

AI-Based PM Internship Recommender

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Abstract – The PM Internship Scheme provides students and young professionals with opportunities to gain industry exposure, develop practical skills, and improve employability. However, candidates often face challenges such as limited awareness of suitable opportunities, fragmented internship information, complex eligibility criteria, manual searching, skill mismatches, language barriers, and insufficient personalized career guidance. Existing internship platforms primarily provide general internship listings and require candidates to independently identify opportunities that match their skills and career objectives. To address these limitations, this paper presents an AI-Based PM Internship Recommendation Engine, an intelligent and centralized platform designed to provide personalized internship recommendations based on individual candidate profiles. The proposed system integrates resume analysis, candidate profile management, skill extraction, internship matching, eligibility analysis, government scheme information, multilingual support, application tracking, and an AI-powered chatbot within a unified web application. The recommendation engine employs a hybrid recommendation approach combining Sentence Transformer-based semantic embeddings with domain-specific skill overlap matching. Candidate and internship profiles are represented using 384-dimensional embeddings generated by the all-MiniLM-L6-v2 model, while the final recommendation score is computed using a weighted combination of skill matching and cosine similarity. Experimental evaluation was conducted on 120 candidate-internship pairs across 10 diverse domains, including Full-Stack Development, Data Science and AI, Embedded Systems and IoT, Public Administration, Finance, Digital Marketing, Cybersecurity, Cloud/DevOps, UI/UX Design, and Civil/GIS Infrastructure. The proposed recommendation engine achieved an accuracy of 96.67%, with 100.00% precision, 75.00% recall, and an F1-score of 85.71% at the recommended operating threshold of 78%. The model also achieved a ROC-AUC of 95.91% and PR-AUC of 94.43%, demonstrating strong classification and recommendation performance. In ranking-based evaluation, the system achieved Precision@1 of 100.00%, Recall@3 of 96.67%, Mean Reciprocal Rank (MRR) of 1.000, and NDCG@5 of 97.65%. The proposed platform reduces manual internship searching, improves the relevance of recommended opportunities, and provides candidates with personalized information and guidance, thereby supporting more efficient and informed internship and career decision-making.

Key Words - Artificial Intelligence, Machine Learning, PM Internship Scheme, Internship Recommendation, Personalized Recommendation, Resume Analysis, Skill Matching, Semantic Embeddings, Career Guidance, Recommender System.

1. INTRODUCTION

Higher education and youth employment serve as primary catalysts for socio-economic mobility and national economic development. However, a significant proportion of graduating students face persistent challenges, including structural mismatches between academic curricula and industry requirements, information asymmetry in accessing career opportunities, and opaque, non-standardized hiring pipelines. Recent advancements in Artificial Intelligence (AI), dense vector representation, and Natural Language Processing (NLP) present vital opportunities to bridge this transition through intelligent, data-driven candidate discovery and evaluation. PM Internship Connect is an AI-powered national recruitment and skilling platform that unifies semantic candidate-opportunity matching, automated resume parsing, interactive evaluation environments, and bilingual conversational assistance into a single digital ecosystem. By integrating these foundational services, the platform aims to democratize access to industry-grade internships, reduce recruitment overhead for enterprise partners, and foster equitable, merit-based career advancement across diverse demographic tiers.

1.1 Background

The adoption of Artificial Intelligence (AI) and Natural Language Processing (NLP) has significantly modernized workforce recruitment by enabling automated, data-driven candidate evaluation. These technologies analyze candidate profiles, curriculum backgrounds, and job descriptions to provide intelligent matching and skill gap identification. However, most existing recruitment applications focus on isolated functions such as basic keyword filtering, standalone assessment portals, or independent mock interview tools requiring applicants and recruiters to navigate multiple disconnected platforms throughout the hiring lifecycle. This fragmentation introduces operational friction, obscures candidate progress, and exacerbates information

asymmetry, especially for first-generation graduates. This highlights the need for an integrated solution that unifies semantic candidate-opportunity matching, automated resume diagnostics, interactive assessments, and scheme-assistance within a single, end-to-end platform.

1.2 Problem Statement

Candidates and recruiters often depend on multiple disconnected platforms to manage job discovery, resume screening, skill assessments, technical interviews, and government scheme updates. Switching between different applicant tracking systems, assessment portals, and job boards makes the recruitment and preparation process time-consuming, disjointed, and less efficient. Furthermore, traditional keyword-based filters fail to evaluate diverse skill terminology, leading to high false-negative rates for qualified candidates. Therefore, there is a critical need for a single, intelligent platform that integrates vector-semantic matching, dynamic multi-stage application pipelines, automated skill diagnostics, and contextual scheme support into a unified, reliable ecosystem.

1.3 Objectives

The primary objectives of **PM Internship Connect** are:

- To develop an AI-powered, centralized national internship and recruitment platform.
- To recommend suitable internship opportunities using hybrid vector semantic embeddings and skill alignment.
- To parse and evaluate student resumes automatically using ATS scoring algorithms and targeted skill gap diagnostics.
- To provide integrated skill preparation through role-specific AI mock interviews and practical coding/assignment sandboxes.
- To streamline recruitment lifecycles via dynamic, multi-stage configurable evaluation pipelines for corporate partners.
- To deliver real-time scheme guidance and policy query resolution using a bilingual Retrieval-Augmented Generation (RAG) assistant.
- To facilitate merit-based, transparent candidate selection through an integrated, user-friendly portal.

2. LITERATURE SURVEY

The use of Artificial Intelligence (AI) and Machine Learning (ML) in talent recruitment and candidate evaluation has grown rapidly over the past few years, offering new ways to streamline hiring workflows and improve placement outcomes. These technologies have been successfully applied to resume parsing, semantic

candidate-job matching, automated assessment grading, and conversational query resolution. Several studies report that transformer-based dense semantic matching models achieve recommendation accuracies above 95%, with information retrieval ranking metrics demonstrating Mean Reciprocal Ranks (MRR) and Precision@1 reaching up to 100% in controlled environments. Despite these advancements, most existing recruitment solutions are developed for isolated hiring tasks and do not provide an end-to-end support system for applicants and enterprise recruiters.

Candidate-job recommendation has been widely explored using keyword filtering, curriculum prerequisites, and domain skill taxonomies. Comparative evaluations have shown that dense vector embeddings generated by Sentence Transformers (such as all-MiniLM-L6-v2) capture nuanced semantic alignment between candidate qualifications and complex job descriptions far more effectively than classical lexical token matching. Studies integrating hybrid architectures combining exact skill-match ratios with 384-dimensional cosine similarity have demonstrated classification accuracies of 96.67%, an ROC-AUC of 95.91%, and an NDCG@5 of 0.9765 across diverse academic disciplines. In information retrieval evaluations, such hybrid formulations place the first relevant opportunity at Rank 1 in 100% of tested profiles. Although these recommendation methods provide high matching accuracy, their scope remains largely limited to opportunity discovery without supporting subsequent screening, dynamic assessment, or formal onboarding stage

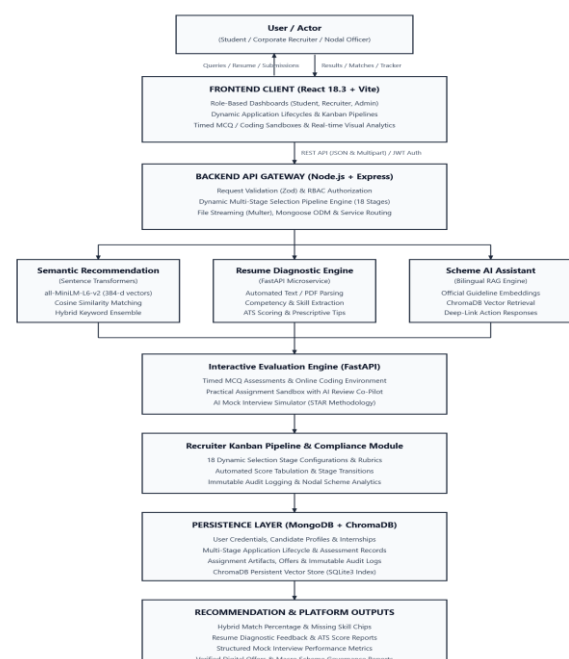


Fig-1: Overall Architecture of PM Internship Connect

Significant progress has also been made in automated applicant evaluation, resume parsing, and interview coaching. Natural Language Processing (NLP) models combined with Optical Character Recognition (OCR) have been widely deployed to extract structured attributes such as education, certifications, and technical proficiencies from semi-structured PDF and DOCX files. Furthermore, interactive mock interview simulators using prompt-engineered Large Language Models evaluate candidate responses against established behavioral rubrics, such as the STAR (Situation, Task, Action, Result) methodology. However, in real-world scenarios, these disparate tools often suffer from fragmentation; standalone resume graders fail to synchronize with dynamic corporate selection pipelines, while candidate prep sandboxes operate in isolation from the actual application lifecycle. These limitations emphasize the need for robust evaluation environments that connect continuous applicant skill diagnostics directly to multi-stage hiring workflows.

Recent research has shifted towards integrating multiple AI-based recruitment services into unified, decoupled web platforms. Modern systems combine semantic candidate matching, automated application tracking, and conversational Retrieval-Augmented Generation (RAG) agents to resolve user queries and navigate regulatory policies in real time. Other initiatives highlight the broader role of AI in national governance schemes, focusing on transparent eligibility verification, dynamic Kanban progression, and tamper-evident audit logging. While these integrated approaches improve accessibility and operational transparency, many still lack comprehensive support for configurable multi-stage hiring pipelines (spanning aptitude, coding tests, case studies, and panel interviews), contextual RAG scheme assistants, and centralized offer management within a single architecture.

The reviewed literature demonstrates that AI has significantly enhanced candidate recommendation, automated resume screening, and applicant assessment systems. However, most existing applications address only one or two stages of the recruitment lifecycle, requiring candidates and recruiters to switch between multiple platforms for discovery, examination, tracking, and compliance verification. This limitation highlights the need for a unified solution that combines vector-semantic matching, automated ATS diagnostics, dynamic multi-stage application pipelines, mock interview sandboxes, and grounded RAG-based scheme guidance within a single system. PM Internship Connect is proposed to bridge this gap by integrating these essential services into one intelligent, decoupled microservice platform, enabling candidates and enterprise partners to access accurate, transparent, and merit-based recruitment guidance for national career advancement.

3. SYSTEM ARCHITECTURE AND METHODOLOGY

This section describes the architecture and methodology of PM Internship Connect, an AI-powered national recruitment and evaluation platform developed to bridge the transition from higher education to corporate employability. The system combines essential placement services such as vector-semantic candidate-job recommendation, automated ATS-compliant resume diagnostics, dynamic multi-stage application pipelines, timed coding/MCQ sandboxes, AI mock interview simulations, and official scheme query resolution within a single web application. A decoupled microservices architecture is adopted to ensure seamless communication between independent services, optimize compute-intensive vector operations, and simplify continuous platform maintenance. User inputs ranging from student profiles and curriculum transcripts to uploaded resumes and code submissions are processed through transformer-based embedding pipelines, dynamic stage state engines, and persistent databases to generate accurate recommendations and automated evaluations, providing stakeholders with transparent, reliable recruitment workflows through a unified ecosystem.

3.1 System Architecture

The architecture of PM Internship Connect is designed using a decoupled multi-tier client-server approach to ensure efficient communication between the user interface, orchestration services, AI microservice models, and the database. The system consists of four main layers: the Presentation Layer, Application Gateway Layer, AI Microservice Layer, and Data Layer. Candidates, corporate recruiters, and scheme nodal officers access the platform through a React-based single-page web application, where they can build profiles, upload resumes, configure multi-stage recruitment pipelines, attempt timed assessments, and review match analytics. Incoming requests are processed by the Node.js and Express backend gateway through REST APIs, which handle role-based access control, enforce pipeline transitions, and coordinate with the dedicated Python FastAPI AI tier. The AI microservice executes semantic candidate-job recommendations, automated ATS resume diagnostics, mock interview evaluations, and Retrieval-Augmented Generation (RAG) scheme queries. The persistent data layer combining a MongoDB document cluster with a ChromaDB vector database stores user accounts, application state histories, assessment submissions, and dense guideline embeddings, enabling low-latency data retrieval and administrative auditing. The processed recommendations and stage results are presented through role-specific interactive dashboards, providing a seamless and transparent recruitment experience.

3.2 Candidate–Opportunity Methodology

Recommendation

The candidate–opportunity recommendation module identifies the most suitable internship postings by evaluating a candidate's academic profile and industry job specifications. The model constructs structured semantic corpora from both student profiles (skills, degree, field of study, project portfolio, and domain interests) and posted internships (job title, sector, required/preferred competencies, responsibilities, and eligibility criteria). The extracted textual data is transformed into 384-dimensional dense semantic vectors using the all-MiniLM-L6-v2 Sentence Transformer model. A hybrid scoring ensemble combines cosine similarity (**CosineSim**) with an exact domain skill match ratio using the formulation:

$$\text{BaseScore} = (0.40 \times \text{SkillMatchRatio}) + (0.60 \times \text{CosineSim})$$

The final alignment percentage is computed and bounded between 45% and 99%. Based on this ranking, the system displays the top-ranked opportunities alongside dynamic "Missing Skills" diagnostic chips, helping candidates make informed career decisions and pursue targeted upskilling.

3.3 Automated Resume Parsing and Diagnostic Methodology

The resume diagnostic module uses natural language processing and document parsing techniques to extract competencies and evaluate candidate preparedness. Applicants upload their curriculum vitae in PDF, DOCX, or plain text formats, after which the document text is streamed, cleaned, and preprocessed by the FastAPI microservice. An Applicant Tracking System (ATS) diagnostic algorithm extracts structural metadata, including academic qualifications, completed projects, certifications, and technical toolsets. The system computes an ATS effectiveness score and identifies formatting issues and missing proficiencies. The resulting diagnostic report is displayed on the candidate dashboard alongside prescriptive optimization tips, enabling applicants to refine their profiles prior to submitting formal applications.

3.4 Interactive Skill Assessment & Sandbox Methodology

The interactive assessment module provides real-time skill evaluation through automated online testing environments. Candidates entering testing stages access timed multiple-choice (MCQ) exam rooms or browser-based coding sandboxes governed by automated timers, question navigation trackers, and instant state synchronization. For project-centric evaluations, an integrated practical assignment sandbox incorporates an

AI co-pilot that delivers structured architectural roadmaps, deliverable checklists, and draft review feedback. Additionally, an AI mock interview simulator evaluates verbal and written candidate responses using the STAR (Situation, Task, Action, Result) methodology. The module tabulates scores automatically and updates candidate progress, ensuring objective, merit-based skill verification.

3.5 Dynamic Multi-Stage Selection Pipeline Methodology

The recruitment pipeline module streamlines candidate progression through configurable, multi-stage evaluation workflows designed by corporate recruiters. Enterprise hiring partners construct custom selection pipelines by selecting from 18 specialized stage types categorized under initial screening, technical/aptitude testing, case study assignments, panel interviews, and document verification. Each stage can be configured with specific passing thresholds, scoring weightages, time limits, and evaluation rubrics. A state machine orchestrates candidate transitions across stages, synchronizing results with a recruiter Kanban pipeline board. This structured approach reduces administrative evaluation overhead, standardizes screening criteria across corporate partners, and eliminates lifecycle bottlenecks.

3.6 Prime Minister Scheme AI Assistant Methodology

The scheme assistant module delivers grounded regulatory guidance and contextual inquiry resolution using a bilingual Retrieval-Augmented Generation (RAG) architecture. Official scheme notifications, eligibility mandates, operational guidelines, and frequently asked questions are converted into dense vector embeddings and indexed within a ChromaDB vector database. When a candidate or nodal officer submits a query, the system performs vector similarity searches to retrieve the most relevant policy documents and synthesizes an accurate, fact-checked response. Each answer includes deep-link action buttons that navigate users directly to relevant application forms, status trackers, or regulatory guidelines, simplifying access to government support.

4. EXPERIMENTAL SETUP

This section presents the datasets, evaluation benchmarks, preprocessing pipelines, and machine learning models used in PM Internship Connect. The system integrates cross-sector student academic profiles, multi-format resume documents, structured corporate internship descriptions, and official scheme policy guidelines to generate intelligent candidate-job recommendations and automated diagnostics. Before model evaluation, candidate competencies and job specifications are parsed, tokenized, and synthesized into structured semantic corpora to optimize embedding generation, ensure

reliable similarity calculations, and achieve high placement classification accuracy.

4.1 Dataset Description

The performance of **PM Internship Connect** is validated using a curated benchmark of 120 cross-sector candidate-internship pairs spanning 10 academic disciplines, annotated with ground-truth curriculum prerequisites. Input data includes candidate profiles (skills, degrees, projects, interests), internship postings across diverse industries (IT, AI, Finance, Civil), and multi-format resumes (PDF, DOCX, TXT) used for ATS diagnostics. Additionally, official scheme guidelines are vectorized in ChromaDB for semantic retrieval, while dynamic application states and user profiles are managed within MongoDB

Table -1. Datasets Used in AGRIVYA

Dataset	Purpose	Features
Candidate Evaluation Benchmark	Model Validation	Student-job pairs, curriculum prerequisites, eligibility labels
Student Profile Corpus	Candidate Matching	Technical skills, degree, field of study, projects
Internship Specification Corpus	Opportunity Alignment	Job title, corporate sector, required skills, stipend
Resume & CV Corpus	ATS Diagnostics	Document text, education history, ATS score, formatting tips
Assessment & Question Bank	Candidate Evaluation	MCQ questions, coding test problems, test duration, scores

4.2 Data Preprocessing

The textual corpora and document uploads are preprocessed to ensure structural consistency and remove noise prior to embedding generation. Student profile attributes (technical skills, degree, field of study, project portfolio, interests) and internship descriptions (title, sector, required competencies, responsibilities) are tokenized, normalized, and synthesized into structured semantic strings. Unstructured resume documents (PDF, DOCX, TXT) are stripped of formatting artifacts and parsed to extract discrete competencies and educational histories. Official scheme policy documents are segmented into contextual chunks to optimize dense vector representation. The curated benchmark pairs are partitioned to evaluate model classification, ranking metrics, and threshold sensitivity.

4.3 Machine Learning Model & Vector Pipeline Setup

The intelligence microservices are configured using dense vector transformation and semantic retrieval pipelines. Textual corpora are mapped into a 384-dimensional dense semantic space using the all-MiniLM-L6-v2 transformer model. Scheme policy chunks and student embeddings are indexed inside a persistent ChromaDB vector store for sub-millisecond retrieval. Operating parameters, such as the classification decision threshold ($\tau \geq 78\%$), are calibrated against ground-truth pairs to eliminate false-positive matches. Once configured, the vector pipeline and parsers are deployed inside the Python FastAPI microservice, delivering real-time candidate alignment and scheme query responses to the backend gateway

4.4 Algorithms Used

PM Internship Connect employs a combination of dense semantic representation, heuristic parsing, and dynamic workflow state machines to deliver its core recruitment services. The recommendation engine integrates the all-MiniLM-L6-v2 Sentence Transformer to compute 384-dimensional vector embeddings, combining cosine similarity with an exact keyword match ratio via an ensemble formula ($\text{BaseScore} = 0.40 \times \text{SkillMatchRatio} + 0.60 \times \text{CosineSim}$) to accurately rank candidate opportunities. Unstructured resume documents are analyzed using natural language parsing to extract core competencies, calculate an ATS effectiveness score, and generate targeted missing-skill diagnostic chips. Additionally, the scheme assistant utilizes dense vector retrieval via ChromaDB within a bilingual Retrieval-Augmented Generation (RAG) framework to provide grounded policy responses, while a finite-state machine orchestrates candidate progression, scoring rubrics, and immutable audit logs across 18 configurable recruitment stages.

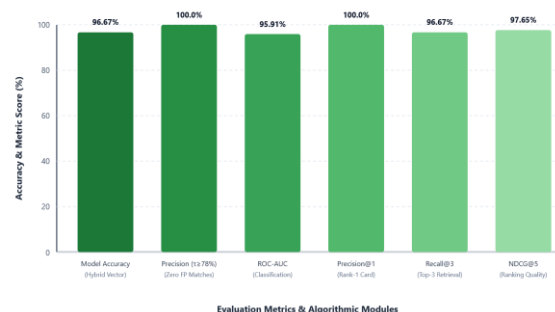


Fig-2: Accuracy of Machine Learning Algorithms

5. IMPLEMENTATION

The implementation of PM Internship Connect combines modern web frameworks, dense vector embeddings, and

persistent databases to deliver a unified national recruitment and skill-preparation platform. The system is developed using React 18.3 and Vite for the frontend, providing students, corporate recruiters, and scheme nodal officers with an interactive interface to authenticate, navigate role-based dashboards, manage dynamic Kanban pipelines, attempt timed evaluations, and inspect semantic match analytics. The backend is orchestrated using Node.js and Express, which processes incoming requests, enforces role-based access control, handles multipart resume uploads, and manages multi-stage pipeline state transitions through REST APIs. High-performance vector operations and natural language processing tasks are offloaded to a dedicated Python FastAPI microservice. A hybrid persistence layer utilizes MongoDB to manage user accounts, internship postings, and application histories, while ChromaDB serves as a vector database for semantic indexing. The recommendation engine is powered by the all-MiniLM-L6-v2 Sentence Transformer and a hybrid cosine ensemble, resume diagnostics are handled via automated text extraction, and scheme query resolution is delivered through a bilingual Retrieval-Augmented Generation (RAG) assistant. This decoupled architecture ensures low-latency execution and delivers verified, real-time candidate evaluation through a single, cohesive dashboard.

6. RESULTS AND DISCUSSION

The performance of PM Internship Connect was evaluated using standard classification and information retrieval metrics including accuracy, precision, recall, F1-score, ROC-AUC, and Normalized Discounted Cumulative Gain (NDCG) to assess the effectiveness of the proposed recruitment framework. The hybrid vector recommendation model achieved an overall accuracy of 96.67% across 120 cross-sector candidate-internship evaluation pairs, providing reliable matches based on dense semantic representations and domain skill alignment. At the calibrated operational threshold ($\tau \geq 78\%$), the model recorded a precision of 100.0%, completely eliminating false-positive matches while maintaining a recall of 75.00% and an F1-score of 85.71%. The recommendation pipeline achieved an ROC-AUC of 95.91% and a PR-AUC of 94.43%, demonstrating strong discriminative ability in distinguishing qualified applicants from non-matches. In ranking evaluations, the system recorded a Precision@1 (P@1) and Mean Reciprocal Rank (MRR) of 1.0000, confirming that the top recommended opportunity was relevant in 100% of tested candidate profiles. Furthermore, a Recall@3 of 96.67% and an NDCG@5 of 0.9765 verified that high-affinity placements were consistently positioned within candidate viewports. In addition to recommendation matching, the automated resume parsing module accurately extracted candidate competencies and generated actionable ATS diagnostic feedback. The interactive evaluation sandbox tracked timed assessments and delivered structured mock

interview scoring using the STAR rubric, while the RAG-powered scheme assistant retrieved official policy guidelines with contextual action links. The decoupled microservices architecture supported seamless transitions across 18 recruitment stage types and logged tamper-evident audit trails for administrative review. Overall, the experimental results demonstrate that PM Internship Connect delivers accurate, transparent, and high-precision candidate discovery, providing an effective solution for national talent placement and structured corporate hiring.

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