

1. Introduction

Mental health challenges among students, especially those living in hostel environments, have been widely recognized. Stress, anxiety, and academic pressures significantly impact student well-being. The **WellNest** project aims to address this issue by developing **smart mental health capsules** that provide students with private, technology-assisted relaxation spaces.

Our approach integrates **AI, IoT, VR, and biofeedback** to create a personalized relaxation experience tailored to individual stress levels and emotional states. By leveraging real-time physiological monitoring and adaptive environmental controls, **WellNest** ensures a scientifically-backed approach to mental wellness in hostels.

2. Detailed Proposed Solution

2.1 System Architecture

WellNest capsules are **modular, self-contained spaces** equipped with advanced **sensors, AI-based decision-making systems, and immersive relaxation tools**. The solution consists of:

- AI-driven Mood Personalization:** Uses EEG and PPG sensors to detect stress and recommend relaxation techniques.
- VR-based Therapy:** Provides immersive meditation, guided breathing exercises, and nature simulations.
- Biofeedback System:** Monitors heart rate, skin conductance, and breathing patterns to adapt relaxation experiences.
- Adaptive Lighting and Sound Control:** Uses LED lighting and ambient sounds to optimize relaxation and sleep.
- Privacy and Comfort Features:** Soundproofing, ergonomic seating, air purification, and temperature control.

2.2 Inputs (Information Sources and Sensors)

Category	Details
Physiological Sensors	EEG headbands, PPG sensors, heart rate monitors, skin sensors
Environmental Sensors	IoT-based temperature, humidity, and noise level detectors
User Inputs	Mobile app-based preferences, feedback-based personalization

2.3 Data Processing and Decision-Making

Process	Description	Technology Used
Data Collection	Sensors capture real-time physiological and environmental data	IoT Framework
AI-based Emotion Recognition	Detects stress and suggests personalized relaxation techniques	Deep Learning (CNNs, LSTMs)
Decision-Making Algorithm	Recommends relaxation strategies based on sensor inputs	Machine Learning Models
VR and Biofeedback Adaptation	Adjusts VR therapy and environment dynamically	VR Development Frameworks
Cloud-based Monitoring	Stores anonymized data for optimizing therapy recommendations	AWS, Firebase

2.3.1 WellNest System Flowchart

Below is a flowchart representing the data flow from inputs (sensors) to AI-based decision-making and final outputs:

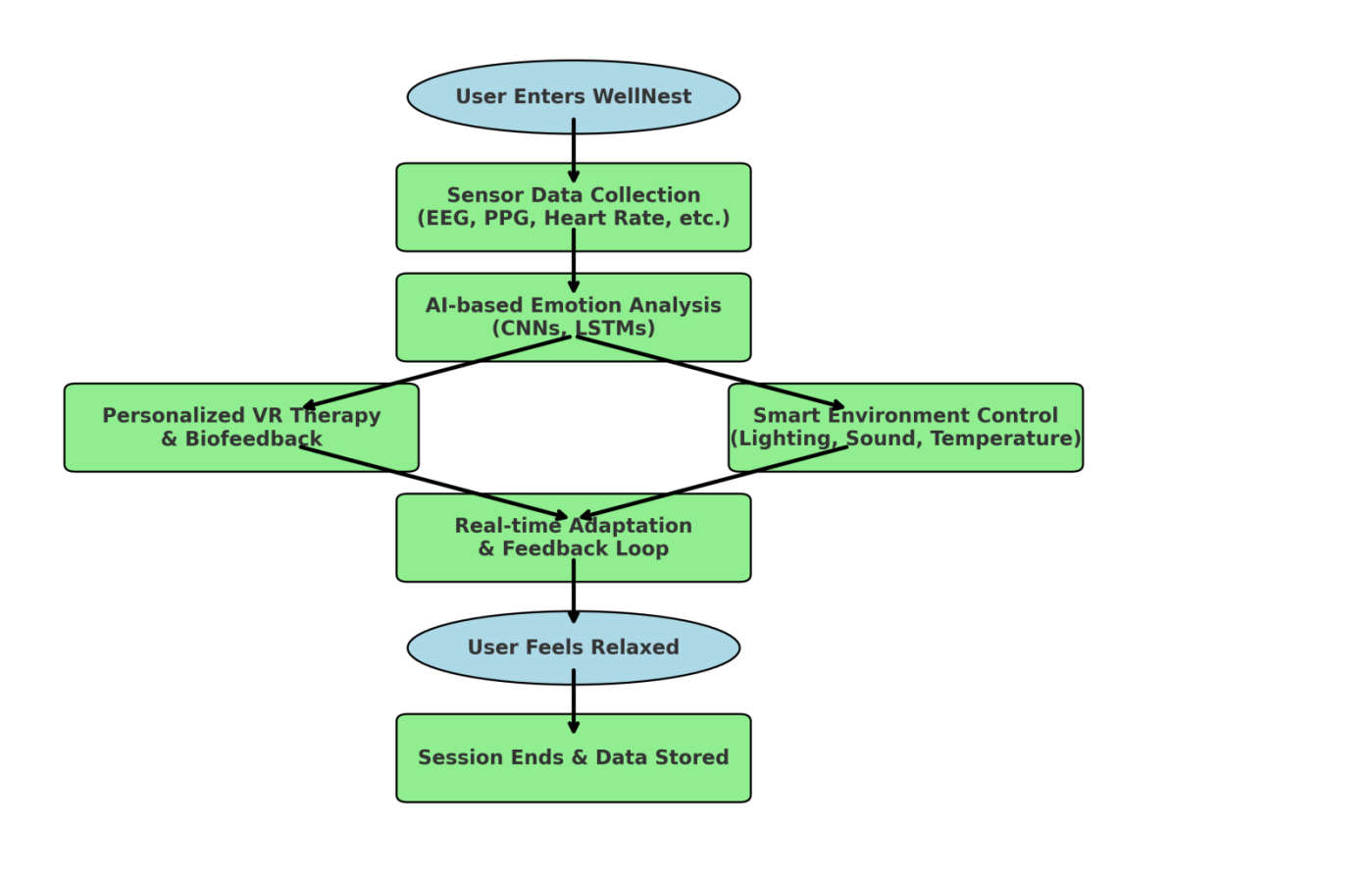


Figure 1: WellNest system flowchart illustrating the data flow from sensors to relaxation solutions.

2.4 Outputs

Category	Details
Personalized Relaxation Sessions	VR therapy, guided breathing, ASMR sounds
Health Insights	Stress trend analysis, relaxation effectiveness
Smart Environment Adjustments	Adaptive lighting, sound, and temperature control

3. Patentable Aspects

Based on our innovation, the following components of **WellNest** may be patentable:

- AI-powered Personalized Relaxation Therapy System** – Combining real-time stress monitoring with adaptive AI.
- Integrated VR and Biofeedback-driven Relaxation Mechanism** – Unique use of physiological feedback to modify VR therapy.
- Modular Adaptive Capsule Design** – Compact, scalable capsule design for hostels.
- Real-time Smart Environment Optimization Algorithm** – AI-controlled temperature, sound, and lighting adjustments.

4. Cost Estimation (5-Year Operational Plan)

Using the provided hostel building drawings, we have estimated the **cost for 5-year deployment** of WellNest capsules:

4.1 Initial Installation Cost (Per Capsule)

Component	Cost (INR)
Structural Shell & Enclosure	50,000
Smart Sensors (EEG, PPG, Temp, etc.)	10,000
AI-based Personalization System	15,000
VR Setup (Headset, Speakers, Content)	20,000
Biofeedback System	15,000
Power & Connectivity Setup	5,000
Installation & Setup	5,000
Total Per Capsule	120,000

4.2 Operational & Maintenance Cost (Yearly)

Expense	Annual Cost (INR)
Maintenance & Repairs	5,000 per capsule
Software Updates & Cloud	3,000 per capsule
Cleaning & Sanitization	2,000 per capsule
Total Annual (Per Capsule)	10,000

4.3 5-Year Cost Estimate

Expense	Cost (INR, per capsule)
Initial Installation	120,000
5-Year Operational Cost	50,000
Total (Per Capsule, 5-Year)	170,000

5. Conclusion

WellNest provides a **scalable, cost-effective solution** to improve student mental well-being in hostels. By leveraging **AI, IoT, VR, and biofeedback**, WellNest creates **personalized relaxation experiences** tailored to each user's stress levels. The project is designed to be **affordable, scalable, and seamlessly integrated** into existing hostel infrastructures.

6. References & Citations

- Cunningham, N. R., & Wasil, A. R. (2021).** *The Role of Virtual Reality in Mental Health Treatment: Current Trends and Future Directions*. Journal of Psychiatric Research, 138, 197-210.
DOI: <https://doi.org/10.1016/j.jpsychires.2021.04.008>
- National Institute of Mental Health (2022).** *Technology-Based Mental Health Interventions*.
Retrieved from: <https://www.nimh.nih.gov/health/topics/technology-and-the-future-of-mental-health-treatment>
- Goyal, M., Singh, S., Sibinga, E. M., & Gould, N. F. (2014).** *Meditation Programs for Psychological Stress and Well-being: A Systematic Review and Meta-analysis*. JAMA Internal Medicine, 174(3), 357-368.
DOI: <https://jamanetwork.com/journals/jamainternalmedicine/fullarticle/1809754>
- Oculus Research (2023).** *VR Therapy: Applications in Stress Reduction and Cognitive Behavioral Therapy*. White Paper.
Retrieved from: <https://www.oculus.com>
