Security Development for Tartan system

2021/6/17 Team 4

Introduction to Team 4

Aka Potential


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Lead & schedule management: Daesik Kim
Architect: Kyungsik Lee
Configuration management & build: Hanil Jang, Yujin Lee (use github)
Acceptance Test & QA: Dahee Jung, Jinchul Kim
Risk Assessment & Mitigations: All
Development & Documentation:

- Application(User Interface) side: Hanil Jang, Yujin Lee, Dahee Jung
- Jetson Nano side: Daesik Kim, Kyungsik Lee, Jinchul Kim

4tential

Introduction to Tartan system

System overview

- Server(Camera) & Client(Monitoring system) for live streaming
- Facial recognition with Database
- Wireless Network

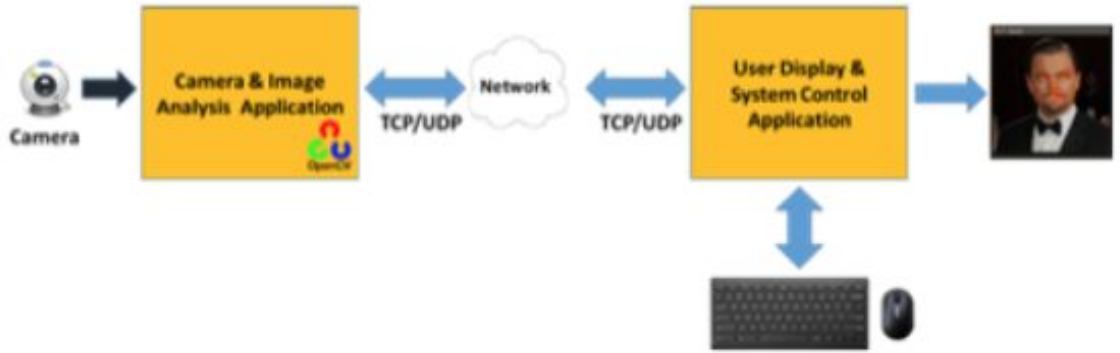


Figure 1: High-level design

Project Goals

- Security Development for Tartan system

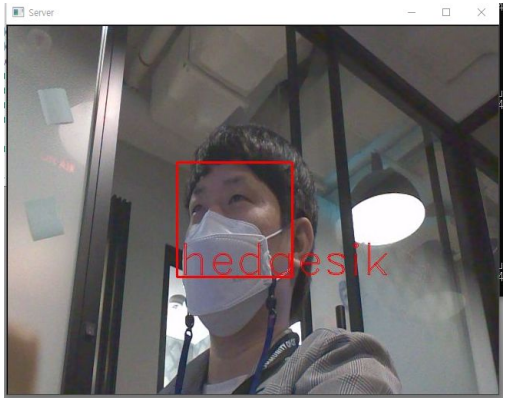
- Business perspective
  - Think of this system as MVP(minimum viable product)
  - Try to avoid implementing fancy features such as GUI.

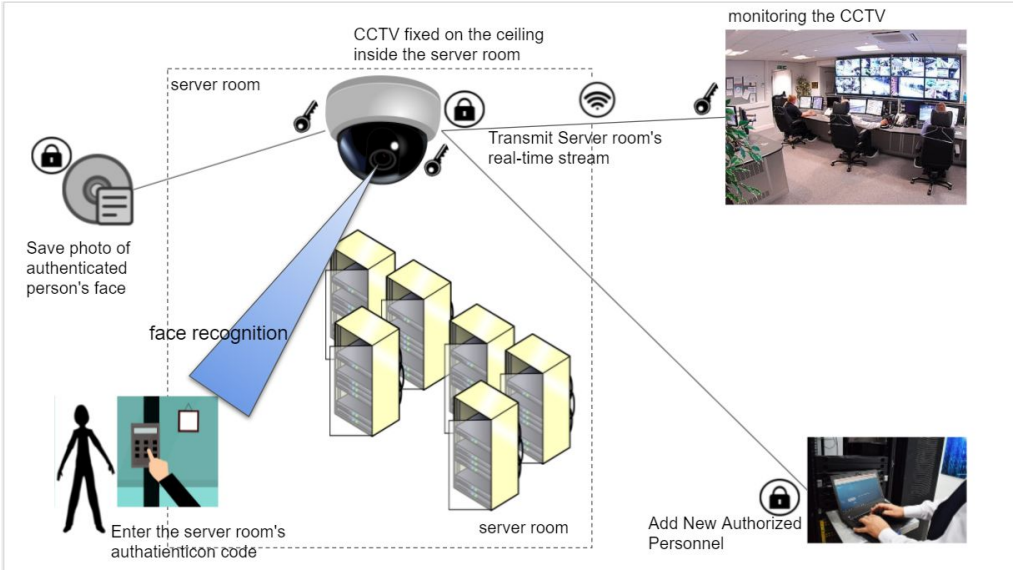
- Security Goals
  - Focused on enhancing security of the product.
  - Should be designed to achieve three principles.

Application

Overview

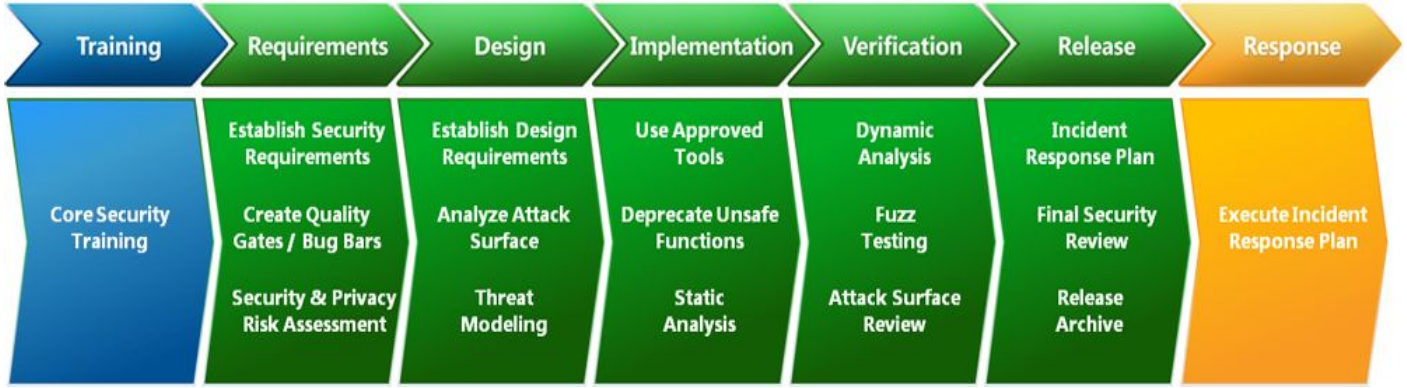
- Monitoring and tracking people with CCTV in the server room
- Detecting unauthorized people with facial recognition
- CCTV in the server room
- Monitoring system in the security room





Security Development Process

- Based on MS-SDL
  - Some items on each stage are excluded due to the project development scope



Requirements - Functions

- Security agents can watch and identify people through the real-time video streaming.
- A manager can access CCTV and register/unregister authorized people.
- The system should provide facial recognition.
- A manager can check the past dis/connection records.
- A manager can check the log file to see who entered the server room and when they did.

Requirements - Security

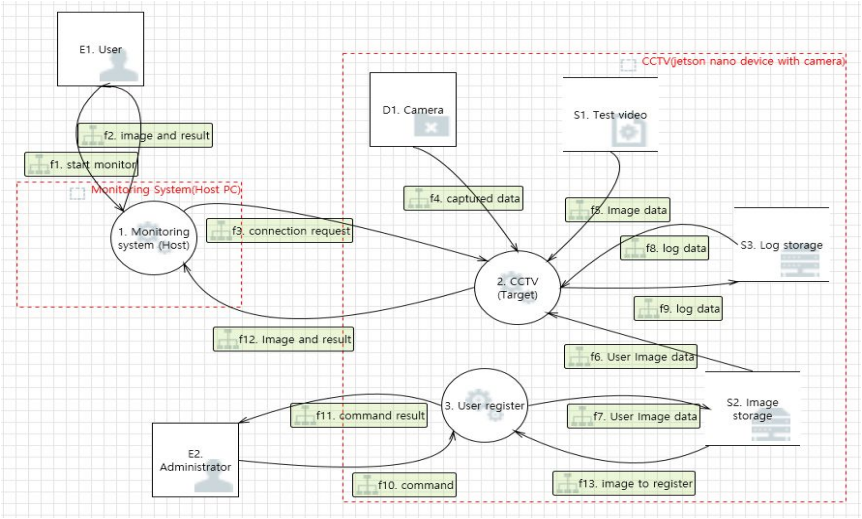
To achieve the security goals, the following security requirements are defined to identify and analyze possible threats and apply the derived mitigation.
These requirements were derived through threat analysis and mitigation measures.

- Secure network
  Network sections between CCTV and the monitoring system are encrypted.
- Personal information encryption
  Relevant data to privacy information should be encrypted securely.
- Key protection
  Keys which are used for encryption should be kept safely.
- CCTV should identify who was in or out and save the information to a log file.

Design - Threat Modeling 1/2

- Data Flow Diagrams
  Decompose the system into parts and show that each part is not susceptible to relevant threats.

- Employ threat modeling using followings
  - STRIDE
  - PnG



Design - Threat Modeling 2/2

- STRIDE

Threats	Spoofing	Tampering	Repudiation	Information Disclosure	Denial Of Service	Elevation Of Privilege
82	22	5	8	9	17	21

- PnG

Threats	Persona 1	Persona 2	Persona 3
8	4	3	1

Jeff

An insider who is morally wrong and angry about incentives.

Jeff, who designed a CCTV system in his company. He has been working for this company as a network engineer. But for some reason he didn't get any incentive from the company, and he thought it was unfair.

Motivation :
Having complaints about incentives.
He got an offer from someone who wants to break into the building to get some information and accepted to help him.

Goal :
Unauthorized person who needs information can break into the server room where it is stored.

Skills :
knowledge of intra network system, knowledge about CCTV recognition algorithm, network skills, network hacking

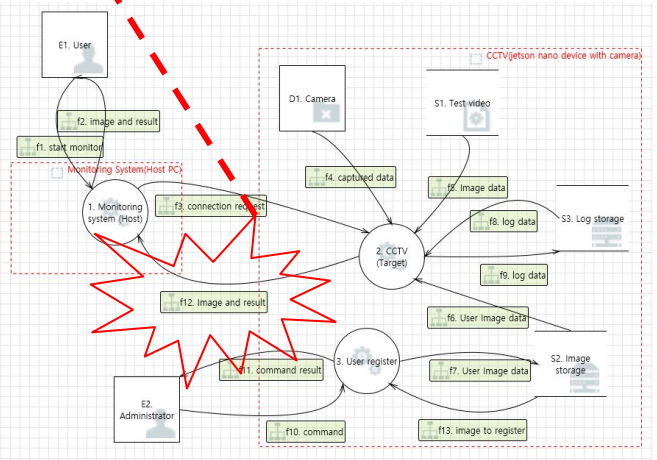
Misuse case 1

1. Jeff tries to log in CCTV with the default ID/password via ssh.
2. After login to the CCTV, Jeff adds a photo of the person who wants to infiltrate and register him as an authorized person.
3. Jeff wants him to be shown as an authorized person and let him pass through the CCTV and safely enter into the server room.

Design - Mitigation

Id	Title	Category	Priority	Description
10	Spoofing the 1. Monitoring system (Host) Process	Spoofing	High	1. Monitoring system (Host) may be spoofed by an attacker and this may lead to information disclosure by 2. CCTV (Target). Consider using a **standard authentication mechanism** to identify the destination process.

Methods	pros	cons
IP/MAC	Implementation is the simplest	Since an attack that modifies IP and MAC is possible, spoofing cannot be reliably prevented.
ID/Password	Implementation is simple.	To prevent the password from being exposed, the communication section must be encrypted, and a module for user credentials is required. If exposed to sniffing attacks, it can be neutralized.
Certificate	**the most effective authentication**	**There is a burden of creating, distributing, and managing certificates.**



Design - Risk Assessments

OWASP

- Identify threats we must mitigate through OWASP risk assessment
- Derive high risks from overall risk severity

Threats	Mitigated	High	Medium	Low
90	25	11	45	9

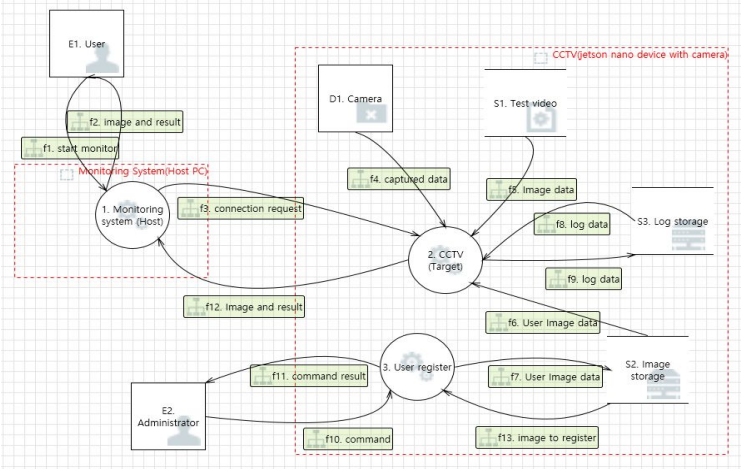
Overall Risk Severity				
Impact	HIGH	Medium	High	Critical
	MEDIUM	Low	Medium	High
	LOW	Note	Low	Medium
		LOW	MEDIUM	HIGH
	Likelihood			

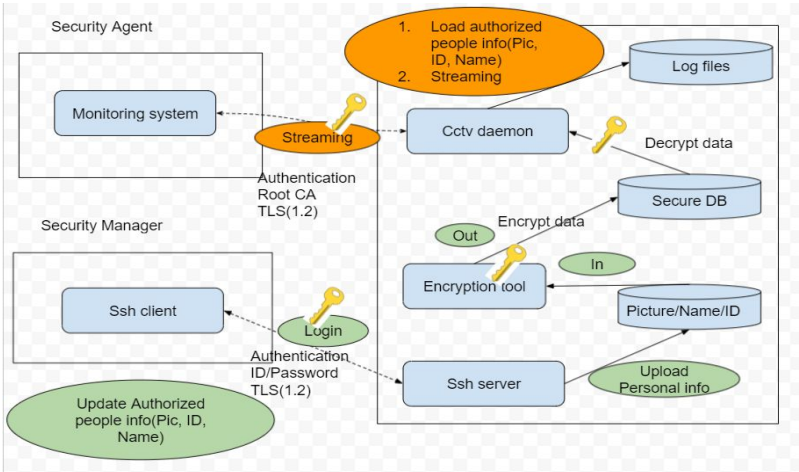
f12. Image and result	#11- Potential Lack of Input Validation for 1. Monitoring system (Host) [Tampering] #11. 1. Data flowing across f12. Image and result may be tampered with by an attacker. This may lead to a denial of service attack against 1. Monitoring system (Host) or an elevation of privilege attack against 1. Monitoring system (Host) or an information disclosure by 1. Monitoring system (Host). Failure to verify that input is as expected is a root cause of a very large number of exploitable issues. Consider all paths and the way they handle data. Verify that all input is verified for correctness using an approved list input validation approach.	Threat Agent	Skill level	3 - Network and programming skills	6.25	HIGH	Technical Impact	Loss of confidentiality	4 - Minimal critical data disclosed, extensive non-sensitive data disclosed	4.875	MEDIUM	High
			Motive	9 - High reward				Loss of integrity	7 - Extensive seriously corrupt data			
			Opportunity	4 - Special access or resources required				Loss of availability	7 - Extensive primary services interrupted			
			Group Size	4 - Intranet users				Loss of accountability	7 - Possibly traceable			
		Vulnerability	Ease of discovery	7 - Easy			Business Impact	Financial damage	3 - Minor effect on annual profit			
			Ease of exploit	5 - Easy				Reputation damage	7 -			
			Awareness	9 - Public knowledge				Non-compliance	3 -			
			Intrusion detection	9 - Not logged				Privacy violation	1 -			

Design - Mitigations - Overall

Risk mitigations

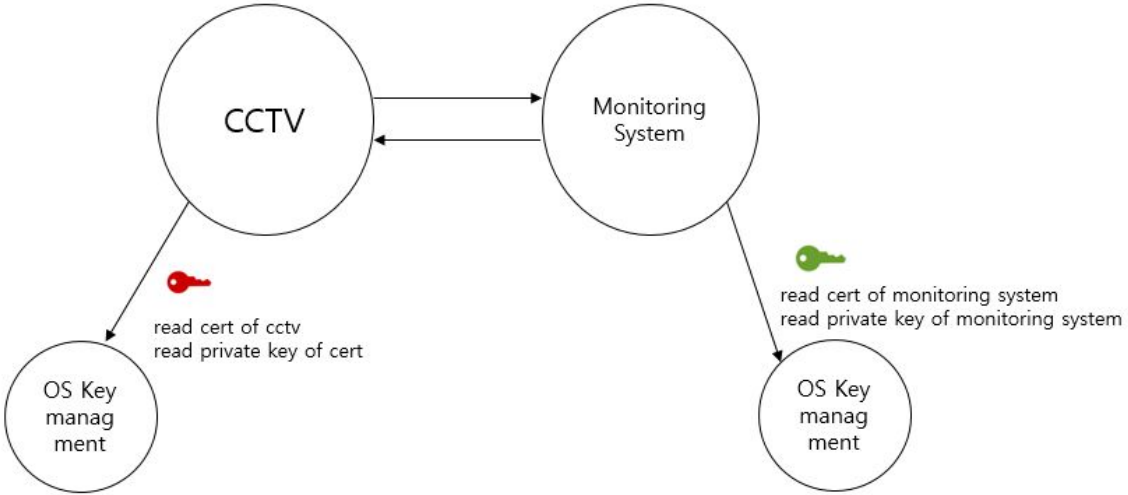
- We have identified high risks through risk assessment.
- There are four sections which require security development to mitigate those risks.
- Network/User Information/Key management/Logging

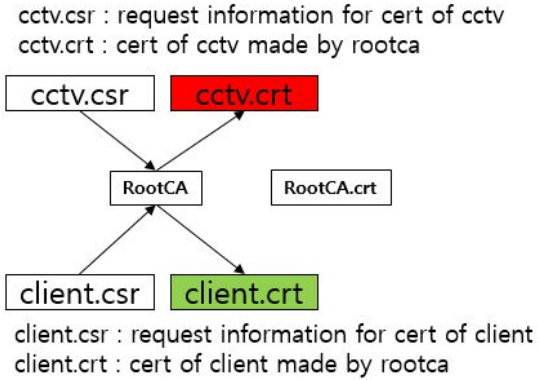




Design - Mitigations - Mutual Authentication

TLS connection using PKI

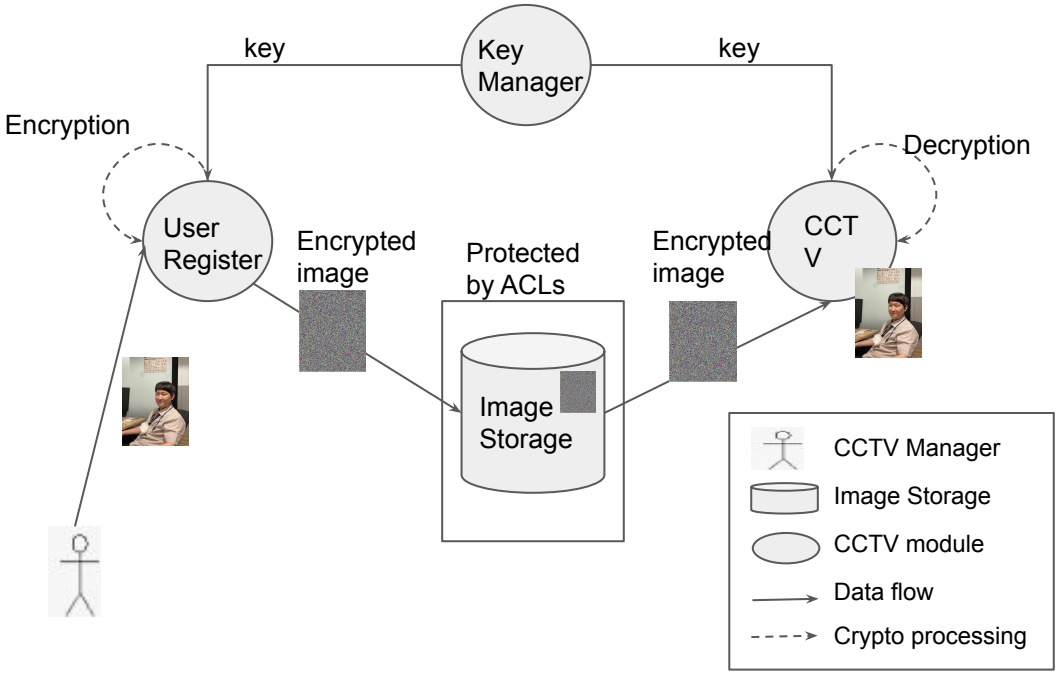




1.Verify monitoring system by cert of monitoring system with root CA cert.
2.Verify CCTV by cert of CCTV with root CA cert
3.If authentication is success, then network transport channel is encrypted by TLS1.2

Design - Mitigations - User Info protection

User image protection overview



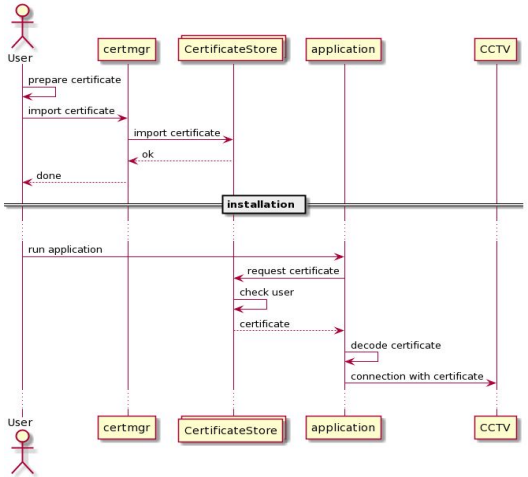
- User image file
  - User image file is encrypted using AES-128 CBC in User Register
  - Encrypted user image file is decrypted using AES-128 CBC in CCTV
  - AES-128 Key is provided by KeyManager
- User image filename
  - User image file name is encrypted using AES-128 CBC in User Register
  - Encrypted file name is Base64 encoded in User Register
  - Apply substitution to slash(/) characters in Base64 encoded file name
  - Encoded file name is Base64 decoded in CCTV
  - Encrypted filename is decrypted using AES-128 CBC in CCTV
  - AES-128 Key is provided by KeyManager

Design - Mitigations - Key Management

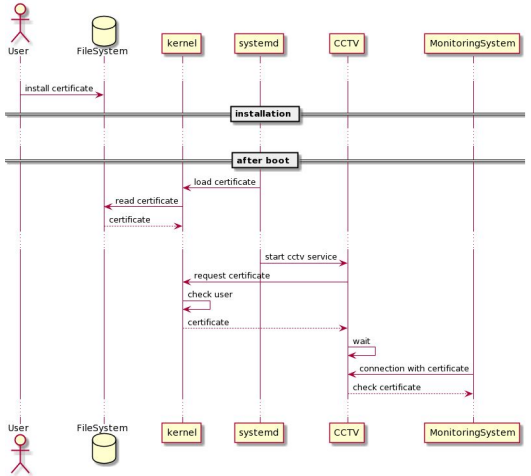
How to protect security keys?

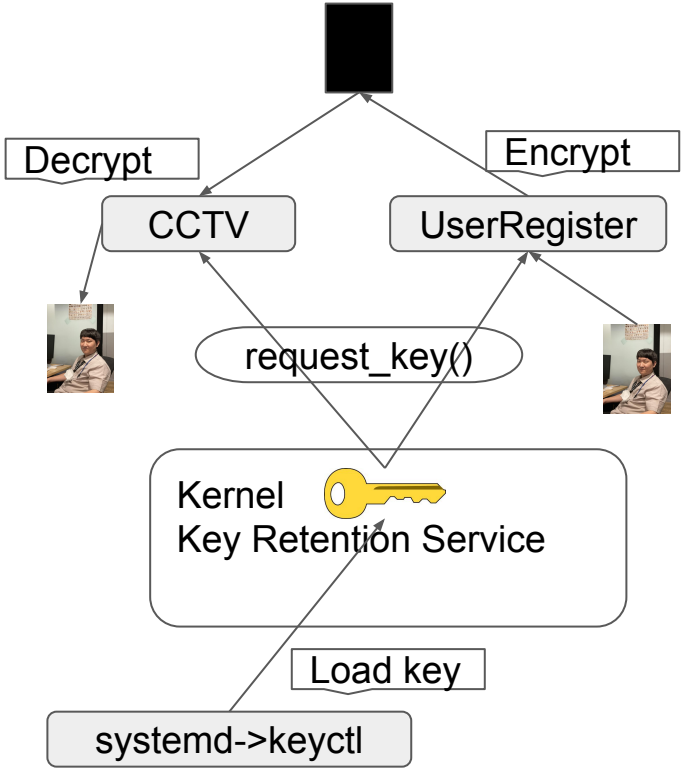
- Identify a method to use keys securely such as Trust zone.
- Figure out Plan B for key management if there is no support.

Monitoring System(Windows)

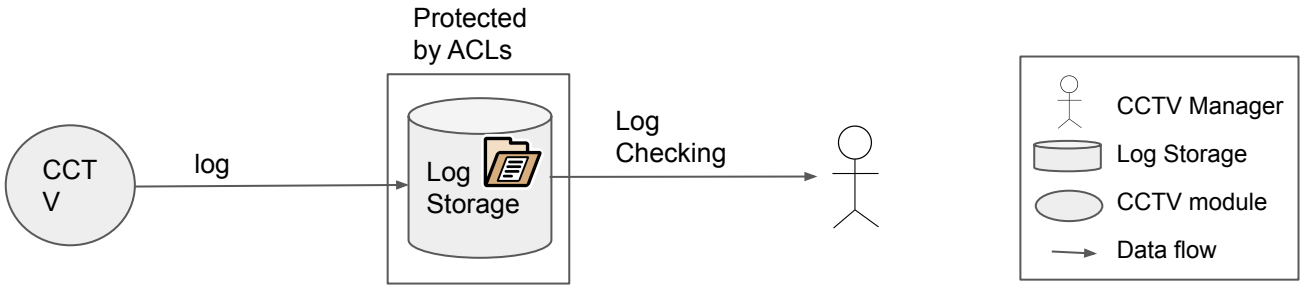


CCTV(Linux)





Design - Mitigations - Save Log Files



Mitigating repudiation

- Connections between the monitoring system and CCTV are logged.
- Failure of access attempt to the CCTV is logged. (certificate authentication failure)
- Server room entry/exit history (authorized/unauthorized persons)

Implementation

Secure Coding

- Static Analysis
  Analyzing the source code prior to the compilation provides a highly scalable method of security code review and helps ensure that secure coding policies are being followed.

Result of static analysis tools

Tools	Target	Total Detected	false positive	To mitigate	Remark
Sonarcloud	Monitoring system components	247	247	0	- 218 issues are detected as a code smell type, which is false positive and the rest are minor issues.
Code x-ray	all components	24	24	0	- The issues detected by Blocker(1 issue) and Major(4 issues) are about the files(out of scope) or have no effect on the code.
Flawfinder	CCTV and user register components	48	43	5	- 5 issues are fixed.(2 issues related to integer overflow, 3 related to statically-sized buffer)

*) We decided to fix the issues found in the static analysis if necessary for items greater than Major (FlawFinder Level 3).

Verification

Test Report

Test Cases	Pass	Fail
19	19	0

Test Case #1(Functional Requirement)
Purpose
- This TC verifies the real-time CCTV person detection function of the CCTV system.

Precondition
- The Monitoring System is installed.(also cert. key is installed)
- A Security agent is logged in.
- CCTV is running and streaming camera video.

Test Constraints
- Only one monitoring system can be connected to CCTV.

Deliverables

https://github.com/hijang/lsc_cctv

Lessons learned

- The more we know about the system, the better we can design and implement threat mitigations
- If I had realized earlier that my mentor was also a stakeholder who should share information, I would have been able to get more help.
- It was a small project, but I could learn a lot because it was my first security project.
- This project was my first security-related work and it was a very new experience.
- I have learned that considering the security point of view of software quality is very important.
- Mutually agreed process is important. Otherwise, collaboration becomes more difficult.