

**A Smart Sensor Network  
for Object Detection,  
Classification and Recognition**

Presented by Yi-Ta Wu

# Agenda

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- The Surveillance System
- Auto-Alarm Based Surveillance System
- Two Problems of Surveillance System
- Wireless Sensor Based Surveillance System
- Conclusions

# The Surveillance System

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- The surveillance system is a series of monitoring devices designed to check on environmental conditions.
- It is widely used nowadays to help a guard with consecutive sensing information.



# Problem of Current Surveillance System

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**Exhaustion** by long-term observation



# Auto-Alarm Based Surveillance System

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# What is the Proper Resolution ?

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**Goal:** Perform the face recognition

**Problem:** It is difficult to determine the proper resolution.



# What is the Target Object?

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First image frame



Second image frame

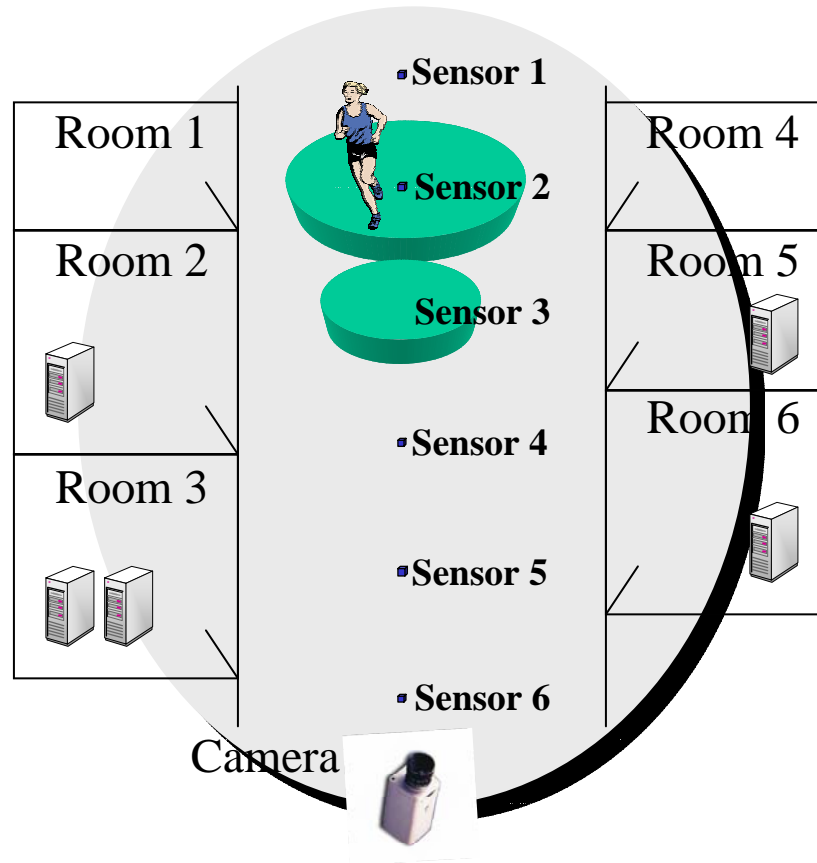


The difference of above two images





# Wireless Sensor Based Surveillance System



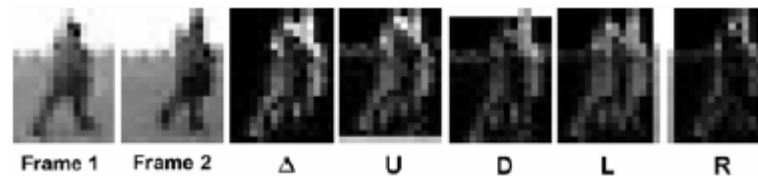
$$X = \frac{\sum m_i x_i}{\sum m_i},$$
$$Y = \frac{\sum m_i y_i}{\sum m_i}$$



# Object Classification, Human/Non-Human

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P. Viola, M. Jones, and D. Snow, “Detecting Pedestrians Using Patterns of Motion and Appearance,” Computer Vision, 2003. Proceedings. Ninth IEEE International Conference on, pp. 734-741, Nice, France, Oct. 2003.



$$\Delta = \text{abs}(I_t - I_{t+1})$$

$$U = \text{abs}(I_t - I_{t+1} \uparrow)$$

$$L = \text{abs}(I_t - I_{t+1} \leftarrow)$$

$$R = \text{abs}(I_t - I_{t+1} \rightarrow)$$

$$D = \text{abs}(I_t - I_{t+1} \downarrow)$$

# The Method for Efficiently Extracting Candidates

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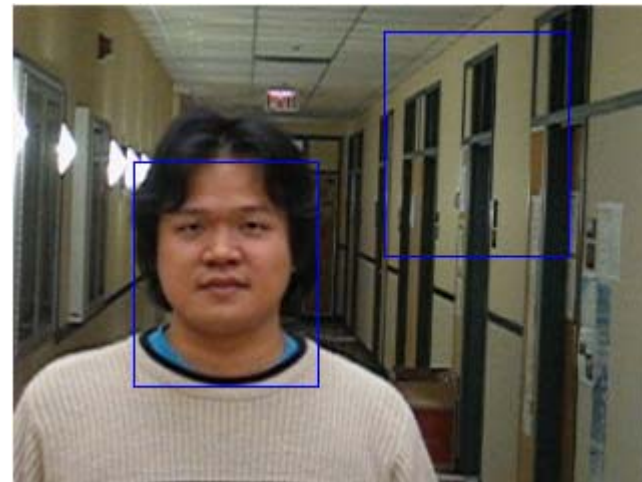
(a)



(b)



(c)

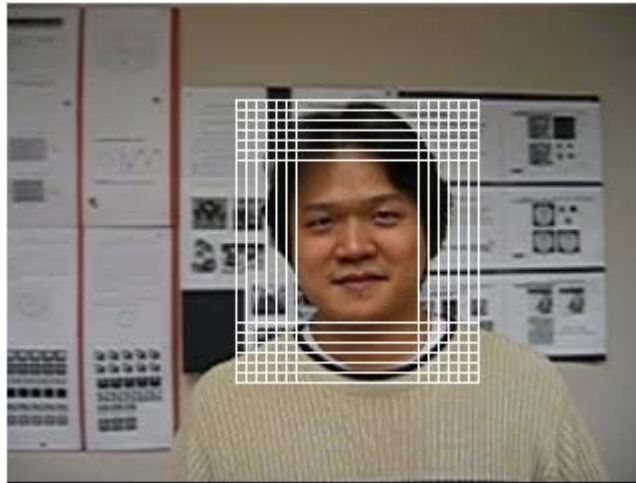


(d)

**Program  
Demo**

# Sets of Candidate for Face Recognition

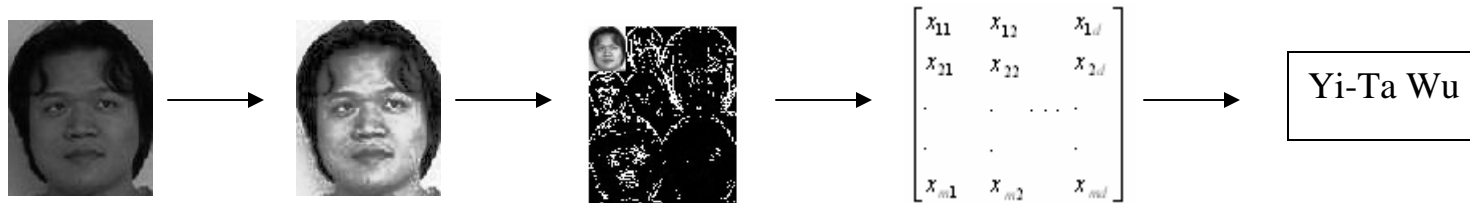
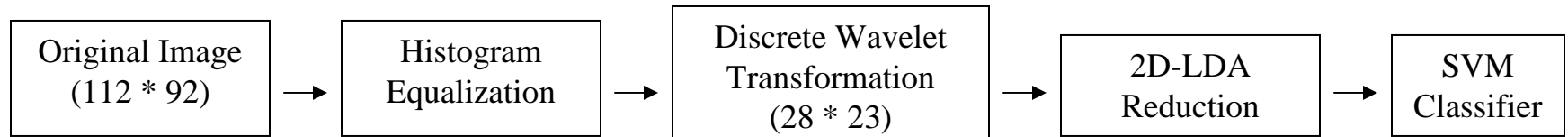
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# Sets of Candidate for Face Recognition

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## The Flowchart of the experimental procedure



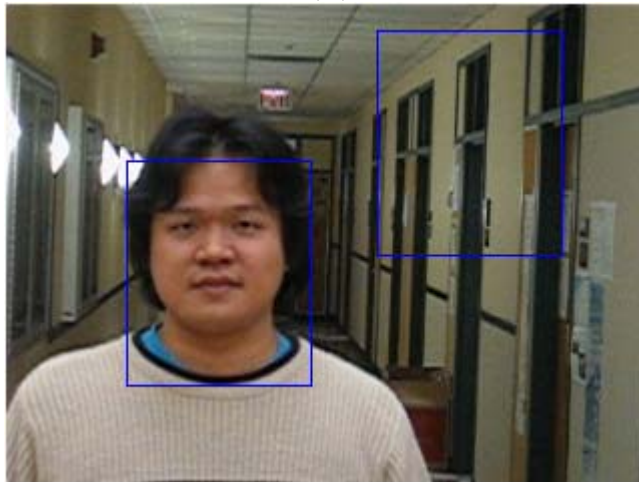
# Experimental Results



(a)



(b)



(c)



(d)

# Conclusions

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- The traditional surveillance systems are performed either **periodically or manually** rotating the cameras, which may have the difficulties of **determining the proper object resolution**, and the **automatically detecting the moving object** when the camera is not fixed.
- Wireless Sensor based surveillance system:
  - ✓ The Wireless Sensors are utilized as the first layer guards to detect the coordinates of the unauthorized invasions
  - ✓ After identify the location of the invasions, the system will arrange cameras to catch the image features for object classification and recognition based on the hierarchical approach.

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# Question

