

Project - Report

College Management System

Course Name: DevOps Foundation

Institution Name: Medicaps University – Datagami Skill Based Course

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Project Number: DO-09

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Academic Year: 2026

Problem Statement & Objectives

1. Problem Statement –

CI/CD for React.js College Management System app

2. Project Objectives –

- To design and develop a modular full-stack College Management System supporting Admin, Faculty, and Student roles.
- To implement secure authentication and role-based authorization using JWT.
- To design a normalized relational database (3NF) ensuring data integrity and consistency.
- To containerize the application using Docker for environment consistency.
- To implement a CI/CD pipeline using GitHub Actions for automated build, testing, and deployment.
- To deploy the system on AWS EC2 using Kubernetes (k3s) for orchestration and scalability.
- To ensure high availability, security, and automated rollback mechanisms.
- To demonstrate an enterprise-level DevOps workflow integrated with application architecture.

3. Scope of the Project-

- Full-stack web-based College Management System
- Student, Faculty, and Admin modules
- JWT-based authentication and RBAC
- Relational database schema design
- Docker containerization
- CI/CD automation using GitHub Actions
- Deployment on AWS EC2
- Kubernetes (k3s) orchestration
- Persistent volume configuration
- Secure secret management
- Automated deployment pipeline

Proposed Solution

The proposed solution is a **DevOps-enabled Full Stack College Management System** that integrates application development with infrastructure automation and container orchestration.

The system follows a layered architecture and uses CI/CD automation to transition from code commit to production deployment with minimal manual intervention.

1. Key features -

- Role-Based Access Control (Admin, Faculty, Student)
- Secure JWT Authentication
- Modular RESTful API Architecture
- Normalized Relational Database Design
- Docker Multi-Stage Containerization
- GitHub Actions CI/CD Automation
- Kubernetes (k8s) Orchestration
- Self-Healing Pods
- Rolling Updates with Zero Downtime
- Secure Secret Management
- Persistent Data Storage using Kubernetes Volumes
- Automated Build & Deployment Pipeline

2. Overall Architecture / Workflow

The CI/CD workflow follows a structured multi-stage process:

Stage 1 – Source Code Management

- Developer pushes code to Git repository.
- GitHub (or Jenkins) detects the push event.
- CI pipeline is automatically triggered.

Stage 2 – Continuous Integration

- Dependencies are installed.
 - Automated unit tests are executed.
 - React production build is generated.
- If any test fails:
- Pipeline execution stops.
 - Deployment is prevented.

If all tests pass:

 - Pipeline proceeds to containerization stage.

Stage 3 – Containerization

- Docker image is built using a multi-stage Dockerfile.
 - Optimized production image is generated.
 - Image is tagged using version or commit hash.
 - Image is pushed to Docker Hub (or private registry).
- This ensures:
- Immutable artifact creation
 - Environment consistency
 - Easy rollback using version tags

Stage 4 – Continuous Deployment

Upon merging code into the production branch:

- Deployment workflow is triggered.
- Kubernetes pulls the latest container image.
- Rolling update process begins.
- Old pods are gradually replaced with new pods.
- Zero downtime is maintained.

Stage 5 – Production Environment

- React CMS app is exposed via Kubernetes Service (NodePort/ClusterIP).
- Pods are monitored by Kubernetes.
- Failed pods are automatically restarted (self-healing).
- Application becomes accessible to end users.

3. Tools & Technologies Used-

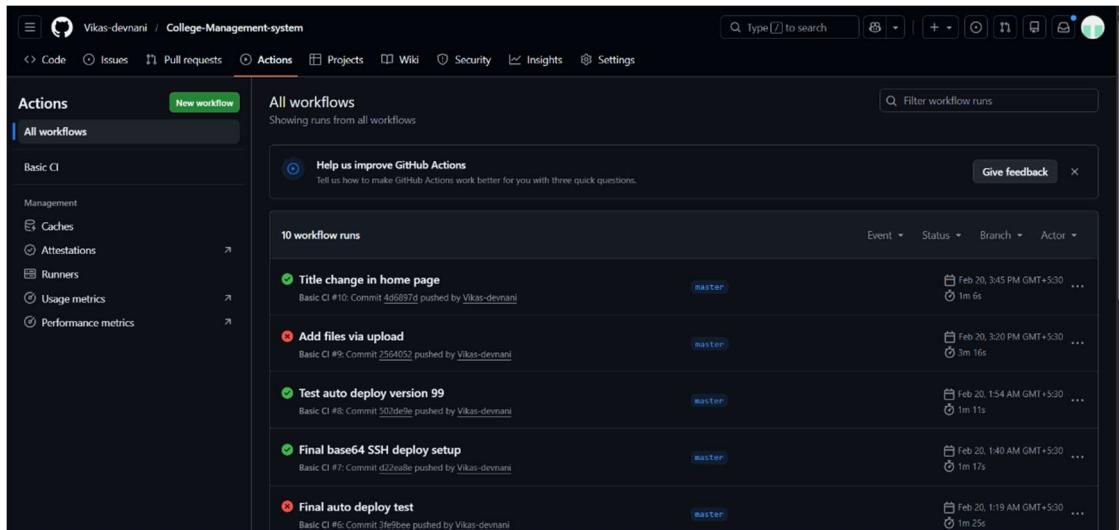
Category	Tools Used
Version Control	Git
Repository Hosting	GitHub
Frontend Framework	React.js
CI/CD Engine	GitHub Actions / Jenkins
Containerization	Docker
Container Registry	Docker Hub
Orchestration	Kubernetes (K8s)
Deployment Strategy	Rolling Update
Infrastructure	Cloud VM (AWS EC2)

Results & Output

1. Screenshots / Outputs-

The following outputs were generated during project execution:

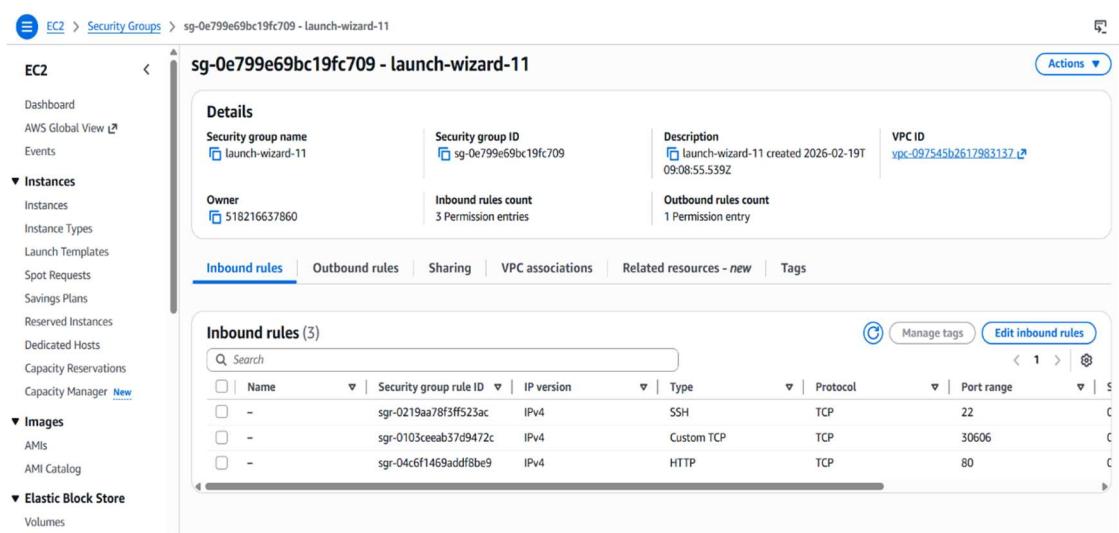
- Git commit triggering CI workflow



The screenshot shows the GitHub Actions interface for the repository 'Vikas-devnani / College-Management-system'. The 'Actions' tab is selected, displaying a list of 'All workflows'. On the right, there is a section titled 'All workflow runs' showing five recent runs:

- Title change in home page**: Basic CI #10: Commit [dd5b97d](#) pushed by [Vikas-devnani](#). Status: master. Run time: Feb 20, 3:45 PM GMT +5:30, duration: 1m 6s.
- Add files via upload**: Basic CI #9: Commit [2564052](#) pushed by [Vikas-devnani](#). Status: master. Run time: Feb 20, 3:20 PM GMT +5:30, duration: 3m 16s.
- Test auto deploy version 99**: Basic CI #8: Commit [502de0e](#) pushed by [Vikas-devnani](#). Status: master. Run time: Feb 20, 1:54 AM GMT +5:30, duration: 1m 11s.
- Final base64 SSH deploy setup**: Basic CI #7: Commit [d2ea8e](#) pushed by [Vikas-devnani](#). Status: master. Run time: Feb 20, 1:40 AM GMT +5:30, duration: 1m 17s.
- Final auto deploy test**: Basic CI #6: Commit [3fe9bee](#) pushed by [Vikas-devnani](#). Status: master. Run time: Feb 20, 1:19 AM GMT +5:30, duration: 1m 25s.

- AWS EC2 Security Group Inbound Rules Configuration



The screenshot shows the AWS EC2 Security Groups console. The left sidebar shows navigation options like Dashboard, AWS Global View, Events, Instances, Images, and Elastic Block Store. The main area displays the details for the security group 'sg-0e799e69bc19fc709 - launch-wizard-11'. The 'Details' section includes:

- Security group name: launch-wizard-11
- Security group ID: sg-0e799e69bc19fc709
- Description: launch-wizard-11 created 2026-02-19T09:08:55.539Z
- VPC ID: vpc-097545b2617983137
- Owner: 518216637860
- Inbound rules count: 3 Permission entries
- Outbound rules count: 1 Permission entry

The 'Inbound rules' tab is selected, showing three rules:

Name	Security group rule ID	IP version	Type	Protocol	Port range
-	sgr-0219aa78f3ff523ac	IPv4	SSH	TCP	22
-	sgr-0103ceebab37d9472c	IPv4	Custom TCP	TCP	30606
-	sgr-04c6f1469addf8be9	IPv4	HTTP	TCP	80

- Live React CMS application in browser

CE CollegeBuddy

For Students For Faculty Sign In

Manage Your College Effortlessly

A modern, secure platform designed for students, faculty, and administrators. Streamline admissions, track attendance, manage courses, and connect with your academic community.

Get Started Explore Features

Courses
Access all course materials

Students
Manage student profiles

Faculty
Track faculty assignments

Finance
Manage payments & fees

Why Choose StudentBuddy?

Built for modern education with powerful features for the entire

CE Studentbuddy Learning Portal

College ERP Students Search students, courses... Go Notifications 3 Super Admin Sign out

Student Management

Manage and track all students

Today Week Month

Total Students	Active	Enrolled Courses	Avg Performance
0	0	42	78%

Enrollment by Course



Your Classmates 6 people

- Aarav Sharma Computer Science
- Neha Gupta Computer Science
- Rohan Singh Computer Science
- Priya Patel Computer Science

CE Studentbuddy Learning Portal

College ERP Finance Search students, courses... Go Notifications 3 Super Admin Sign out

Finance & Fees

Total Amount ₹64,000 Amount Paid ₹55,000 Amount Due ₹9,000 Payment Status 86%

Outstanding Dues You have ₹9,000 outstanding. Please make payment before the deadline.

Overview Installments Transactions

Fee Breakdown

Tuition Fee	Due: 2025-02-15	₹50,000	Paid
Lab Fee	Due: 2025-02-15	₹5,000	Paid

3. Key Outcomes

- Successfully automated build and deployment lifecycle.
- Reduced deployment time significantly.
- Eliminated manual deployment steps.
- Ensured consistent production environments.
- Achieved automated test validation on every commit.
- Implemented version-controlled container artifacts.
- Enabled zero-downtime rolling deployments.
- Demonstrated scalable Kubernetes-based architecture.
- Achieved enterprise-level CI/CD automation for the College Management System.

Conclusion

The project successfully implemented a professional CI/CD pipeline for the React.js College Management System application using Git, Docker, GitHub Actions, and Kubernetes.

By automating testing, build, containerization, and deployment processes, the system ensures:

- High code quality
- Faster release cycles
- Reliable and repeatable deployments
- Reduced human errors
- Scalable enterprise-grade infrastructure

This project provided hands-on experience in implementing modern DevOps practices and demonstrated how automation enhances reliability, efficiency, and scalability in real-world applications.

Future Scope & Enhancements

- Integration of Prometheus and Grafana for monitoring
- Horizontal Pod Autoscaler (HPA)
- Blue-Green deployment strategy
- Canary deployments
- Automated vulnerability scanning in CI pipeline
- Advanced logging using ELK stack
- Multi-environment staging pipelines
- Infrastructure as Code using Terraform
- Advanced security hardening