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AI Based Interview Evaluator: An Emotion and Confidence Classifier

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Abstract: The AI-based interview evaluator is a comprehensive system designed to provide an objective and data-driven assessment of candidates during job interviews. By leveraging cutting-edge technologies in machine learning, computer vision, and natural language processing, the system analyses video and audio inputs to evaluate a candidate's emotions, confidence, and knowledge. For emotion recognition, the system utilizes Deep face and Haar Cascade models, which can detect a wide range of facial expressions and subtle emotional cues. These models help determine the candidate's emotional state throughout the interview, providing valuable insights into their level of engagement and comfort. In addition, the system employs Google Speech Recognition for accurate speech-to-text conversion, allowing it to analyse the content of the candidate's responses. This feature enables the system to assess the candidate's communication skills, articulation, and knowledge of the subject matter. To evaluate the candidate's confidence levels, the system utilizes a Random Forest Classifier trained on datasets containing confident and non-confident speech patterns. By comparing the candidate's speech patterns against these datasets, the system can determine their level of confidence in their responses. Furthermore, a neural network-based chatbot is integrated into the system to provide a more interactive interview experience. The chatbot can ask follow-up questions, clarify doubts, and engage the candidate in a conversation, simulating a real-life interview scenario. Based on the analysis of the candidate's emotions, confidence, and knowledge, the system generates insights and suggestions to aid organizations in making informed hiring decisions. These insights can help identify candidates who are well-suited for the role and provide valuable feedback for candidates looking to improve their interview performance.

Keywords: AI Based Interview Evaluator, Facial Expression Analysis, Deep Face, Machine Learning, Convolution Neural Network, Speech-based Confidence Detection, Librosa, mfcc, confidence evaluator, AI interview.

I. INTRODUCTION

An innovative project at the nexus of cutting-edge technology and human skill development is the AI Interview Evaluator: an Emotion and Confidence Classifier, which stands out in the quickly changing field of artificial intelligence and its many applications.

The project's clear goal is to redefine interview preparation techniques by utilizing cutting-edge AI capabilities to offer an extensive and dynamic training environment. Essentially, the AI Interview Evaluator uses state-of-the-art methods from affective computing to perform the combined roles of interviewer and evaluator.

This software goes above and beyond traditional interviewing practices with its combination of speech modulation assessment and facial expression analysis. This project is in line with the current movement to use artificial intelligence to mimic real-world situations, Providing interviewees with an exclusive and indispensable resource. The creation of models that can identify human emotions from speech patterns and facial expressions is an intriguing field of research in this field.

Deep learning techniques are used in this multidisciplinary discipline to develop reliable and effective emotion detection systems. There are many uses for emotion detection; earlier techniques frequently depended on feature engineering and explicit rules, but deep learning has completely changed the field. Deep neural networks are perfect for capturing complicated patterns in speech signals and facial expressions because they can automatically learn hierarchical representations from raw input.

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II. PROBLEM STATEMENT

Traditional job interview processes often rely heavily on subjective assessments, which can introduce biases and inconsistencies in evaluating candidates. These biases can lead to suboptimal hiring decisions, potentially overlooking qualified candidates or selecting unsuitable ones. Additionally, manual evaluation processes can be time-consuming, resource-intensive, and prone to human error. The AI-based interview evaluator system aims to address these challenges by providing an objective and data-driven approach to candidate evaluation during job interviews. The primary goals of the system are as follows:

- **Objective Emotion Analysis:** Develop a method to accurately analyze the emotional state of candidates during interviews by leveraging computer vision techniques and deep learning models for facial emotion recognition.
- **Confidence Level Assessment:** Implement a system to assess the confidence levels of candidates during the interview process by analysing their audio input and extracting relevant features using signal processing techniques.
- **Knowledge Evaluation:** Develop a mechanism to evaluate the candidates' knowledge and understanding of the subject matter by comparing their responses to expected answers and calculating similarity scores.
- **Interactive Experience:** Integrate a conversational AI assistant (chatbot) into the system to provide an interactive and engaging experience for candidates during the interview process.
- **Data-Driven Insights:** Leverage machine learning algorithms and natural language processing techniques to generate objective insights and personalized feedback for candidates based on the analysis of their emotions, confidence levels, and knowledge assessment.
- **Scalability and Efficiency:** Design a system that can efficiently handle and evaluate many candidates, reducing the time and resources required compared to traditional manual evaluation processes.
- **Ethical Considerations:** Ensure that the system adheres to ethical principles, addressing concerns related to privacy, bias, and transparency in the use of AI for hiring processes.

By addressing these objectives, the AI-based interview evaluator system aims to revolutionize the hiring process by providing a fair, consistent, and data-driven approach to candidate evaluation. The system's ability to objectively assess emotions, confidence levels, and knowledge, combined with an interactive chatbot experience, can help organizations make more informed and unbiased hiring decisions, ultimately leading to better talent acquisition and improved organizational performance.

III. OBJECTIVES

The objective of developing an AI-based system for objective evaluation of candidates during job interviews encompasses a multifaceted approach aimed at revolutionizing the interview process. Through the integration of cutting-edge technologies, including facial emotion recognition utilizing Deepface and HaarCascade models for video analysis, and speech-to-text conversion employing Google Speech Recognition or SpeechRecognizer for audio processing, the system aims to provide a comprehensive assessment of candidate performance. Moreover, the incorporation of a confidence prediction model, utilizing MFCCs and a Random Forest Classifier, enables the system to gauge candidates' confidence levels accurately. To enhance evaluation precision, the system evaluates the similarity between candidate responses and expected answers using sequence matching techniques. Furthermore, the integration of a neural network-based chatbot fosters interactive conversation and candidate engagement, contributing to a dynamic interview environment. Storing and retrieving interview results and insights using a MongoDB database facilitates efficient data management and analysis, while generating personalized suggestions and feedback based on analysis results aids in candidate improvement. With a user-friendly interface designed for seamless interaction and result review, the system prioritizes scalability, efficiency, and ethical considerations throughout its development and deployment stages, ensuring a fair and positive experience for all stakeholders involved in the interview process.

IV. REQUIREMENT SPECIFICATION

Hardware requirements

This application is designed to run on the minimum possible configuration of hardware.

- RAM: 8GB
- Processor: AMD Ryzen 5 10th generation
- Hard disk: compatible
- A computer or server with sufficient processing power and memory to handle video and audio processing.
- A webcam or video input device for capturing candidate video during the interview.
- A microphone or audio input device for recording candidate audio during the interview.

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Software requirements

- Python 3.11.2
- Flask (web framework)
- TensorFlow/Keras (for neural network-based chatbot)
- OpenCV (for computer vision tasks)
- Librosa (for audio processing)
- Scikit-learn (for machine learning algorithms)
- NumPy (for numerical operations)
- Matplotlib (for data visualization)
- MongoDB (for data storage)

V. METHODOLOGY

The AI-based interview evaluator system employs several machine learning and natural language processing techniques to evaluate candidates during job interviews. The methodology can be divided into the following key components:

Data Collection:
Video and audio data from mock interviews or real job interviews are collected and annotated with ground truth labels for emotions, confidence levels, and expected answers. The data is split into training and testing sets for model development and evaluation.

Video Processing:

- Face Detection: The HaarCascade classifier, a pre-trained object detection algorithm, is used to detect faces in the video input.
- Facial Emotion Recognition: The Deepface model, a deep learning-based framework, is employed for facial analysis and emotion classification into seven categories: neutral, happy, sad, surprise, angry, disgust, and fear.

Audio Processing:

- Speech-to-Text Conversion: The audio input from the candidate is converted into text using the Google Speech Recognition API or the SpeechRecognizer library.
- Feature Extraction: Mel-Frequency Cepstral Coefficients (MFCCs) are extracted from the audio input using the librosa library, capturing the characteristics of the audio signal.

Confidence Prediction:
A Random Forest Classifier is trained on confident and non-confident datasets using the extracted MFCC features. This model predicts the candidate's confidence level during the interview on a scale of 0 to 10.

Similarity Evaluation:
The SequenceMatcher from the difflib module in Python is employed to calculate the similarity between the candidate's responses (obtained from the speech-to-text conversion) and the expected answers.The similarity score provides insights into the candidate's knowledge and understanding of the subject matter.

Chatbot Integration:
A neural network-based chatbot is developed using Keras, a high-level neural networks API, and TensorFlow as the backend.The chatbot is trained on JSON intents to enable natural language understanding and response generation, providing an interactive conversational experience.

Model Training and Evaluation:
The individual components (emotion recognition, confidence prediction, similarity evaluation, and chatbot) are trained and evaluated using appropriate machine learning techniques, such as cross-validation and performance metrics (e.g., accuracy, precision, recall, F1-score). Hyperparameter tuning and model selection are performed to optimize the performance of each component.

System Integration:
The individual components are integrated into a unified system using Flask, a Python web framework, along with HTML, CSS, JavaScript, and Bootstrap for the user interface. The system allows users to initiate interviews, capture video and audio inputs, and receive real-time analysis and feedback.

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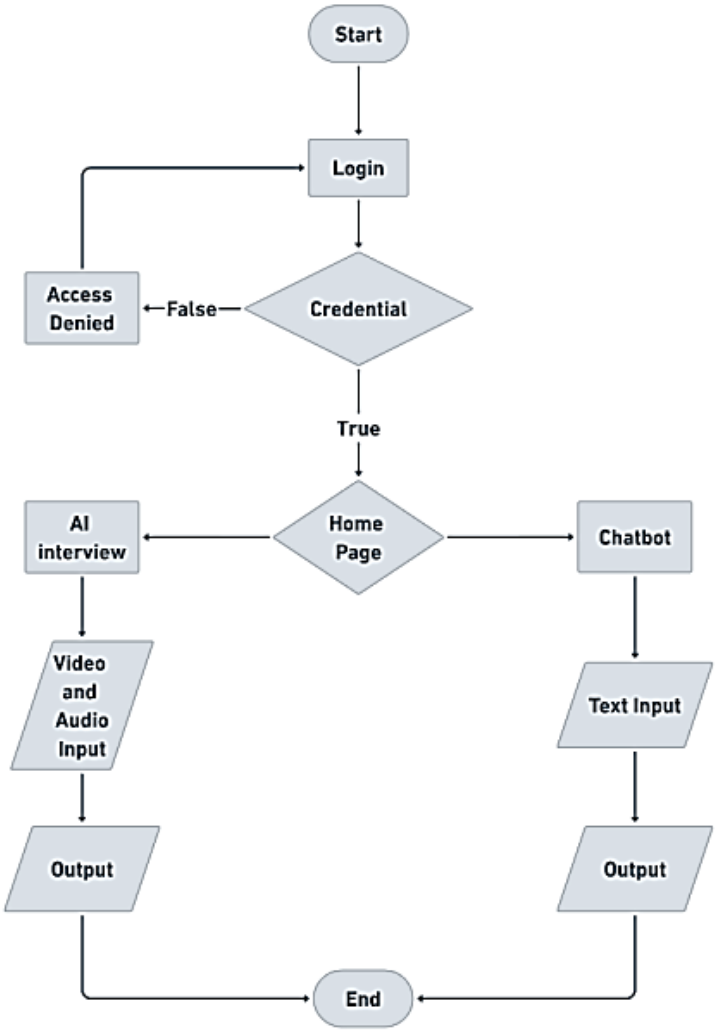
Data Storage and Retrieval:
The interview results, including emotions, confidence levels, similarity scores, and chatbot interactions, are stored in a MongoDB database for efficient storage and retrieval.

Suggestion Generation:
Based on the analysis results, the system generates personalized suggestions and feedback for the candidates. These suggestions are derived from predefined rules and templates, taking into account factors such as emotions, confidence levels, and similarity scores.

VI. SYSTEM DESIGN

AI-based interview evaluator system is designed with a modular and scalable approach, comprising frontend and backend components. The frontend uses HTML, CSS, JavaScript, and Bootstrap for a user-friendly interface. The backend, powered by Flask in Python, handles data processing, model integration, and communication. For video processing, the system uses Deepface and HaarCascade for facial detection and emotion recognition. The audio module employs Google Speech Recognition or Speech Recognizer for speech-to-text and librosa for feature extraction, feeding into a Random Forest Classifier for confidence prediction. Similarity evaluation uses Sequence Matcher to compare responses to expected answers. A neural network-based chatbot, developed with Keras and TensorFlow, enhances interaction. MongoDB stores interview results, and a suggestion module generates feedback based on analysis results. The system's modular design allows for easy integration, maintenance, and scalability, leveraging machine learning and NLP for objective candidate evaluation in interviews.



Flow chart

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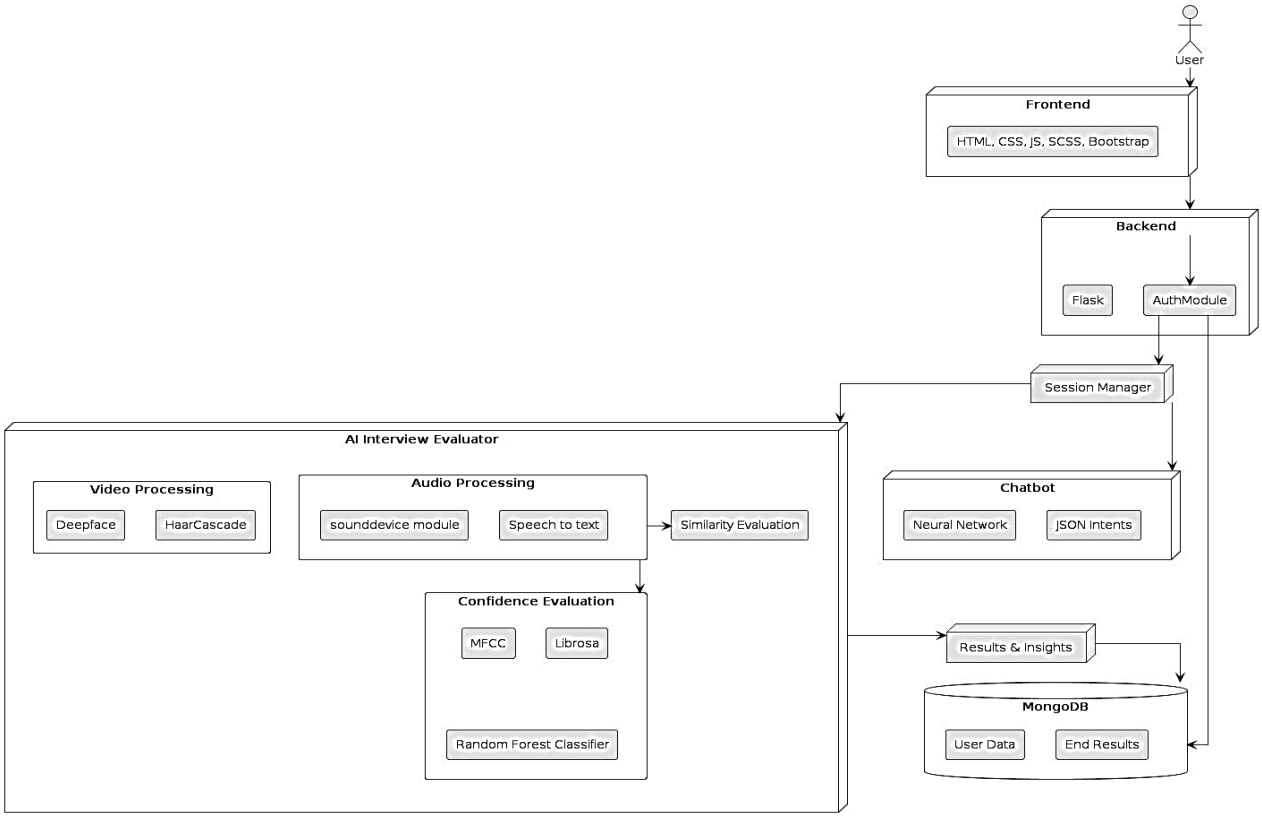
The diagram presents a flowchart illustrating the process flow of a video interview system, beginning with a "Start" step and proceeding to a "Login" step where the user provides credentials. A decision point labelled "Credential" evaluates the validity of the provided credentials, granting access to the "Home Page" if valid or denying access if invalid. From the "Home Page," the user can choose between an "AI Interview" option or interacting with a "Chatbot." If selecting the "AI Interview," the user provides "Video and Audio Input," after which the system generates an "Output," though the specifics are unspecified. Alternatively, the user can provide "Text Input" to the chatbot, which generates a text-based "Output" in response. The flowchart ends after these outputs, utilizing standard symbols like rectangles for steps, diamonds for decisions, and arrows indicating flow, with a circular "End" point.

While simple, it offers a high-level visual representation of the core process, potentially serving as an initial blueprint for further development, documentation, and stakeholder understanding of the video interview system. Flowcharts are commonly used for documenting processes, systems, or algorithms in a standardized manner, facilitating effective communication and analysis. The lack of specific details about inputs, outputs, and processing steps suggests room for elaboration as development progresses. Effective flowchart usage can improve communication, documentation, and comprehension of complex processes among stakeholders, developers, and end-users. As the system evolves or new features are introduced, the flowchart may require updates or modifications to accurately reflect changes. Flowcharts are versatile tools adopted across various domains for process documentation due to their visual nature and ability to convey complex information structurally. They can be manually created or generated using specialized software, with the choice depending on complexity and organizational preferences. Beyond documentation, flowcharts serve as valuable resources for training, process analysis, and identifying potential inefficiencies. Regular updates are crucial to maintain accurate documentation and consistent communication as processes undergo changes. Overall, flowcharts contribute to effective process documentation, communication, and understanding across various contexts.



Architecture diagram

The diagram illustrates the architectural overview of a system designed for AI-based video interview evaluation, consisting of a frontend and a backend component. The frontend is built using HTML, CSS, JS, SCSS, and Bootstrap technologies. The backend comprises Flask, an AI module, a Session Manager, and a Chatbot component. The core element is the AI Interview Evaluator, which handles video and audio processing through modules like Deepface, HaarCascade, sounddevice, and speech-to-text conversion. The processed video and audio data are evaluated for similarity against expected responses using a Similarity Evaluation module.

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The system performs confidence evaluation of the candidate during the interview, utilizing techniques like MFCC, Librosa, and a Random Forest Classifier to assess the candidate's confidence level. The Chatbot component integrates Natural Networks and JSON intents to facilitate conversational interactions. The backend also includes a Session Manager responsible for managing user sessions. The system integrates with a MongoDB database to store user data and end results generated by the "Results & Insights" module, which likely provides feedback and insights based on the evaluation.

The user interacts with the frontend, which communicates with the backend components for processing, evaluation, and data storage/retrieval. The video processing module utilizes Deepface and HaarCascade for facial recognition and analysis. The audio processing module employs a sounddevice module to capture audio input and a speech-to-text module to convert the audio data into text format. The Similarity Evaluation module compares the processed video and audio data with expected responses to assess the candidate's performance.

The confidence evaluation component plays a crucial role in analyzing the candidate's confidence level during the interview. It incorporates techniques like Mel-Frequency Cepstral Coefficients (MFCC) for audio feature extraction and Librosa for audio signal processing. The Random Forest Classifier, a machine learning algorithm, is employed to classify and evaluate the candidate's confidence based on the extracted features.

The Chatbot component integrates Natural Networks, likely utilizing natural language processing techniques, and JSON intents, which are pre-defined conversational rules or patterns, to enable engaging and interactive chat-based communication with the candidates or users. The Session Manager component manages and maintains user sessions throughout the interview process, ensuring seamless data flow and user experience.

The MongoDB database serves as the central repository for storing user data, such as candidate profiles, interview responses, and end results generated by the "Results & Insights" module. This module likely analyzes the evaluation data and generates comprehensive feedback, insights, and recommendations based on the candidate's performance during the video interview.

VII. OUTPUT

The screenshots of the output of A I Based Interview Evaluator is shown in the figures below :

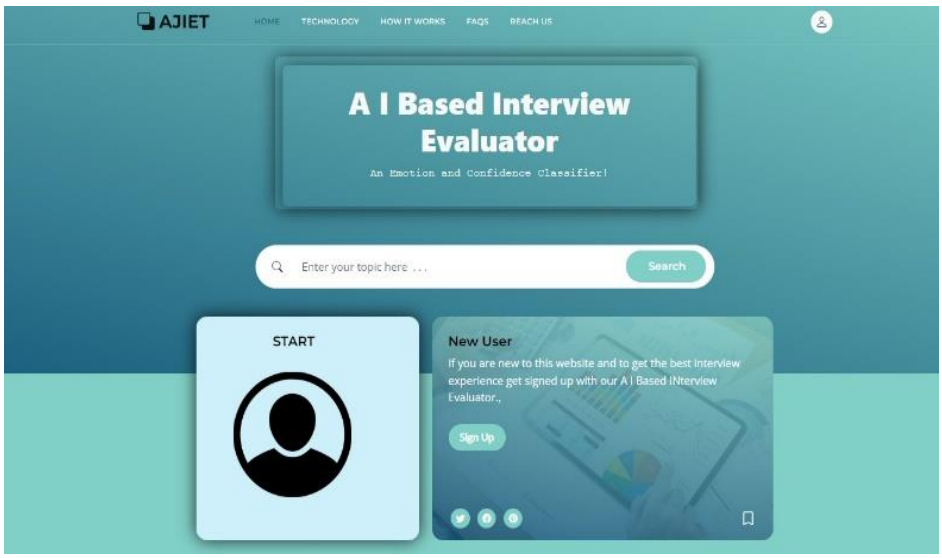

Figure 1: Frontpage of A I Based Interview Evaluator

Figure 1 shows the frontpage of AI Based Interview Evaluator. The frontpage showcases the main interface of the AI-powered interview evaluation system. It features the system's logo, navigation options, and an overview of its key functionalities.

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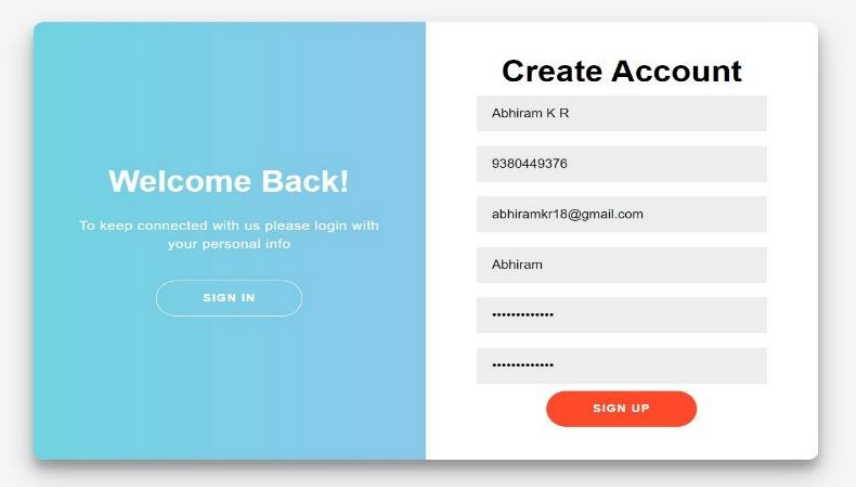

Figure 2: Sign up page of A I Based Interview Evaluator

Figure 2 shows the sign-up page of an AI-Based Interview Evaluator platform. It likely includes fields for users to input their information and create an account, along with options for password creation and user agreement acceptance.

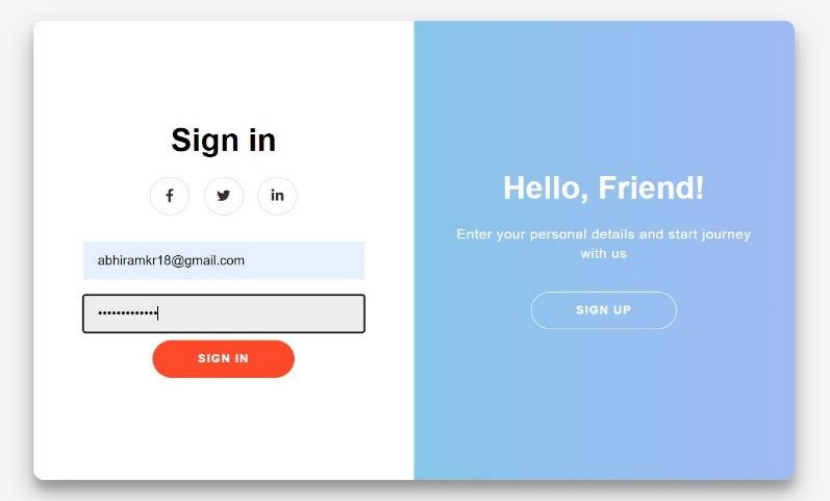

Figure 3: Sign in page of A I Based Interview Evaluator

Figure 3 shows the sign-in page of an AI-Based Interview Evaluator platform. It probably features fields for users to input their credentials, such as username and password, along with options for password recovery and account creation if users are new to the platform.

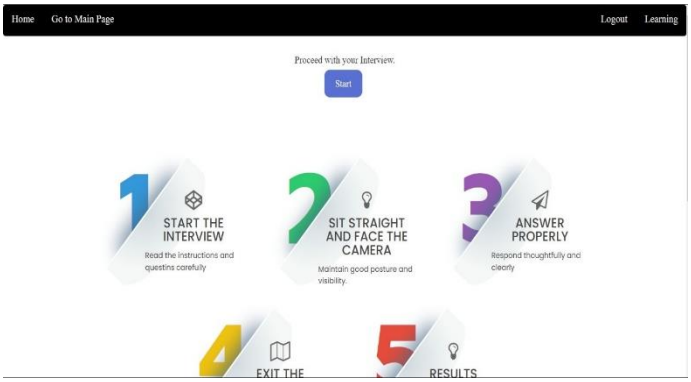

Figure 4: Start Page of A I Based Interview Evaluator

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Figure 4 showcases the start page of the AI-Based Interview Evaluator platform, providing users with options to initiate interviews, access evaluation tools, or navigate sections. It serves as the gateway for users to engage with the platform's functionalities and begin their evaluation journey.

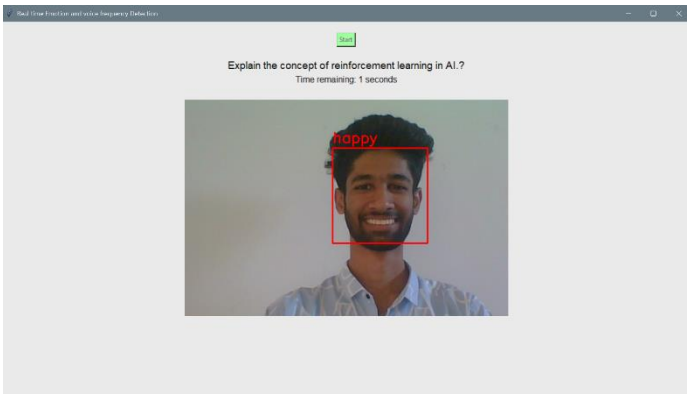

Figure 5: Happy emotion detected by Interview Evaluator

Figure 5 demonstrates the software's capability to detect a happy emotion. This detection likely indicates the successful recognition of positive emotional cues in a user's expression, showcasing the software's effectiveness in emotion detection.

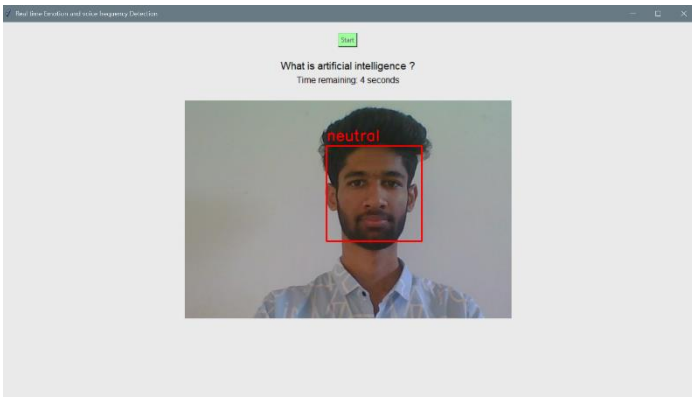

Figure 6: Neutral emotion detected by Interview Evaluator

Figure 6 indicates the detection of a neutral emotion by the Interview Evaluator software. This detection suggests the recognition of a neutral emotional state in a user's expression, showcasing the software's ability to discern various emotional cues during evaluations.

Figure 7: Result of A I based Interview Evaluator

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Figure 7 displays the result of the AI-based Interview Evaluator, providing an assessment of the interviewee's performance. It includes factors such as emotional cues and confidence levels, offering valuable feedback for decision-making and performance improvement.

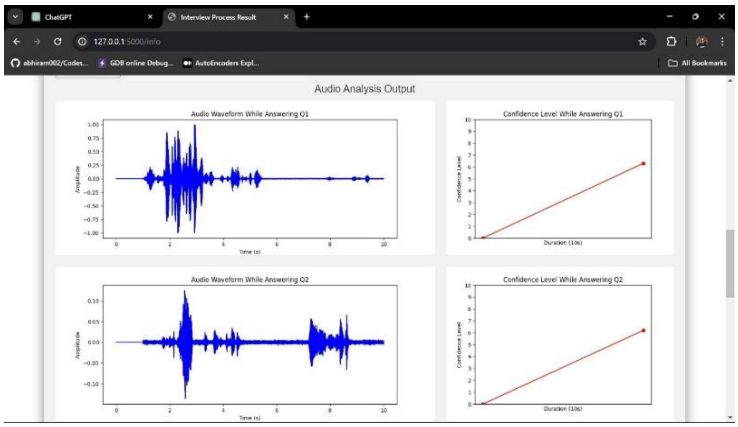

Figure 8: Audio analysis output of A I based Interview Evaluator

Figure 8 shows the audio analysis output of the AI-based Interview Evaluator, offering verbal feedback on the interviewee's performance. This provides convenient access to evaluation results and additional insights for users.

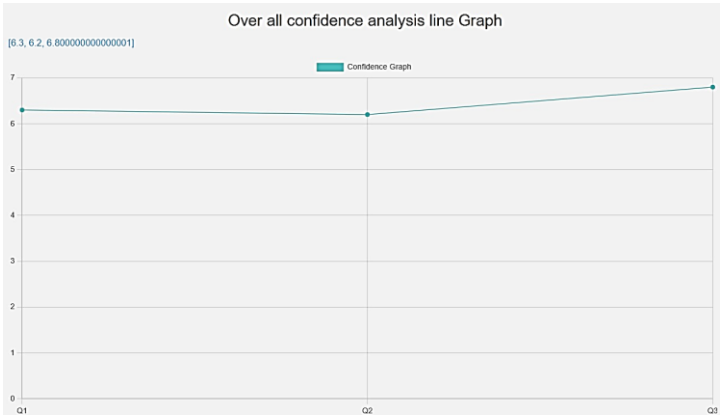

Figure 9: Overall confidence analysis graph of A I based Interview Evaluator

Figure 9 shows the overall confidence analysis graph generated by the AI-based Interview Evaluator. It provides insights into the interviewee's confidence levels throughout the interview process, aiding in understanding their performance.

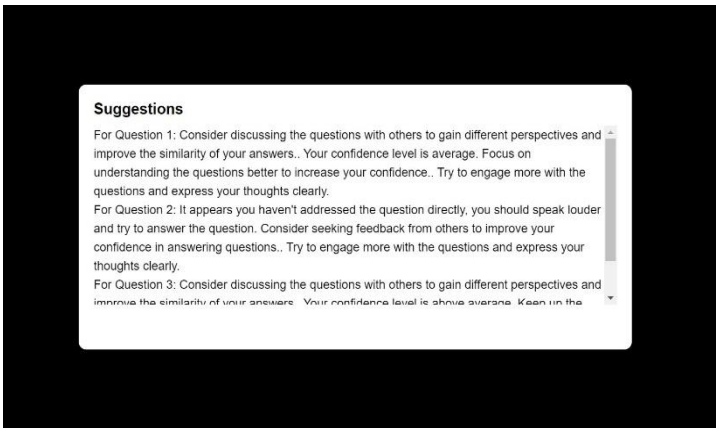

Figure 10: Suggestion given by A I based Interview Evaluator

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Figure 10 shows the suggestions provided by the AI-based Interview Evaluator for each question posed during the interview. These suggestions likely offer guidance or feedback on improving responses, enhancing interview performance. This feature aids interviewees in refining their answers and addressing areas of improvement.

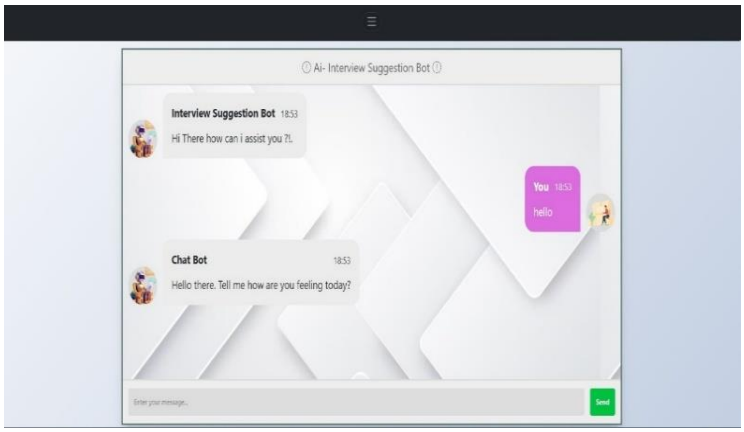

Figure 11: Chatbot integrated to A I based Interview Evaluator

Figure 11 illustrates the integration of a chatbot into the AI-based Interview Evaluator platform. This feature likely allows users to interact with the chatbot to receive assistance, guidance, or feedback during the interview process. The chatbot serves as a valuable tool for interviewees, providing real-time support and enhancing their overall interview experience.

Figure 12: Learning material provided by A I based Interview Evaluator

Figure 12 depicts the learning material provided by the AI-based Interview Evaluator. This material likely includes resources such as articles, tutorials, or guides aimed at assisting users in improving their interview skills and performance. By offering educational content, the platform supports continuous learning and development for interviewees.

VIII. CONCLUSION

In summary, the AI-based interview evaluator is a comprehensive system designed to provide an objective and data-driven assessment of candidates during job interviews by leveraging cutting-edge technologies in machine learning, computer vision, and natural language processing to analyze video and audio inputs and evaluate a candidate's emotions, confidence, and knowledge. It utilizes Deep Face and Haar Cascade models for emotion recognition by detecting facial expressions and subtle emotional cues to determine the candidate's emotional state, providing insights into their engagement and comfort levels. The system employs Google Speech Recognition for accurate speech-to-text conversion, enabling analysis of response content to assess communication skills, articulation, and subject knowledge. A Random Forest Classifier trained on confident and non-confident speech patterns evaluates the candidate's confidence level by comparing their speech patterns.

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A neural network-based chatbot provides an interactive interview experience by asking follow-up questions, clarifying doubts, and engaging the candidate in conversation, simulating a real-life scenario. Based on the analysis of emotions, confidence, and knowledge, the system generates insights and suggestions to aid organizations in making informed hiring decisions by identifying suitable candidates and providing valuable feedback for improvement.

This novel approach combines advanced techniques to offer a data-driven and objective evaluation of candidates' emotions, confidence, and knowledge by capturing and analyzing verbal and non-verbal cues, providing insights into their emotional state, communication skills, and expertise. The confident speech classifier and interactive chatbot further enhance the system's capabilities in assessing confidence and simulating real-life interviews. The system has the potential to revolutionize the recruitment process by eliminating biases and providing comprehensive insights for better candidate-role fit.

IX. FUTURE WORK

While the current AI-based interview evaluator system provides a comprehensive and data-driven approach to assessing candidates, there are several areas for future exploration and improvement. One avenue for future research is to expand the system's capabilities to analyze additional nonverbal cues, such as body language and hand gestures, which could provide further insights into a candidate's emotional state and confidence levels. Incorporating eye-tracking technology could also enhance the system's ability to gauge a candidate's focus and engagement during the interview process. Another area of potential development is the integration of cross-cultural analysis, which could account for cultural differences in emotional expression and communication styles, making the system more inclusive and adaptable to diverse candidate pools.

Exploring the application of the system in different industries and sectors could also be valuable, as the specific requirements and criteria for evaluating candidates may vary across fields. Continuously refining and updating the machine learning models with larger and more diverse datasets could improve the system's accuracy and robustness over time. Integrating the system with other HR technologies, such as applicant tracking systems and talent management platforms, could streamline the recruitment process and provide a more comprehensive view of candidates throughout their journey. Additionally, developing user-friendly interfaces and dashboards for recruiters and hiring managers could enhance the interpretability and usability of the system's outputs.

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