物聯網推動平台109年年會－探索AIoT+智慧健康照顧新契機

NB-IoT長者居家智慧照護產品與AI雲服務之開發和應用

徐業良

元智大學機械系特聘教授

老人福祉科技研究中心主任

Editor-in-chief, Gerontechnology

SEDA GTech CEO

2020/07/23

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高齡社會3G顯學：Gerontology, Geriatrics, Gerontechnology

- 長者的生活支援與健康照護需求，已經不能單純思考增加照護人力來滿足；廣泛應用智慧科技輔助照護應是重要策略之一

- First International Congress on Gerontechnology, 1991; International Society for Gerontechnology, 1997; 老人「福祉」科技，樂齡科技…

"Design technology and environment for independent living and social participation of older persons in good health, comfort and safety"

- 老人福祉科技的範疇：健康、住家、行動力、溝通、休閒、工作

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從研究開發到生活應用

- Think like a boss (not like a professor…)

創意 → 原型 → 產品 → 銷售

Commercialization

SEDA G-Tech

天才家用

New Taipei City

憶起玩學堂

Industry-academia collaboration

Gerontechnology Industry-Academia Alliance

Research & Development

Smart Living
IoT
Gerontechnology

YZU d.school Gerontechnology

Innovative Product Development Program

Design Thinking Transdisciplinary education program

Transdisciplinary Education

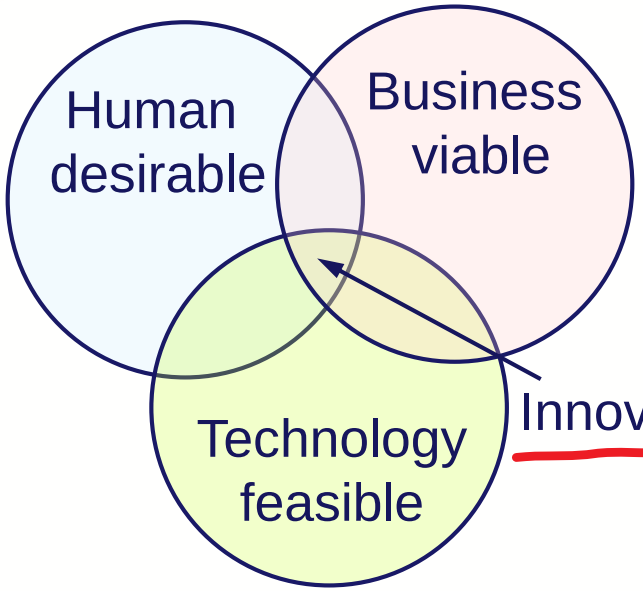
International Society for Gerontechnology

Gerontechnology
Official Journal of the ISG

福祉科技與服務管理學刊

International academic exchange

Design thinking!



IDEO (http://www.ideo.com)
CEO Tim Brown

使命：完成一場成功的產業與教育實驗

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What exactly do people do in *Gerontechnology*?

- My (unscientific) classification of the 86 papers published in *Gerontechnology*, from 2017~2020, average 200.2 downloads per paper (data collected 2020/07/11)

1. Monitoring of vital signs / behavior patterns, and platforms for health management
   - 18 papers (20.9%), 170.5 downloads
2. Technology interventions for enhancing physical and cognitive ability
   - 12 papers (14.0%), 237.6 downloads
3. Technology assistance for everyday lives for older adults and caregivers
   - 18 papers (20.9%), 206.7 downloads
4. Platforms for social communication and participation
   - 10 papers (11.6%), 209.8 downloads
5. Robots for senior care
   - 4 papers (4.7%), 191.5 downloads
6. General issues: design methodology, education, culture, business, policy, etc.
   - 24 papers (27.9%), 196.3 downloads

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二十四孝—「嚙指心痛」

參嘗採薪山中，家有客至。母無措，望參不還，乃嚙其指。參忽心痛，負薪而歸，跪問其故。母曰：「有急客至，吾嚙指以悟汝爾。」

遠距居家照護的起源…

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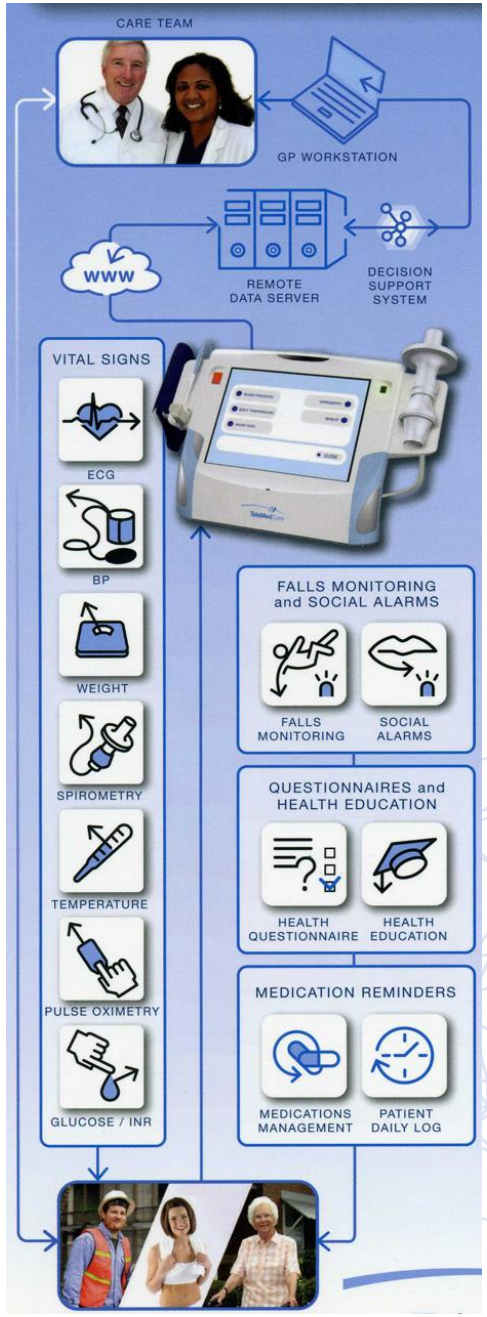
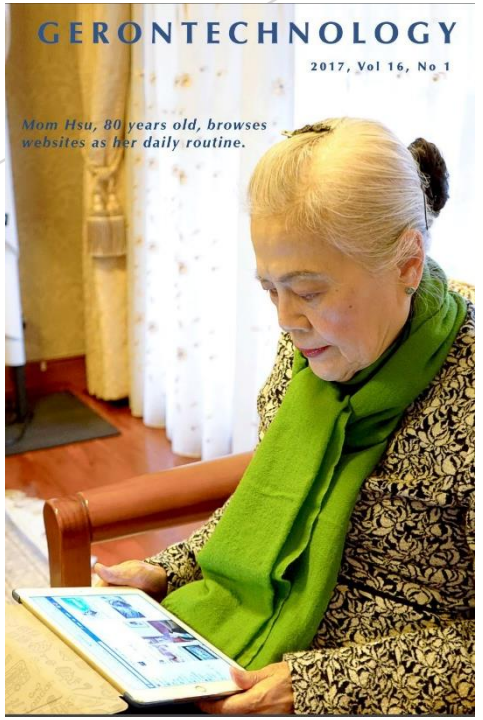
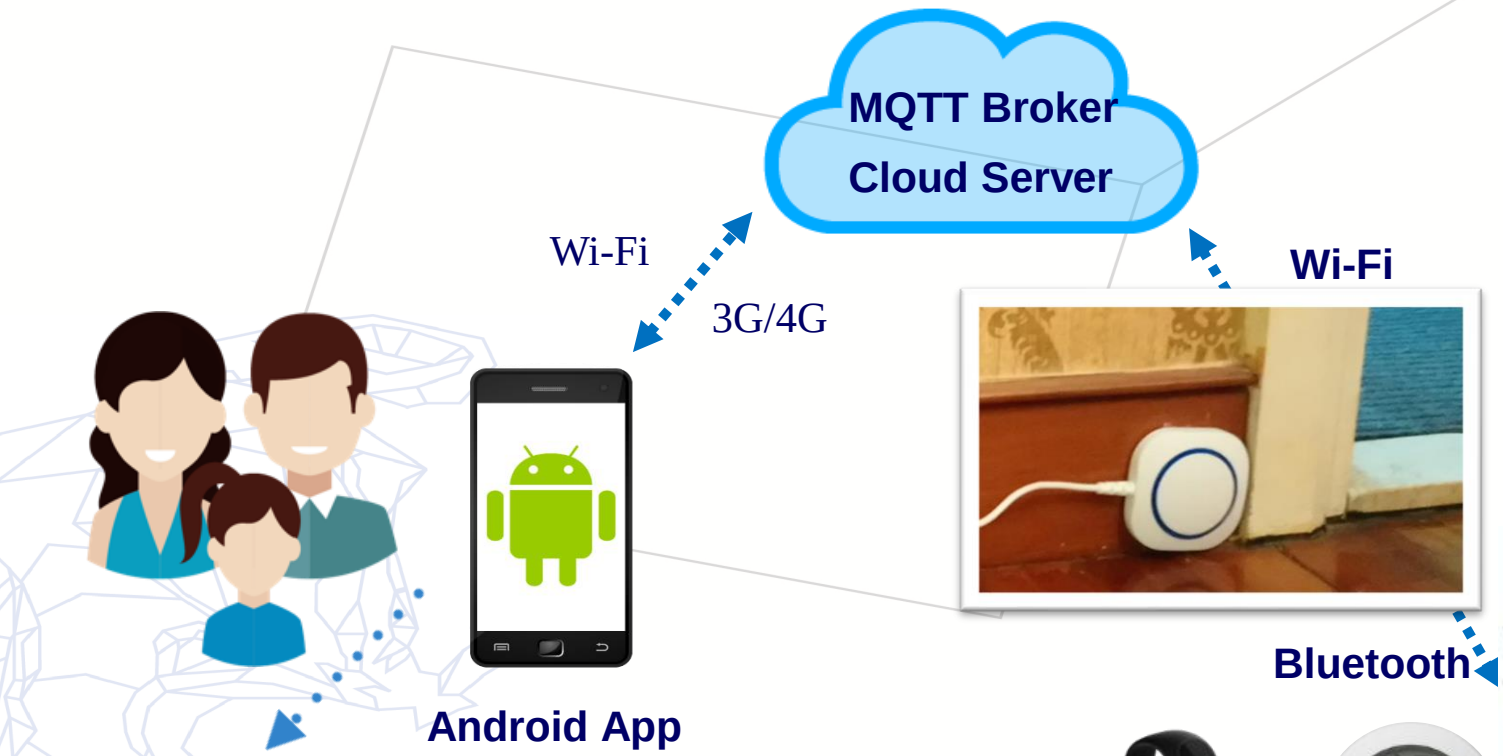
如果遠距照護生理訊號傳輸對象是子女、家人而非醫療院所？

- 糖尿病長輩如何產生每日自我量測的行為？
- 藍牙產品如何進入物聯網Ecosystem？







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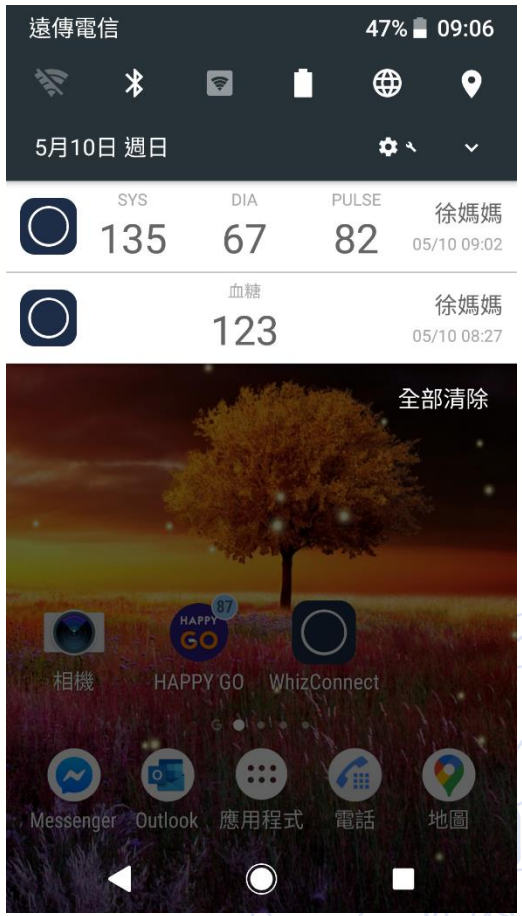
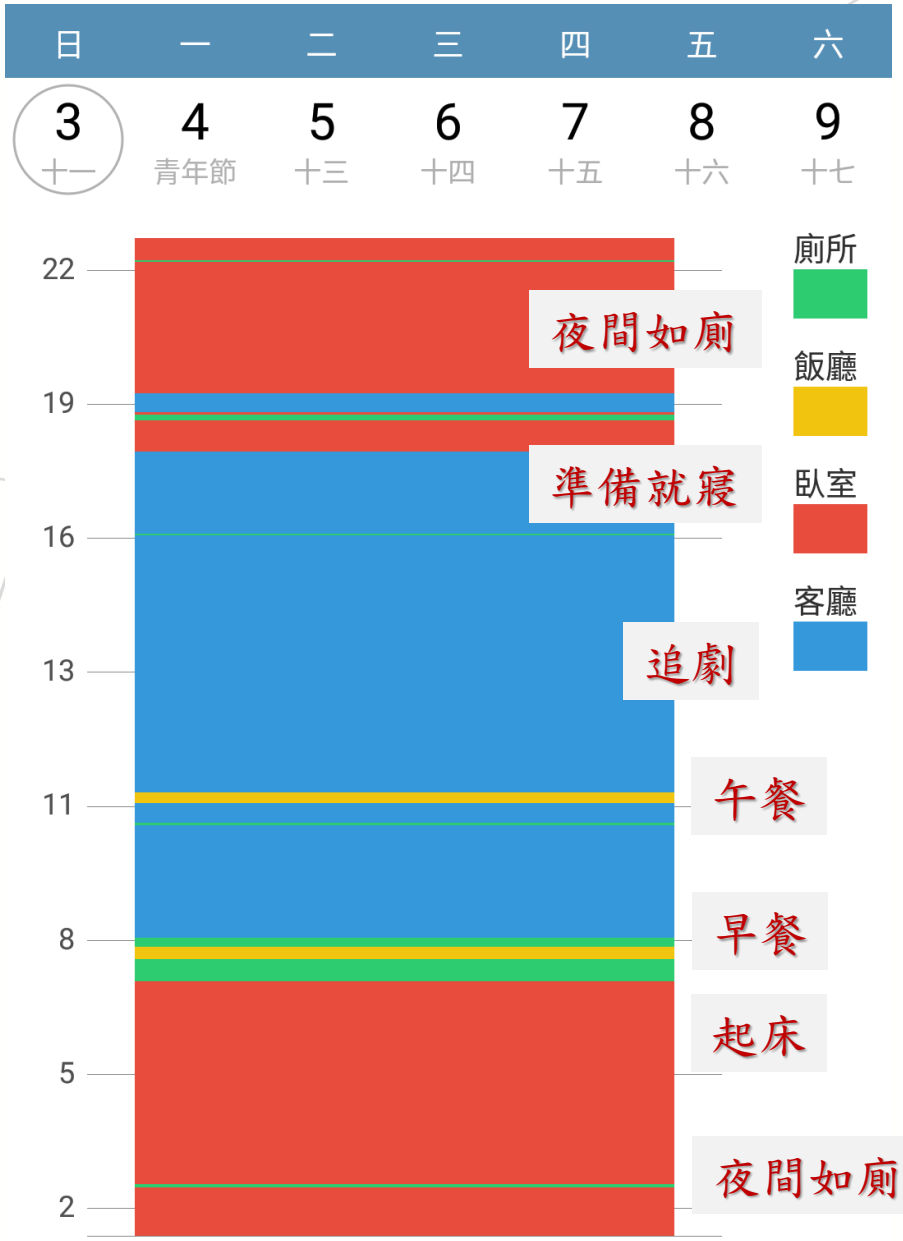
兒子是媽媽每日自我量測的動機...





對照護者的支持—
關懷、互動、連結而不只是健康監測

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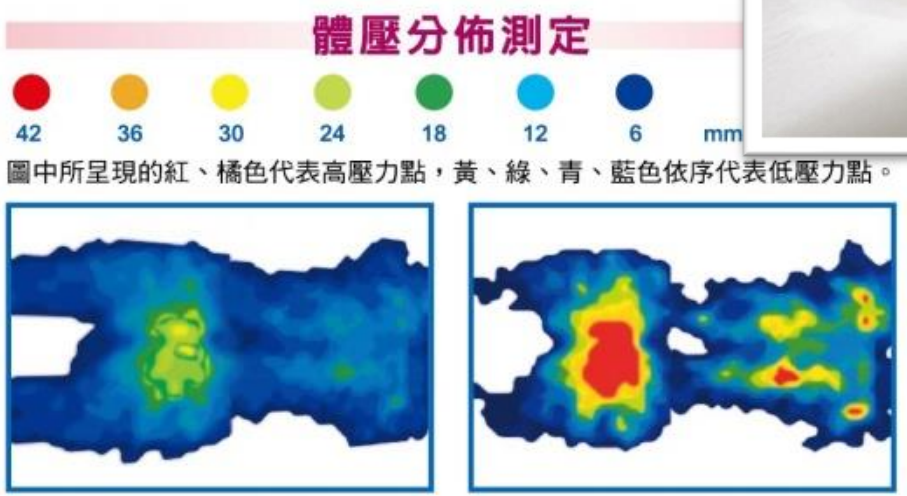
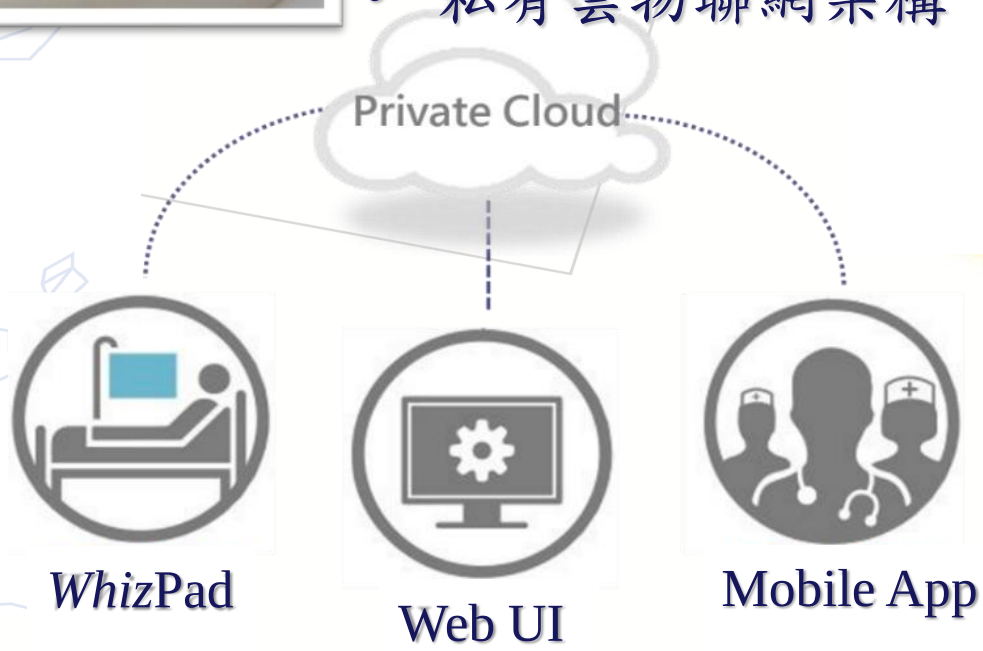
智慧科技「大數據人工智慧物聯網」照護的應用－以床為核心

- *Whiz*Pad是一張非常舒適的床墊
- 溫感釋壓泡綿**壓傷**使用者需要甚麼？
- 照護者需要甚麼？

台中榮總、台大醫院、台北榮總
台安醫院、成大醫院，羅東聖母
醫院



- **跌倒**是醫院通報事件第二位(25.2%)，跌倒事件發生時活動以「上下床移位時」佔 22.5%最多【台灣病人安全通報系統2017年年報】
- 坐床、床緣、離床三階段離床警示跌倒預防，Web/App整合管理介面
- 私有雲物聯網架構



台北榮總

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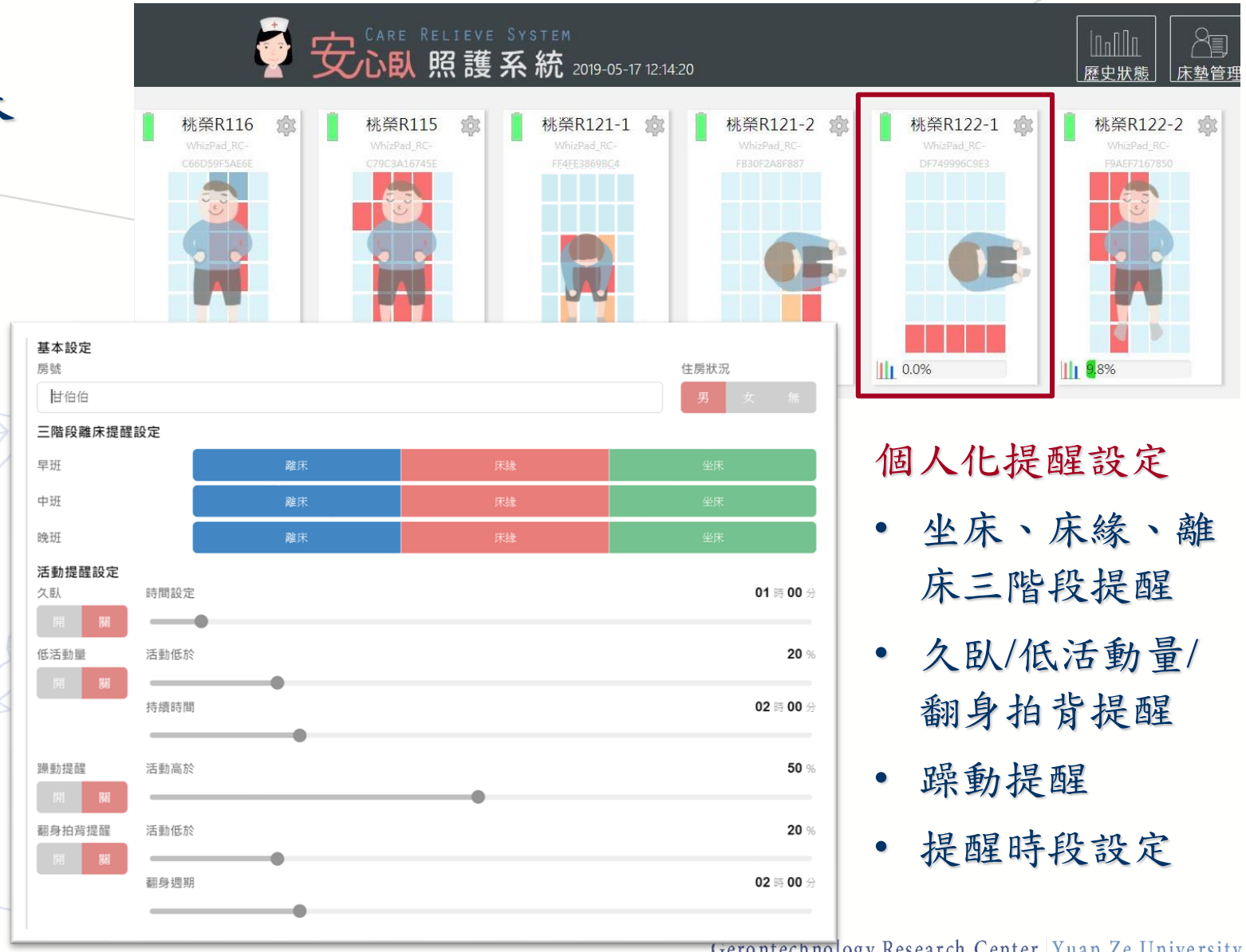
4感測區塊、Rule-based ➔ 30感測區塊、類神經網路機器學習

- 21位受測者依體重分為8組 (30~109kg)蒐集600+學習樣本
- 6種臥床狀態機器學習
  - 躺床/左側躺/右側躺
  - 坐床/左床緣/右床緣
- 10 fold cross validation 98.0%
- 演算法燒錄控制盒晶片 250樣本實測準確率94.4%
- 久壓紀錄、活動量計算
- 低耗能，使用兩顆三號電池



個人化提醒設定

- 坐床、床緣、離床三階段提醒
- 久臥/低活動量/翻身拍背提醒
- 躁動提醒
- 提醒時段設定

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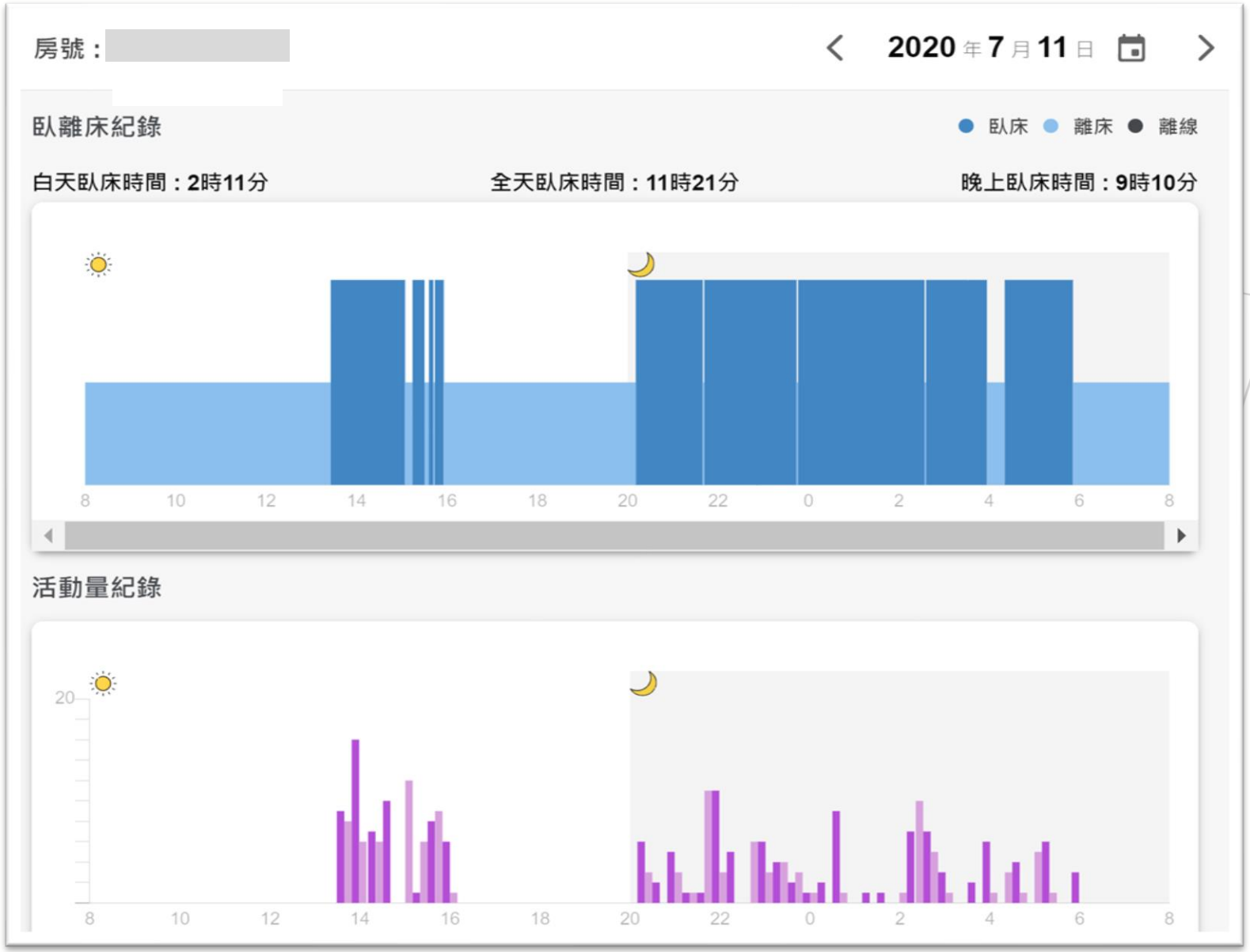
更多生活模式記錄



- **Cloud AI: Amazon Web Service (AWS)**
- 生活模式、睡眠品質...

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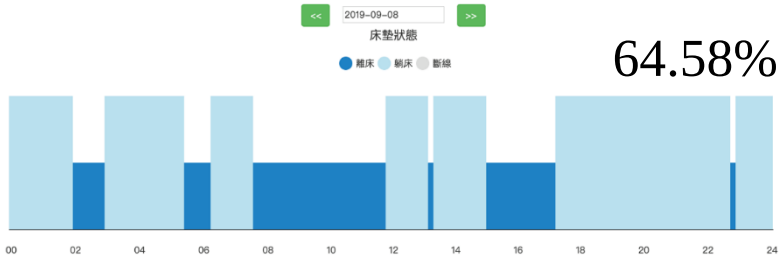
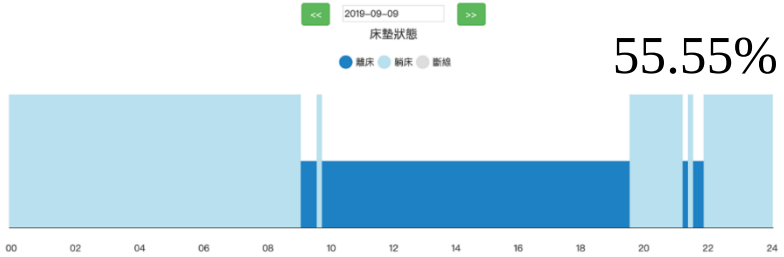
大數據：蒐集➔儲存➔分析➔視覺化

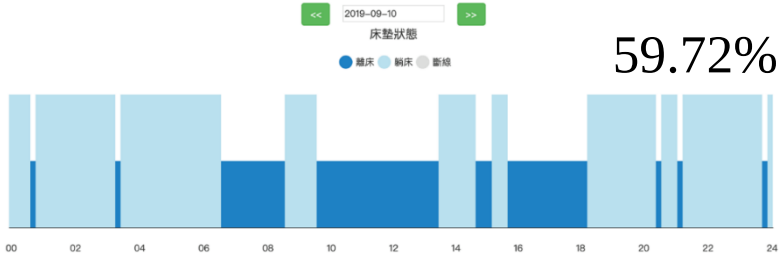
甘伯伯每日臥離床模式



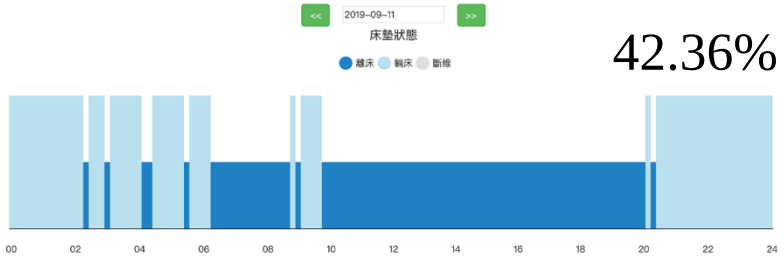
64.58%



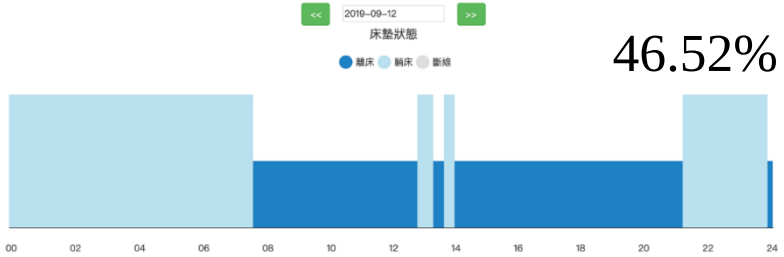
55.55%



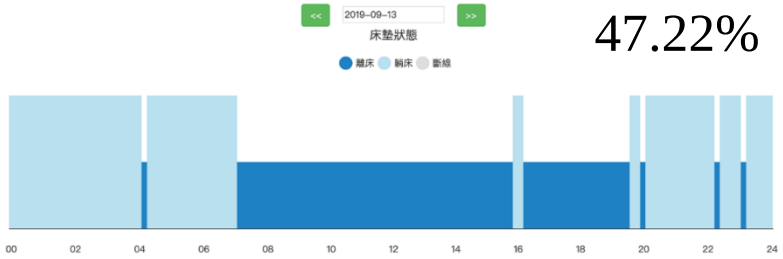
59.72%



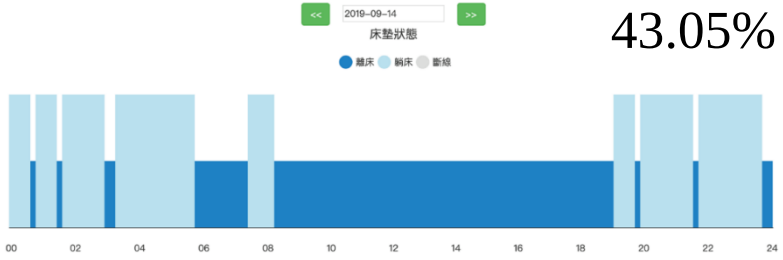
42.36%



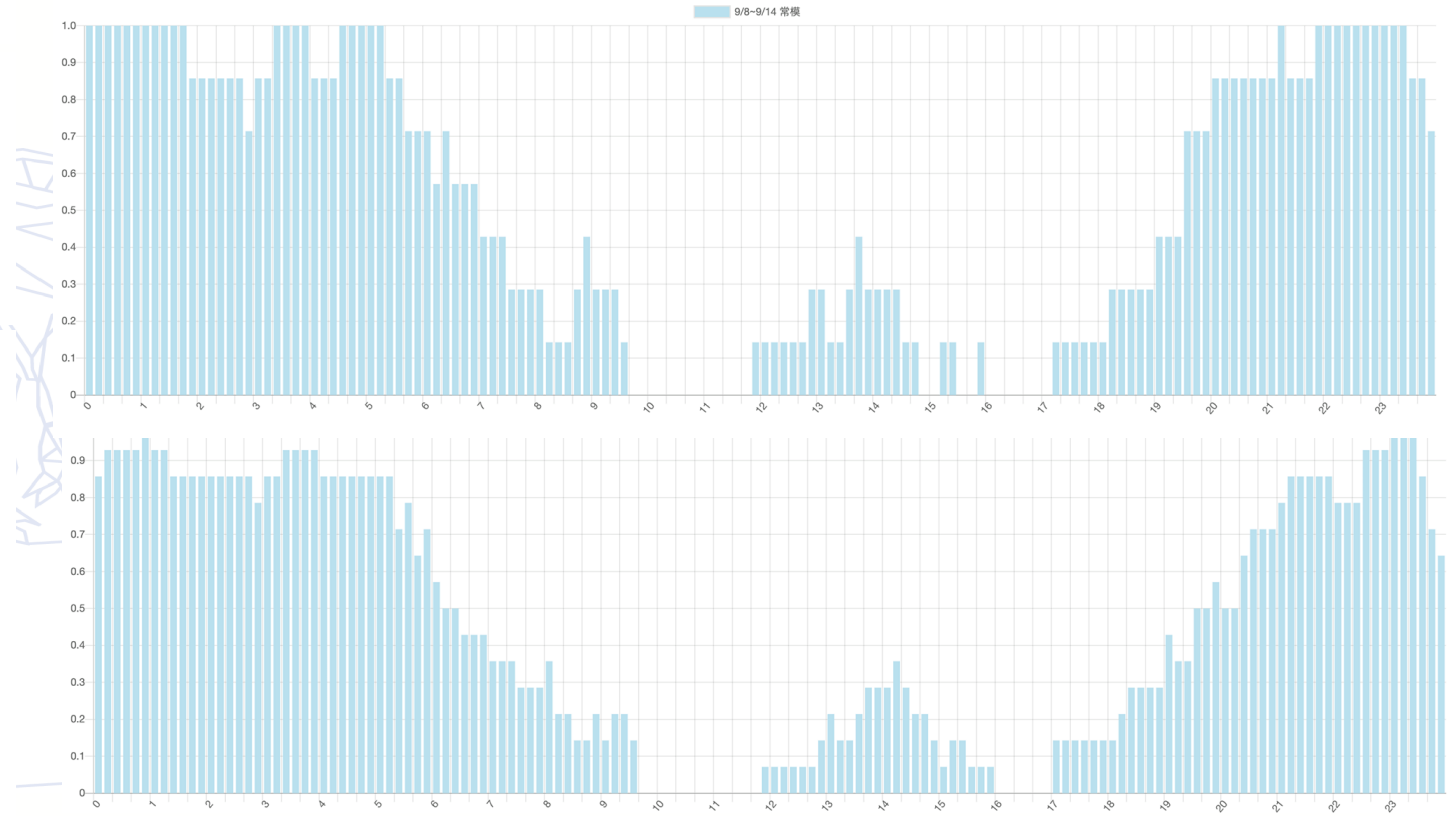
46.52%



47.22%



43.05%



1 week

2 weeks

臥床比例

45.88%

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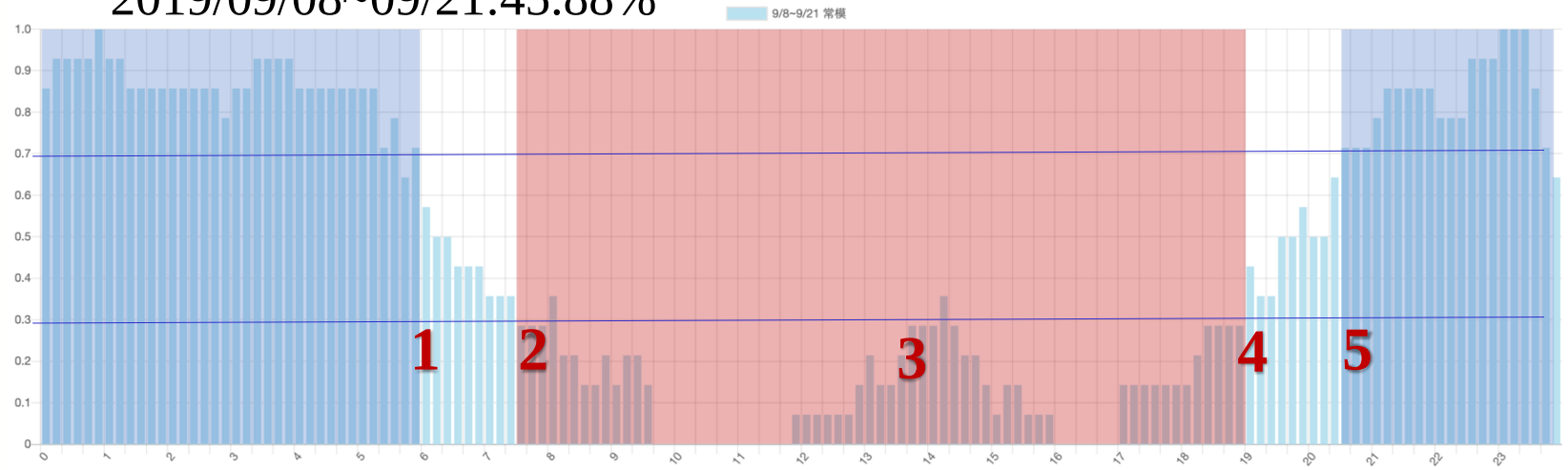
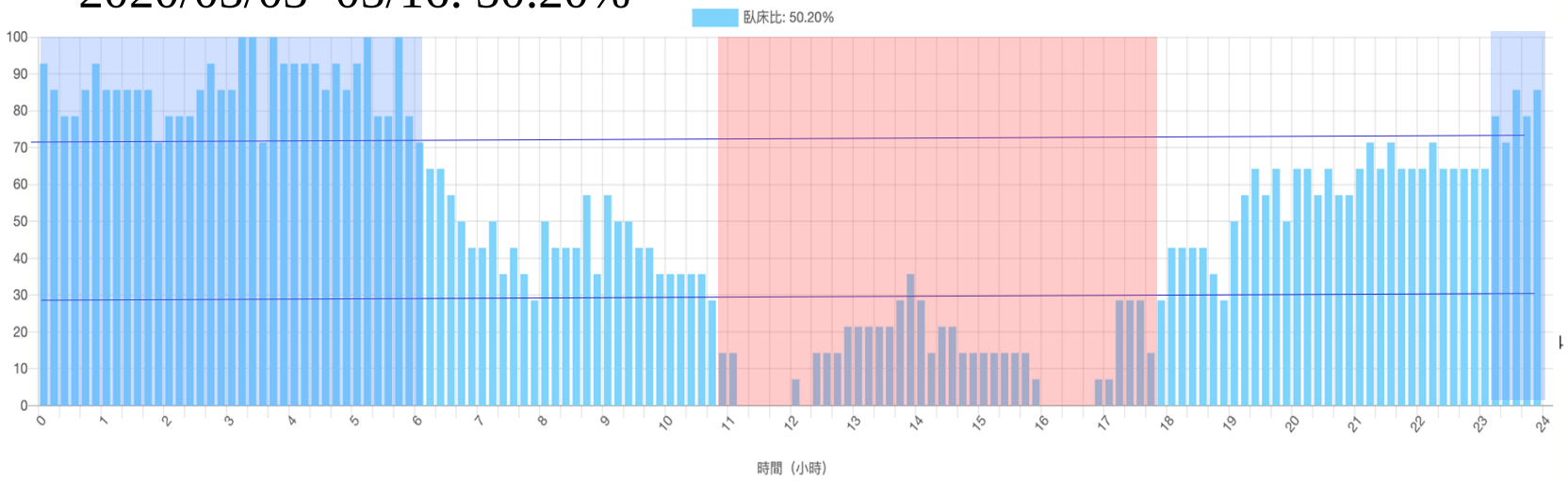
以70%為門檻值定義常態活動(normal activity)

2019/09/08~09/21:45.88%



1. 起床時間通常不早於05:50
2. 起床時間通常不晚於07:30
3. 日間通常不臥床休息
4. 上床時間通常不早於19:00
5. 上床時間通常不晚於20:40

2020/05/03~05/16: 50.20%



1. 臥床比例64.58%遠較常模45.88%為高
2. 起床時間07:50晚於常態時間
3. 日間多次臥床休息
4. 上床時間17:30早於常態時間
5. 夜間異常離床

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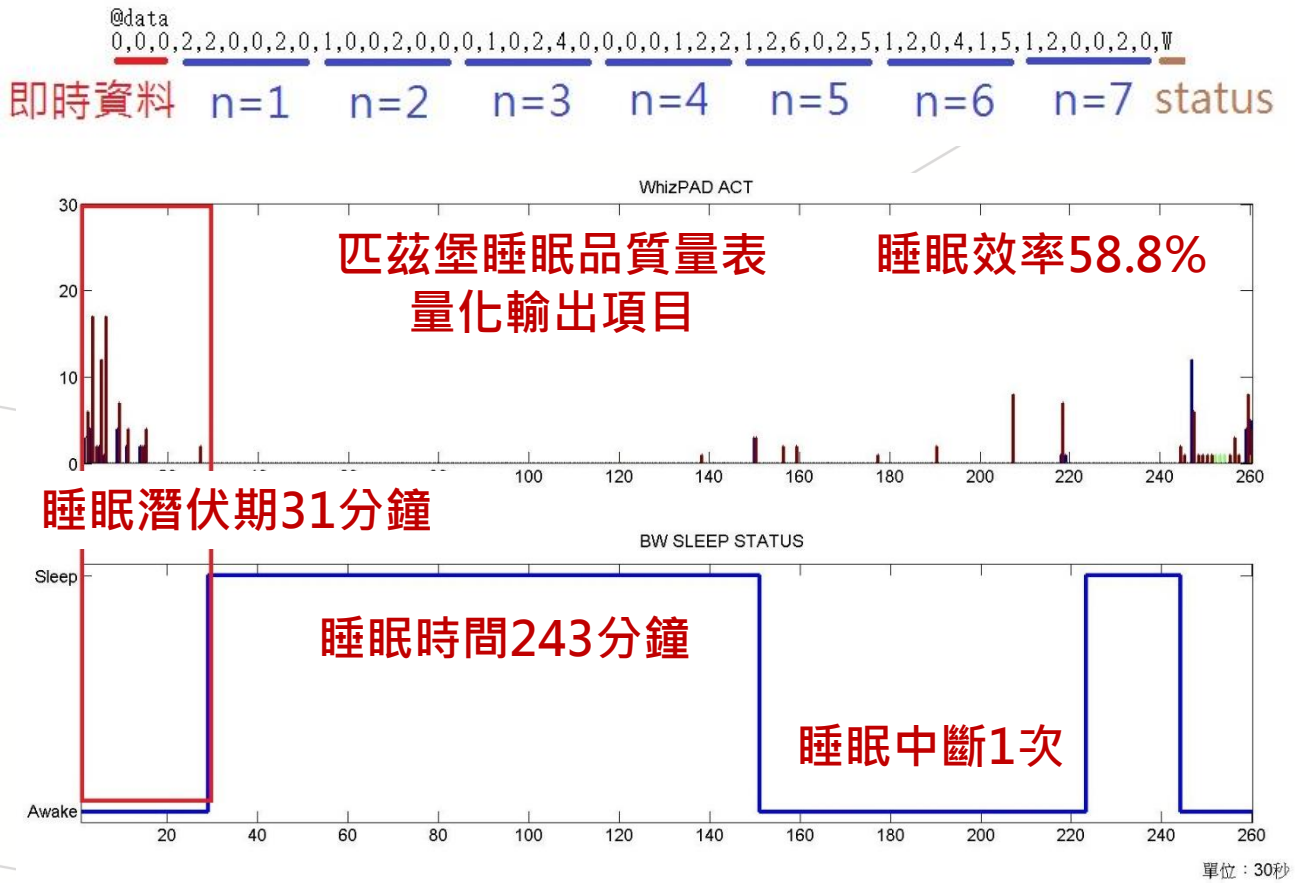
Bed-actigraphy 睡眠判讀

- 以感測區塊時間序列活動資料（無呼吸、心率訊號），對照PSG睡眠判讀（以PSG睡眠判讀軟體標示資料），進行清醒/淺眠/深眠機器學習
- 除建置在AWS 的雲端進行整晚睡眠品質判讀外，並將演算法建置在床墊控制盒的單晶片上，進行即時睡眠狀態判讀
- 連動控制其他居家物聯網裝置（如冷氣、燈光、電視等），塑造優質睡眠環境



N		預測結果		預測正確率%	
		清醒	睡眠	整體	清醒
0	清醒	348	349	86.50	49.93
	睡眠	61	2278		
6	清醒	474	211	88.96	69.20
	睡眠	123	2216		

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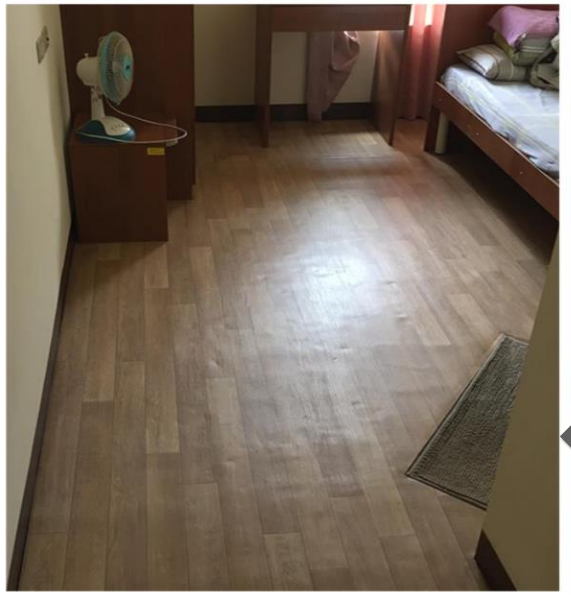
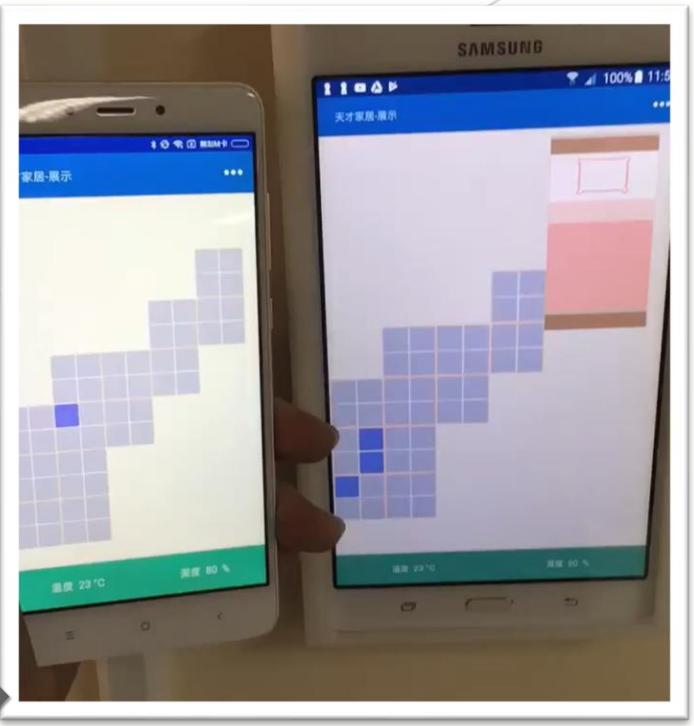
巧拼形式物聯網活動感知地墊*Whiz*Carpet：跌倒警示/長者活動大數據蒐集

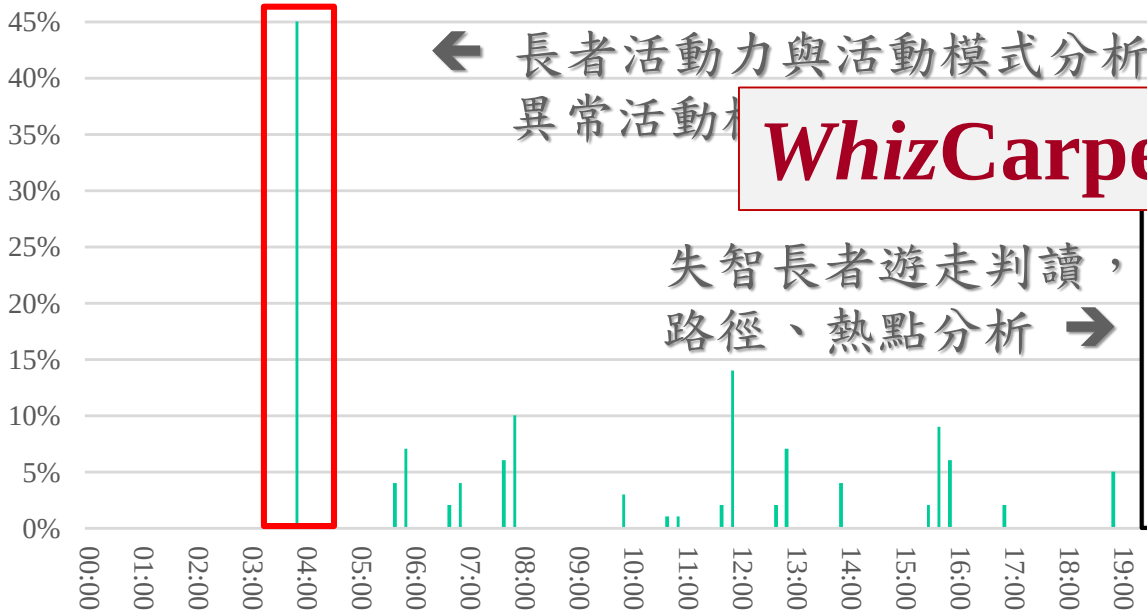


快速鋪設，軟質地墊降低長者跌倒骨折風險



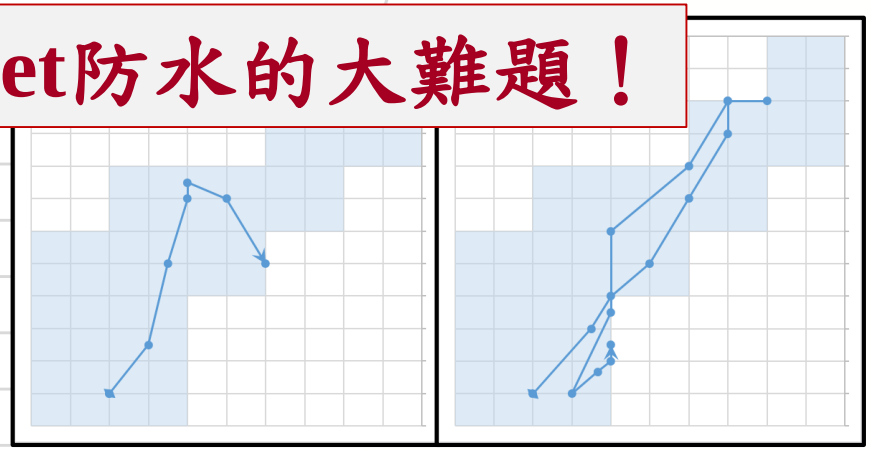
長者即時位置顯示，跌倒偵測與警示

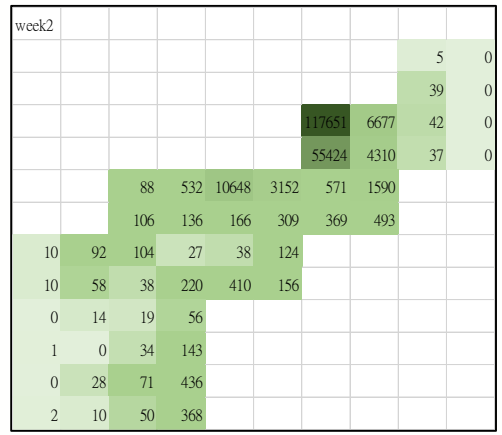
長者活動力與活動模式分析，異常活動



_Whiz_Carpet防水的大難題！

失智長者遊走判讀，路徑、熱點分析





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*Whiz*Touch: 物聯網呼叫鈴

- 超大按鈕，能以手掌輕鬆按壓
- 多人手機接收，沒有距離限制
- 照護者回傳確認改變燈光顏色，或以手機單鍵快速撥號通話
- 但是…物聯網本身是進入居家的障礙！

- 長者網路使用率低(31.1%/8.6%@2018)，因智慧照護應用月繳高額網路費用並不合理
- 將產品連接上網操作複雜，家中臥室無線網路訊號不佳，也是使用性上的障礙

NB-IoT－智慧照護進入居家最後一哩！

- 窄帶物聯網NB-IoT產品以SIM卡直接連接電信公司基地台，家中不必建置任何網路設備便可直接使用
- 網路費可內含在產品售價（下表為遠傳電信費率）

方案類型	輕量型	重量型	勁量型
月租費	$10	$25	$60
免費傳輸量	5MB	15MB	40MB
適用上傳頻率 (*5KB/次)	每小時/次	每15~30分/次	每5分/次

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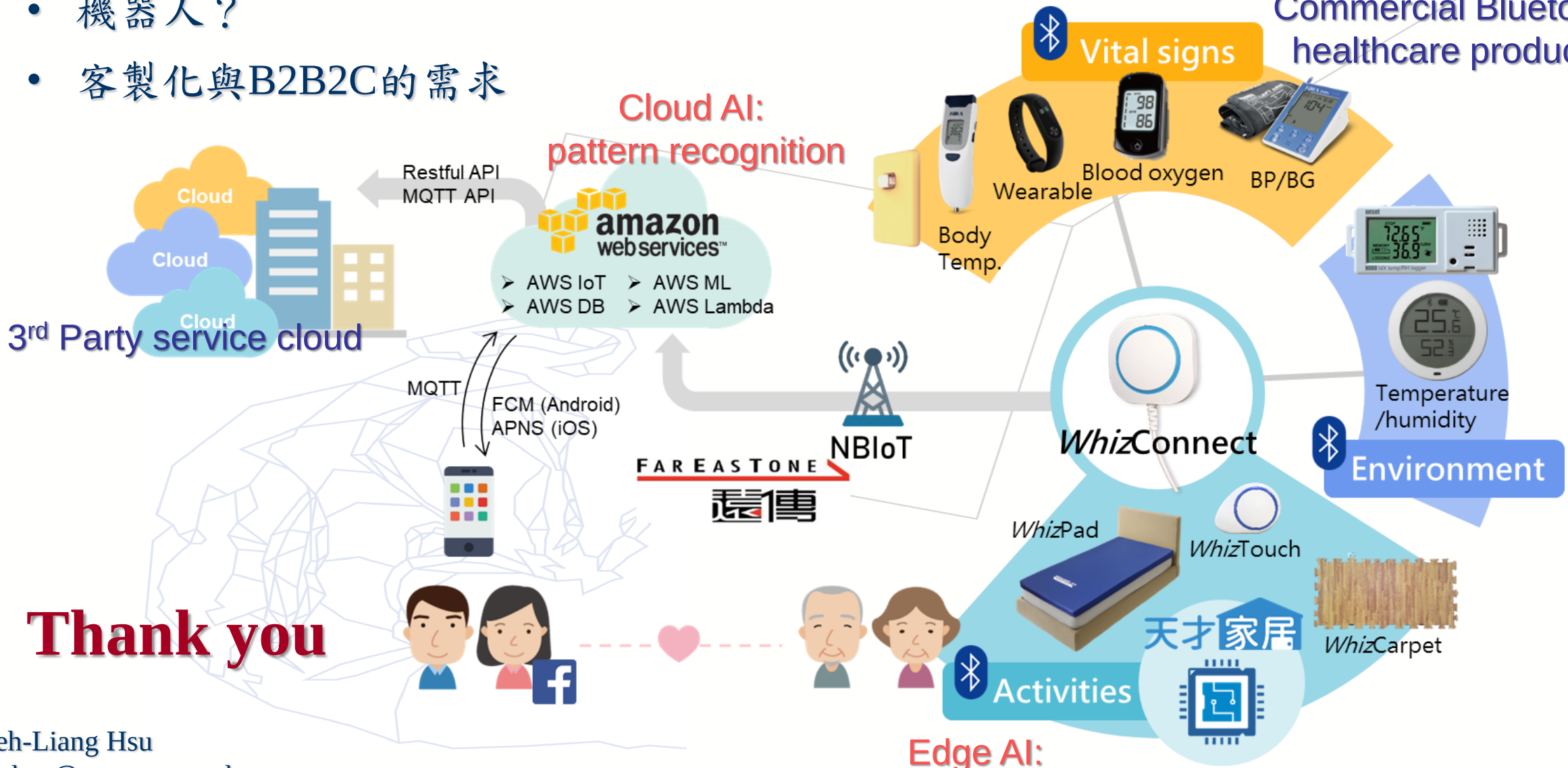
選擇屬於居家環境的智慧科技 (2015: IoT; 2017: NB-IoT; 2019: ML/AI)

- 機器人？
- 客製化與B2B2C的需求



Thank you

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mehsu@saturn.yzu.edu.tw

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