

PhysioBuddy: A Real-World Django-React System for Remote Physiotherapy Pose Assessment

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Abstract - The demand for remote physical therapy solutions has surged, yet verifying patient adherence at home remains a persistent challenge. Traditional telehealth applications struggle with monitoring real-time biomechanical accuracy, often relying on subjective self-reporting. This manuscript presents PhysioBuddy, an advanced web-based platform engineered to automate rehabilitation tracking. The proposed system integrates a decoupled architecture using React.js for the client interface and Django Channels configured with a Daphne ASGI server for stateful WebSocket data transmission. To achieve clinical-grade tracking without requiring high-end hardware, the platform employs a neuro-symbolic artificial intelligence pipeline. Google's MediaPipe Pose model acts as the perception layer to extract three-dimensional joint coordinates. These coordinates are subsequently processed by deterministic, mathematical state machines that calculate joint angles and validate exercise execution based on strict clinical thresholds. The deployment on zero-cost cloud tiers demonstrates the system's economic viability and low-latency performance. The findings indicate that this framework effectively translates physical motions into quantitative compliance metrics, offering a reliable and scalable solution for remote physiotherapy.

Key Words: Tele-rehabilitation, Neuro-Symbolic AI, Pose Estimation, WebSockets, Django Channels, Biomechanics.

1. INTRODUCTION

The landscape of medical recovery and physical therapy relies heavily on consistent, accurate repetitive motions. However, the transition from in-clinic supervision to unmonitored home care often results in a steep decline in patient adherence. Without direct oversight, patients frequently perform exercises with improper posture, risking further musculoskeletal injury and prolonging recovery times. Existing digital solutions typically offer static instructional media or rely on manual logbooks, which fail to provide actionable, real-time corrections.

To bridge this critical gap, this paper introduces a centralized, intelligent web application designed to act as an automated digital physiotherapist. By leveraging modern full-stack web technologies alongside lightweight computer vision models, the system processes live video feeds to provide instantaneous feedback. This research outlines the architectural decisions, asynchronous networking protocols, and algorithmic state machines required to build a highly responsive, secure, and accurate telehealth platform.

2. ARCHITECTURAL FRAMEWORK

The system's architecture is deliberately decoupled to isolate presentation logic from heavy mathematical processing, ensuring smooth data flow across the network.

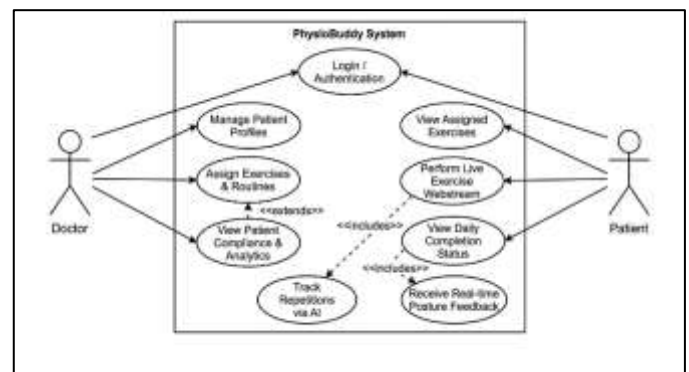


Fig 2.1: Use Case Diagram

2.1 Presentation Interface (Frontend)

The client-facing layer is constructed using the React.js library. This component-driven approach allows for dynamic rendering of separate interfaces tailored for medical professionals and patients. The interface captures continuous media streams via the user's web camera, converting individual image frames into compressed Base64 strings. These strings are aggressively dispatched over the network at optimal intervals to maintain fluidity without saturating bandwidth.

2.2 Asynchronous Core (Backend)

Standard synchronous web servers are incapable of maintaining the persistent connections required for live video processing. Consequently, the backend infrastructure replaces standard WSGI protocols with an Asynchronous Server Gateway Interface (ASGI), powered by Daphne and Django Channels. This configuration permits the server to handle conventional RESTful API requests (for user authentication and dashboard data) simultaneously with high-frequency WebSocket traffic.

2.3 Data Persistence

To guarantee data integrity and support concurrent access from multiple clinics, the system utilizes a PostgreSQL relational database. This layer securely archives user profiles, doctor assignments, and daily compliance logs, fully abstracting the data away from the ephemeral compute instances.

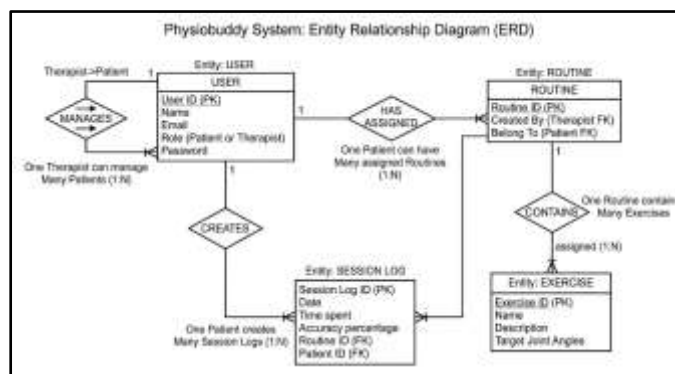


Fig 2.3.1: ER Diagram

3. NEURO-SYMBOLIC TRACKING METHODOLOGY

Unlike conventional "black-box" deep learning approaches that require massive computational overhead and lack explainability, this platform utilizes a hybrid neuro-symbolic pipeline.

3.1 Neural Perception Layer

The system incorporates the MediaPipe Pose framework as its primary sensory mechanism. Incoming Base64 arrays are decoded and passed through this highly optimized convolutional network, which successfully identifies 33 distinct anatomical landmarks in three-dimensional space, utilizing solely the server's CPU.

3.2 Symbolic Execution and Vector Geometry

The coordinates extracted by the neural network are passed into custom, rule-based algorithms. Human limbs are modelled as mathematical vectors. By computing the Euclidean dot products of intersecting anatomical points (e.g., shoulder, elbow, and wrist), the system calculates precise internal joint angles.

These dynamic angles are fed into customized state machines. For instance, during a bicep curl, the state machine monitors the transition from full arm extension (> 150 degrees) to peak contraction (< 35 degrees). A repetition is strictly registered only when the user completes both the concentric and eccentric phases without violating form constraints.

4. IMPLEMENTATION OUTCOMES

The deployment of the proposed architecture yielded significant improvements over manual tracking paradigms. The integration of WebSocket protocols with the Daphne server resulted in near-zero latency, allowing patients to observe their repetition counts increment in real-time. The strict visibility guard clauses embedded within the symbolic algorithms successfully filtered out environmental noise, preventing false-positive counts in low-light conditions. Furthermore, the platform was successfully hosted using cloud-native free tiers (AWS EC2, Vercel), proving that clinical-grade motion tracking can be achieved with minimal financial overhead.

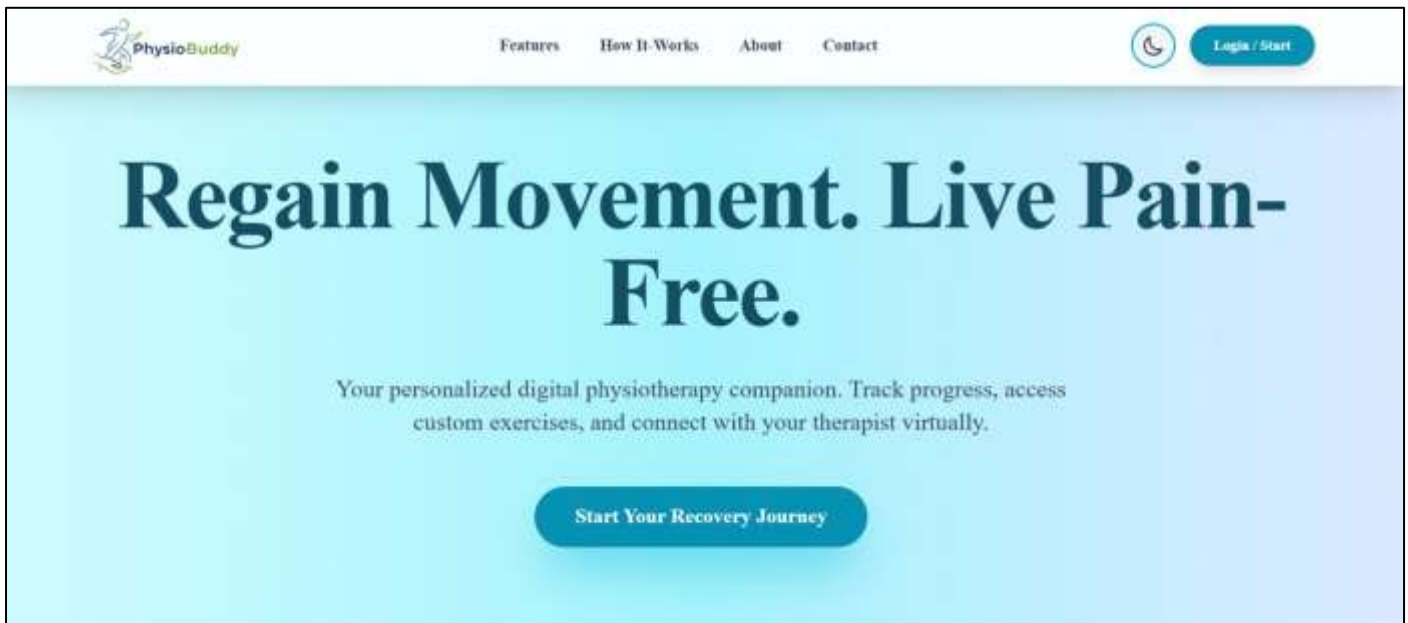


Fig 4.1: Landing Page

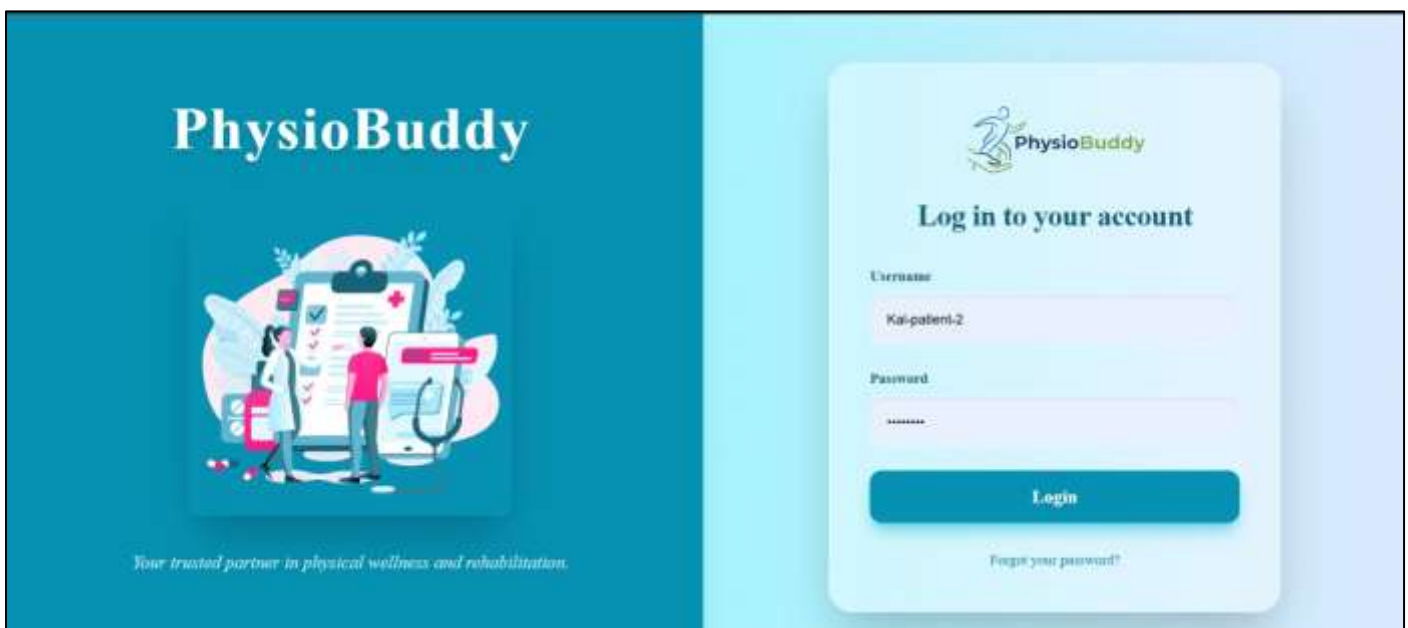


Fig 4.2: Login Page

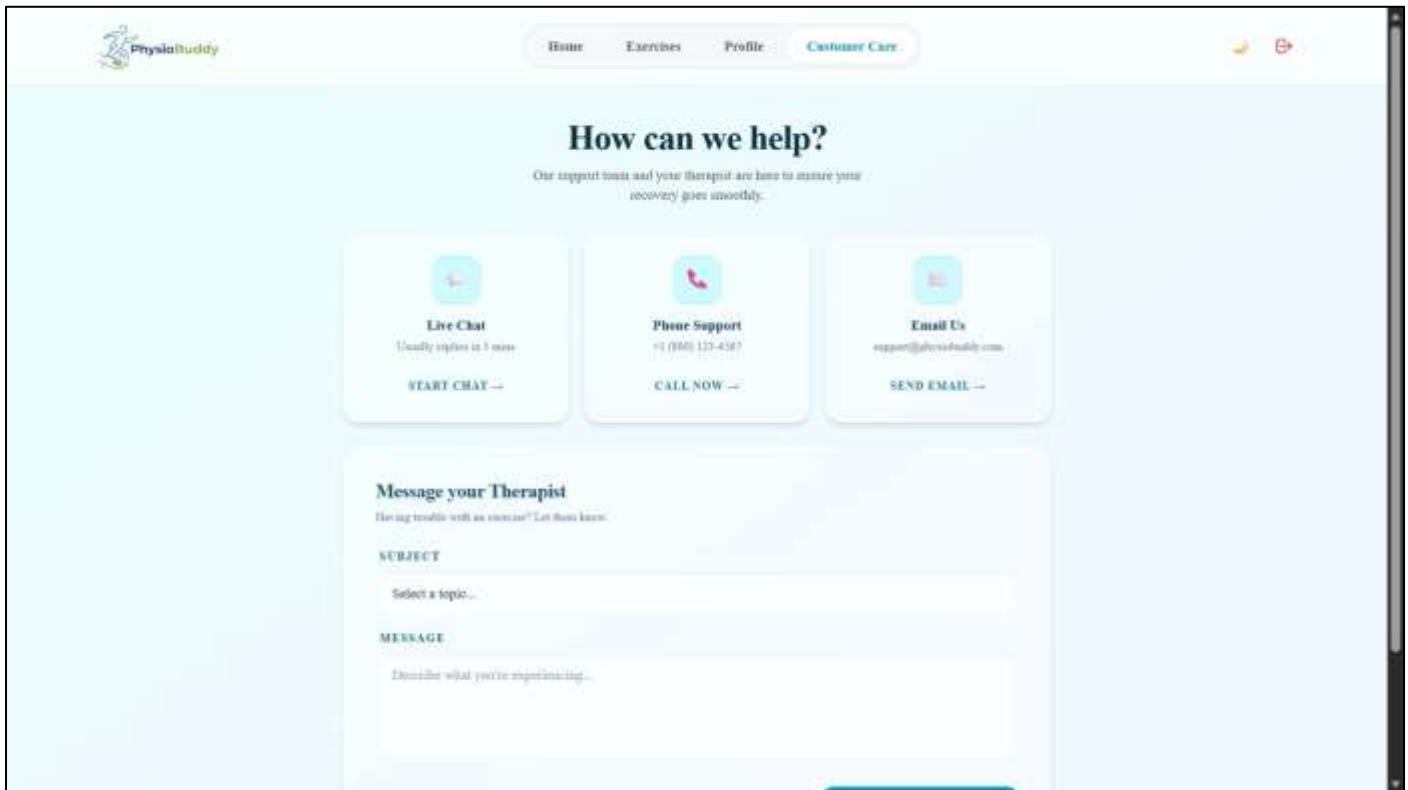


Fig 4.3: Customer Care Page

Patient Side Pages

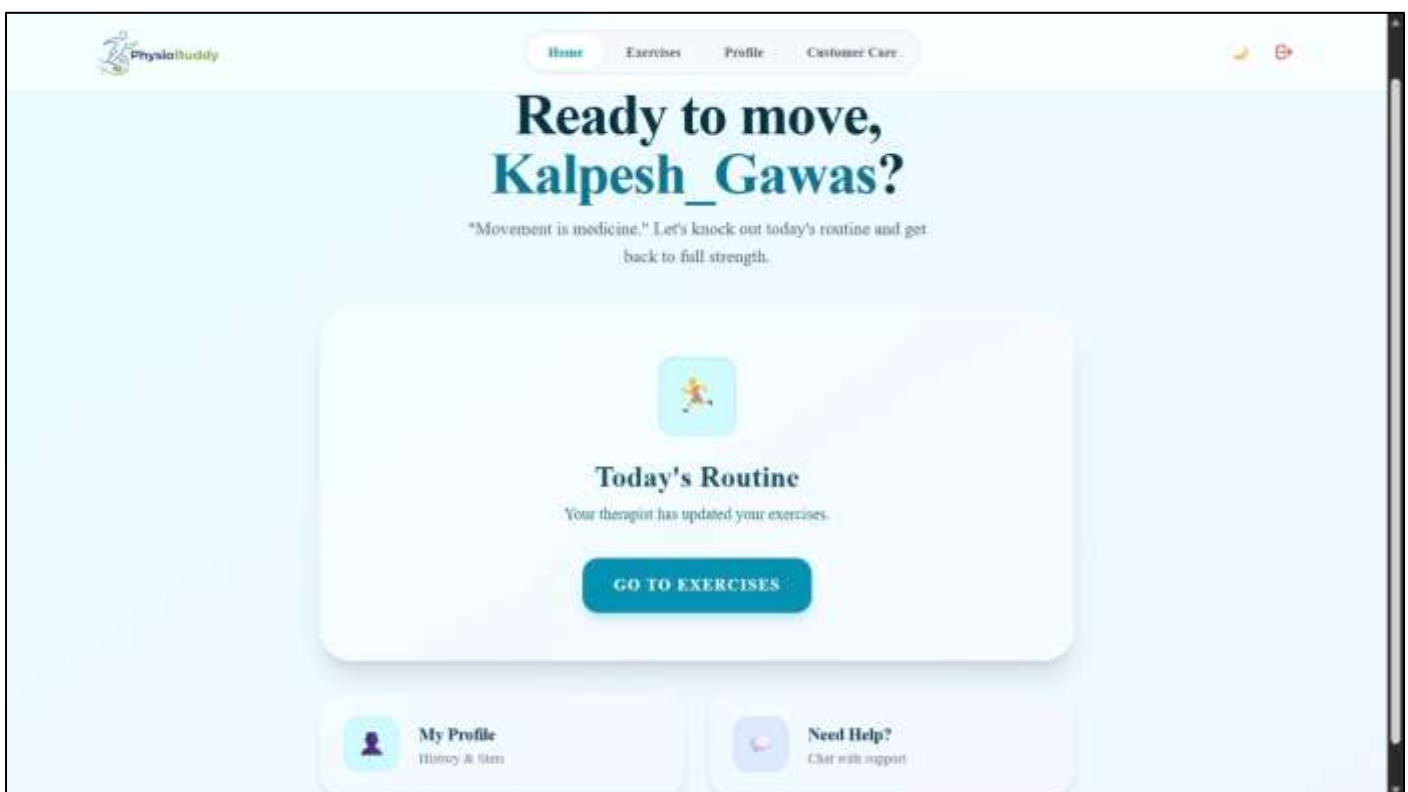


Fig 4.4: Patient Home Page

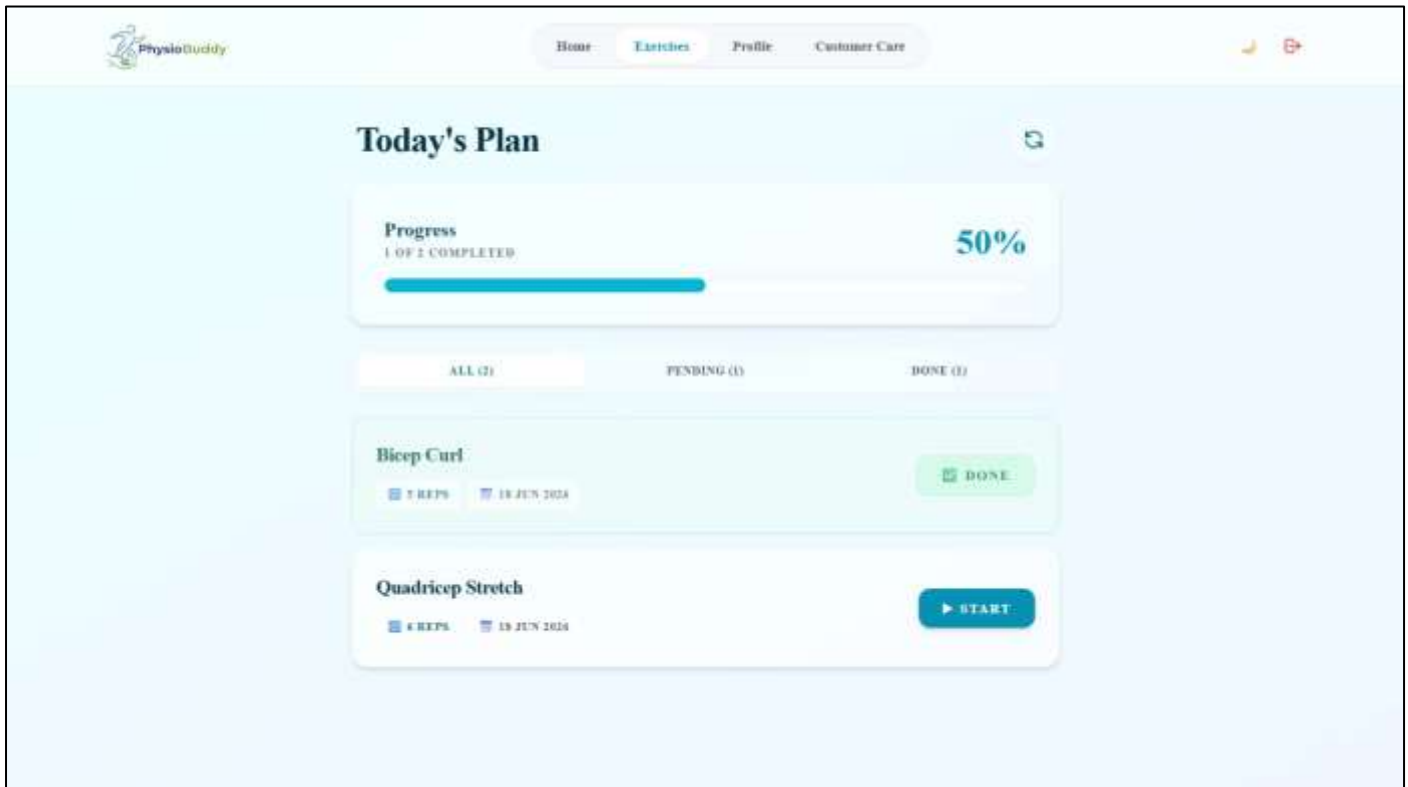


Fig 4.5: Exercise List Page

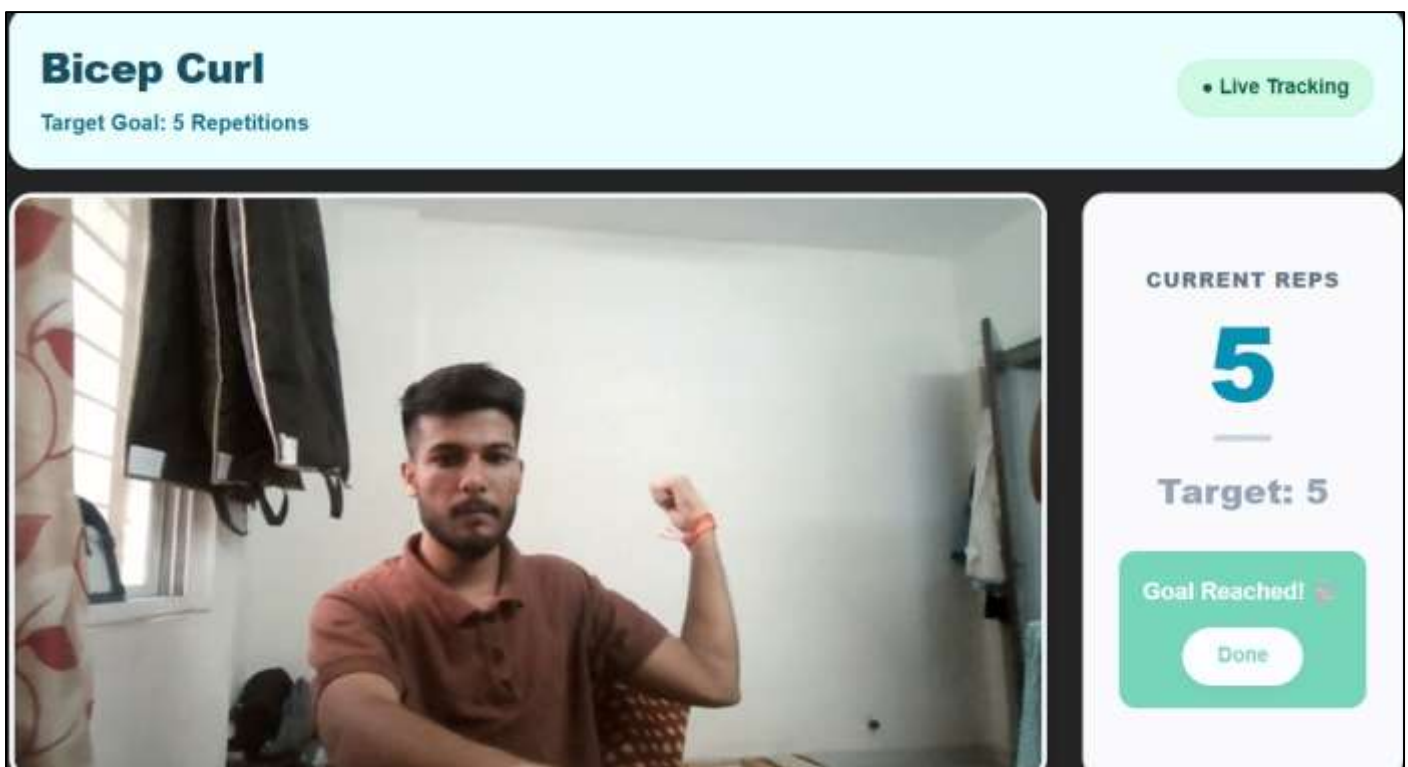


Fig 4.6: Live Exercise Tracking

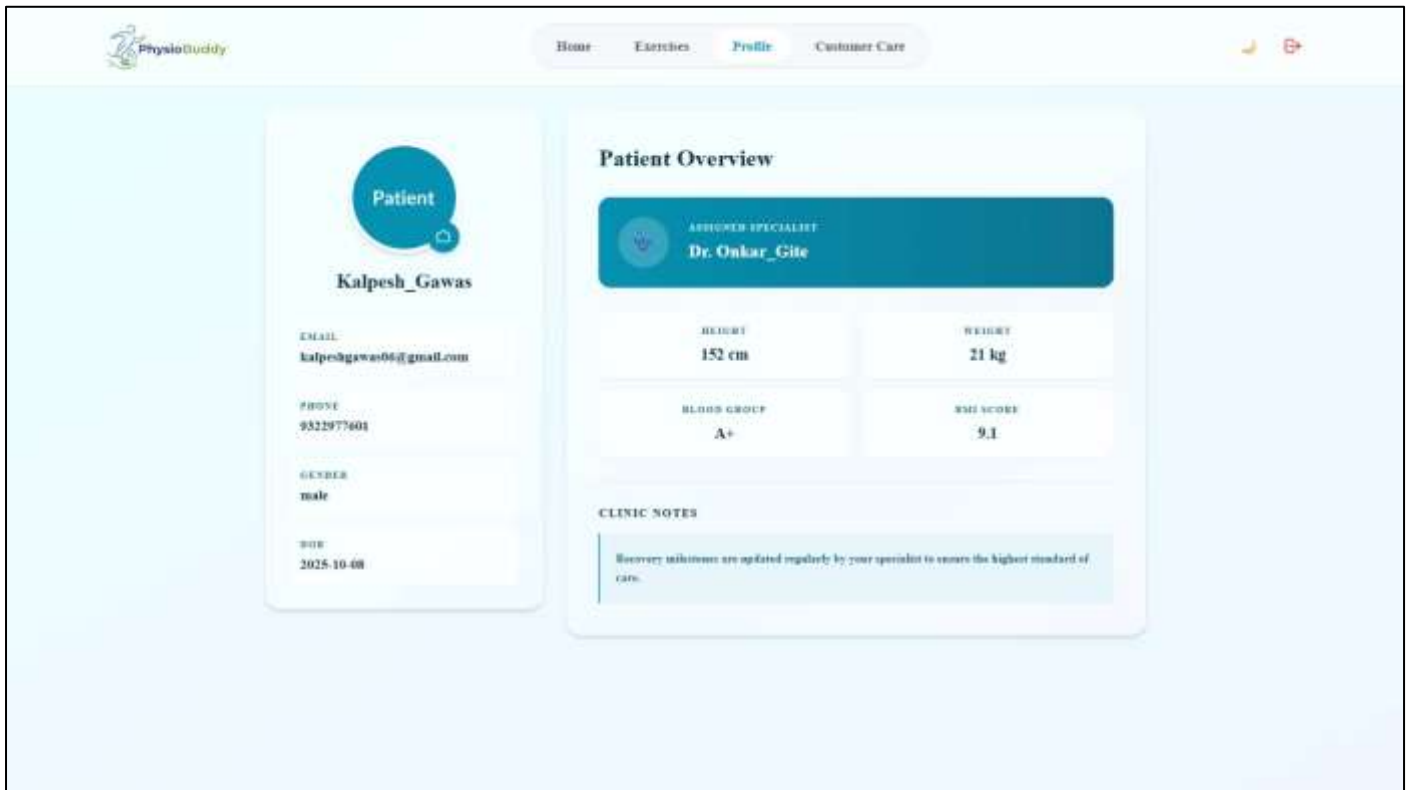


Fig 4.6: Patient Profile Page

Doctor Side Pages

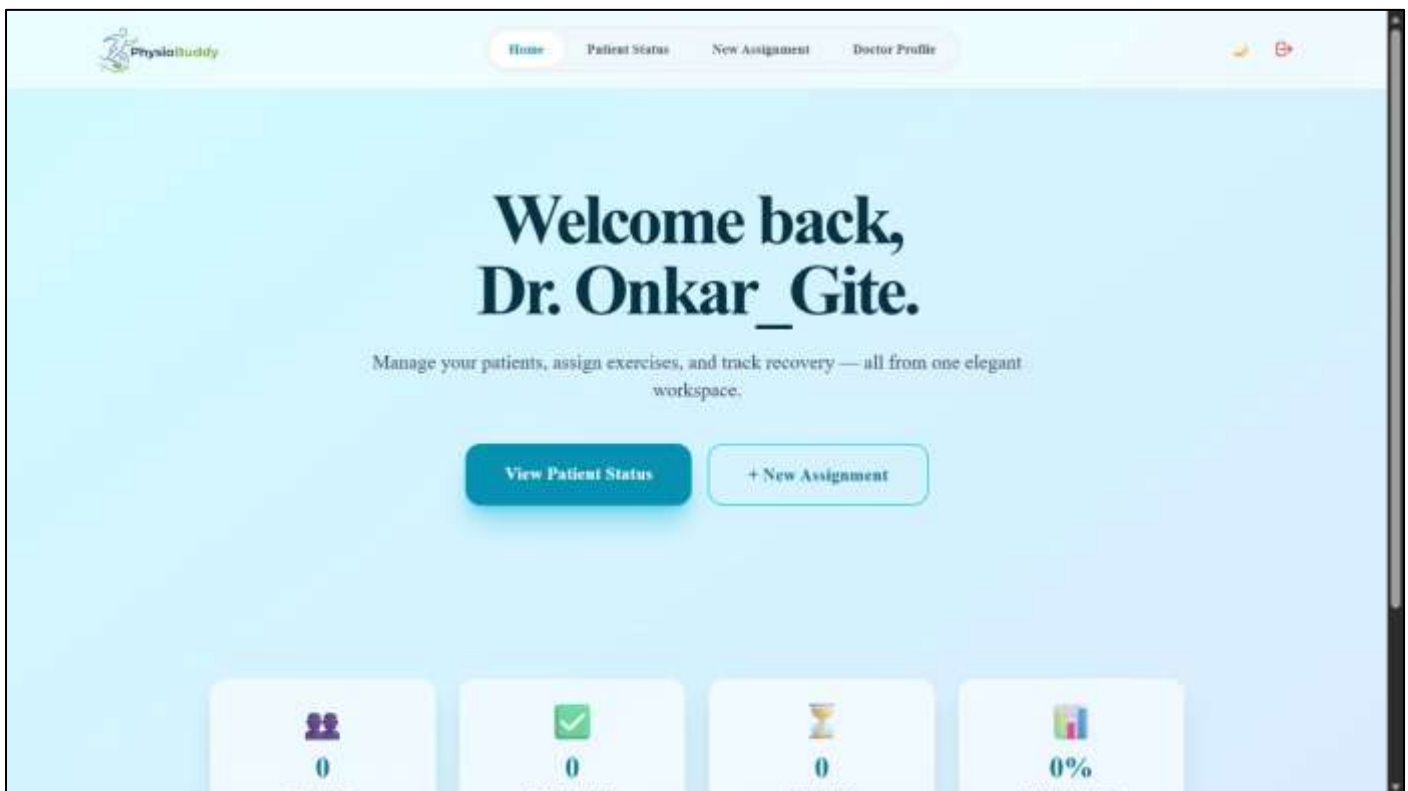
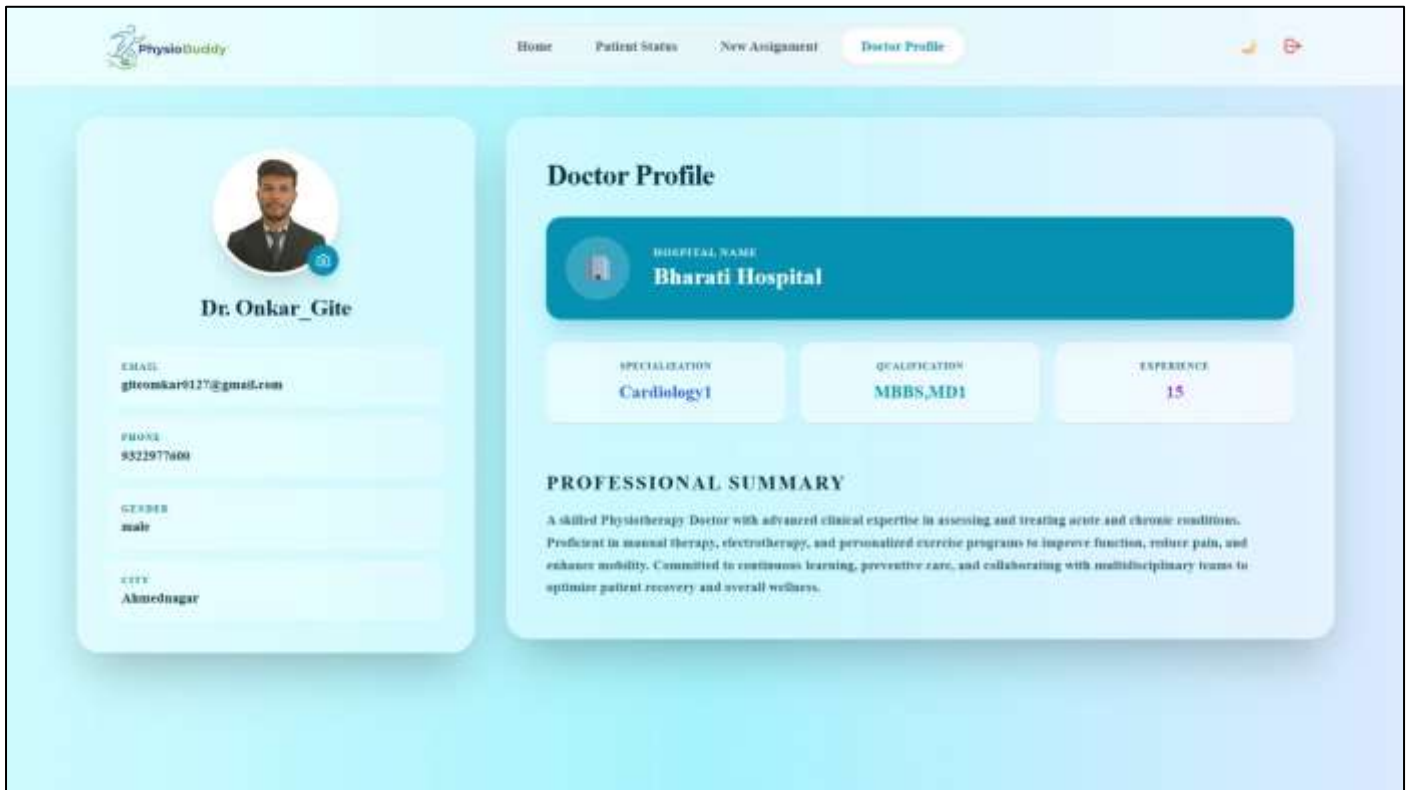
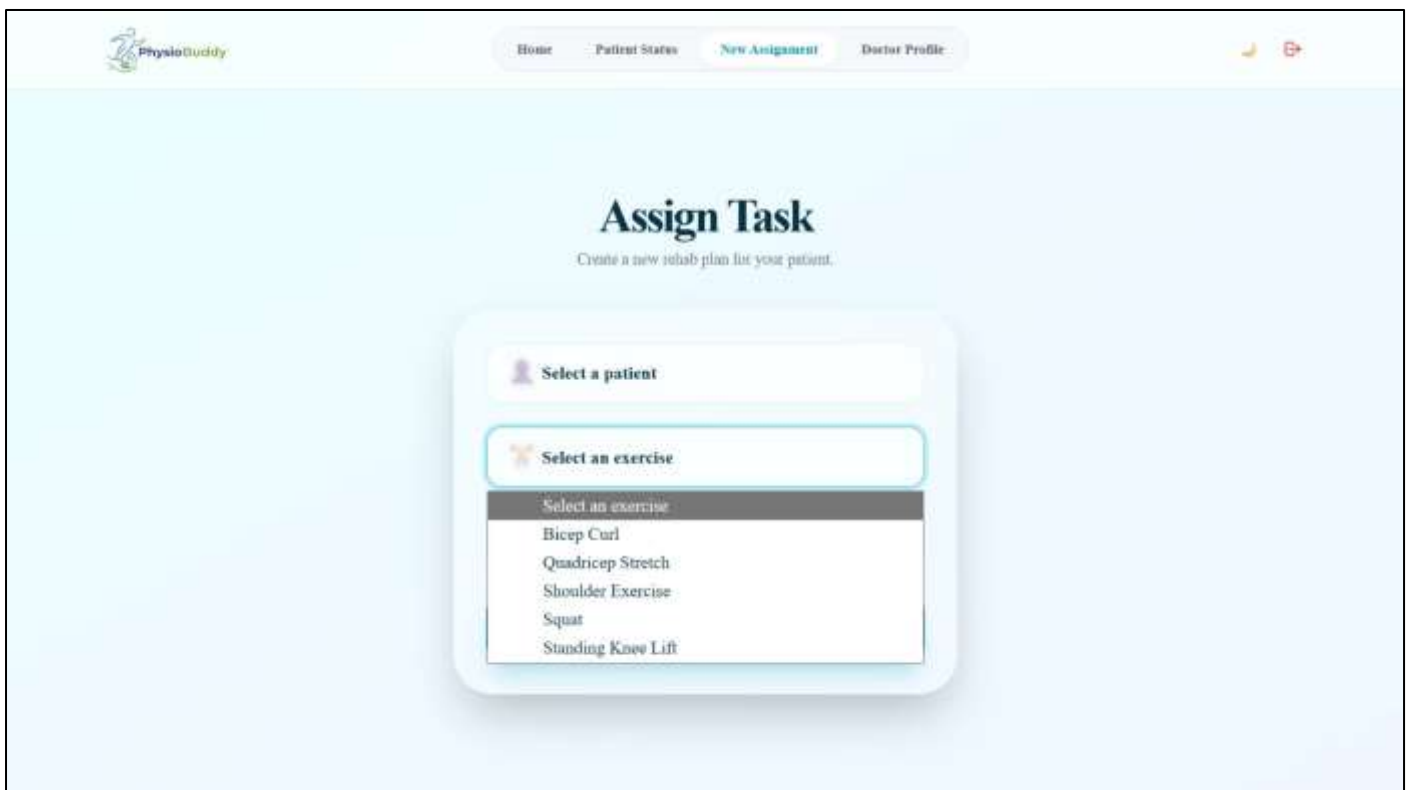


Fig 4.7: Doctor Home Page



The image shows a web interface for a doctor's profile. The header includes the PhysioDaddy logo and navigation links: Home, Patient Status, New Assignment, and Doctor Profile (which is highlighted). The main content area is divided into two columns. The left column displays the doctor's profile for Dr. Onkar_Gite, including a circular profile picture, email (giteonkar9127@gmail.com), phone (9322977600), gender (male), and city (Ahmednagar). The right column is titled 'Doctor Profile' and features a blue bar for the hospital name 'Bharati Hospital'. Below this, three boxes show the doctor's specialization (CardiologyI), qualification (MBBS,MDI), and experience (15 years). A 'PROFESSIONAL SUMMARY' section follows, describing the doctor as a skilled Physiotherapy Doctor with advanced clinical expertise in assessing and treating acute and chronic conditions, proficient in manual therapy, electrotherapy, and personalized exercise programs to improve function, reduce pain, and enhance mobility. The summary also mentions a commitment to continuous learning, preventive care, and collaborating with multidisciplinary teams to optimize patient recovery and overall wellness.

Fig 4.8: Doctor Profile Page



The image shows a web interface for assigning tasks. The header includes the PhysioDaddy logo and navigation links: Home, Patient Status, New Assignment (which is highlighted), and Doctor Profile. The main content area is titled 'Assign Task' with the subtitle 'Create a new rehab plan for your patient.' Below the title, there are two dropdown menus. The first dropdown is labeled 'Select a patient' and is currently empty. The second dropdown is labeled 'Select an exercise' and is open, showing a list of exercises: Select an exercise, Bicep Curl, Quadricep Stretch, Shoulder Exercise, Squat, and Standing Knee Lift. The 'Select an exercise' option is currently selected.

Fig 4.9: Exercise Assignment Form

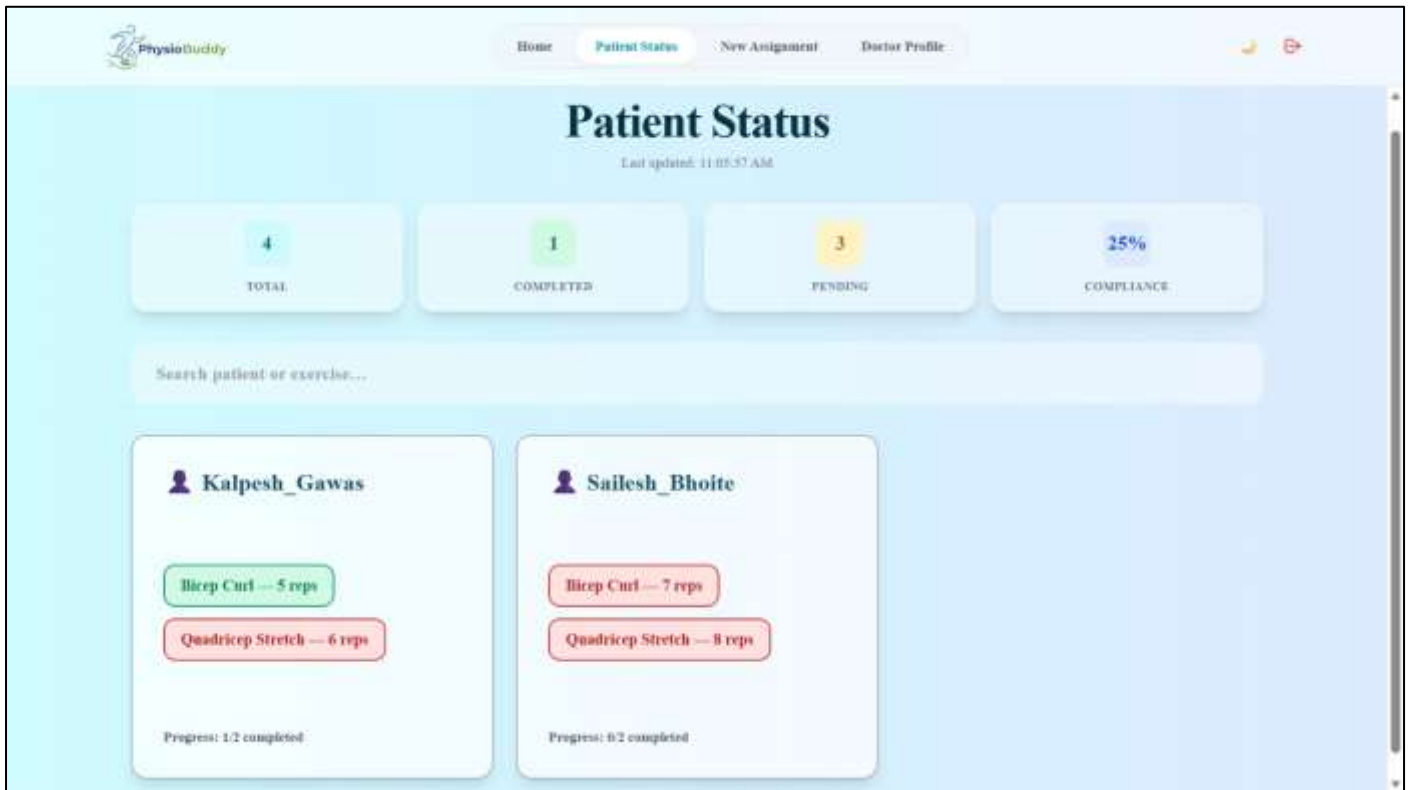


Fig 4.10: Patient Status Page

5. CONCLUSIONS

This research demonstrates the viability of integrating lightweight computer vision within asynchronous web frameworks to solve real-world healthcare challenges. The developed platform effectively eliminates the unreliability of self-reported physical therapy by providing verifiable, data-driven compliance metrics. Future iterations of this work aim to migrate the neural perception processing entirely to the client-side browser via WebAssembly, thereby further reducing server network payloads and enhancing user privacy.

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BIOGRAPHIES

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