

Robot Design and Ethical Analysis Report

Healthcare – Robotic Physical Therapy Assistant

Robot Design

Description

The robot, **Therabot**, is designed to assist patients in physical therapy, especially those recovering from surgeries, strokes, or injuries. Therabot looks humanoid but friendly and non-intimidating — about 5 feet tall, with soft, rounded edges and a smooth white and light-blue exterior. Its face is a digital screen that can display human-like expressions to comfort and encourage patients.

Unique Features:

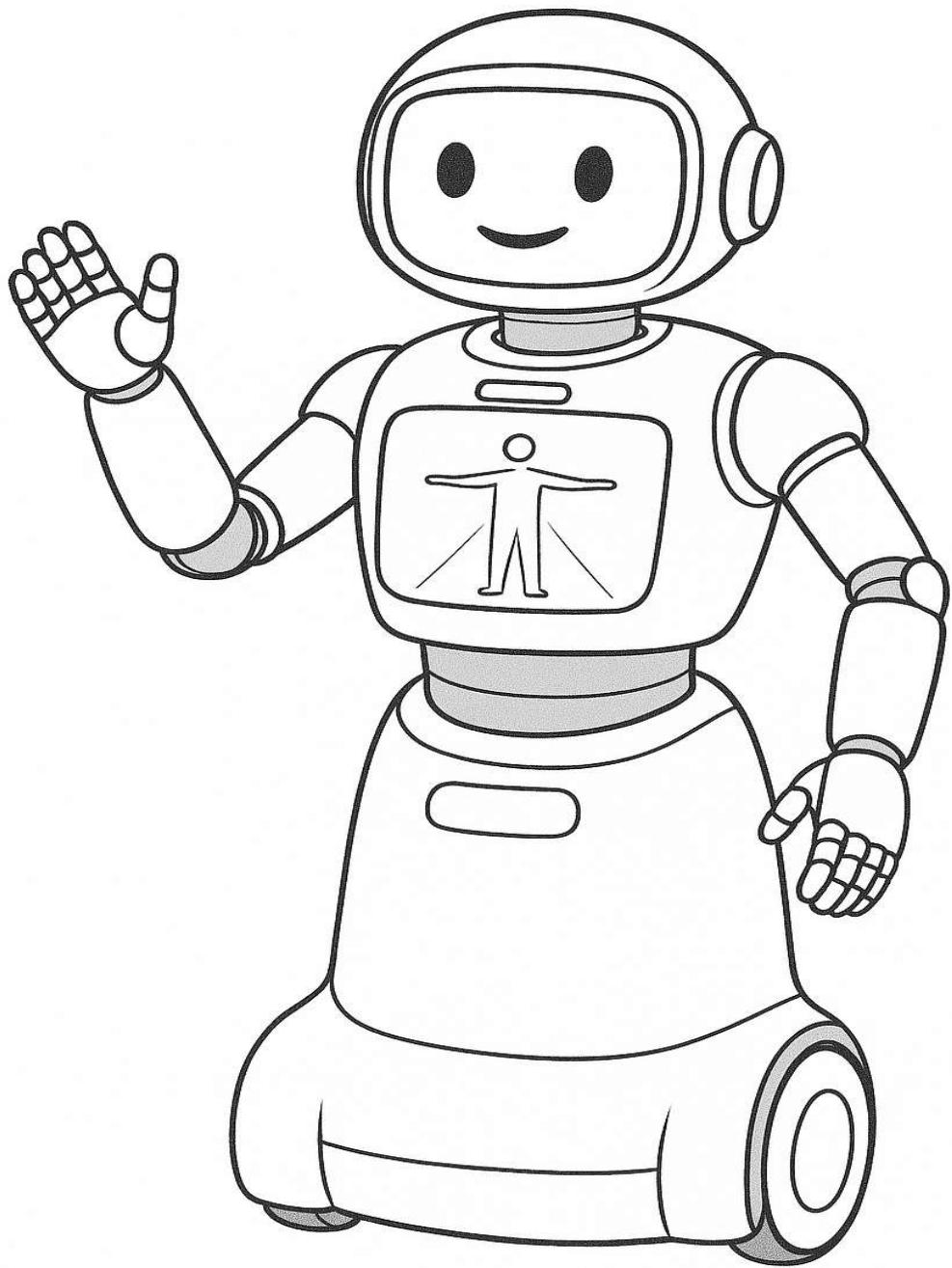
- Adjustable arms and hands with a soft but firm grip for assisting with exercises.
 - Holographic projection from its chest to demonstrate exercises visually.
 - Built-in speech generation for instructions, encouragement, and feedback.
 - Autonomous mobility (it can follow patients around therapy rooms).
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Sketch

ITAI1370

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Automation Learners



Functionality and AI Integration

AI Integration: Therabot uses AI to:

- Personalize therapy sessions based on a patient's recovery progress.
- Recognize and adapt to patients' emotional states using facial and voice recognition.
- Autonomously guide patients through exercises, monitoring form, and suggesting corrections.

Tasks Performed Autonomously:

- Conducting physical therapy routines.
- Giving motivational feedback.
- Monitoring patient vitals (heart rate, oxygen saturation) during sessions.

Interaction with Humans and the Environment:

- It uses a combination of natural language processing (NLP) and computer vision to understand patient commands and body movements.
- Therabot's AI updates therapy routines based on patient improvement, doctor instructions, and patient fatigue.

Sensors and Inputs:

- **Cameras:** Depth-sensing cameras for 3D movement tracking.
- **Microphones:** Multi-directional microphones for voice recognition.
- **Touch sensors:** In its hands and arms for detecting pressure and assisting without injury.

- **Environmental sensors:** These are used for obstacle detection and safe navigation around therapy rooms.
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Ethical Analysis

Potential Ethical Implications:

- **Privacy:** Storing and processing patient health data could risk breaches.
- **Safety:** Malfunctions could physically harm patients during therapy sessions.
- **Job Displacement:** Human physical therapists might fear replacement by Therabots.
- **Societal Impact:** Over-reliance on robots might reduce human interaction in healthcare, affecting emotional recovery.

Solutions and Guidelines:

- **Privacy Protection:** Use end-to-end encryption for all patient data and limit storage to local systems unless patients consent.
- **Safety Protocols:** Regular maintenance checks, built-in emergency stop mechanisms, and supervised use during initial therapy.
- **Support for Human Workers:** Position Therabot as a **support tool** rather than a replacement for human therapists, helping manage more patients and reducing therapist burnout.
- **Maintaining Human Connection:** Ensure Therabot promotes human involvement by reminding patients to connect with their therapists regularly.

Research Insights Integrated

- From **Murphy's "Introduction to AI Robotics"**, understanding basic autonomy and sensing helped shape Therabot's capability to adjust to its environment without constant human control.
 - From the **Nature Machine Intelligence** article on AI ethics guidelines, the need for **privacy, transparency, and accountability** guided the privacy solutions and transparency protocols for Therabot.
 - The **UNESCO Ethics of Artificial Intelligence** article emphasized the importance of **fairness** and **human oversight**, influencing the idea that Therabot should *support*, not replace, human therapists.
 - The **ArXiv literature review** on AI ethics highlighted current challenges like "explainability" of AI decisions, inspiring Therabot's feature of providing patients with easy-to-understand feedback on how it makes therapy decisions.
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References

- Murphy, R. R. (2019). *Introduction to AI Robotics* (2nd ed.). MIT Press.
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- UNESCO. (2021). *Recommendation on the Ethics of Artificial Intelligence*. <https://unesdoc.unesco.org/ark:/48223/pf0000381137>
- Hagendorff, T. (2020). The Ethics of AI: A Systematic Literature Review of Principles and Challenges. *arXiv preprint arXiv:2001.09768*.