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"Cloud Based Solution Architecture for Placement Cell Web Based Application"

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ABSTRACT:
The paper offers valuable insights into utilizing cloud services to enhance project deployment efficiency and effectiveness. These suggestions are applicable to both broad and specific aspects of cloud and software security, including data encryption and privacy practices for secure management. Implementing these strategies can improve our understanding of potential threats and support the development of measures to reduce risks that may lead to software slowdowns or system crashes. plus it helps design good security measures and manage cloud safety. These security measures include private computing and resource optimization for better cost management, lower latency and high bandwidth. It covers important stuff like looking at attack models, different kinds of security solutions, and even basics about three-tier as well as two-tier architecture and general difference between them and comparison and use cases of those architecture for the best way to handle cloud related things. Using various tools and techniques for continues development continues integration and continues deployment. These tools include Docker which allows apps run in easy-to-manage spaces. Which its features of containerization Docker allows it to achieve all kinds of virtualization and platform independency. Cloud Storage is all about keeping files safe and sound for long time with data recovery and data backups. Cloud Storage helps to store large amount of data with ease and also provides with the plans for disaster recovery which will good for the software. It will make the software more reliable and secure. On top of that, the entire Cloud services that we will see and use will be cost efficient and secure which will have some layers of security and the solution architecture will only improve it by utilizing the resources effectively. By using all the above-mentioned techniques, we were able to optimize the resources to several levels so the total cost can be reduced to 30% and even more on free days when the students are not using the platform. Platform is only busy on the placement days and in other times it has no huge use so at that time resourced are automatically scaled down to minimum and thus cost can be further reduced.

KEYWORDS: Cloud Service Provider, Cloud Computing, Solution Architecture, Cloud Security, DevOps, Digital cloud deployment.

1. INTRODUCTION

Within the constantly changing landscape of higher education, the role of a college placement cell is becoming increasingly crucial and dynamic. Placement cells are responsible not only for managing student resumes and coordinating with employers but also for creating essential industry pathways that meet the demands of the job market. Traditional methods are often prone to errors and inefficiencies, hindering the real-time interaction necessary among students, recruiters, and administrators. To tackle these issues, this research introduces a cloud-native framework for a College Placement Cell Web-Based Application. This solution utilizes flexible infrastructure, modular design, and smart automation to enhance placement operations. The primary objective is to move away from outdated, legacy systems towards a centralized, online platform that is accessible, cost-effective, and scalable. Central to this platform is cloud computing technology, which enables dynamic resource allocation, real-time access, improved security, and significant cost savings. The foundation of this project rests on analysing the existing gaps in placement systems and the evolving needs of digitally native students and tech-savvy recruiters. Many academic institutions rely on either generic solutions that fail to scale or expensive third-party platforms that lack customization and integration options. These observations significantly influenced the direction of this research. The proposed system delivers a comprehensive web application built using the MERN (MongoDB, Express.js, React.js, and Node.js) stack and hosted on Amazon Web Services (AWS). Docker containers are employed to package various microservices, ensuring ease of maintenance, high availability, and fault tolerance. The application supports multiple user roles—students, recruiters, and placement officers—equipped with specific features such as intelligent job matching, document verification, resume management, interview scheduling, real-time notifications, and analytical dashboards. The research methodology adopted for this project is design-centric and problem-driven. The presentation layer guarantees a sleek, user-friendly interface; the application layer manages transactional logic and decision-making processes; and the cloud service layer oversees data storage, backups, and computational tasks. A key component of the architecture is AWS Lambda, which facilitates server less execution of background tasks like email notifications, document uploads, and application tracking. Security considerations are deeply integrated into the strategy. The system employs role-based access control (RBAC), encrypted communication over HTTPS, data-at-rest encryption through AWS Key Management Service (KMS), and intrusion detection via AWS CloudWatch.

Additionally, best practices such as the principle of least privilege, segregation of duties, and defence-in-depth have been applied throughout the development and deployment process, ensuring that student information, recruiter details, and organizational data remain confidential and secure. To validate the design and ensure robust implementation, an agile approach was utilized, divided into iterative sprints. Each sprint targeted a specific module, starting with user onboarding, followed by job postings, resume management, and then analytics and reporting features. Continuous integration and continuous delivery (CI/CD) were supported through GitHub Actions and Jenkins, ensuring that each code modification was automatically tested and deployed to a staging environment. Docker containers enabled smooth testing across development and production environments, thereby minimizing bugs and deployment delays. The evaluation phase focused on testing the platform with actual user data and simulated load conditions. Performance metrics such as request-response time, system uptime, transaction success rate, and user satisfaction were monitored using AWS CloudWatch and Google Analytics. The platform efficiently handled over 100 concurrent users with minimal latency and no service interruptions, showcasing its

viability for real-world deployment in a medium-sized college setting. In addition to technical assessments, qualitative feedback was gathered through structured user surveys. Placement officers praised the centralized dashboard and bulk job tracking tools, while students appreciated the clean interface and smart recommendations. Recruiters found the candidate shortlisting feature especially useful. These insights were incorporated into the final system release, which also included modules for offer generation, feedback collection, and report exporting. This presentation lays the groundwork for a robust, secure, and intelligent placement system that transforms how educational institutions manage recruitment. By adopting a methodical research approach and leveraging cutting-edge cloud technologies, this project delivers a future-ready platform that is both technically sound and practically impactful. The subsequent sections of this paper will delve deeper into the architecture, implementation details, results, and future potential, illustrating how this system sets a new benchmark for cloud-based placement solutions.

2. LITERATURE SURVEY

Cloud computing has transformed numerous industries by providing scalable computing resources on demand. A key development in cloud services has been the shift from monolithic applications architectures based on microservices. Micro enable the creation of highly scalable and interconnected systems that enhance flexibility and fault tolerance. However, this shift also brings new challenges related to optimizing service quality (QoS) and resource utilization in cloud settings [1].

A study examining microservices in the cloud investigates the effects of such architectures on system bottlenecks and server design. The research features an end-to-end application utilizing widely used open-source microservices to create a modular and extendable service for renting and streaming movies. It emphasizes the scalability and performance limitations of microservices and their influence on the data centre's hardware design. Specifically, it reviews the discussion around powerful versus lightweight cores, quantifies the cache and processing demands introduced by microservices, and assesses the equilibrium between computation and communication among services via RPC. This study underscores the necessity to revaluate conventional management strategies for cloud systems as they increasingly adopt microservice architectures [1].

Recently, microservices have gained traction as a preferred architecture for building cloud-native systems due to their flexibility. In cloud-native environments, autoscaling is a vital technique for adapting to workload variations by dynamically reallocating computing resources. However, autoscaling in microservice applications presents challenges due to complex interactions among multiple services. A new system called Microscaler has been created to pinpoint the required services for scaling and optimize resource allocation to meet service level agreement (SLA) requirements while minimizing costs. Microscaler leverages QoS within a microservice framework to identify underperforming or idle services. By employing online learning and heuristic methods, Microscaler achieves an impressive 93% accuracy in identifying scaling services and balancing resources optimally in large-scale microservice applications. This advancement demonstrates the potential of intelligent autoscaling to enhance performance and profitability within microservices [2].

To design and implement modern cloud infrastructure or applications, both Docker and Kubernetes have significantly transformed the development and software operations landscape. While they serve different purposes, they harmonize the development and integration processes that enable the construction of any architecture using these platforms. Docker is utilized for building, packaging, and

deploying applications seamlessly across various environments. It optimizes resource usage and facilitates quicker deployments through containerization. Containers are efficient, take up less space, and enhance operational performance. Docker Swarm helps manage Docker containers, offering orchestration capabilities [3].

Conversely, Kubernetes is an automated management system for container deployment and scaling. It efficiently orchestrates container applications, making it a favored choice for large-scale microservice implementations. Using Google Cloud Platform (GCP) for deploying containers within the Kubernetes engine expedites application development and management. Kubernetes provides essential features like easy deployment, scaling, and monitoring, ensuring optimal development and management of cloud applications. Recently, integrated authentication technologies combining the Internet of Things (IoT) with cloud computing have been actively investigated for secure data recovery and robust access control in extensive IoT networks. However, a standardized best practice for safely merging IoT with cloud computing has yet to be established. A novel authentication scheme for IoT-based frameworks coupled with cloud servers has been proposed to tackle this issue. This scheme utilizes lightweight cryptographic modules, such as unidirectional hash functions and exclusive operations, to enhance security while minimizing computational load. This makes the authentication method particularly suitable for resource-constrained devices, such as sensors and IoT nodes. Formal verification using Prover if ensures the robustness of the authentication scheme, while performance evaluations illustrate its effectiveness, achieving acceptable computational costs for users [4].

For a cloud-based solution for university placement cells, leveraging microservices, Docker, Kubernetes, and secure authentication mechanisms can yield numerous advantages, including modularity, ease of maintenance, scalability, and efficient resource management. The placement cell system can be structured with independent microservices for student registration, job postings, company interactions, interview scheduling, and analytics. However, to ensure optimal performance, it is crucial to address potential bottlenecks, such as RPC overhead, resource allocation, communication delays among services, and secure access control. By integrating findings from existing studies about microservices, containers, and authentication in cloud environments, the placement cell system can be designed to maximize efficiency and reliability while minimizing resource constraints. Literature indicates that microservices in cloud solutions are increasingly becoming the norm for modern applications. Implementing these principles in a university placement cell can enhance operational efficiency, allowing seamless integration with companies and improving the overall experience for both students and recruiters [5].

The transition to cloud-native systems, primarily driven by microservices, has profoundly reshaped application architecture. Traditional monolithic systems, which bundle all functionality into a single deployable unit, struggle with scalability, maintainability, and fault isolation. Microservices, by contrast, enable application components to be independently developed, deployed, and scaled. This modularity is particularly advantageous in dynamic environments such as educational institutions, where functional needs evolve rapidly [5].

A prominent area of research highlights the performance implications of microservices. As explored by Delimitrou and colleagues, the decomposition of services introduces increased overhead due to inter-service communication, particularly via RPC mechanisms. Their findings indicate that while microservices improve flexibility, they also amplify cache pressure and network latency. This trade-

off necessitates optimized orchestration strategies and tailored server configurations, especially in large-scale cloud deployments like those envisioned for college placement systems [6].

Complementing these insights, autoscaling strategies in microservice environments have become a focal point in cloud research. Traditional autoscalers, which monitor CPU or memory usage, fall short in distributed applications where performance bottlenecks stem from service-to-service dependencies. Microscaler, as discussed in recent studies, introduces a QoS-aware scaling technique that dynamically reallocates resources using online learning models. This solution achieves superior accuracy in predicting which microservices need scaling, ensuring SLA adherence and efficient cost management. In a placement cell application, such intelligent autoscaling ensures that spikes in student activity—e.g., during mass job application submissions or interview scheduling—do not degrade system performance [7].

Meanwhile, containerization technologies such as Docker have redefined software development pipelines by encapsulating application dependencies into portable containers. Docker simplifies the deployment of microservices across heterogeneous environments and minimizes conflicts between development and production setups. In multi-user academic systems, this enables consistent experiences and fast iterations. Docker Swarm, although effective for basic orchestration, is generally superseded by Kubernetes, which provides fine-grained control over container scheduling, health checks, and rolling updates [8].

Kubernetes' role in scaling microservices is especially important in use cases like campus placement platforms. Using features such as Horizontal Pod Autoscaling (HPA) and node pools, Kubernetes dynamically manages workloads, ensuring continuous availability even under unpredictable user loads. Integrated monitoring via Prometheus and Grafana enhances system observability, supporting proactive diagnostics and optimization.

Another essential aspect explored in literature is cloud storage and data management, particularly the use of distributed object stores such as AWS S3 or Azure Blob Storage. These systems offer scalable, secure, and durable storage for critical files—such as resumes, offer letters, and analytics reports. Cloud-native placement systems benefit from these services through lifecycle management (e.g., archiving old records) and cost-efficiency (e.g., tiered storage for infrequently accessed data) [9].

In addition to performance and scalability, security and privacy remain primary concerns in cloud-based systems. Studies on IoT-cloud integration propose lightweight cryptographic schemes suitable for low-power devices. While placement systems may not involve constrained devices, the principles of lightweight authentication and secure communication are still relevant—especially for handling sensitive student data. Techniques like JWT (JSON Web Tokens) for session management, OAuth2 for role-based access, and TLS encryption for data-in-transit are widely recommended [10].

Further, research by Krishnan et al. explores intrusion detection in dynamic environments using anomaly detection techniques. Applying similar models in university systems could proactively detect suspicious access patterns—e.g., brute-force login attempts or unauthorized data access—thus adding another layer of protection.

From a design standpoint, several studies emphasize the importance of observability and fault-tolerance in microservice systems. Distributed tracing tools such as Jaeger and Zipkin provide insights into service interaction latencies, helping diagnose bottlenecks in complex deployments. Logging solutions like the ELK Stack (Elasticsearch, Logstash, Kibana) further enhance transparency, allowing institutions to monitor placement trends, recruiter activity, and system usage in real-time [10].

Finally, student-centric platforms that utilize recommendation systems are gaining momentum in academic contexts. Inspired by e-commerce and content delivery platforms, personalized recommendations in placement systems—based on student profiles, job roles, and historical preferences—are shown to improve engagement and outcomes. Algorithms such as collaborative filtering or content-based filtering, when integrated with cloud-native microservices, allow placement portals to offer intelligent job suggestions, thus improving placement efficiency [11].

3. METHODOLOGY

1 Resources Required

Server Processor (Quad-Core CPU, 2.4 GHz or higher): The Processing Unit (CPU) functions as the core of a server, overseeing and managing backend operations, executing cloud services, and balancing loads. Quad-core processors that operate at speeds above 2.4 GHz are essential for efficiently handling multiple tasks, especially during peak demand periods. Nonetheless, this component carries various risks. Primarily, if the server processor becomes overloaded due to high queries or poor resource management, performance may decline, resulting in slower processing times and reduced system functionality. In addition, hardware malfunctions pose significant risks, especially in environments requiring continuous operation. Thermal management is another concern; inadequate cooling solutions or excessive loads can threaten the CPU, potentially leading to hardware damage and affecting overall system stability and performance.

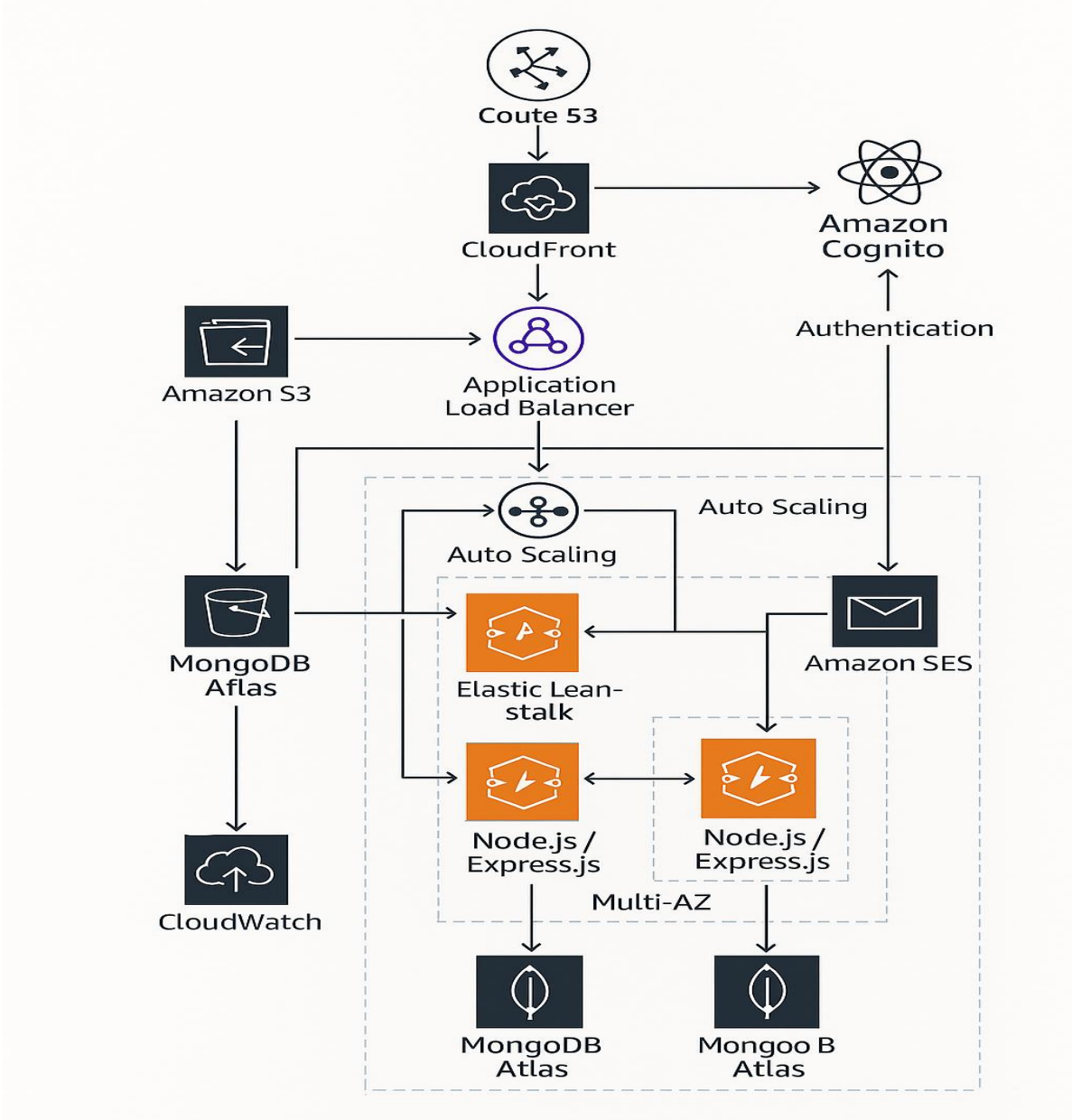
Load Balancer (Dedicated Hardware Load Balancer): The primary purpose of load balancing is to distribute incoming traffic across several servers to prevent any one server from becoming overwhelmed, ensuring high availability and consistent performance, particularly during peak traffic periods. However, risks arise in this area as well. If the load balancer fails, traffic may not be distributed correctly, resulting in system downtime. Additionally, misunderstandings regarding load balancing can lead to inefficient traffic allocation, where some servers may sit idle while others are overloaded, diminishing overall performance and availability. Security vulnerabilities also pose a threat to load balancing. If an attacker exploits weaknesses in the configuration, they could bypass security measures, redirect traffic to malicious sites, or potentially cause data breaches or service interruptions [12].

Cloud Infrastructure (AWS, Infrastructure): Leveraging cloud infrastructures like AWS offers access to a range of tools that enhance scalability, autoscaling, disaster recovery, and application performance. However, cloud environments come with their own set of risks. Chief among them is data security. While providers like AWS implement strong security protocols, threats of unauthorized access and data breaches persist. Misconfigured resources—such as inadequate access controls or mishandling of sensitive information—can create significant vulnerabilities. Furthermore, dependence on third-party providers can introduce risks, including potential service disruptions from network issues, hardware failures, or cyberattacks targeting the provider's infrastructure. Economic risks also exist; poor resource management or scaling practices can lead to unexpectedly high expenses, particularly in dynamic settings where computational resources are adjusted based on demand [13].

Protected Memory (1 TB Cloud Storage): A reliable storage system is crucial for ensuring business continuity by offering secure and easily accessible data backups in case of data loss or system failure.

However, using backup memory involves several risks. Although cloud storage provides redundancy, data loss is still a possibility, especially if there are errors in the cloud provider's infrastructure or problems with the backup process, such as incomplete backups or data synchronization issues. Moreover, reliance on cloud-based backups can affect data availability, especially during periods when the cloud provider experiences downtime, which may hinder access to backups. Security of the data is another concern; without proper encryption and access controls, sensitive information stored in backups could be accessed by unauthorized individuals. Additionally, there might not be adequate storage capacity; while 1 TB may suffice for some organizations, limitations could arise concerning data retention services. Alternatively, backups might be incomplete or delayed, complicating the restoration process. Regular software updates and proactive security measures are vital to mitigate the risks associated with each of these essential components [14] [15].

2 Cloud Architecture



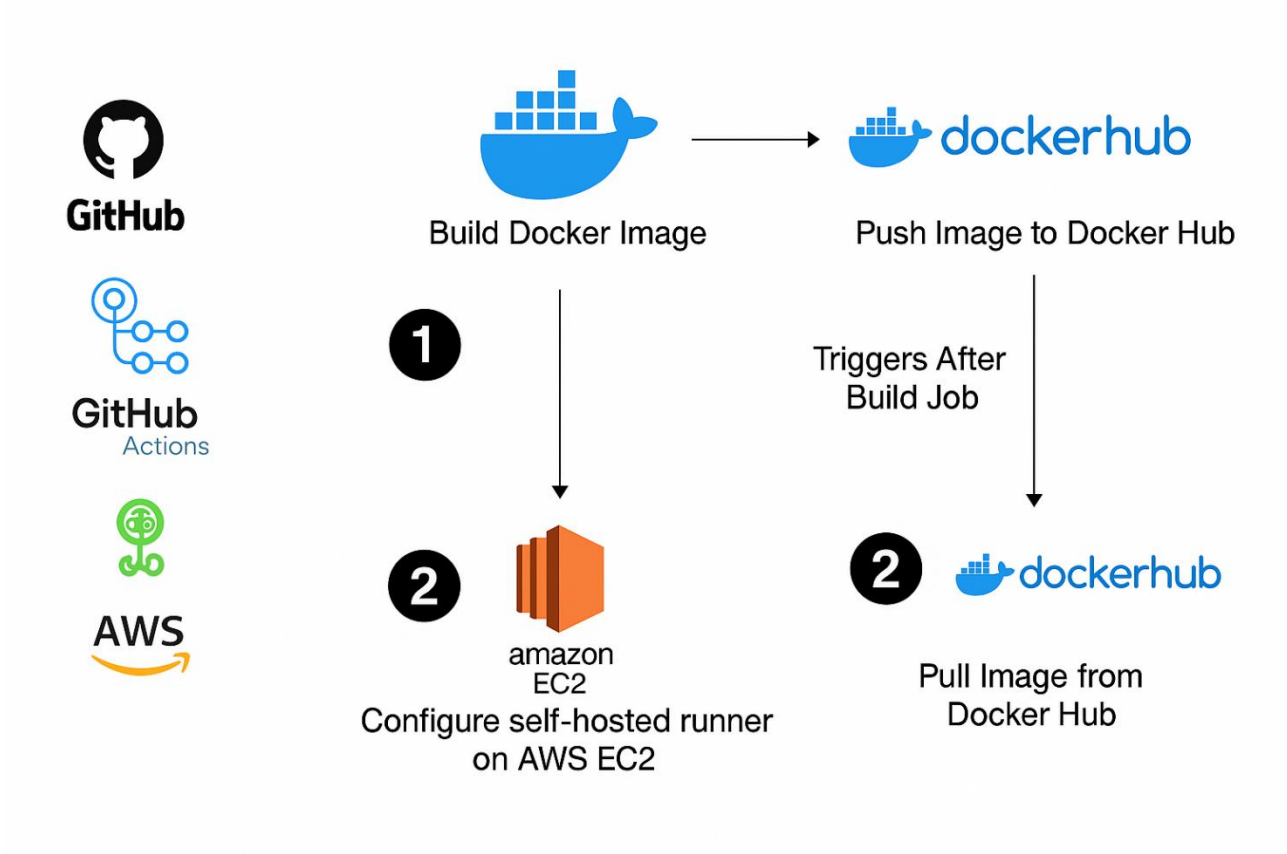
2.A Architecture of AWS Cloud

The AWS architecture described is structured into multiple layers, each serving a specific purpose to ensure a secure, scalable, and highly available cloud environment. At the top layer, the AWS Cloud Layer encompasses core services that support DNS management, security enforcement, and storage. Amazon Route 53 handles Domain Name System (DNS) management, routing user traffic intelligently to the correct EC2 instances or AWS resources with capabilities like failover and geolocation routing. AWS Firewall Manager provides centralized security control, applying consistent firewall and WAF rules across accounts and protecting against threats such as DDoS attacks. Amazon S3 is used for storing various types of data, including logs and media files. It offers high durability and scalability, making it ideal for static content hosting and backups. A dedicated S3 bucket may also be used specifically for media data, offloading large video and image content from EC2 instances for better performance. Moving down to the Virtual Private Cloud (VPC) Layer, this forms the isolated network environment where the application runs. The VPC includes public subnets, which host internet-accessible services like web servers, and private subnets, which hold backend components such as databases. Security is enforced through Network ACLs and Security Groups, which manage traffic rules and access control to ensure only authorized communications occur.

At the Compute & Application Layer, the main application logic is hosted. Amazon EC2 instances are deployed here to run web applications, APIs, or microservices. These are typically placed in public subnets for external access. The system includes an Auto Scaling Group, which dynamically adjusts the number of EC2 instances based on demand to maintain performance and minimize costs. A Load Balancer distributes incoming traffic across EC2 instances to enhance fault tolerance and ensure even resource usage. Additionally, VPC Peering and other network components are used to connect various segments of the infrastructure securely and efficiently.

The Database Layer, at the bottom of the stack, ensures secure and reliable data storage. It begins with a Database Subnet Group, which consists of private subnets reserved for databases, isolating them from public access. The core database service is Amazon RDS, a managed solution that supports engines like MySQL and PostgreSQL, offering features such as automated backups and scalability. To enhance resilience, Multi-AZ deployments are used, replicating data across multiple availability zones to enable failover in case of an outage. Lastly, the Security Layer underpins the entire architecture, providing protection and compliance mechanisms. AWS Firewall Manager reinforces security policies across WAF, Shield, and VPC configurations, guarding against unauthorized access and network threats. IAM (Identity and Access Management) plays a crucial role in defining granular access permissions for users and services, ensuring that only authorized entities can interact with sensitive AWS resources.

3 Deployment Pipeline



3.B. DevOps Workflow Diagram

This diagram illustrates a comprehensive Continuous Integration and Continuous Deployment (CI/CD) process that leverages GitHub, GitHub Actions, Docker, Docker Hub, and AWS EC2 to automate the building, storing, and deploying of containerized applications. The workflow begins with a codebase hosted on GitHub, where developers can upload their changes. Once the updates—such as commits or pull requests—are pushed to the repository, a pre-defined GitHub Actions workflow gets automatically activated. This workflow includes a series of steps specified in a YAML file, with one essential task being the construction of a Docker image from the application source code via a Dockerfile. This Docker image contains the entire application environment, along with its dependencies, ensuring portability and uniformity across different platforms.After the successful creation of the image, the next step involves pushing it to Docker Hub, a popular public or private container registry. This step guarantees that the Docker image is stored in a central location, making it readily available for deployment. Following the image upload, the deployment phase of the pipeline is initiated.During this phase, an AWS EC2 instance is utilized to run a self-hosted GitHub runner. Unlike the default runners provided by GitHub, a self-hosted runner offers complete control over the environment and is particularly advantageous when specific software, configurations, or security settings are required. The self-hosted runner is set up to respond to deployment jobs from GitHub Actions. Once it receives the trigger, it starts a deployment job that retrieves the Docker image from Docker Hub to the EC2 instance. After the image is pulled, the runner can launch the container using Docker commands (like docker run or docker-compose up), thus deploying the latest

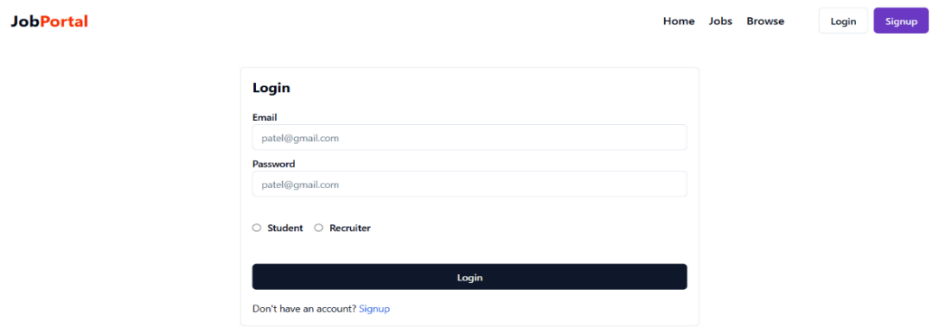
version of the application.This entire arrangement creates a smooth and automated CI/CD pipeline—from the moment code is committed to GitHub to the deployment of the updated application on a cloud server. It combines the advantages of containerization (through Docker), centralized storage and version control (using Docker Hub), and scalable cloud infrastructure (with AWS EC2). The use of GitHub Actions for automation further streamlines the workflow by minimizing manual tasks, ensuring consistency, and accelerating deployment cycles.

Git's Role in Managing Code Changes:
Git was an invaluable tool for efficiently managing and tracking alterations within files and project. Its design incorporates key features that make it exceptionally practical for version control. In College Placement Cell git is used for version control and to keep code in check.
Decentralized Development Approach: Each developer working with Git receives a complete copy of the project repository on their local machine. This enables independent work, even without a constant internet connection, with the ability to merge completed changes later.
Branching and Merging Capabilities: Git facilitates the creation and management of multiple, parallel versions of a project. This allows developers to experiment with new features and ideas in isolation, without risking instability in the primary codebase. Once validated, these changes can be seamlessly integrated back into the main project.
Comprehensive History Tracking and Management: Git maintains a detailed log of every modification made to each file. This feature allows developers and engineers to easily go back to previous versions or identify the author responsible for any specific change. This allows to make changes without worrying about the code loss or data loss bug hunting error handling becomes so much easier.

Advantages of Using Git for Version Control
Enhanced Collaboration: Git enables multiple developers to collaborate effectively on the same project simultaneously. It provides tools and techniques for merging their respective changes that can be made and resolve conflicts that may arise through overall development and testing process.
Easy and Adaptable Workflow Support: Git is designed to accommodate a wide range of development workflows, providing teams with the flexibility to choose the methodology that best suits their needs, including GitFlow, Feature Branching, and others.

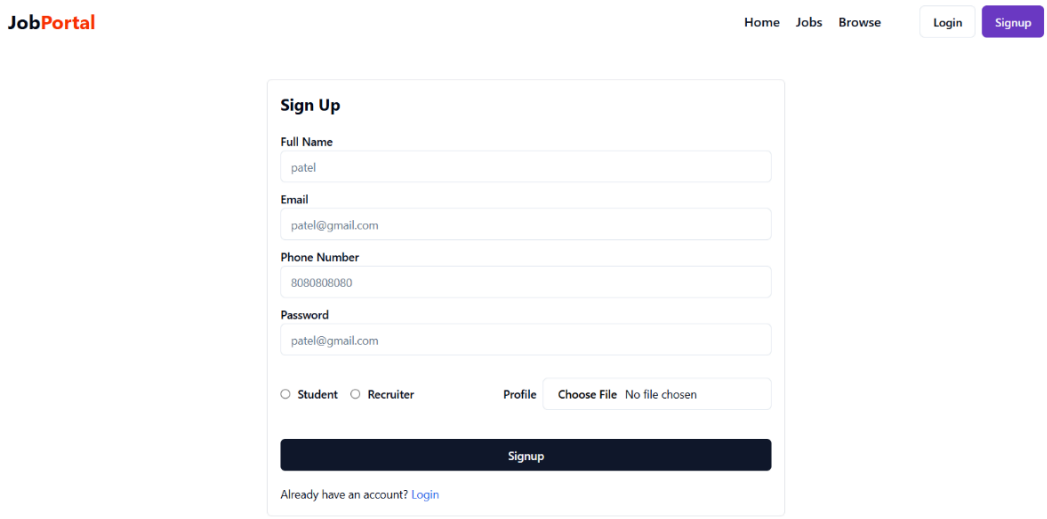
4. EXPERIMENTAL RESULTS

The image displays the login page of a web-based Job Portal application. Users are prompted to enter their email and password, and to select their role as either a Student or Recruiter. The UI includes navigational links at the top for Home, Jobs, and Browse, along with buttons for Login and Signup. The design is minimalistic with a focus on usability and clear role-based access selection.



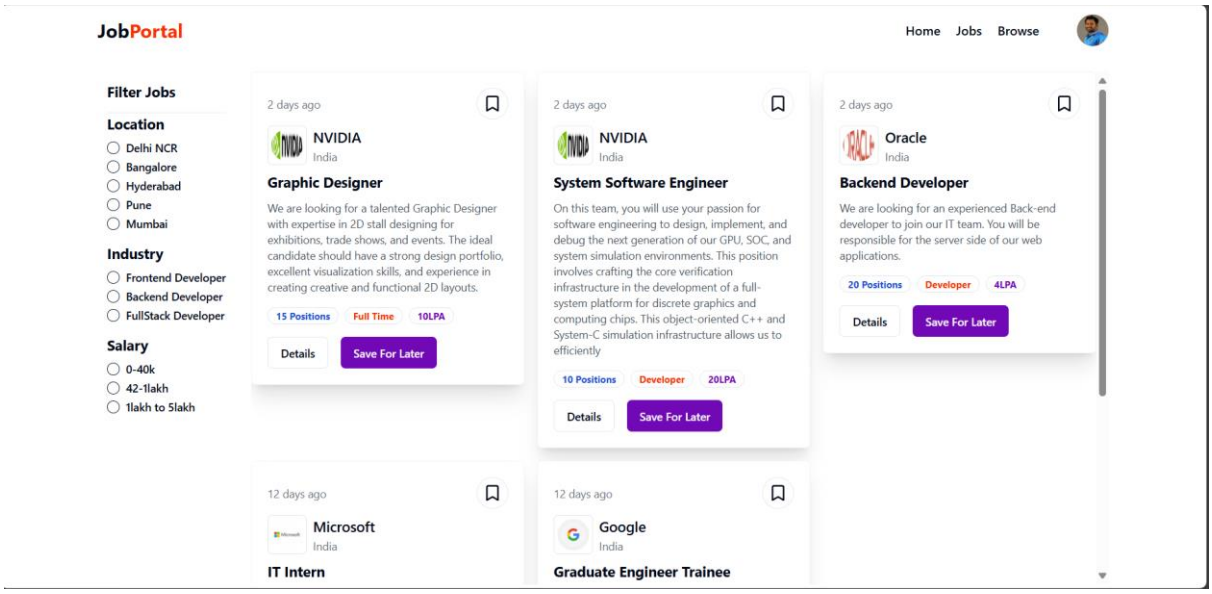
IV A

The image shows the signup page of a Job Portal web application. New users are required to provide essential registration details, such as email, password, and role selection (Student or Recruiter). The interface offers a clean and intuitive layout, with top navigation links for Home, Jobs, Browse, Login, and a highlighted Signup button. The form design emphasizes ease of access and clarity for on boarding new users.



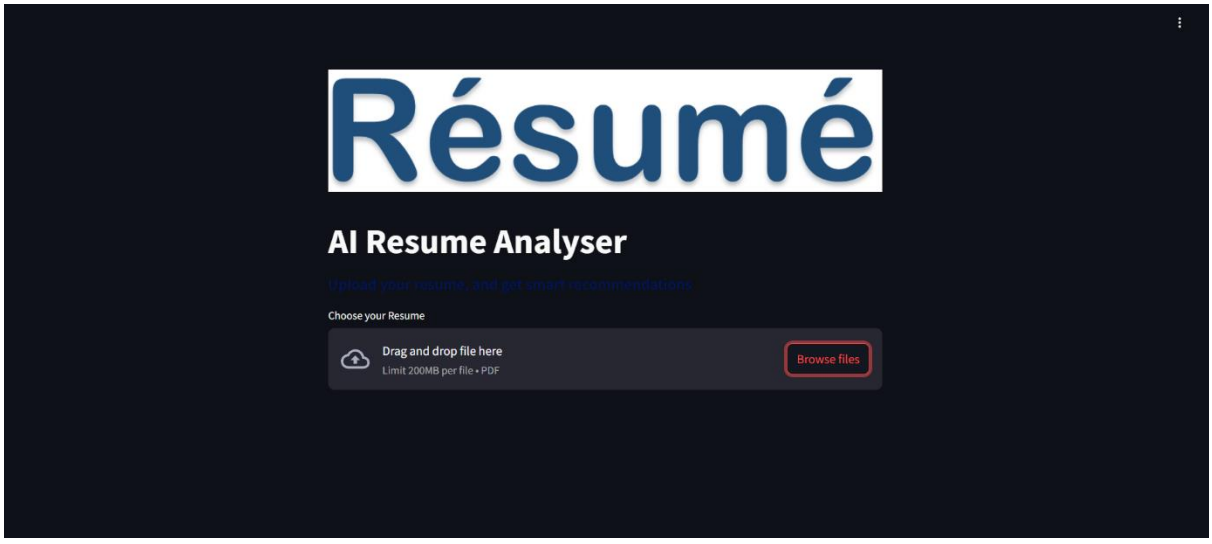
IV B

This image showcases a job portal interface with job listings from various companies. The portal allows users to filter jobs based on location, industry, and salary range. Each listing provides the company name, job title, and a brief description of the role, along with the number of open positions and required qualifications. Also provided filters ti filter out the necessary industry according to your skills and expertise. Filters works simultaneously as location, Industry, salary so user can easily get any job. All three filters can work together so data fetching such as in Pune with salary of 50k and in Backend Development.



IV C

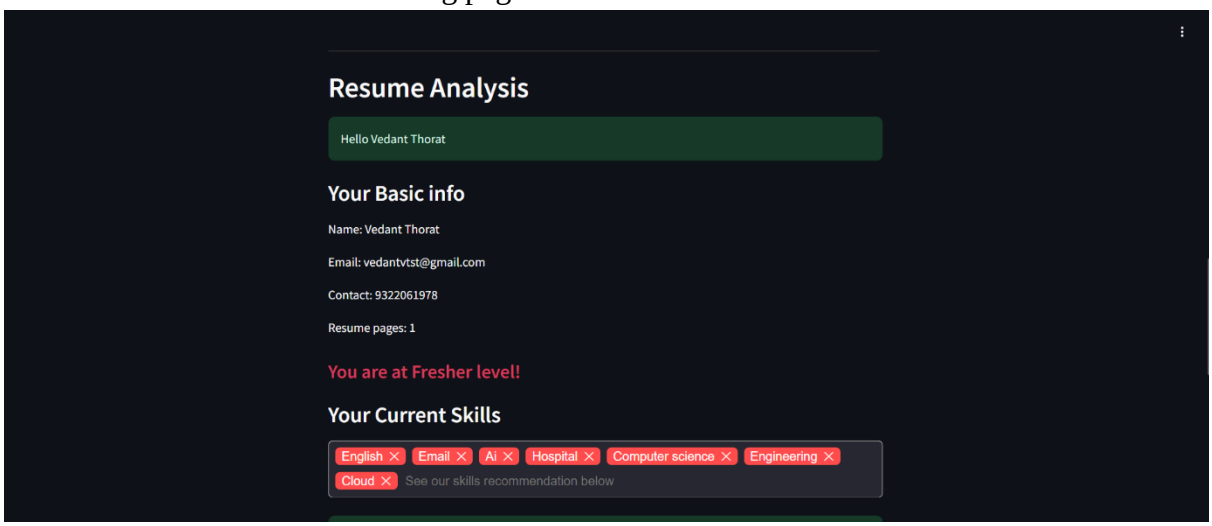
This image shows the initial landing page of the "AI Resume Analyzer" application. At the top, there is a stylized "Résumé" banner, followed by the application's title and a brief instruction prompting users to upload their resume for smart recommendations. Below this, a file upload section is available, allowing users to either drag or drop their PDF resume or click the "Browse files" button to select a file manually. The interface supports PDF uploads up to 200MB and features a clean, dark-themed user interface.



IV D

This image displays the results page after a user has uploaded their resume to the AI Resume Analyzer. It greets the user by name ("Vedant Thorat") and presents key personal information extracted from the resume, such as email, contact number, and resume length. The system classifies the user as a "Fresher" based on the data. Below that, it showcases the extracted skills from the resume using labeled tags such

as "English", "AI", "Computer science", and "Cloud". The interface uses color-coded labels and maintains the same sleek dark theme as the landing page.



IV E

5. CONCLUSION

The usage of a cloud-based arrangement engineering for the college situation cell web-based application presents critical focal points in terms of versatility, cost-efficiency, and openness. By leveraging cloud advances, the situation prepare gets to be more streamlined, empowering understudies and selection representatives to associate consistently over geological boundaries. This arrangement not as it were upgrades operational productivity for the arrangement cell but too gives real-time information bits of knowledge, empowering more educated decision-making. Be that as it may, challenges such as information security, integration with existing foundation, and client appropriation must be tended to for fruitful execution. Looking ahead, the consolidation of progressed highlights like AI-driven analytics and made strides security conventions might assist optimize the stage. Eventually, the cloud-based design has the potential to revolutionize the arrangement prepare, making it more productive and open for all partners included, and offers a establishment for future headways within the instructive innovation space.

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