VIRNECT

QA Automation & Code Quality Management

QAOps Implementation

VIRNECT QA Team

Sungtae Kim

I. Project Overview

Purpose

- Establish a test automation pipeline and standardize code quality measurement to systematically ensure project quality.
- Enhance collaboration efficiency between development and QA teams by integrating Agile and CI/CD processes.
- Centralize multi-stack environments (Frontend, Backend, Unity C#) into a single SonarQube dashboard for unified quality visualization.
- Strengthen release stability by implementing a continuous regression testing framework and fostering a team-wide quality culture.

Goals

1. Build a Static Analysis Environment for Automated Test Code
   - Integrate SonarQube with the Jenkins pipeline to identify code smells, bugs, and security vulnerabilities early.
2. Secure and Visualize Test Coverage
   - Use tools such as Jest, JaCoCo, and Istanbul to measure Statement, Branch, and Line coverage with automated reports.
3. Enforce CI/CD Quality Gates
   - Apply merge-blocking policies on pull requests when quality gate conditions are not met to mitigate risks in advance.
4. Strengthen Development–QA Collaboration
   - Share test and quality reports in real time through Jenkins, Slack, and GitHub to facilitate Agile team collaboration.
5. Reduce Code Duplication and Promote Modular Refactoring
   - Lower duplication rates and implement common modules to reduce maintenance costs and improve development productivity.
6. Implement Unified Quality Management Across Multi-Stack Projects
   - Standardize overall project quality metrics by managing Java, TypeScript, and C# codebases on a single platform.

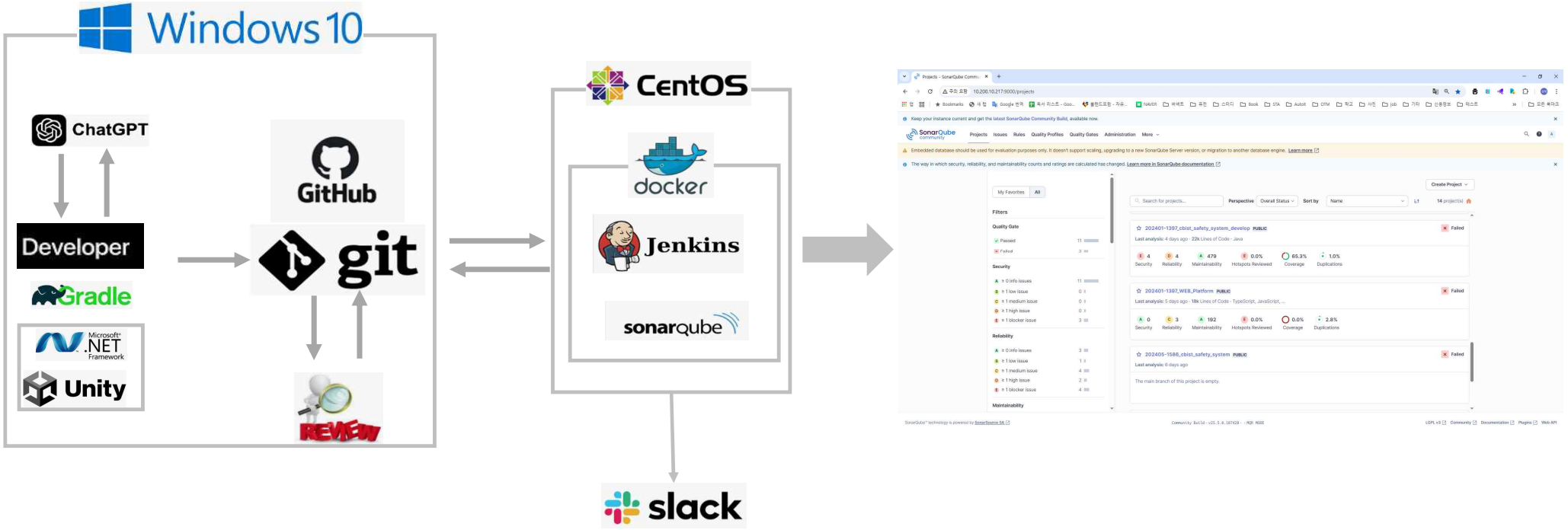
I. Project Overview

Schedule

No.	Schedule	Category	Key Tasks	Responsible Person		Remarks
1	Monday, April 14, 2025	Configuration & Integration	• Configure advanced quality gates and rules per tech stack (Java, TS, C#). • Implement branch coverage thresholds in CI. • Automate Slack and GitHub PR notifications for quality gate results.	VIRNECT Co., Ltd. | QA Team	Kim Sung-tae, Senior Engineer	
2	Tuesday, May 13, 2025	Test Coverage Expansion	• Expand unit test coverage with Jest, JUnit, and Istanbul. • Identify and address coverage blind spots. • Create coverage heatmap dashboards in SonarQube.	VIRNECT Co., Ltd. | QA Team	Kim Sung-tae, Senior Engineer	Target coverage ≥80% (backend)
3	Monday, June 16, 2025	Automation & Optimization	• Optimize Jenkins pipeline parallelization for faster builds. • Integrate caching mechanisms for test runs. • Refactor repetitive modules to reduce duplication.	VIRNECT Co., Ltd. | QA Team	Kim Sung-tae, Senior Engineer	
4	Monday, July 14, 2025	Security & Vulnerability	• Enable SonarQube security hotspot analysis. • Conduct vulnerability scanning and remediation. • Establish monthly security quality gate reviews.	VIRNECT Co., Ltd. | QA Team	Kim Sung-tae, Senior Engineer	
5	Monday, August 11, 2025	Stabilization & Reporting	• Finalize dashboards for CI/CD & QA metrics. • Automate quarterly test coverage & quality trend reports. • Conduct knowledge-sharing sessions across teams.	VIRNECT Co., Ltd. | QA Team	Kim Sung-tae, Senior Engineer	Quarterly summary planned

I. Project Overview

Building an Integrated Quality Management Pipeline (Java + TS + C#)



I. Project Overview

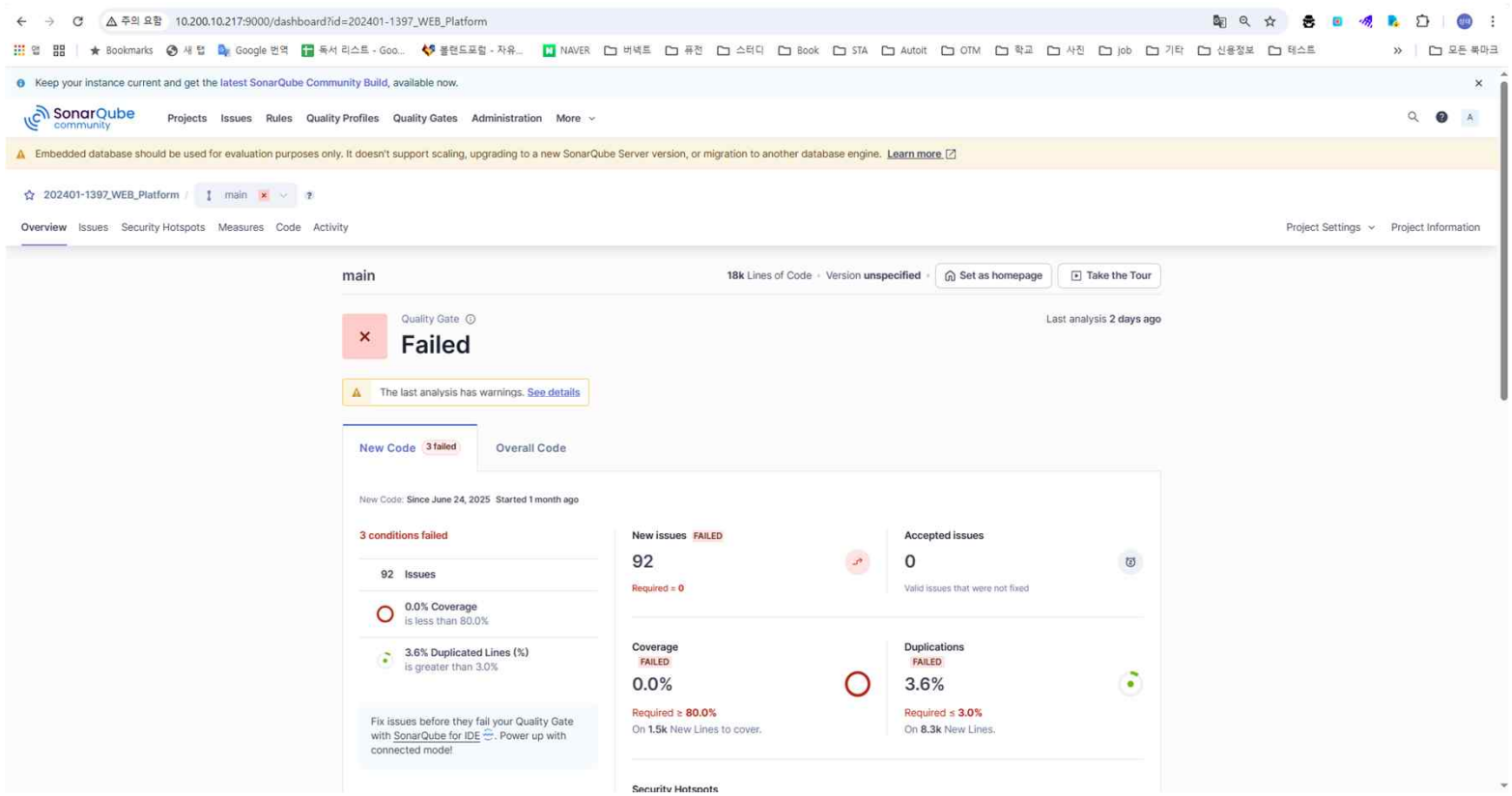
1. SonarQube Static Analysis Status – Frontend (TypeScript)

- **Language / Environment**
  - TypeScript (Web Frontend)

- **Analysis Metrics**
  - Coverage: 0.0% (Needs collection/integration)
  - New issues: 92
  - Duplication: 3.6% (Exceeds threshold of ≤3.0%)
  - Quality Gate: X Failed (3 conditions failed)
  - Last analysis: 2 days ago

- **Key Points**
  - Current coverage not collected → Plan to integrate with Jest lcov.
  - Code duplication and new issues are the main reasons for Quality Gate failure.

- **Role**
  - Build SonarQube environment & integrate with CI pipeline.
  - Configure language-specific rules and Quality Gate settings.
  - Visualize and manage coverage, issues, and code duplication.



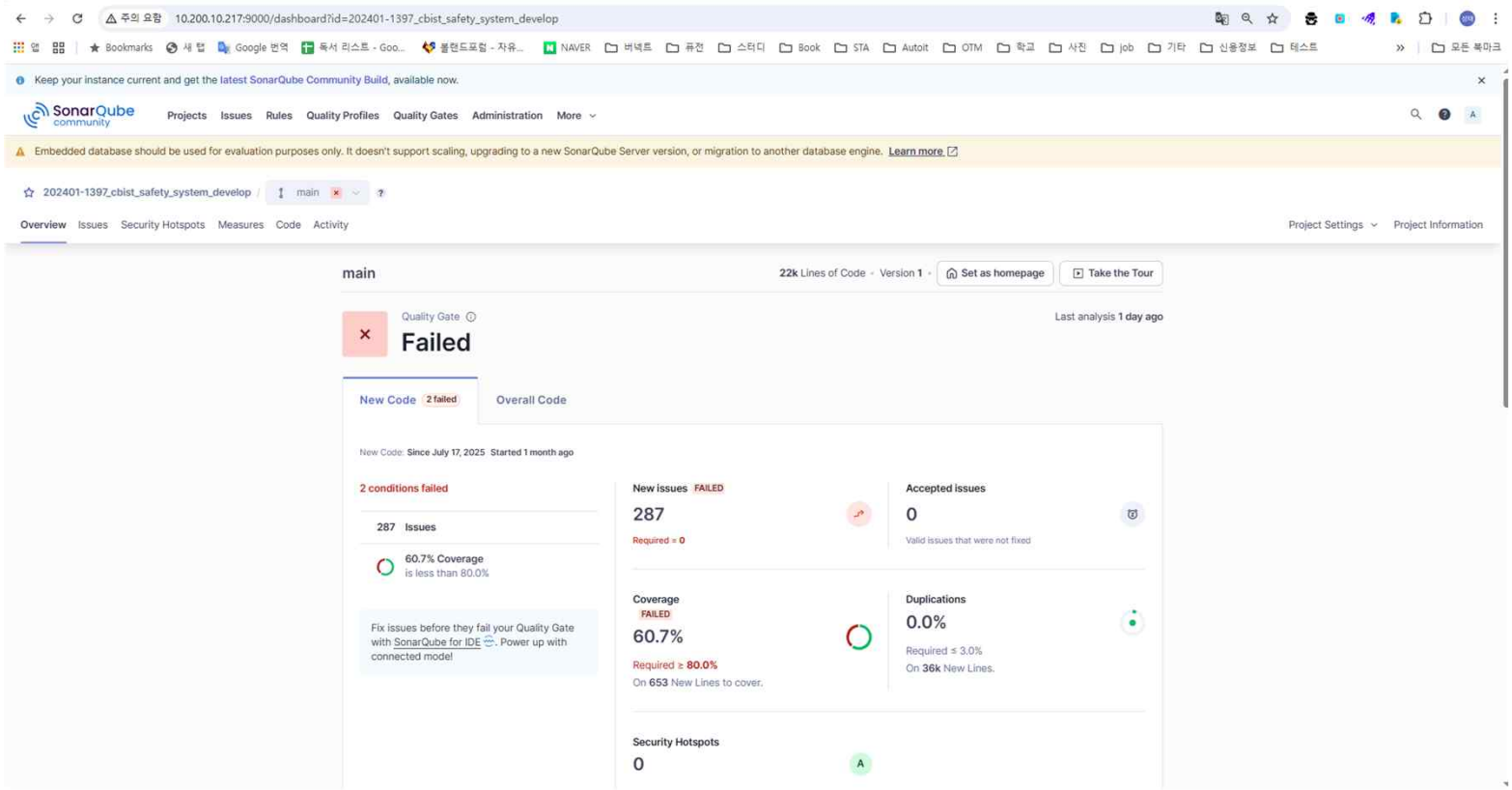
2. SonarQube Static Analysis Status – Backend (Java)

- Java (Spring Boot)
- Gradle + JUnit + JaCoCo

- Coverage: 60.7% (Target ≥ 80%)
- New issues: 287
- Duplication: 0.0%
- Quality Gate: ✗ Failed (2 conditions failed)
- Last analysis: 1 day ago

- Coverage collection enabled through JaCoCo integration.
- Coverage has been collected but does not meet the target.
- A large number of new issues are the main reason for Quality Gate failure.

- Build SonarQube environment & integrate with CI pipeline.
- Configure quality rules and Quality Gate settings per language.
- Visualize and manage coverage, issues, and code duplication.



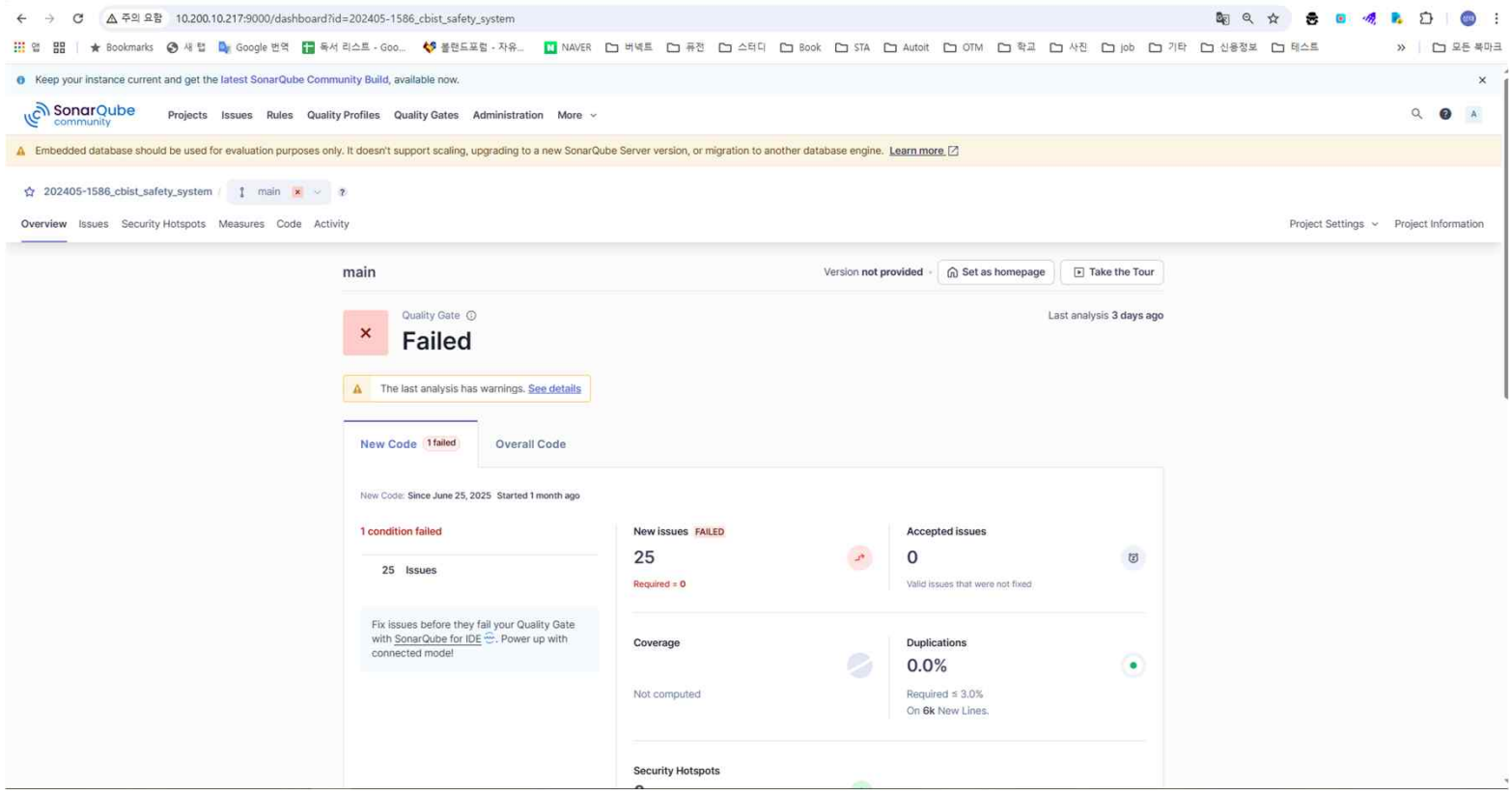
3. SonarQube Static Analysis Status – Unity (C#)

- C# (Unity WebGL)

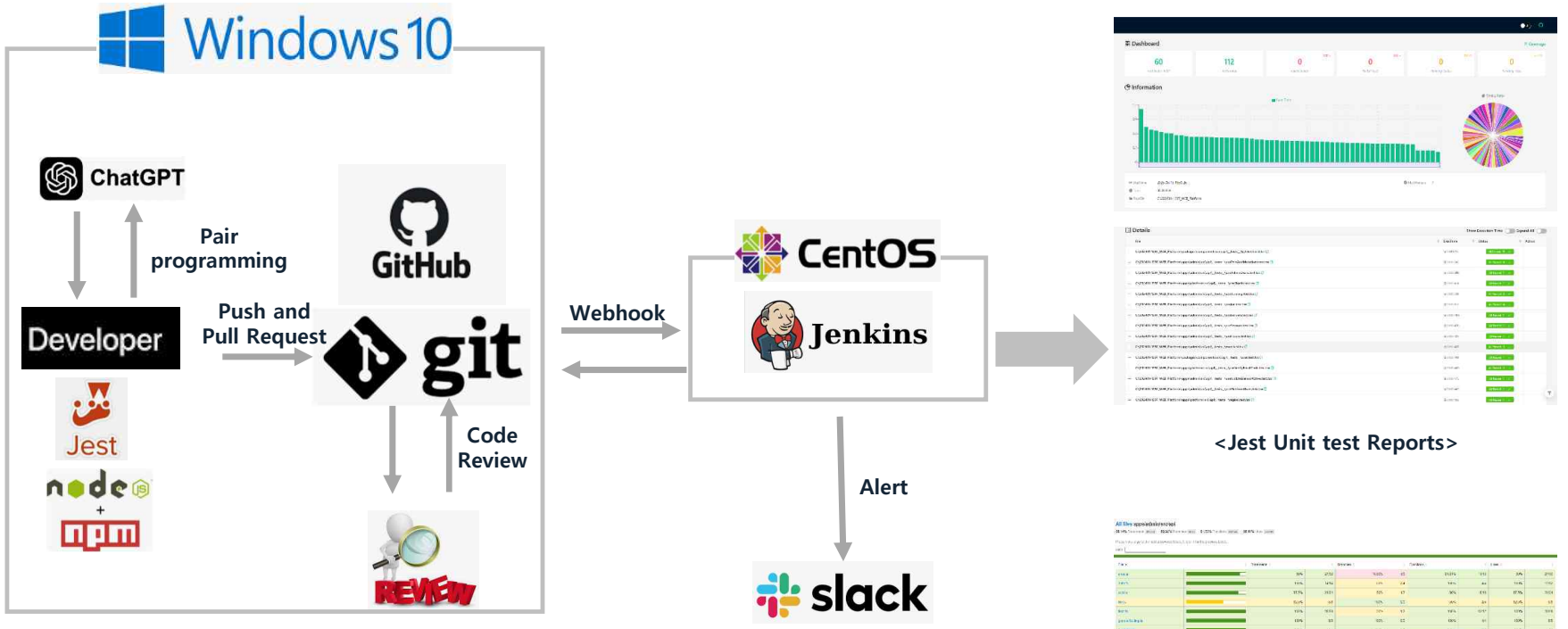
- Coverage: Not computed (Unable to collect)
- New issues: 25
- Duplication: 0.0%
- Quality Gate: X Failed (1 condition failed)
- Last analysis: 3 days ago

- Unity project also managed under SonarQube.
- Environment makes coverage collection difficult (Test framework not integrated).
- 25 new issues caused Quality Gate failure.

- Build SonarQube environment & integrate with CI pipeline.
- Configure quality rules and Quality Gate settings per language.
- Visualize and manage coverage, issues, and code duplication.



4. Unit Test Automation Pipeline – Frontend (TypeScript)



<GitHub → Jenkins → Jest → Slack>

<Jest Unit test Reports>

<Jest Unit test Coverage>

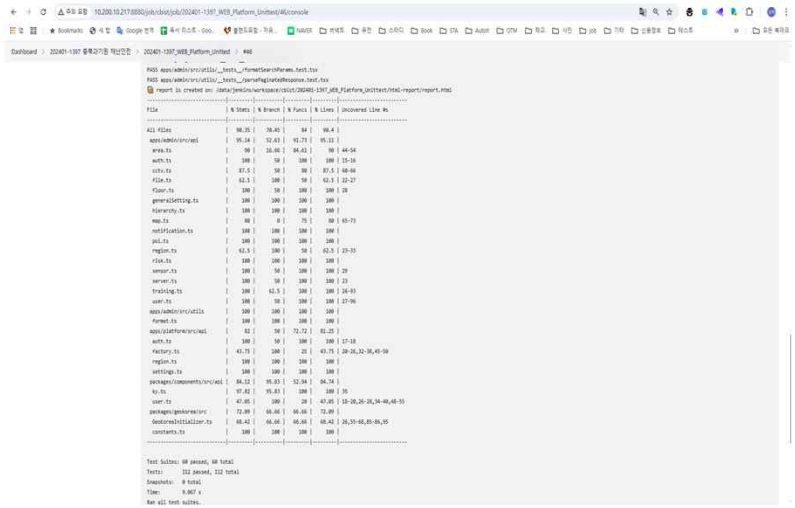
5. Frontend (TypeScript) – Test Execution Results & Coverage

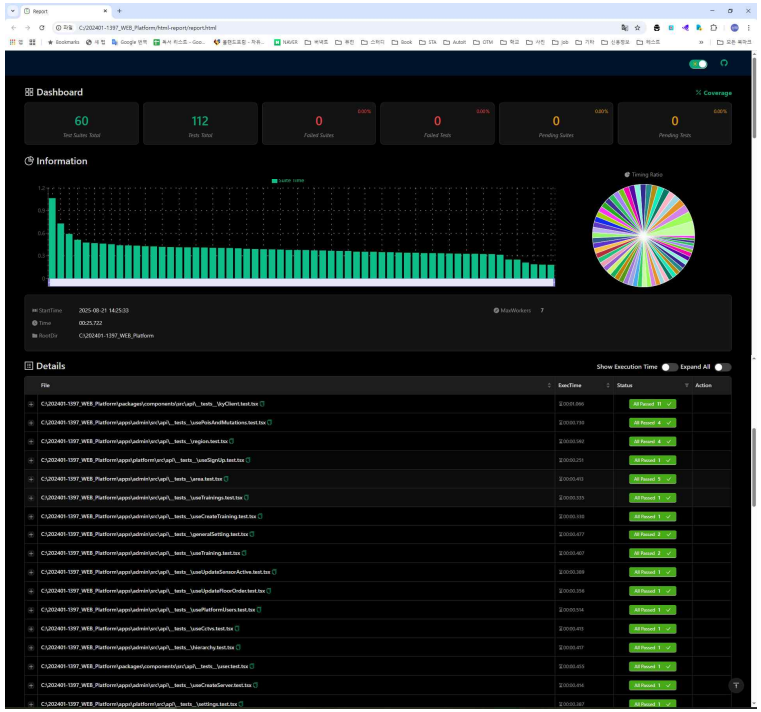
- Node.js / pnpm-based Frontend Monorepo environment
- CI Environment: Automated tests executed via Jenkins

- TypeScript-based module-level unit testing
- React Query / Hooks / API unit-level validation

- Jest (Test framework)
- Jenkins (Test automation and execution history management)
- HTML Report (Visualization of execution time and duration by module)

- Test Suites: 60 / Tests: 112 → 100% passed (All tests passed)
- Visualized execution time and per-module duration of tests
- Automatically reflected results in Jenkins pipeline → Strengthened regression test reliability





<Jenkins Log · Jest HTML Report · Coverage>

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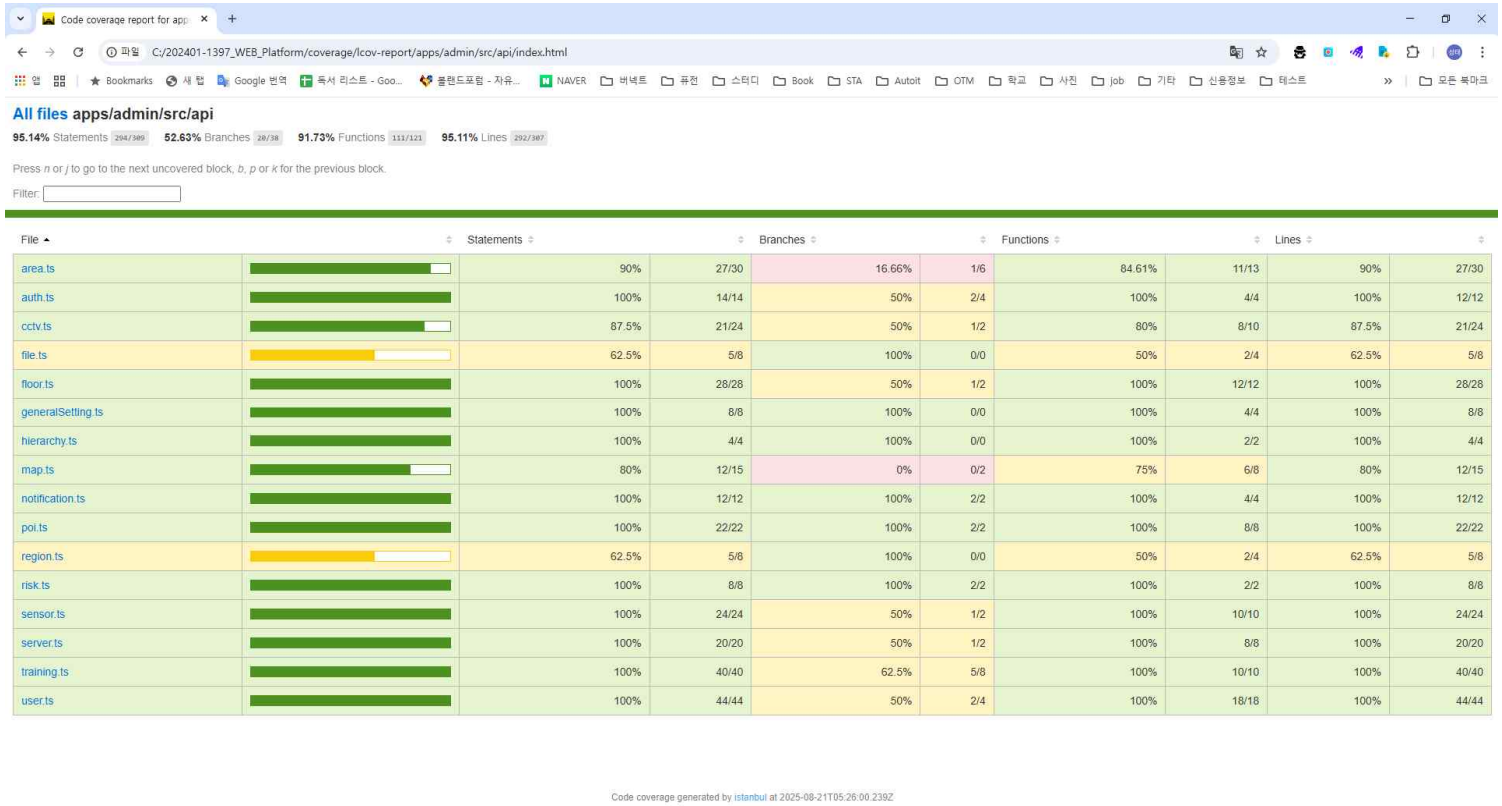
6. Run the Docker Compose file

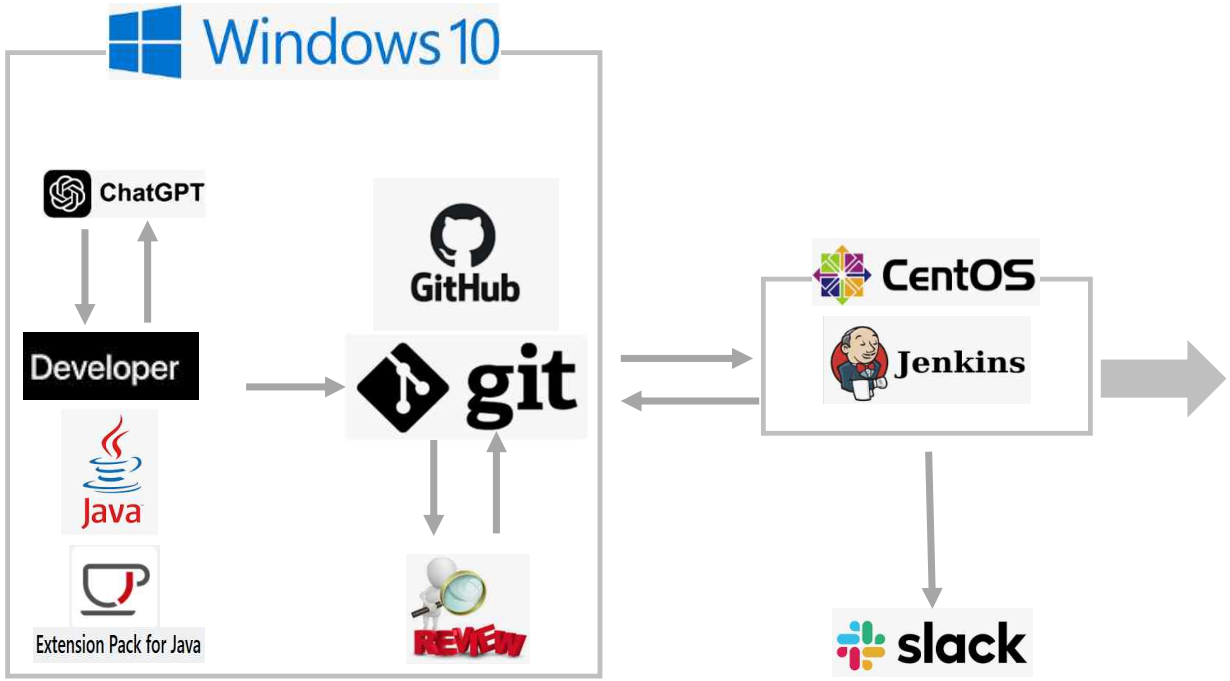
- ➢ Unit tests applied per business domain based on TypeScript/React.
- ➢ Measure Statement, Branch, Function, and Line Coverage per feature.
- ➢ Jest + Istanbul (Coverage collection)
- ➢ HTML Coverage Report (Visualize coverage by file)
- ➢ Achieved 96%+ average Statement coverage overall.
- ➢ Achieved 100% Line coverage for most critical business files.
- ➢ Identified low Branch coverage (conditional logic) areas.
- ➢ Able to visually track per-feature coverage differences for risk management.
- **Role**
- ➢ Standardized frontend test code writing practices.
- ➢ Built Jenkins Job & Slack notification automation pipeline.

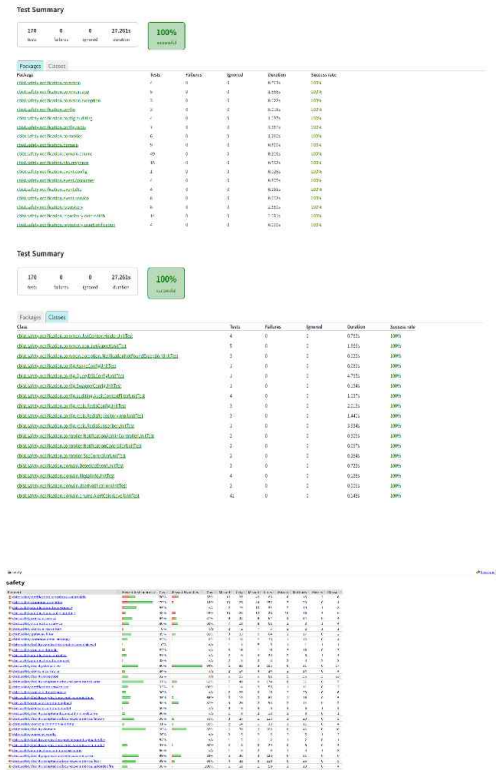


File	Statements		Branches		Functions		Lines	
area.ts	90%	27/30	16.66%	1/6	84.61%	11/13	90%	27/30
auth.ts	100%	14/14	50%	2/4	100%	4/4	100%	12/12
cctv.ts	87.5%	21/24	50%	1/2	80%	8/10	87.5%	21/24
file.ts	62.5%	5/8	100%	0/0	50%	2/4	62.5%	5/8
floor.ts	100%	28/28	50%	1/2	100%	12/12	100%	28/28
generalSetting.ts	100%	8/8	100%	0/0	100%	4/4	100%	8/8
hierarchy.ts	100%	4/4	100%	0/0	100%	2/2	100%	4/4
map.ts	80%	12/15	0%	0/2	75%	6/8	80%	12/15
notification.ts	100%	12/12	100%	2/2	100%	4/4	100%	12/12
poi.ts	100%	22/22	100%	2/2	100%	8/8	100%	22/22
region.ts	62.5%	5/8	100%	0/0	50%	2/4	62.5%	5/8
risk.ts	100%	8/8	100%	2/2	100%	2/2	100%	8/8
sensor.ts	100%	24/24	50%	1/2	100%	10/10	100%	24/24
server.ts	100%	20/20	50%	1/2	100%	8/8	100%	20/20
training.ts	100%	40/40	62.5%	5/8	100%	10/10	100%	40/40
user.ts	100%	44/44	50%	2/4	100%	18/18	100%	44/44

<Jenkins 로그 · Jest HTML Report · Coverage>

7. Unit Test Automation Pipeline – Backend (Java)





GitHub → Jenkins → JUnit → Slack

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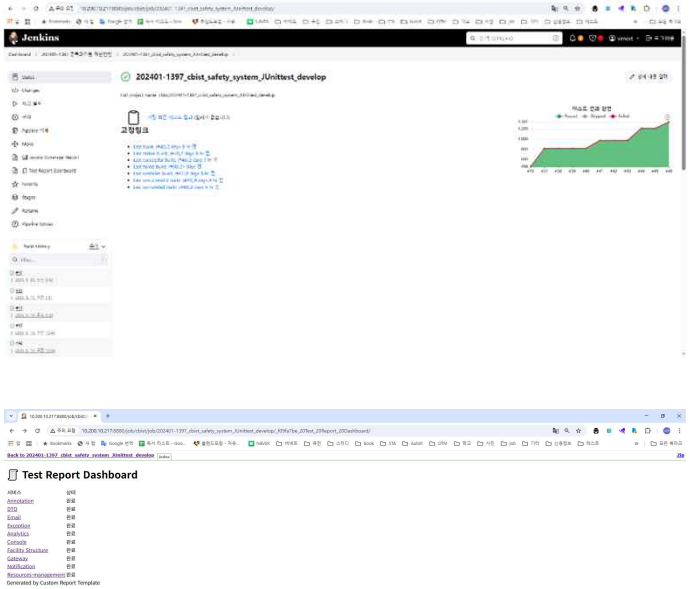
8. Backend (Java) – Test Execution Results & Coverage

- Spring Boot-based modular architecture
- Automated test execution in a Jenkins-based CI environment

- Java + JUnit-based unit testing
- Verification at Domain / Application / Adapter layer levels

- JUnit Report Dashboard
- Jenkins Test Trend (Graph & History)
- Gradle-based automated report generation

- Recent builds: 1,341 tests executed, 100% success rate
- Established a module-level test execution status dashboard
- Built a foundation for regression test automation and continuous expansion



‹Jenkins Trend · JUnit Report · JaCoCo Coverage›

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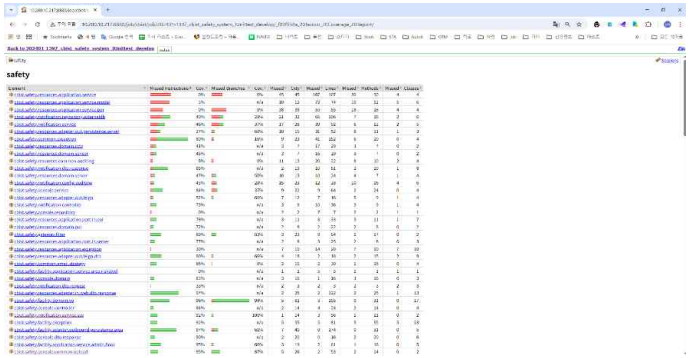
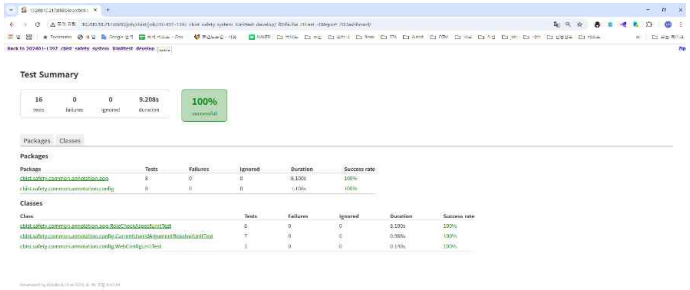
9. Verify that SonarQube is installed in Docker

-
  - Spring Boot-based modular architecture
  - Automated test execution in a Jenkins-based CI environment
-
  - Measure Statement, Branch, Line Coverage using JaCoCo
  - Detailed coverage tracking per module and detection of uncovered lines
-
  - JaCoCo Coverage Report
  - Jenkins Coverage Integrated View
  - Gradle automated report generation scripts
-
  - Achieved 60%+ average Statement coverage overall
  - Achieved 90%+ coverage for core business modules
  - Identified coverage blind spots for future improvement
- **Role**
  - Designed and implemented backend service unit test cases
  - Configured JaCoCo-based coverage collection and automated reports





‹Jenkins Trend · JUnit Report · JaCoCo Coverage›

2. Project Results

- Successfully deployed and configured SonarQube using Docker and Docker Compose on Linux, enabling a stable environment for code quality analysis.
- Integrated SonarQube with Jenkins CI/CD pipelines, ensuring continuous static code analysis for both frontend and backend services.
- Performed static analysis of automated test scripts using the SonarScanner CLI, identifying code smells, bugs, and vulnerabilities early in the development cycle.
- Established quality gates and code review workflows to enforce coding standards and reduce technical risks.
- Built centralized SonarQube dashboards to visualize key metrics such as code duplication, coverage trends, and security hotspots.
- Implemented Slack notifications and automated reporting, allowing real-time visibility of test quality status to the development and QA teams.
- Achieved measurable improvements in test script maintainability, significantly reducing technical debt and strengthening regression testing reliability.