

# Independence Mobility Device (IMD) & Rehabilitation Application (RA)

Ha Thi Xuan Chi, PhD



# Contents

- Introduction
- Problem statements
  - Unmet global need for rehabilitation
  - Barriers to Accessing Assistive Technologies LMIC
- IMD & RA
  - Benefits
  - Features
  - Functions
  - Illustrations
- Conclusions
- Future improvements

# Introduction



**WHO:**

**1.3 billion** disabled people

**16%** of the world's population

**2.4 billion** need rehabilitation

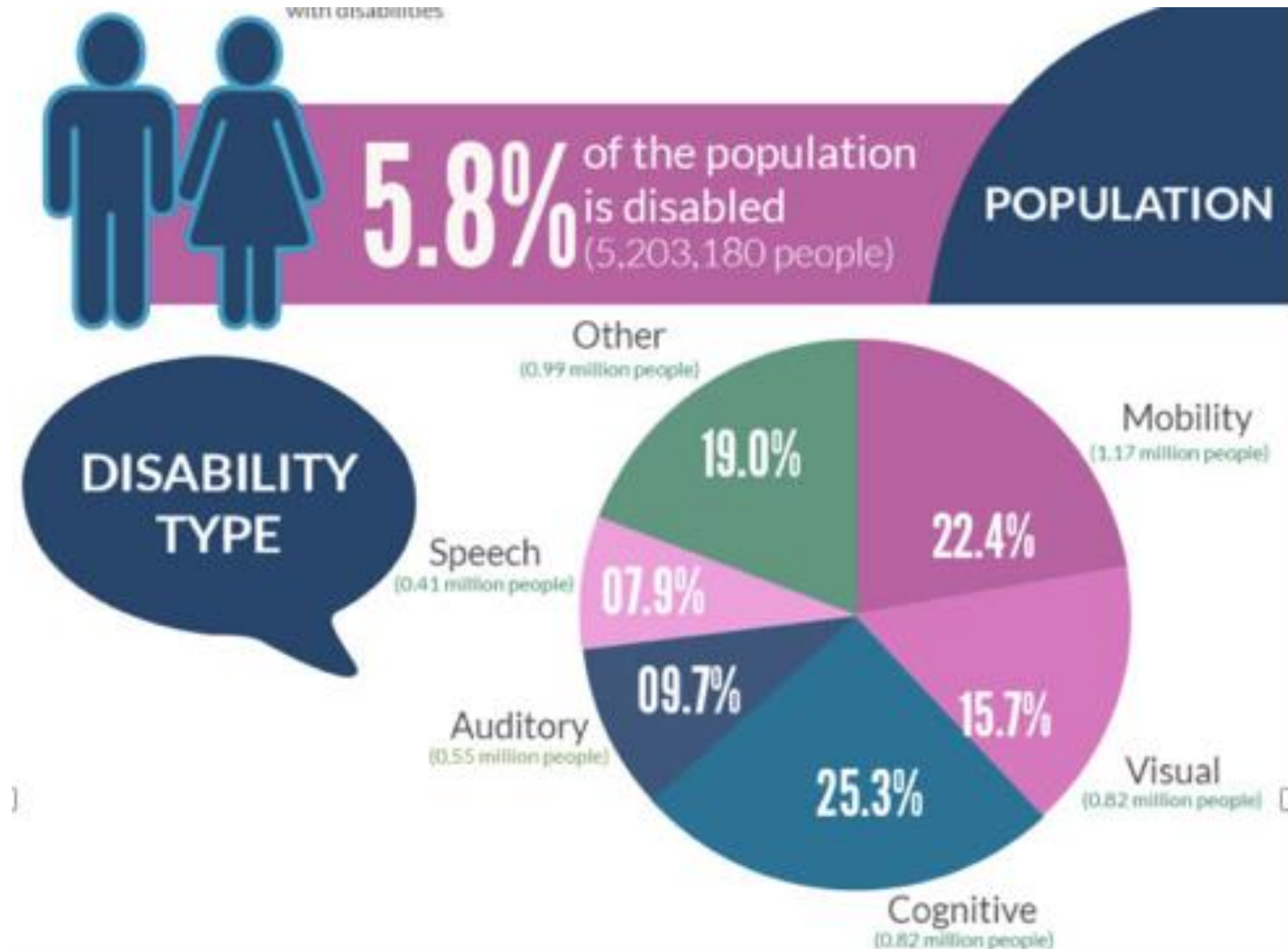
**> 50%** lack needed rehab services in **LMIC**

**87%** of stroke-related disability occurring in **LMIC**

**>2.5 billion** people need one or more assistive products

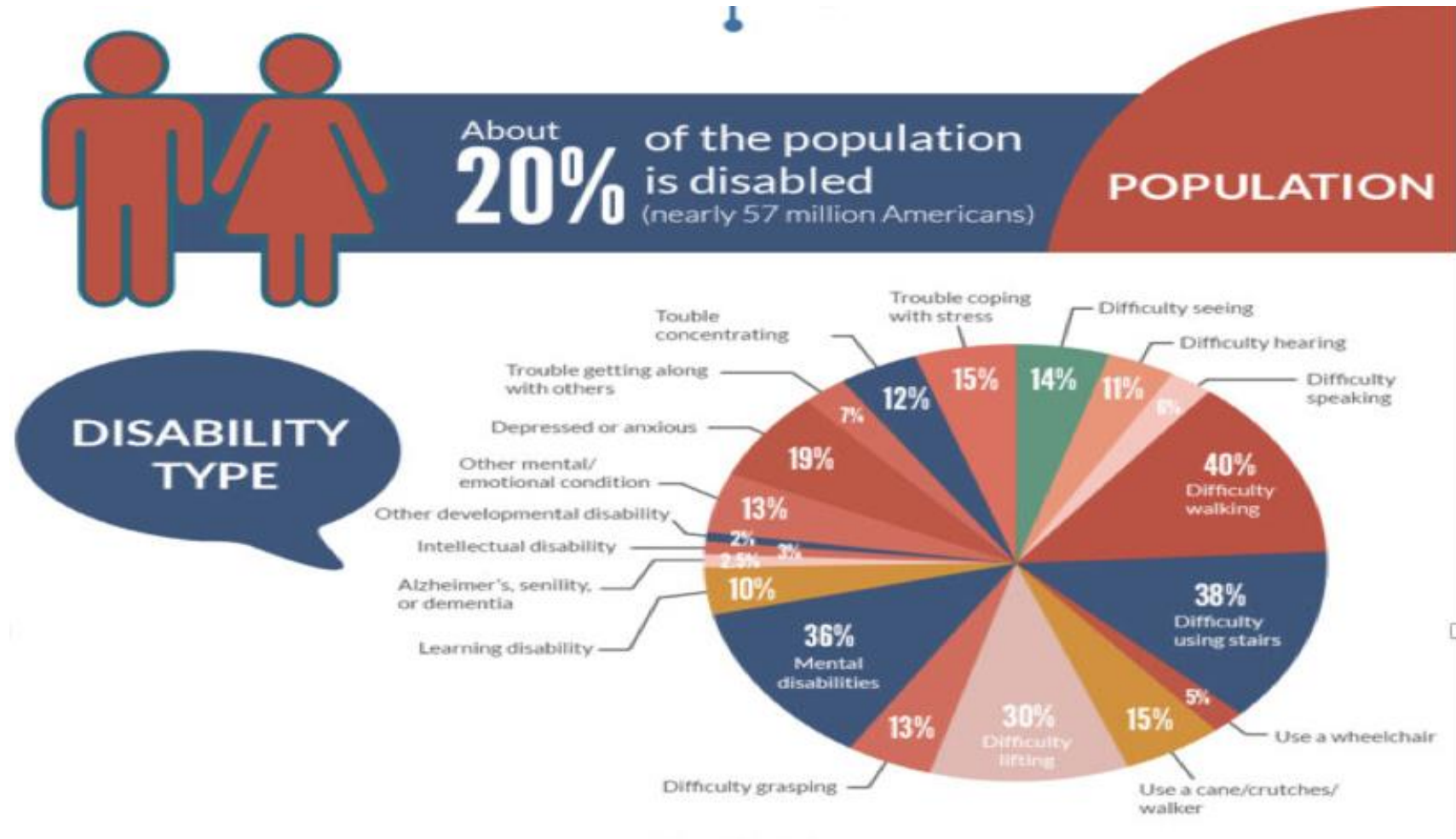
# Introduction

Vietnam  
2015

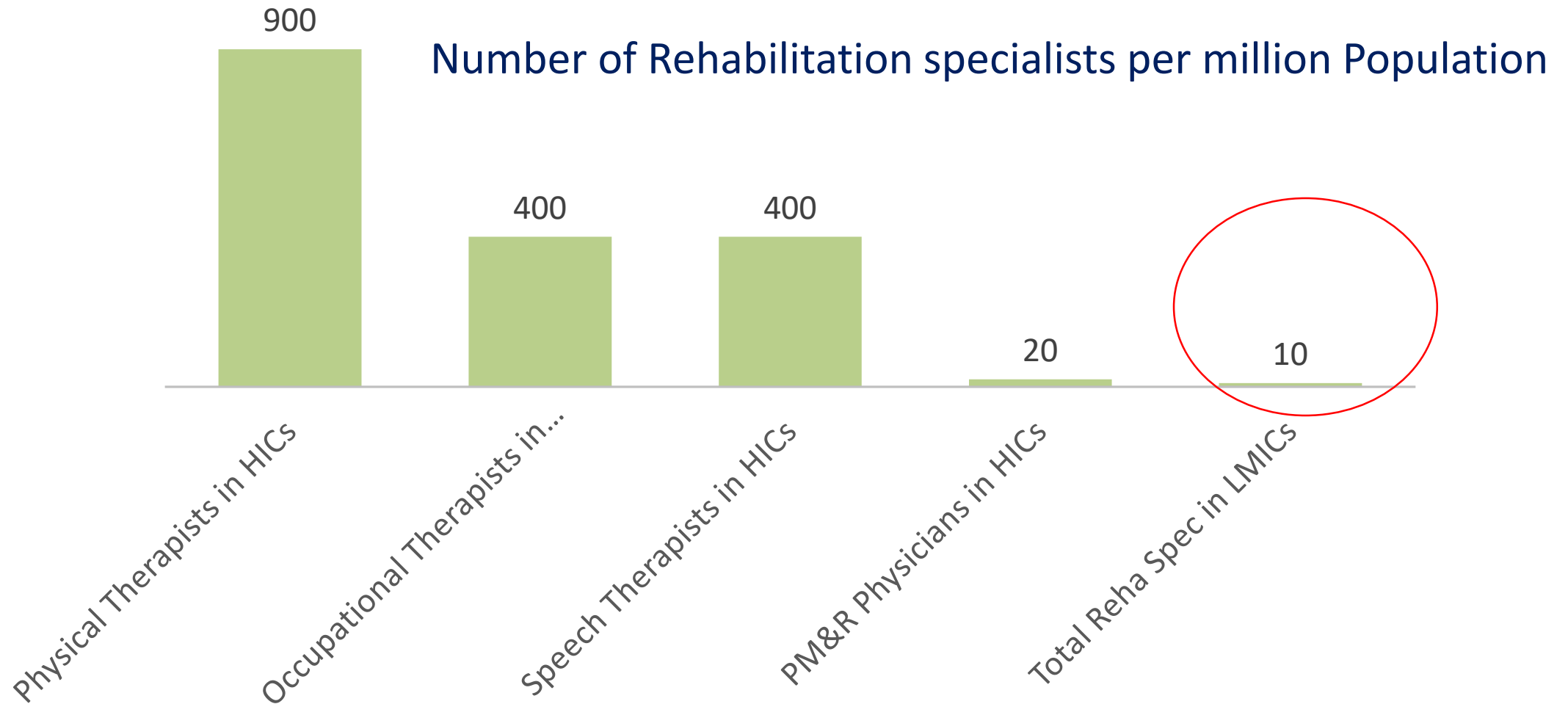


# Introduction

America  
2012



# Introduction



# Unmet global need for rehabilitation

Prioritization, funding, policies, and plans for rehab at a national level

Available rehab services outside urban areas, long waiting times

**WHO:**

**< 10** skilled practitioners/ mi population LMIC countries

Assistive technology, equipment, and consumables

Need for more research and data on rehab

# Barriers to Accessing Assistive Technologies LMIC



# Commercial Assistive Mobility Devices



Tek RMD

~ \$24,000 – 40,000 USD



EASY UP 100  
\$7000

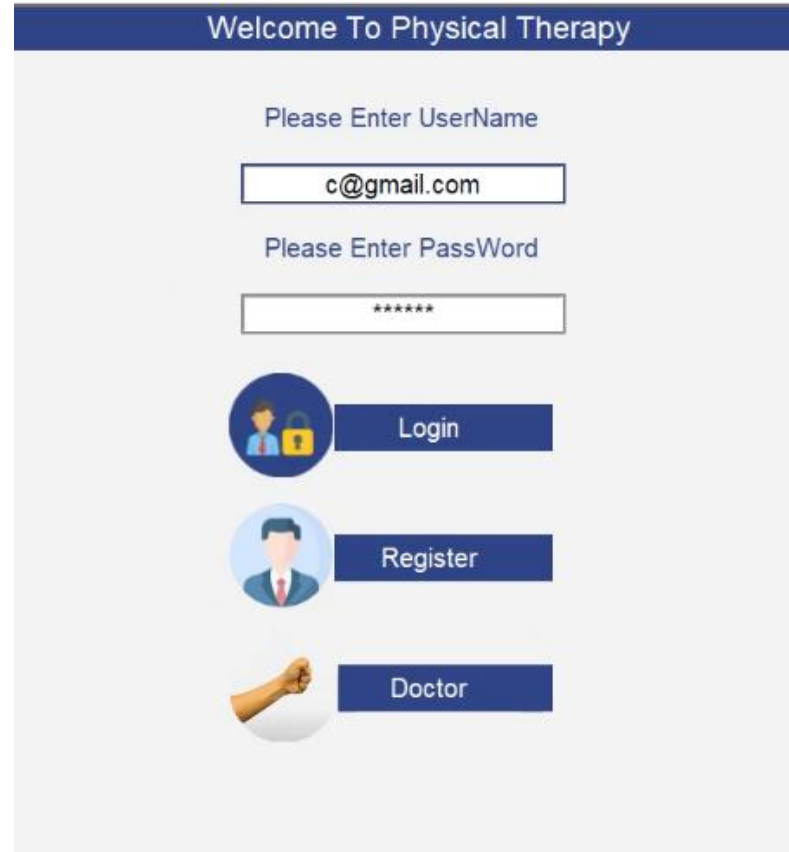


FREEDOMRISE :  
\$5000

# IMD & RA

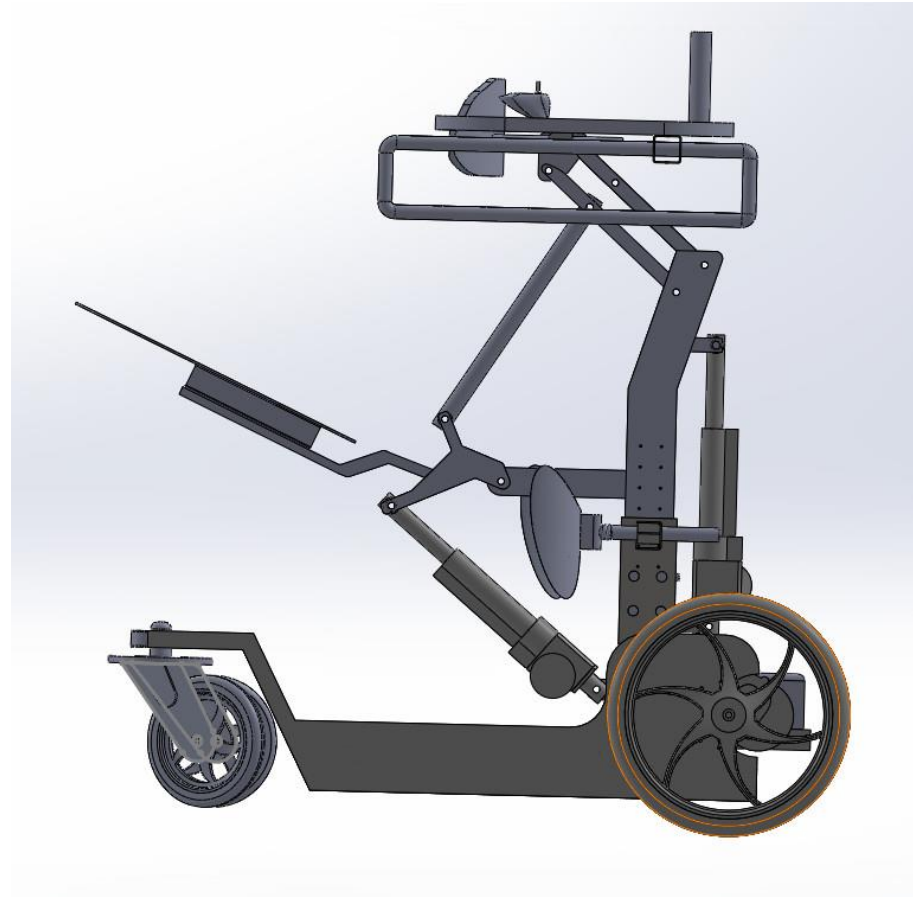


Independence Standing and Mobility Device



Rehabilitation Application

# IMD



# IMD Benefits

## ❑ Increased Independence

- Perform daily tasks and activities without relying on others
- Fostering a sense of autonomy and self-reliance.

## ❑ Improved Mobility

- Enhance the user's ability to move around
- Explore their surroundings
- Participate in social activities.

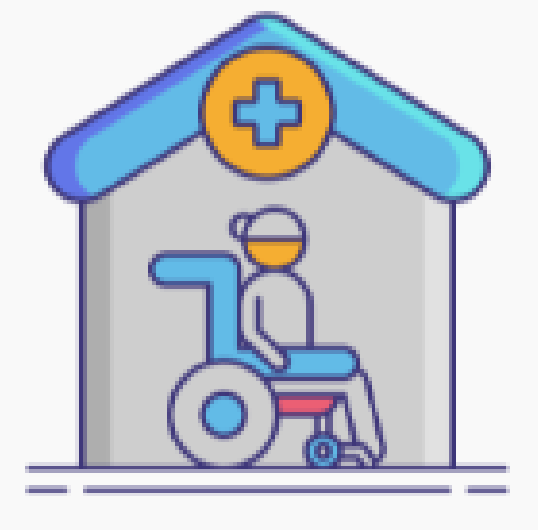
## ❑ Better Health

- Improve circulation, posture, and muscle tone
- Contribute to overall physical well-being.



# Where use IMD device?

Outdoor



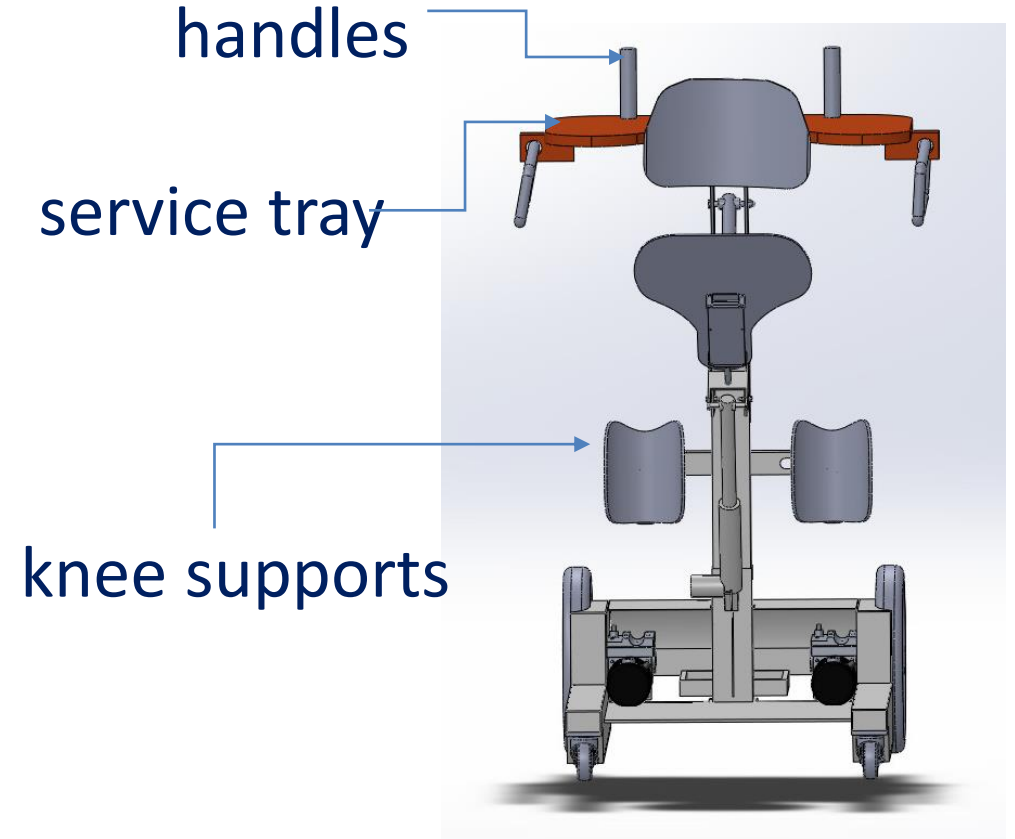
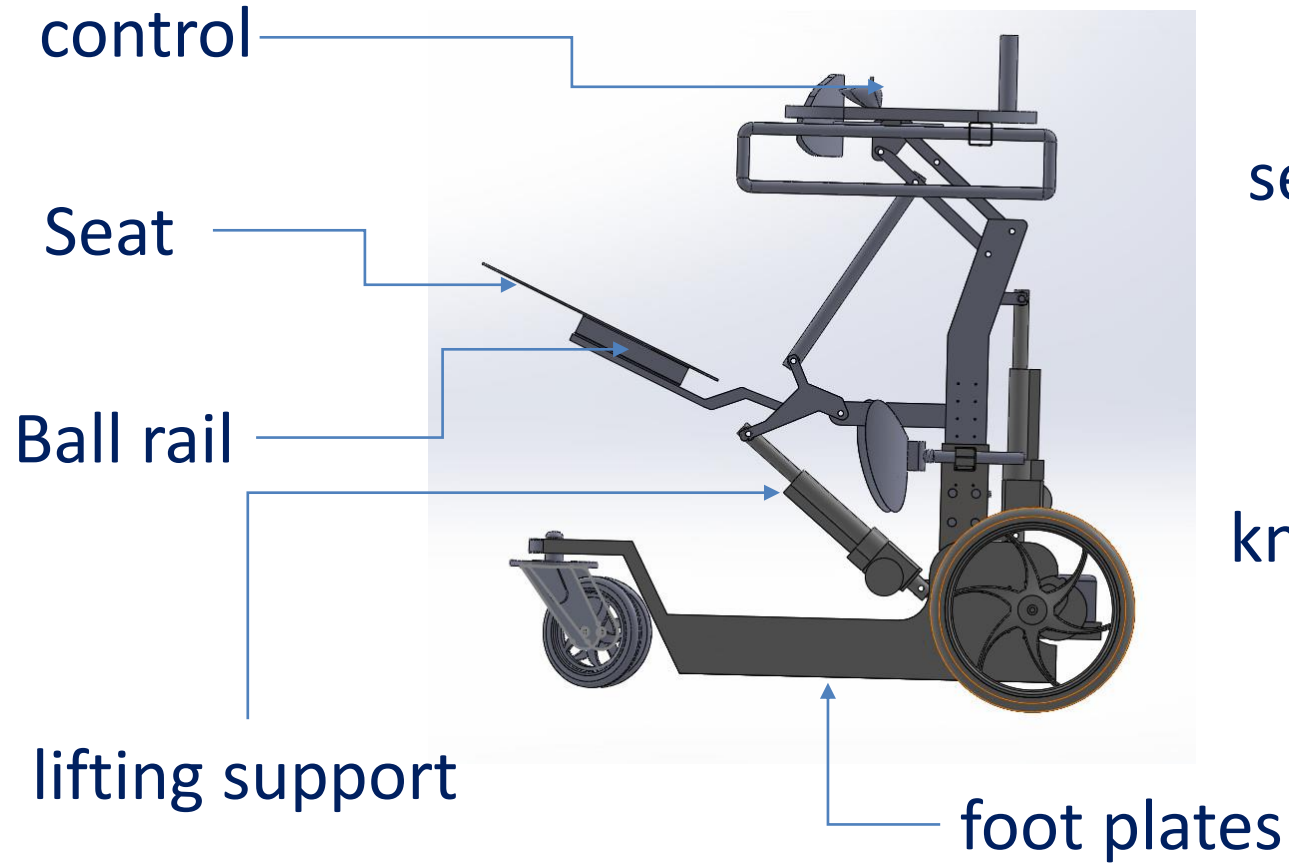
Hospitals

Workplace



Extended Care Units

# IMD Key Features



# IMD Functionalities

## Transferring



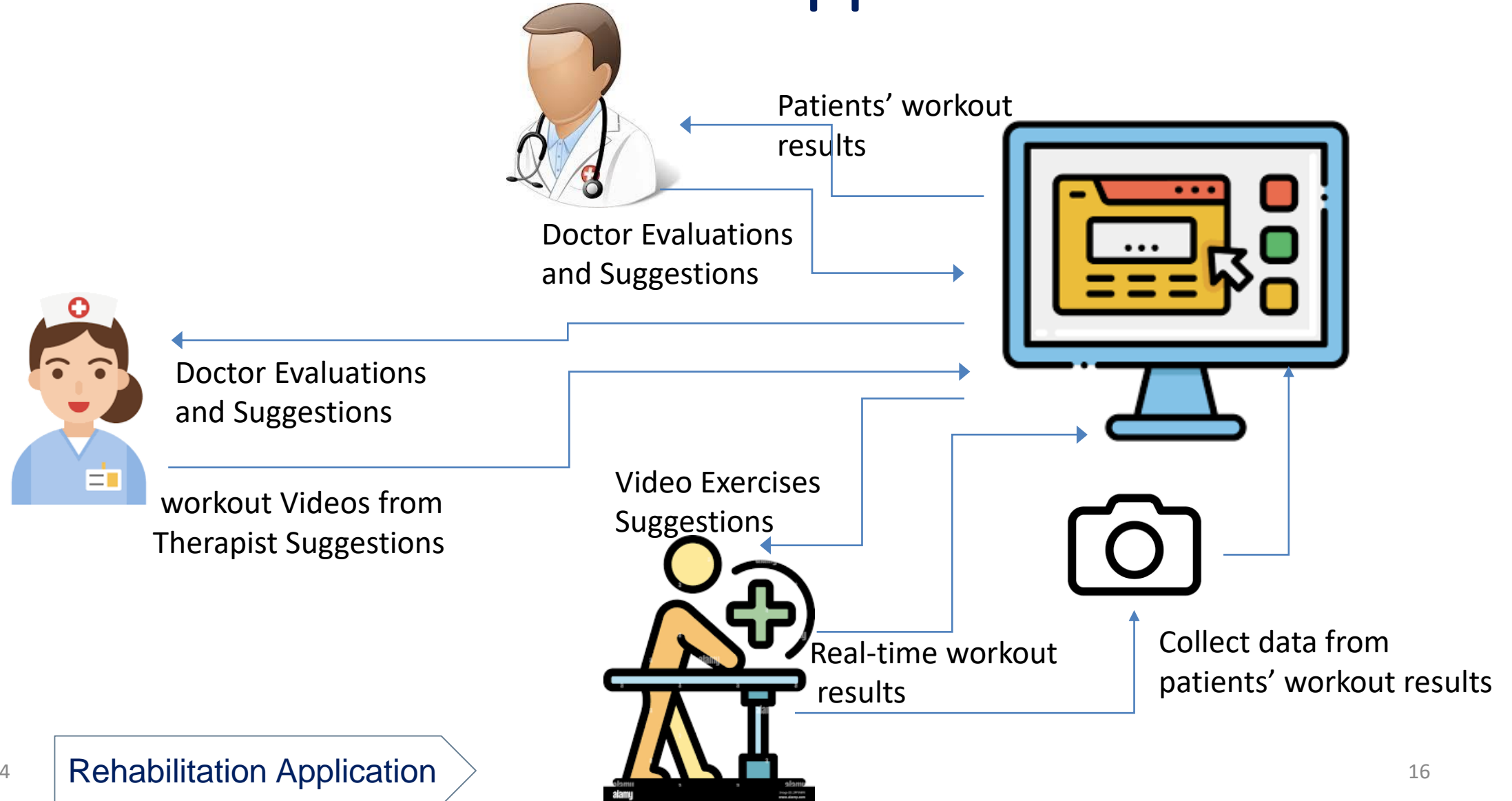
## Standing



## Mobility



# 2. Rehabilitation Application



# RA Benefits



# Tools



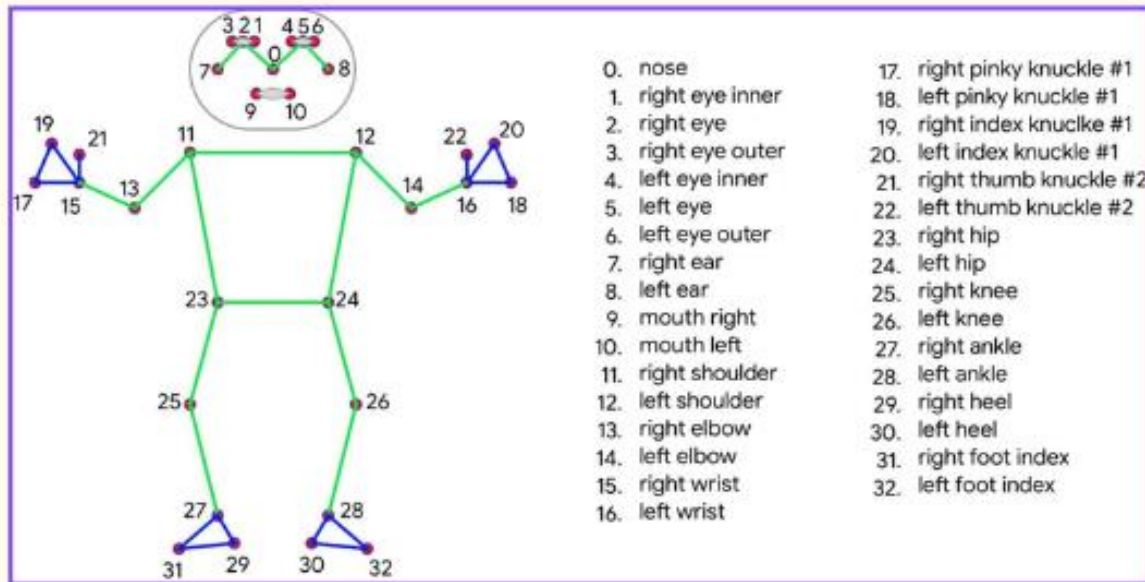
Open-source package of techniques for image processing



Transform postures

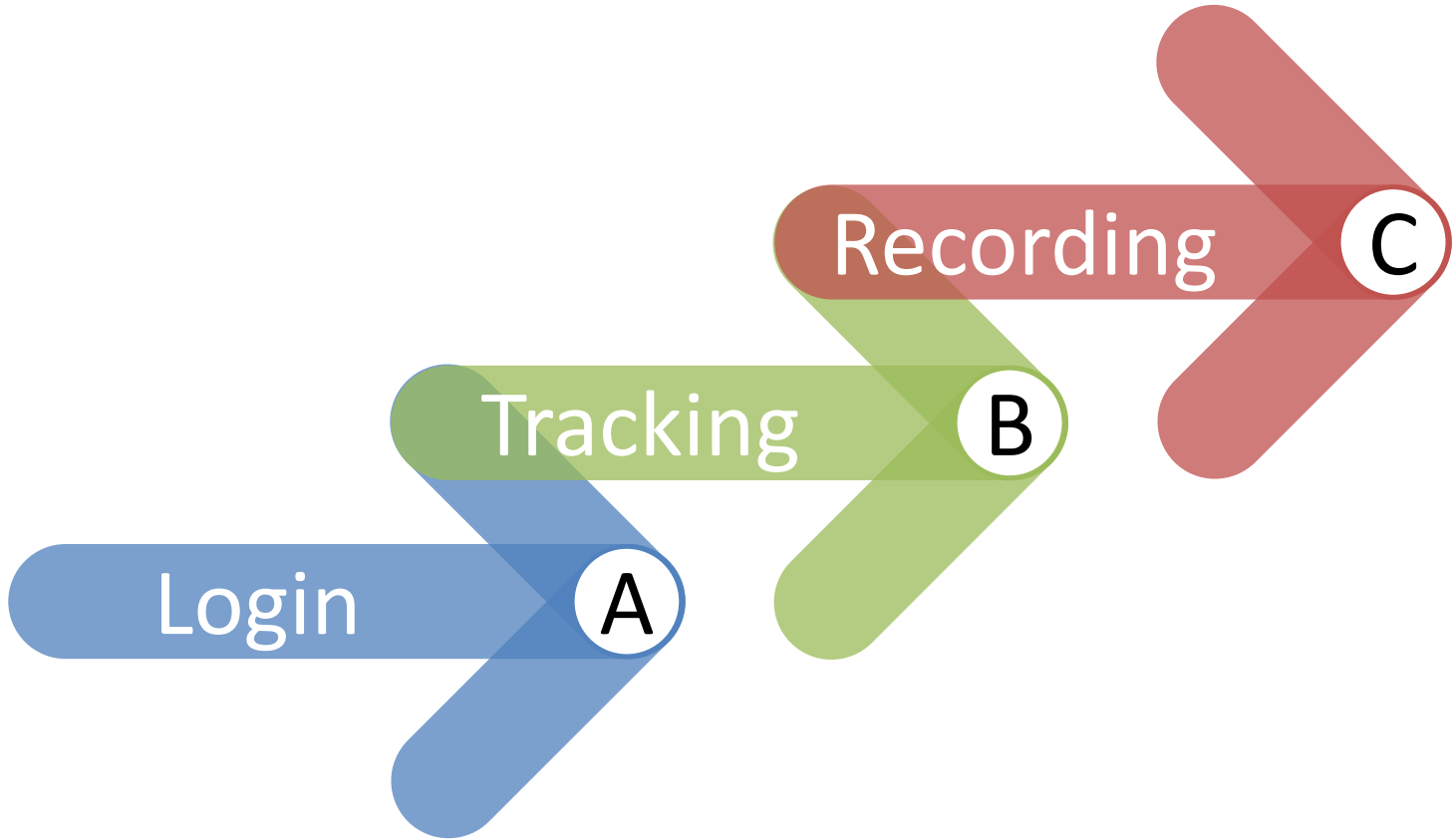
# Detection and Recognition

## Pose detection



## Hand detection

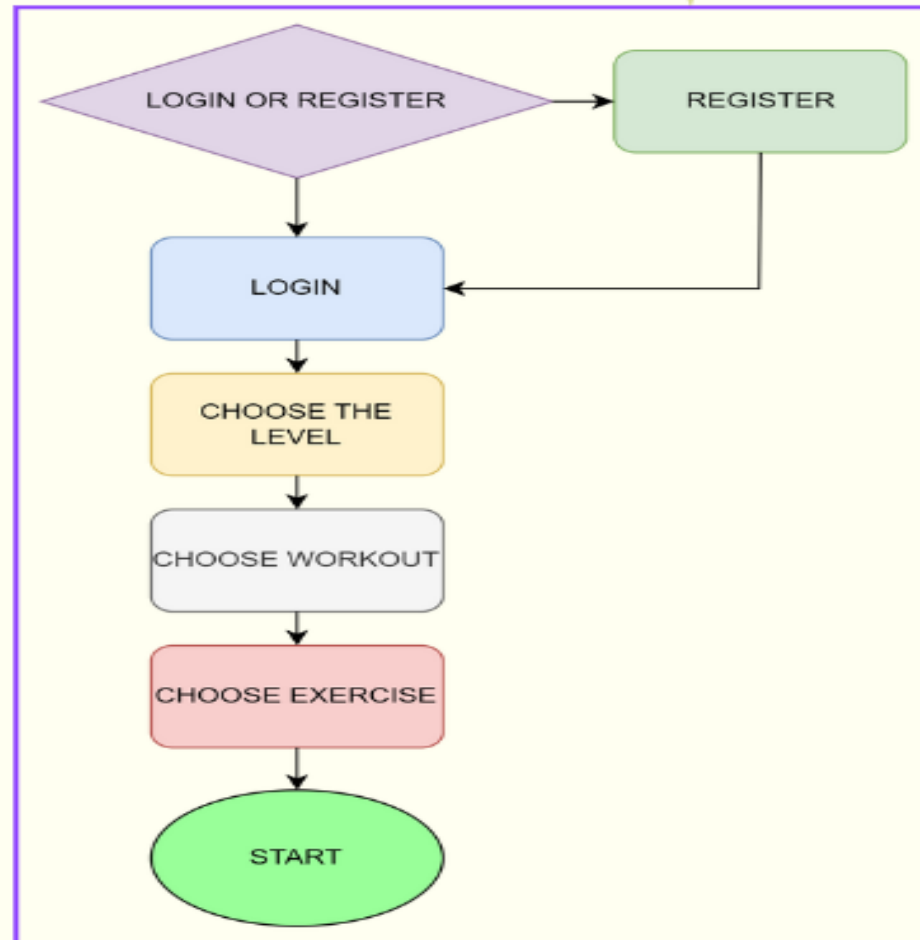
# System workflow



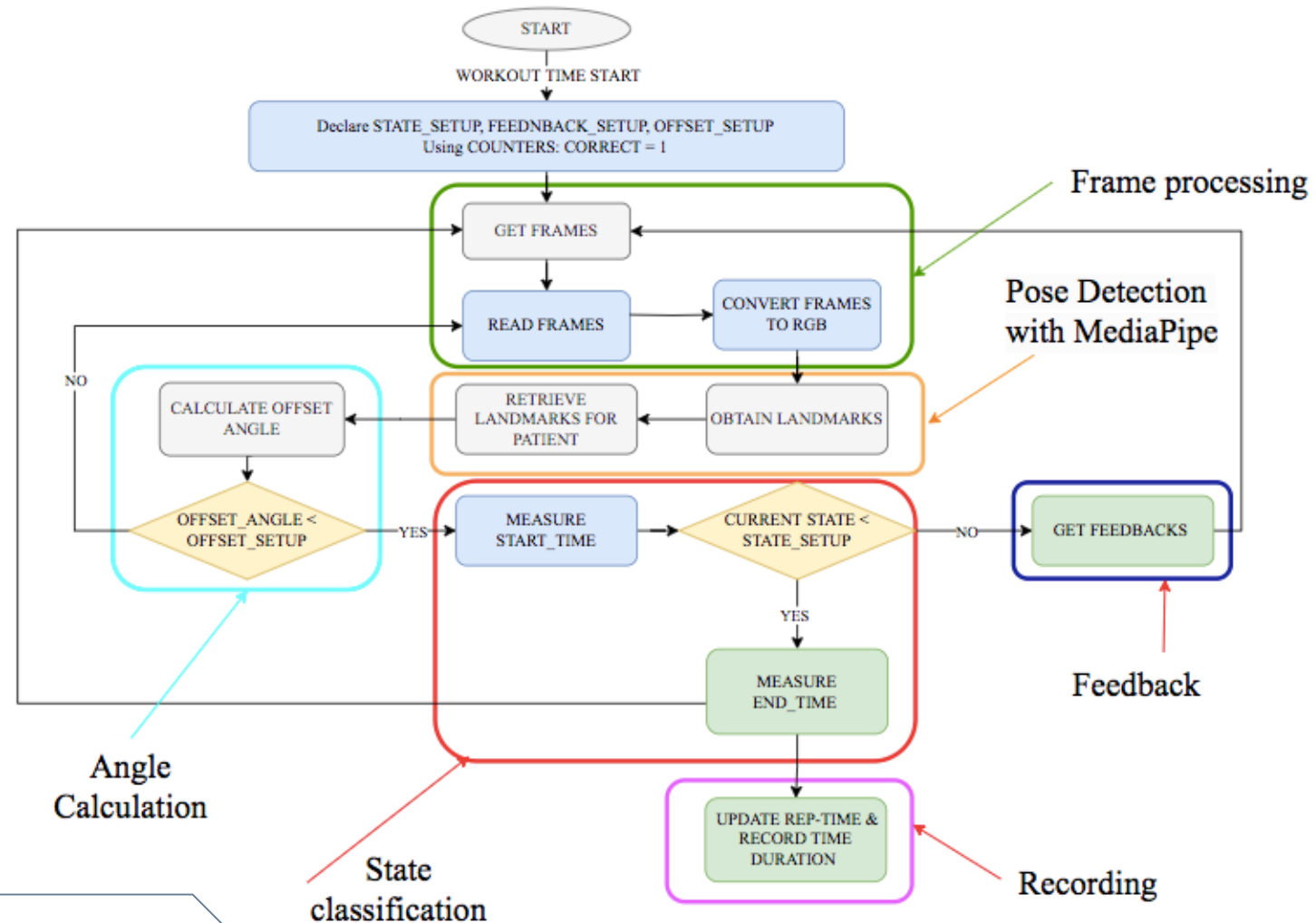
Rehabilitation Application



# Login workflow

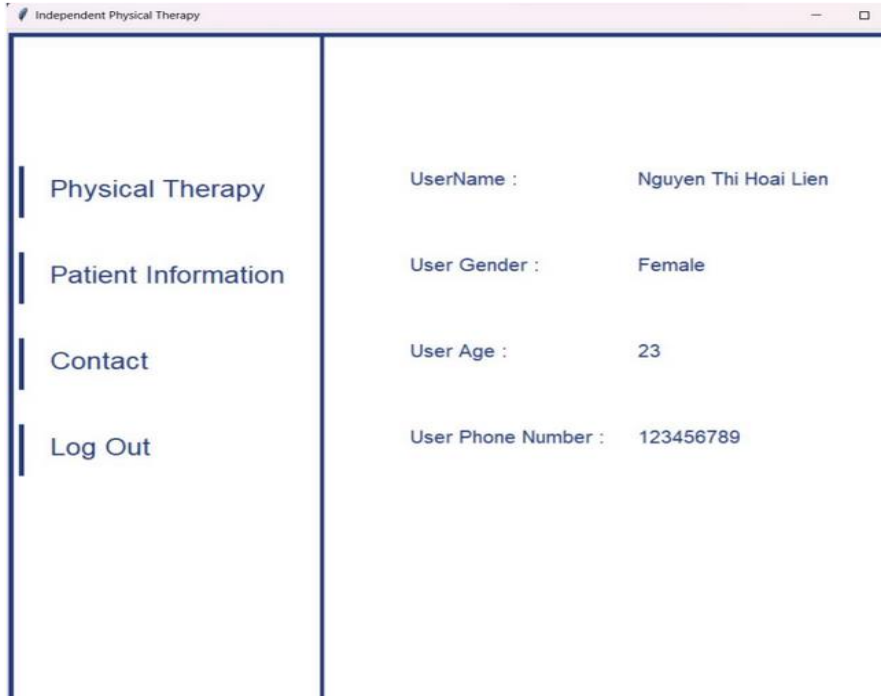


# Tracking and recording workflows

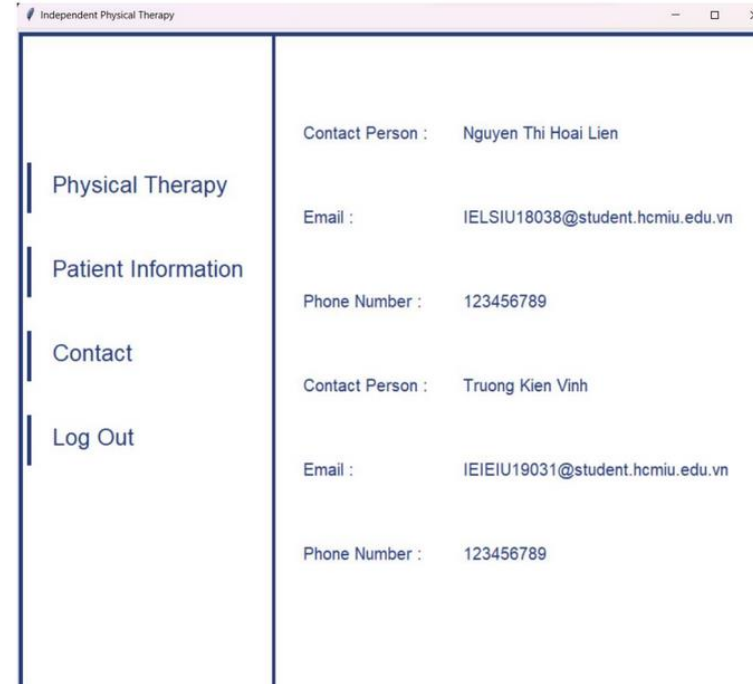




# App Interface- information

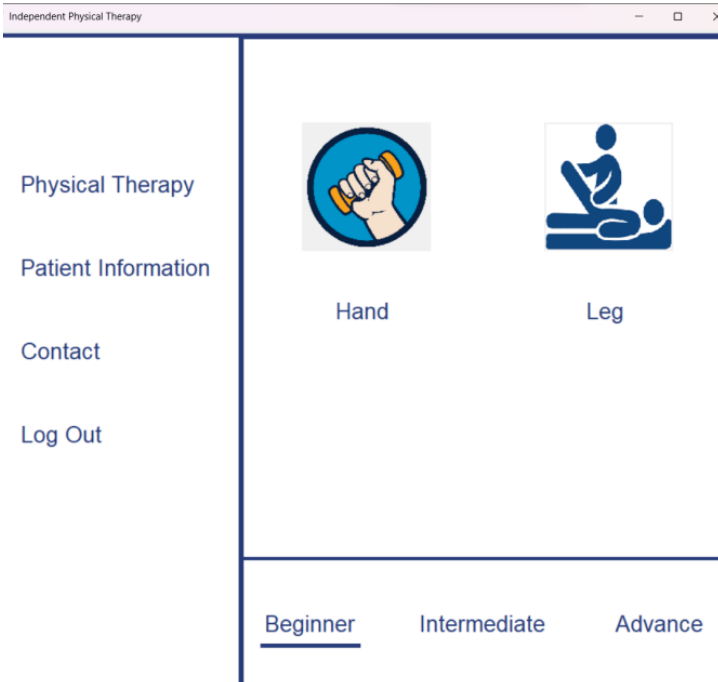


Patient'  
Information



Contact's  
Information

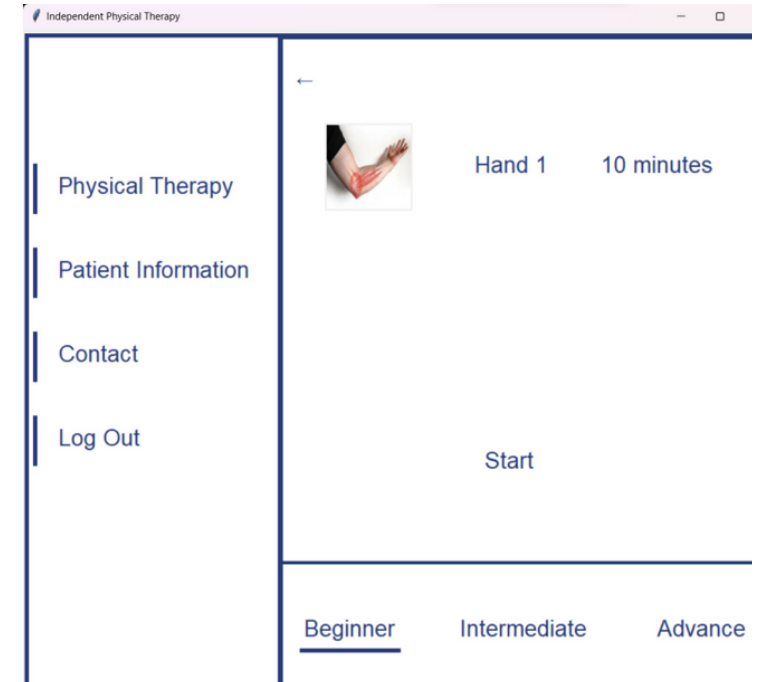
# App Interface – workouts and levels



Workout levels



Workout List



Starting Screen

# App Interface-feedbacks

Independent Physical Therapy

Physical Therapy  
Patient Information  
Contact  
Log Out

You Almost Done The Exercise!  
Can You Give Us Your Feedback?

The Exercise Is Too Hard  
The Exercise Is Too Long  
Other:  Submit

Skip

Beginner Intermediate Advance

Not Done Exercise

Independent Physical Therapy

Physical Therapy  
Patient Information  
Contact  
Log Out

You Excellent Done The Exercise!  
Can You Give Us Your Feedback?

Submit

Skip

Beginner Intermediate Advance

Done Exercise

Independent Physical Therapy

Physical Therapy  
Patient Information  
Contact  
Log Out

Are You Want To Change To  
Others Excersices?

No Yes

Beginner Intermediate Advance

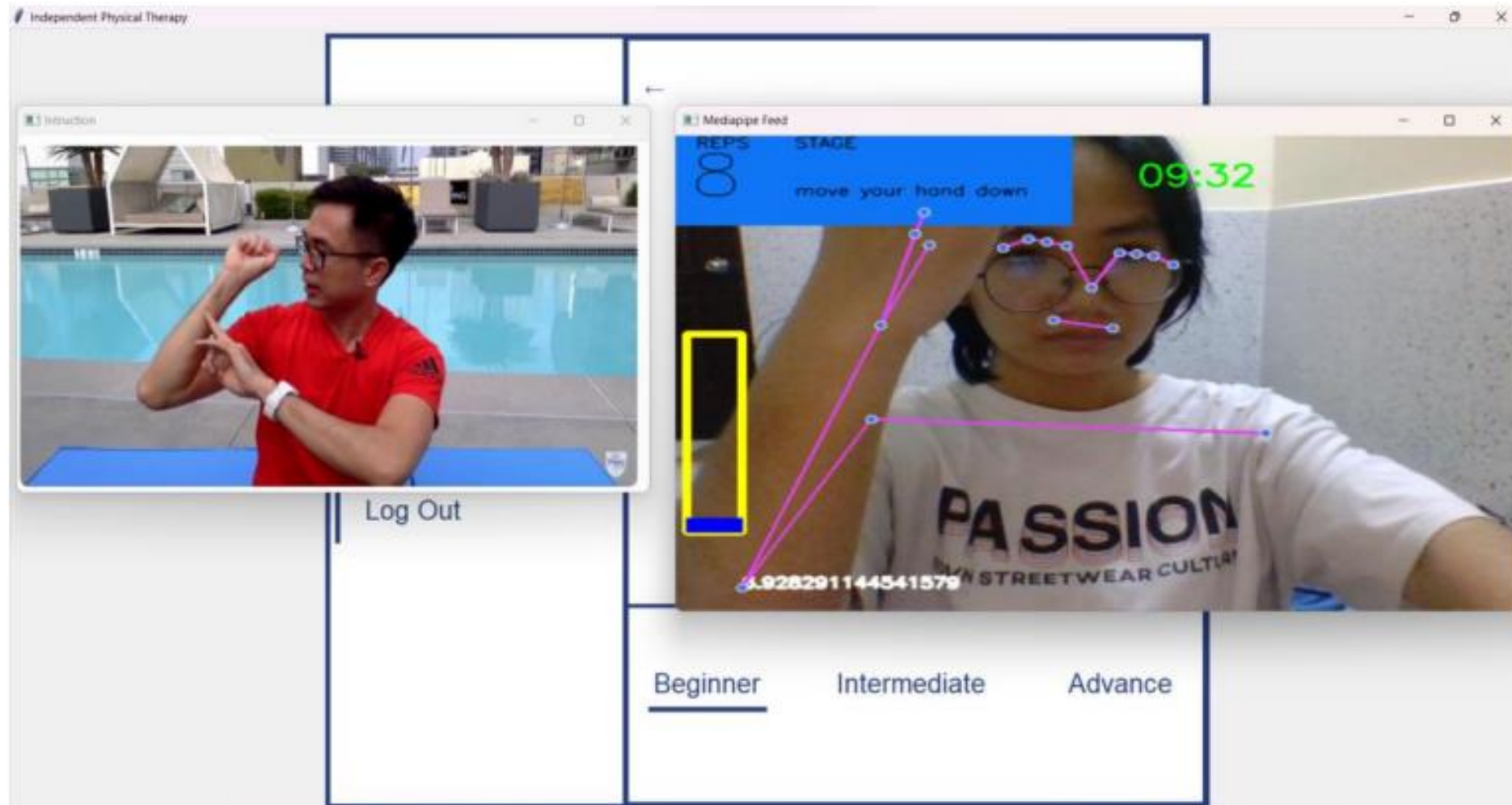
Options

# App Interface-recording

BEGINNER		
REPETITIONS	DURATION (SECONDS)	FEED BACK
1	3.67	
2	4.64	
3	3.01	
4	3.68	
5	4.27	
6	4.17	
7	3.67	
8	3.39	
9	2.96	
10	3.25	
11	2.60	THIS EXERCISE IS GOOD
1	4.25	
2	3.54	
3	4.49	
4	3.64	
5	3.34	
6	3.74	
7	3.01	THIS EXERCISE IS TOO LONG

## Recording File

# Illustration



# Illustration

The screenshot displays a software interface for a rehabilitation application. It features two main windows:

- Intruction Window:** Contains the text "BÀI TẬP 3" and "Tập nắm bàn tay" (Hand grip exercise) next to an image of a clenched fist.
- Mediapipe Feed Window:** Shows a real-time video feed of a person performing the exercise. The feed includes:
  - A blue header bar with "REPS 4" and "STAGE pull in hand down".
  - A green digital clock showing "09:27".
  - Pink skeletal tracking markers on the hand and forearm with numerical values: 33.50, 20.87, 18.52, 21.07, and 109.96.
  - A yellow rectangular box highlighting a blue square on the person's hand.

At the bottom of the interface, there are three difficulty level buttons: "Beginner" (underlined), "Intermediate", and "Advance". A "Log Out" button is also visible.

# Conclusions



Correct performance

Accessibility



Reduce travel time & costs

Assistive Device



Safely promoting independence



Access and reduce the burden on healthcare facilities.

# Future Improvements



**Exercise Variety**



**Online**

# References

- ❑ <https://www.who.int/teams/noncommunicable-diseases/sensory-functions-disability-and-rehabilitation/world-report-on-disability>
- ❑ <https://www.who.int/news-room/fact-sheets/detail/rehabilitation>
- ❑ Stroke Rehabilitation in Low- and Middle-Income Countries: Challenges and Opportunities [Grace Kayola](#), BS, MPH,<sup>1,\*</sup> [Mataa M. Mataa](#), MBChB, MMED,<sup>2,\*</sup> [Melody Asukile](#), MBChB MMED,<sup>1</sup> [Lorraine Chishimba](#), MBChB MMED,<sup>3</sup> [Mashina Chomba](#), MBChB MMED,<sup>3</sup> [Dominique Mortel](#), MD,<sup>5</sup> [Aparna Nutakki](#), BS,<sup>4</sup> [Stanley Zimba](#), MBChB, MMED,<sup>1</sup> and [Deanna Saylor](#), MD MHS<sup>1,5</sup>
- ❑ Kamenov K, Mills JA, Chatterji S, et al. Needs and unmet needs for rehabilitation services: a scoping review. *Disabil Rehabil.* 2018;41(10):1227–1237
- ❑ Aenishänslin, J., Amara, A., & Magnusson, L. (2020). Experiences accessing and using rehabilitation services for people with physical disabilities in Sierra Leone. *Disability and Rehabilitation*, 44(1), 34–43. <https://doi.org/10.1080/09638288.2020.1755375>.
- ❑ <https://www.who.int/news-room/fact-sheets/detail/assistive-technology>

# References

- ❑ D. S. Kale, N. Kulkarni, S. Kumbhkarn, A. Khuspe, and S. Kharde, “Posture Detection and Comparison of Different Physical Exercises Based on Deep Learning Using Media Pipe, Opencv,” vol. 07, no. 04, 2023.
- ❑ A. Gupta, P. L. Shrestha, B. Thapa, R. Silwal, and R. Shrestha, “Knee Flexion/Extension Angle Measurement for Gait Analysis Using Machine Learning Solution ‘MediaPipe Pose’ and Its Comparison with Kinovea<sup>®</sup>,” *IOP Conf. Ser.: Mater. Sci. Eng.*, vol. 1279, no. 1, p. 012004, Mar. 2023, doi: 10.1088/1757-899X/1279/1/012004.
- ❑ J. Hruthika and P. K. Chaitanya, “DEEP LEARNING BASED HUMAN POSE ESTIMATION USING OPENCV,” vol. 7, no. 12.
- ❑ J. Seo and S. Lee, “Automated postural ergonomic risk assessment using vision-based posture classification,” *Automation in Construction*, vol. 128, p. 103725, Aug. 2021, doi: 10.1016/j.autcon.2021.103725.
- ❑ M.-F. R. Lee, Y.-C. Chen, and C.-Y. Tsai, “Deep Learning-Based Human Body Posture Recognition and Tracking for Unmanned Aerial Vehicles,” *Processes*, vol. 10, no. 11, p. 2295, Nov. 2022, doi: 10.3390/pr10112295.
- ❑ B. C. Santoso, H. Santoso, and J. Sandjaya, “DEVELOPMENT OF INDEPENDENT TAEKWONDO TRAINING MACHINE LEARNING WITH 3D POSE MODEL MEDIAPIPE,” *Sinkron*, vol. 8, no. 3, pp. 1427–1434, Jul. 2023, doi: 10.33395/sinkron.v8i3.12571.
- ❑ I. Nath, A. Shaw, A. Bhadra, D. D. Bhowmick, and S. Ghosh, “A Novel Personal Fitness Trainer and Tracker powered by Artificial Intelligence enabled by MEDIAPIPE and OpenCV,” *International Journal of Intelligent Systems and Applications in Engineering*.
- ❑ W. Liu, Y. Fan, Z. Li, and Z. Zhang, “RGBD Video Based Human Hand Trajectory Tracking and Gesture Recognition System,” *Mathematical Problems in Engineering*, vol. 2015, pp. 1–15, 2015, doi: 10.1155/2015/863732.
- ❑ Akshit Tayade and A. Halder, “Real-time Vernacular Sign Language Recognition using MediaPipe and Machine Learning.” Unpublished, 2021. doi: 10.13140/RG.2.2.32364.03203.

**Thank you for your attention!**