BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI

SECOND SEMESTER 2024-25

DSECS ZG628T DISSERTATION (DSE)

Mid Semester Project Report on

CI/CD Pipeline with DevSecOps Integration for a Microservices-Based Application

Submitted By

Yash Hoshing
BITS ID: 2021MT70136

Name of supervisor : Nomitha Angadi

Designation: Associate Principal – Software Engineering

Name of Examiner: Praveenkumar Gopagoni

Designation: Professor

INDEX:

1.Project Overview

This project is centered on the combined design, development, and deployment of an advanced Task Management Application and the creation of a robust Continuous Integration/Continuous Deployment (CI/CD) pipeline. Both components play equally critical roles in the automation, reliability, scalability, and productivity delivered through the final solution. The dual focus ensures that not only is a functional application created, but it is also built, tested, secured, and deployed through industry-standard pipelines.

2.Project Goal and Objectives

Goal :

Design, develop, and deploy a robust Task Management Application that streamlines organizing, tracking, and completing tasks for individuals and teams, ensuring productivity and collaboration.

Objectives :

- Implement secure user authentication and authorization systems.
- Enable creation, updating, deletion, and retrieval of tasks with features like status, progress tracking, priority, dependencies, and labels.
- Provide real-time dashboards and reporting features for monitoring progress and productivity.
- Lay the groundwork for integrating CI/CD pipelines to automate testing, building, and deployment in future stages.

System Requirements

Hardware Requirements :

- Processor: Quad-core 2.4GHz or greater.
- RAM: Minimum 8GB (16GB recommended for production).
- Storage: At least 20GB of available disk space.

Software Requirements :

- **Backend:** Python 3.9+, FastAPI, SQLAlchemy, PostgreSQL.
- **Frontend:** React.js
- **Containerization:** Docker (for future deployment).
- **Optional (Future plans):** monitoring tools (Grafana, Prometheus).

Progress to Date :

- **Requirements Analysis:** Defined use cases and main features around secure task operations and user roles.
- **System Design:** Designed the application architecture and database schemas to support advanced task features (status, dependencies, priorities, progress, labels).
- **Backend Implementation:** Developed API endpoints for:
    - Secure user registration/authentication.
    - CRUD operations for tasks, including support for dependencies, priorities, and labels.
    - Dashboard endpoints supplying real-time data.

API Endpoints Used in the Project :

- **User Service Endpoints:**
  These endpoints allow users to register a new account, authenticate (log in) and obtain a JWT token, and retrieve their own profile information.

Endpoint	Method	Description
/register	POST	Register a new user account with required credentials.
/login	POST	Authenticate user and return a JWT token for secure access.
/users/me	GET	Retrieve profile information of the currently authenticated user.

- **Task Service Endpoints:**

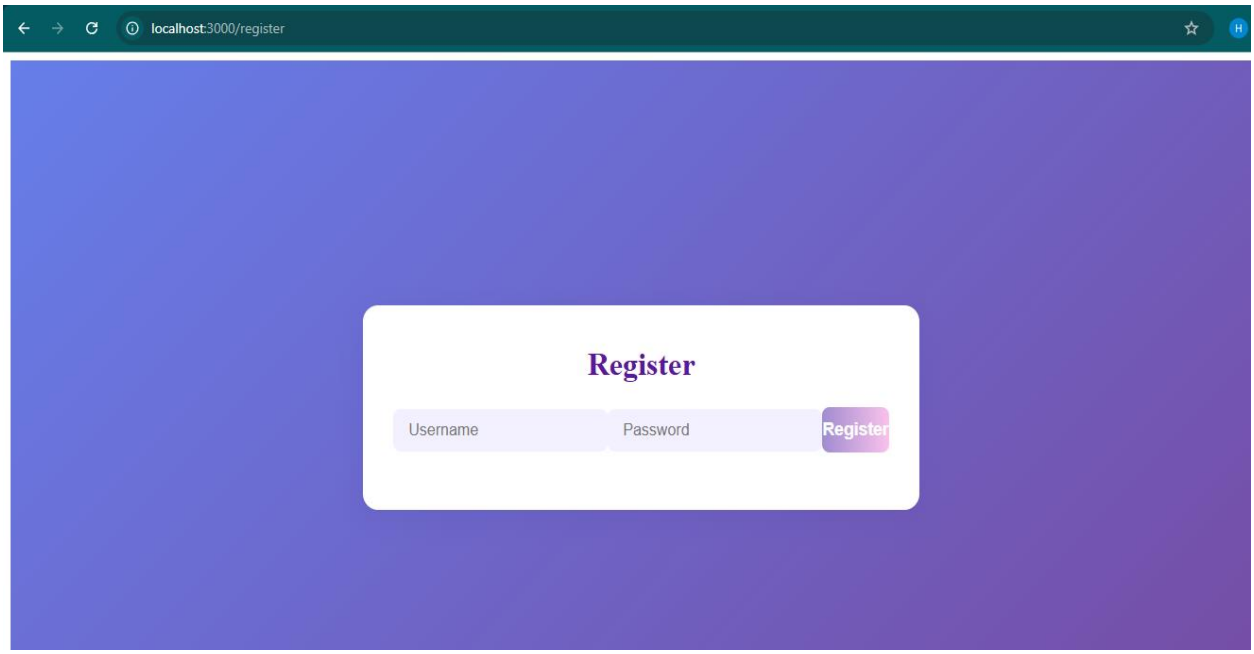
  These endpoints let authenticated users create, read, update, and delete tasks—supporting features such as filtering by priority , reporting, and dashboard analytics. They provide all functionality required for users to manage their workflow and monitor their progress.

Endpoint	Method	Description
/tasks	POST	Create a new task for the authenticated user.

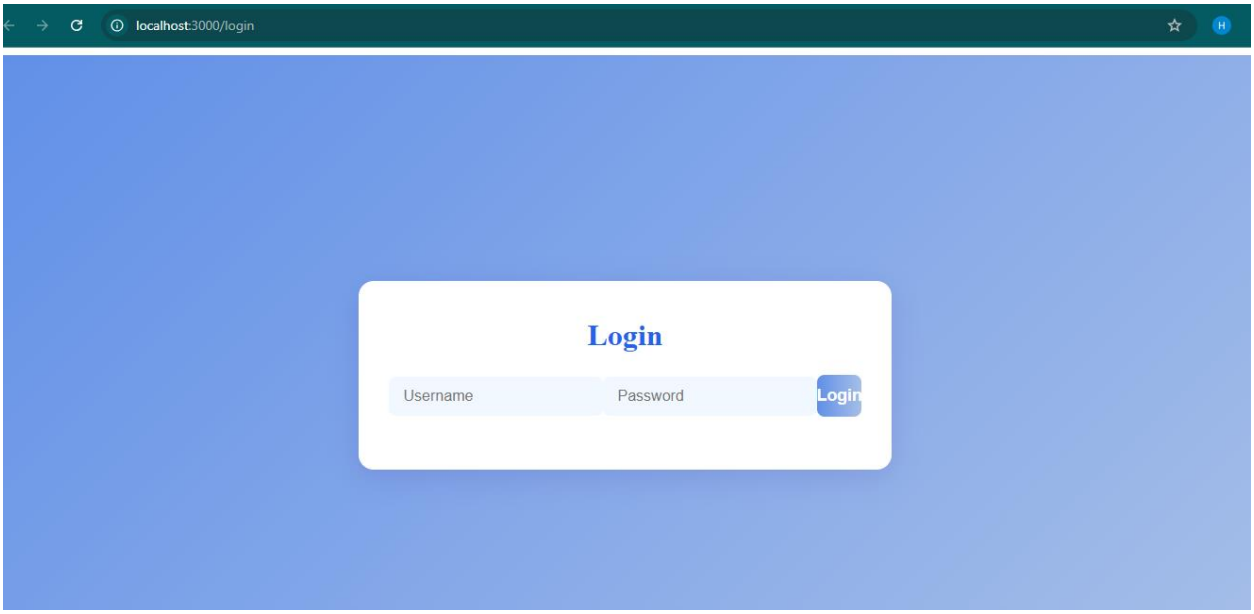
/tasks	GET	Retrieve the list of tasks for the authenticated user.
/tasks/{task_id}	GET	Get detailed information on a specific task owned by the authenticated user.
/tasks/{task_id}	PUT	Update an existing task's data, including status, priority, dependencies, and labels.
/tasks/{task_id}	DELETE	Delete a specific task.
/dashboard/summary	GET	Get real-time analytics including counts of completed, in-progress, blocked, and overdue tasks, plus averages.

3.UI Overview:

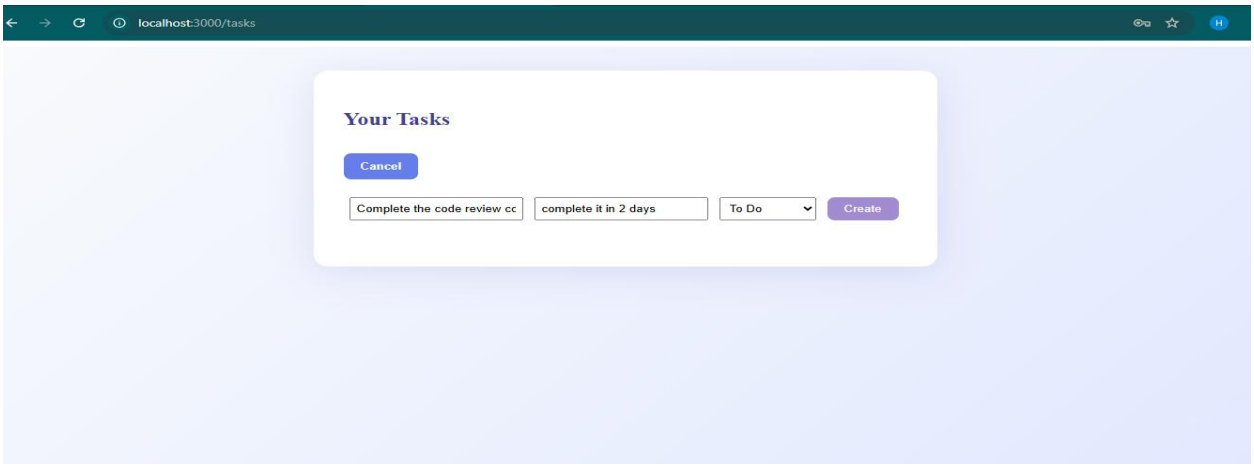
- **Register User**



- **User login Page**



- **Add Task Page**



4.Challenges Encountered

- Managing and validating complex task dependencies, ensuring data integrity.
- Designing extensible schemas to accommodate future collaborative and reporting features.
- Planning for future CI/CD integration while maintaining clean separation of concerns.

5.Project Timeline and Status

Week(s)	Task/Activity	Deliverables	Status
1-2	Requirement analysis, literature review, and technology selection	Project plan, reviewed literature	Completed
3-4	Design application architecture and microservices	Architecture diagrams, service specs	Completed
5-6	Develop individual microservices	Source code for microservices	Completed
7	Containerize microservices with Docker	Dockerfiles, container images	In Progress
8	Set up CI/CD pipeline for build and unit testing	Pipeline scripts, test reports	In Progress
9	Integrate static code analysis and dependency scanning	Security scan reports	Pending
10	Implement integration and dynamic security testing	Integration test and DAST reports	Pending
11	Configure and deploy to Kubernetes cluster	Deployment YAMLs, running services	Pending
12	Set up monitoring and logging	Monitoring dashboards, logs	Pending
13	Conduct system-level testing and performance evaluation	Test results, performance metrics	Pending
14	Documentation of architecture, pipeline, and security analysis	Draft documentation	Pending
15	Final review, addressing feedback from supervisor/examiner	Revised documentation, final tweaks	Pending
16	Submission of final report and project demonstration	Final report, presentation	Pending

Future Plans and Immediate Next Steps

- **Frontend Development:** Build a user-friendly interface for interacting with the backend APIs, supporting dashboards .
- **Documentation Expansion:** Complete end-user and deployment manuals.

6.Planned CI/CD Integration

- **CI/CD Pipeline Implementation:**
    - Automate code building, testing, and packaging using tools such as Jenkins.
    - Integrate static (SonarQube) and dynamic (OWASP ZAP) security scanning into the pipeline.
    - Enable automated Docker image creation and publishing for backend services.
    - Develop and test deployment scripts for Kubernetes.
    - Configure continuous deployment with automatic rollback, monitoring, and reporting.

7.Testing and Security:

- Expand unit and integration test coverage.
- Harden the system against vulnerabilities through automated scans.

- **Deployment:**
    - Roll out production deployments using the new pipeline.
    - Establish centralized logging and monitoring.