CSIE 2018 Fall: Introduction to Image Processing, Embedded Robot Vision and Human-Computer Interaction

Instructor: Jenn-Jier James Lien (連 震 杰), Professor, jjlien@csie.ncku.edu.tw, Ext. 62540.

Website: http://robotics.csie.ncku.edu.tw/course.html **Prerequisites:** C, C++ or Python

Class Time/Location: 09:10 ~ 12:00 Friday/ room CSIE65405/ for undergraduate and master students.

Syllabus: (W: Week - Ch: Bradski's book chapter)

	01-01	Introduction to **industry 4.0** - Intelligent robotics and automation: Sensors, machine vision, deep learning, big data and IoT (Internet of Things).
Image Processing	01-01~04	Introduction to **OpenCV**: Image processing and robot vision (or computer vision).
	02-06, 05	Image processing 1 - **Convolution**: High-Pass (edge) and low-pass (smooth) filters, and morphology operation with CCLabeling (connected-component labeling– 09).
	03-05, 06	Image processing 2 - **Image transforms**: Hough transformation, geometric trans., FT (Fourier transform), II (integral image) and histogram equalization.
	Assignment 1	
	04-06	Image processing 2 - **Image transforms:** Hough transformation, geometric trans., FT (Fourier transform), II (integral image) and histogram equalization.
	05-07	Image proc. 3 – **(Texture) Histograms and matching:** Stochastic and probability.
	06-08	Image Processing 4 – **(Shape) Contours:** Data structure - **Linked list**.
Computer Vision, and HCI	07-11	Sensor - **Camera models and calibration**: Optimization process and **AR** (Augmented reality).
	Assignment 2	
	08-12	Sensor - Projection and **3D vision**: Geometric transformations between 2D and 3D; and 1) **Stereo**, 2) ToF (Time-Of-Flight: Kinect 2, SoftKinetic), and 3) Structured light (Kinect 1: DLP projector).
	09-09	Image parts and segmentation: **Background subtraction/modeling** - Real-time motion detection using **GMM**.
	10-	**Midterm exam** (from W01~08)
	11-10	Tracking and motion: **Optical flow** (feature tracking), mean-shift, **Camshift** tracking, and condensation algorithm (particle filter).
Machine Learning	12-13	1) **SIFT** (and brief HOG): Feature extraction, 2) **AdaBoost**: Face detection,
	13-13	3) **PCA, LDA**: Face recognition.
	14-13	4) **SVM** (support vector machines): Non-linear classification.
	14-13	5) **VQ** (vector quantization): Clustering and K-means.
	Assignment 3	
Deep Learning	15-	Deep Learning: From **AI** (artificial intelligence) to **ML** (machine learning), to **DP** -From **Bayes' Rule** (posterior probability) to Gaussian model, to similarity measure (likelihood probability: Mahalanobis distance, SSD (sum of squared differences) and correlation (or **pattern matching**)), to PCA (linear combination). -From BPNN (back propagation neural networks) to deep learning. -From supervised、unsupervised、semi-supervised learning, to DP - Reinforcement
	16-	Deep Learning
	17-	Deep Learning
	18-	**Final exam.**

Textbooks/Reference Books:

1. Textbook1: Class lecture notes.
2. Textbook2: Learning OpenCV, Computer Vision with the OpenCV Library by Gary Bradski and Adrian Kaebler, O'Reilly, 2008.

3. Ref1. OpenCV (V.2.4.7 or above) documents including 1) tutorials, 2) reference manual, and 3) user guide.
4. Ref2. Digital Image Processing by Rafael C. Gonzalez and Richard E. Woods, 3rd, Pearson, 2007.
5. Ref3. Computer Vision: Algorithms and Applications by Richard Szeliski, Springer, 2010.

Grading: Assignment x 3: 20% x 3 = 60%, Exam x 2: 20% x 2 = 40%.