# Documentation for Jenkins CI/CD Project

## Pipeline Overview

The Jenkins pipeline performs the following tasks in a continuous integration/continuous deployment (CI/CD) workflow:

1. **Checkout Code**: Retrieves the latest code from the specified Git repository.
2. **Build and Test**: Builds the application using Maven and runs tests to validate code functionality.
3. **JaCoCo Coverage Report**: Generates and publishes a code coverage report using JaCoCo.
4. **SonarQube Analysis**: Analyzes the code quality with SonarQube to ensure that it adheres to the set standards.
5. **Sonar Quality Gate Scan**: Waits for the SonarQube quality gate to pass before proceeding.
6. **Lizard Complexity Analysis**: Analyzes the code complexity using Lizard.
7. **OWASP Dependency Check**: Scans the application dependencies for known vulnerabilities using OWASP Dependency Check.
8. **Docker Build & Push**: Builds a Docker image, tags it, and pushes it to Docker Hub.
9. **Deploy to Container**: Deploys the built Docker image to a container for testing or production purposes.
10. **Post Notification:** Integrated gmail as post notification for failure and success notification.

## Tools Integrated

The following tools are integrated into the pipeline to ensure automated code quality checks, building, and deployment:

- **Git**: For version control and code management.
- **Maven**: For building and testing Java applications.
- **JaCoCo**: For generating code coverage reports.
- **SonarQube**: For analyzing and ensuring code quality.
- **Lizard**: For analyzing the complexity of the codebase.
- **OWASP Dependency Check**: For scanning project dependencies for known vulnerabilities.
- **Docker**: For building and pushing Docker images.
- **Email Notifications**: For sending success and failure alerts.

# Configuration Steps:

1. **AWS EC2 Setup for Jenkins Server:**
   - EC2 Instance: Created an EC2 instance with instance type t2.medium on AWS using Amazon ubuntu image to host Jenkins.

sg-03802a9b6e8750b93 - launch-wizard-1

**Instances** (1) Info

Last updated less than a minute ago | Connect | Instance state | Ac

Find Instance by attribute or tag (case-sensitive) | All states

Instance state = running | Clear filters

| Name | Instance ID | Instance state | Instance type | Status check | Alarm status | Availability Zone |
|---|---|---|---|---|---|---|
| Jenkins-Server | i-0019d198f7396b714 | Running | t2.medium | 2/2 checks passec | View alarms + | ap-south-1a |

   - Generated a key-value pair for secure access purposes.
   - Security Group: Configured inbound rules for HTTP (8080)/HTTPS(443) , SSH (port 22), Sonarqube port (9000) and Jenkins port (8080) to allow Jenkins access and server management.

**Security groups**

sg-03802a9b6e8750b93 (launch-wizard-1)

**Inbound rules**

Filter rules

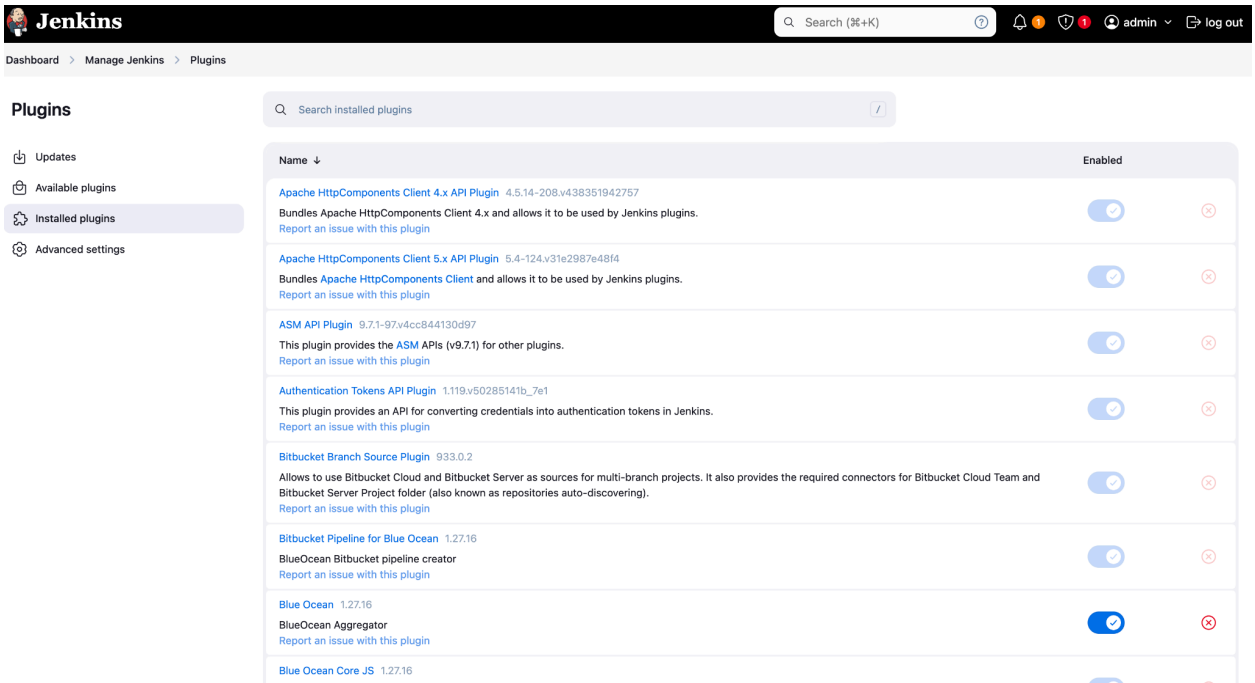
| Name | Security group rule ID | Port range | Protocol |
|---|---|---|---|
| – | sgr-0efba26c0d47d3230 | 80 | TCP |
| – | sgr-0f2137b44f882a53c | 5432 | TCP |
| – | sgr-08afff8289f758973 | 9000 | TCP |
| – | sgr-07ad9f4e848ad77f3 | 443 | TCP |
| – | sgr-0ecd7abd76beec30f | 8080 | TCP |
| – | sgr-00f9321c97412b92e | 22 | TCP |

2. **Jenkins Installation:** Installed jenkins on ec2 machine.

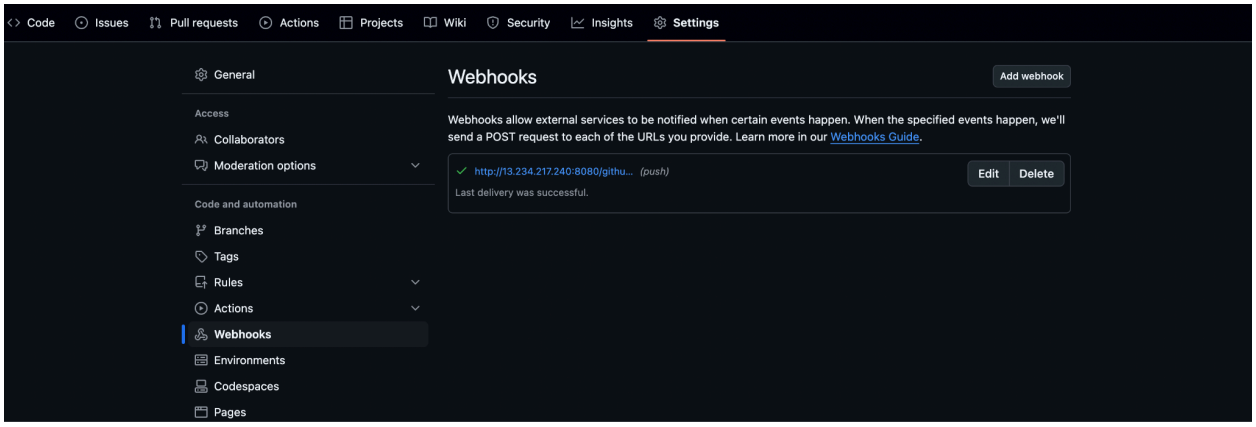
```
ubuntu@ip-172-31-36-75:~$ sudo systemctl status jenkins
● jenkins.service - Jenkins Continuous Integration Server
     Loaded: loaded (/usr/lib/systemd/system/jenkins.service; enabled; preset: enabled)
     Active: active (running) since Fri 2024-12-20 07:18:49 UTC; 3h 17min ago
   Main PID: 21971 (java)
      Tasks: 67 (limit: 4676)
     Memory: 958.1M (peak: 1.3G)
        CPU: 9min 53.916s
     CGroup: /system.slice/jenkins.service
             └─21971 /usr/bin/java -Djava.awt.headless=true -jar /usr/share/java/jenkins.war --webroot=/var/ca

Dec 20 08:43:08 ip-172-31-36-75 jenkins[21971]: 2024-12-20 08:43:08.026+0000 [id=1285]        INFO        c.c.
Dec 20 08:43:27 ip-172-31-36-75 jenkins[21971]: 2024-12-20 08:43:27.436+0000 [id=1324]        INFO        h.p.
Dec 20 08:43:27 ip-172-31-36-75 jenkins[21971]: 2024-12-20 08:43:27.442+0000 [id=1324]        INFO        h.p.
Dec 20 08:43:37 ip-172-31-36-75 jenkins[21971]: 2024-12-20 08:43:37.781+0000 [id=17]        INFO        o.s.s.
Dec 20 08:44:25 ip-172-31-36-75 jenkins[21971]: 2024-12-20 08:44:25.270+0000 [id=1324]        INFO        h.p.
Dec 20 08:44:25 ip-172-31-36-75 jenkins[21971]: 2024-12-20 08:44:25.272+0000 [id=1324]        INFO        h.p.
Dec 20 08:44:37 ip-172-31-36-75 jenkins[21971]: 2024-12-20 08:44:37.593+0000 [id=15]        INFO        o.s.s.
Dec 20 10:12:02 ip-172-31-36-75 jenkins[21971]: 2024-12-20 10:12:02.146+0000 [id=1565]        INFO        h.p.
Dec 20 10:12:02 ip-172-31-36-75 jenkins[21971]: 2024-12-20 10:12:02.150+0000 [id=1565]        INFO        h.p.
Dec 20 10:12:13 ip-172-31-36-75 jenkins[21971]: 2024-12-20 10:12:13.038+0000 [id=17]        INFO        o.s.s.
ubuntu@ip-172-31-36-75:~$
```

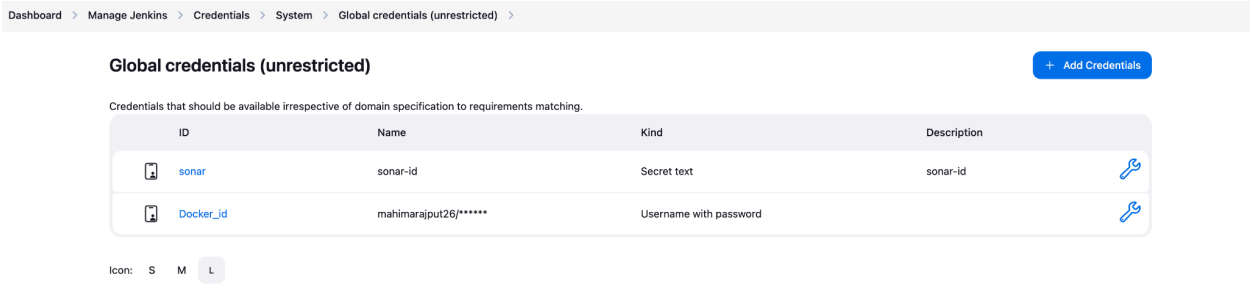
3. **Jenkins Plugin:**
   - Installed all the plugin required to integrate all the necessary tools.



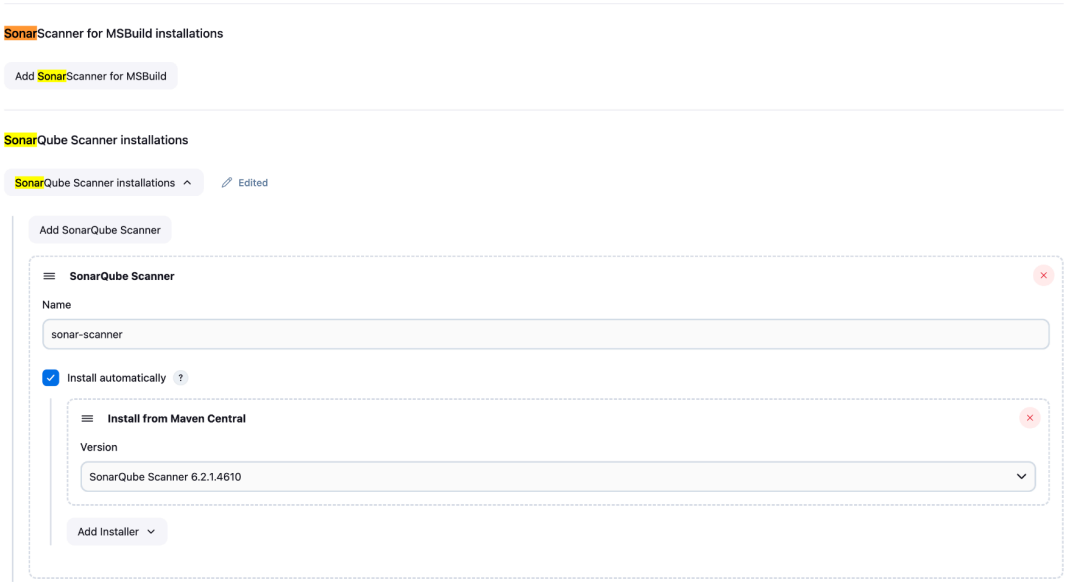

4. **Github Repo setup with webhook:**




5. **Set Up Jenkins Credentials**:
   - Store sensitive information like API tokens, passwords, Sonar and Docker credentials securely in Jenkins' **Credentials Store**.




6. **SonarQube Configuration**:
   - Configure SonarQube within Jenkins by adding the **SonarQube server** in the Jenkins Global Tool Configuration. Set up of Sonar-Scanner with the required version of **SonarScanner**.


7. **Maven Configuration**:
    - Set up the Maven tool installation in Jenkins **Global Tool Configuration**, ensuring it's pointing to the correct Maven version.
    -
8. **Docker Configuration**:
    - Ensure that the Jenkins agent has Docker installed and is properly configured to build Docker images. It needs to have access to Docker's daemon and the necessary permissions to execute Docker commands.
9. **Email Setup:**

E-mail Notification

SMTP server

smtp.gmail.com

Default user e-mail suffix ?

Advanced

Edited

Use SMTP Authentication ?

User Name

fourthmahima@gmail.com

Password

Concealed

Change Password

Use SSL ?

Use TLS

SMTP Port ?

465

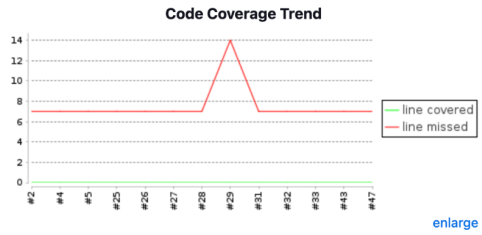
Reply-To Address

fourthmahima@gmail.com

Save

Apply

# Detailed Pipeline Steps:




**Stage View**

| | Checkout Code | Build and Test | JaCoCo coverage report | SonarQube Analysis | Sonar Quality Gate Scan | Run Lizard | Docker Build & Push | Deploy to container | Declarative: Post Actions |
|---|---|---|---|---|---|---|---|---|---|
| Average stage times: (Average full run time: ~44s) | 818ms | 9s | 127ms | 9s | 221ms | 484ms | 19s | 590ms | 3s |
| #50 Dec 20 13:30 No Changes | 703ms | 8s | 119ms | 8s | 197ms (paused for 2s) | 440ms | 18s | 1s | 3s |

### 1. Checkout Code:

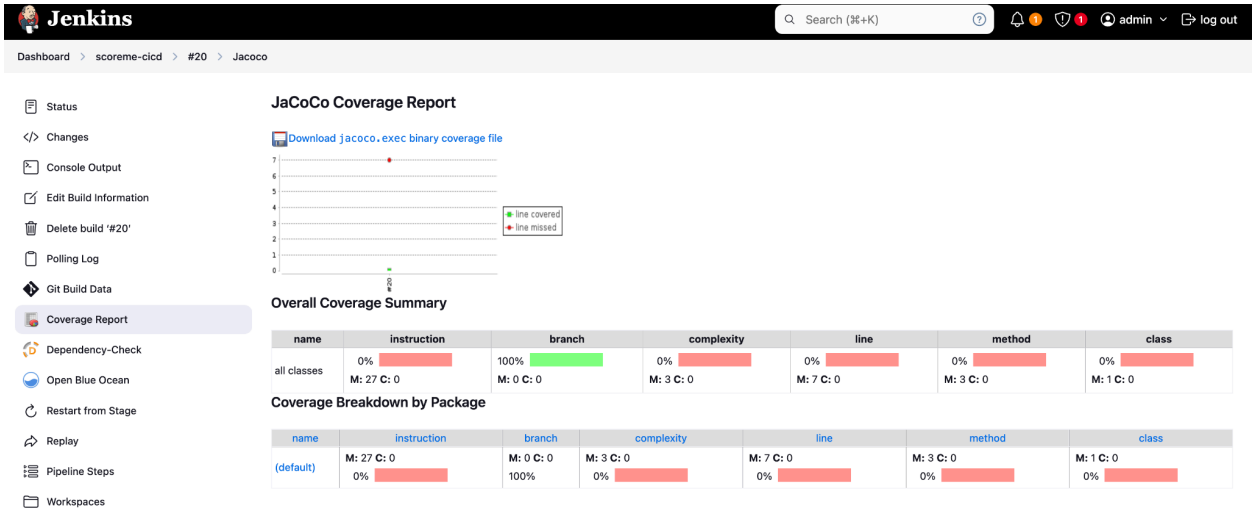
- The pipeline begins by checking out the latest code from the Git repository using the `git` step. This ensures the build always runs with the latest changes.

### 2. Build and Test:

- The pipeline uses Maven to build the project and run unit tests. The command `mvn clean package` builds the project, while `mvn clean test` runs the tests.
- A `demo.war` file is created during this process and moved into a designated directory (`pkg`).

### 3. JaCoCo Coverage Report:

- This stage generates a coverage report using JaCoCo and publishes it as part of the build results.

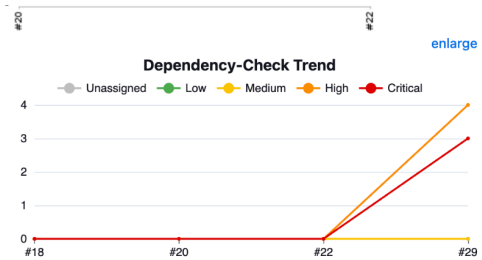



## 4. SonarQube Analysis:

- SonarQube analysis is triggered using the `sonar-scanner` tool. The pipeline uses SonarQube's `sonar-scanner` to analyze code quality and send the results to the SonarQube server.

## 5. Sonar Quality Gate Scan:

- This step waits for the quality gate to pass before moving to the next stage. If the quality gate fails, the pipeline will stop.




| | Declarative: Checkout SCM | Checkout Code | Build and Test | JaCoCo coverage report | SonarQube Analysis | Sonar Quality Gate Scan | Run Lizard | Docker Build & Push | Deploy to container | Declarative: Post Actions |
|---|---|---|---|---|---|---|---|---|---|---|
| times: | 1s | 672ms | 9s | 109ms | 11s | 232ms | 93ms | 91ms | 94ms | 3s |
| | 1s | 672ms | 9s | 109ms | 11s | 232ms (paused for 2s) failed | 93ms failed | 91ms failed | 94ms failed | 3s |

sonarqube | Projects | Issues | Rules | Quality Profiles | Quality Gates | Administration | Search for projects... | A

Quality Gates [Create]

Sonar way DEFAULT BUILT-IN

cicd-qualityGate

cicd-qualityGate [Rename] [Copy] [Set as Default] [Delete]

**This quality gate complies with Clean as You Code**

This quality gate complies with the Clean as You Code methodology, so that you benefit from the most efficient approach to delivering Clean Code. It ensures that:

- No new bugs are introduced
- No new vulnerabilities are introduced
- All new security hotspots are reviewed
- New code has limited technical debt
- New code has limited duplication
- New code is properly covered by tests

Conditions

Conditions on New Code

| Metric | Operator | Value |
|---|---|---|
| Coverage | is less than | 80.0% |
| Duplicated Lines (%) | is greater than | 8.0% |
| Maintainability Rating | is worse than | A (Technical debt ratio is less than 5.0%) |
| Reliability Rating | is worse than | A (No bugs) |
| Security Hotspots Reviewed | is less than | 100% |
| Security Rating | is worse than | A (No vulnerabilities) |

You may click unlock to edit this quality gate. Adding extra conditions to a compliant quality gate can result in drawbacks. Are you reconsidering Clean as You Code? We strongly recommend this methodology to achieve a Clean Code status.

[Unlock editing]

**Projects**

[With] [Without] [All] Search

testcicd
testcicd

**Permissions**

Users with the global "Administer Quality Gates" permission and those listed below can manage this Quality Gate.

sonar-administrators

Dashboard > scoreme-cicd > #19

```
[Pipeline] { (Sonar Quality Gate Scan)
[Pipeline] timeout
Timeout set to expire in 2 min 0 sec
[Pipeline] {
[Pipeline] waitForQualityGate
Checking status of SonarQube task 'AZPhFGoJ_U7s9zdwHhnU' on server 'sonar-server'
SonarQube task 'AZPhFGoJ_U7s9zdwHhnU' status is 'PENDING'
SonarQube task 'AZPhFGoJ_U7s9zdwHhnU' status is 'SUCCESS'
SonarQube task 'AZPhFGoJ_U7s9zdwHhnU' completed. Quality gate is 'ERROR'
[Pipeline] }
[Pipeline] // timeout
[Pipeline] }
[Pipeline] // stage
[Pipeline] stage
[Pipeline] { (Lizard Test)
Stage "Lizard Test" skipped due to earlier failure(s)
[Pipeline] getContext
[Pipeline] }
[Pipeline] // stage
[Pipeline] stage
[Pipeline] { (OWASP Dependency Check)
Stage "OWASP Dependency Check" skipped due to earlier failure(s)
[Pipeline] getContext
[Pipeline] }
[Pipeline] // stage
[Pipeline] stage
[Pipeline] { (Declarative: Post Actions)
[Pipeline] mail
[Pipeline] }
[Pipeline] // stage
[Pipeline] }
[Pipeline] // withEnv
[Pipeline] }
[Pipeline] // node
[Pipeline] End of Pipeline
ERROR: Pipeline aborted due to quality gate failure: ERROR
Finished: FAILURE
```

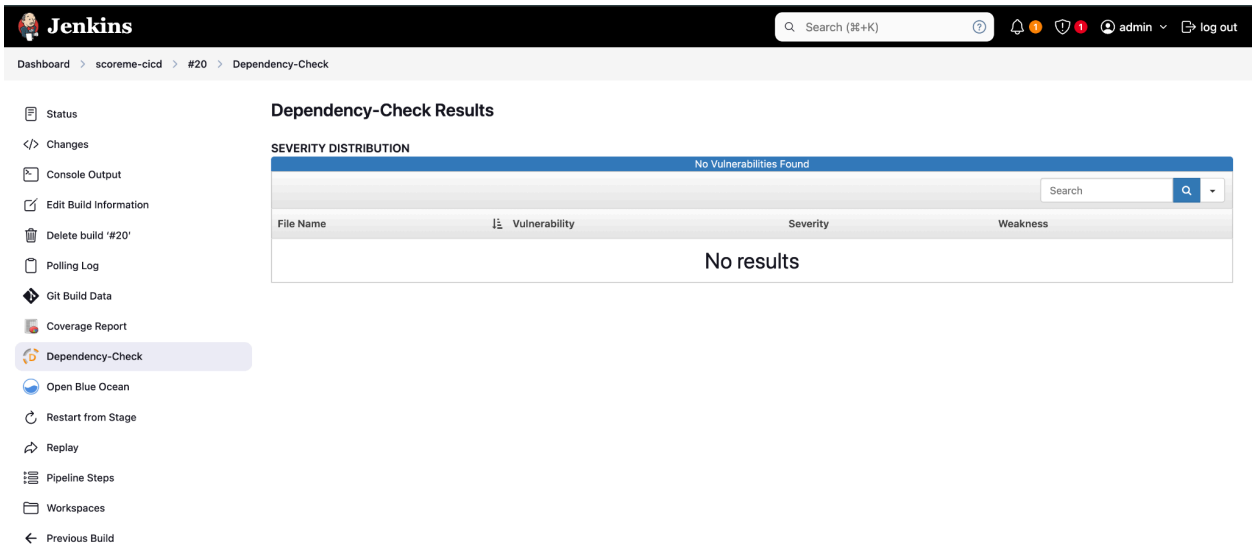
## 6. Lizard Test:

- Lizard is used to analyze the complexity of the code. This helps ensure that the codebase isn't overly complex or hard to maintain.

```
[Pipeline] // timeout
[Pipeline] }
[Pipeline] // stage
[Pipeline] stage
[Pipeline] { (Run Lizard)
[Pipeline] script
[Pipeline] {
[Pipeline] sh
+ /home/ubuntu/lizard-env/bin/lizard . --output report.txt
[Pipeline] }
[Pipeline] // script
[Pipeline] }
[Pipeline] // stage
[Pipeline] stage
[Pipeline] { (Owasp Dependency)
[Pipeline] dependencyCheck
[INFO] Checking for updates
[INFO] Skipping the NVD API Update as it was completed within the last 240 minutes
```

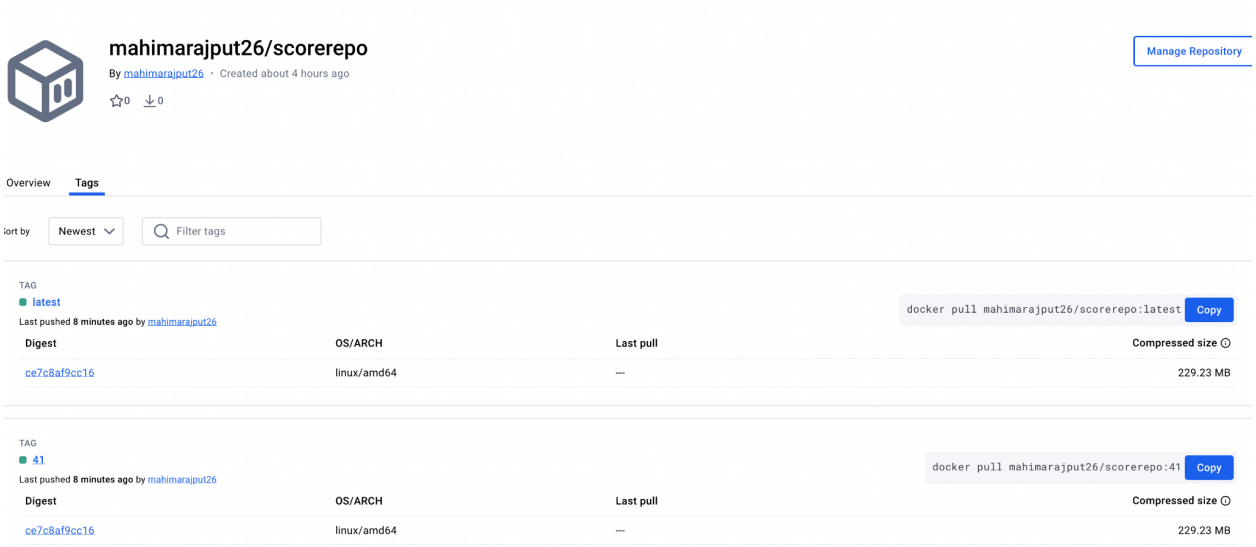
## 7. OWASP Dependency Check:

- This stage uses OWASP Dependency Check to scan project dependencies for known vulnerabilities.



## 8. Docker Build & Push:

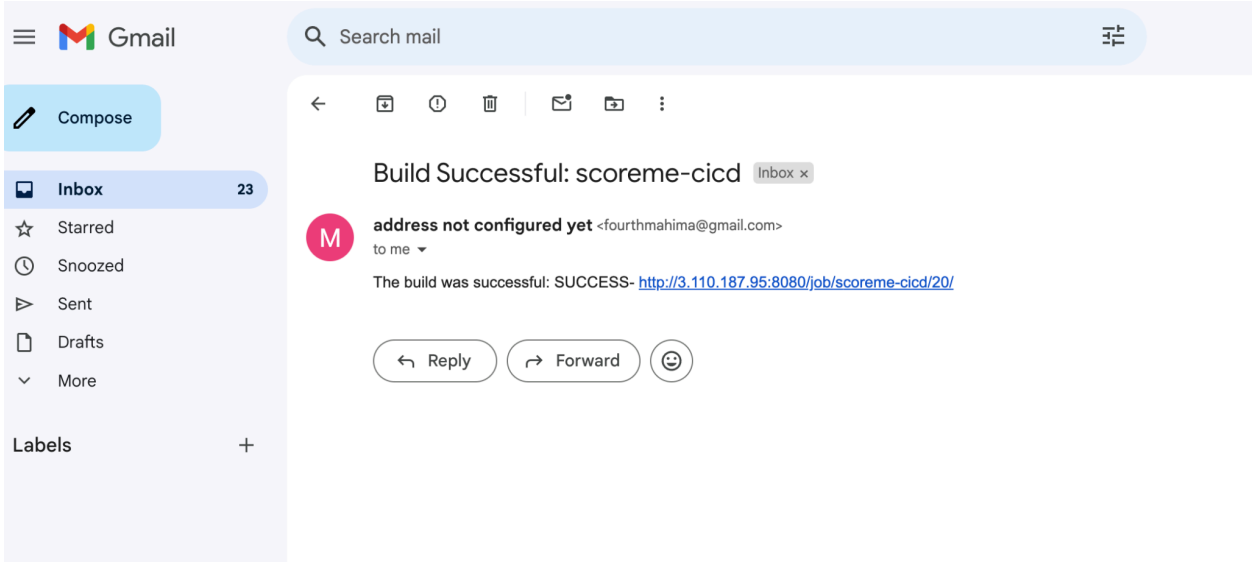
- The pipeline builds a Docker image and pushes it to Docker Hub. The image is tagged with both the build number and the `latest` tag.




## 9. Deploy to Container:

- This stage runs the Docker container and exposes the application on port 8000.

## 10. Email Notification:



## Troubleshooting Steps

Below are some common issues and troubleshooting steps:

### 1. Docker Permission Denied Error

- **Symptom**: `permission denied while trying to connect to the Docker daemon socket`.

**Solution**: Ensure the Jenkins user has the necessary permissions to interact with the Docker daemon. Add the Jenkins user to the Docker group:
`sudo usermod -aG docker jenkins`

### 2. Maven Build Failures

- **Symptom**: Errors like missing dependencies or plugin errors.
- **Solution**: Verify that Maven is properly configured and that all dependencies are available. Also, check the repository for any issues with dependencies or plugins.

### 3. SonarQube Analysis Failures

- **Symptom**: SonarQube reports are not generated or are incomplete.
- **Solution**: Ensure that the `sonar-scanner` is correctly configured and that the SonarQube server is accessible. Also, verify that the necessary authentication tokens are correctly set in Jenkins' **Credentials Store**.

### 4. Docker Build Issues

- **Symptom**: Docker build fails with errors related to missing files or incorrect Dockerfile.
- **Solution**: Check that the Dockerfile is in the correct location and properly configured. Ensure all required files (e.g., `demo.war`) are available and correctly named in the Docker context.

### 5. Test Failures

- **Symptom**: Tests fail during the Maven build.
- **Solution**: Review the test logs to identify the cause of the failure. Common causes include incorrect test configurations or dependencies. Ensure that the tests are passing locally before triggering them in Jenkins.