AACS Architectural Design

About This Document

Document Information

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Revision History

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Purpose

This document specifies the software architecture design for AACS to support Software Requirement. This design document also serves as a guideline on how each software components in the system should be implemented and how the components should interact with each other.

Scope

- Architectural Drivers
- SW Architectural Representations
- Architectural Alternatives
- Quality Attribute Scenarios

Related Documents

Documents related to this document include :

- AACS_Requirements
- AACS_ThreatAnalysis_RiskAssessment_Result
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Acronyms / Glossary

Acronym	Description
AACS	AI Attendance Check System
FRS	Face Recognition System
ACS	Attendance Check System

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1. Architectural Drivers

1.1. SW Main Features

Table 1 Software Main Features 1

Level 1	Level 2	Level 3	Descriptions
AACS	FRS	Communication	-Communication on the system is between FRS and ACS. -Provides a function for secure communication between FRS and ACS. -A protocol is defined for communication between two systems, and communication is performed accordingly.
		Face Recognition	-Provides a face recognition function to check the attendance of students in the class. -Face recognition provides the process of registering new students and the ability to recognize registered students through images.
		User Auth	-Provides authentication function for users. -The user information transmitted from ACS is compared with the authorized user information in the system for authentication.
	ACS	Communication	-Communication on the system is between FRS and ACS. -Provides a function for secure communication between FRS and ACS. -A protocol is defined for communication between two systems, and communication is performed accordingly.
		User Auth	-Provides authentication function for users. -The information received from the user through the UI is transmitted to the FRS system to check whether the user is a valid user.
		UI	-Provides a UI for system users. -When a student accesses the system, it provides a function to register his or her face. -When the administrator accesses the system, he or she can view the attendance status of the students. You can check the current attendance status and past attendance status through saved videos.

1.2. Quality Attributes

Quality attribute refers to the characteristic attributes of a product. Satisfying quality attributes can satisfy customers' requirements for quality.

Quality attributes were derived through customer requirements.

In addition, some Quality attributes were derived through threat analysis.

1. ID: Quality Attribute ID with AACS-QA-xxx
2. Properties : Types of quality attributes
3. Contents : Detailed description of quality attribute
4. Importance : Scoring importance to the system on a scale of 1 to 5.
5. Difficulty : The difficulty in implementing the Quality Attribute is scored on a scale of 1 to 5.
6. Priority : Importance x Difficulty = Priority given by Quality Attribute. Accordingly, the quality attribute that this system should have is determined.

ID	Properties	Contents	Importance	Difficulty	Priority
AACS-QA-001	Performance	The system must deliver video as close to real time as possible, especially in real-time mode.	2.5	4	10
AACS-QA-002	Authentication	The system must use two factor authentication for sign on and user credentials must be protected. Lost or compromised credentials must be handled in a reasonable way.	4	3	12
AACS-QA-003	Communication privacy	When in the desired mode the system must ensure that data sent to a user remains private while in transit. No intermediary should be able to snoop or spy on an ongoing video feed.	5	4	**20**
AACS-QA-004	Proof of identity (nonrepudiation)	Users should be confident that the camera they are using is the one that they believe it is.	2	4	8
AACS-QA-005	Multi-user privacy:	The system must ensure that multiple video feeds remain private between the intended users.	4	3	12
AACS-QA-006	reliability	The system must ensure that video is reliably delivered. The system should recover from networking errors as soon as possible. The goal is to maintain a secure, performant connection at all	2.5	4.5	11.25

		costs.			
AACS-QA-007	Testing	Ensure the developed software is adequately tested.	3	3.5	10.5
AACS-QA-008	Availability	Conduct proper fault/error detection, recovery and reporting.	4	4	16
AACS-QA-009	Security	Ensure the developed software adheres to the company coding standard and quality standards.	4	4	16
AACS-QA-010	Security	Key management for system must be secure.	4	4.5	18

As above, the main Quality Attribute that the system should have is internally determined for items 3 and 10 according to the priority according to Importance and Difficulty. We will think about the design direction to achieve this.

1.3. Constraints

Describe the restrictions on this system.

List the business and technical limitations of this system.

This constraint will serve as a driver for architectural design.

ID	constraints	Summary	Contents
AACS-Const-001	Business constraints	Development schedule	Phase 1 period is 3 weeks
AACS-Const-002		Budget issue	No additional budget for development environment
AACS-Const-003		Development Language	C/C++

Technical constraints

AACS-Const-004		Development Board (Jatson Nano)	GPU: 128-core NVIDIA Maxwell™ architecture-based GPU CPU: Quad-core ARM® A57 Video: 4K @ 30 fps (H.264/H.265) / 4K @ 60 fps (H.264/H.265) encode and decode Camera: MIPI CSI-2 DPHY lanes, 12x (Module) and 1x (Developer Kit) Memory: 4 GB 64-bit LPDDR4; 25.6 gigabytes/second Connectivity: Gigabit Ethernet OS Support: Linux for Tegra® Module Size: 70mm x 45mm Developer Kit Size: 100mm x 80mm
AACS-Const-005		PC Development Tool	MS Visual Studio
AACS-Const-006		Router	TP-Link ac1750
AACS-Const-007		no physical modifications	no physical modifications to Jetson Nano.
AACS-Const-008		selected router	use of the supplied and configured router.

2. SW Architectural Representations

2.1. Initial Dynamic View

FRS consists of a component for performing a function for recognizing faces to enroll students.
ACS is composed of components to provide a function for attendance to students and administrators by providing UI.
A component is defined between the ACS and FRS system, and data flowing through the component is defined.

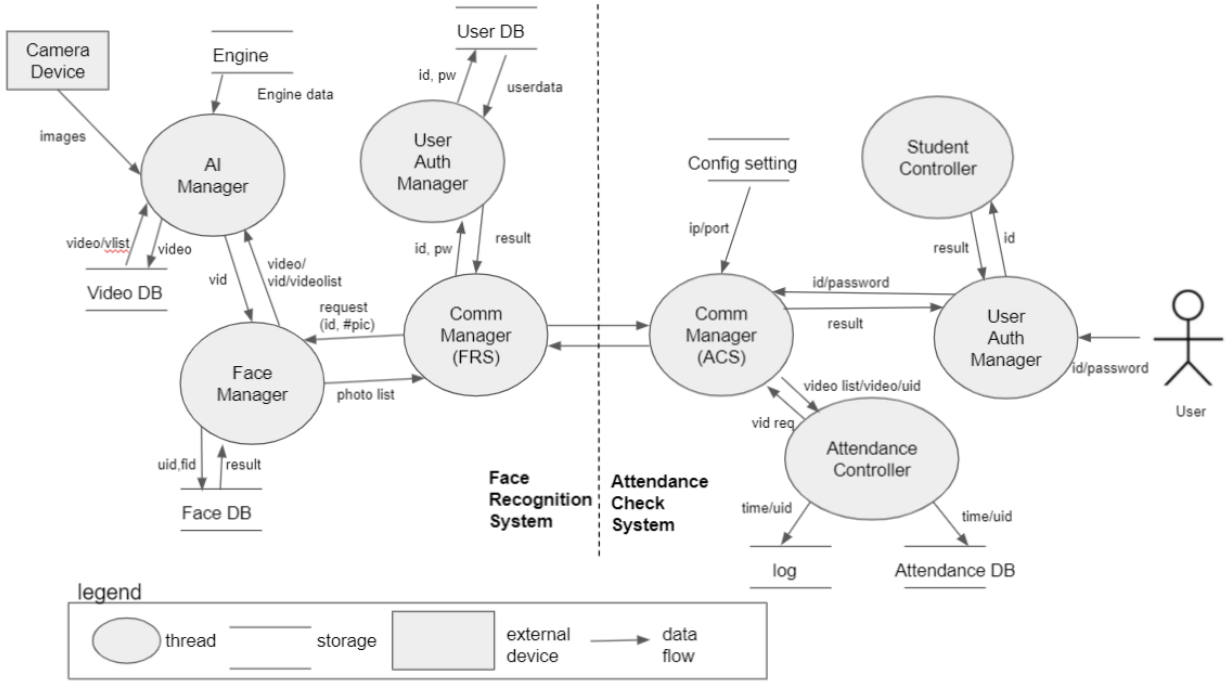


Figure 1 Dynamic View

2.1.1. SW Component Descriptions

Below table describes the software components which are specified in the chapter 2.1.

Table 6 SW Component Descriptions

System	Component	R&R	Description

FRS	AI Manager	This component provides the ability to recognize a person's face when attending.	This component provides the ability to verify faces through the AI engine.
	Face Manager	This component manages face photos registered as students.	This component manages student faces through face DB.
	Comm Manager	This component provides functions for communication between FRS and ACS.	Communication function provides secure mode in addition to real-time mode.
	User Auth Manager	This component provides functions for user authentication.	For user authentication, it is checked whether the user is a previously registered user through the user DB.
ACS	Attendance Controller	This component provides a function to show the students in attendance through the UI.	This component provides a function to check student attendance, tardiness, and absence based on school attendance time.
	Student Controller	This component provides a UI function for registering a student's face.	This component provides the ability to add and delete student photos.
	Comm Manager	This component provides functions for communication between FRS and ACS.	Communication function provides secure mode in addition to real-time mode.
	User Auth Manager	This component provides functions for user authentication.	Provides a function to receive user information from the UI for user authentication.

3. Refined Architecture

3.1. Dynamic view with security applied after threat analysis

The design below is an architecture that reflects the security requirements derived through risk assessment based on the contents analyzed through threat analysis.

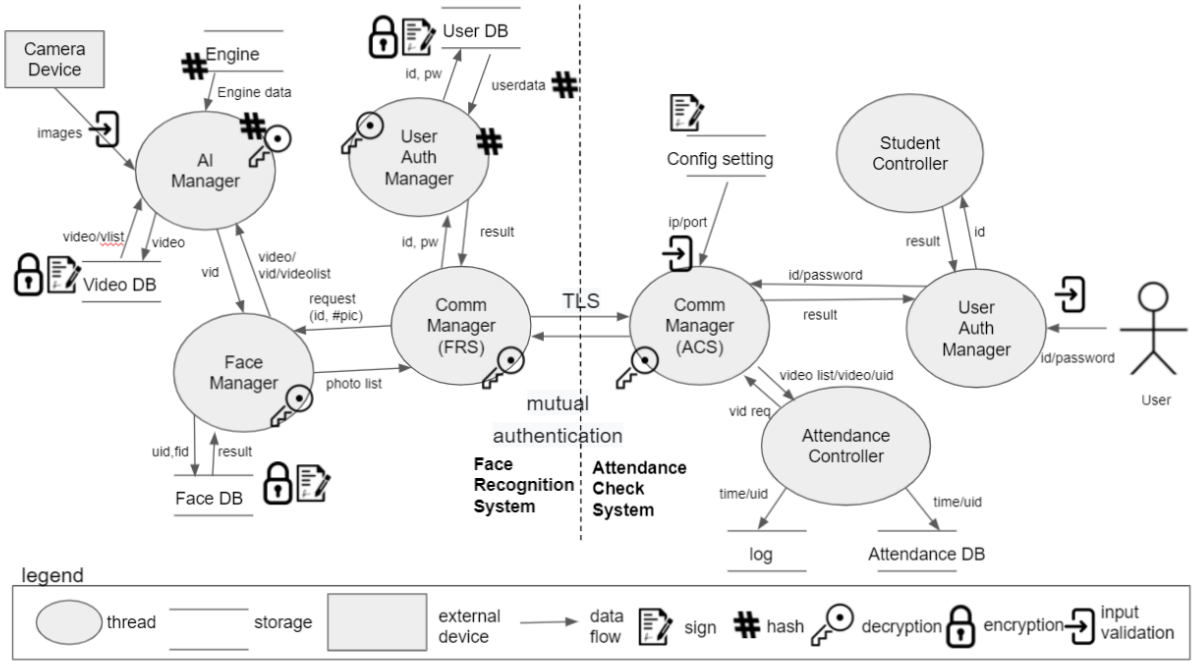


Figure 2 Dynamic View

The above architecture reflects the security requirement and the following functions are added.
1. Encryption and sign are applied to the DB managed by the system to correspond to confidentiality and integrity.
2. Input validation was applied to prevent errors in the values input through the system.
3. The TLS method is applied to secure communication between systems.
4. Hash is applied for security such as password in the system.

3.2. Static View

Through the AACS static view, it could show the modules for each layer of the system.
A security layer has been added to satisfy the security requirement as shown below.

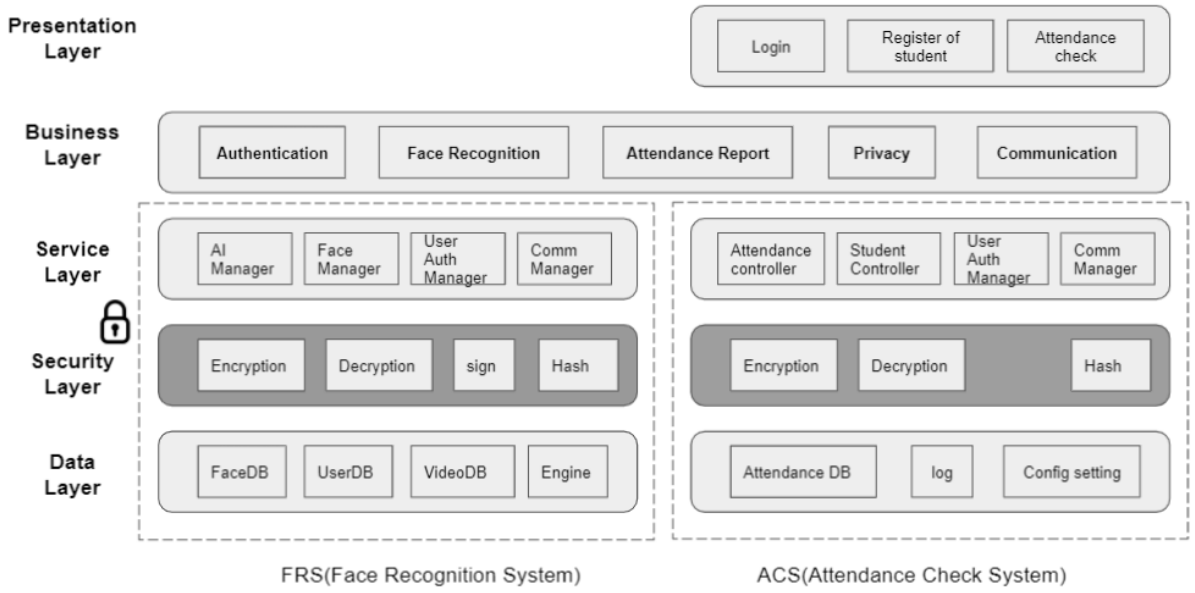


Figure 4 Static View

3.3. Architectural Alternatives

AACS believed that if data was leaked or compromised, it could cause big confusion and damage to CMU
How can we keep our data safe?
We thought that the most efficient way would be to manage the encryption key more securely.
We had to think about key management.

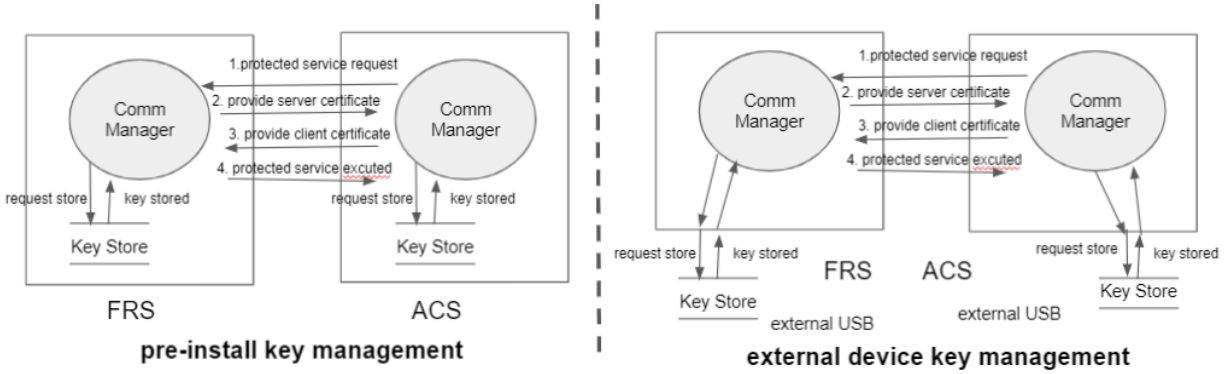


Figure 5 Architectural Alternatives

	Pre-installed key management	External Device key mangement
Pros	Easy to distribution Easy to key management	Update usb to update key Securely distribution Secure key storage
Cons	Update the whole program to update the key The key is easy to be exposed to risk	Physical usb key management Difficult to distribution

Architectural Decision :

Selected as an **external device key management** for key lifecycle management and secure key management

3.4. Physical View

The architecture reflecting the architectural decision is expressed below.
The additional physical device is expressed through the physical view as shown below.

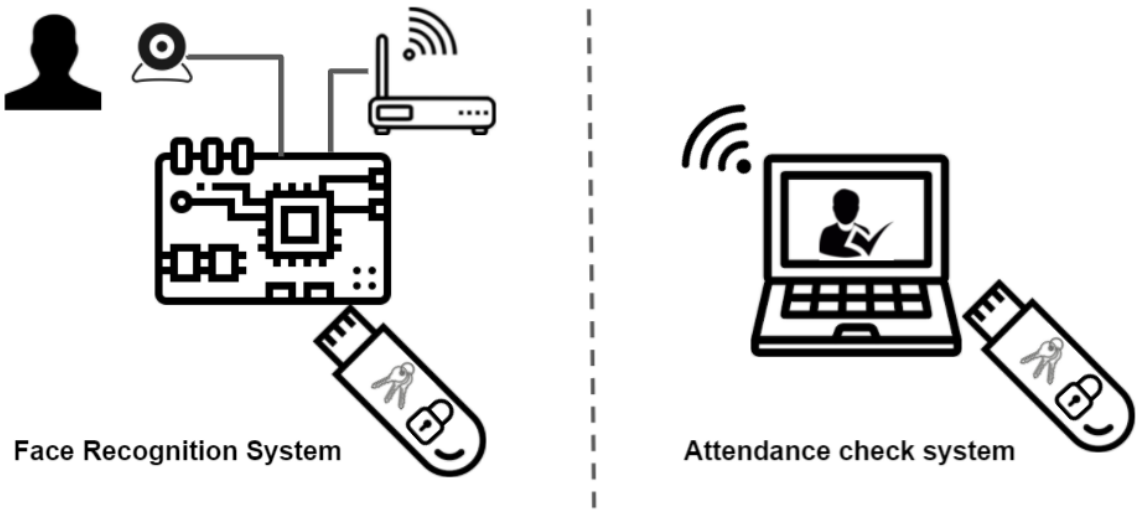
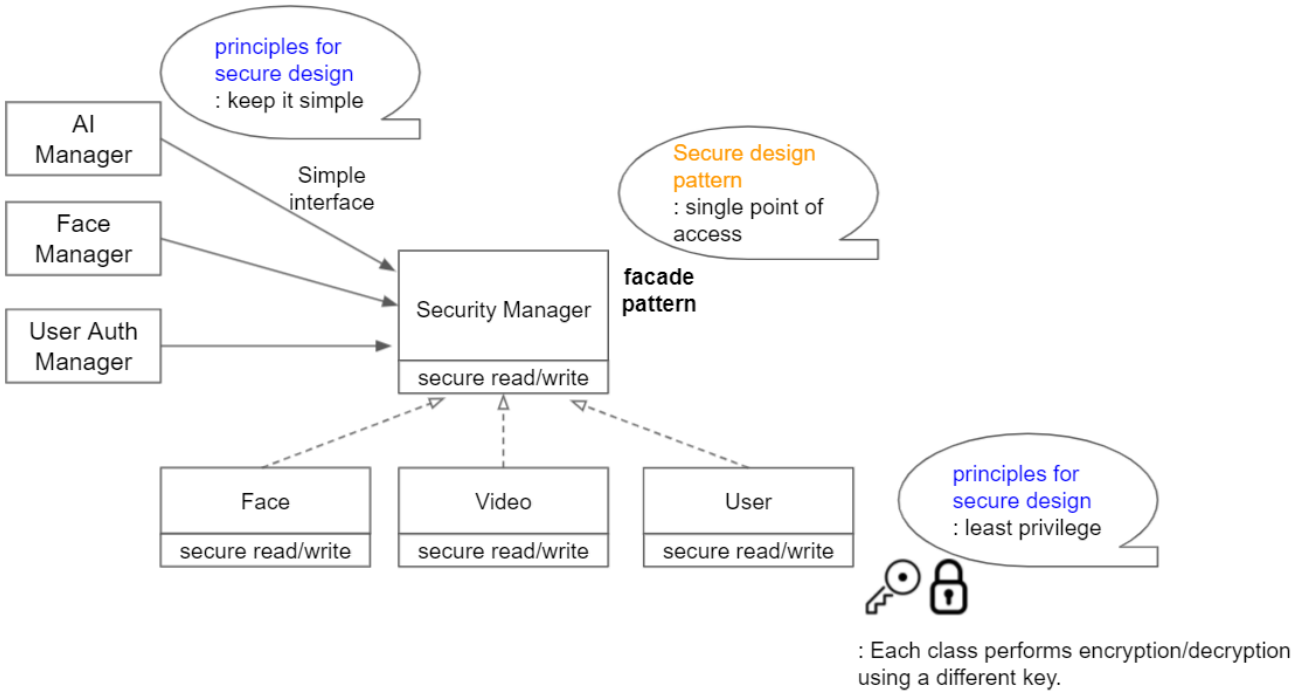
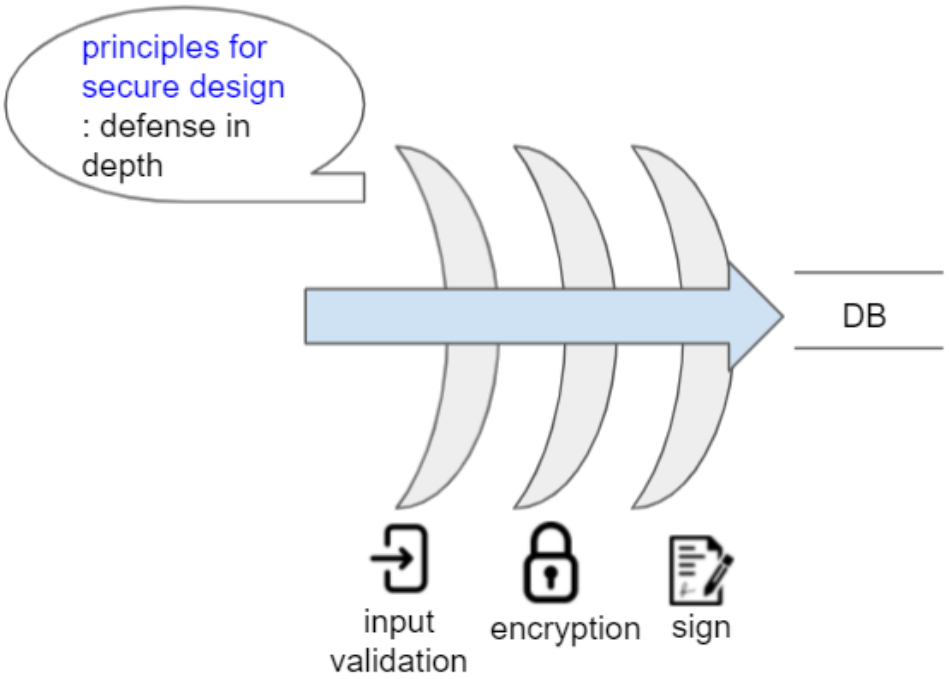


Figure 6 physical view

3.5. Secure Design Pattern





-The End-