www.stb.org.tw

Stanford-Taiwan Biomedical Fellowship Program (STB)

National Cheng Kung University

Dept. of Computer Science and Information Engineering

Robotics Lab.

（國立成功大學資訊工程學系 機器人實驗室）

Professor Jenn-Jier James Lien / 連震杰

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國立成功大學

Content:

NCKU: National Cheng Kung U.
MRC: Musculoskeletal Research Center
MDIC: Medical Device Innovation Center
eCV: Embedded Computer Vision

1. Profile in Academia

1.1 2002~Now Current Employment - NCKU, TW
1.2 1991~1998 Education - USA

2. Startup Company Experience

2.1 1999~2002 Face Recognition Company - Visionics (IPO VSNX), USA
2.2 2004~2008 Found Automatic Optical Inspection Company - BroBri Vision, TW
2.3 2009~2013 Found eCV Surveillance Company – Visionatics, TW

3. Medical Device Project Recently

3.1 2010~2011 Microscope Imaging Analysis - PlexBio, TW
3.2 2015~Now 3D Tooth Mold Scanning for Dental Implant
3.3 2015~Now Adjustable Motion Control Shoes for Pronated Foot Patients - NCKU MRC and Hospital
3.4 2017~Now Food Calorie Calculator as a Service - NCKU MDIC and Hospital
3.5 2018~Now Medical Aid by Visual-Guided Robot Arm - Brain Navi Biotechnology, TW

1.1 Profile in Academia – Current Employment:

BME: Biomedical Engineering
NCKU: National Cheng Kung U.
CSIE: Computer Science and Information Engineering
IMIS: Institute of Manufacturing Information and Systems

- **National Cheng Kung University, TW:**
  - 2002/08 ~ Current
    - Professor, CSIE, NCKU, Taiwan – 41 Faculties
    - Vice Chairman of CSIE and Director of IMIS (2015/08~2018/07)
    - Director of Robotics Lab., around 24 graduate students
    - AI Professor, at

BME
1) Musculoskeletal Research Center (MRC with NCKU hospital)
2) Medical Device Innovation Center (MDIC with NCKU hospital)

- **Research Fields at Robotics Lab., NCKU:**
  - Image Processing、Computer Vision and Pattern Recognition, and Deep Learning

- **Medical Device Projects:**

1) 3D Tooth Mold Scanning for Dental Implant
2) Adjustable Motion Control Shoes for Pronated Foot Patients - MRC
3) Food Calorie Calculator as a Service (CCaaS, Cloud Computing with App.) - MDIC
4) Medical Aid by Visual-Guided Robot Arm - Brain Navi Biotechnology by Dr. Jerry Chen, CEO

STB Fellow

1.2 Profile in Academia – Education:

RI: Robotics Institute
SCS: School of Computer Science
CMU: Carnegie Mellon U.
UPMC: U. of Pittsburgh Medical Center
EMG: Electromyography
ECE: Electrical and Computer Engineering

❑ Education:

- 1985/09 ~ 1989/05 - B.S. Dept. of Biomedical Engineering, Chung Yuan Christian University, Taiwan.
- 1991/08 ~ 1993/05 - M.S. Program of Biomedical Engineering, ECE, Washington U., St. Louis, MO.
- 1993/08 ~ 1998/04 - Ph.D. ECE, U. of Pittsburgh, Pittsburgh, PA.
  - Research Assistant: Research conducted at the RI, SCS, CMU.
  - Dissertation Title: "Automatic Recognition of Facial Expressions Using Hidden Markov Models and Estimation of Expression Intensity"
  - Advisor: Takeo Kanade, RI, SCS, CMU.

> Member of National Academy of Engineering

> Fellow of the American Academy of Arts and Sciences

❑ Apply facial expression analysis dissertation work to plastic surgery and EMG at UPMC

1) Original motion trajectory uses attached circle dots and manually mark dot center frame by frame

2) Facial expression analysis uses computer vison with optical flow tracking for motion trajectory

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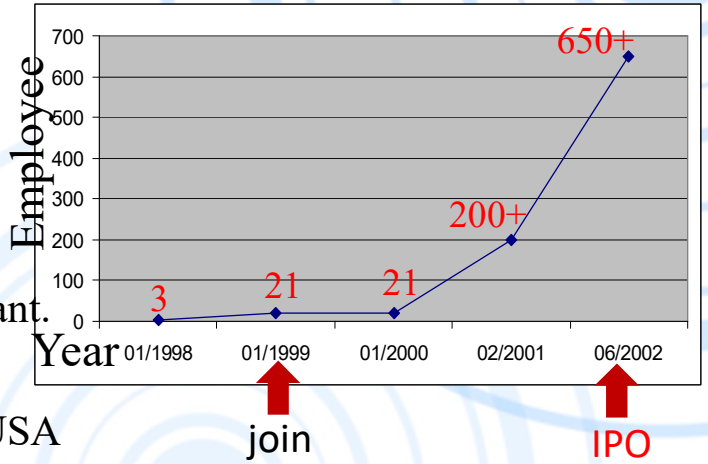
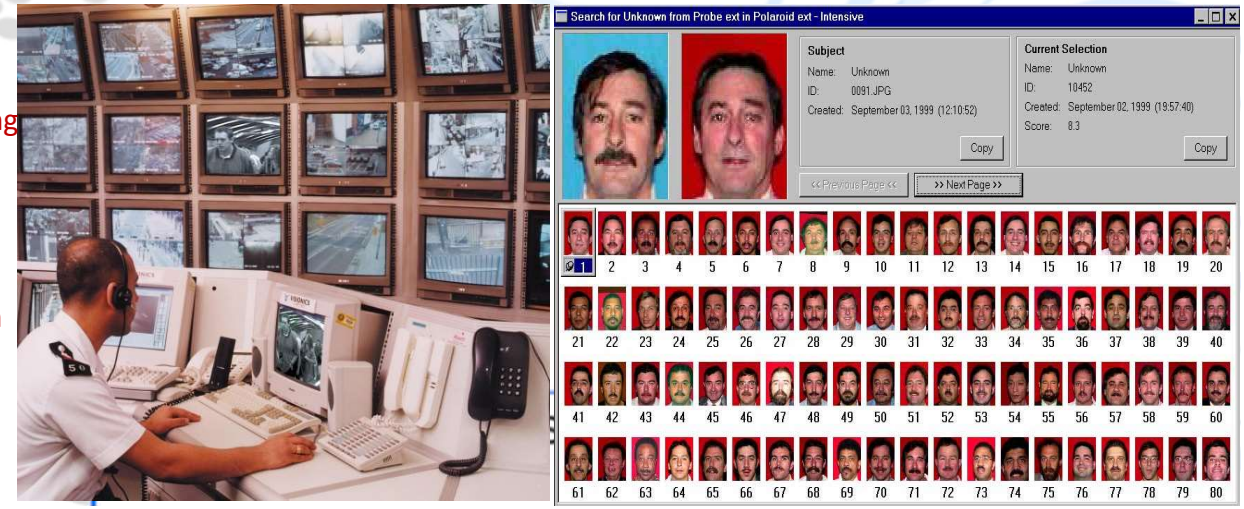
2.1 Face Recognition Company – Visionics (IPO VSNX): 1999~2002, USA

- **Biometrics technology: Face and fingerprint recognition**
  - Capital: US$40M
  - Award: DARPA FERET Face Recognition Competition: No.1 in 2002 & 2004
  - Grant: Project leader for US$5M DARPA surveillance grant.
  - Business: Government - Surveillance in Birmingham, UK
    - Surveillance for Customs & Border Protection, USA
  - Strategy: - Merge small (200+ employees) and then big (400+) fingerprint companies
    - Partnership with NEC, Japan – made face detection chips in 2005.
  - Stock: IPO VSNX at Nasdaq in 2002



1) Surveillance and security: Preprocessing and display

2) Central management system (CMS) and database center: Recognition process and data management

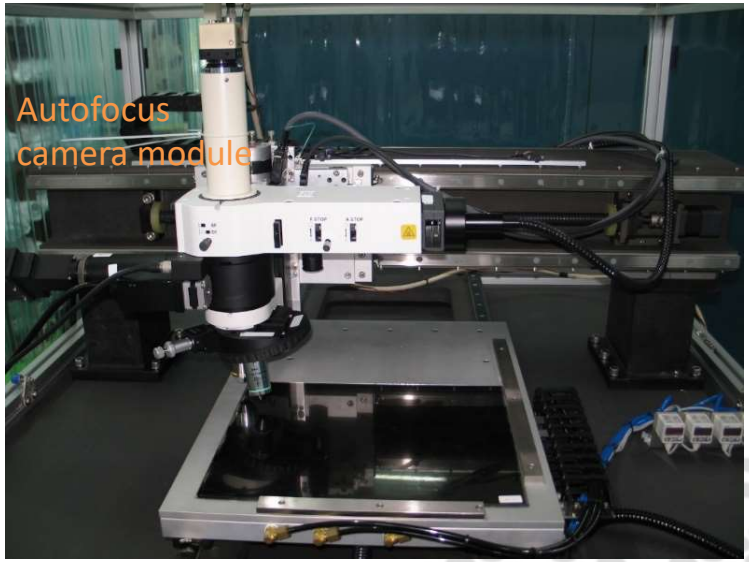


2.2 Found Automatic Optical Inspection Company - BroBri Vision: 2004~2008, TW

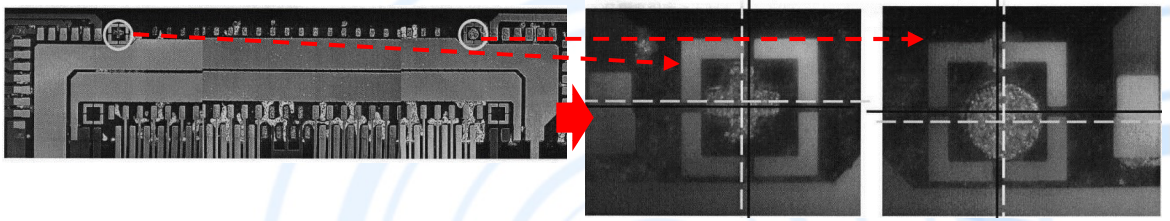
1) TFT-LCD Panel Inspection:

- Capital: US$1.7M (NT$50M)
- Employees: 8
- Business: Manufacturing companies. Charge the service fee

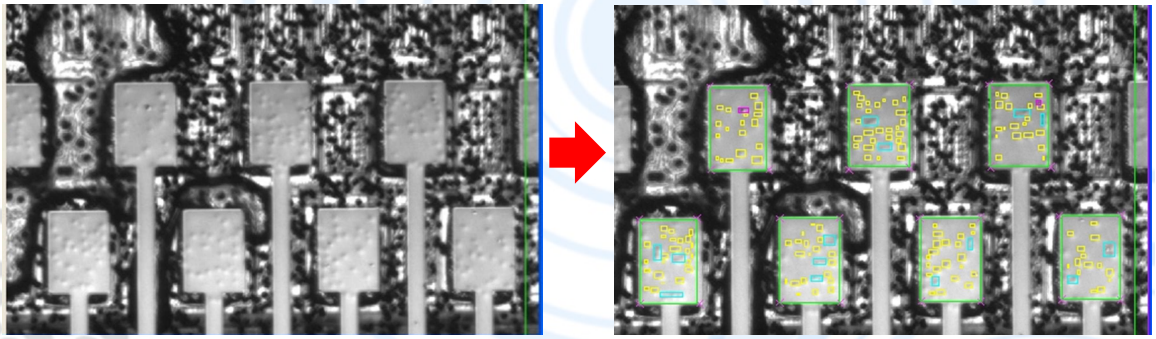
(1) AOI machine, defect inspection



(2) Mark alignment: x ≤ ±10μm, y ≤ ±10μm, 1 pixel = 0.5 um



(3) If (count particle numbers > 5) OK else NG



2) Solar Cell Inspection:

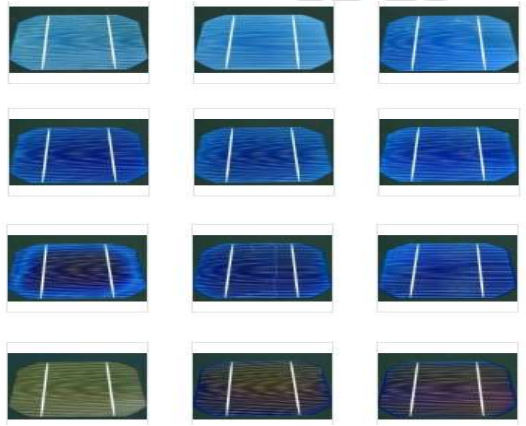
(1) 4 color classification

a) Light blue

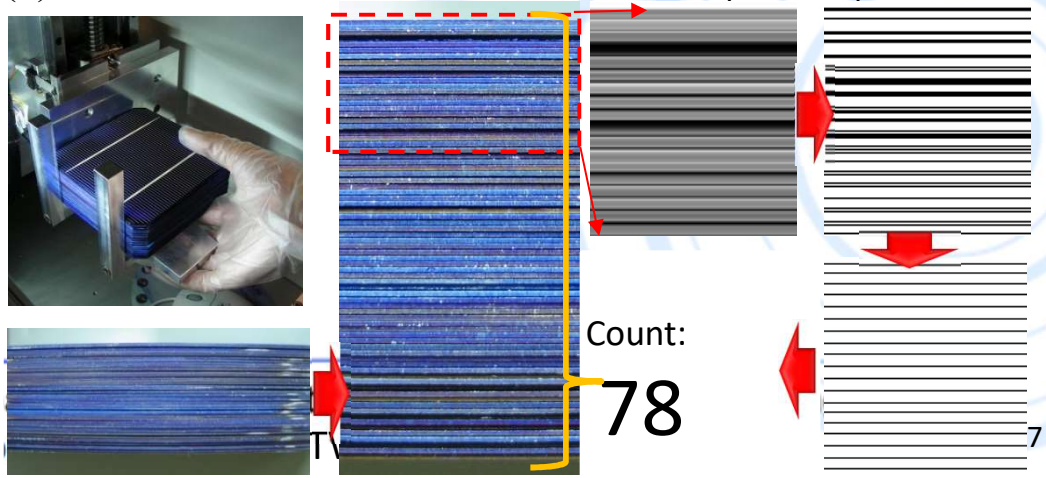
b) Deep blue

c) Purple

d) Brown



(2) Count a stack of slides. Thickness 200 μm±30 μm/slide



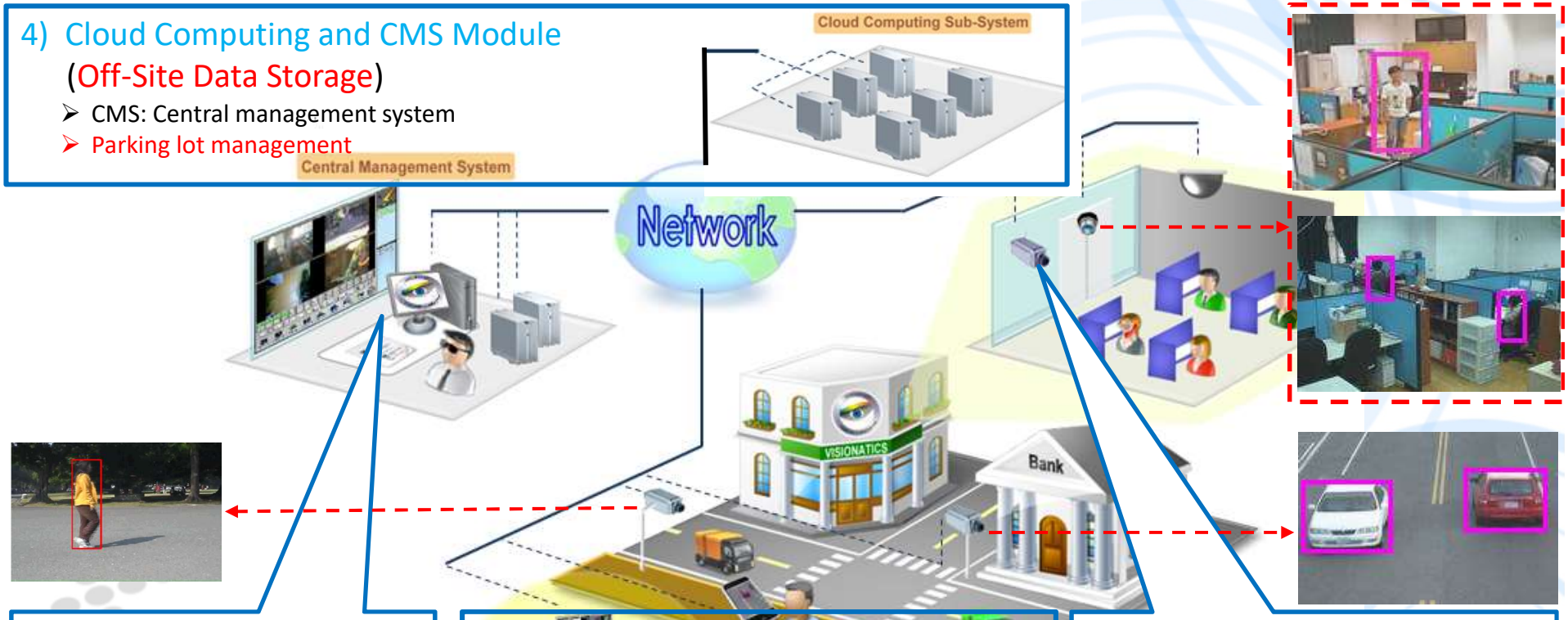
2.3 Found eCV Surveillance Company – Visionatics: 2009~2013, TW

eCV: Embedded Computer Vision

Faraday, TW

- **Embedded Surveillance System:**
  - Capital: US$2.0M (NT$60M)
  - Employees: 15
  - Business: Partnership with IC design companies. Charge the royalty fee

4) Cloud Computing and CMS Module (Off-Site Data Storage)
- CMS: Central management system
- Parking lot management



2) NVR with eCMS and iSearch at TI DM8168 Module (On-Site Data Storage)

- 32-Ch iNVR with eCMS and iSearch

3) Remote Monitoring Module
- Mobile Phone: Android, iOS, WinPhone
- Tablet: Android, iOS…
- NoteBook: Windows

1) Monitoring/ IP Camera Module at TI DM-365
- IP CAM, PTZ IP CAM or
- Analog Camera + Video Server Box

- Parking Lot Management

NVR: Network Video Recorder

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3. Medical Device Project Recently (my wife is a MD in psychiatry)

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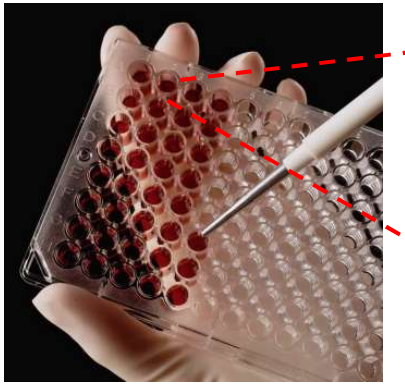
3.1 Microscope Imaging Analysis for PlexBio: 2010~2011, TW

- **Micro Barcode Detection and Decoding - In-Vitro Diagnostics:**
  - Business: Sell reagent, NOT AOI machine

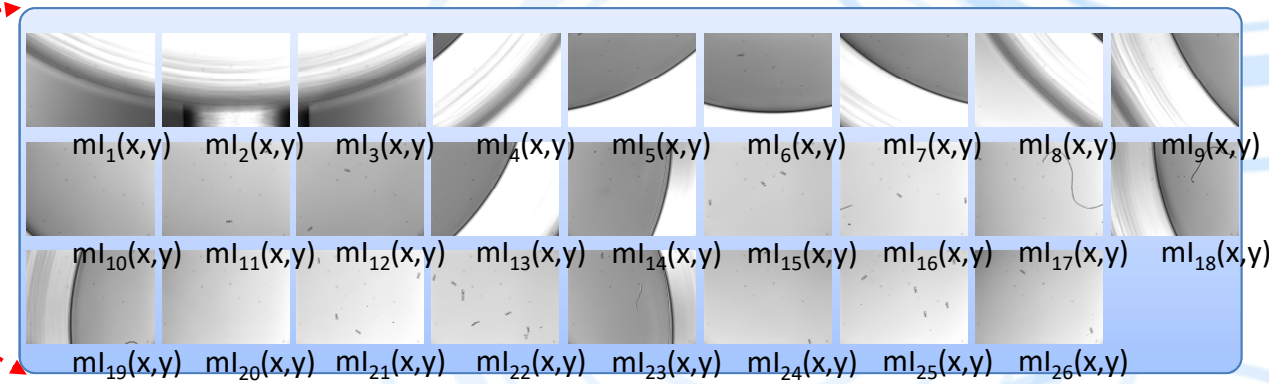
Resolution: 1.06 um/pixel
Well diameter:
6.0 mm = 5666 pixels

1.1) 96 wells/plate

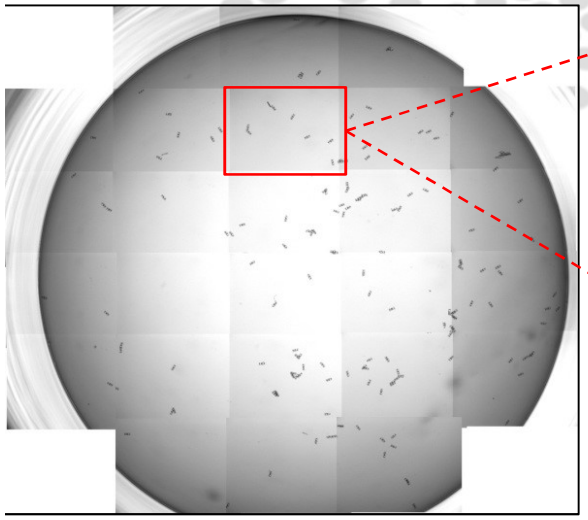


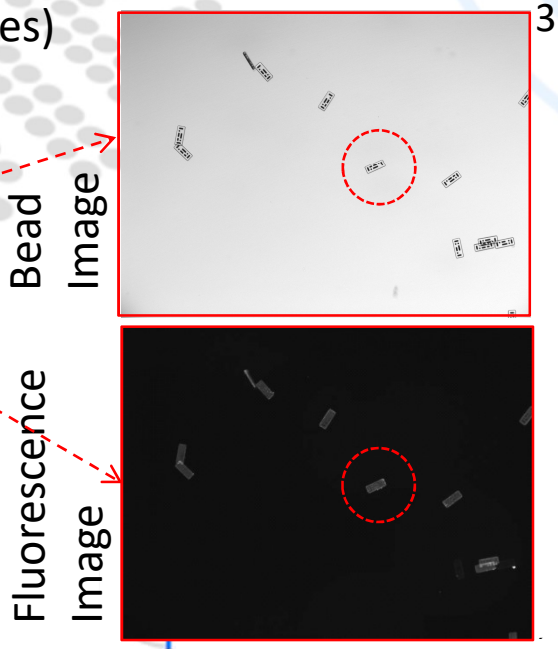
Automatically inject blood, reagent & barcode

1.2) 26 bead images/well corresponding to 26 fluorescence images/well



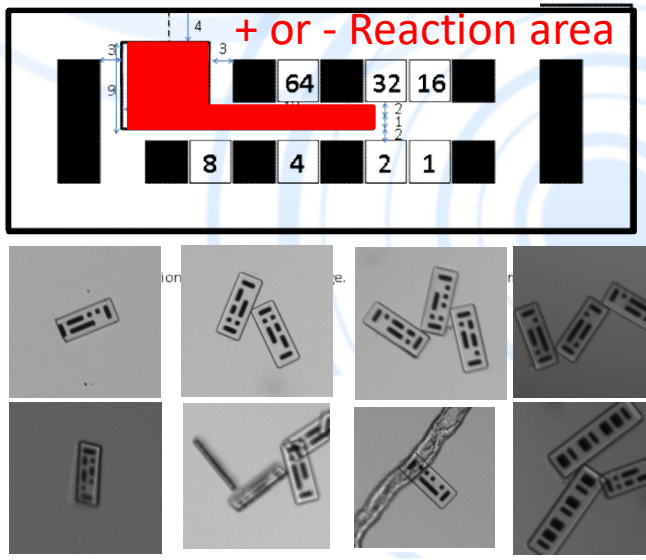
2) Well Stitching (26 Bead Images)





3) AOI: Micro Barcode Detection & Decoding

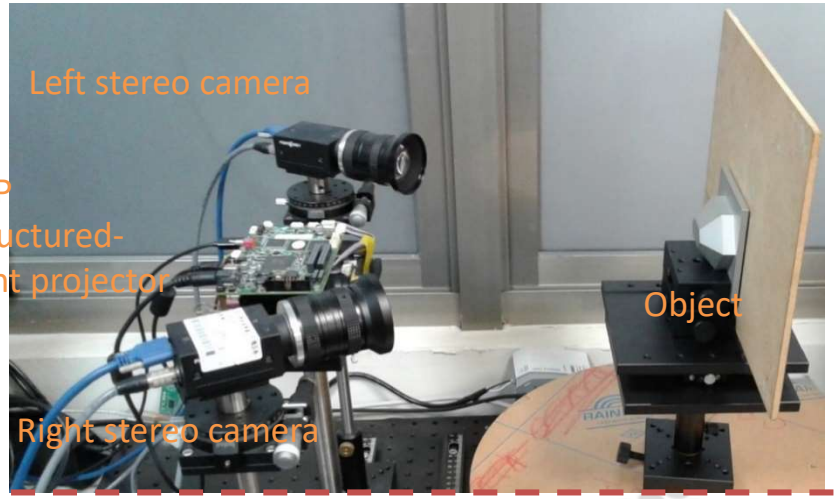
Fluorescence Reading Area = 100 pixels



3.2 3D Tooth Mold Scanning for Dental Implant: 2015~Current

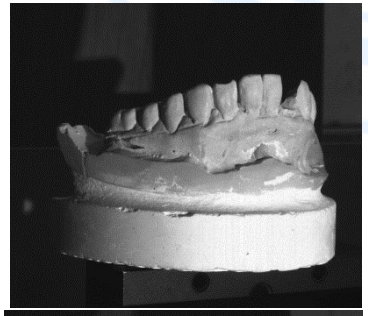
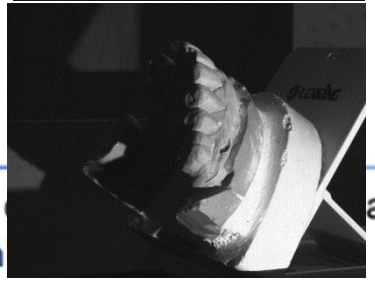
- **Structured-Light 3D Reconstruction with De-Reflection and CAD File Reversion:**
  - Business: Sell 3D scanning system (market price NT$2M (US$67K) > car price)

1) System setup, depth resolution is 20 *um*

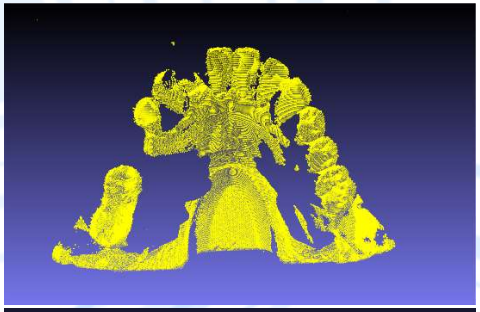
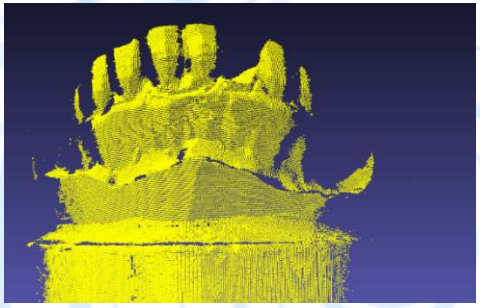
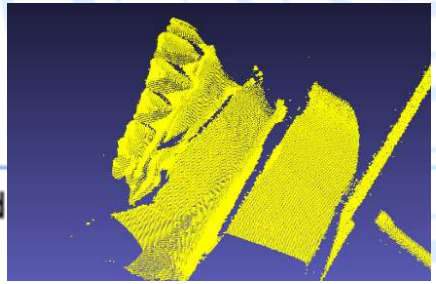


2) 3D tooth mold reconstruction Vs. man-made tooth

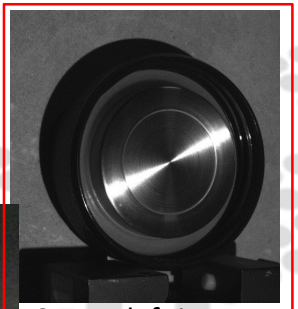


3D point cloud

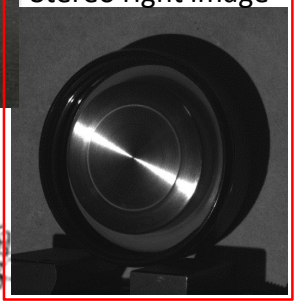




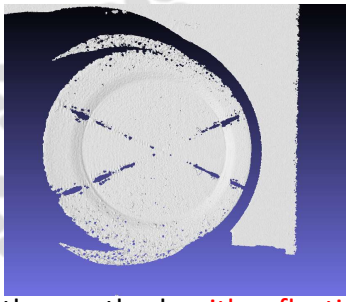
3) Cup cover with reflection



Stereo left image

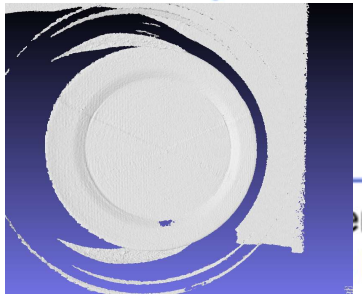
Stereo right image





Other methods with reflection

Our method with de-reflection

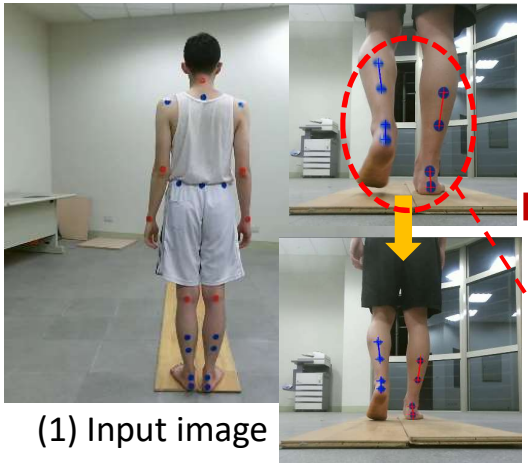


3.3 Adjustable Motion Control Shoes for Pronated Foot Patients with NCKU Hospital: 2015~Current

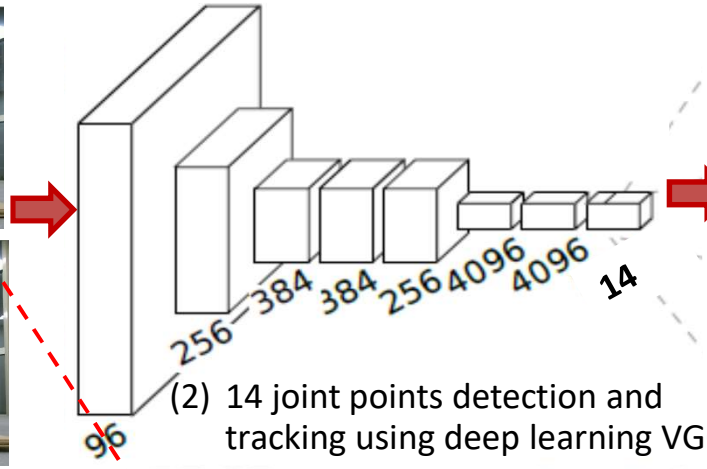
MRC: Musculoskeletal Research Center at NCKU

- **Adjustable Motion Control Shoes for Pronated Foot Patients at MRC with NCKU Hospital:**
  - Business: Sell shoes

1) 14 Joint point detection and tracking using deep learning VGG16



(1) Input image

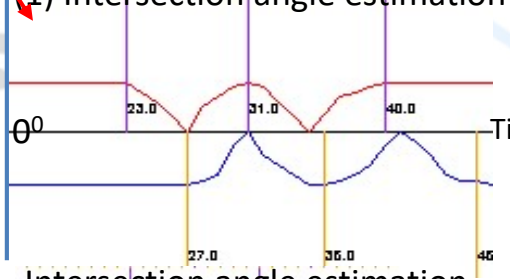


(2) 14 joint points detection and tracking using deep learning VGG16

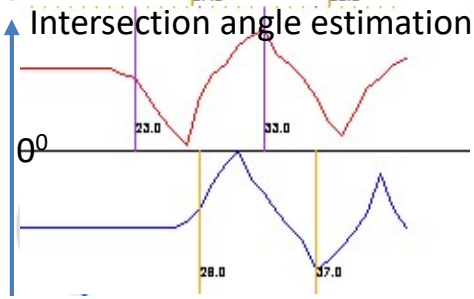
(3) Detection and tracking result for 14 joint points

2) Joint angle estimation for pronated foot analysis

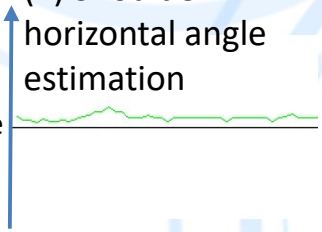
(1) Intersection angle estimation



Intersection angle estimation



(2) Shoulder horizontal angle estimation



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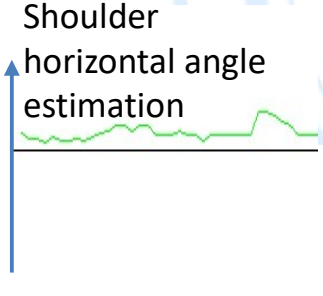


(3) Pronated foot correction by using adjustable motion control shoes

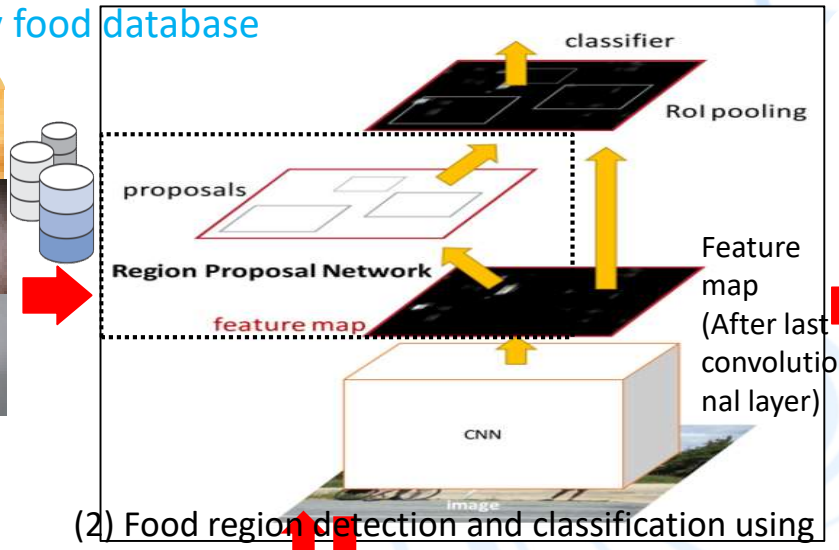
3.4 Food Calorie Calculator as a Service with NCKU Hospital: 2017~Current

MDIC: Medical Device Innovation Center at NCKU

❑ Food Calorie Calculator as a Service (CCaaS) at MDIC with NCKU Hospital:

1) Deep learning training process by food database

(1) Food database



Feature map (After last convolutional layer)

(2) Food region detection and classification using faster R-CNN deep learning modeling

每日飲食指南

(3) Functions:

a) Food region detection

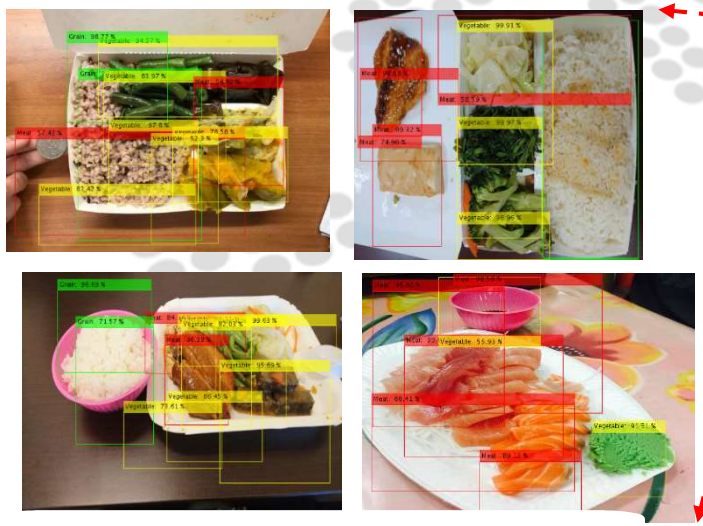
b) Food classification

c) Calorie calculation

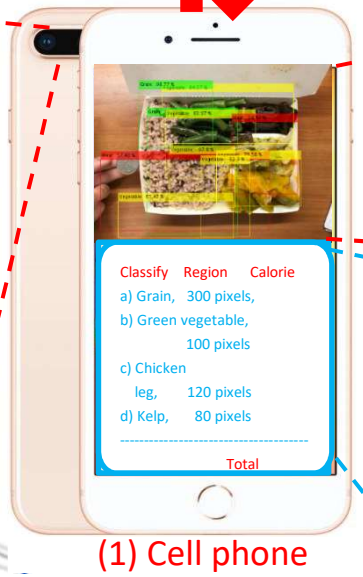
(3) Transmit food image to cloud

(4) Transmit result to cell phone and display

2) Food region detection and classification, and calorie calculation on cell phone

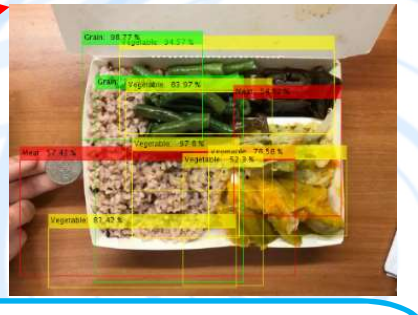


(2) Take photo using cell phone camera



(1) Cell phone

(5) Display function result on cell phone



Classification	Region area	Calorie
a) Grain,	, 300 pixels,	
b) Green vegetable,	100 pixels	
c) Chicken leg,	120 pixels	
d) Kelp,	80 pixels	
	Total	