Intelligent Virtual Interview Preparation & Skill Evaluation System

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Dr. Babasaheb Ambedkar Technological University, Lonere | Academic Year: 2025–2026

Abstract- *The competitive employment landscape demands not only technical proficiency from candidates but also confident communication, composed behavior, and structured articulation during interviews. A significant proportion of job seekers underperform in interviews due to limited access to realistic practice environments and the absence of personalized, real-time feedback. This paper presents the design and implementation of an Intelligent Virtual Interview Preparation & Skill Evaluation System (IVIPSES)—a web-based, AI-powered platform that simulates authentic interview scenarios and delivers comprehensive multi-modal performance assessment. The system integrates Quork AI for adaptive, profile-driven question generation; Whisper ASR for high-accuracy speech-to-text transcription; Natural Language Processing (NLP) for evaluating verbal response quality across dimensions of relevance, fluency, grammar, and keyword coverage; and computer vision-based behavioral analytics to assess non-verbal cues including eye contact, facial expressions, and confidence indicators. The technology stack comprises Next.js (frontend), Node.js (backend), and Firebase (real-time cloud database). Functional validation confirms end-to-end operational effectiveness across all system modules, with the integrated multi-modal pipeline demonstrating superior assessment breadth compared to existing single-dimension interview tools.*

Keywords: Virtual Interview Simulation, Artificial Intelligence, Natural Language Processing, Automatic Speech Recognition, Behavioral Analysis, Adaptive Question Generation, WebRTC, Firebase.

I. INTRODUCTION

The modern hiring process has grown significantly demanding, placing equal emphasis on a candidate's technical depth, communication clarity, and behavioral composure. Despite this, a large proportion of job seekers—particularly fresh graduates—lack access to preparation platforms that authentically replicate real interview dynamics. Conventional approaches such as self-study, scripted practice, or group coaching sessions fail to provide the personalized, interactive, and feedback-driven experience that genuine interview readiness demands.

The emergence of Artificial Intelligence (AI), Natural Language Processing (NLP), and modern web technologies has created an opportunity to build intelligent, adaptive, and cost-effective platforms for this purpose. The Intelligent Virtual Interview Preparation & Skill Evaluation System (IVIPSES) is designed to bridge this gap by providing a single integrated platform that covers adaptive question generation, real-time response capture, automated multi-dimensional evaluation, and personalized feedback delivery.

IVIPSES leverages Quork AI for profile-driven adaptive question generation, Whisper ASR for speech-to-text transcription, NLP for verbal response analysis, and computer vision for behavioral assessment—all orchestrated within a Next.js/Node.js/Firebase architecture. The primary contribution of this work is the unified integration of four previously fragmented assessment dimensions into a single, accessible, end-to-end interview preparation pipeline.

II. LITERATURE SURVEY

A review of related work reveals that while individual components of intelligent interview assessment have been studied, their cohesive integration into a unified platform remains largely unexplored.

A. Speech and Verbal Analysis

Mehta et al. [6] proposed a speech-analytics platform for soft skill evaluation focusing on vocal fluency, pronunciation, and speech rate. Although effective for acoustic assessment, it lacked semantic NLP evaluation and adaptive questioning. T.K. et al. [4] combined NLP with speech analysis for personalized feedback but relied on static question banks without real-time video behavioral assessment.

B. Mock Interview Platforms

Gupta et al. [7] developed a browser-based virtual mock interview system with automated textual feedback. However, its question generation was static and non-verbal evaluation was entirely absent. Chavan and Jadhav [1] presented an NLP-based evaluator highlighting automated feedback value but without dynamic question generation or behavioral analysis.

C. Behavioral and NLP Evaluation

Singh et al. [8] demonstrated that facial expression recognition provides valuable behavioral signals during interviews. Sharma et al. [10] built an early NLP-based virtual interviewer using keyword extraction and semantic matching, but required typed input without audio/video interaction. Sagare [3] concluded through a comprehensive review that combining speech recognition and behavioral analysis is essential for holistic candidate evaluation—a gap directly addressed by IVIPSES.

The convergent finding across literature is that no reviewed system integrates all four dimensions—adaptive AI question generation, ASR transcription, NLP verbal evaluation, and video behavioral analysis—into a unified, user-facing platform.

III. PROBLEM ANALYSIS

A. Problem Definition

Despite the critical role of interviews in career advancement, most candidates enter them inadequately prepared. Existing preparation tools suffer from compounding deficiencies that collectively create a significant preparedness gap:

- Static, non-adaptive question banks that cannot tailor content to a candidate's specific job role, domain, or experience level.
- No verbal evaluation of spoken communication—fluency, articulation, vocabulary, and grammar—which are assessed in virtually every real interview.
- Complete absence of behavioral assessment for non-verbal cues such as eye contact, facial composure, and confidence posture.
- Delayed or generic feedback that provides no actionable per-question insight enabling iterative improvement.
- Technological fragmentation—solutions addressing individual dimensions are scattered across disconnected tools.

B. Objectives

The key objectives of IVIPSES are:

- Develop a web-based virtual interview platform requiring no installation beyond a standard browser.
- Implement Quork AI-driven adaptive question generation personalized to job role, description, experience, and technology stack.
- Integrate WebRTC-based real-time audio/video capture to simulate live interview dynamics.
- Deploy Whisper ASR for high-accuracy speech-to-text transcription of candidate responses.
- Apply NLP to evaluate response relevance, accuracy, grammar, fluency, and keyword coverage.
- Analyze video feeds using computer vision for eye contact, facial expression, and behavioral confidence metrics.
- Generate composite per-question and overall scores with detailed personalized feedback reports.
- Persist all session data in Firebase for longitudinal progress tracking across multiple sessions.

IV. SYSTEM DESIGN

A. System Architecture

IVIPSES is structured as a five-layer architecture. The User/Client Layer encompasses all candidate-facing interactions through the browser. The Frontend Layer is built on Next.js with Tailwind CSS, delivering a reactive, server-rendered, responsive UI. The Backend Layer, implemented in Node.js, orchestrates session management, API routing, and inter-service communication. The AI/Service Layer comprises Quork AI (question generation), Whisper ASR (transcription), the NLP Engine (verbal evaluation), and the Behavioral Analysis Module (video assessment). The Database Layer uses Firebase Firestore for persistent, real-time, cloud-synced data storage and Firebase Authentication for secure session management.

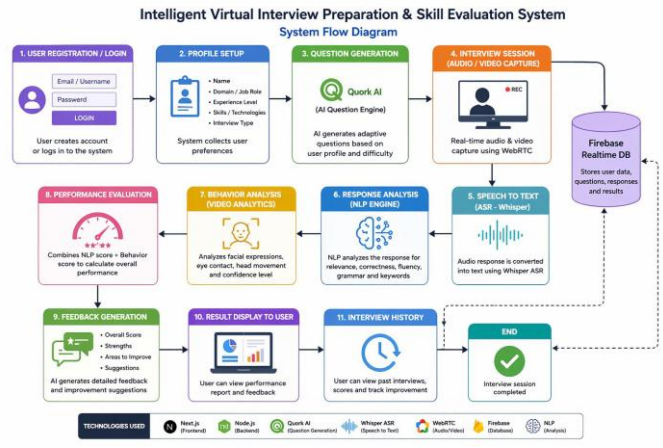

Fig. 1: System Flow Diagram – IVIPSES End-to-End Pipeline

B. Module Descriptions

Quork AI (Question Generation): Receives a structured user profile payload and returns a JSON array of contextually appropriate, difficulty-calibrated interview questions. The model applies prompt engineering to ensure domain specificity and question diversity across session reruns.

Whisper ASR (Speech-to-Text): Processes audio buffers submitted after each candidate response and returns high-accuracy transcripts. Whisper's transformer-based architecture provides robustness to accented speech and varying speaking speeds.

NLP Engine (Response Analysis): Applies semantic similarity scoring, keyword extraction, grammar analysis, and fluency metrics to each transcript. Scores are normalized and weighted by question type (technical, behavioral, or situational).

Behavioral Analysis Module: Processes video frames at regular sampling intervals using facial landmark detection and gaze estimation. Outputs include eye contact percentage, expression stability score, head movement frequency, and a composite behavioral confidence rating.

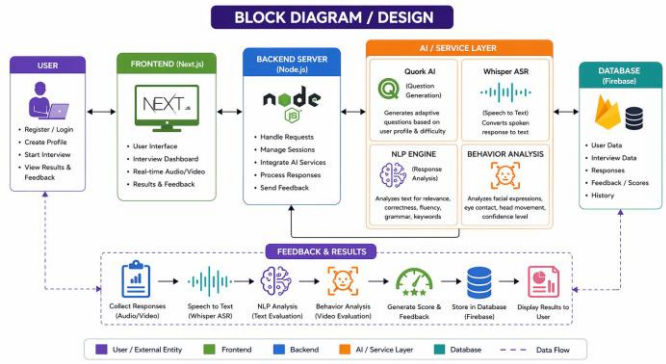

Fig. 2: Block Diagram – System Architecture of IVIPSES

C. System Workflow

The system follows a ten-stage sequential workflow: (1) User Registration & Authentication via Firebase Auth; (2) Profile Configuration capturing job role, description, experience, and tech stack; (3) Adaptive Question Generation via Quork AI; (4) Real-Time Interview Session with WebRTC audio/video capture; (5) Whisper ASR Speech-to-Text Transcription; (6) NLP-Based Verbal Response Evaluation; (7) Behavioral Video Analysis; (8) Weighted Score Aggregation combining verbal and behavioral sub-scores; (9) Personalized Feedback Report Generation; and (10) Data Persistence and Result Display via Firebase and the performance dashboard.

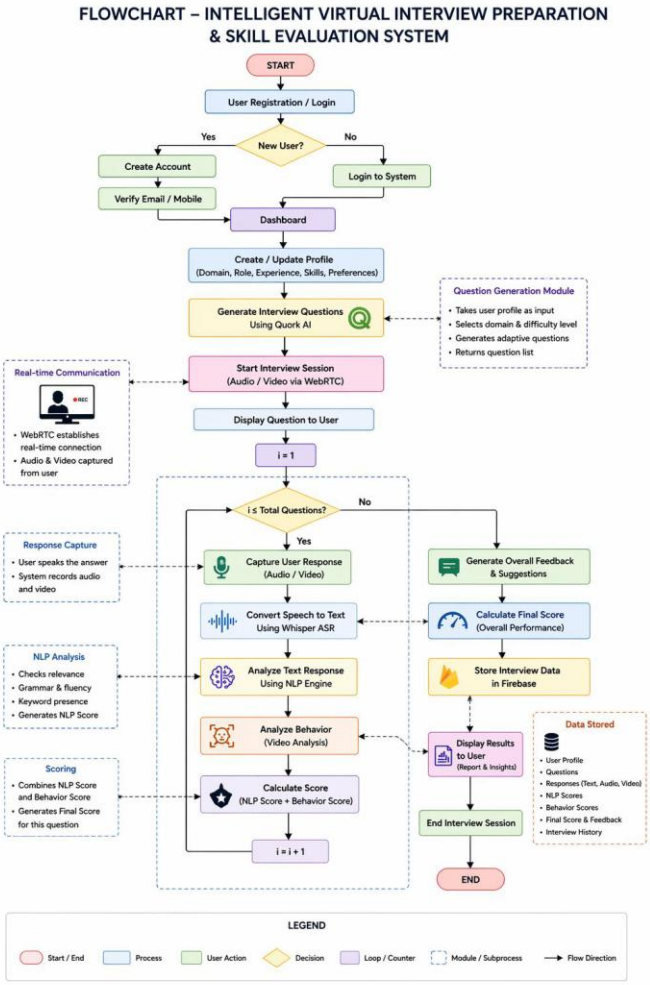

Fig. 3: System Flowchart – Operational Flow of IVIPSES

V. REQUIREMENT ANALYSIS

A. Software Requirements

Component	Technology
Frontend	Next.js, Tailwind CSS
Backend	Node.js
Database	Firebase Firestore & Auth
AI Engine	Quork AI (GPT-based)
Speech Recognition	Whisper ASR (OpenAI)
Audio/Video	WebRTC
Dev Tools	VS Code, Git & GitHub

Table I: Software Requirements

B. Hardware Requirements

Component	Specification
Processor	Intel i3 or higher
RAM	4 GB min (8 GB recommended)
Storage	250 GB free space
Webcam	720p or above
Microphone	Built-in or external
Internet	Min. 2 Mbps stable broadband

Table II: Hardware Requirements

VI. RESULTS

IVIPSES was successfully developed and subjected to end-to-end functional validation across all core modules. The following outcomes were confirmed:

- Adaptive question generation via Quork AI produced domain-relevant, non-repetitive question sets across diverse profiles including Full Stack Developer, Data Analyst, ML Engineer, and DevOps Engineer.
- Whisper ASR transcription demonstrated high accuracy for clearly articulated English-language responses captured under standard broadband conditions.
- The NLP engine successfully discriminated between high-quality (comprehensive, accurate, well-structured) and weak (brief, off-topic, grammatically poor) responses, producing discriminative per-question verbal scores.
- Behavioral video analysis successfully quantified eye contact patterns, facial expression consistency, and head movement frequency across test candidates.
- Firebase data persistence was verified across the complete session lifecycle, with real-time synchronization confirmed between backend scoring operations and the user dashboard.
- The interview history module correctly retrieved and displayed past sessions for authenticated users, supporting longitudinal self-assessment.

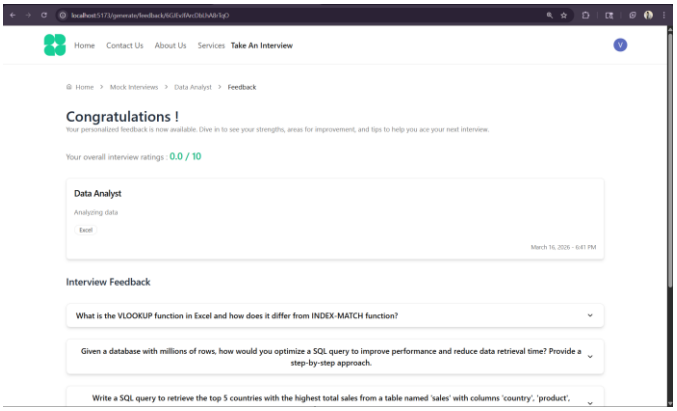

Fig. 4: Feedback Generation – Performance Report and Per-Question Review

VII. LIMITATIONS AND FUTURE SCOPE

A. Current Limitations

- Internet Dependency: Real-time WebRTC streaming and cloud AI services require stable broadband; poor connectivity degrades audio/video quality and ASR accuracy.
- AI Model Accuracy Bounds: Whisper ASR may produce transcription errors for heavily accented or noisy audio; NLP accuracy is bounded by the training corpus, which may not cover highly niche emerging domains.
- Behavioral Analysis Depth: Current module evaluates limited non-verbal cues; complex signals such as stress indicators, voice modulation, and micro-expressions are not yet captured.
- English-Only Support: The system currently supports only English-language interviews, limiting accessibility for non-English-speaking candidates.
- Web-Only Deployment: Absence of dedicated mobile applications restricts usage for smartphone-primary users.

B. Future Scope

- Multilingual Support: Integration of multilingual NLP models and ASR engines for regional and international language interview sessions.
- Advanced Emotion Detection: Deep learning-based affective computing to detect stress levels, enthusiasm, hesitation, and emotional composure.
- Mobile Applications: Native iOS and Android apps with offline-capable question delivery and local response recording.

- Recruiter Platform Integration: API-level integration with LinkedIn, Naukri, and similar portals for live job description-aligned practice.
- VR Interview Environments: Virtual reality modules simulating physical interview room dynamics for immersive preparation.

VIII. CONCLUSION

This paper presented the design, implementation, and validation of the Intelligent Virtual Interview Preparation & Skill Evaluation System—a multi-modal, AI-integrated platform addressing a well-documented gap in interview preparation tools. By unifying adaptive AI question generation, ASR-based speech transcription, NLP-based verbal evaluation, and computer vision-based behavioral analysis within a single cohesive Next.js/Node.js/Firebase application, IVIPSES delivers an unprecedented breadth of self-directed, personalized feedback to candidates.

Functional testing confirmed successful end-to-end operation across all core modules. The literature review confirms that no prior system has achieved this level of multi-modal integration at the application level, establishing IVIPSES as a meaningful novel contribution at the intersection of AI, NLP, computer vision, and educational technology. Future work will focus on multilingual support, mobile deployment, emotion-aware behavioral analysis, and integration with institutional recruitment platforms—further extending the system's reach and societal impact.

IX. ACKNOWLEDGMENT

The authors express sincere gratitude to the Principal Dr. S.S. Mohite, Head of Department Mrs. D.D. Dhokate, Project Incharge Mr. V.B. Dhere, and all faculty members of the Department of Computer Science & Engineering, PVPIT Budhgaon (Sangli), for providing the technical facilities and institutional support essential to completing this work.

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