深度學習研究成果分享

陳敦裕 教授/系主任
元智大學 電機工程系

簡歷

- 學歷

  臺灣交通大學，資訊工程系，博士 (2004.06)

- 經歷

  中央研究院資訊科學研究所， 博士後研究員 (國防役 2005.02 -2009.01)

  元智大學 電機工程系，助理教授 (2009.02 -2013.01)

  元智大學 電機工程系，副教授(2013.02 -2016.01)

  元智大學 電機工程系，教授 (2016.02 -至今)

  元智大學 電機工程系，系主任 (2015.08 -至今)

元智大學電機系－人工智慧團隊

林志民
講座教授/
副校長
(IEEE Fellow)

陳敦裕
教授/系主任

方士豪 教授

施皇嘉
副教授

蘇泰元
助理教授

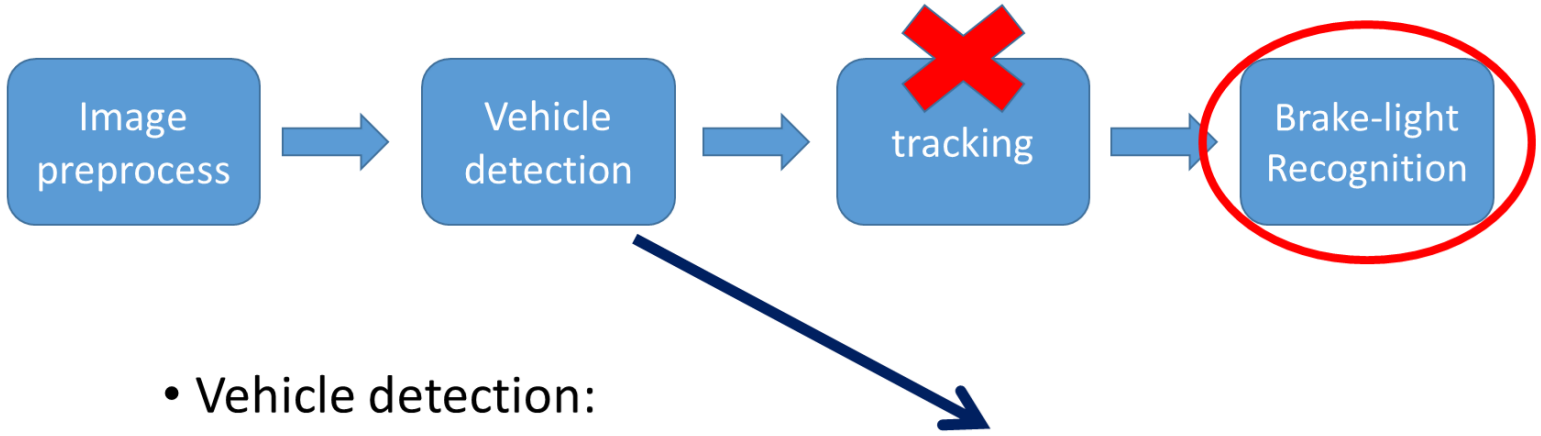
林仁俊
助理教授

深度學習研究成果

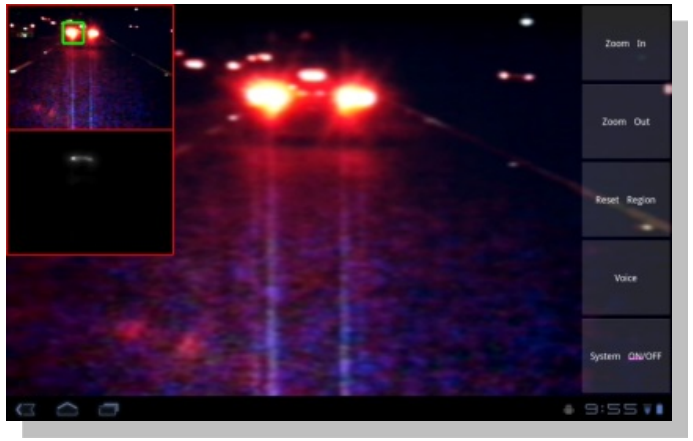
- 圖像識別
- 電力系統分析
- 室內定位
- 行為分析
- 醫學診斷應用
- 音訊及視訊融合

圖像識別 – 智慧交通應用

- Deep Vehicle Brake-Light Detection

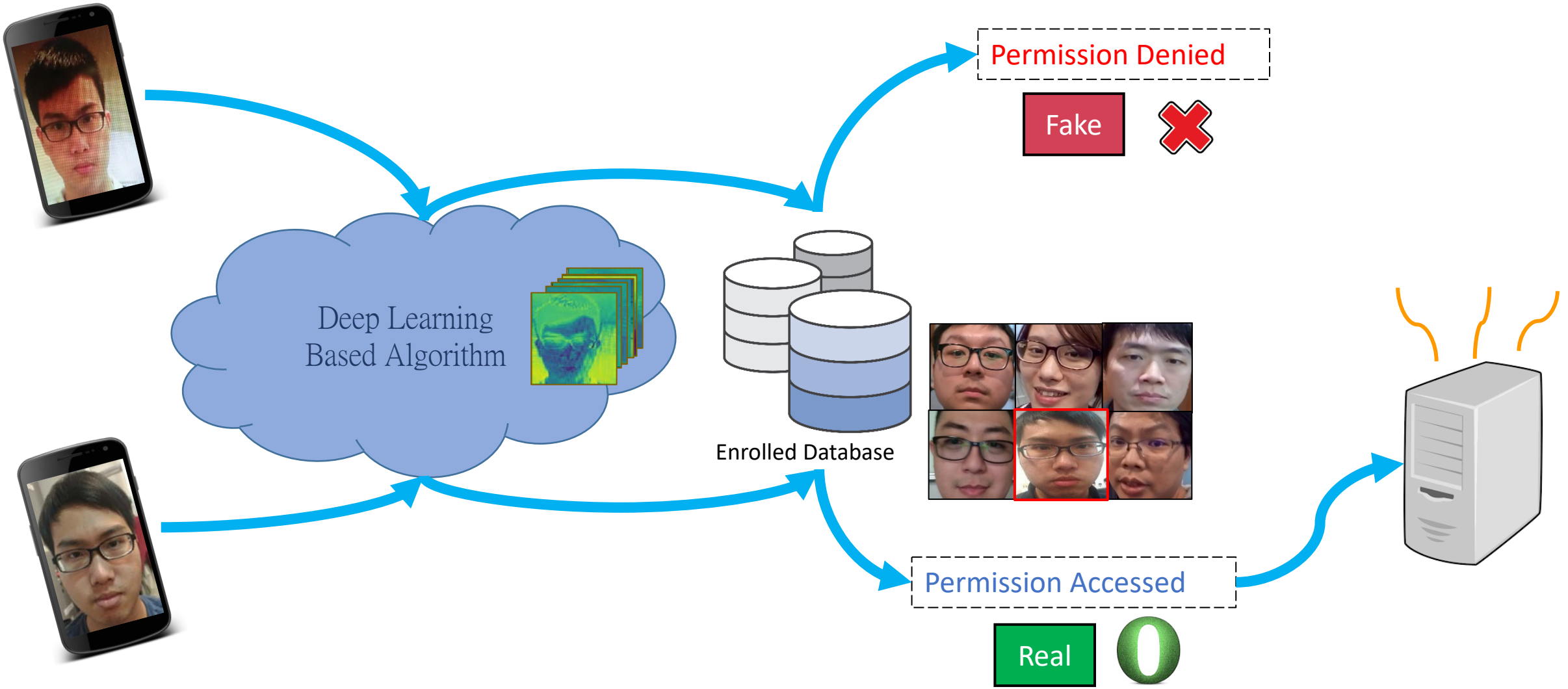


- Vehicle detection:
  - One stage: SSD、YOLO、FPN、 **RetinaNet**
  - Two stage:R-CNN、FAST-RCNN、FASTER-RCNN
- Brake-light Recognition:
  - AlexNet、VGG、ResNet 、**Densenet**
  - optical flow、C3D、LSTM



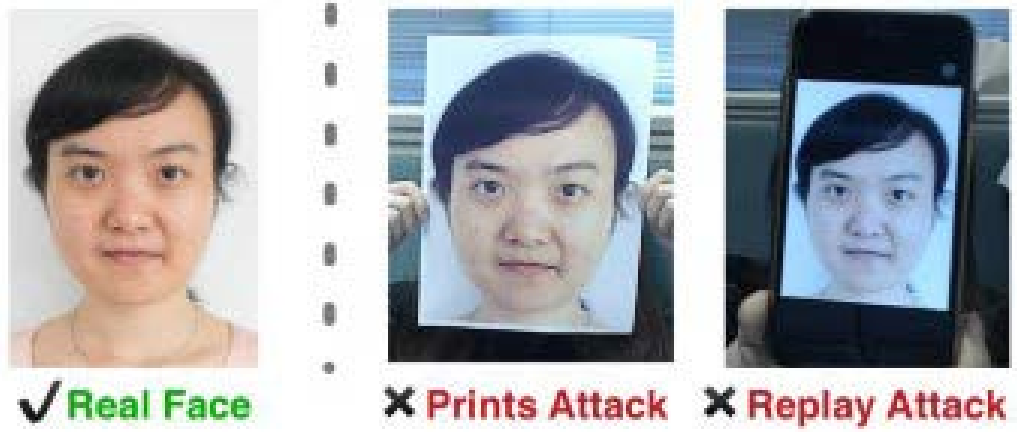
Duan-Yu Chen, Yu-Hao Lin and Yang-Jie Peng, "Nighttime Brake-Light Detection by Nakagami Imaging," ***IEEE Transactions on Intelligent Transportation Systems***, Vol. 13, No. 4, pp. 1627-1637, Dec. 2012.
Duan-Yu Chen and Jhi-Yang Lin, "Deep Vehicle Brake-Light Detection," ***IEEE Sensors Journal***, 2018. (submitted)

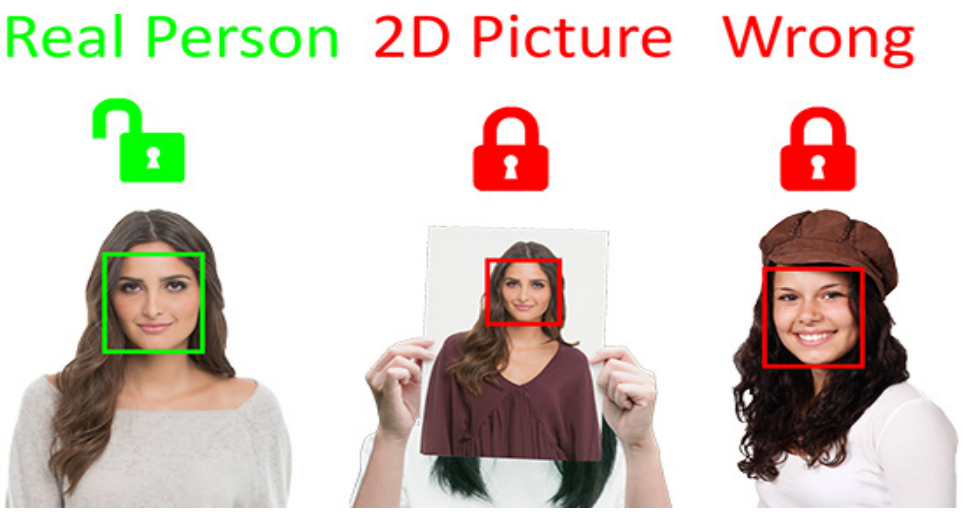
圖像識別 – 活體檢測 (Anti-spoofing)



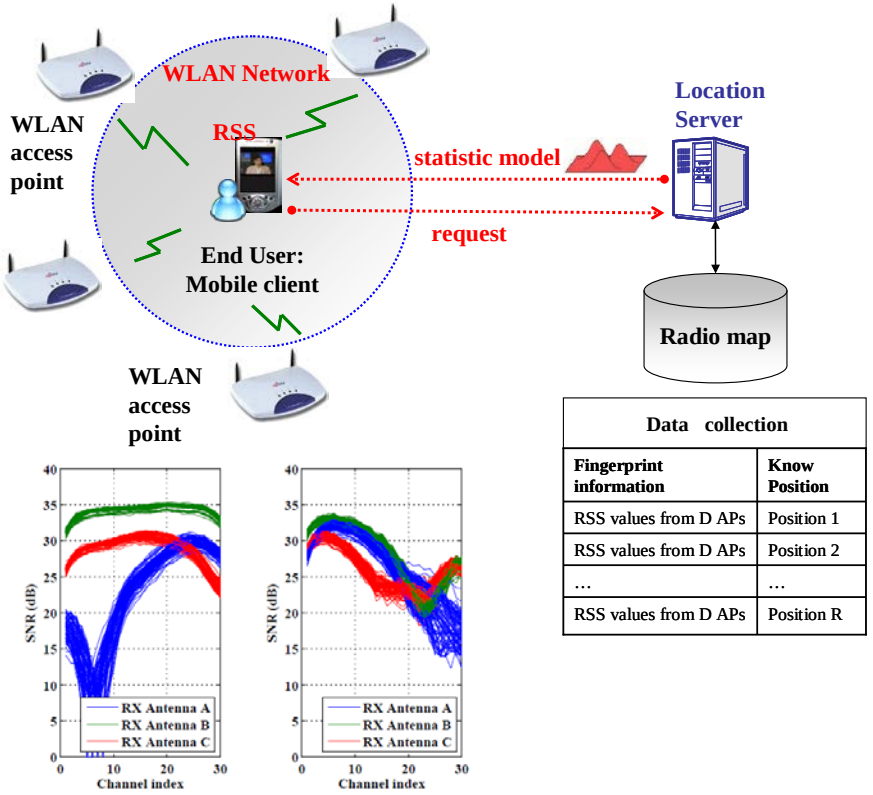
人臉識別目前主要攻擊手段

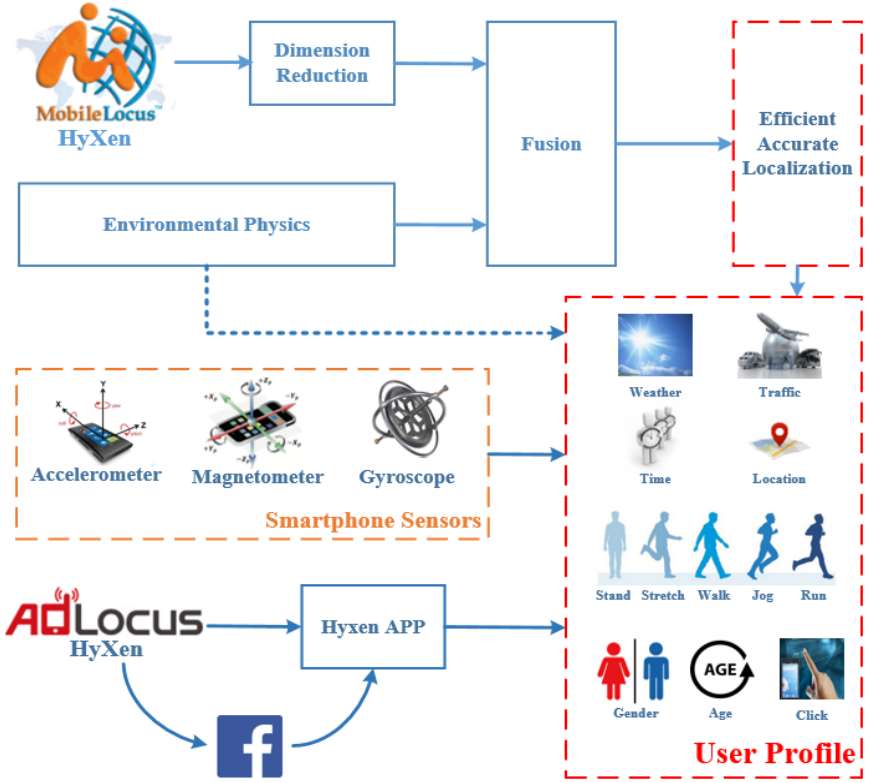
- Prints Attack
- Replay Attack
- Mask Attack





智能手機感測訊號 - 室內定位





[1] Shih-Hau Fang and Chu-Shuan Wang, "A Novel Fused Positioning Feature for Handling Heterogeneous Hardware Problem," ***IEEE Transactions on Communications***, vol. 63, no. 7 pp. 2713-2723, 2015.

[2] Shih-Hau Fang, Chu-Shuan Wang, and Y. Tsao, "Compensating for Orientation Mismatch in Robust WiFi Localization Using Histogram Equalization," ***IEEE Transactions on Vehicular Technology***, vol. 64, no. 11, pp. 5210-5220, Nov. 2015.

[3] Shih-Hau Fang, Wei-Hsiang Chang, Yu Tsao, Huang-Chia Shih, Chiapin Wang, "Channel State Reconstruction Using Multilevel Discrete Wavelet Transform for Improved Fingerprinting-Based Indoor Localization," ***IEEE Sensors Journal***, vol. 16, no. 21, pp. 7784-7791, Nov. 2016

[4] Chiapin Wang, Shih-Hau Fang, Hsiao-Chun Wu, Sheng-Min Chiou, Wen-Hsing Kuo, Po-Chiang Lin, "Novel User-Placement Ushering Mechanism to Improve Quality-of-Service for Femtocell Networks," to appear in ***IEEE Systems Journal***, 2017

國際室內定位競賽@日本北海道大學

New Award: Rank 3 in IPIN 2017 (YAI team)

IPIN 2017
Eighth International Conference on
INDOOR POSITIONING AND INDOOR NAVIGATION
September 18-21, 2017, Sapporo, Japan

IPIN 2017 SAPPORO

I hereby certify that the team formed by

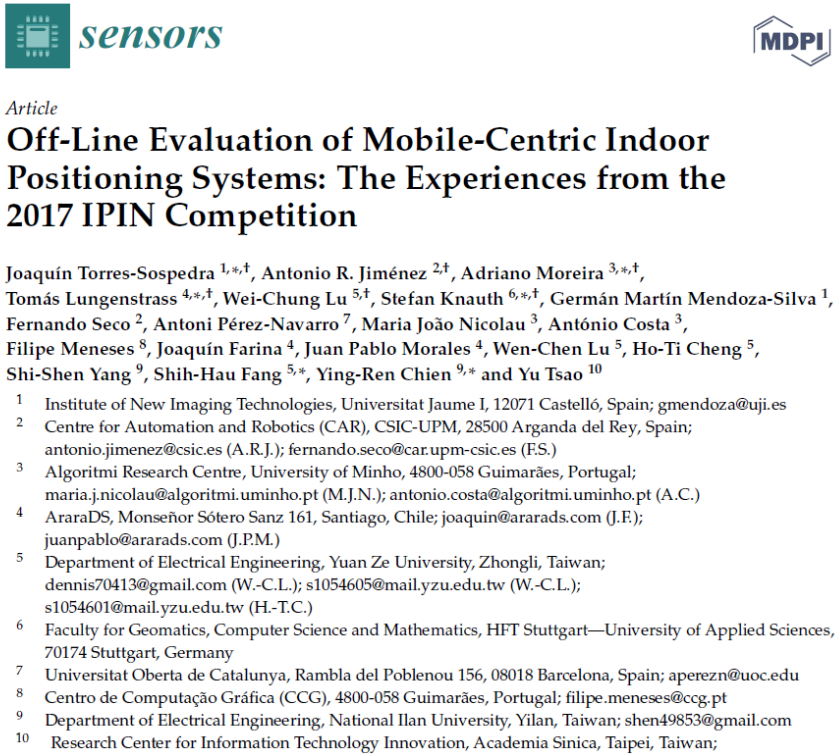
Wei-Chung Lu, Wen-Chen Lu, Ho-Ti Cheng, Shi-Shen Yang, Shih-Hau Fang, Ying-Ren Chien and Yu Tsao,

Yuan Ze University, National Ilan University,
Academia Sinica Research Center for Information Technology Innovation, Taiwan

has participated in the IPIN 2017 Competition
Track 3: Smartphone based positioning (Off-site)
18-21 September 2017, Sapporo, Japan
and their system was ranked in the 3rd Position

Joaquín Torres-Sospedra, Track 3 Chair

Publication with Spain, Portugal, Chile, Germany



sensors

MDPI

Article

Off-Line Evaluation of Mobile-Centric Indoor Positioning Systems: The Experiences from the 2017 IPIN Competition

Joaquín Torres-Sospedra [1,*,†], Antonio R. Jiménez [2,†], Adriano Moreira [3,*,†], Tomás Lungenstrass [4,*,†], Wei-Chung Lu [5,†], Stefan Knauth [6,*,†], Germán Martín Mendoza-Silva [1], Fernando Seco [2], Antoni Pérez-Navarro [7], Maria João Nicolau [3], António Costa [3], Filipe Meneses [8], Joaquín Farina [4], Juan Pablo Morales [4], Wen-Chen Lu [5], Ho-Ti Cheng [5], Shi-Shen Yang [9], Shih-Hau Fang [5,*], Ying-Ren Chien [9,*] and Yu Tsao [10]

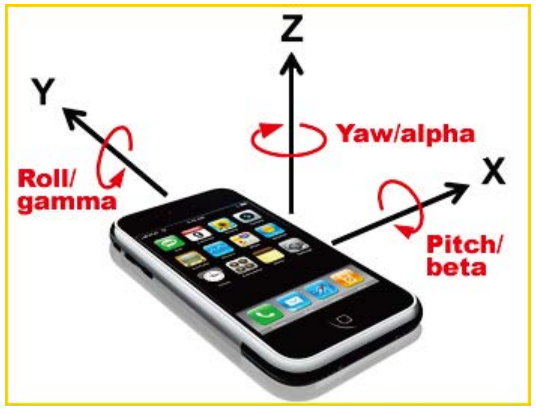
1 Institute of New Imaging Technologies, Universitat Jaume I, 12071 Castelló, Spain; gmendoza@uji.es
2 Centre for Automation and Robotics (CAR), CSIC-UPM, 28500 Arganda del Rey, Spain; antonio.jimenez@csic.es (A.R.J.); fernando.seco@car.upm-csic.es (F.S.)
3 Algoritmi Research Centre, University of Minho, 4800-058 Guimarães, Portugal; maria.j.nicolau@algoritmi.uminho.pt (M.J.N.); antonio.costa@algoritmi.uminho.pt (A.C.)
4 AraraDS, Monseñor Sótero Sanz 161, Santiago, Chile; joaquin@ararads.com (J.F.); juanpablo@ararads.com (J.P.M.)
5 Department of Electrical Engineering, Yuan Ze University, Zhongli, Taiwan; dennis70413@gmail.com (W.-C.L.); s1054605@mail.yzu.edu.tw (W.-C.L.); s1054601@mail.yzu.edu.tw (H.-T.C.)
6 Faculty for Geomatics, Computer Science and Mathematics, HFT Stuttgart—University of Applied Sciences, 70174 Stuttgart, Germany
7 Universitat Oberta de Catalunya, Rambla del Poblenou 156, 08018 Barcelona, Spain; aperezn@uoc.edu
8 Centro de Computação Gráfica (CCG), 4800-058 Guimarães, Portugal; filipe.meneses@ccg.pt
9 Department of Electrical Engineering, National Ilan University, Yilan, Taiwan; shen49853@gmail.com
10 Research Center for Information Technology Innovation, Academia Sinica, Taipei, Taiwan;

智能手機感測訊號 - 行人交通模式分類

- 行人姿態與交通模式識別
  - **IEEE BigMM 2016 HTC Challenge 第三名**

Shih-Hau Fang, Hao-Hsiang Liao, Yu-Xiang Fei, Kai-Hsiang Chen, Jen-Wei Huang, Yu-Ding Lu and Yu Tsao, "Transportation Modes Classification Using Sensors on Smartphones," ***Sensors***, vol. 16, issue 8, Aug. 2016

- HyXen_AdLocus
  - 勝義科技
  - 精準行銷
  - 地理廣告投放



Shih-Hau Fang, Ying-Tso Hsu, Yao Shiao, and Fan-Yu Sung, "An Enhanced Device Localization Approach Using Mutual Signal Strength in Cellular Networks," ***IEEE Internet of Things Journal***, vol. 2, no. 6, pp. 596-603, Dec. 2015.

聲學訊號 - 病理嗓音偵測與分類

[動機] 病理嗓音偵測與分類

- 嗓音問題由於聲帶位處喉部深處
- 非專科醫師與特殊儀器難以進行檢查

[資料] 聲學訊號偵測病理嗓音

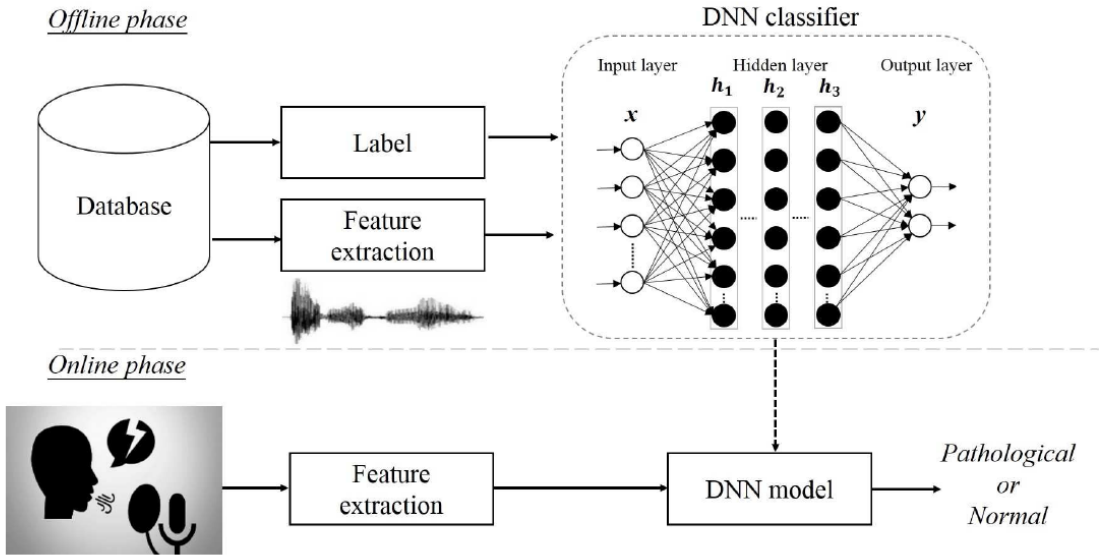
- 利用母音阿數秒/自然說話(固定講稿)之語音訊號/病史
- 八種病理嗓音

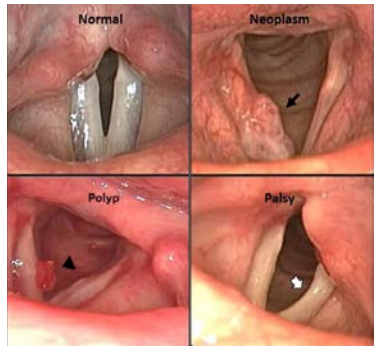
[效益]

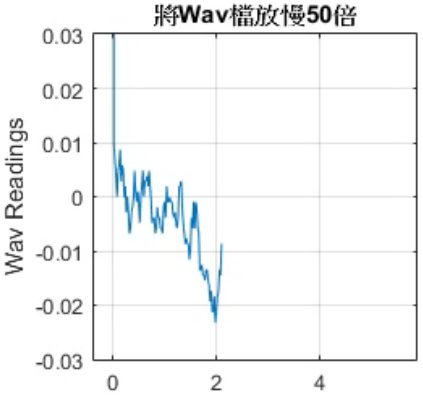
- 輔助醫療資訊之判讀
- 高風險患者(如教師、業務、導遊、歌手) 於初期徵兆時及早介入
- 供醫療匱乏地區之遠端諮詢 (節省醫療資源，減少患者往返)

聲學訊號 - 病理嗓音偵測與分類 (cont.)

聲帶萎縮
聲帶癌症
聲帶發育不良
聲帶囊腫
聲帶結癰
聲帶瘜肉
聲帶顫動
聲帶溝及
聲帶麻痺



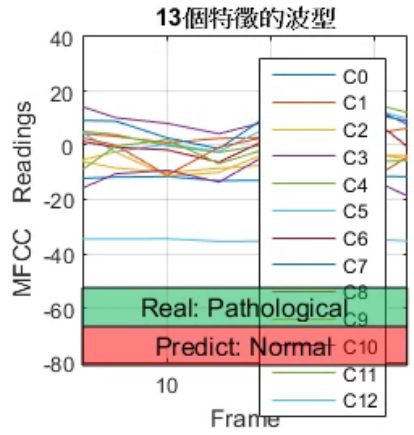


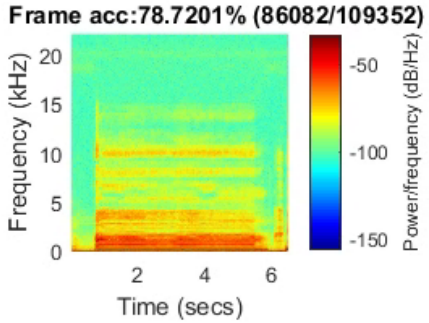


Detection of Pathological Voice

此領域第一個引入深度學習/人工智慧之團隊

- FEMH 亞洲唯一病理語音資料庫
- 獨特之華文語音
- MEEI 效能居全球領先地位
- 雛形系統展示





聲學訊號 - 病理嗓音偵測與分類 (cont.)

病理嗓音偵測研究成果

- 具臨床應用價值，應用於健康照護服務
- 亞東資料庫偵測率可達94.26%(男)、90.52%(女)
- 公開資料庫偵測率達99.1% (MEEI, 美國馬薩諸塞州醫院)

第一個引用深度學習於此領域之團隊

- [2018/02]中華民國專利獲證
- [2018/03] Detection of Pathological Voice Using Deep Learning, accepted by *Journal of Voice*

FEMH資料

- 目前唯一的華語文病理嗓音資料庫
- 全球個案數最多且標記最完整的病理語音資料庫

	Number		Mean age (years)		Age range (years)		Std. deviation (years)	
	♂	♀	♂	♀	♂	♀	♂	♀
Normal	16	44	30.69	30.08	23-37	22-47	3.93	5.79
Pathology	191	211	56.05	44.2	20-87	8-87	15.93	14.93

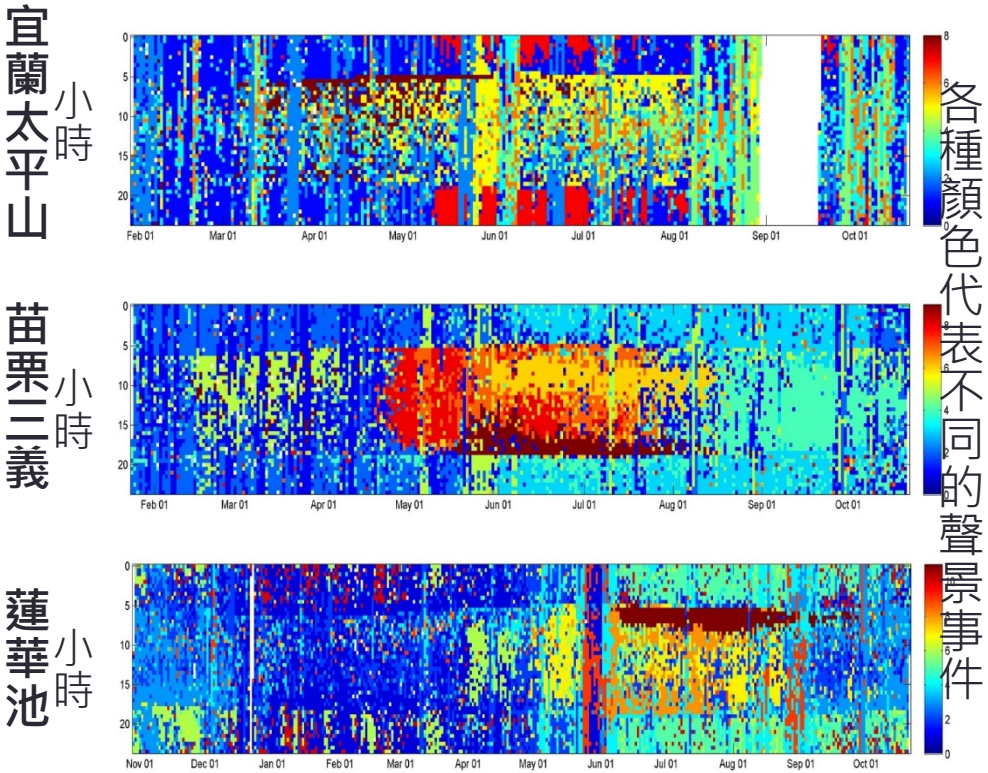
人數從最初研究時的462人 現已增加逾1000 (持續收錄中)

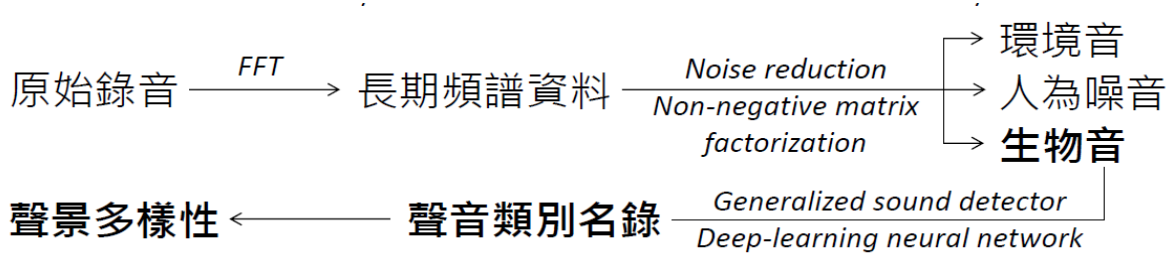
	病種							
	結節	息肉	囊腫	癌症	萎縮	震顫	麻痺	聲帶溝
男生	1	18	16	50	41	2	42	21
女生	51	32	34	7	16	17	26	28

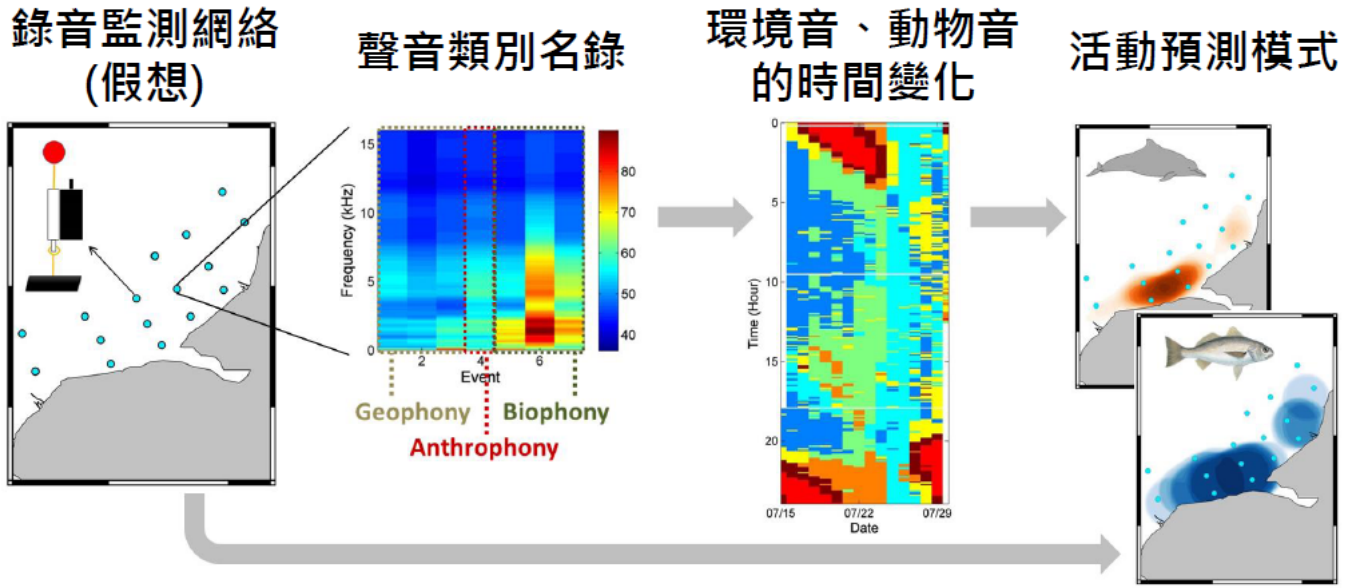
提升鑑別力(2類=>3類=>....=>8類)　提升精確度 (70%=> 90%)
提升強健性 (安靜錄音室/麥克風 => 自然室內環境/手機)
提升擴充性 (母音阿 => 關鍵字 =>自然對話)

聲學訊號 - 聲景資訊分析生態環境

Tzu-Hao Lin, Shih-Hua Fang, and Yu Tsao, “Improving biodiversity assessment via unsupervised separation of biological sounds from long-duration recordings, ***Scientific Reports***, *2017*







生醫影像－乾眼症診斷

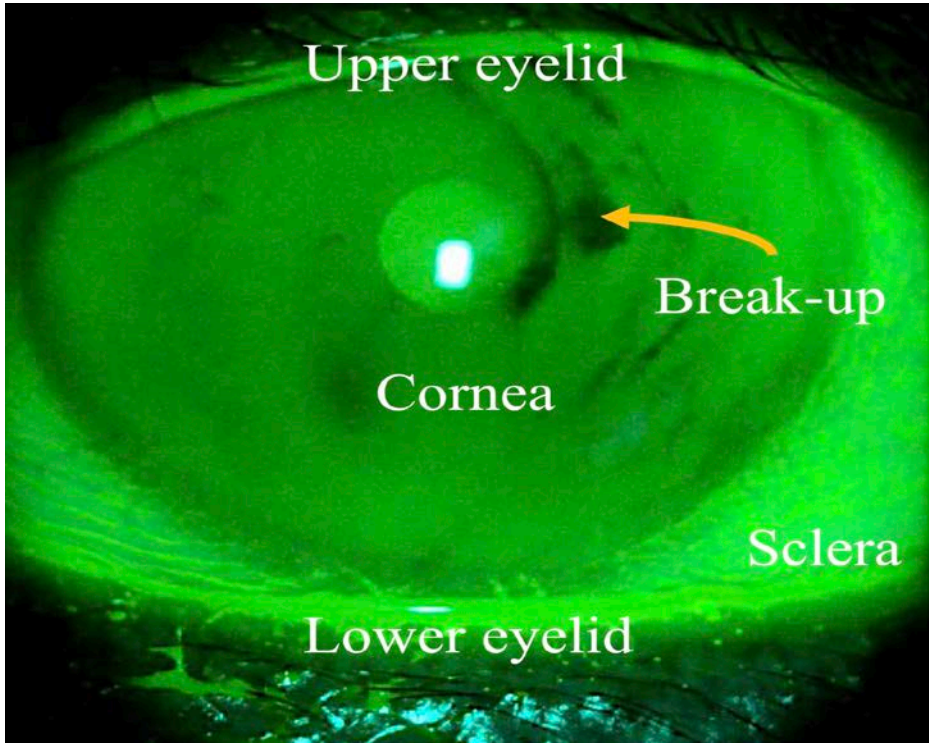
- Dry eye syndrome is one of the most common eye diseases
  - Functional visual acuity
  - Quality of a patient's life

- Symptoms
  - Sandy-gritty irritation
  - Dryness
  - Blurred vision

- The tear film stability test : Fluorescent tear film break up time test

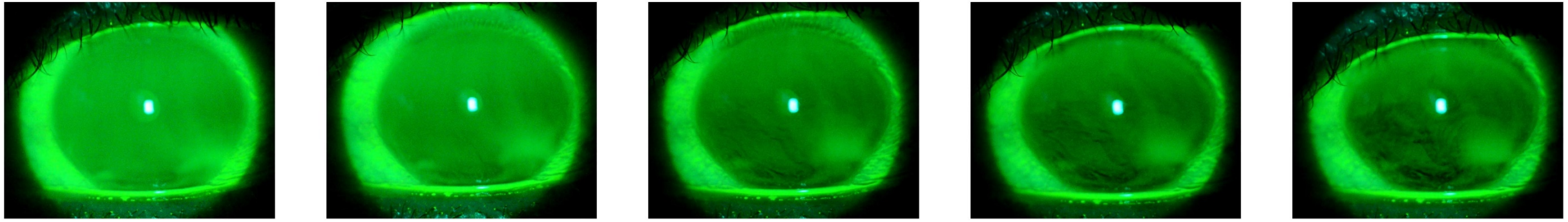
Fluorescent tear film break up time test (FTBUT)

- The FBUT test consists of measuring the time that the tear film remains stable without blinking
- Two microliter of 2% sodium fluorescein is instilled into the eye
- Tear film observed with the cobalt light source
- The patient is instructed to blink several times naturally
- The FTBUT is measured as the time elapsed between the last blink and the first appearance of a dark spot on the ocular surface.
- The appearance of the dark spot corresponds to the tear film thickness, which identifies the break-up of the tear film.
- An FTBUT shorter than 5 s indicates low tear-film stability (Dry eye)



Disadvantage of FTBUT test

- FTBUT test is affected by low repeatability mainly due to a subjective appreciation of the dark spots. The automation of this test would reduce its subjective character.



1 sec | 2 sec | 3 sec | 4 sec | 5 sec

Break-up yet? | Break-up yet? | Break-up yet?

Preparing for Deep Learning

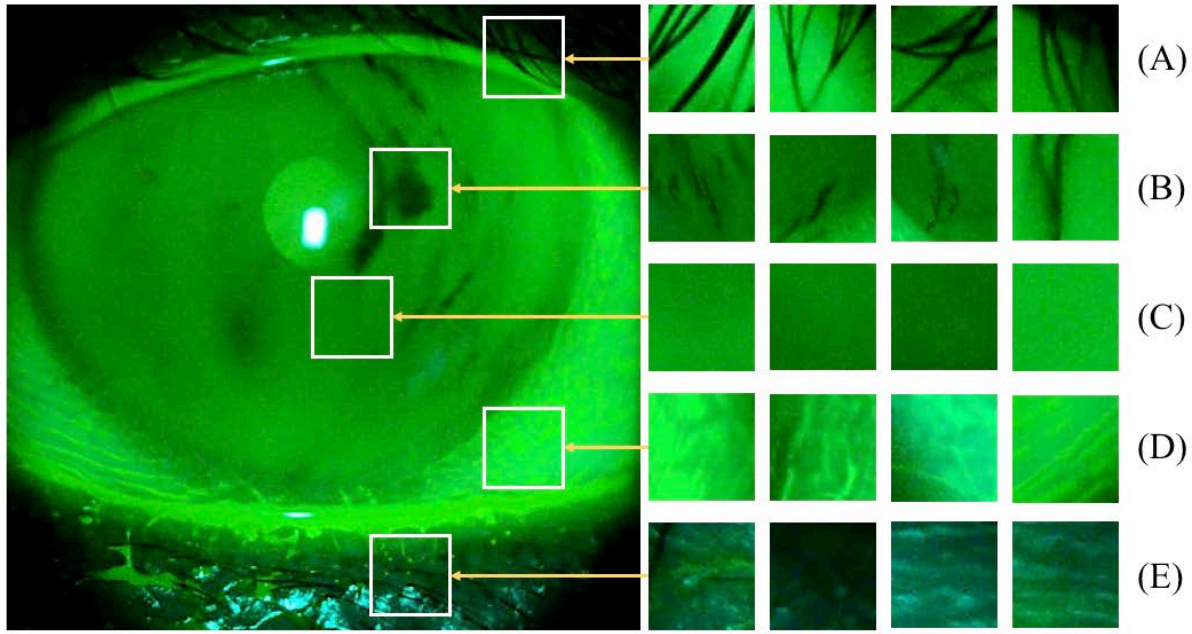
Features:

- (A) Eyelash
- (B) Tear film break-up area
- (C) Tear film non-break-up area
- (D) Sclera
- (E) Eyelid

- Size = 96 x 96 pixels

Table 2. Summary among training, validation and testing datasets for features of fluorescent tear film image.

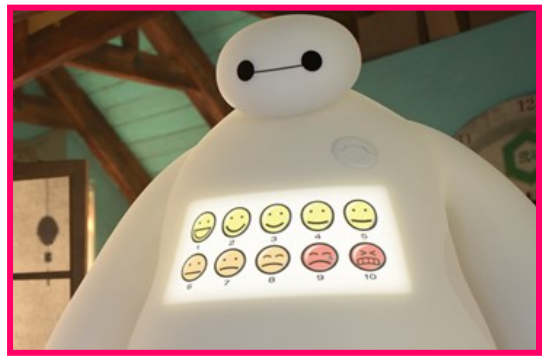
	Train	Val	Test	Total
Break-up	6367	707	786	7860
Non-break	2421	269	298	2988
Eyelash	4390	487	541	5418
Eyelid	5364	595	662	6621
Sclera	1685	187	208	2080



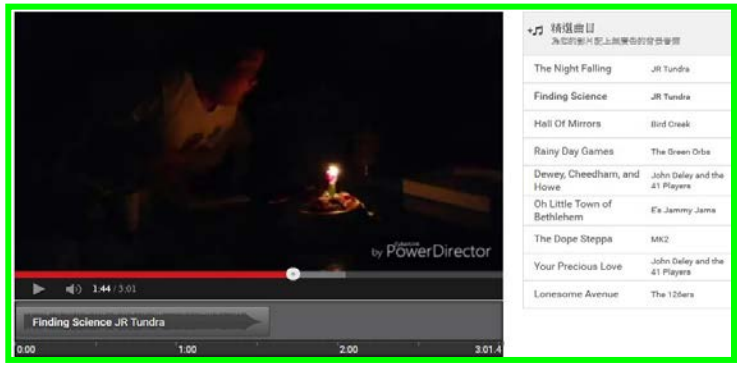
Tai-Yuan Su, Ze-Yuan Lu, Duan-Yn Chen, Shu-Wen Chang, "Tear film break-up time measurement using deep convolutional neural networks for screening dry eye disease," ***IEEE Sensors Journal***, *2018*. (submitted)

音訊與視訊融合與整合之應用

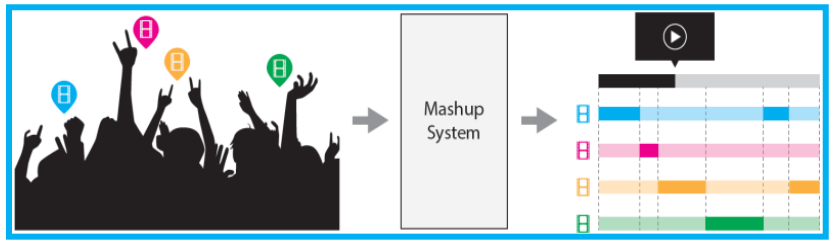
- Audio-Visual Multimodal Data Fusion and Integration for Multimedia Applications



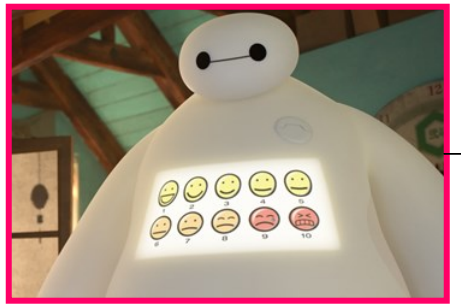
Emotion Recognition



Automatic Music Video Generation

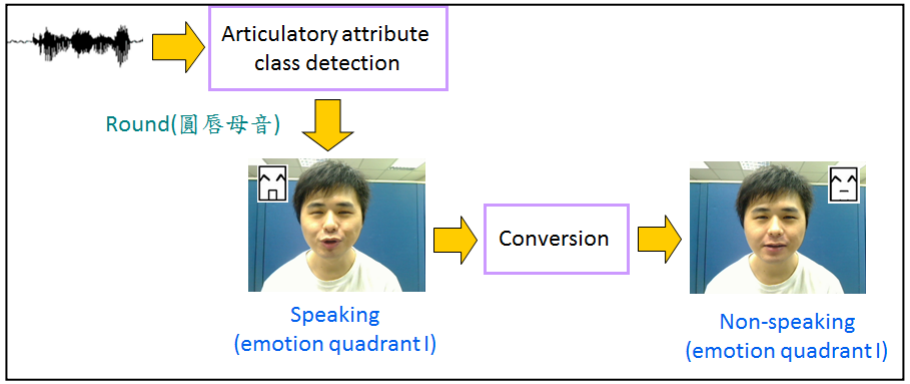


Automatic Concert Video Mashup

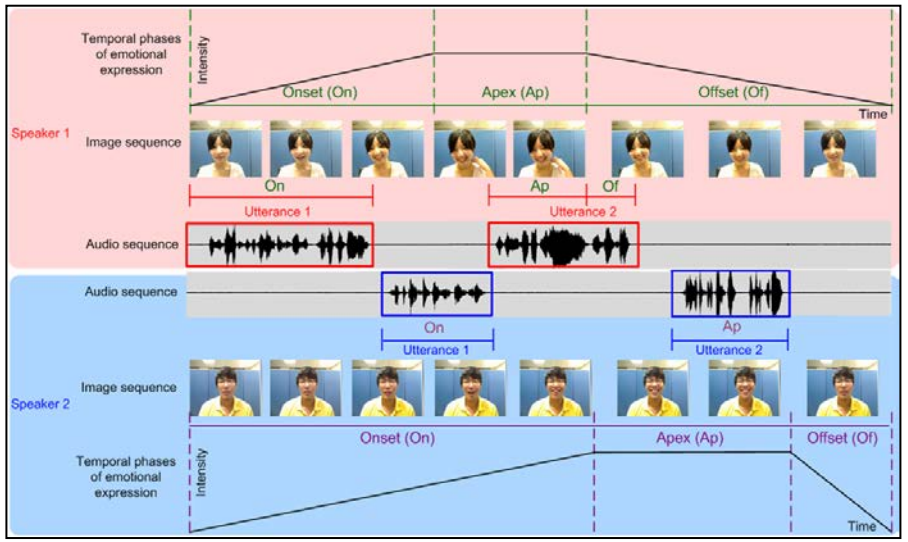


Emotion Recognition

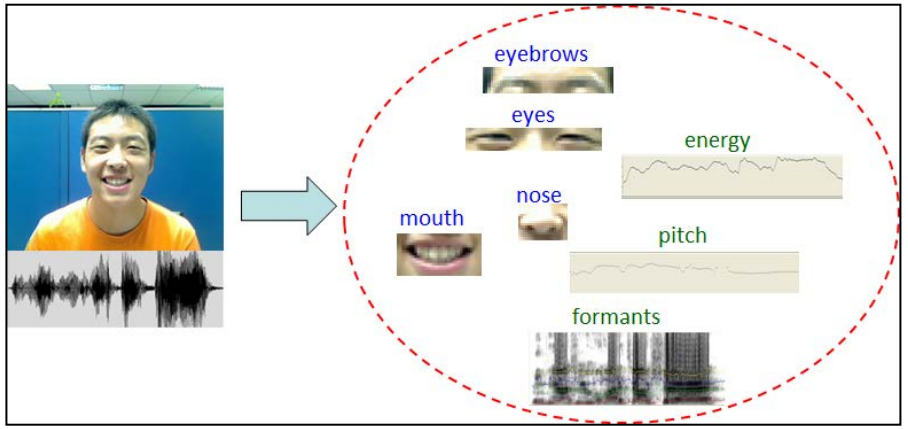
Facial Expression Recognition



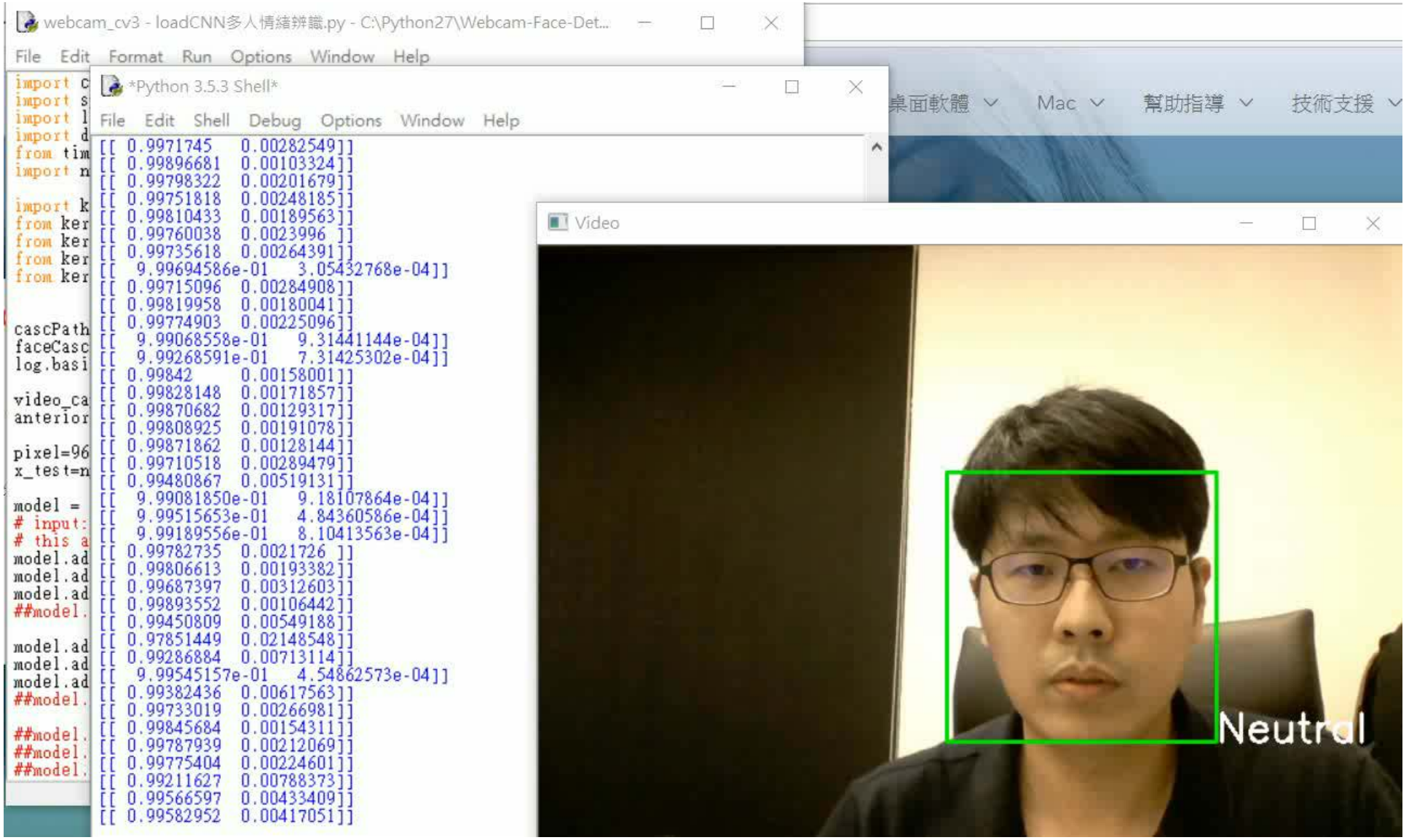
Speech Emotion Recognition



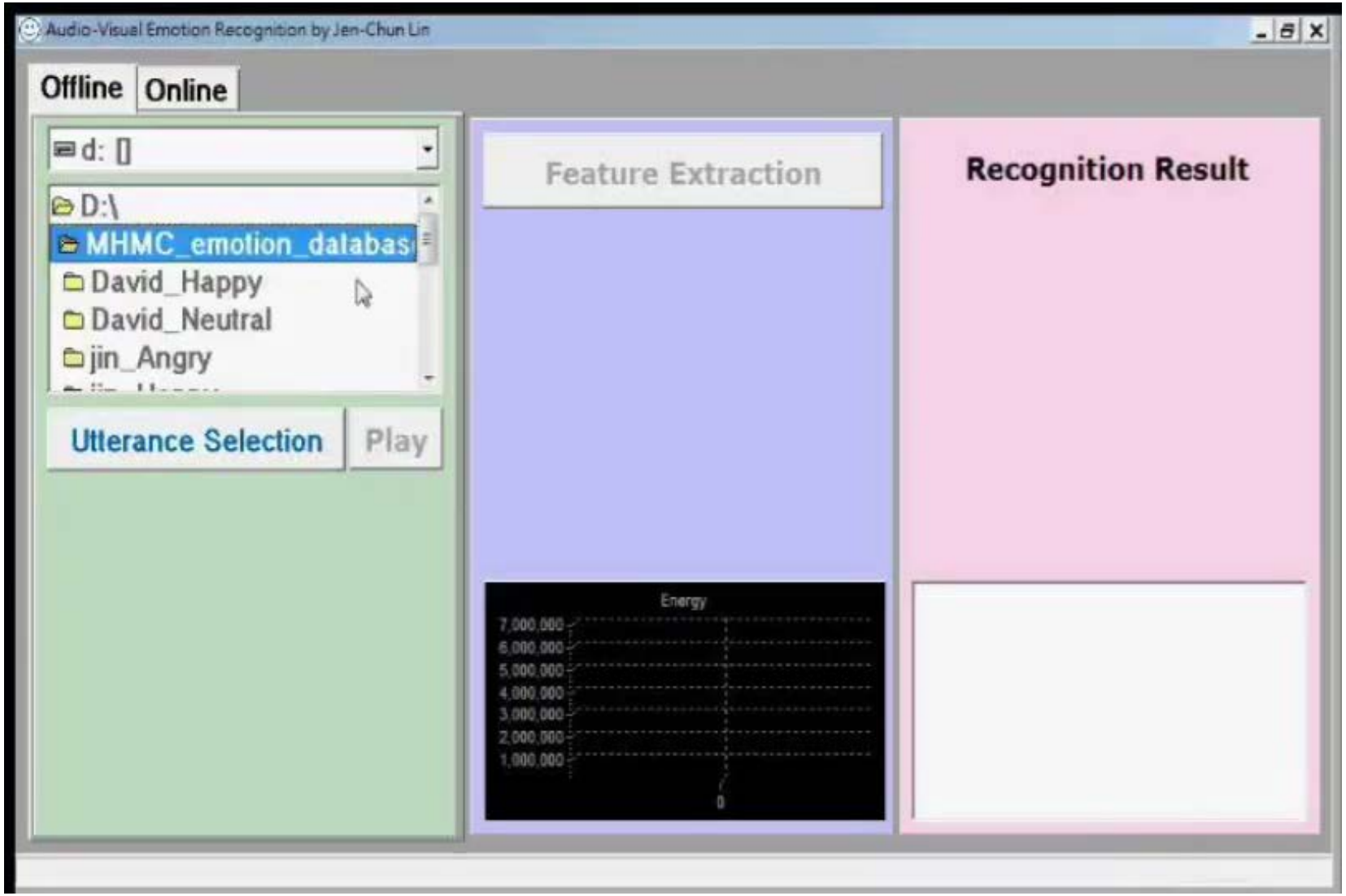
Audio-visual Emotion Recognition



Laughter Detection



Audio-Visual Emotion Recognition



Publications (Emotion Recognition)

Journal

Total: 6

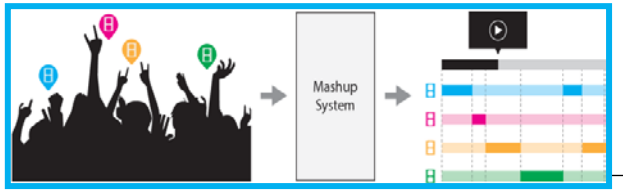
Source：	**IEEE Trans. on Multimedia**	**(SCI)**	**2012, 2013, 2013**
	IEEE Trans. on Audio, Speech and Language Processing	**(SCI)**	**2014 (on the cover)**
	IEEE Trans. on Affective Computing	**(SCI)**	**2017**
	APSIPA Trans. on Signal and Information Processing	**(invited)**	**2014**

International Conference

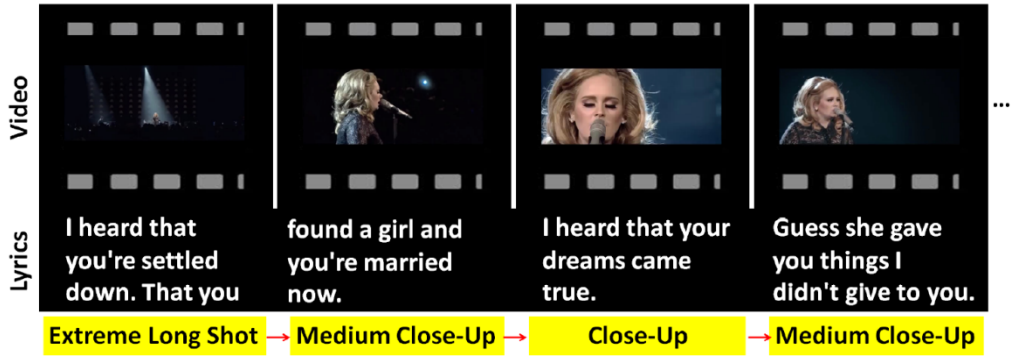
Total: 11

Source：	**ICASSP**	**2013, 2013**
	INTERSPEECH	**2013**
	APSIPA	**2010, 2013, 2014**
	ACII	**2011, 2011**
	ACII Workshop	**2015 (is awarded with "Most Interesting Paper")**
	ICOT	**2013, 2014**

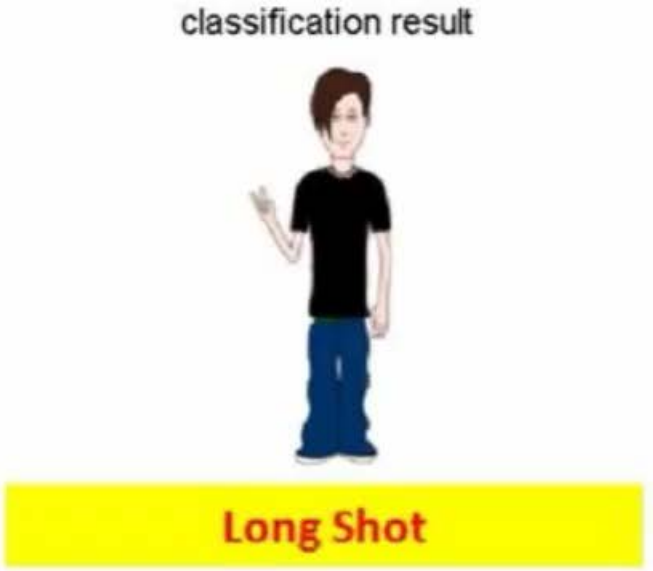
自動化演唱會視訊混搭（Mashup）



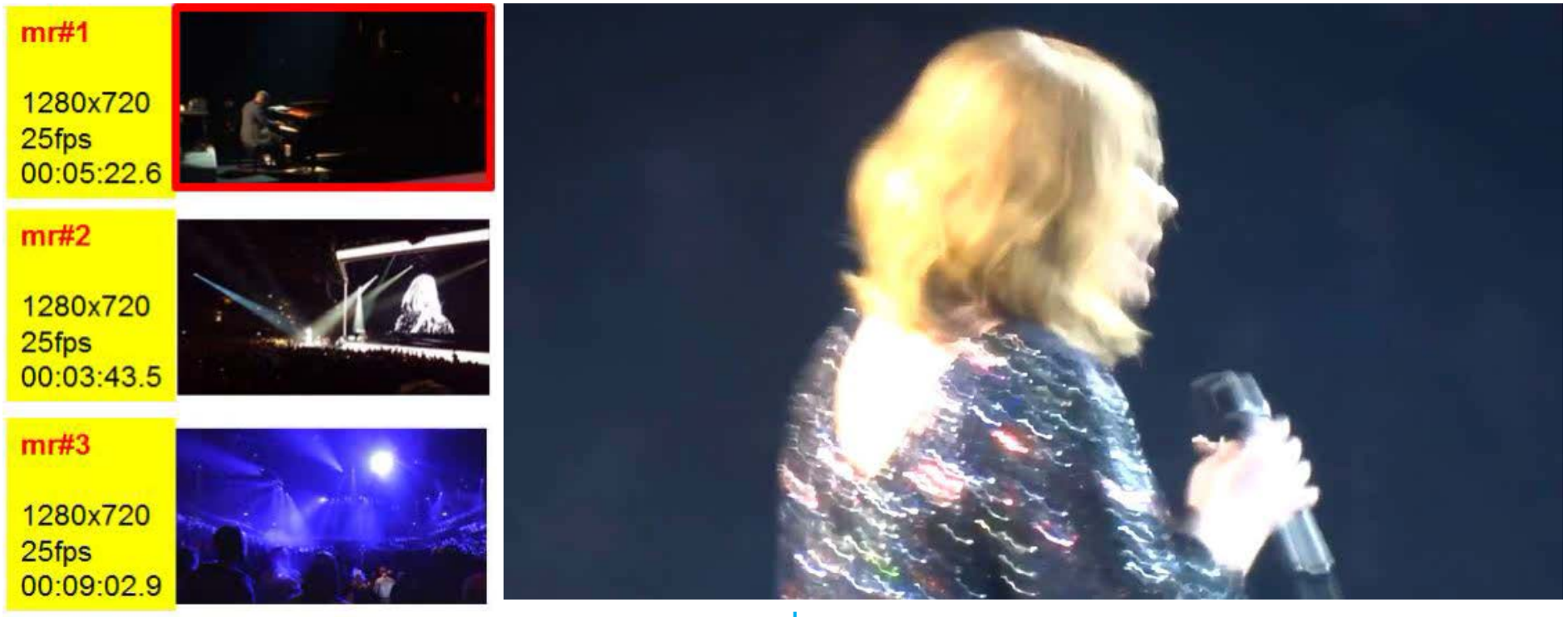
Automatic Concert Video Mashup



Demo



Demo - Mashup Result



Publications (Automatic Concert Video Mashup)

Journal

Total: 1

Source： **IEEE Trans. on Multimedia (SCI) accepted 2018**

International Conference

Total: 2

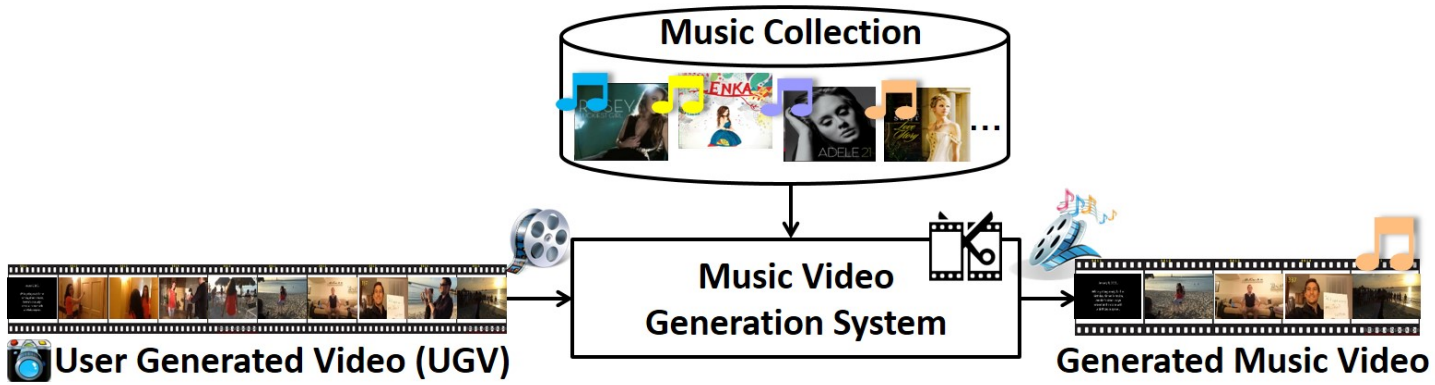
Source：	**ICME**	**2018**
	ICASSP	**2017**

Domestic Conference

Total: 1

Source： **TANET** **(Best Paper Award)** **2016**

Automatic Music Video Generation



DEMO

video length：00:12:25

video length：00:05:06

Publications (Automatic Music Video Generation)

International Conference

Total: 4

Source：	**ACM Multimedia (Top Conference)**	**2015, 2016, 2017**
	ICASSP	**2016**

Q & A