulness (Q8) received more than 86% positive responses, indicating that the system was user-friendly for monitoring users' moods. Informational Clarity (Q9) also followed, with 84% affirmative results, indicating that users generally perceived the interface as clear. Similarly, Q10, the healthcare recommendation, earned 82% positive user attitudes, thus providing a green signal to consider IntelliMirror for healthcare purposes and to suggest it.

4 Conclusion

The wearable technology market has grown significantly in recent years due to rising user interest in fitness and health tracking. Smart mirror-based health monitoring becomes more popular due its ease of use. Existing research work primarily focuses on the technical feasibilities with very limited attention given to user acceptance, satisfaction, trust, ease of use, and willingness to adopt health-related smart mirrors. Therefore, the proposed IntelliMirror, an IoT smart mirror for health and mood tracking, and tested its validity through a three-step user-centric methodology that consists of a pre-survey, system development and usage and post-evaluation. Pre-survey was conducted with 50 users and exhibited great user enthusiasm: 60% thought it can lead to benefits for health, 70% users were inclined towards mood tracking feature of it, and another 70% users said that they are fine with use of such technologies and 96% users trusted the data handling while 62% would utilize it in their respective health services. Similarly, post-evaluation results across all parameters showed positive user feedback and strong inclination and acceptance of use and its application in health services, especially in user interface design and ease of use, the usefulness of mood-tracking features, and health information.

In the future, participants can be expanded to include a broader range and diversity of demographics, and longitudinal analysis will be performed to provide long-term insights. Validating the technical aspects of multiple sensor integration for health measurements and mood-monitoring functions while strengthening data security and privacy protections, can further demonstrate its value to the healthcare sector as an effective smart healthcare system integrated with IoT technology.

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6 Data Availability Statement

The data used in this study were collected directly from the participants/users and contain information that is not publicly shareable due to privacy and confidentiality considerations. Therefore, the data are not publicly available. However, data may be made available from the corresponding author upon reasonable request, subject to appropriate ethical and confidentiality requirements.

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