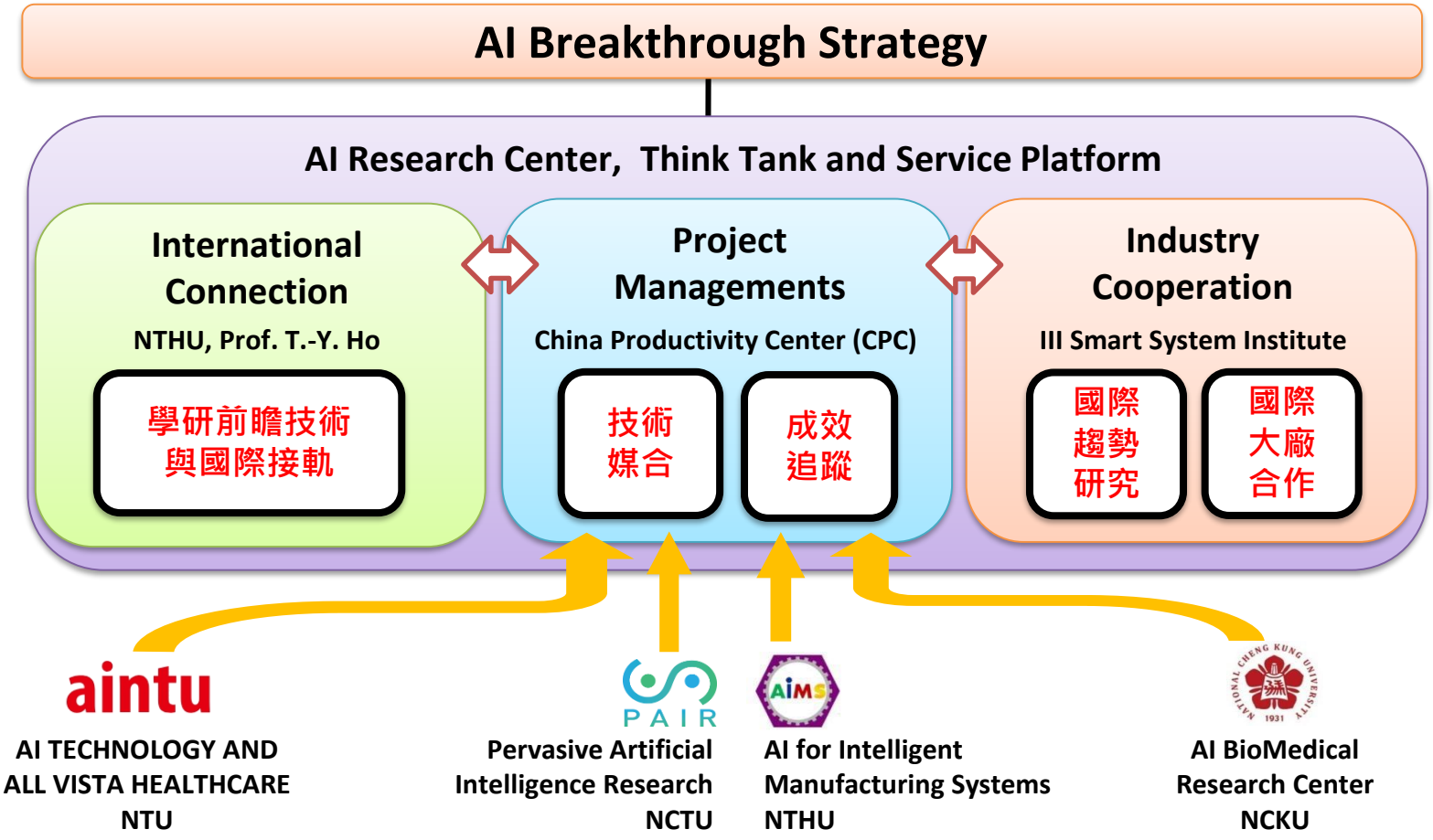
Pervasive AI Research Labs

科技部人工智慧普適研究中心

Pervasive Artificial Intelligence Research Labs

AI Innovation Research Centers

A 5-year US$167M initiative for AI Research
funded by Ministry of Science and Technology (MOST)

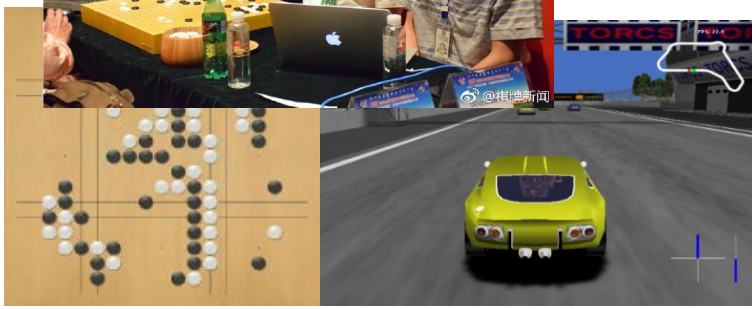


PAIR Lab Introduction

Vision	Apply AI technologies pervasively, into applications for life, work, and leisure
Research Teams	18 project teams, 100+ PI and Co-PI, Over 300 publications per year

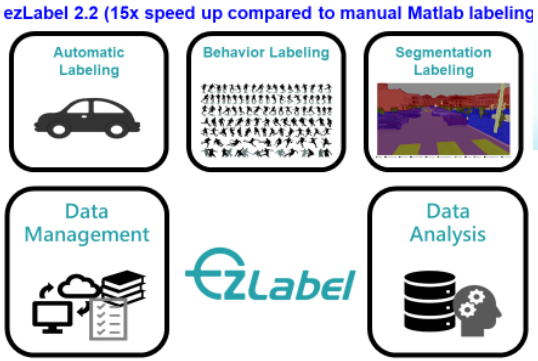
Autonomous drone/driving, 5G+AI+IoT, Data fusion, Emotion detection, BCI, Home care, NLP/NLU, Smart Robots, Imitation Learning, CV, Gesture, Compression, Smart Agriculture, FinTech, Game, etc.

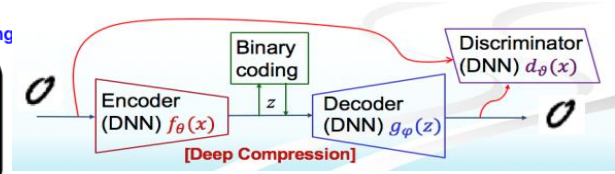
Go, Video Games & Transfer Learning



Beat Tencent in 2017 Go
Win Rate 74%, CGI vs. Facebook ELF OpenGo v2

Robots, 3competitions in 2019, FIRA RoboWorld Cup, RoboCup, International Intelligent RoboSports, total 17 Gold, 12 Silver, 4 Bronze





Learning-based image compression, better than H.265

EzLabel - AUDI Innovation Award: WeMo scooter prize and AUDI HQ Prize

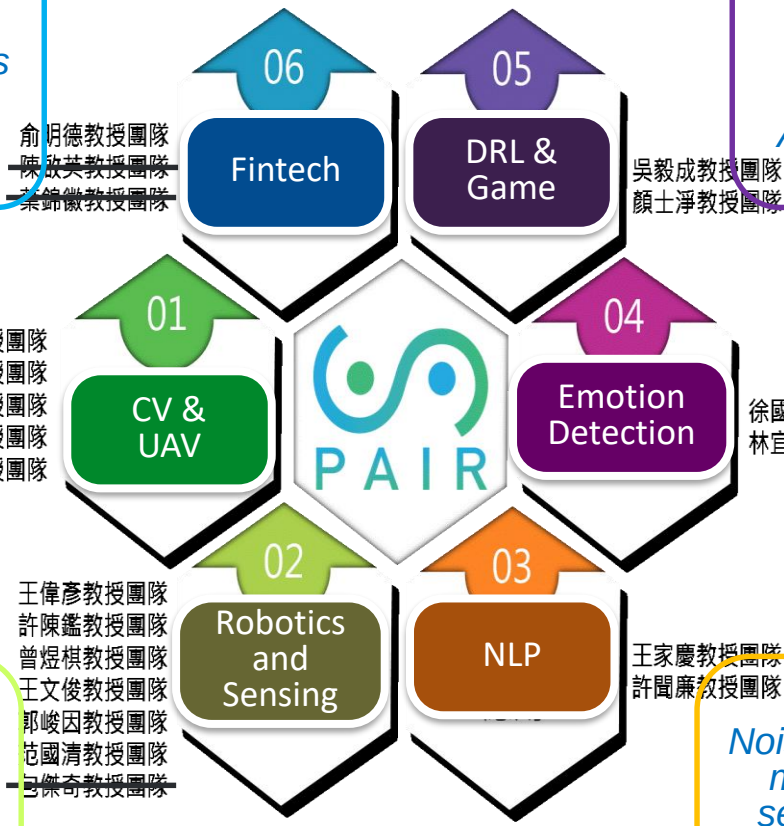
Core Technologies of Research Teams

Fintech, AI for Portfolio Management, Trading Strategy, Stock Picking, Market Timing, Derivatives pricing and Risk Management, Robo-Advisor

Gaming Applications, Improved Alpha Zero technologies, DRL Applications, AI Bot for weakness/bug detection AI Bot for self-driving and robots

Autonomous drone, Object identification, Positioning, Obstacle avoidance, Route planning, non-GPS navigation, 3D modeling, Swarms, Smart Agriculture, Image/Video compression, Drone communications, Radio map

Emotion detection by all means, (e.g., brain wave). Applications include BCI, emotional therapy, psychological intervention for cardiovascular disorder, etc.



18 projects (2020)
21 projects (2019)

Imitation learning, Precise manipulation, Safety analysis of robot perceptions/motion, Artificial general intelligence, Data fusion, AIoT, Real-name electronic fence, Smart retail, ITS, Gesture, AR, Air writing, Blind assist, LBS, Recommendations

Noise cancelling, translation, mixed language inputs, semantic understanding, NLP parser, etc.

Core Technologies of Research Teams

線上理專
普惠金融

Fintech, AI for Portfolio Management, Trading Strategy, Stock Picking, Market Timing, Derivatives pricing and Risk Management, Robo-Advisor

金融服務

俞明德教授團隊
陳啟英教授團隊
葉錦徽教授團隊

Gaming Applications, Improved Alpha Zero technologies, DRL Application, Bot for weakness/bug detection AI Bot for self-driving and robots

遊戲、教育

吳毅成教授團隊
顏士淨教授團隊

長照

Autonomous drone, Object identification, Positioning, Obstacle avoidance, Route planning, GPS Navigation, Swarm, Smart warehouse, Image/video compression,

無人機
救災、巡檢、通訊、偵蒐
智慧農業、災損保險

Drone communications, Radio map

教授團隊
教授團隊
教授團隊
教授團隊
教授團隊

Emotion detection by all means, (e.g., brain signal, Application of the theory of physical intervention for cardiovascular disorder, etc.

居家照護、心理情緒
相關疾病預防

徐國鎧教
林宜美教

外骨骼機械輔助、
復健輔助

王偉彥教授團隊
許陳鑑教授團隊
曾煜棋教授團隊
王文俊教授團隊
郭峻因教授團隊
范國清教授團隊
[illegible]傑奇教授團隊

王家慶教授團隊
許聞廉教授團隊

Imitation learning, Precise manipulation, Safety analysis of Human-Robot Collaboration, Deep learning, Reinforcement learning, Computer vision, Sensing and Control, Human-Robot Interaction, Motion planning, Grasping, Dexterous manipulation, Assembly, Industrial robotics, ITS, Gesture recognition, Handwriting, Blind assist, LBS, Recommendations

智慧工廠、電子圍籬、
盲人輔助、AR應用、
智慧交通、自動駕駛、
LBS、推薦服務

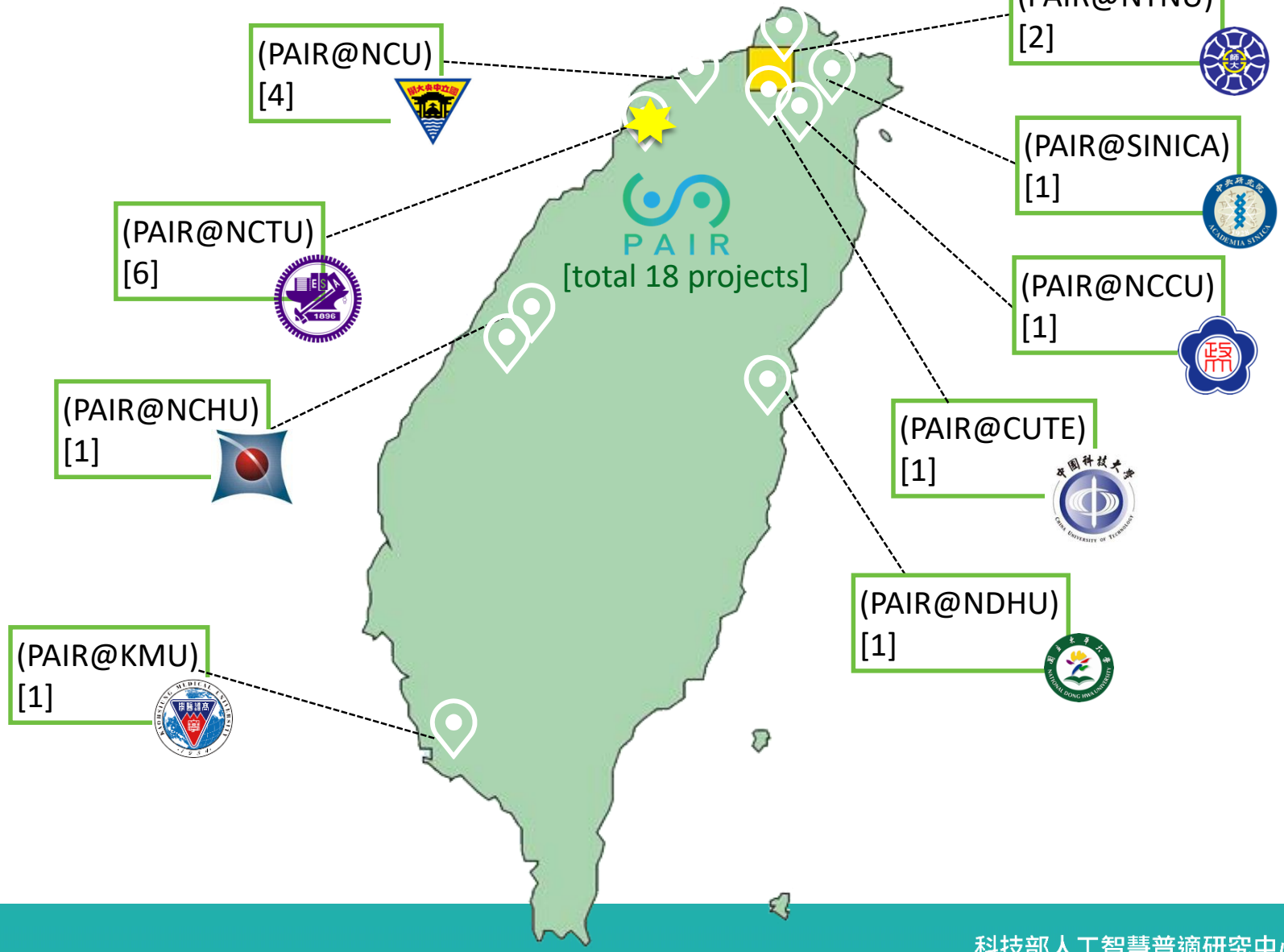
Noise cancelling, translation, multi-turn dialogue, speech understanding, NLP, parser, etc.

翻譯、語言教學、
會議紀錄、智慧音箱

18 projects (2020)
21 projects (2019)

服務型機器人(工坊、餐飲)

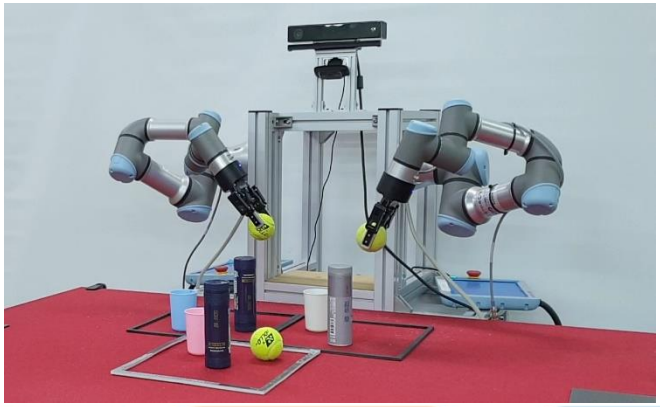
Labs Organization & Projects

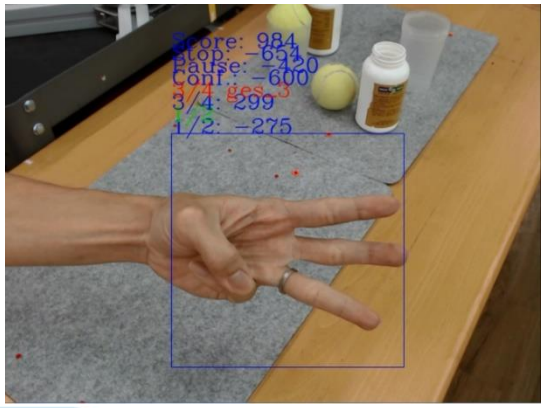


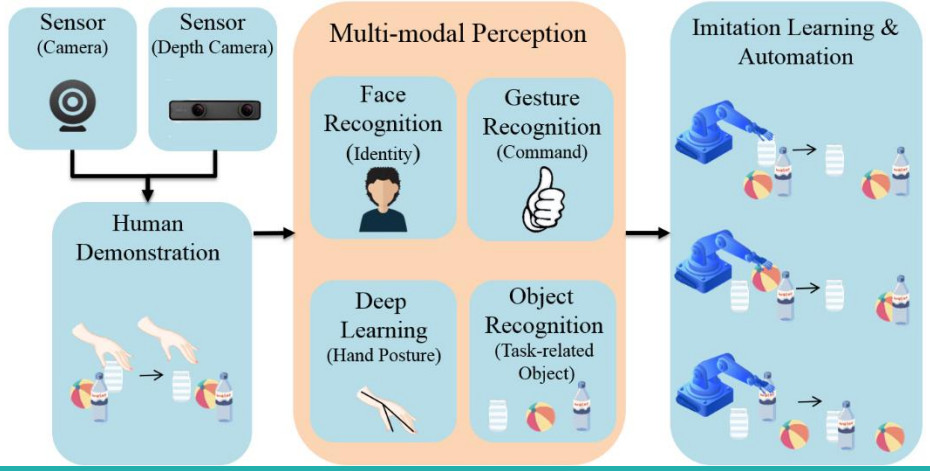
Collaborative Robot + NLP/U and more

Not just collaborative, but also interactive with human

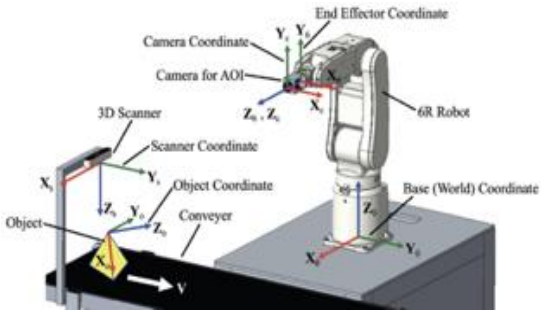
- Imitation learning, precise manipulation, safety analysis of robot perceptions/motion, noise cancelling and mixed language inputs, semantic understanding, gesture, etc.







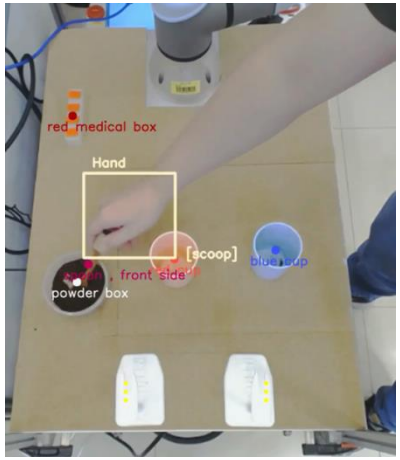
Dynamic Object Tracking



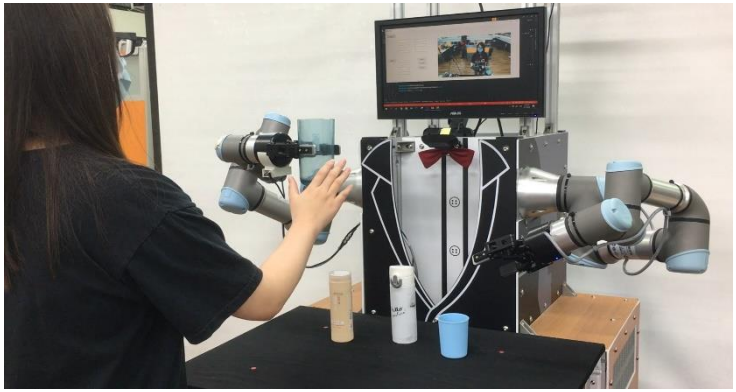
小明打算明天給小華每公斤100元的富士蘋果兩個

小明
給
target(小華)
possession（蘋果）
數量(2個)
單位價(100元/公斤)
品牌(富士)
time(明天)
意願(打算)

Collaborative Robot – Technologies

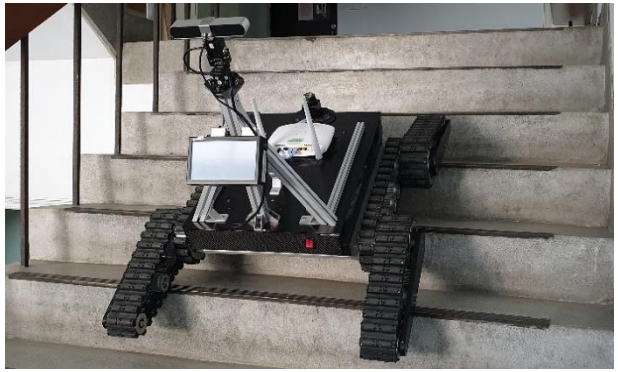


Hand motion recognition
(single image and video)



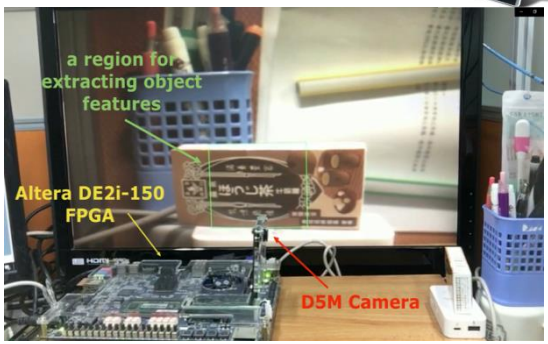
Learning by demonstration
and safe motion control

Real-time multiplayer
motion recognition



Robotic arm and mobile platform

FPGA accelerated positioning
and mapping (V-SLAM)

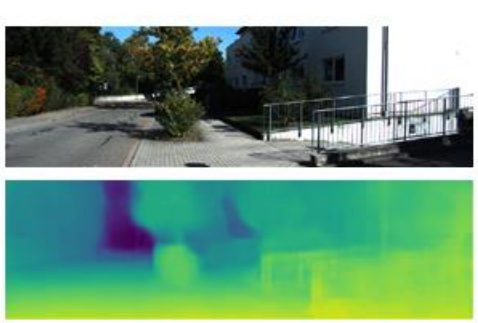


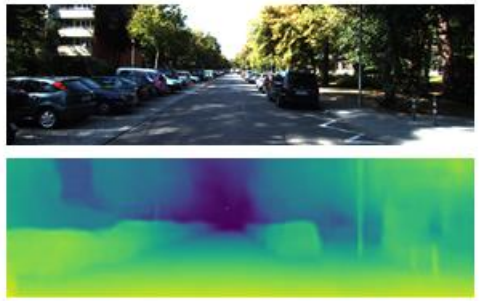
AI chip for image recognition

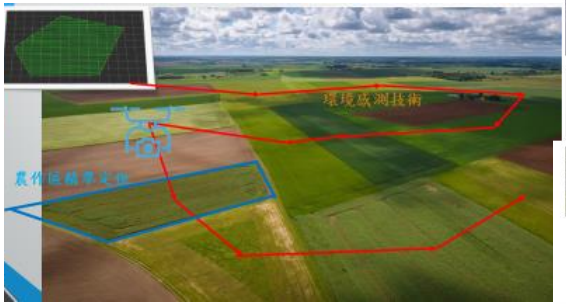
Autonomous Drone Applications

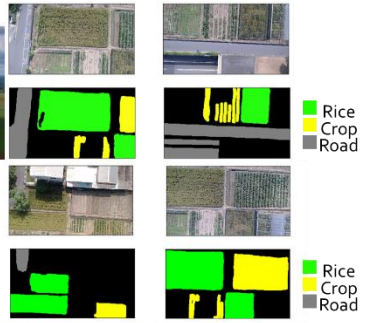
Autonomous drones for field services: agriculture, facility inspection, communication hot spot, emergency, etc.

- 5+ teams working in autonomous drone technologies or applications
- SLAM, Flight control/simulation, Environment sensing, Vision and video compression, Object identification, positioning and counting, 3D route planning, DSM, Image stitching, etc.

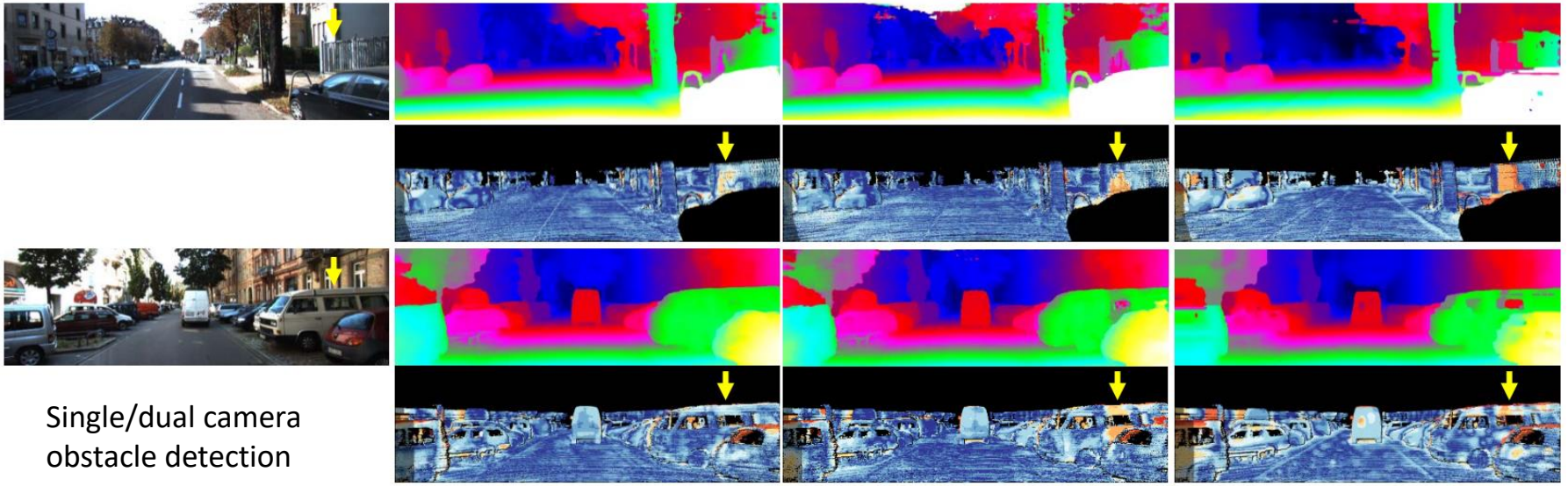








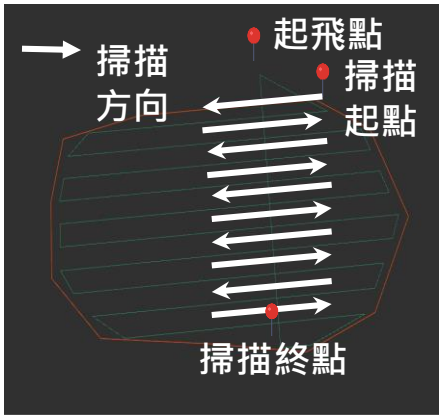
Autonomous Drone – Technologies

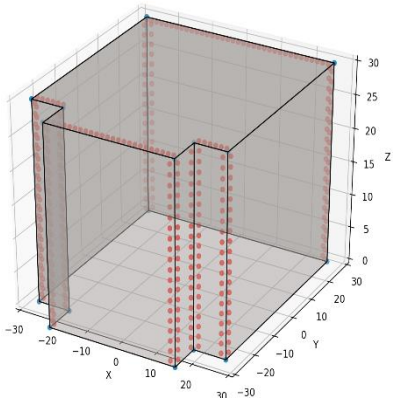


Single/dual camera obstacle detection

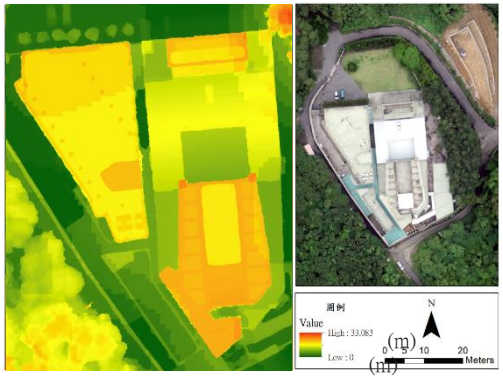
(a) PSMNet (b) GC-Net (c) MC-CNN

Route planning





Building point cloud

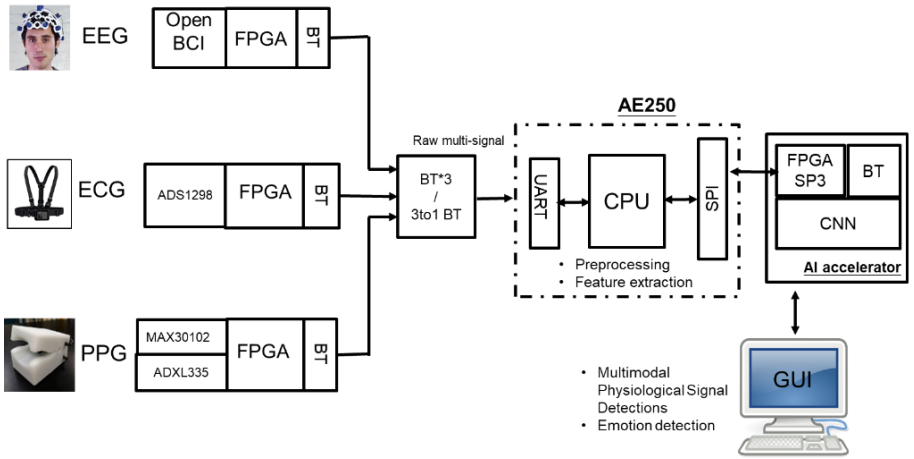


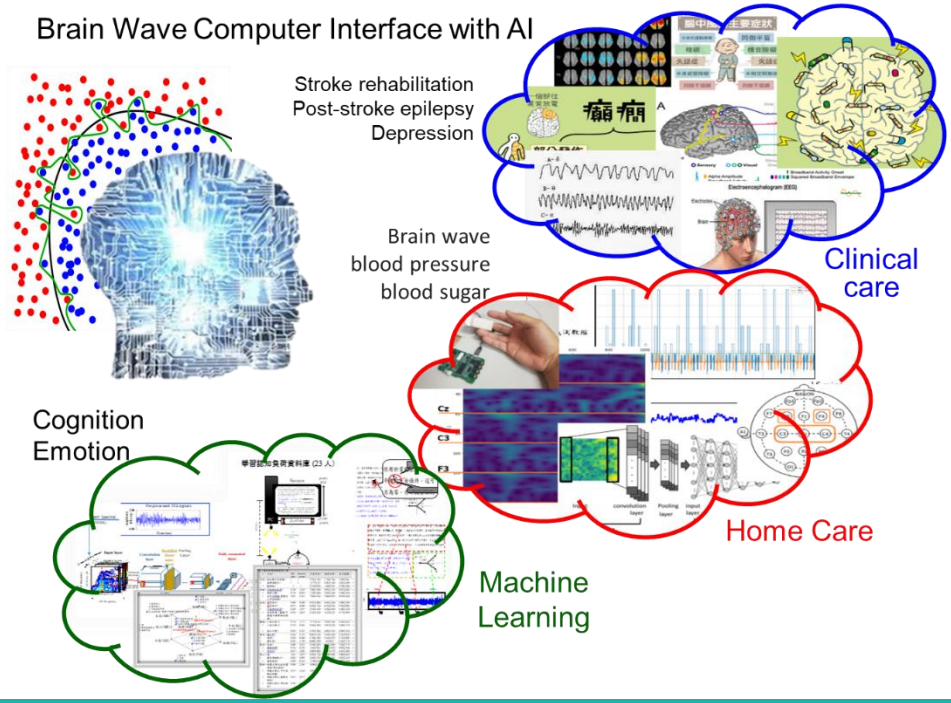
Building DSM (spatial modeling)

Affective Computing, BCI, and Medical

Emotion detection by all means, (e.g., brain wave). Applications include BCI, emotional therapy, psychological intervention for cardiovascular disorder

- By means of voice, EEG, ECG, PPG, applying AI to detect emotion at anywhere
- Bio-neuro-feedbacks were confirmed as an evidence-based clinical intervention
- Brain wave can also be applied as a novel man-machine interface

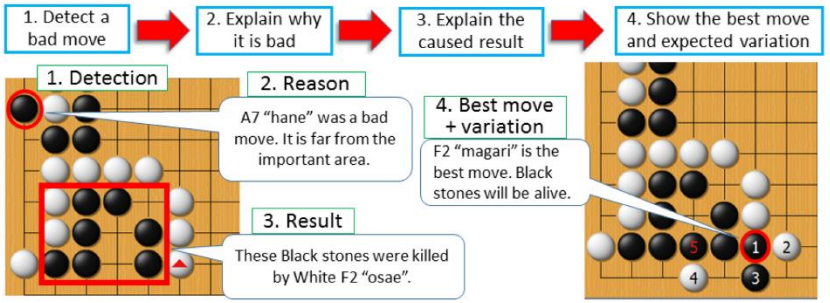


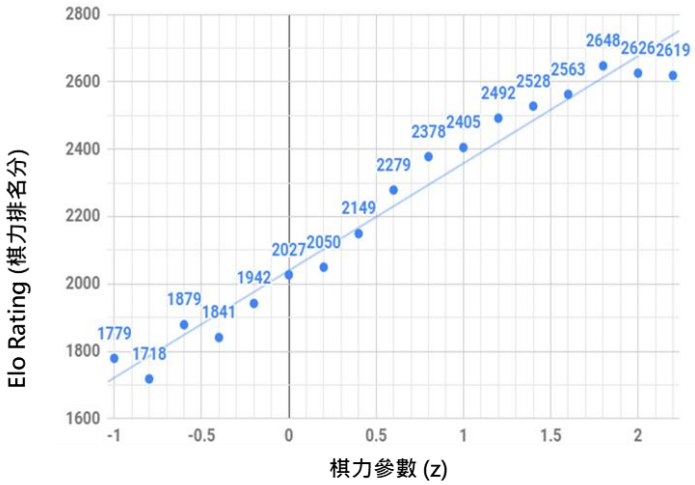


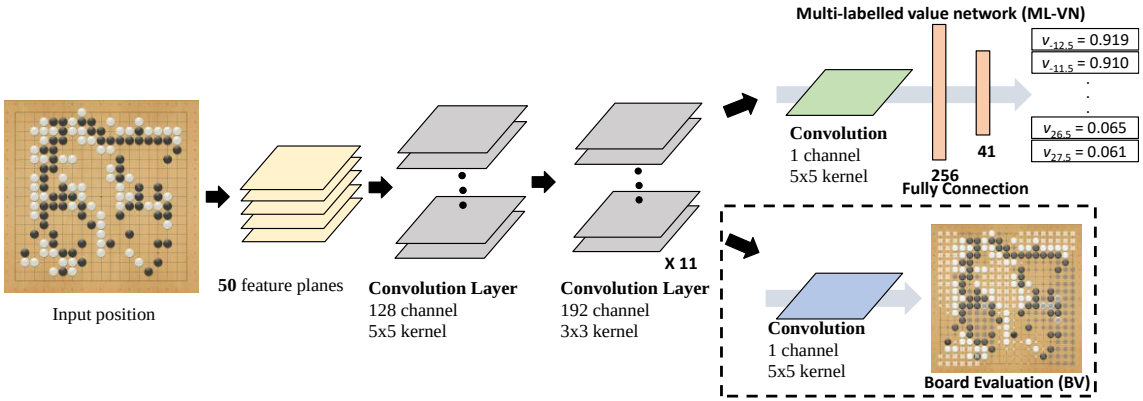
DRL and Gaming

Improved Alpha Zero technologies, DRL Applications, Gaming Applications

- Multi-labelled value network
- Population Based Training (PBT) for multi-agents
- Strength adjustment for MCTS-based programs
- Automatic commentary of chess style
- AI Bot for weakness/bug detection
- AI Bot for self-driving and robots



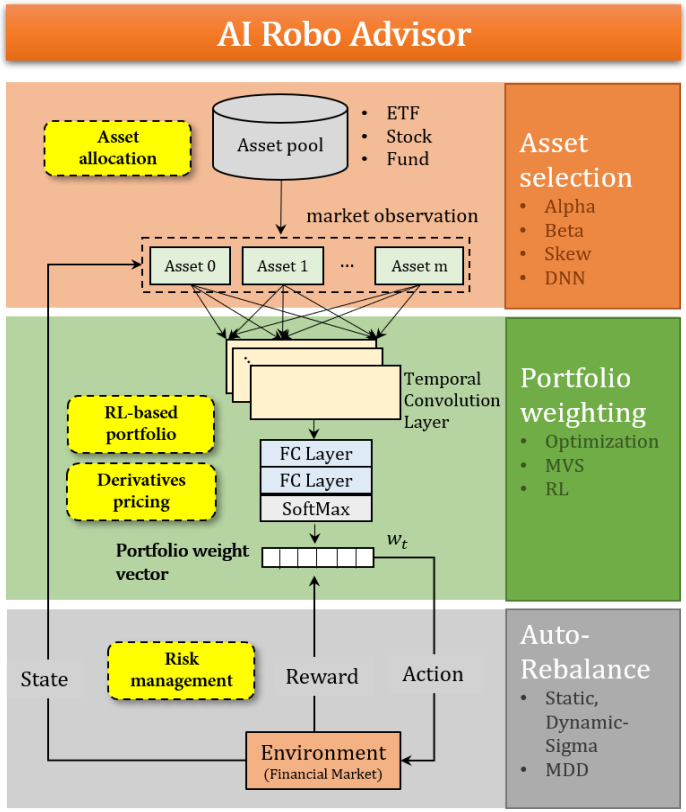




Fintech + AI

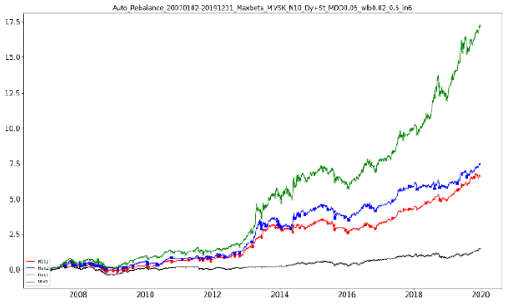
Applying AI for Portfolio Management, Trading Strategy, Stock Picking, Market Timing, Derivatives pricing and Risk Management.

- Smart-AI Index ETF; Stochastic Volatility Model; Market Calibration; Economic Scenario Generator; Value at Risk; Expected Shortfall



- 智能理財 BFAIDNN-Robo (3-Stage Algorithm)
  I: Picking Assets (Alpha, Beta, Skew, DNN)
  II: Optimization (Modified Markowtiz MVS)
  III: Auto-Rebalance (Static, Dynamic-Sigma or MDD)

Asset Pool: Top 50 most valuable stocks of TW
Test period: 2007.01.02~2019.12.31



MaxBeta_MVSK_Dy+St_MDD0.05 資產價值走勢

MaxBeta_MVSK_Dy+St_MDD0.05 績效

績效指標	R1	R2	R3	TW0050
R_mean	0.1882	0.2034	0.2858	0.0926
IRR	0.1714	0.1812	0.2540	0.0719
R_sigma	0.1688	0.1928	0.2239	0.1959
Sharpe_R	1.1151	1.0549	1.2763	0.4729
Sharpe_IRR	1.0154	0.9400	1.1341	0.3669
MDD	1.0313	1.1772	1.6546	0.7070
Turn over	64	72	83	

AI + IoT + 5G

Data fusion, Real-name electronic fence, Smart retail, 5G V2X + AI, Intelligent traffic system, 5G MEC + Drone, Radio map and people counting

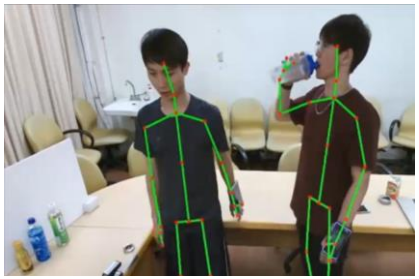
5 senses

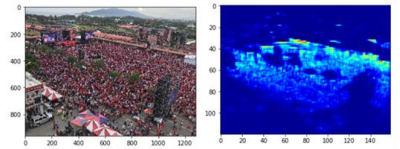
Intelligent Robot

Info by CV only

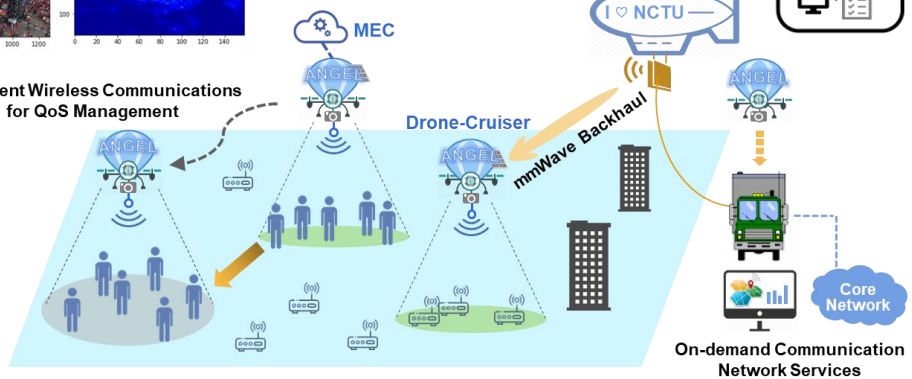
data fusion

Info in Robots

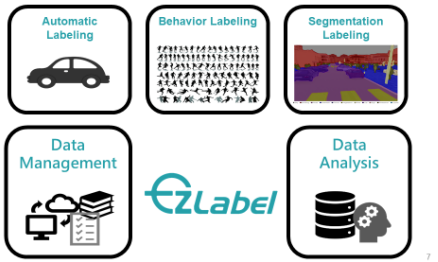


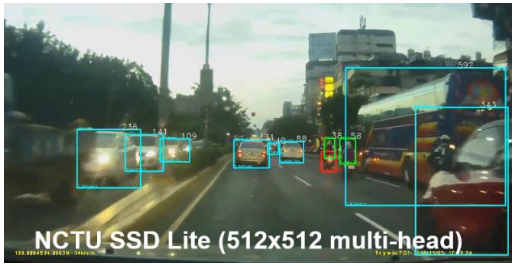


Hybrid UAV Flying Edge-AI Platform for Flash Crowd Detection

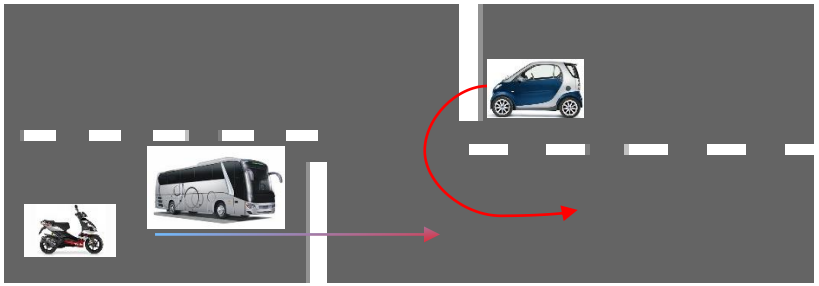


- ezLabel 2.2 (15x speed up compared to manual Matlab labeling)





ITS example: U-turn warning



AR, Social map, LBS and Recommendation

Air Writing, Text Locating and Recognition, Positioning, LBS, Recommendation

Identified text areas of interest

Recognized texts

Identified text areas of interest

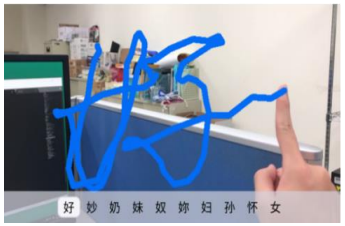
INPUT : a street view & GPS: 24.955331, 121.2175038

Textline detection

Character detection

Coordinate comparison

Text Recognition model



GPS: 24.955331, 121.2175038

String:
- 瘋好殼
- 割寬印表機
- 台灣大哥大

Google Place API

Search result:
- 瘋好殼
瘋好殼數位科技
24.9552944, 121.2173247
- 割寬印表機
勝程電腦公司 UV直噴 T恤直噴 割字 噴刻貼紙 熱昇華 熱轉印 3D雕刻
25.060954, 121.6494396
- 台灣大哥大
台灣大哥大中壢 - 中正特約服務中心
24.9552198, 121.217281

Filter coordinates (radius<50m) & Calculate azimuth

Social Recommendation Technologies

Location Image and Comment Analysis

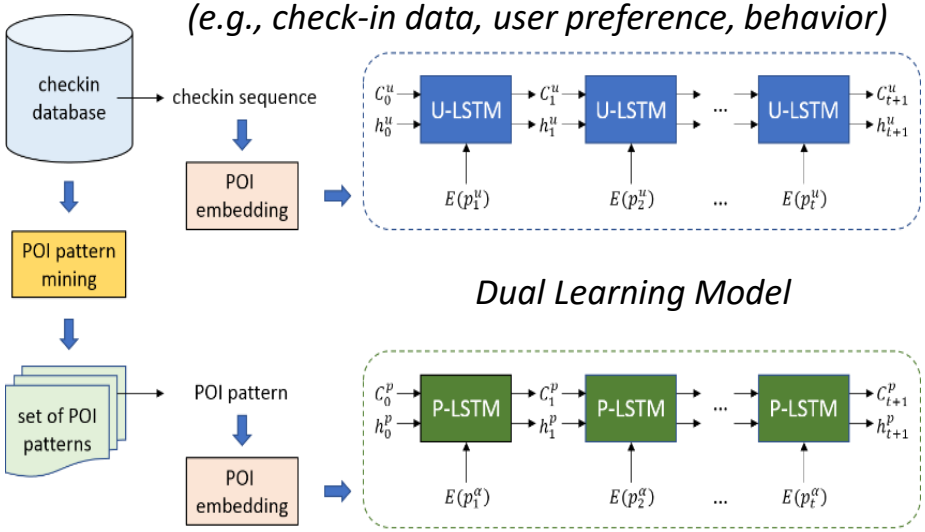
(a)

(b)

Scene Classification

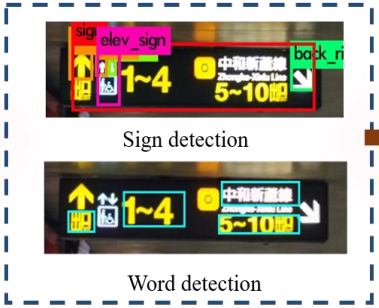
Pattern-Based POI Recommendation

(e.g., check-in data, user preference, behavior)



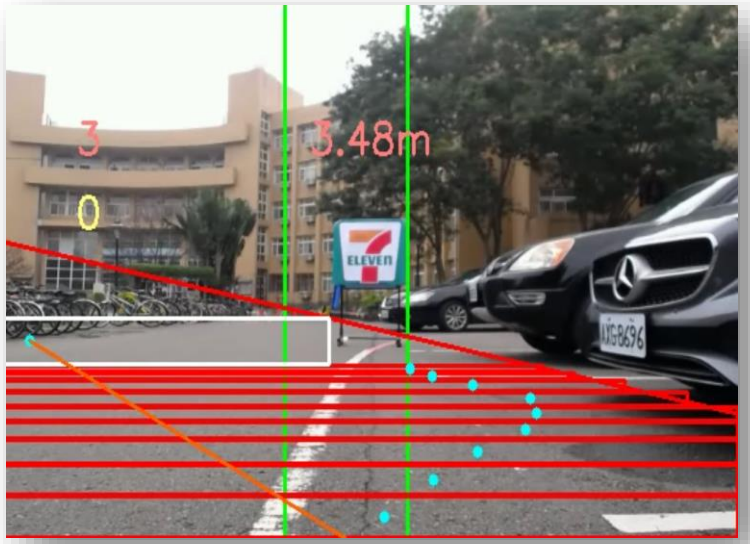
LBS and Direction Guiding Technologies

Obstacle and road sign detection, Walking guidance (blind assistance)



Region detection

Return message:
出口 電梯 1~4 繼續直行
中和新蘆線 5~10 出口 右後方



Thank You

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