Chapter 1

INTRODUCTION

Telerehabilitation uses **Information and Communication Technologies** (ICT) (like video calls, apps, wearables) to deliver therapy remotely, bringing services like PT, OT, speech therapy to patients at home, increasing access, convenience, and patient autonomy by reducing travel, while enabling continuous monitoring and personalized exercise guidance for conditions from stroke to orthopaedic recovery. It bridges gaps in traditional care by connecting patients with therapists via digital tools for assessment, intervention, and support, making rehab accessible anywhere, anytime.

1.Brief history of Tele rehabilitation system

Telerehabilitation's history blends early telemedicine efforts (**NASA, military**) with late 90s/early 2000s tech growth, gaining formal footing around 1998-2002 with **RERCs** and the first web-based cognitive rehab software, then expanding via video conferencing, internet apps, and increased awareness, accelerating with the **COVID-19 pandemic**, driven by technology and the need to reach remote patients affordably.

2. Modern Tele Rehabilitation System

A **modern telerehabilitation system** uses information and communication technologies (ICT) to deliver remote rehabilitation services, such as physical, occupational, or speech therapy, to patients outside of traditional clinical settings. These systems integrate a variety of technologies to enhance accessibility, personalization, and monitoring.

Chapter 2

Problem Statement

2.1 Description

A tele-rehabilitation system uses technology (video calls, apps, sensors) to deliver rehab services like therapy, monitoring, education, and coaching remotely, connecting patients and therapists without being in the same physical space for conditions from stroke to orthopaedics, improving access, convenience, and self-management. It encompasses evaluation, intervention, and progress tracking, using synchronous (real-time video) or asynchronous (store-and-forward) methods to bridge geographical gaps in care.

2.2 Challenge Statement

1. Technical & Infrastructure Barriers
2. Patient-Related Challenges
3. Clinical & Professional Challenges
4. Data Privacy & Security
5. Regulatory & Ethical Issues
6. Risks & Considerations

Chapter 3

3.1 Design Thinking Process

1. **Empathize**

- **Goal:** Understand the needs of patients, therapists, and caregivers.
- **Actions:**
- Conduct interviews with patients (especially those with mobility or neurological issues).
- Observe rehabilitation sessions to identify pain points in remote delivery.
- Map out challenges like digital literacy, motivation, and accessibility.

2. **Define**

- **Goal:** Frame the core problems clearly.
- **Actions:**
- Identify barriers such as lack of tactile feedback, poor internet access, or difficulty tracking progress.
- Create problem statements like: *"Patients need a way to stay motivated and correctly perform exercises at home without direct supervision."*

3. **Ideate**

- **Goal:** Generate creative solutions.

Actions:

- Brainstorm features: video consultations, AI-driven motion tracking, gamified exercises, wearable sensors.
- Consider hybrid models (in-person + remote).

- Involve clinicians and patients in co-design workshops.

4. **Prototype**

- **Goal:** Build tangible models of solutions.
- **Actions:**
- Develop low-fidelity prototypes (wireframes of the app, mock-ups of dashboards).
- Create functional prototypes with limited features (e.g., exercise tracking via smartphone camera).
- Simulate rehabilitation scenarios using VR or AR.

5. **Test**

- **Goal:** Validate solutions with real users.
- **Actions:**
- Pilot with small patient groups to measure usability and adherence.
- Collect feedback from therapists on clinical effectiveness.
- Refine based on outcomes (e.g., adjust exercise difficulty, improve UI for elderly patients).

3.2 Methodology

(Working procedure Flow chart with description)

Step	Patient Role	Therapist Role	System Role
Enrolment	Register, provide history	Review patient info	Store data
Assessment	Participate in video consult	Conduct evaluation	Record results
Plan Design	Agree to plan	Create personalized plan	Generate schedule
Session Scheduling	Confirm timings	Manage calendar	Send reminders
Therapy Delivery	Perform exercises	Guide via video	Track movements
Monitoring and Feedback	Wear sensors, follow guidance	Provide feedback	Log progress
Progress Evaluation	Share experience	Review reports	Generate analytics
Adjustments	Adapt exercises	Modify plan	Update system
Completion	Continue maintenance	Discharge patient	Archive records

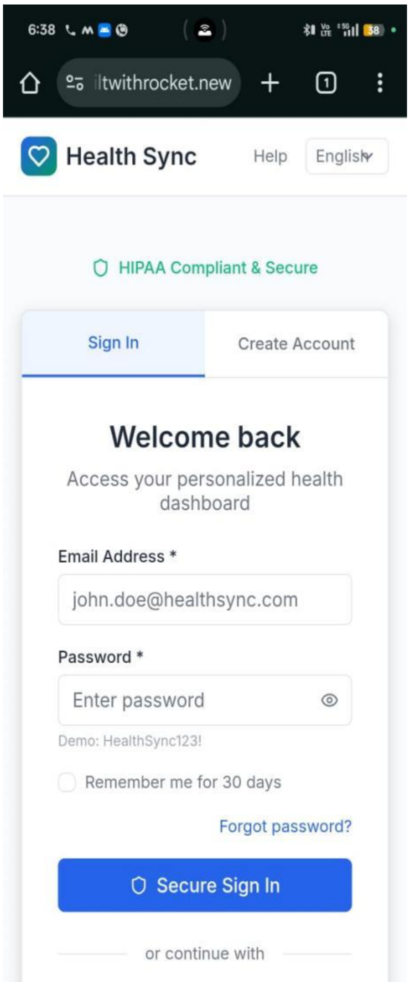
3.3 Prototype Description

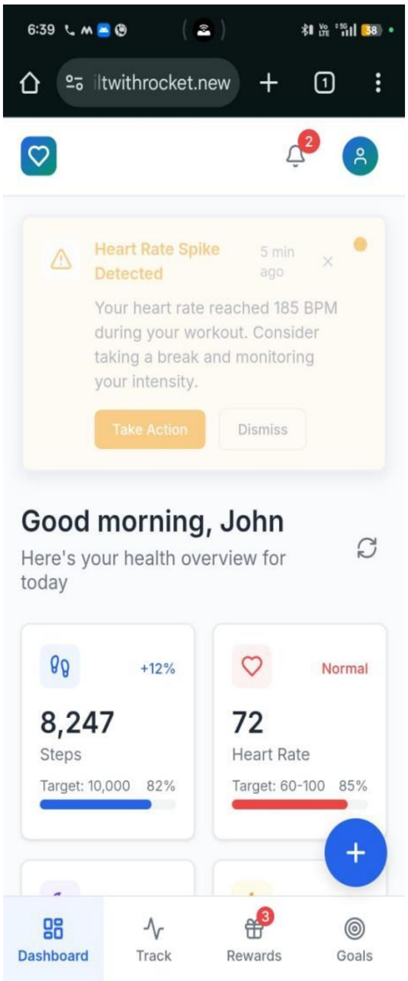
3.3.1 Materials Used (With specific images, descriptions and specifications)

https://health-tracker-qtun523.public.builtwithrocket.new

Project title: Tele Rehabilitation
System

3.3.2 System Diagram (Circuit connection diagram/Software architecture/product architecture with description)





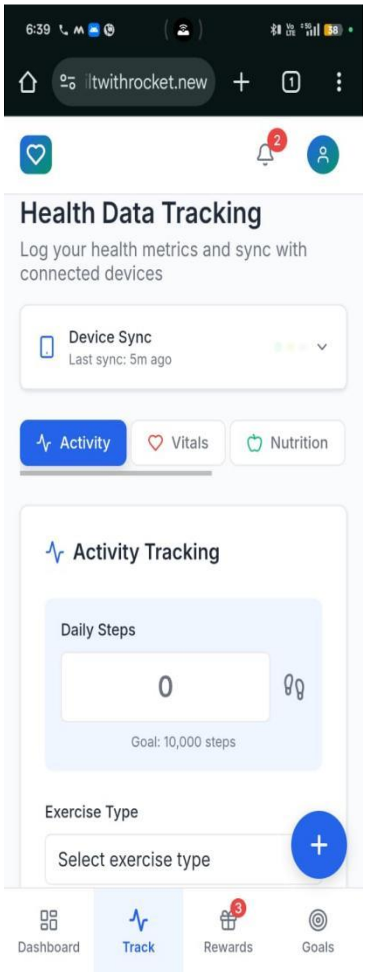
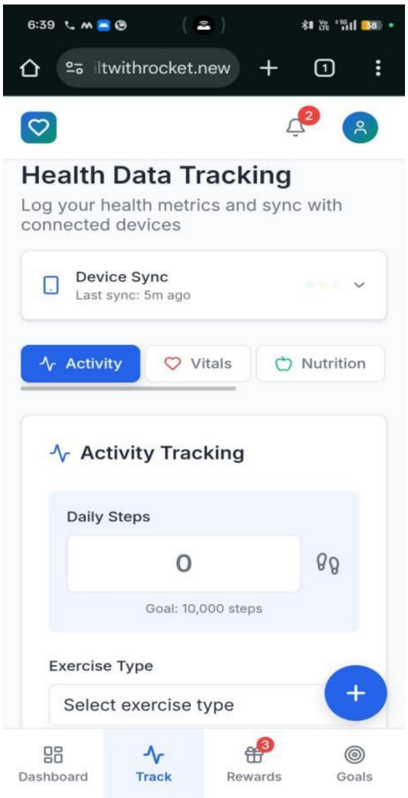
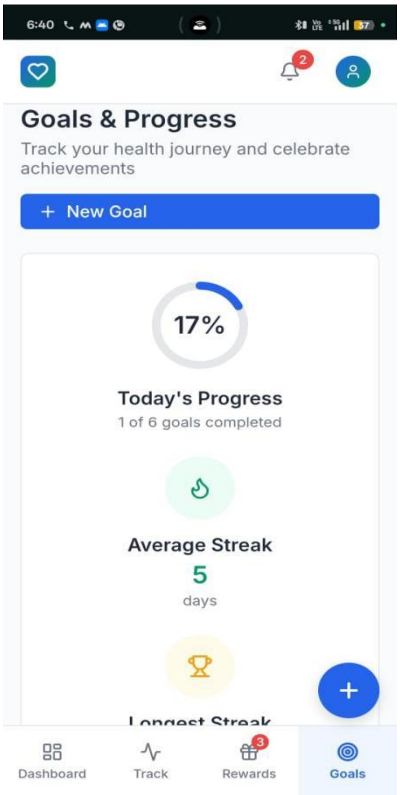


Fig 3.1 Fig 3.2 Fig 3.3





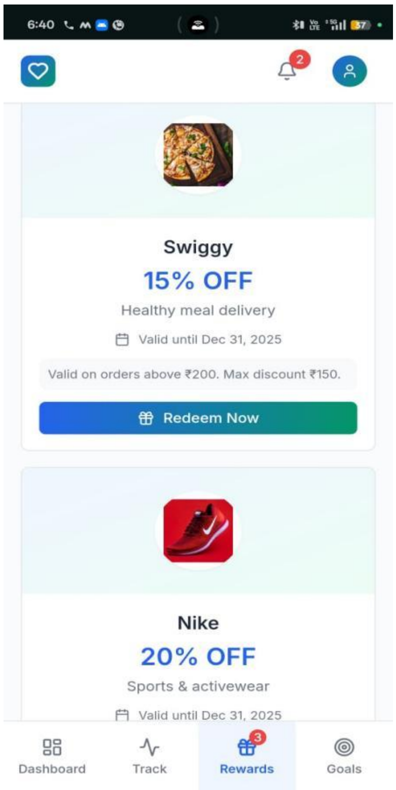


Fig 3.4 **Fig 3.5** **Fig 3.6**

Chapter 4

Implementation

(Insert codes used in this project)

```
package com.punarnava.rehabapp;


import android.os.Bundle;
import android.view.View;
import android.widget.*;
import androidx.appcompat.app.AppCompatActivity;
```

```
public class MainActivity extends AppCompatActivity {

    TextView heartRateText, progressText, voucherText;
    EditText journalInput;
    Button saveJournalBtn, uploadVideoBtn, chatbotBtn;

    int heartRate = 76;
    int completedDays = 5;

    @Override
    protected void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.activity_main);

        heartRateText = findViewById(R.id.heartRate);
        progressText = findViewById(R.id.progress); voucherText =
findViewById(R.id.voucher);
        journalInput = findViewById(R.id.journalInput);
        saveJournalBtn = findViewById(R.id.saveJournal);
        uploadVideoBtn = findViewById(R.id.uploadVideo);
        chatbotBtn = findViewById(R.id.chatbotBtn);

        updateUI();
```

```
        saveJournalBtn.setOnClickListener(v -> {
            Toast.makeText(this, "Journal Saved. Healing logged.",
Toast.LENGTH_SHORT).show();
        });

        uploadVideoBtn.setOnClickListener(v -> {
            Toast.makeText(this, "Rehab video uploaded for review.",
Toast.LENGTH_SHORT).show();
});
 }

    private void updateUI() {
        heartRateText.setText("Heart Rate: " + heartRate + " bpm");
        progressText.setText("Exercise Streak: " + completedDays + "
days");

        if (completedDays >= 7) {
            voucherText.setText("Voucher Unlocked 🎉");
        } else {
            voucherText.setText("Voucher in " + (7 - completedDays) + "
days");
        }
}}
```

Chapter 5

Results and Analysis

User Testing & Feedback

Sample:

Participants: Darsh Kumar Choudhary, Dhanush Panta, Dhruva Kantan N T

Quantitative Results:

Qualitative Feedback:

Chapter 6

Conclusion & Future Work

Tele-rehabilitation represents a transformative step in healthcare delivery, bridging the gap between patients and clinicians through technology. By combining **AI-driven monitoring, wearable integration, video feedback, progress tracking, and patient education**, such systems make rehabilitation more **accessible, personalized, and cost-effective**.

Future Work:

1. Advanced AI & Personalization
2. Integration with Emerging Technologies
3. Enhanced Patient Engagement
4. Clinical & Hospital Integration
5. Security & Compliance
6. Scalability & Accessibility

References

Research Papers

- Escobar, I. (2018). *Virtual System using Haptic Device for Real-Time Tele-Rehabilitation of Upper Limbs.* Springer

- IEEE. (2023). *The Tele-Rehabilitation as a Service (TRaaS) Project: Rationale, Study Design, and Implementation.* IEEE Xplore.
- GitHub. (2025). *OpenTera – Open TeleRehabilitation Server and Micro-Services.* Retrieved from
- Oracle. (n.d.). *Java Networking Documentation*
- WHO. (2020). *Global Strategy on Digital Health 2020–2025.* World Health Organization.

Text books

1. https://doi.org/10.1007/978-3-319-95282-6_10
2. https://ieeexplore.ieee.org/document/10254814
3. https://github.com/topics/telerehabilitation
4. https://docs.oracle.com/javase/tutorial/networking/

Annexures

Annexure A – User Feedback Forms

Annexure B – Iteration Notes

Annexure C – Team Roles