AI-Powered Next-Gen Job Recommendation System Using NLP and Machine Learning

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Abstract

NextWorkX is an **AI-powered job recommendation** platform that leverages **(NLP) techniques**—such as **TF-IDF vectorization** to extract semantic meaning from user resumes and job descriptions. In parallel, it applies **(ML) algorithms**, including **cosine similarity-based ranking** to provide personalized, **context-aware job** suggestions. Built using **HTML, CSS, JavaScript, PHP, Python,** and **MySQL**, the system supports **role-based interfaces** tailored for both job seekers and recruiters. By analyzing user profiles, uploaded documents, search behavior, and **job metadata**, NextWorkX delivers **intelligent recommendations**, thereby streamlining the recruitment process with improved relevance, **scalability**, and **accuracy**.

Problem Domain

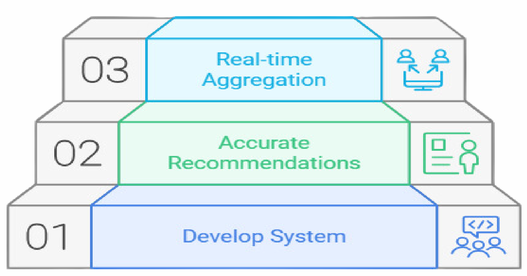
- Inefficiency in Job Matching: Keyword-based systems often provide irrelevant results.
- Challenges in Niche Skills: Limited contextual understanding overlooks specialized skills.
- Need for Context-Aware Solutions: Lack of intelligent algorithms misses opportunities for users.

Motivation

- Traditional platforms fail to match jobs effectively due to **keyword-based limitations**.
- The growing demand for specialized roles requires smarter, **context-aware systems**.
- **AI-based** solutions can streamline recruitment, save time, and enhance the user experience for both job seekers and employers.

Objective

- To develop an AI-powered job recommendation system using Natural Language Processing (NLP) and Machine Learning .
- To provide accurate, context-aware job recommendations tailored to user profiles and preferences.
- To implement real-time job data aggregation and scalable functionality for both job seekers and employers.



Literature Review

Table 1: Summary of Key Findings from Relevant Literature

Author	Contribution	Limitation
Sharma et al [1]	Accurate, customized job recommendations using web scraping, NLP, and BERT embeddings.	Dependency on data quality, potential biases, and limited real-time adaptability
Goyal et al [2]	Combines social media profiling, resumes, and ML to suggest employability scores and emotional intelligence.	Limited data privacy, reliance on API availability, and potential bias in social media analysis.
Behrouz H et al [3]	Automates resume shortlisting using BERT, reducing workload and improving decision-making efficiency.	Relies on historical data quality, lacks interpretability, and may inherit biases from training data.
Patanwadia et al [4]	Enhances recruitment with NLP, dynamic profiles, video interview emotion analysis, and Job Fit Scores.	Emotion analysis accuracy, reliance on video quality, and limited adaptability to diverse industries.
Anju et al [5]	Identifies challenges and potential AI-based solutions for employee-job profile matching using Delphi methodology.	Subjective expert opinions, limited sample size, and focus on feasibility rather than implementation results

Tools & Techniques

- **IDE:** Visual Studio Code – For writing, testing, and debugging code.
- **Frontend:** HTML/CSS for layout; JavaScript for filters, interactivity, and dynamic updates.
- **Backend:** PHP – Handles authentication, sessions, form processing, and database interaction.
- **Model:** Python – Builds the job recommendation engine using NLP and ML techniques.
- **Database:** MySQL – Stores user data, job posts, applications, skills, and profiles.
- **Version Control:** Git & GitHub – For collaboration and source code management.
- **Recommendation Logic:** A Python-based model using TF-IDF and cosine similarity to match user profiles with relevant jobs.

Backend Design (ER-Diagram)

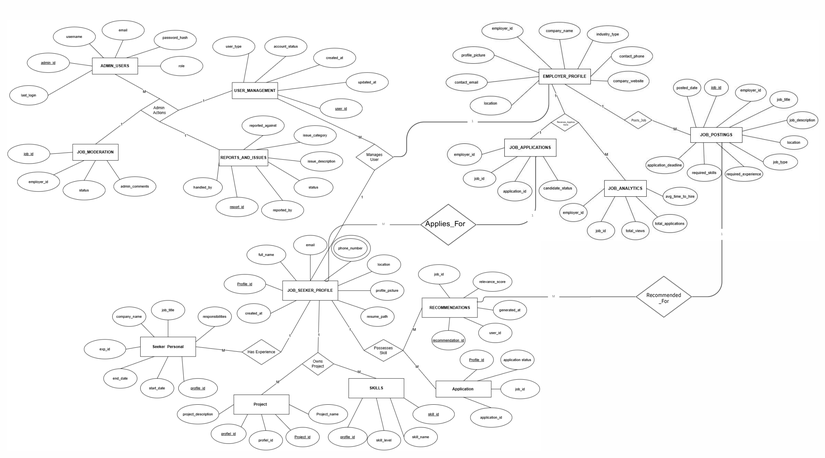
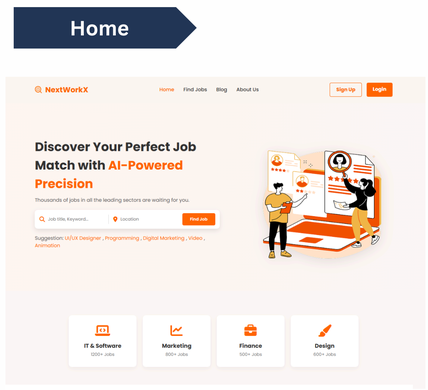
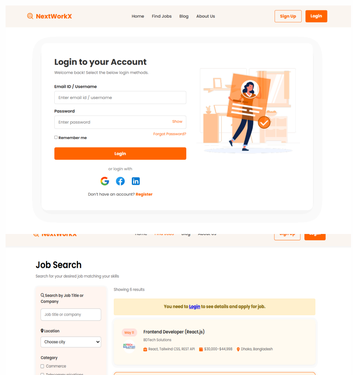


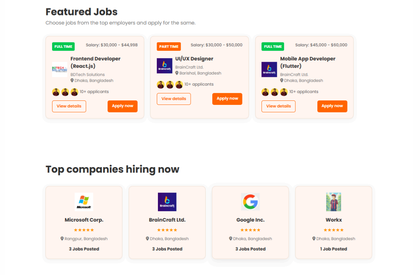
Figure 1: ER Diagram of NGJRS

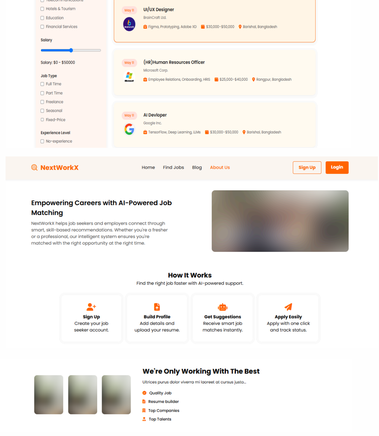
Implementation

Home

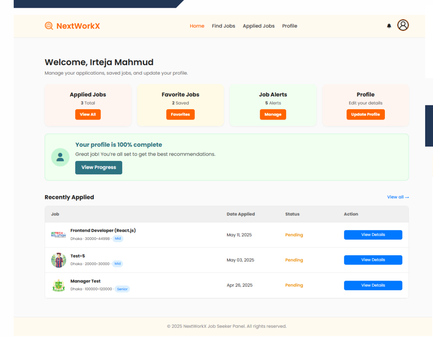


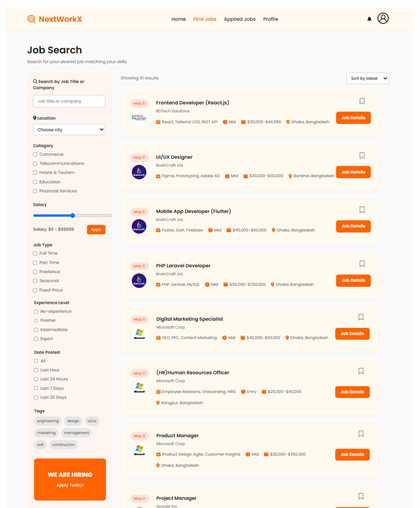




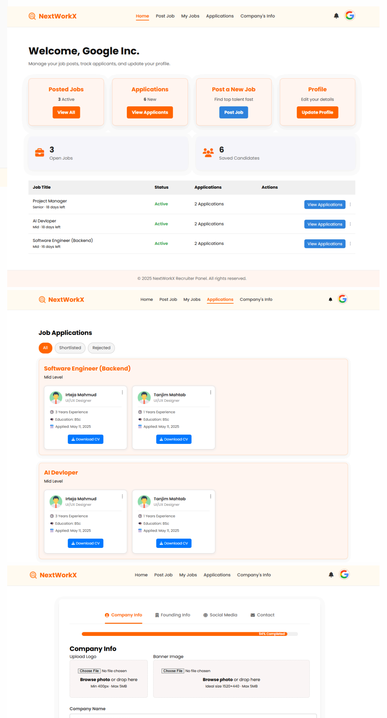


Job Seekers

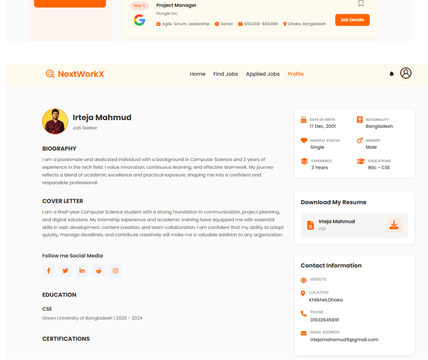


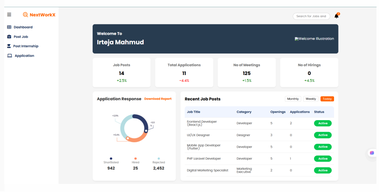


Recruiter



Admin





Testing

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Project Name	NGJRS	Test Designed by:	Group -1
		Test Executed by:	Nazmul Hasan,Irteja Mahmud,Pankaj Mahanta
Pre-Condition:	Need Internet Connection		
Dependencies	None		
: Test Priority:	Security,Reliabl e, Easy to use		

Test Case Number	Criteria	Test Case Description	Action	Input(Test Case)	Expected Output	Actual output	Test Result
TC-001	Valid Registration	User registers with valid details	1) User submits valid registration form	Full Name: John Doe Email: john@example.com Password: abc123 Confirm Password: abc123	"Account created successfully" message Redirect to login page	Account created and redirected	Pass
			2) User enters an invalid email format	Email: john@.example.com	Email format valid	Invalid email detected	Pass
			3) Password is encrypted	Password: abc123	Password encrypted	Password stored in encrypted format	Pass
			4) Data saved to database	All valid data	Account created in database	Account saved successfully	Pass
			5) Redirect to login page after registration	N/A	Redirected to login page	Login page loaded	Pass
TC-002	Valid Login	User logs in with valid details	1) User submits login form	Email: john@example.com Password: abc123	Credentials submitted	Credentials accepted	Pass
			2) Credentials are validated	Email: john@example.com Password: abc123	Credentials matched	User authenticated	Pass
			3) Session token is generated	User ID: 102	Session token generated	Token created	Pass
			4) User is redirected to dashboard	N/A	User redirected to dashboard	Dashboard page loaded	Pass
TC-003	Job Recommendation	System recommends jobs based on user skills	1) User clicks on 'Show My Matches'	User ID: 1005	Top 5 matched	Top 5 job IDs	
			2) Profile data is loaded	User ID: 1005	Profile data loaded	Profile fetched from DB	Pass
			3) Matching scores are calculated	TF-IDF vectors from profile and jobs	Similarity scores generated	Scores: [0.92, 0.87, ...]	Pass
TC-004	Job Application	User applies to a selected job	1) User clicks 'Apply Now'	User ID: 1005 Job ID: 203	Application is submitted	Application submitted	Pass
			2) Application is recorded	user_id, job_id, applied_at	Saved to applications table	Application stored successfully	Pass
TC-005	Resume Upload	User uploads a valid resume file	1) User uploads a valid PDF resume	File: resume.pdf Size: 3MB	Resume uploaded successfully	Resume saved and displayed	Pass
			2) File type and size are validated	File: resume.docx or size > 5MB	Invalid file or size error shown	Error message displayed	Pas
TC-006	Admin Login	Admin logs in using correct credentials	1) Admin submits login form	Email: admin@nextworkx.com Password: admin123	Admin redirected to dashboard	Admin dashboard loaded	s Pass
			2) Invalid login credentials entered	Email: admin@wrong.com Password: wrongpass	Error message displayed	Invalid credentials alert	Pass
TC-007	Job Posting	Recruiter posts a new job	1) Submit new job post form	Title: Web Developer Location: Dhaka Salary: 25,000–35,000 BDT	Job posted successfully	Job entry added to database	Pass
			2) Leave required fields empty	Title: [Blank] Location: Dhaka	Form validation error	Warning: Required fields missing	Pass
TC-008	Company Profile Setup	Recruiter completes company profile steps	1) Fill out 'Company Info' step	Company Name: DevTech Ltd. Founded: 2018	Company info saved	Info saved in company_profiles table	Pass
			2) Skip a step and try to continue	Step: Social Media Info Fields: [Blank]	Validation error message	Step cannot proceed without data	Pass
TC-009	Bookmark Job	User bookmarks a job for later viewing	1) User bookmarks a job	User ID: 1005 Job ID: 203	Job added to saved list of bookmarked jobs displayed	Job saved in bookmarks table	Pass
			2) User views saved jobs	User ID: 1005		Saved job list shown	Pass
			3) User removes a saved job	User ID: 1005 Job ID: 203	Job removed from saved list	Job deleted from bookmarks table	Pass
TC-010	Search Filter	User searches for jobs using keyword filter	1) User searches by keyword	Keyword: Python Developer	Jobs with title or description containing keyword are shown	Relevant jobs displayed	Pass
			2) Filter by city	City: Dhaka	Jobs located in Dhaka are displayed	City-filtered jobs shown	Pass
			3) Filter by salary range	Min: 20000, Max: 50000	Jobs within salary range are shown	Salary-filtered jobs shown	Pass
			4) Apply multiple filters together	Keyword: Developer City: Dhaka Salary: 20000–50000	Jobs matching all filters are shown	Filtered job list displayed	Pass
			5) Clear all filters	Click on 'Reset/Clear Filters'	All filters cleared and default job list shown	Filters reset and full list reloaded	Pass

Social Impact

- **Empowering Job Seekers:** Provides personalized job recommendations, helping individuals find roles that match their skills and aspirations.
- **Enhancing Recruitment Efficiency:** Reduces hiring time and effort for employers, ensuring the right candidates are matched to the right roles.
- **Promoting Fair Opportunities:** Utilizes unbiased AI algorithms to ensure equitable access to job opportunities for all candidates.
- **Adapting to Modern Workforce Needs:** Addresses the growing demand for specialized roles and context-aware solutions in a dynamic job market.

Conclusion

- Utilizes AI, NLP, and ML to enhance job-matching accuracy.
- Provides personalized, context-aware job recommendations.
- Developed using Agile methodology for adaptability and continuous improvement.
- Integrates a Python-based recommendation engine using TF-IDF and cosine similarity.
- Enables dynamic matching by analyzing user profiles (skills, education, experience).
- Supports a role-based platform for recruiters and job seekers with a clean, responsive UI.

Reference

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