

# 港大團隊研發人工智能 SmartRehab 平台 為全球中風患者提供方便及經濟的家居復康策略

## HKU Develops AI-Powered SmartRehab Platform to Provide an Accessible and Affordable Rehabilitation Strategy for Stroke Patients Globally



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# 全球中風負擔

## Global Burden of Stroke

- 每年全球約有一千三百七十萬宗新的中風個案  
~13.7 million new cases of stroke worldwide every year
- 每年香港約有一萬五千宗新的中風個案  
~15,000 new cases of stroke in Hong Kong every year
- 中風是全球導致死亡的第二大原因，以及殘疾的第三大原因  
Second leading cause of death and third leading cause of disability globally
- 約三分之一中風康復者受殘疾影響  
~1/3 of stroke survivors experience some form of disability



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# 中風復康

## Stroke Rehabilitation

- 適時且充分的復康活動對中風癒後恢復至關重要，服務多數由醫院或日間復康中心提供
- Timely and adequate stroke rehabilitation is critical in facilitating post-stroke recovery and is usually provided in the hospital or day rehabilitation centre setting
- 隨著人口老齡化和中風個案上升，全球對中風後復康服務的需求也隨之增加
- With an ageing population, and with an increasing prevalence of stroke, there has been a high and rising demand for rehabilitation services globally



# 現時狀況

## Current Situation

- 全球：在低收入和中等收入國家，每四位中風患者只有一位能夠獲得復康服務
- Globally: Only 1 in 4 stroke patients have access to rehab in low- and middle-income countries
- 中國內地：只有<12%中風患者出院後一周內接受復康服務；約43%從未接受任何復康服務
- Mainland: Only <12% patients undergo rehabilitation within 1-week of discharge; ~43% do not undergo any rehabilitation at all



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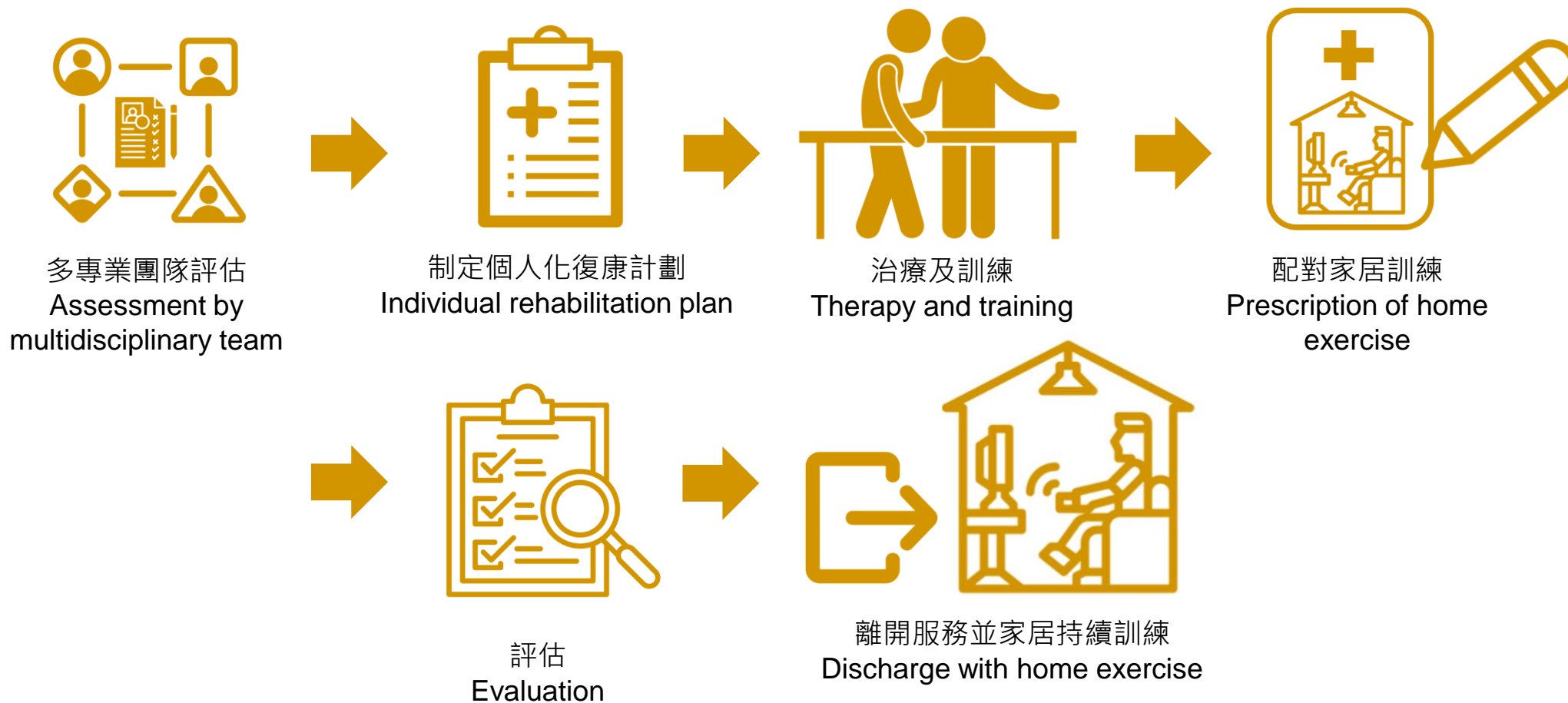
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# 香港復康會現時中風社區復康服務的流程

## Current Service Flow of Community-based Stroke Rehabilitation in HKSR



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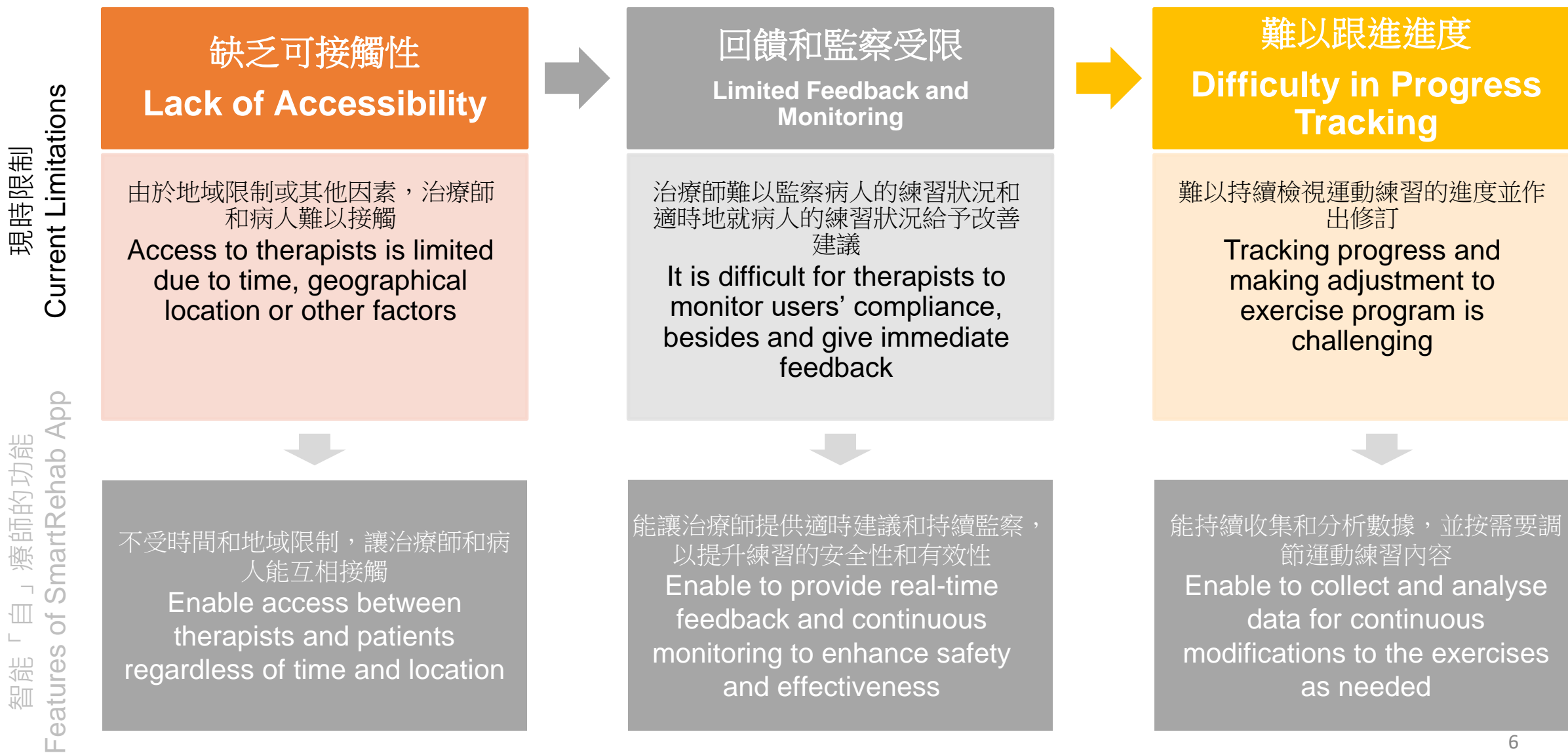
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# 傳統家居運動練習的限制

## Limitations of Conventional Home Exercises



# 現時的產品

## Current Solutions

- 遠程醫療和遠程復康的服務愈見普及，但目前的做法仍然非常依賴視頻或電話訪談形式進行主觀的報告

Increasing use of telemedicine and telerehabilitation services. However, current solutions rely heavily on subjective reporting through video conferences or phone interviews

- 難以有效監察訓練進度和執行性

Difficult to monitor progress and compliance with exercises



視像會議形式的訓練  
Video-conference-based training



網上訓練短片  
Online training Video

### 回到社區 - 中風復康運動

📌 八大中風患者運動原則 📌 鼓勵患者做運動的方法

腦細胞一旦死亡，它負責的功能便會失去，不能復元。科學家發現，大腦內的細胞，有8成是未有運用的、處於沉睡狀態。透過不斷重複訓練，將附近細胞喚醒，代替已死亡的細胞，重組新的路徑，便可恢復已失去的功能。這個現象叫做大腦可塑性功能。

因此，中風患者持續多做運動，特別是患肢的訓練。這些強化訓練可以加速大腦皮質功能重組的過程，希望能夠成功達至恢復患肢的活動全部或部份能力

#### 📄 八大中風患者運動原則

1. 運動前確保血壓及脈搏正常
2. 為減少跌倒的機會，建議多做拉筋、訓練平衡及轉換姿態的運動，
3. 以步行作為耐力運動，鍛鍊心肺功能及下肢肌肉耐力
4. 多活動患肢及利用患肢參與日常生活的活動
5. 在運動中間可安排一些休息時段，避免長時間的劇烈運動

### 電子訓練資訊 Online training information



# 現時的產品

## Current Solutions

- 另外，一些方案嘗試利用有傳感器和特殊攝像鏡頭的設備記錄中風患者在練習時的表現，但所需的成本相對較高且對空間的需求較大，實際上有不少局限。
- Other solutions attempt to use various sensor- and camera-based devices to capture a stroke victim's exercise performance, but fall short in the real-life application of home-based tele-rehabilitation, given the relatively high cost per unit and spatial requirements



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# 傳統家居運動練習的限制

## Limitations of Conventional Home Exercises

現時限制  
Current Limitations

缺乏可接觸性

**Lack of Accessibility**

由於地域限制或其他因素，治療師和病人難以接觸

Access to therapists is limited due to time, geographical location or other factors

回饋和監察受限

**Limited Feedback and Monitoring**

治療師難以監察病人的練習狀況和適時地就病人的練習狀況給予改善建議

It is difficult for therapists to monitor users' compliance, besides and give immediate feedback

難以跟進進度

**Difficulty in Progress Tracking**

難以持續檢視運動練習的進度並作出修訂

Tracking progress and making adjustment to exercise program is challenging

智能「自」療師的功能  
Features of SmartRehab App

不受時間和地域限制，讓治療師和病人能互相接觸

Enable access between therapists and patients regardless of time and location

能讓治療師提供適時建議和持續監察，以提升練習的安全性和有效性

Enable to provide real-time feedback and continuous monitoring to enhance safety and effectiveness

能持續收集和分析數據，並按需要調節運動練習內容

Enable to collect and analyse data for continuous modifications to the exercise as needed



# 關於智能「自」療師

## About SmartRehab

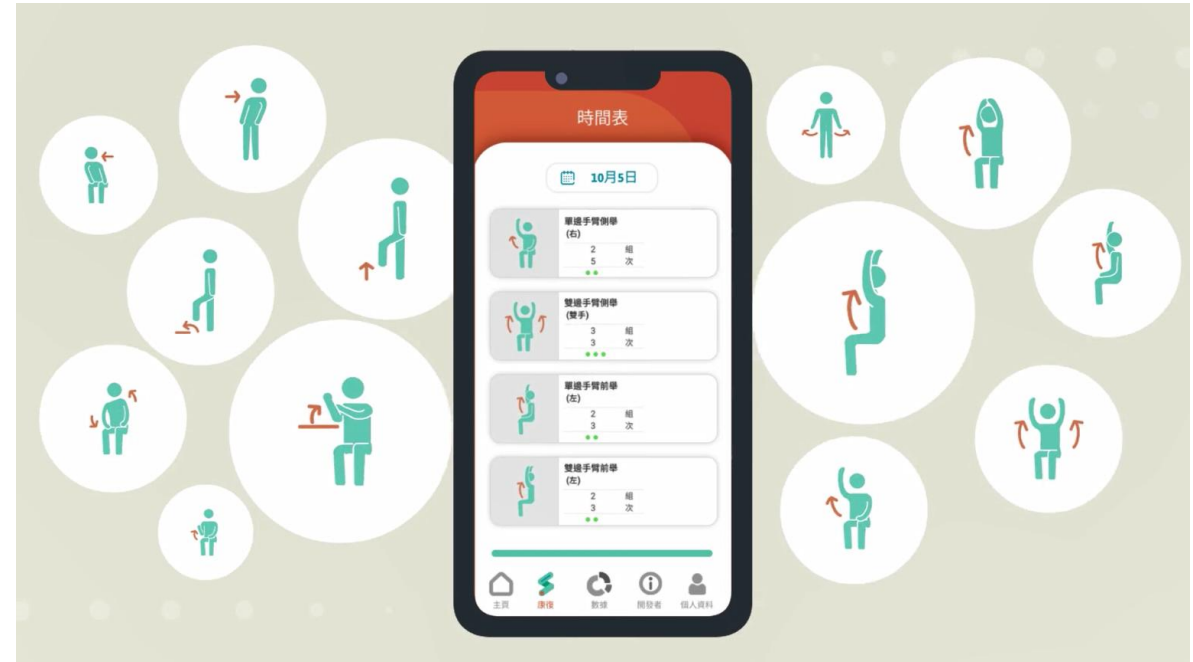
- SmartRehab是一個可在平板電腦或手機上使用的流動應用程式，旨在促進社區環境中的個人化中風復康進程
- SmartRehab is a mobile application that is accessible from a tablet or mobile phone that aims to facilitate personalised stroke rehabilitation in the community setting
- SmartRehab的開發團隊包括神經科醫生、工程師、轉化神經科學家、物理治療師和職業治療師，成員分別來自港大醫學院中風研究組、港大運動人工智能實驗室和香港復康會
- Developed and validated by a multidisciplinary team comprising neurologists, engineers, translational neuroscientists, physiotherapists and occupational therapists from HKU Stroke, HKU Sport AI Laboratory and The Hong Kong Society for Rehabilitation





# 關於智能「自」療師 About SmartRehab

- 目前，SmartRehab平台內置10組大肌肉運動練習，這些練習由香港復康會的治療師推薦和設計，專門為改善中風患者的肢體活動能力、重心轉移能力和平衡力而設
- Currently encompasses 10 gross movement exercises that are recommended and designed by therapists from The Hong Kong Society for Rehabilitation and are tailored specifically for stroke patients to improve limb function, weight shifts and balance



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# 智能「自」療師的技術和原理

## Technologies Behind SmartRehab

- 與傳統的遠端復康平台相比，團隊開發了一套基於電腦視覺的姿勢演算法，利用平板電腦或手機的內置攝像鏡頭，SmartRehab能偵測使用者的體型和不同關節接觸點
- In contrast to traditional telerehabilitation platforms, SmartRehab utilises the built-in RGB camera of a tablet or mobile phone, for which the team has developed a computer vision-based pose-estimation algorithm to predict the precise body framework and segment key locations



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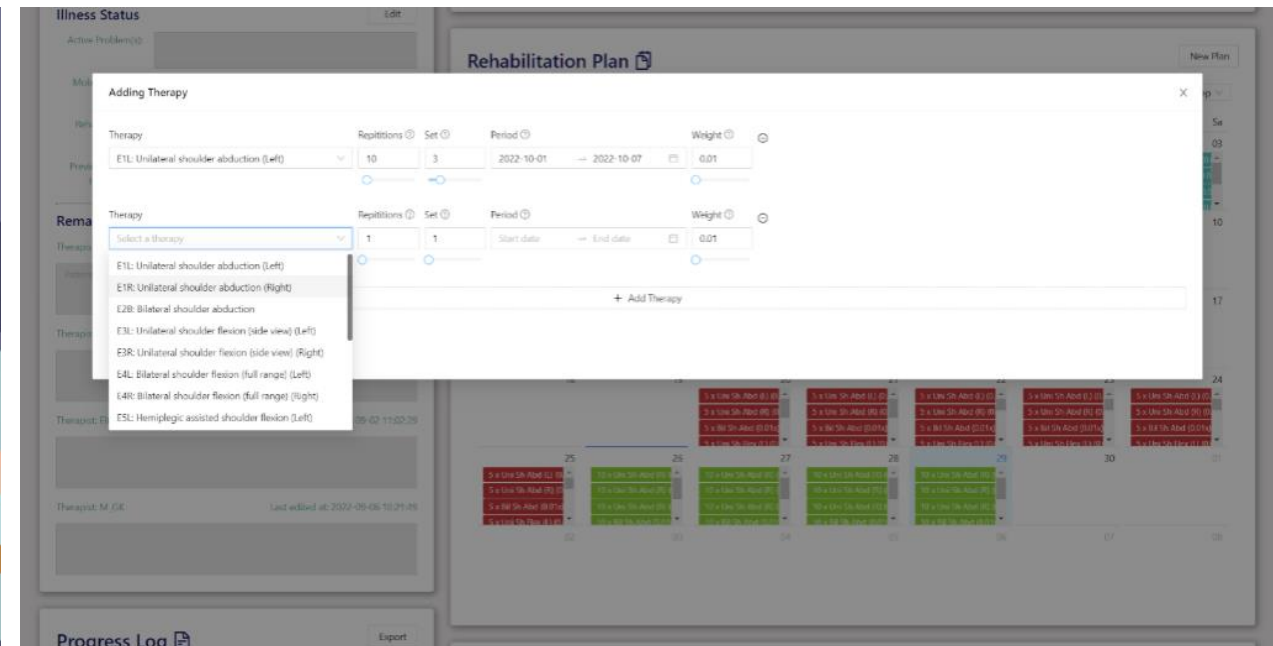
# 智能「自」療師的技術和原理

## Technologies Behind SmartRehab

- 有關演算系統令SmartRehab能計算與運動相關的特徵，包括通過患者關節角度、速度變化及痙攣風險，評估動作是否符合標準並作出即時反饋
- The system allows SmartRehab to compute movement-related features, including changes in joint angles, velocity, and the presence of spastic movement, all of which can be used to evaluate the quality of a patient's movement and provide immediate feedback
- SmartRehab還包括一個網上平台系統，治療師可以在平台找到為患者度身訂造的復康練習運動（包括練習類型、頻率及重複次數），並通過遠程監察患者的表現、進展及運動姿勢是否標準
- SmartRehab also includes a portal system, in which therapists can assess the stroke patient and provide exercises (including the type of exercise, frequency and number of repetitions) tailored to the needs of each patient, and remotely monitor the patient's functional and motor performance progress and compliance



# 智能「自」療師 治療師介面 SmartRehab Therapist's Interface



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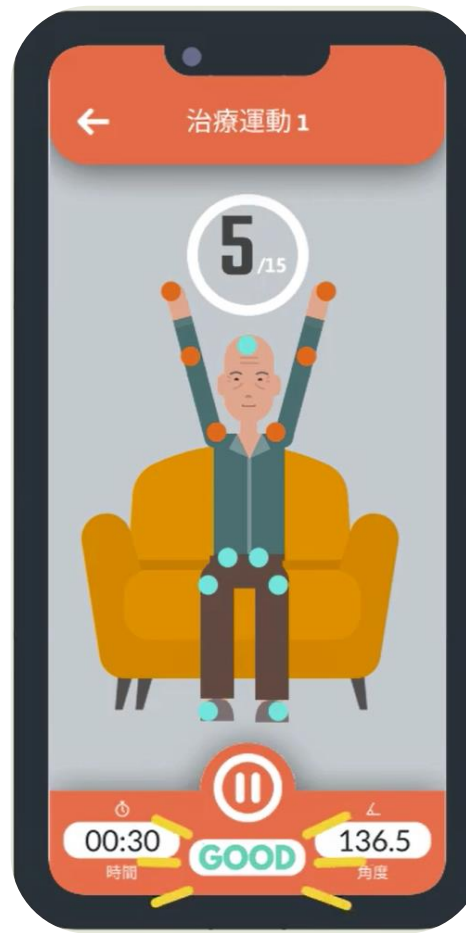


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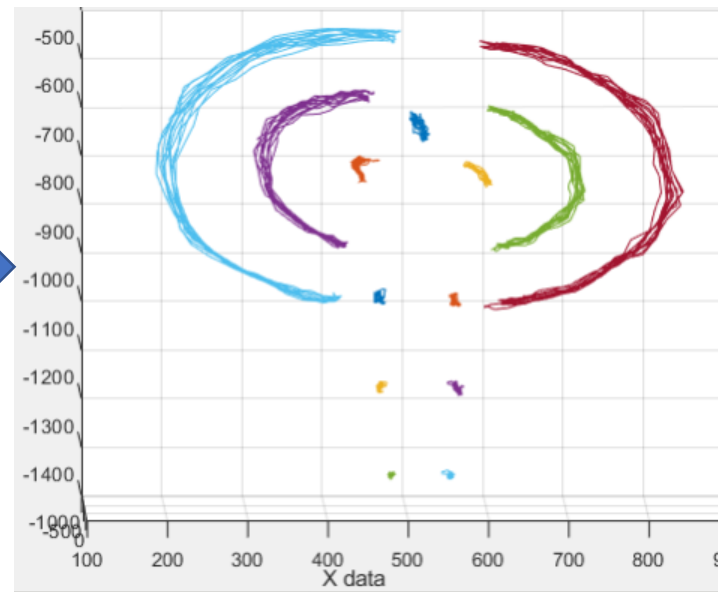
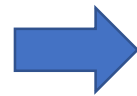
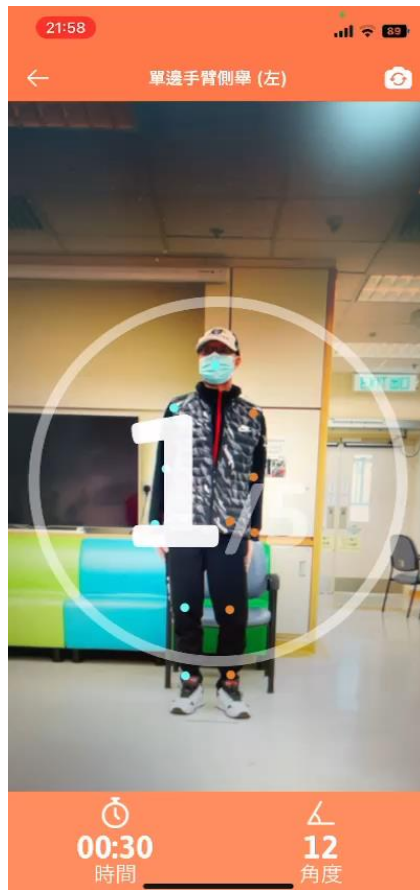


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# 智能「自」療師 使用者介面 SmartRehab Patient's Interface



# 智能「自」療師：自動化遙距偵測及評估 SmartRehab: Automated Remote Assessment



## Statistics

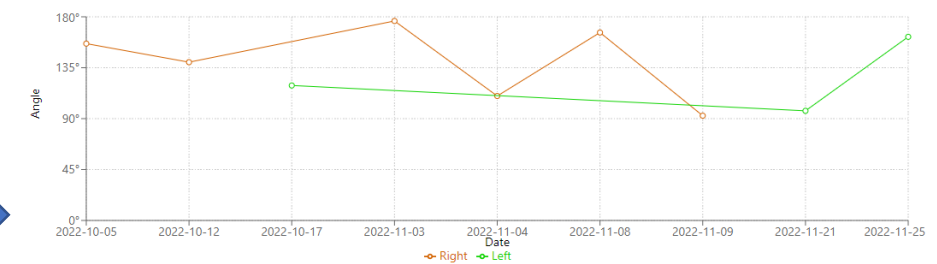
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### Full History

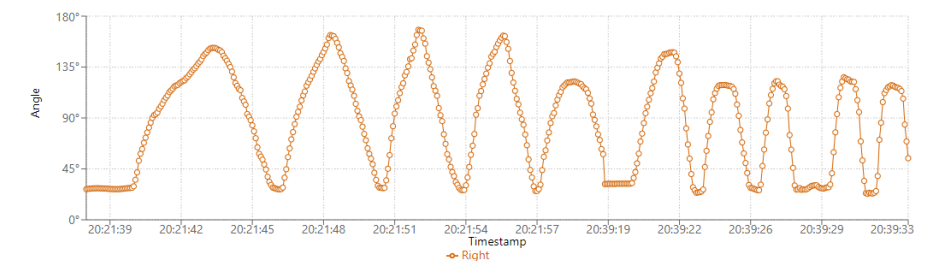
Full History

Range of motion Quality of movement Count

### Range of motion



### Movement (2022-10-12)



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# 意義和影響

## Significance and Impact

- SmartRehab將於未來數月在香港復康會投入復康服務，並將在其他醫療機構（例如東華醫院）進行試驗
- SmartRehab will be incorporated into stroke rehabilitation services of HKSR in the coming few months, and will also be explored in other healthcare providers (e.g. at Tung Wah Hospital)
- 每年將有約150名香港復康會中風患者，以及全港的2,700名中風患者受惠
- ~150 stroke patients under the care of HKSR and ~2,700 stroke patients within Hong Kong may benefit from SmartRehab every year



# 意義和影響

## Significance and Impact

- 我們將會納入更多小肌肉復康訓練、虛擬實境和擴增實境技術、遊戲化功能，以及各種生物識別監測功能
- Further development including the incorporation of more movements to facilitate the rehabilitation of fine motor functions, augmented and virtual reality and gamification functions, and various biometric monitoring functions
- 希望令其他需要復康服務的患者及年長人士（例如認知障礙症、帕金森症等）也能受益
- Potential to benefit other patients and older adults who also require rehabilitation (e.g. dementia, Parkinson's disease etc.)

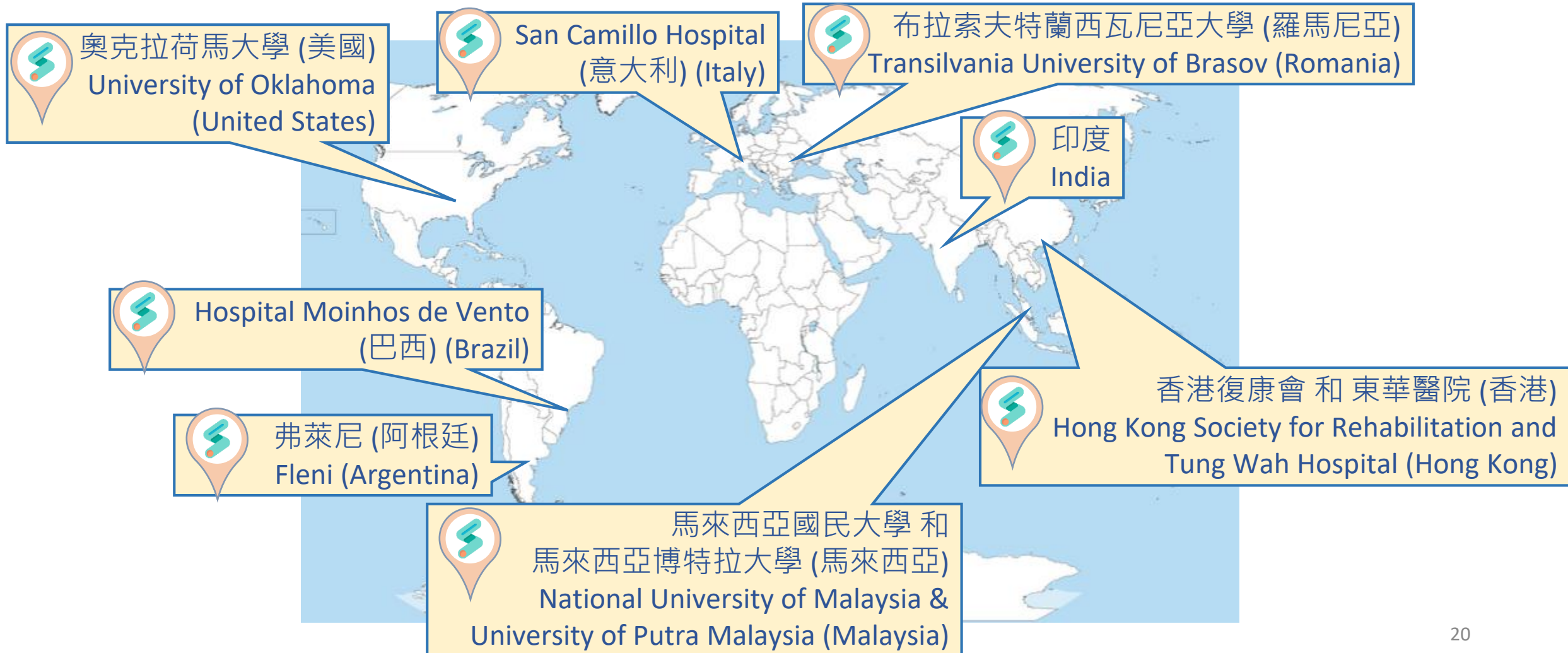


# 意義和影響

## Significance and Impact

- 獲得世界中風組織的支持，在全球七個國家測試平台的可行性：
  - 印度、馬來西亞、羅馬尼亞、阿根廷、巴西、美國，及意大利
- Support from the World Stroke Organization to test the feasibility of SmartRehab in seven countries outside of Hong Kong:
  - India, Malaysia, Romania, Argentina, Brazil, the United States and Italy
- 希望惠及其他低收入和中等收入國家，以應對物理治療師和職業治療師嚴重短缺以致復康服務受限的問題
- Hope to benefit other low- and middle-income countries, where rehabilitation services are limited due to severe shortages of physiotherapists and occupational therapists

# 香港大學最近獲得世界中風組織支持，在全球七個國家測試平台的可行性 HKU has received support from the World Stroke Organization to test the feasibility of SmartRehab in 7 countries outside of Hong Kong



# 示範 智能「自」療師 的使用方法

## Demonstration of SmartRehab



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