國立中正大學 電機工程系 應用運算與多媒體實驗室

Applied Computated and Multimedia Lab
應用運算與多媒體實驗室

http://acm.ee.ccu.edu.tw/

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ACM（應用計算和多媒體實驗室）設立於國立中正大學電機工程系。我們的研究致力於探索深度學習、機器學習、計算機視覺、影像處理以及信號處理之相關技術與演算法，並將其應用於不同的場域，例如（a）基於感測器融合之相關應用、（b）多相機資訊融合技術、（c）場景理解之推論演算法、（d）新式計算式相機之成像與攝影技術、與（e）用於 3D 顯示之立體影像合成。本團隊專注於執行多項國家型研究計畫，並緊密與校外廠商進行前瞻計畫之合作，其議題包含停車場管理、自動駕駛車輛、AI 視頻壓縮、智慧型掃地機器人設計、用於無人機之基於影像的深度估計、基於多 RGBD 攝影機之人體骨架估測、博物館導覽系統、智能機器手臂以及基於物聯網之智慧建築。此外，ACM 實驗室具備完全國際化之研究環境。團隊的成員和實習生分別來自不同的國家，如台灣，越南，印度尼西亞，印度，馬來西亞和泰國。現在，我們已經做好準備，希望邀請未來有計畫於台灣取得學位之合格候選人（碩士或大學部學生）加入 ACM 實驗室就讀學位與實習研究。

本實驗室之研究方向

- **停車場管理系統 (Parking Lot System)**
  - 創新技術: 深度類神經網路、遷移式學習。
  - 應用範圍: 停車場位置導覽, 停車格空位分析與規劃。

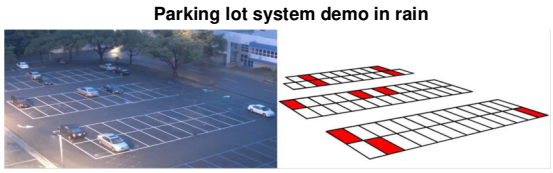

Fig1. The proposed algorithm Fig.2 The demonstration of Parking Space detection

- **無人機 – 行人數量計算與深度估測 (UAV – Crowd counting and density estimation)**
  - 創新技術: 深度學習網路、影像處理、Distribution Estimation。
  - 應用範圍: 視訊監控大型活動場域的人群管控，如演唱會、運動賽事、音樂節等。

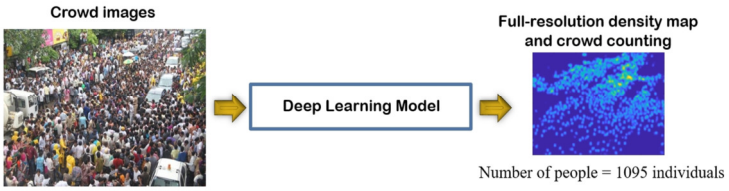

Fig.3 The result of the proposed framework

- **使用全景攝影機之掃地機器人的主動式 SLAM 研究**

  (A Study of Active SLAM for a Cleaning Robot using an Omnidirectional Camera)

  - 創新技術: Simultaneous Localization and Mapping (SLAM) 。
  - 應用範圍: 家用機器人， 倉儲機器人 (場域了解及自我定位) 。

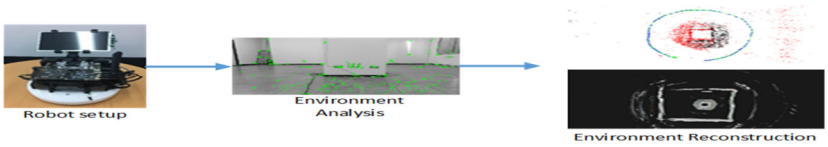

Fig.4 The result from the robot

- **室內定位系統 (Indoor Localization System)**

  - 創新技術: 深度類神經網路、 機率圖論模型、 多感測器資訊融合 (Wi-Fi 訊號、IMU、相機等) 。
  - 應用範圍: 博物館、超級市場等大型場域之展品導覽。

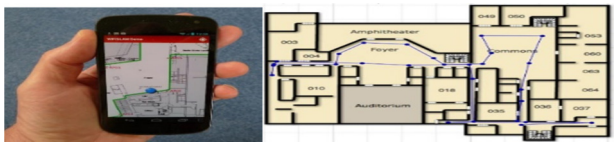

Fig.5 The schematic diagram of the proposed system

本實驗室合作單位與方案

- **台灣積體電路製造股份有限公司(TSMC):** 本實驗室與台積電合作，主要致力於大數據分析及其在智能建築中的應用。 智能建築的研究議題包括自動感測、分析以及響應功能。 其設計之系統應滿足安全、舒適及方便的需求，並實現節能、降低維護和管理的成本。

- **萬潤科技股份有限公司:** 本團隊協助開發機器人視覺應用的深度學習算法。 此技術可幫助機器人透過攝影機和其他感測器了解當下工作環境。在取得環境資訊後，機器人便可以執行自我定位和路徑規劃。這些技術有著廣泛的應用場域，如家用機器人或工作機器人等。

- **中華民國科技部:** 我們的團隊目前已參與了多項與政府單位合作的研究計畫，其計畫內容包含圖像/視頻壓縮及工業機器人手臂。在這些執行項目中，我們專注於開發及應用深度學習的演算法，以實現與其他傳統方法相比更高的性能。 此外，我們還提出了一系列應用於系統設計的新式演算法；其研究結果發表在多個國際會議和期刊上，如 ICIP、ICASSP、SMC、IEEE transactions on Image Processing 以及 IEEE Transactions on Circuits and Systems for Video Technology。

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Applied Computing and Multimedia Laboratory

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ACM (Applied Computing and Multimedia Laboratory) is a research lab established at Department of Electrical Engineering, National Chung Cheng University, Taiwan. We aim to explore Deep Learning, Machine Learning, Computer Vision, Image Processing, Signal Processing and apply them to different applications such as (a) Sensor fusion-based Applications, (b) Multi-Camera Fusion, (c) Cooperation Algorithms for Scene Understanding, (d) Computational Camera, Imaging, Photography, and (e) Synthesis of Stereoscopic Images for 3D Display. Our previous and current projects include Parking Lot Management, Autonomous Vehicle, AI Video Compression, Intelligence Cleaning Robot Design, UAV Image-based Density estimation, Multiple RGBD Camera-based Human Skeleton Detection, Museum Guidance System, Intelligence Robot Arm, and IoT-based Smart Building. Along with researching, we also build up the international environment in our lab. Our lab members and interns come from different countries such as Taiwan, Vietnam, Indonesia, India, Malaysia, and Thailand. Now, we are ready and would like to invite selected and qualified candidates (master or undergraduates), who have plans for degree study in Taiwan, to join ACM Lab for degree study and research intern.

Research topics in ACM

- **Parking Lot System**
  - Innovative technology: Deep neural network models, Transfer learning.
  - Application domains: Car parking guidance, Parking space analysis and management.

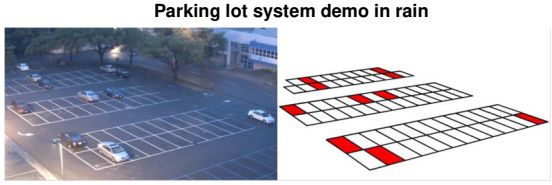

Fig1. The proposed algorithm Fig.2 The demonstration of Parking Space detection

- **UAV – Crowd counting and density estimation**
  - Innovative technology: Deep neural models, Image processing, Distribution Estimation.
  - Application domains: Video surveillance, Crowd Management at such as music events, sport events, street parade…

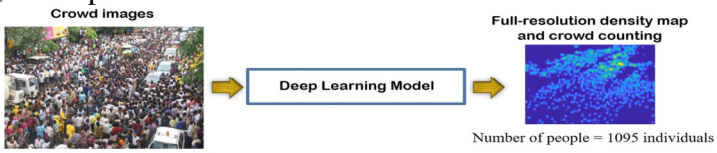

Fig.3 The result of the proposed framework

- **A Study of Active SLAM for a Cleaning Robot using an Omnidirectional Camera**
  - Innovative technology: Simultaneous Localization and Mapping (SLAM).
  - Application domains: Household robot, Warehouse robot (understand environment and self-localize).

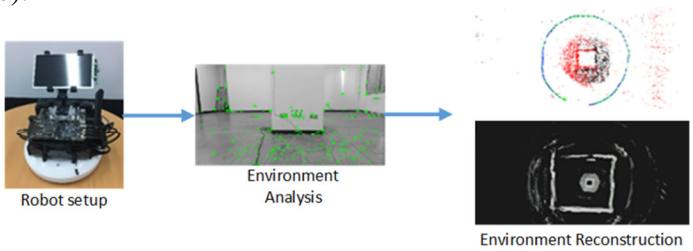

Fig.4 The result from the robot

- **Indoor Localization System**
  - Innovative technology: deep neural network models, probability graphical model, multiple sensors fusion (Wi-Fi signal, IMU, camera, …).
  - Application domains: guide visitor in museum, supermarket.

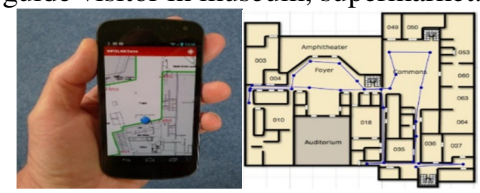

Fig.5 The schematic diagram of the proposed system

Collaborations with our lab

- **Taiwan Semiconductor Manufacturing Co., Ltd. (TSMC):** Our lab cooperates with TSMC and mainly focus on big data analysis and its application to a smart building. The research issues of intelligent building cover automatic sensing, analysis, and response functions. The designed system should satisfy the requirements of safety, comfort, convenience, and also achieve energy saving, reduce maintenance and management costs.
- **All Ring Technology Co., Ltd.:** Our lab helps to develop deep learning algorithms for robot vision applications. The developed technology helps the robot to understand the working environment through the camera and other sensors. Upon the understanding of environment, the robot can perform self-localization and path planning. These techniques can be applied to a wide range of applications like a household robot or a warehouse robot.
- **Ministry of Science and Technology:** We have granted government research projects related to image/video compression and industrial robot arm. In these projects, we focus on developing and applying deep learning algorithm to achieve higher performance compared with other traditional methods. Besides, we have proposed some novel algorithms for system designs; the research results are published on some international conferences and journals, e.g. ICIP, ICASSP, SMC, IEEE Transactions on Image Processing, IEEE Transactions on Circuits and Systems for Video Technology.

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