# Design and Applied Technology CASE STUDY

# Application of Intelligent Security Systems







Students should be made aware of the relevance of the technology they are studying to the real world. Case studies on technology and design enable students to put their learning into an authentic context.

Authentic Context: Students could realize the application of system and control technology through the study of security systems design of a A-Grade commercial building.

#### **Topics Covered:**

Compulsory Part	Strand 2: Technological Principles			
Elective Part	Module 1: Automation			

Application of Intelligent Security Systems

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### **The Story**

Suppose you are a security director. You are responsible for the design and planning of a new commercial complex security system. It is comprised of two high-rise Class A commercial buildings which will be opened 24 hours a day. The challenge is that there will be over hundreds thousands patrons walking in and out of these commercial buildings daily. The commercial buildings are open to public access during normal office hour, say from 7:30am to 7:30pm. The entrance will be restricted to staffs only after 7:30pm until dusk.



You are leading a team of security engineers and are responsible for designing security strategies. The inauguration ceremony of commercial buildings will be coming soon. You are going to chair a meeting and present your plan to the property manager and major tenants of this commercial complex after two weeks.

You do not need to go into details, such as the number of CCTV to be installed and where to put the burglar alarm, but you have to recommend a macroscopic strategy of what security measures and what technology level will be adopted. You need to support your decision and try your best to persuade your clients to adopt your proposal. You have to bear in mind that they are all layman to your discipline and are budget conscious.



# Background studies 1 – What is a security system?





Form a group of 3 students to prepare a concept map and present your findings. Think reflectively about the purposes of using them.







### Background studies 2 – Premises Survey

You may have heard of the term Class A office buildings in Central Business District and Class B office buildings in a less prestigious areas in the financial news roundup. What do you think the attributes a Class A office building should have?



Form a group of 3 students and discuss: what criteria you think of an office building should have in order to be classified as a Class A office building?



Draw a Concept map about the criteria for Class A office building



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# Background studies 3 – Needs analysis

#### **Brain Storming**

Suppose you are one of the representatives of a major tenants in a Class A office building. What are your concerns about what types of security systems are needed for your office and how sophisticated they should be?







### **Technological Principles of Fingerprint verification**

#### Why Fingerprint system?

It is a system that incorporates fingerprint verification technology to produce precise clocking system of each employee. This system is usually worked with time and attendance management system that will provide a one-stop solution for administration and human resources.



#### **Specifications**

This system is PC-based, can be operated standalone or in a networked environment through TCP/IP or RS485 environment. The capacity of this system can usually store up to 120,000 transactions at a time and 2,800 fingerprint templates. It allows a maximum of 10 fingerprints enrollment per user and 3600 fingerprint placement during verification process. The fingerprint identification time is usually less than 2 sec. For better reliability, usually comes with an uninterrupted power supply (UPS) for its application.

Do you have any experience of using fingerprint identification and verification in your daily life? Would you give two daily examples?

Here are some terminology you need to know:

FAR – False Acceptance Rate?
FRR – False Rejection Rate?
EER – Equal Error Rate?
N finger-scan templates in 1:N mode?
RoHS compliant?





Figure 1 Fingerprint Identification Process(left) Fingerprint Recognition Unit (Right)

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Please explain the following terminologies regarding Fingerprint verification technology:

- 1. FAR is the short form of False Acceptance Rate. It is a ratio to indicate ...
- 2. FRR is the short of False Rejection Rate. It is a ratio to indicate ....
- 3. EER is a short form of Equal Error Rate. It is actually a ratio of .....
- 4. N finger-scan templates in 1:N mode means ....
- RoHS compliant is a short form of Restriction of Hazardous Substances Directive. It was......





Please illustrate the advantages and disadvantages of using fingerprint recognition from end-user perspectives.

#### Guidelines:

- (1) you may think of the societal and psychological factors to your clients.
- (2) use the cost against benefit approach to analyze the fingerprint recognition technology.





#### **Technological Principles of IRIS Recognition**

Why IRIS?



Figure 2 Human IRIS Binary code of IRIS (upper left corner)

The uniqueness is the core of iris recognition. The probability of having two identical irises is  $1:10^{78}$ . The structure of iris remains unchanged during the whole life and was determined at the fetus stage. The identification is based on the structure, not the color of the iris.

#### **Recognition Process**

The iris recognition is non-contact and can be identified from a distance of 8 to 25cm. Looking into the lens of a video camera in an optical unit to carry out the identification process of iris. The camera will capture two eyes in rapid succession, such as 15 frames per second, for 1-2 seconds.



#### **Figure 3 IRIS Recognition Process**



#### **Hardware Configuration**

The identification control unit (ICU) generates the digital code of the captured image and compares it with the stored iris records. If the matching is correct, ICU will generate a signal to open the door through door interface board (DIB). The ICU is installed behind the wall and inside a protected area to prevent tempering. The configuration of the iris recognition comprises of Server, Enrolment Station, Monitoring Station and Management Station. The Enrolment Station performs the iris registration with ICU; the Monitoring Station monitors the status of Enrolment Optical Unit, Remote Optical Unit, ICU and the door interfacing board. The Management Station maintains the database of users and allows downloading of data to the ICU.

#### Stop and Think:

What is Enrolment Optical Unit (EOU)? And What is Remote Optical Unit (ROU) ?

There is a proximity sensor installed near the ROU, it activates the camera when peoples are approaching. There is a voice-recorded message to guide the identification procedure.





Explain the IRIS recognition for a security purpose. What advices will you give to persuade the tenants to adopt the IRIS recognition technology?

#### Task:

Prepare a 4-page PowerPoint for your presentation.

- What is IRIS recognition?
- What are the benefits of using IRIS recognition?
- What are considerations of adopting IRIS recognition?
- What is the meaning of EOU and ROU?





#### Technological Principles of CCTV Video Surveillance system

#### Why CCTV?

A CCTV Video Surveillance system is used to remotely monitor the activities of the whole commercial buildings in the security control room or even at home through the Internet. A motion detector can be added to the system so that it will automatically alert you via SMS when there is a disturbance at the site.

#### **CCTV** hardware

The CCTV system is commonly a combination of a PTZ security camera and a video recorder. The camera motion can be pre-programmed or real-time control through network whenever there is disturbance occurs. The PTZ camera is connected by coaxial cable or unshielded twisted-pair (UTP) cables, and is either NTSC or PAL mode. A heater or cooling fan unit can also be added under adverse and extreme temperature condition. The camera can be a combination of B/W or full color to lower the average cost.

Here are some terminology you need to know:						
What is PTZ?						
What is UTP?						
What is Coaxial cable?						
What is NTSC?						
What is PAL?						





Figure 4 Wall-mounted (left) and ceiling-type (right) PTZ camera









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#### Advantages of Digital Surveillance System

Unlike traditional video surveillance system that uses S-VHS tape for the storage of video, the digital recorder has dual function of a digital recoding and image transmission. The digital recorder is a non-PC based device and is dedicated to this purpose.

The advantages of using digital media over S-VHS magnetic tape:

- 1. No messing of tapes;
- 2. No additional cost for consumable tapes;
- 3. Low maintenance cost, use of hard disk and modular design;
- 4. Superior performance over analogue recording;
- 5. Delivering high quality images for viewing instantly without having to search the magnetic tape and conventional video cassettes;
- Images will do not degrade no matter how many times they are copied;
- Gives perfect 'picture pause' with no distortion or flicker (thus making images easier to be scrutinized);
- Completely removing the possible torn of videotape when using 'fast-forward' or 'rewind'.

#### Value-added Features

The digital recorder has some superb features for security purpose. The monitor can display images from either a single camera full-screen or images from several cameras at a reduced size automatically. Its sophisticated built-in motion detector that can be programmed to increase the recording rate when suspicious motion is detected. The higher the speed of recording can produce images of higher quality that may be very important for scrutiny. Some advanced PTZ camera will even zoom in to the spot of disturbance automatically when disturbance is spotted in the scene. The PTZ can be controlled by remote keyboard for close scrutiny that is known as telemetry control.



For the application connected to an ATM/cash dispenser, or cash register, an overlaying the transaction details can be inserted over the corresponding video sequence. Tampering with stored data protected by digital signature on all recordings and encrypting them with time/date/unit markings so that every recorded image can be verified.



Figure 5 Typical configuration of advanced CCTV video surveillance system



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Although there are many advantages in using digital storage media than the conventional VHS tapes, please explain why VHS-tape recordings are still widely be adopted in the Class B or Class C office building?



#### What is Facial Recognition?



Figure 6 Facial Recognition Algorithm

Facial recognition utilizes distinctive features of the face to perform verification and identification, such as:

- 1. the upper outlines of the eye sockets;
- 2. the distance between the eyes;
- 3. the location of the nose and eyes
- 4. the length of the nose;
- 5. the sides of the mouth;
- 6. the angle of the jaw;
- 7. the areas surrounding the cheekbones.

Facial recognition systems use computer programs to analyze images of human faces for the purpose of identifying them. The programs take a facial image, measure characteristics and create a unique file called a "template."

Based on this template, the software then compares that image with another image. It produces a score that represents how similar these two images (the captured image and the template image) are to each other.



#### **Facial Recognition Processes**

A typical facial scan technology includes 4 major steps - sample capture, feature extraction, template comparison, and matching. The sources of image for making the template can be come from Enrolment. Enrollment is usually a 20-30 second process taking several pictures of one's face. A series of pictures will be taken for incorporating slightly different angles and facial expressions, to allow for more accurate matching. After enrollment, distinctive features are extracted for the creation of a template. The template is much smaller than the enrolment image from which it is derived. Facial images can require 15-30kb whilst template images range from 84 bytes to 3000 bytes. The smaller templates size is normally used for 1:N matching.

#### **Drawbacks of Facial Recognition**

Up to this moment, face-recognition software has high rates of both "false positives" and "false negatives". One problem is that it unlike fingerprints or irises recognition, human faces does not stay the same over time. These systems are easily failed by changes in hairstyle, facial hair, body weight, disguises and simply aging.

#### Stop and Think

What are "false positives" and "false negatives"?

Will it pose a significant treat to our privacy?



Facial Recognition technology has the disadvantage that they are intrusive both physically and socially. They require the user to position their body relative to the image-capturing device, and pause for few second to 'declare' themselves. This 'pause and declare' process likes saying an "oath". This type of identification does not conform to an normal human interaction and social manner.



Suppose you are the head of this security team. You need to introduce the emerging technology – Facial Recognition during the meeting with Class A tenants. You can give "pros and cons" and state your standpoints according to your professional judgment.



Prepare not more than 3 pages PowerPoint to state your views. In the PowerPoint presentation, you need to explain the technical terms of "false positives" and "false negatives" and address the privacy issue.

Slide 1: What are the "Pros" of Facial Recognition? Slide 2: What are the "Cons" of Facial Recognition? Slide 3: What are your professional recommendations to this technology?





You are told by the Property manager that the composition of the major tenants include the (A) Gold and jewelry flagship shop with gold and diamond bank behind the shop; (B) ICAC headquarter; (C) Middle East Ambassador and etc. With a view to these keynote tenants, you and your team need to analyze the situations individually and recommend what types of access control are appropriate for their situations. Complete your answers in the worksheet below.

#### Task: Conduct a preliminary analysis for the potential clients.

#### (A) Gold and jewelry flagship shop with gold and diamond bank.

#### Situation:





### (B) ICAC headquarter

#### Situation:



**Recommendations:** 





(C) Middle East Ambassador

Situation:



#### **Recommendations:**









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We encourage collaborative learning throughout this case study; therefore peer assessment and evaluation on their learning were suggested. It is recommended that you take a minute to evaluate and reflect on your own leaning after each lesson. A simple checklist rubric is provided. You will also take responsibility to assess the performance of other groups during the final presentation with the scored rubrics.



# Self / Peer assessment (checklist)

This assessment rubric can be used to keep your learning progress and schedule. Put "Yes" or "No" after each lesson. Teacher can easily check whether you can meet the lesson objectives.

Stu	dent Name:	Team:						
	Focus of Assessment: Teamwork	Date:/						
	Criteria	Self	Peer	Teacher				
1.	I understand the lesson objectives.	Yes / No	Yes / No	Yes / No				
2.	I work with team members cooperatively.	Yes / No	Yes / No	Yes / No				
3.	I give my views responsibly.	Yes / No	Yes / No	Yes / No				
4.	I respect and listen to other members' ideas.	Yes / No	Yes / No	Yes / No				
5.	I can draw conclusion after this lesson.	Yes / No	Yes / No	Yes / No				
6.	I am satisfied with my learning today.	Yes / No	Yes / No	Yes / No				





# Assessment rubrics (Presentation)

Peer Assessment for Final presentation													
Team:							Date:	/					
Assessors:					Class:								
Focus	Focus No Scores			es		Assessment Criteria	Scores						
	1	1	2	3	4	5	$\leftarrow$ Understanding of the topic $\rightarrow$	6	7	8	9	10	N/A
ge	2	1	2	3	4	5	$\leftarrow$ Content is consistent with the topic $\rightarrow$	6	7	8	9	10	N/A
owled	3	1	2	3	4	5	$\leftarrow$ Content is supported with evidence $\rightarrow$	6	7	8	9	10	N/A
Kn	4	1	2	3	4	5	$\leftarrow \text{Content is at appropriate level} \rightarrow$		7	8	9	10	N/A
	5	1	2	3	4	5	$\leftarrow$ Show key concept in content $\rightarrow$		7	8	9	10	N/A
	6	1	2	3	4	5	$\leftarrow \text{Show effort in group discussion} \rightarrow$	6	7	8	9	10	N/A
de	7	1	2	3	4	5	$\leftarrow \text{Show effort in information search} \rightarrow$	6	7	8	9	10	N/A
ttituo	8	1	2	3	4	5	$\leftarrow$ Show effort in preparing presentation $\rightarrow$	6	7	8	9	10	N/A
A	9	1	2	3	4	5	$\leftarrow$ Show competency in IT skills $\rightarrow$	6	7	8	9	10	N/A
	10	1	2	3	4	5	$\leftarrow$ Show organization skills $\rightarrow$		7	8	9	10	N/A
	11	1	2	3	4	5	$\leftarrow$ Present their views and idea clearly $\rightarrow$		7	8	9	10	N/A
ion	12	1	2	3	4	5	$\leftarrow$ Logical and consistent flow of ideas $\rightarrow$	6	7	8	9	10	N/A
sentat	13	1	2	3	4	5	$\leftarrow$ Have interaction with audiences $\rightarrow$	6	7	8	9	10	N/A
Pre	14	1	2	3	4	5	$\leftarrow$ Show appropriate use of visual aids $\rightarrow$	6	7	8	9	10	N/A
	15	1	2	3	4	5	$\leftarrow$ Have eye contact with audiences $\rightarrow$		7	8	9	10	N/A
Total Scores													

\* Performance descriptors: 1 is incomplete; 5 is fair; 7 is good; 8 is very good; 9 is outstanding

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