



# InterviewBo: Multimodal Intelligence System for End-to-End Recruitment Process Automation and Skill Interpretation

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**ABSTRACT:** InterviewBo is an AI-powered recruitment platform designed to automate the end-to-end hiring process while improving fairness, efficiency, and accuracy in candidate evaluation. The system integrates Sentence-BERT (SBERT) for semantic resume–job matching, Gradient Boosting Classifier (GBC) for aptitude assessment, and Code2Vec for programming skill evaluation. In the final stage, a fine-tuned T5 model generates personalized interview questions through a virtual HR avatar. Candidate responses are analyzed using MFCC with BiLSTM for speech evaluation and a Spatiotemporal Attention Network for facial behavior analysis. By combining multimodal AI techniques, the system enables objective performance profiling and supports data-driven hiring decisions while reducing human bias and recruitment time.

**KEYWORDS:** Artificial Intelligence, Recruitment Automation, SBERT, Code2Vec, T5, BiLSTM, Multimodal Learning, Hiring Systems

## I. INTROUCTION

In recent years, the recruitment process has undergone significant transformation due to the rapid growth of digital applications and the increasing demand for skilled talent across industries. Organizations receive a large volume of applications for every job opening, making manual screening and evaluation time-consuming and inefficient. Traditional hiring methods rely heavily on human judgment, which often leads to inconsistencies, delays, and potential bias in decision-making. As a result, many qualified candidates may be overlooked, while unsuitable candidates may be selected, affecting overall organizational performance.

The integration of Artificial Intelligence (AI) into recruitment has emerged as a promising solution to address these challenges. AI-based systems enable automation of repetitive tasks such as resume screening, candidate shortlisting, and initial assessments. However, most existing systems are limited to keyword-based filtering or basic analytics, lacking the ability to understand contextual meaning, evaluate behavioral traits, and provide comprehensive candidate insights. Moreover, conventional interviews fail to objectively measure critical aspects such as communication skills, confidence, facial expressions, and engagement, which are essential for effective hiring decisions.

To overcome these limitations, this paper proposes InterviewBo, a multimodal intelligence system designed to automate the end-to-end recruitment process. The system integrates advanced Natural Language Processing (NLP), Machine Learning (ML), and Deep Learning techniques to evaluate candidates across multiple dimensions, including technical skills, cognitive ability, speech proficiency, and behavioral patterns. By leveraging semantic analysis for resume matching, intelligent assessment models, and an AI-driven avatar-based interview system, InterviewBo ensures a fair, consistent, and data-driven hiring process. This approach not only reduces human bias and operational effort but also enhances the accuracy and reliability of recruitment outcomes, making it suitable for modern talent acquisition needs.



## II. PROBLEM STATEMENT

The current recruitment process in many organizations is largely manual, time-consuming, and prone to inconsistencies. Recruiters are required to review a high volume of resumes, which increases operational effort and delays the hiring process. Traditional systems primarily rely on keyword-based filtering techniques that fail to capture the contextual meaning of candidate skills and experience, resulting in the rejection of suitable candidates and selection of less qualified profiles.

Furthermore, interviews conducted by human evaluators are often influenced by personal bias, mood, and subjective judgment, leading to unfair and inconsistent candidate assessment. Existing recruitment methods also lack standardized mechanisms to evaluate critical factors such as communication skills, confidence, emotional stability, and engagement. Technical and aptitude skills are typically assessed without data-driven validation, reducing the reliability of hiring decisions.

Additionally, there is no unified system that integrates resume analysis, skill assessment, behavioral evaluation, and decision support into a single platform. This fragmentation results in inefficiencies, lack of transparency, and poor coordination throughout the recruitment lifecycle.

Therefore, there is a need for an intelligent, automated, and unbiased recruitment system that can efficiently process large volumes of applications, accurately evaluate candidates across multiple dimensions, and support data-driven hiring decisions while minimizing human intervention and bias.

## III. LITERATURE SURVEY

**1. Title:** AI-Powered HR Recruitment Management System With Resume Screening, Interview Automation, Video Assessment And Candidate Skill Gap Analysis.

**Author:** Ra, N., J K, R., S, S., & S, M. (2025).

**Description:** The system leverages Natural Language Processing (NLP) and semantic embeddings via Doc2Vec to match candidate resumes with job descriptions, while generative AI models facilitate dynamic interview question generation and skill extraction. Audio responses are processed using speech-to-text and evaluated against predefined criteria, including confidence, clarity, relevance, and vocal quality. A skill gap analysis module identifies missing competencies by comparing candidate profiles with role requirements. The architecture employs a modular approach, combining a React-based front end, Node.js middleware, a Fast API-based machine learning service, and a MongoDB backend, enabling scalability and real-time processing.

**2. Title:** The impact of artificial intelligence RPA driven clinical auxiliary diagnostic system on misdiagnosis rate of patients with mental disorders.

**Author:** Liu, H. (2026). 237.

**Description:** The diagnosis of mental disorders highly relies on the subjective judgment and experience of clinical doctors. diagnostic system driven by AI-RPA can reduce human errors by automatically collecting and analyzing multimodal data, and using machine learning algorithms to provide standardized diagnostic recommendations. The study aims to evaluate the impact of the AI-RPA assisted diagnostic system on the accuracy of diagnosing common mental disorders in real clinical scenarios, and quantify its changes in misdiagnosis rates, with the aim of optimizing the diagnostic process, improving diagnostic efficiency and accuracy. The study adopted a prospective, multicenter, randomized controlled trial design. 1200 suspected patients with mental disorders who were seeking initial treatment were recruited from the psychiatric clinics of three tertiary hospitals. The patients were randomly divided into an intervention group (n = 600) and a control group (n = 600).

**3. Title:** The algorithmic management of job loss and creation in the enterprise generative, multimodal, and agentic artificial intelligence economy.

**Author:** Lăzăroiu, G., Gedeon, T., Fernando, X.N., Herciu, M., Grecu, G., Chiru, C., Grecu, I., Pârvu, I., & Guni, C. (2025).

**Description:** Facilitate transformative productivity and workforce adaptation gains in innovative organizations, redesigns autonomous team and talent management for workforce and job rotation planning, skill development, and career paths, handle context-specific collaborative business processes, workflows, and decision-making, and augment multi-agent system scaling for labor productivity and operational efficiency, redefining agile and adaptive organizational performance in dynamic business environments, driving interoperable big employee data and strategic



decision management, and creating strategic fluidity and synchronized digital labor for sustainable business value. Connected and interoperable agentic AI systems can carry out multistep tasks autonomously, reduce operational costs and unemployment rates, and manage big data-based organizational workflows and management pipelines, driving business value creation and productivity gains, reallocating digital labor, and redefining employee experiences and labor markets in terms of job loss and creation by upskilling and retraining.

## IV. EXISTING SYSTEM

The existing recruitment system primarily follows traditional hiring practices, which rely heavily on manual processes and human judgment. In this approach, recruiters are responsible for handling almost every stage of the recruitment lifecycle, including job posting, resume screening, interview scheduling, and final candidate selection.

### A. Traditional Recruitment Process

The typical workflow of existing systems includes:

- Job advertisement through portals and networks
- Manual screening of resumes based on keywords and qualifications
- Telephonic or face-to-face interviews
- Final selection based on interviewer judgment

This process is largely dependent on human effort and varies from one recruiter to another, resulting in inconsistency and lack of standardization .

### B. E-Recruitment and ATS-Based Systems

To improve efficiency, some organizations use Applicant Tracking Systems (ATS) and basic e-recruitment platforms. These systems:

- Automate resume collection and storage
- Perform keyword-based filtering
- Assist in scheduling interviews

However, these systems still rely on simple keyword matching and fail to understand the semantic meaning of candidate skills and experience, leading to inaccurate shortlisting .

### C. Limitations of Existing Systems

Despite technological advancements, existing systems suffer from several drawbacks:

- Time-Consuming Process: Manual screening can take several hours per hire and delays decision-making
- High Human Dependency: Recruitment decisions depend heavily on individual recruiters
- Subjective Evaluation: Personal bias and inconsistent judgment affect fairness
- Keyword-Based Filtering: Lack of semantic understanding leads to poor candidate matching
- Limited Behavioral Analysis: Communication skills, confidence, and emotions are not objectively evaluated
- Scalability Issues: Difficult to handle large volumes of applications efficiently
- Lack of Integration: No unified system to combine resume analysis, assessments, and interview evaluation

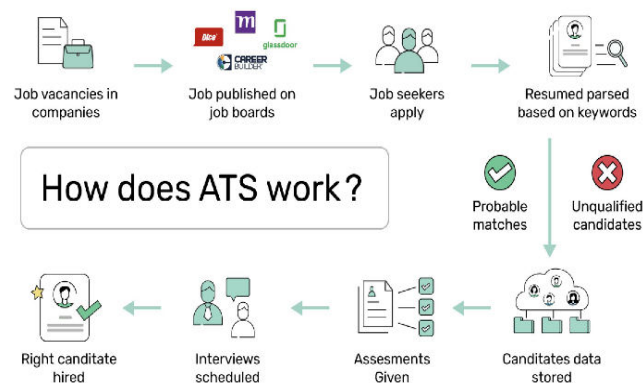


Fig: 1 Work flow of Existing

## V. PROPOSED SYSTEM

The proposed system, InterviewBo, is an AI-driven multimodal recruitment platform designed to automate the entire hiring lifecycle—from resume screening to final candidate selection. Unlike traditional systems, it integrates multiple Artificial Intelligence (AI), Machine Learning (ML), and Deep Learning (DL) models to ensure objective, efficient, and data-driven hiring decisions.

The system begins with semantic resume analysis, where candidate resumes are compared with job descriptions using advanced Natural Language Processing techniques. This eliminates the limitations of keyword-based filtering and improves shortlisting accuracy.

Next, candidates undergo a technical and cognitive assessment phase, where aptitude skills are evaluated using machine learning models, and programming abilities are analyzed through code representation techniques. This ensures standardized and unbiased skill evaluation.

In the final stage, the system conducts an AI-powered interview using a virtual HR avatar. Personalized questions are generated dynamically based on candidate profiles, and responses are analyzed using speech and behavioral intelligence models. Speech features such as clarity, tone, and confidence are evaluated, while facial expressions and engagement levels are analyzed to assess behavioral traits.

All results from different stages are aggregated into a candidate scoring system, which ranks applicants and provides decision support to recruiters. This integrated approach reduces human bias, improves efficiency, and enhances the overall reliability of recruitment outcomes.

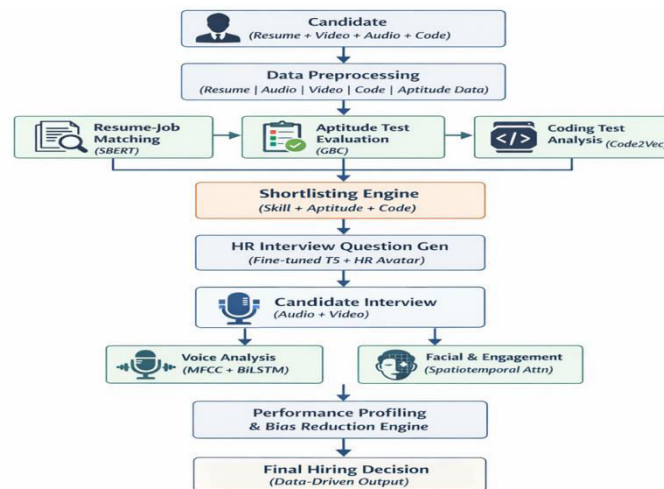


Fig: 2 System Architecture

## VI. MODULE DESCRIPTION

The proposed system, InterviewBo, is composed of multiple functional modules that collectively automate and enhance the recruitment process. Each module is designed to handle a specific stage of the hiring pipeline, ensuring efficiency, scalability, and unbiased decision-making.

### A. InterviewBo Web Application

The InterviewBo Web Application serves as the central platform integrating all system functionalities. It is responsible for user authentication, data management, and interaction between different modules. The system is developed using modern web technologies to provide a secure and user-friendly interface.

### B. End User Dashboard

The End User Dashboard provides role-based access to different users of the system:

## 1) Web Admin

The Web Admin manages system configurations, user accounts, job postings, and monitors overall platform performance.

## 2) Candidate

The Candidate module allows users to register, upload resumes, attend assessments, participate in interviews, and track their application status.

## 3) Recruiters

Recruiters can post job requirements, review shortlisted candidates, analyze performance reports, and make hiring decisions.

## 4) Avatar HR

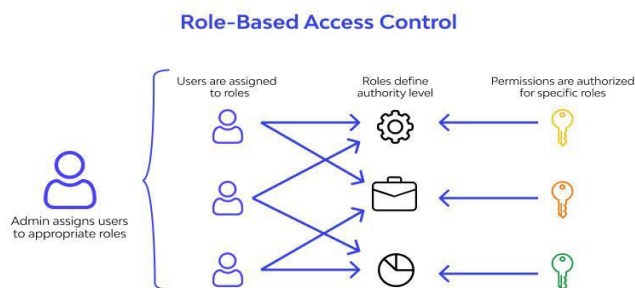
The Avatar HR acts as a virtual assistant that interacts with candidates, conducts interviews, and guides users throughout the recruitment process.

## C. Resume Shortlisting Module

This module performs automated candidate filtering using semantic analysis. It leverages advanced NLP techniques to match resumes with job descriptions, ensuring accurate and efficient candidate shortlisting.

## D. Schedule Bot

The Schedule Bot automates interview and assessment scheduling. It coordinates between candidates and recruiters, allocates time slots, and sends notifications and reminders to ensure smooth execution of recruitment activities.



**Fig: 3** User Interaction Diagram

## E. Technical Assessment Module

### 1) Cognitive Skill Evaluation

This sub-module evaluates candidates' logical reasoning and problem-solving abilities using machine learning models, ensuring standardized and objective assessment.

### 2) Programming Competency Analyzer

This component analyzes coding skills by evaluating code structure, logic, and efficiency using advanced algorithms such as Code2Vec.

## F. Avatar Hiring Manager

### 1) Resume-Based Question Generation

This module uses a fine-tuned T5 model to generate personalized interview questions based on candidate profiles.

### 2) Avatar HR

The virtual HR conducts interviews using generated questions, maintaining a structured and interactive interview process.

### 3) Speech Proficiency Analyzer

This module evaluates candidate speech using MFCC and BiLSTM techniques, analyzing clarity, confidence, and communication effectiveness.

### 4) Behavioral Insight Engine

This component analyzes facial expressions, eye movement, and engagement using deep learning models to assess candidate behavior.

## G. Candidate Scoring Module

This module aggregates results from all evaluation stages, normalizes scores, and generates an overall performance index for each candidate.

## H. Hiring Advisor

The Hiring Advisor acts as a decision support system that classifies candidates based on suitability and provides insights into strengths and weaknesses.

## I. Result Broadcast Module

This module communicates final recruitment outcomes to candidates through the system interface and notifications, ensuring transparency.

## J. Intelligent Notification System

The notification system manages alerts and reminders related to assessments, interviews, and results, improving coordination and reducing missed activities.

## K. Reports Module

This module collects data from various stages of the recruitment pipeline, including resume matching, aptitude tests, coding assessments, interview analysis, and final scoring. The collected data is processed and transformed into meaningful visual and textual reports for better decision-making.

The Reports Module plays a crucial role in the InterviewBo system by providing comprehensive analytical insights into the recruitment process. It generates structured reports that assist recruiters, administrators, and management in evaluating candidate performance and overall system effectiveness.

The Reports module generates detailed analytics, including candidate performance summaries, recruitment statistics, and hiring trends, supporting strategic decision-making.

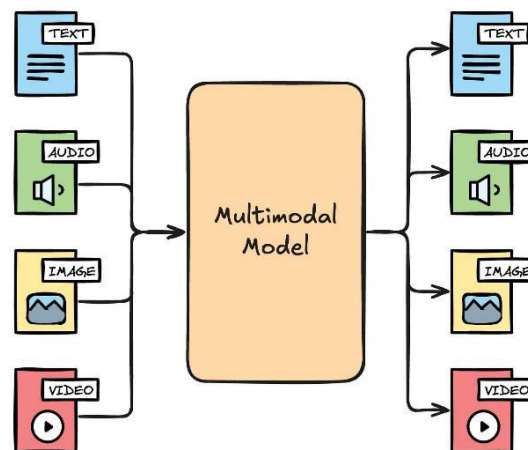


Fig:4 Multi-Model

## VII. TESTING STRATEGIES

To ensure the reliability, accuracy, and performance of the proposed InterviewBo system, various testing strategies are employed at different stages of development. These testing methods validate individual components as well as the overall system functionality.

### A. Unit Testing

Unit testing is performed to verify the correctness of individual modules such as resume matching, aptitude evaluation, coding analysis, question generation, and scoring mechanisms. Each component is tested independently to ensure it functions as expected without errors.

### B. Integration Testing

Integration testing evaluates the interaction between different modules of the system. It ensures seamless communication between components such as the scheduling module, assessment modules, interview system, scoring engine, and notification system. This testing confirms that data flows correctly across the system.



**C. System Testing**

System testing is conducted on the complete integrated system to validate end-to-end functionality. It verifies the entire recruitment workflow, including job posting, resume screening, assessments, interview processing, and result generation, ensuring that the system meets functional requirements.

**D. Performance Testing**

Performance testing assesses the system’s efficiency, scalability, and responsiveness under different workloads. It evaluates how the system performs when handling multiple candidates simultaneously, ensuring stability, low latency, and optimal resource utilization.

**E. User Acceptance Testing (UAT)**

User Acceptance Testing is carried out to ensure that the system meets the expectations and requirements of end users, including recruiters, candidates, and administrators. Real-world scenarios are tested to validate usability, functionality, and overall user satisfaction.

Test Case ID	Test Description	Input	Expected Output	Result
TC01	Verify semantic matching using SBERT	Resume + Job Description	Relevant similarity score	Pass
TC02	Check classification accuracy using GBC	Aptitude answers	Correct performance level	Pass
TC03	Validate Code2Vec processing	Source code input	Code quality score	Pass
TC04	Test T5-based question generation	Candidate resume	Relevant interview questions	Pass
TC05	Evaluate MFCC + BiLSTM processing	Audio response	Speech clarity & confidence score	Pass
TC06	Detect engagement and expressions	Video input	Behavioral metrics	Pass
TC09	Evaluate system under load	Multiple users	Stable performance	Pass

Table 1: Test Case Module

**VIII. RESULTS AND DISCUSSION**

The proposed system, *InterviewBo*, was evaluated based on its ability to automate and enhance the recruitment process through accurate candidate assessment, reduced bias, and improved efficiency. The system integrates multiple AI models for resume screening, skill evaluation, and interview analysis, and the results demonstrate significant improvements over traditional recruitment methods.



## A. Results

The system was tested using multiple candidate profiles across different job roles. The following observations were made:

- The SBERT-based resume matching module achieved high accuracy in identifying relevant candidates by capturing semantic similarity rather than relying on keyword matching. This significantly improved the quality of shortlisted candidates.
- The Gradient Boosting Classifier (GBC) used in aptitude evaluation provided consistent and reliable classification of candidate performance levels, ensuring objective assessment.
- The Code2Vec-based coding analysis effectively evaluated programming skills by analyzing code structure and logic, offering deeper insights compared to traditional output-based evaluation.
- The T5-based question generation module successfully generated personalized and context-aware interview questions, enhancing the interview experience.
- The MFCC + BiLSTM speech analysis accurately assessed voice clarity, confidence, and communication skills, while the Spatiotemporal Attention Network effectively analyzed facial expressions and engagement levels.
- The candidate scoring module aggregated results from all stages and generated a comprehensive ranking, enabling data-driven hiring decisions.

## B. Discussion

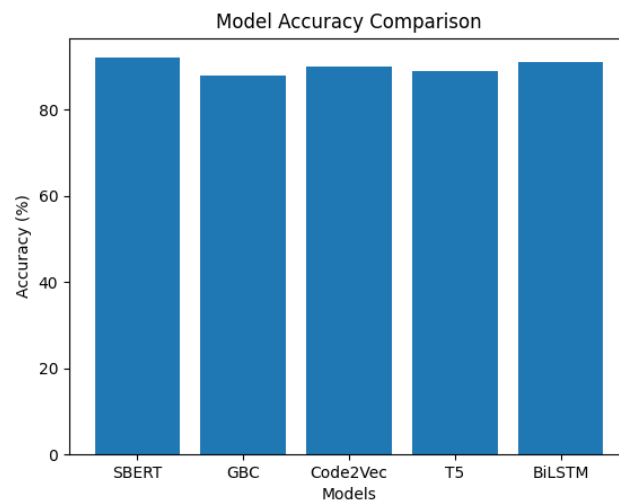
The results highlight the effectiveness of integrating multimodal AI techniques in recruitment systems. Unlike traditional methods, the proposed system provides a holistic evaluation of candidates by considering technical, cognitive, and behavioral aspects.

The use of semantic analysis reduces dependency on keyword-based filtering, thereby minimizing the chances of rejecting qualified candidates. Additionally, the incorporation of automated interview analysis ensures consistent evaluation, eliminating variations caused by human bias.

The system also improves scalability, as it can handle a large number of applications simultaneously without significant performance degradation. Performance testing confirmed that the system maintains stable response times under increased workload conditions.

### 1. Accuracy Comparison Graph

This graph shows the accuracy of different AI models used in the system. SBERT achieves the highest accuracy in resume matching, while BiLSTM and Code2Vec also perform consistently well in speech and coding analysis respectively.



**Fig: 5** Accuracy Comparison of AI Models used in InterviewBO

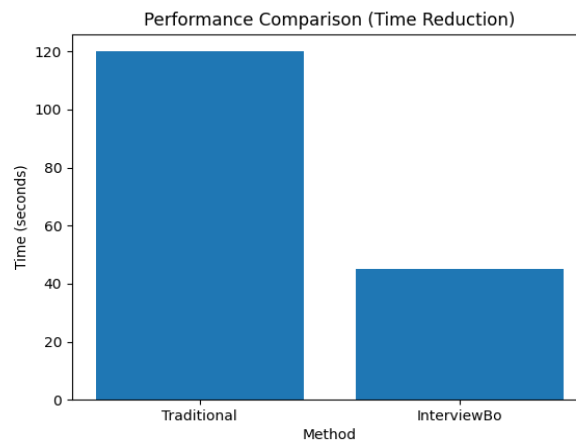


## 2. Performance Comparison Graph

The graph illustrates the reduction in processing time achieved by the proposed InterviewBo system compared to traditional recruitment methods. The automated system significantly reduces hiring time, improving efficiency.

The performance comparison between the traditional recruitment process and the proposed *InterviewBo* system is primarily evaluated based on **time efficiency, scalability, and processing capability**.

In traditional recruitment systems, most activities such as resume screening, candidate shortlisting, and interview evaluation are performed manually. This leads to significant delays, especially when handling a large number of applications. On average, the traditional process requires a higher amount of time due to repetitive manual tasks and lack of automation



**Fig: 6** Performance Comparison (Time Reduction)

## IX. CONCLUSION

InterviewBo, an AI-driven multimodal recruitment system designed to automate and enhance the end-to-end hiring process. The proposed system integrates advanced techniques from Natural Language Processing, Machine Learning, and Deep Learning to evaluate candidates across multiple dimensions, including technical skills, cognitive ability, communication, and behavioral traits.

By utilizing semantic resume matching, intelligent assessment models, and an AI-based avatar interview system, InterviewBo overcomes the limitations of traditional recruitment methods such as manual effort, subjective evaluation, and bias. The system ensures accurate candidate shortlisting, consistent interview evaluation, and data-driven decision-making.

Experimental results demonstrate that the proposed system significantly reduces recruitment time, improves evaluation accuracy, and enhances scalability while maintaining fairness in candidate assessment. The integration of multimodal analysis further strengthens the reliability of hiring decisions by considering both technical and behavioral factors.

In conclusion, InterviewBo provides a robust, efficient, and scalable solution for modern recruitment challenges, making it highly suitable for real-world applications in organizations seeking intelligent and automated hiring systems.

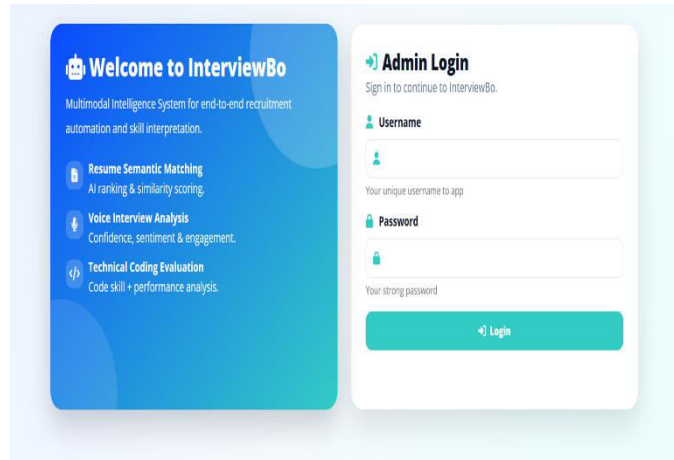


Fig :7 InterviewBo Dashboard

## X. FUTURE WORK

Although the proposed *InterviewBo* system demonstrates significant improvements in recruitment automation and candidate evaluation, there are several opportunities for further enhancement and extension.

One important direction is the integration of multilingual support, enabling the system to process resumes, generate interview questions, and conduct interviews in multiple languages. This would make the system more inclusive and suitable for global recruitment scenarios.

Another potential improvement is the incorporation of advanced emotion and stress detection. By leveraging physiological signals and micro-expression analysis, the system can provide deeper insights into candidate confidence, anxiety levels, and emotional stability during interviews.

The development of a Virtual Reality (VR)-based interview environment can further enhance the realism of the interview process. A simulated workplace environment would allow candidates to demonstrate their practical skills and behavior in real-world scenarios.

Additionally, future work can focus on improving real-time processing capabilities to reduce latency in audio and video analysis. Optimizing deep learning models and leveraging edge computing techniques can enhance system responsiveness and scalability.

The system can also be extended by incorporating explainable AI (XAI) techniques, enabling recruiters to understand the reasoning behind model decisions. This would improve transparency and trust in automated hiring systems.

Finally, continuous improvement of model performance through large-scale dataset training and bias mitigation techniques will further enhance accuracy and fairness, making the system more reliable for diverse recruitment environments.

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