# "Like Having Family Nearby": An LLM-Powered Family-Resembling Avatar for offering Psychological Support and Training Guidance during Stroke Rehabilitation

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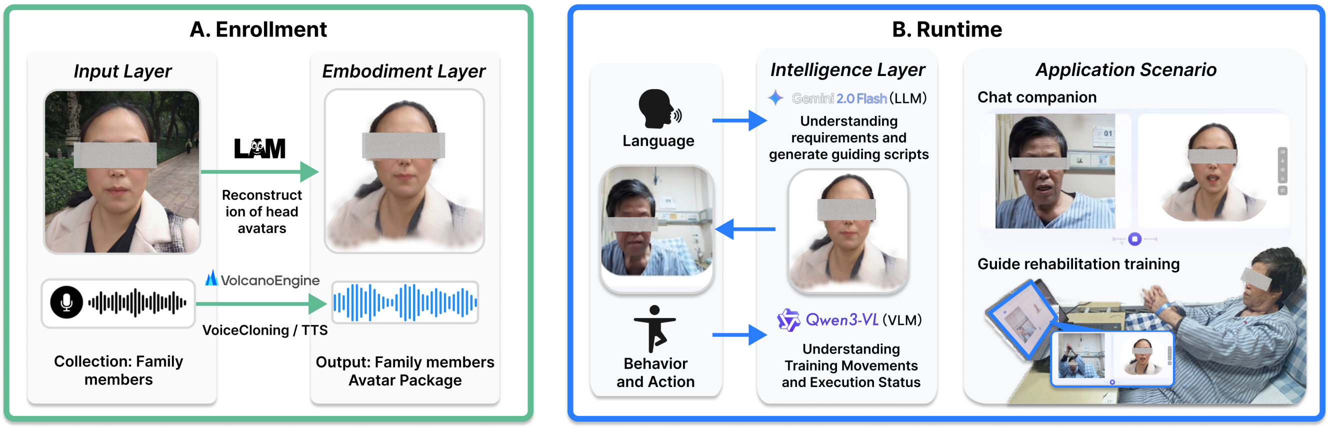


**Figure 1: Personalized companion–coach system: (A) Avatar enrollment. Assembling a family-member avatar by reconstructing head avatars from a single photo and voice cloning from voice recording. (B)Runtime. The patient converses with the avatar. The avatar uses Gemini for dialogue and uses Qwen3-VL for action understanding. The avatar can simultaneously serve as a conversational companion and provide rehabilitation training guidance.**


## Abstract

Stroke rehabilitation is prolonged and emotionally demanding, yet family members cannot provide continuous companionship or coaching. We explore a family-resembling avatar that offers psychological support and training guidance when relatives cannot be present. We conducted an empirical user study with six stroke patients and their family members (N=12). Our qualitative findings suggest such companions may reduce loneliness and increase perceived warmth, while action-relevant guidance can complement caregivers' limited rehabilitation knowledge. Participants also raised concerns about emotional dependence, privacy, and the need for stronger clinical alignment to avoid inappropriate guidance. We discuss implications for designing family-resembling companion-coach avatars with clear boundaries, privacy-preserving personalization, and supervised deployment in rehabilitation workflows.



## CCS Concepts

• **Human-centered computing** → **Empirical studies in HCI**; **Natural language interfaces**; • **Applied computing** → **Health care information systems**.

## Keywords

Motor impairments, Rehabilitation, LLM-powered animated avatar

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## 1 INTRODUCTION

Stroke remains a leading cause of long-term disability worldwide [18]. The rehabilitation process is often prolonged, demanding, and psychologically challenging, requiring not only consistent functional training under professional guidance [14] but also robust psychosocial support [7, 36, 39]. One key support is the presence and meaningful engagement of family members. However, many inpatients in stroke rehabilitation units lack family member company[28, 30]. Due to work commitments, financial constraints, or other caregiving duties, a substantial number of patients lack consistent family presence altogether. Even when family members are physically present, they may be unable to provide high-quality, engaged companionship or effective assistance due to a lack of professional knowledge, feelings of helplessness, or habitual distractions such as smartphone use—a state of "physical presence but psychological absence" [4]. This deficit in effective social support can exacerbate feelings of loneliness, anxiety, and depression in patients, directly undermining their motivation and adherence to prescribed rehabilitation exercises, thereby hindering functional recovery [10, 34].

Advances in digital health interventions, particularly large language models (LLMs) and reconstruction of head avatars, offer new opportunities to bridge this support gap. In this work, we took an initial step to investigate a personalized companion-coach system that leverages generative AI to deliver an interactive, family-resembling avatar to offer psychological and training support. The system is designed to generate a "virtual family member" that embodies the visual appearance and vocal characteristics of the patient's actual relative, integrated with a dialogue and guidance model informed by professional therapists. This avatar would serve a dual function: providing emotional support, encouragement, and empathetic companionship through a familiar and intimate persona, while also delivering guidance on rehabilitation exercises and progress reminders. These heightened functions may improve perceived support and training experience, and ultimately, potentially improve functional outcomes.

We conducted a user study with 6 pairs of patients and their families to answer the following questions: **How can an LLM-powered rehabilitation avatar embodying a family member's appearance and voice deliver psychological support while guiding patients through rehabilitation?** In summary, we have the following key findings:

- Our system provides patients with a degree of psychological support and rehabilitation guidance. Patients generally feel more reassured, and relatives widely acknowledge that the system can guide patients through their rehabilitation.
- There exists a trade-off between ethics and system fidelity. Introducing less information for privacy protection will limit the model's contextual grounding.

## 2 BACKGROUND AND RELATED WORK

Rehabilitation is not only a physical training process but also a sustained psychological and social challenge. Prior work has shown that patients' engagement with repetitive rehabilitation exercises is shaped by both training guidance and psychological support. On the one hand, emerging technologies such as virtual coaches and automated feedback can reduce uncertainty about how to perform movements and increase confidence in training [9, 13, 21, 40]. On the other hand, psychological support is equally vital. Empathic encouragement from clinicians [16], affective engagement from family members [15], and ongoing social support [8, 33], have been shown to buffer negative affect and promote positive affect, which are core needs of patients during recovery [37].

However, existing rehabilitation practices frequently fall short in providing sustained, multifaceted support. Clinical and empathic support from therapists is effective but resource-intensive and episodic; it rarely scales to provide continuous companionship outside scheduled sessions. Family caregivers can offer high-quality psychological support; however, they often have to balance caregiving with paid work or childcare, and those who could provide care exclusively are frequently older women who experience higher physical and psychological strain [12]. Moreover, sustained bedside presence is associated with increased caregiver burden, including reduced quality of life and deterioration in physical and psychological health, which further constrains their availability [26, 27]. Meanwhile, although technology-mediated interventions—from digital applications to robotic exoskeletons, virtual reality, and virtual coaches—can deliver detailed instructions, they do not inherently provide the psychological or relational support required in long-term rehabilitation [2, 21, 31].

Recent advancements in multimodal generative AI present a unique opportunity to bridge these gaps. LLMs demonstrate strong capabilities in understanding complex behavioral and emotional contexts, enabling real-time, empathetic feedback that traditional rule-based systems cannot offer [25, 29]. Further, generative techniques allow for the creation of hyper-personalized scenarios [6, 23] and realistic, interactive agents, which can simulate social presence more effectively than static interfaces [11, 22]. Despite this potential, the integration of these generative capabilities into holistic rehabilitation systems remains underexplored. In particular, there is a lack of unified systems that leverage the familiarity of personal relationships (e.g., family resemblance) alongside professional technical guidance to simultaneously support psychological needs and training adherence. In this study, we investigate a personalized companion–coach system that leverages generative AI to deliver an interactive, family-resembling avatar for both psychological and training support.

## 3 USER STUDY

To explore whether a family-resembling avatar can support stroke rehabilitation training, we conducted an empirical user study in which patients interacted with an avatar using a family member's appearance and voice, and we collected feedback from both patients and family members. All procedures were ethics-approved and consented, and all collected data (including facial images and voice samples) were deleted after the study.

### 3.1 System design

We built a camera-mediated rehabilitation companion system that enables patients to converse with an on-screen avatar resembling a designated family member in both facial appearance and voice. The interface is intentionally minimal: patients interact through natural spoken dialogue while performing rehabilitation exercises within the camera's field of view. The system guides patients through rehabilitation training and indirectly serves as a conversational companion. The system design is shown in Fig. 1

**Avatar embodiment.** The avatar's facial appearance is generated from a single portrait image of the family member using Large Avatar Model (LAM) [17], which produces an animatable face model for on-screen rendering. To create a familiar auditory identity, the avatar speaks with a cloned version of the family member's voice produced by VolcanoEngine VoiceCloning [1]. Together, these components create a consistent family-resembling embodiment intended to increase familiarity and perceived social presence during rehabilitation.

**Dialogue generation.** The system's conversational behavior is powered by Gemini-2.0-flash [2], which handles language understanding and response generation. Patient speech is transcribed into text and passed to Gemini to generate a textual reply. Responses are designed to be supportive and rehabilitation-relevant, for example, by acknowledging fatigue or discomfort, encouraging adherence, and explaining exercise goals in accessible language. The generated text is then converted into speech using the cloned voice and delivered through the avatar.

**Vision-based action understanding.** To provide exercise feedback grounded in what the patient is doing, the system analyzes the camera stream with Qwen3-VL [3], a vision-language model used

[1] https://www.volcengine.com/
[2] https://gemini.google.com/
[3] https://bailian.console.aliyun.com/

for visual understanding of patient actions. Qwen3-VL interprets the patient's ongoing movements and posture within the captured frames [41]. The system uses these visual cues to generate feedback, such as providing suggestions based on the actions the patient is currently performing. This enables avatars to provide more scientifically grounded responses to patient behavior compared to caregivers.

## 3.2 Participants

We recruited 6 patients and their family members from the local hospital. Half of the participants are cared by paid caregivers, while others are cared by family members. All patients demonstrated normal cognitive abilities to express emotion and perform simple calculations and demonstrated basic cognitive and communication abilities with Mini-Mental State Examination (MMSE) scores above 22 [20]. Only P2 has knowledge about AI, and only C2 and C6 have experience with using AI. Approval was obtained from the ethical committees of our home institution and the hospital. All participants gave us written informed consent and received a local standard compensation. Detailed demographics are shown in the appendix Table. 1.

## 3.3 Procedure

Each study session included (1) a patient-facing interaction with the rehabilitation avatar and (2) a family member-facing evaluation conducted either on site or remotely (family members watched a recording of the patient's session). We collected pre- and post-study self-reports from patients, and pre- and post-observation reports from family members. The whole procedure can be regarded in Fig. 2.

**Patient session.** After arriving in a separate room, patients received a brief introduction and were explicitly told the avatar was AI-generated, followed by consent and a short warm-up chat. Patients then completed a pre-questionnaire (5 min). Next, they performed a single guided rehabilitation exercise (hands clasped and raised above the shoulders/head in this work, which is safe and easy to follow) while conversing with the avatar (10 min). The researcher only initiated and ended the session with standardized prompts and intervened only for safety or technical issues; sessions were paused upon patient request or observable discomfort. Patients then completed a post-questionnaire and open-ended feedback, followed by a short debrief (5 min).

**Family member session.** Family members completed a pre-viewing questionnaire, observed the patient session either on site or via video, and then completed a post-viewing questionnaire with open-ended comments (5 min each). Measures focused on perceived patient comfort/engagement, communication appropriateness, perceived benefits/risks (e.g., dependence), and willingness to support continued use.

## 3.4 Qualitative Data and Analysis

We analyzed patients' and family members' open-ended responses and the researcher's field notes. We used inductive thematic analysis: two researchers open-coded an initial subset, refined a shared codebook, and then coded the full dataset, resolving differences through discussion to derive themes around companionship, training guidance, and concerns. All data collected during the experiment was anonymized and stored in a secure location.

# 4 RESULTS AND FINDINGS

**Affective Engagement and Support** Most of the patients reported that the avatar alleviated loneliness and emotional fluctuation when family could not be present to a certain extent. P1 expressed strong affective engagement and emphasized feeling cared for, even when the mother was present during the experiment. P2 similarly found the system useful because his child was often away, while others described feelings of encouragement (P3) and warmth (P4). However, P5 didn't need companionship because family members were always present, whereas P6 explicitly rejected virtual accompaniment, preferring real human interaction despite initially mistaking the avatar for a real person.

**Automated Coaching in Rehabilitation** Participants broadly acknowledged the instrumental role of the rehabilitation exercise instruction in facilitating safe and accurate movement execution. P3 liked being able to see his movement through the camera and receive timely guidance. P4 highlighted the importance of the system recognizing fatigue and responding accordingly. C2 added that even when physically present, the system could compensate for their lack of rehabilitation knowledge by providing coaching.

**Challenges and User Concerns** Despite the positive reception, participants articulated specific concerns regarding the system's deployment. Regarding companionship, C4 concerned about the potential patients might develop emotional dependence on the avatar. Conversely, P5, whose two daughters alternated full-day care, did not experience a lack of family companionship and therefore saw limited added value. Furthermore, reactions regarding "presence" varied: P4 felt the system could make them miss their family more, and P6 preferred real human companionship because it carries genuine emotions. Regarding training guidance, C2 and C6 requested an upfront assessment to customize the coaching. However, this direction may require gathering additional personal information, such as medical history, raising further privacy considerations. Specifically, C3 worried about the potential misuse of family images, while P2 expressed discomfort with being observed by a camera during rehabilitation.

# 5 DISCUSSION AND FUTURE WORK

**Conversational companionship** Our results reveal that patients perceive some degree of familiarity and a sense of family presence while using this system, leading to further willingness to engage in rehabilitation. Compared to chatting with real people, patients sometimes even feel more cared for. This may be because avatar chats are more proactive, using more positive language to show concern and encourage patients than real people do [35].

However, we did not explore the interaction effects between companionship and willingness to engage in rehabilitation using quantitative measures. Being cared for may enhance compliance. Previous research indicates that enhancing perceived psychological support can improve rehabilitation adherence [38]. Future research may design additional experiments to explore the relationship between psychological support and adherence to training guidance.

| Patient ID | Gender | Age | Caregiver | Family Member ID | Gender | Age | Relation to the patient | Companion Frequency |
|---|---|---|---|---|---|---|---|---|
| P1 | Female | 56 | Mother | C1 | Female | 87 | Mother | Everyday |
| P2 | Male | 53 | Paid Caregiver | C2 | Male | 27 | Son | Once a day |
| P3 | Male | 67 | Paid Caregiver | C3 | Female | 63 | Wife | Everyday |
| P4 | Male | 59 | Wife | C4 | Female | 57 | Wife | Once a day |
| P5 | Female | 81 | Daughter | C5 | Female | 58 | Daughter | Everyday |
| P6 | Female | 67 | Paid Caregiver | C6 | Female | 41 | Daughter | None |

**Table 1: Patients' and their caregivers' demographics in the user study. It contains participants' gender, age, and the relationship between the patient and their caregiver**

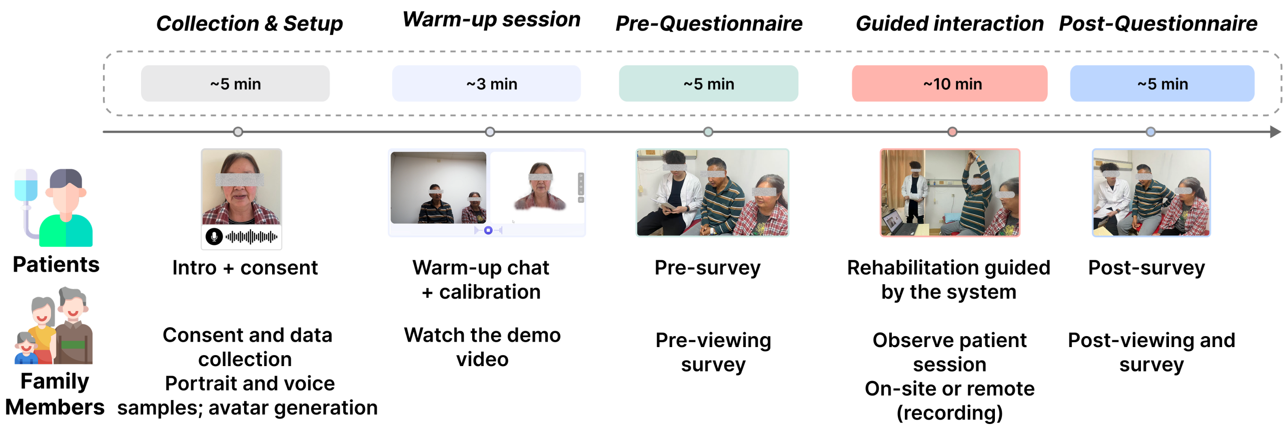


**Figure 2: Study Procedure. Patients completed the introduction and consent, a short warm-up chat with system calibration, a pre-questionnaire, an avatar-guided rehabilitation interaction, and a post-questionnaire. In parallel, family members provided consent and portrait/voice samples for avatar generation, watched a demo video, completed a pre-viewing survey, observed the patient session either on site or via a recording, and then completed a post-viewing survey.**

**Rehabilitation training guidance** Family members generally agreed that the system is more structured than themselves in guiding patients through rehabilitation training and wish to take it home to assist patients with their rehabilitation. Additionally, some family members have raised concerns about usage methods, including whether therapist involvement is necessary, as well as the control of prescriptions and usage frequency. This concern becomes increasingly significant during the process of AI agents guiding treatment [1, 3]. Future research requires therapist participation in discussions to evaluate the system's effectiveness in rehabilitation guidance, as well as its usage methods and frequency. Another limitation is the absence of physical assistance: unlike therapists who can guide patients' movements hands-on, the current system cannot directly provide hands-on assistance. Future work could address this gap by integrating robotic assistance or deploying the avatar as a supervised adjunct within formal rehabilitation workflows.

**Ethical Considerations** We considered ethical issues throughout the study. We collected only the family member's facial image and a voice recording for avatar creation, and deleted all collected data after the study. To further reduce privacy risks, we intentionally minimized the collection of patients' and family members' personal information. This conservative design choice, however, limited contextual grounding and occasionally led to interactions that felt less authentic or contextually appropriate. The trade-off between data privacy and model performance has always been a significant issue [5, 19]. In future work, patients and family members could optionally provide user-controlled, personalized context (e.g., preferences or rehabilitation-relevant background) to improve conversational realism while adopting privacy-preserving safeguards to prevent unnecessary disclosure [24].

Beyond ethical concerns regarding personal information, usage risks must also be considered. Our findings indicate that patients face the risk of excessive immersion during use, potentially mistaking avatars for real individuals and becoming overly engrossed. Regarding emotion management, an emotional outburst could potentially lead to depression [32]. In the future, such AI agents should also be included within the scope of prescription, with their use supervised by physicians to prevent harm to patients.

## 6 LIMITATION

As an exploratory study, this work has limitations. We did not assess age-related differences, and the system has limited contextual grounding without a structured patient profile. The avatar cannot provide hands-on assistance or rich embodied demonstration, and it does not support dialectal speech. Finally, we evaluated only single sessions, limiting conclusions about long-term use.

## 7 CONCLUSION

This paper explores whether a family-resembling rehabilitation avatar can support stroke patients during short training sessions. In a qualitative user study, patients and family members valued the avatar's familiar companionship and simple, action-relevant coaching, especially when relatives could not be present. They also raised concerns about relationship fit, over-identification, and the need for stronger clinical grounding to avoid inappropriate guidance. These findings motivate privacy-conscious personalization, clinician-aligned deployment, and longer-term evaluation.

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