A

Project Report On

"Intelligence system for personality assessments from video interview"

Submitted

in partial fulfillment of the requirements for the degree of

Bachelor of Technology

in

Information Technology

By

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K. E. Society's
Rajarambapu Institute of Technology, Rajaramnagar

(An autonomous Institute, Affiliated to Shivaji University)

2021-2022

K. E. Society's

Rajarambapu Institute of Technology, Rajaramnagar

(An autonomous Institute, Affiliated to Shivaji University)

Department of Information Technology

CERTIFICATE

This is to certify that below mentioned students have successfully completed phase II of the project entitled *"Intelligence system for personality assessments from video interview"* for the Capstone Project in the academic year 2021-22.

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Place: Rajaramnagar

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Mrs. S. S. Kulkarni

Director   External Examiner

RIT, Rajaramnagar   Dept. of IT

DECLARATION

We declare that this report reflects our thoughts about the subject in our own words. We have sufficiently cited and referenced the original sources, referred or considered in this work. We have not plagiarized or submitted the same work for the award of any other degree. We also declare that we have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in our submission. We understand that any violation of the above will be cause for disciplinary action by the Institute.

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Place: RIT, Rajaramnagar.

COMPETITION CERTIFICATES

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We are thankful to and fortunate enough to get constant encouragement, support and guidance from all teaching staff of the Information Technology Department which helped us in successfully completing our project work. Also, we would like to extend our sincere esteems to all staff in the laboratory for their timely support.

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ABSTRACT

Job interviews are a predominant part of any hiring process to evaluate applicants. It is used to evaluate applicant's knowledge, skills, abilities, and behaviour in order to select the most suited person for the job. Recruiters make their opinion, on the basis of both verbal and nonverbal communication of an interviewee. Our behaviour and communication in daily life are cross modal in nature. Facial expression, hand gestures and body postures are closely linked to speech and hence enrich the vocal content. Nonverbal communication plays an important role in what we are saying and what we actually mean to say. It carries relevant information that can reveal social construct of a person as diverse as his personality, state of mind, or job interview outcome; they convey information in parallel to our speech. In this paper we present an automated, predictive expert system framework for computational analysis of HR Job interviews. The system includes analysis of facial expression, language and prosodic details of the interviewees and thereby quantifies their verbal and nonverbal behaviour. The system predicts the rating on the overall performance of the interviewee and on each behaviour traits and hence predict their personality and hireability. We introduce a computerized, predictive expert system framework of HR Job interviews. The framework incorporates the examination of facial expression appearance, dialect and prosodic subtle elements of the interviewees and accordingly evaluates their verbal and nonverbal conduct. The framework predicts the rating on the general execution of the interviewee and on every conduct attribute and henceforth foresee their identity and hireability.

Keywords: cross modal, expert system, facial expression, HR Interviews, Behaviour Analysis, Cross-modal analysis.

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1. Introduction

People in today's society spend the majority of their time and share their opinions on social media, which has become a vital part of their lives. HR began posting job adverts on social media to attract prospects. However, this results in a large number of applicants, making it difficult for HR to find the right person in a timely manner. Not only did firms have to hire a lot of recruiters to filter and review a big number of applications for a single job post, which was highly expensive, but the efficacy and efficiency of digital tools is much higher than that of a human. Furthermore, human cognitive biases are always a possibility. To overcome these obstacles and make recruitment more efficient and timelier, recruitment firms must employ AI-driven digital and products.

It is not cost-effective to invite every job candidate to face-to-face interviews. As an alternative, the asynchronous video interview (AVI) has been developed, in which job candidates are asked to login to an interview platform and record their responses to predefined interview questions using their mobile device or computer's webcam and microphone, with their answers being examined by human ratters at a later time. Candidates can use AVI to record and answer questions at any time and from any location. Furthermore, because the interview video records may be shared and reviewed independently at the convenience of the human ratters without having to schedule an interview, AVI speeds up the selection process.

In today's circumstances, there is a need for software to be developed that is an automated video interview utilising artificial intelligence (AVI-AI) system to make it easier to assess the personality and talents of candidates during an online interview according to requirements. The AVI-AI system is a candidate and organization hiring system. Candidates and organizations will be the two end consumers. The system can record a candidate's video and create interview texts. The technology not only provides organizations with the results of applicant evaluations, but it may also assist candidates in self-evaluation.

To make an unbiased assessment of a candidate's personality and to save the company time and money. It may be beneficial in overcoming the typical recruitment process. The user can use the system at any time and from any location.

2. Problem Life Cycle

2.1. Problems Identification

People in today's society spend the majority of their time and share their opinions on social media, which has become a vital part of their lives. Many businesses place a premium on finding the best staff for the job. Organizations face a challenging problem in picking the best employee from a large pool of candidates. Organizations spend more time and money on interviewers to interview a large number of people in order to select the best employee. Interviewers are higher-ranking officials. Employee recruitment takes a lengthy period. Organizations spend more money and time on any drive.

Many organisations do interviews online in pandemic situations such as COVID-19, and there is a new trend emerging in many organisations to conduct interviews online. As a result, conducting an online interview is a new responsibility for both interviewees and businesses. Every candidate has challenges such as adapting to a new system and maintaining eye contact. Personality assessments of self-Interview in online form were required for interviewees to prepare for the online interview.

2.2. Problem Selection

The project aims to assessment of personality. As such, the system should automatically asses and analyse Personality from Video Interview, the primary data source for this project.

2.3. Problem Definition

To make an Expert System, a computational predictive framework that assess the personality and skills of candidates during the interview for respective job profile.

This system provides solution to identify the personality type characteristics of an interviewee and classification according to the levels exhibited in respective personality characteristic through facial expression recognition techniques to match with the personality characteristics of Passion, Cooperation, Confidence and Emotional Stability for job.

Objectives

- ➢ To reduce the time to hire employee and save organization's time and money.
- ➢ To speed up the screening process of hiring employee.
- ➢ To make unbiased standard assessments of the candidate.

2.4. Problem Analysis:

The goal is to build system that can help to remove deficiency in traditional recruitment process with respect of time, money, manpower and assessment process. AVI-AI system using image processing and Convolutional Neural Network algorithm will help to speed up the screening process of hiring employee and to make unbiased standard assessments of the candidate.
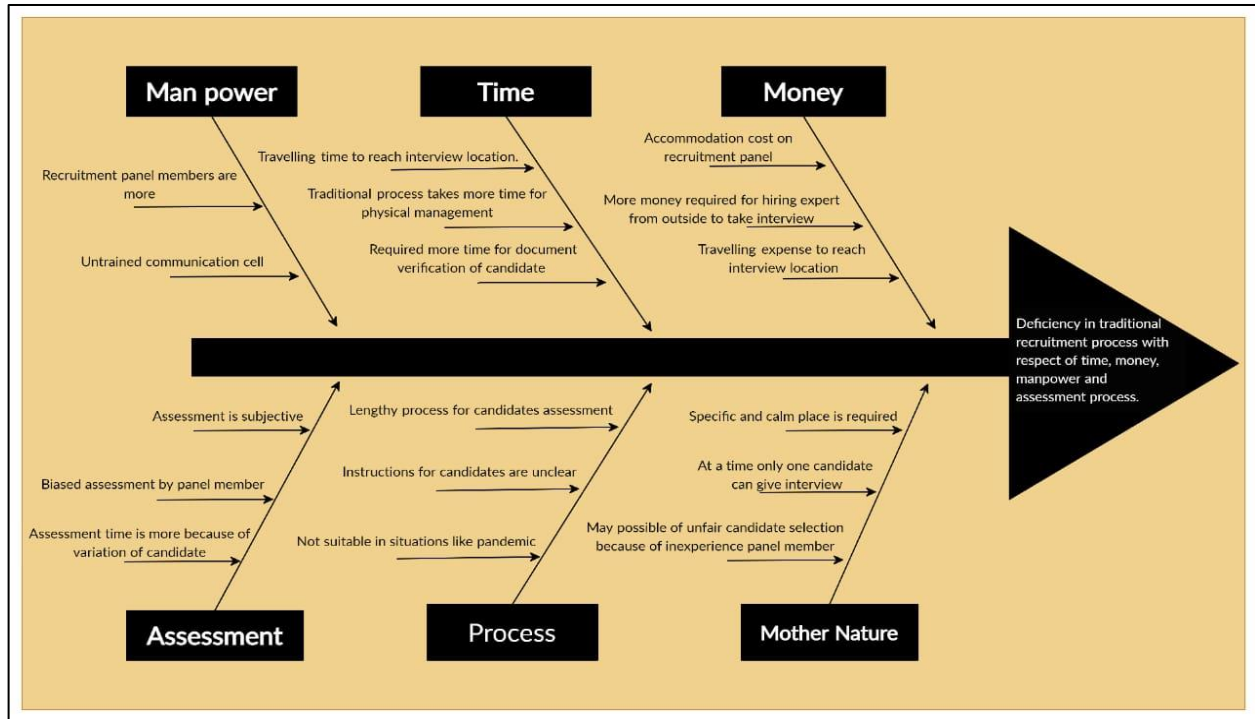
Fig. No. 2.4.1. Fishbone Diagram

The reason with respect to asses personality during video interview using image processing and machine learning are indicated using cause and effect diagram(Fish bone diagram) as shown in figure 2.4.1. The rectangle symbol under each category indicate the cause that are found for implementation of AVI-AI system. Causes that are identified during problem analysis are applied using WHY-WHY analysis. After doing WHY-WHY analysis, the solution i.e., Digitalization in traditional recruitment process using Image Processing and Machine Learning is proposed. This system is implemented to make unbiased standard assessments of the candidate.

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│                                               │
│   Digitalization in traditional recruitment   │
│                  process.                      │
│                                               │
└─────────────────────────────────────────────┘
                        │
                        ▼
        ┌───────────────────────────────────┐
        │  Deficiency in traditional         │
        │  recruitment process with respect  │
        │  to time, money, manpower &        │
        │  assessment process.               │
        └───────────────────────────────────┘
```

| why | why | why | why |

Why ore Manpower Requires	More Time Consumption	Lots of Money Investment	Lengthy Assessment process
✓ Training System Models using ML algorithms in place of recruitment panel. ✓ Recording of interview also can done . ✓ It is automated system, so there is no required any communication cell. ✓ We can take interview of multiple candidate at a time.	✓ System can be used at anytime and anywhere. ✓ Save time that required for physical process management. ✓ Report of interview assessment get in less amount of time. ✓ No need of document verification	✓ Save money for travelling and accommodations expenses of recruitment panel as well as candidate. ✓ There is no need to hire experts as panel members so spending on panel member is less.	✓ Unbiased assessment can be done by using machine. ✓ Less time required for assessment of candidate. ✓ Perfect candidate get selected as per requirement. ✓ Self assessment can be done so candidate can identify their weakness. ✓ Instructions are clearly mentioned.

Fig 2.4.2 WHY-WHY analysis

In Figure 2.4.2, why is important Digitalization in traditional recruitment process and by using which techniques we can implement this system is shown. This application will help recruiters to complete hiring process as early as possible. Reason behind providing this system to people is that More Manpower, More Time Consumption, Lots of Money Investment & Lengthy Assessment process.

2.5. End Users

➢ Candidate: Who wants to know their personal assessment.

➢ Organization: Who wants to hire the candidate by online mode.

➢ Other: Programmers who are interested in working on the project by further developing it.

3. Literature Survey and Motivation

3.1. Literature Survey

To select the finest candidates, an artificial intelligence-trained video interviewing system analyses the interviewees' facial features, moods, expressions, and intonations. Speech recognition, personality insights, tone analysis, the relevance of responses, emotional recognition, and psycholinguistics are all used in this technology-assisted recruiting process. Human recruiters are informed of the best matches, as well as AI's own observations on specific individuals. To the extent that AI research can assist organization's in finding the right people, convincing them to apply, screening out unqualified applicants, and distinguishing between more and less qualified candidates, it will have significant implications for the world of practice.

Personality traits and interpersonal communication skills have been identified as critical success factors for job performance and organizational effectiveness. Communication skills enable workplace members to effectively exchange, share, and provide feedback to various stakeholders via verbal and nonverbal messages. Nonverbal messages, such as gestures, facial expressions, posture, and tone of voice, are useful for understanding underlying emotions, attitude, and feelings. Personality traits are individual patterns of thinking, feelings, and behaviour that can be used to predict whether a person is a good fit for a particular job context or organizational environment. All of the articles in this study were retrieved from various sources, including Google Scholar, Research Gate, and IEEE.

3.1.1 Research Paper

T. DeGroot and J. Gooty. "Can nonverbal cues be used to make meaningful personality attributions in employment interviews?" Journal of Business and Psychology, 24(2):179–192, 2009.

3.1.a Abstract

a. This paper studies the relationships between nonverbal cues and interview performance ratings and also examines the role of personality attributions.

b. Conscientiousness attributions explain the relationship between visual cues and interview ratings, extraversion attributions mediate the relationship between vocal cues and interview ratings. Neuroticism attributions had a suppressing effect for both visual and vocal cues.

c. The structured behavioural interview is rich in behavioural and non-behavioural information available to the interviewer. While the non behavioural information might consist of right or wrong answers related to the content of questions, the behavioural information is less structured and therefore more open to interpretation.

d. In this paper three types of nonverbal cues are studied - dynamic, static, and paralinguistic cues. Dynamic cues are easily changed such as eye contact, body orientation, smiling, gesturing, and head movement. Static cues are demographic variables and physical attractiveness. Paralinguistic cues refer to vocal characteristics such as speech rate, volume, tone, and pausing.

e. The Brunswik lens model shows the potential impact of personality attributions when both channels of information are used.

3.2.b Inference drawn from the paper

- Coefficients for the model are computed by regressing the combined personality attributions on both dependent variables, job performance on one side of the lens model and expert interview ratings on the other side of the lens model.

- This suggests that interview raters and job performance raters almost equally use personality attributions when making their ratings.

- Understanding the impact of effects of personality in interviews has great organizational relevance. Extraversion has been shown to be a much-desired managerial trait.

- One conclusion which can be made is that no matter how much an interview is structured; nonverbal cues cause interviewers to make attributions about candidates.

Andrew S. Imada and Milton D. Hakel ."Influence of Nonverbal communication and Rater Proximity on Impressions and Decisions in Simulated Employment Interviews"Journal of Applied Psychology 1977, Vol. 62, No. 3, 295-300.

2.1.a Abstract

- This paper studies various ways to assess job applicants and examines the role of nonverbal communication in hiring process.
- Nonverbal behaviours enable the applicant to convey an "immediacy" dimension in interviews. Immediacy in an interaction between two individuals involves greater perceptual availability of two persons.
- It investigates the effects of the applicant's nonverbal behaviours and rater proximity on interview impressions and decisions.

2.2.b Inference drawn from the paper

- According to the paper, through the use of eye contact, gestures, smiling, smaller interpersonal distances, an attentive posture, and a more direct body orientation, the applicant will be perceived and described as a warmer and more enthusiastic person.
- When nonverbally immediate, the applicant will be perceived and rated as being more likely to be accepted, more successful, more qualified, better liked, as having more desirable characteristics, being more motivated, more competent, and more satisfied if given the position, and as a result will be recommended for the position.
- Interviewers feel very comfortable and satisfied when interacting with a nonverbally immediate applicant and uncomfortable and dissatisfied when interacting with a non-immediate applicant. This, however, is not the case for observers.

Naim Iftekhar, Tanveer Md, Gildea Daniel & Hoque Ehsan. (2015). Automated Prediction and Analysis of Job Interview Performance: The Role of What You Say and How You Say It.. 10.1109/FG.2015.7163127.

2.1.a Abstract

a. A common perception surrounding job interviews is that the content of the interviewee's answers is the most important determinant for success.

b. However, empirical studies show that nonverbal behaviour is as important as the verbal response in job interviews. Nonverbal behaviours are subtle, □eeting, subjective, and sometimes even contradictory, posing a significant challenge for any prediction framework.

c. In this paper, an automated prediction framework is designed and implemented for quantifying the outcome of job interviews, given the audio-visual recordings.

d. The proposed prediction framework automatically extracts a diverse set of multimodal features (lexical, facial, and prosodic), and quantifies the overall interview performance, the likelihood of getting hired, and 14 other social traits relevant to the interview process.

2.2. b Inference drawn from the paper

a. The outcome of job interviews often depends on a subtle understanding of the interviewee's response. A momentary mistake can ruin the interview outcome.

b. Therefore, anomaly detection techniques are better.

c. Facial features, particularly the smile, are found to be significant for predicting friendliness. Besides smiling, people who speak more words associated with "We" than "I" are perceived as being friendlier.

d. Therefore, it is recommended to speak more fluently, use less filler words, speak as "we" (vs. "I"), use more unique words, and smile more.

L. Nguyen, A. Marcos, M. Marron, and D. Gatica. Multimodal analysis of body communication cues in employment interviews. In ACM International Conference on Multimodal Interaction (ICMI), 2013.

2.1.a Abstract

- Gestures are an essential component of body communication as they are used to enrich the vocal content and aid listener comprehension by augmenting the attention, activating images or representations in the listener's mind, and increasing the recall of what is being said.
- Job hireability impressions and self-rated personality can be predicted using body communication cues.
- Speaking status can be used to improve the prediction performance of personality and hireability
- In order to analyse the predictive validity of body posture with respect to self-rated personality traits and hireability impressions, a regression problem was defined which aims at predicting the exact hireability and personality scores, where each social variable is considered as an independent regression task.

2.2.b Inference drawn from the paper

- Except communication and conscience, all hireability measures are significantly correlated with each other.
- Extraversion is significantly and positively correlated with three hirability scores: hiring decision, conscience, and stress resistance.
- The automatic features based on hand speed and hand acceleration are conditioned on the speaking status.
- The best prediction results for the hiring decision and stress resistance are achieved using automatic cues based on activity histograms.

Research Paper No.	Problems Solved	Verbal	Non-Verbal	Methodology
[1]	Automatic prediction of hirability	-	Yes	Regression Methods
[2]	Automatic prediction of rating to interviewees	-	Yes	16 Regression Models
[3]	Assessment of psychological and personality traits	Yes	Yes	CNN
[4]	Job analysis based on behavioural description	Yes	Yes	KSAO's identification technique
[5]	Automated personality Assessment by Video interview	Yes	Yes	Machine learning, Nomological network
[6]	Prediction of interpersonal communication skills	Yes	Yes	CNN
[7]	Knowing viability of AI in recruitment process	-	-	-

3.2. Motivation

The motivation behind this project came from the placement going on in the college for our 2021-22 B.Tech batch. In a placement process there are different rounds through with a candidate has to go through, from qualifying aptitude test to technical interview and finally the HR interview. HR interview is the last round but is as important as any other round. During such interview along with our verbal communication, the nonverbal behaviour play a very important role. Research says that application who use their nonverbal communication proper have high chances of getting hired. So, this motivated us to take a project on automated human behaviour analysis in Job Interviews.

4. Proposed System and Requirement Specification

4.1. Proposed System

The AVI-AI system is a system for candidate and organization to hire. There will be two end users that is candidate and organization. The system can capture video of candidate, generate interview scripts. The system provides result of candidate assessment to organizations and also can helps candidate to take self-assessment.

For making unbiased judgment of personality of candidate and to save time & money of the organization. It can helpful to overcome the traditional method of recruitment process. The user can use the system at anytime and anywhere.
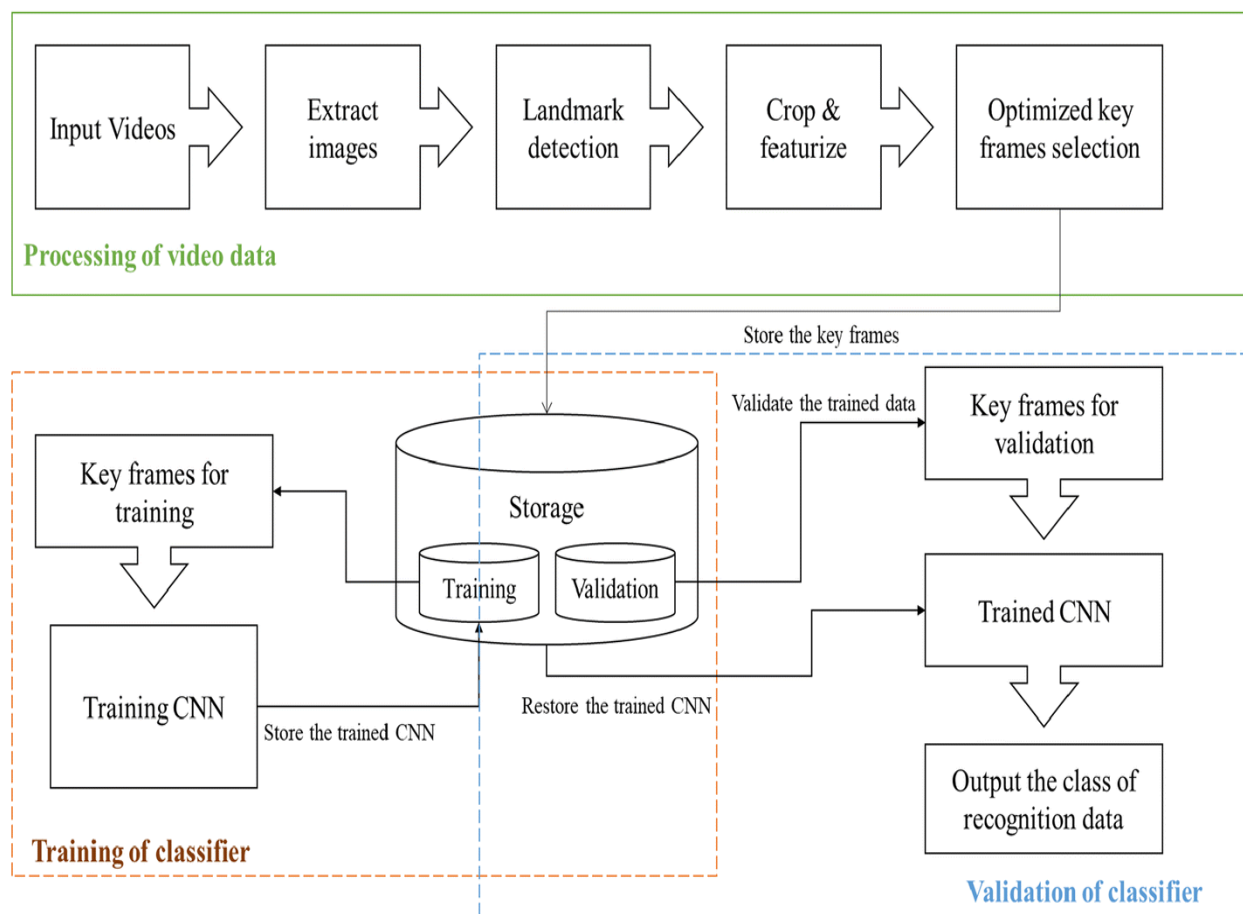
Fig. No. 4.1. System Architecture

4.2. Software Requirements Specification

4.2.1. Functional Requirements

➢ With priority, to find out how the candidate is acknowledging with facial expressions and their tone of speech and thereby conduct the required analysis.

➢ Utilizing the voice of the candidate to know more about the competency of the candidate (Physical behaviour of nervousness, confidence, shyness.)

➢ It should give an overall candidate score to make better decision.

➢ It should be able to handle multiple candidates simultaneously.

➢ It should analyse the interview videos and automatically extract features from them.

4.2.2. Non-functional Requirements

➢ Performance Requirements:

The System should be able to handle the following task:

Users can access the system as much as they want from any location and at any time. The camera should be able to capture a clear image of the candidate's expression. As for this prototype version, we will continue to detect if the system crashed, hanged, or experienced an operating system error. Detecting the system's performance in terms of the efficiency of integration of the various components.

➢ Safety Requirements:

There are chances of database may crash due to some failure. This may cause loss of video recording and results of assessment also. Therefore, it is required to take the database as a backup.

➢ Security Requirements:

There are no specific security requirements, anyone who wants to use the system can use. But when organization uses the system only organizations persons can use and access the result of the assessment not candidate. Organization takes a permission from candidate to resume. Streaming the device camera on web makes security measurements crucial. Accessing and interacting with the streaming web server should be controlled and any message should be prevented. User authorization and data encryption are very

important security requirements of the project. User stream should not be available to anyone who is not authorized by the user of the minimized.

4.3. Significance of the Project

Increase hiring process rate by reducing time spent that required for physical process management and take unbiased standard assessments of the candidate using image processing. By using machine learning we are able to digitalize recruiting process.

4.4. Scope of Project

The software product to be produced is an automated video interview using artificial intelligence (AVI-AI) system is to ease to assess the personality and skills of candidates during the online interview as per requirement.

There are two end users for this system. The two end users are the Candidates and hiring companies. The AVI-AI Systems objectives is to provide a system to assess a candidate. It is helpful to companies to select best candidate as per their requirement. It Saves time and money of organization for recruitment process. It is helpful to interviewees for personality assessments of self-Interview in online mode while preparing the online interview. The main feature of our system is to make personality judgement of candidate during interview.

4.5. Deployment Requirements

4.5.1. Hardware Requirements

➢ i5 Processor Based Computer or higher

➢ Memory: 8 GB RAM

➢ Hard Drive: 256 GB

➢ SSD Up to 256GB

➢ Internet Connection

➢ Depth Camera - The basic purpose of camera is to capture the video of the interviewee.

➢ Microphone - It will be used for capturing audio of the interviewee.

4.5.2. Software Requirements

➢ Windows 7 or higher

➢ Anaconda

➢ Python

➢ Praat / Audacity

➢ Apache Server

➢ MySQL Database

➢ Visual Studio 2019

➢ Graphic Processor

➢ Graphics Card 2GB

4.6. Project Cost Estimation

Sr. No.	Project Phase	Estimate Hours (Per Week)	Developers	Cost (50/Person)
1.	Phase 1. Problem Life Cycle			
	1.1. Problem identification	8	4	1600
	1.2. Problem selection.	6	4	1200
	1.3. Problem definition	4	4	800
	1.4. Problem analysis	10	4	2000
2.	Phase 2. Design			
	2.1. System Architecture	8	2	800
	2.2. DFD	8	2	800
	2.3. UML	6	4	1200
3.	Phase 3. Coding	24	4	4800
			Total Cost (Rs)	13200

Table. No. 4.6. Project Cost Estimation

5. Design

5.1. Data Flow Diagram

 A Data Flow Diagram (DFD) is a traditional visual representation of a system's data flows. A neat and clear DFD can graphically depict the appropriate amount of system requirement. It can be manual, automated, or a hybrid of the two. It demonstrates how data enters and exits the system, what changes the data, and where data is stored.

A DFD's purpose is to demonstrate the scope and boundaries of a system as a whole. It can be used as a tool for communication between a system analyst and anyone who is involved in the order that serves as a starting point for redesigning a system. The data flow diagram (DFD) is also known as a data flow graph or bubble chart.

5.1.1. DFD Level 0
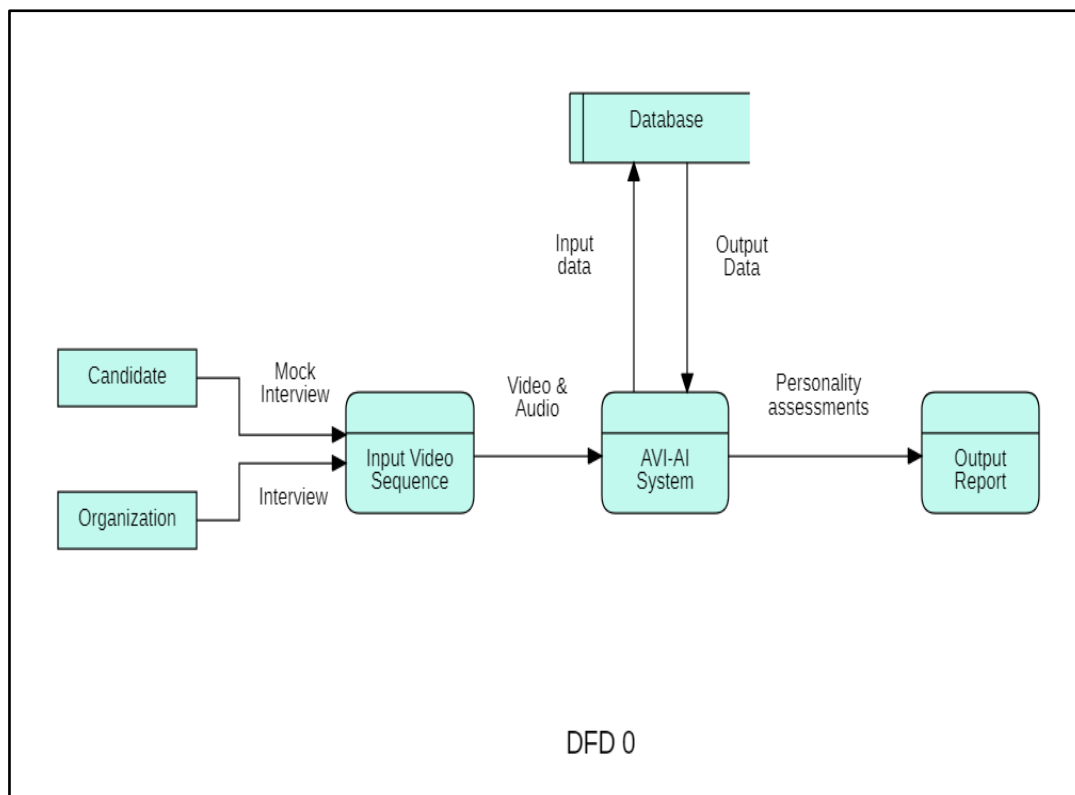
Fig. No. 5.1.1. DFD Level 0

In fig 5.1.1, Candidate & Organization are entities,. The line with arrow indicate data flow. DFD diagram provides information about outputs and inputs of each entity and process itself. Here, the Candidate gives input video sequences to the process, the process of AVI-AI system using image processing and machine learning will extract image features from the video given by entity candidate, the process receives output image and then the result is given to the organizer

5.1.2. DFD Level 1
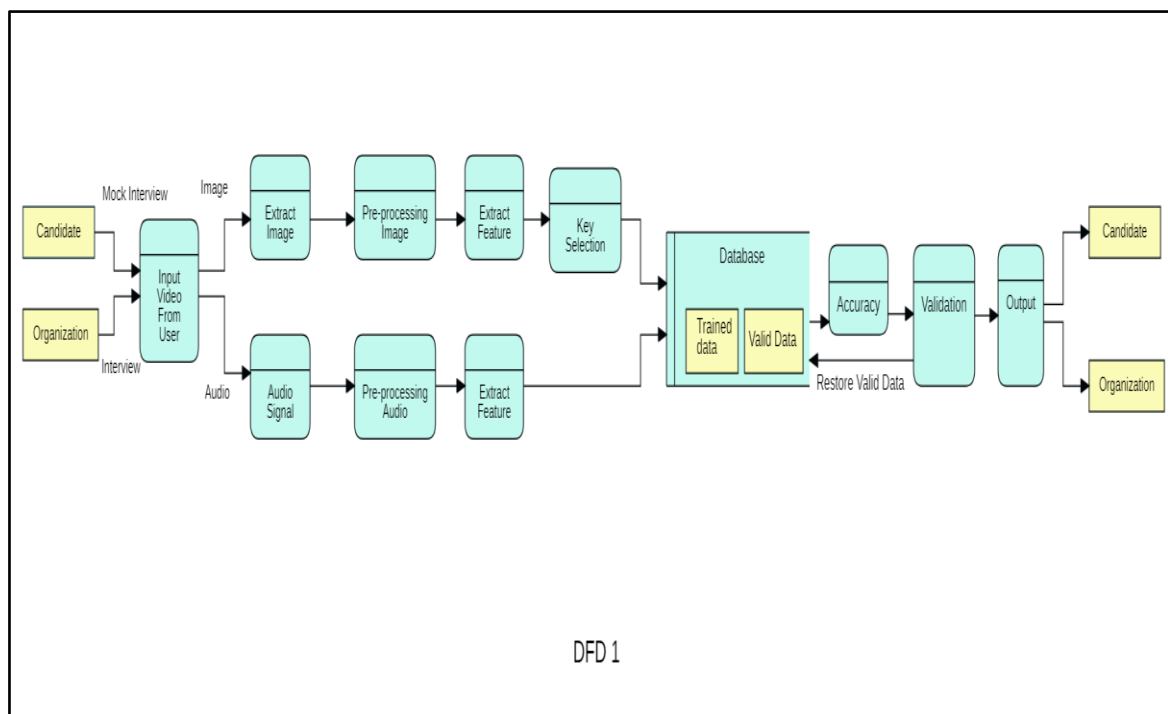
Fig. No. 5.1.2. DFD Level 1

In Figure 5.1.2, Candidate and Organization are entities, Input video sequence, Extract Images, pre-processing , Feature Extraction, Training & Testing of data , validation & report generation are process, Line with arrow indicates data flow. Candidate starts the interview, from video sequences, extract images for image processing as an input. The features which are extracted are given as an input to Machine Learning which in turn gives output report to Organization.

5.1.3. DFD Level 2
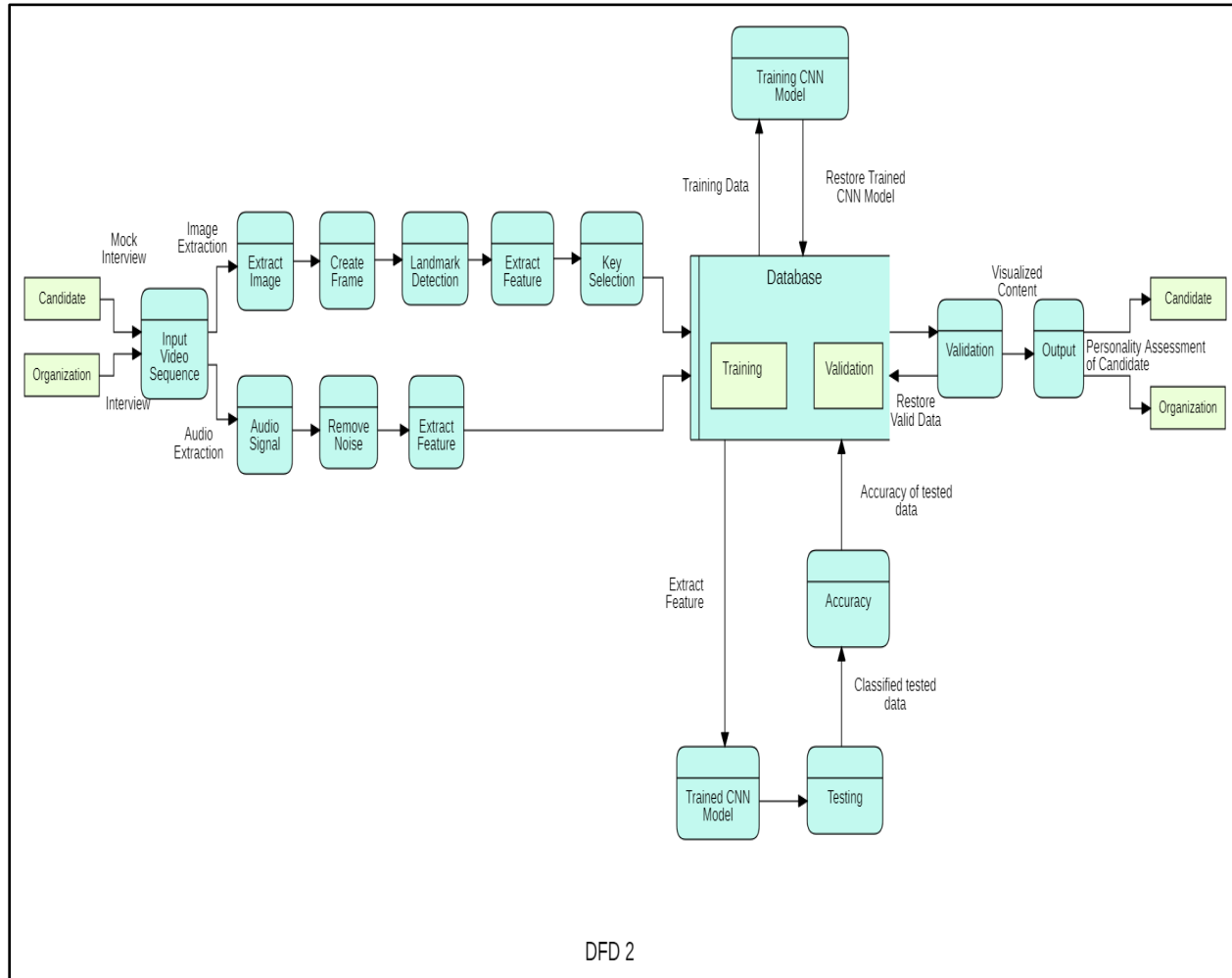
Fig. No. 5.1.3. DFD Level 2

In Figure 5.1.3, Candidate and Organization are entities, Input video sequence, Extract Images, pre-processing , Feature Extraction, Training & Testing of data ,Validation & Report generation are processes. Training system, Testing system and Images are the data storage. Candidate inputs video on model, model sends image to training system data store, The training set is sent to training system, then the test system inputs image into image processing which extract features of that image and send it to Machine learning process. Machine Learning process gives result which is received by Organization.

5.2. UML Diagram

We create UML diagrams to help us understanding the system more clear and concise manner. To cover all features of the systems, a single diagram is insufficient. UML defines a variety of diagrams to address the majority of a system's characteristics.

5.2.1. Use Case Diagram

Use case diagram is a combination of actors and their functionality represented by graphical components. Use case diagrams are a set of use cases, actors, and their relationships. They represent the use case view of a system. A use case represents a particular functionality of a system. Hence, use case diagram is used to describe the relationships among the functionalities and their internal/external controllers. These controllers are known as actors.
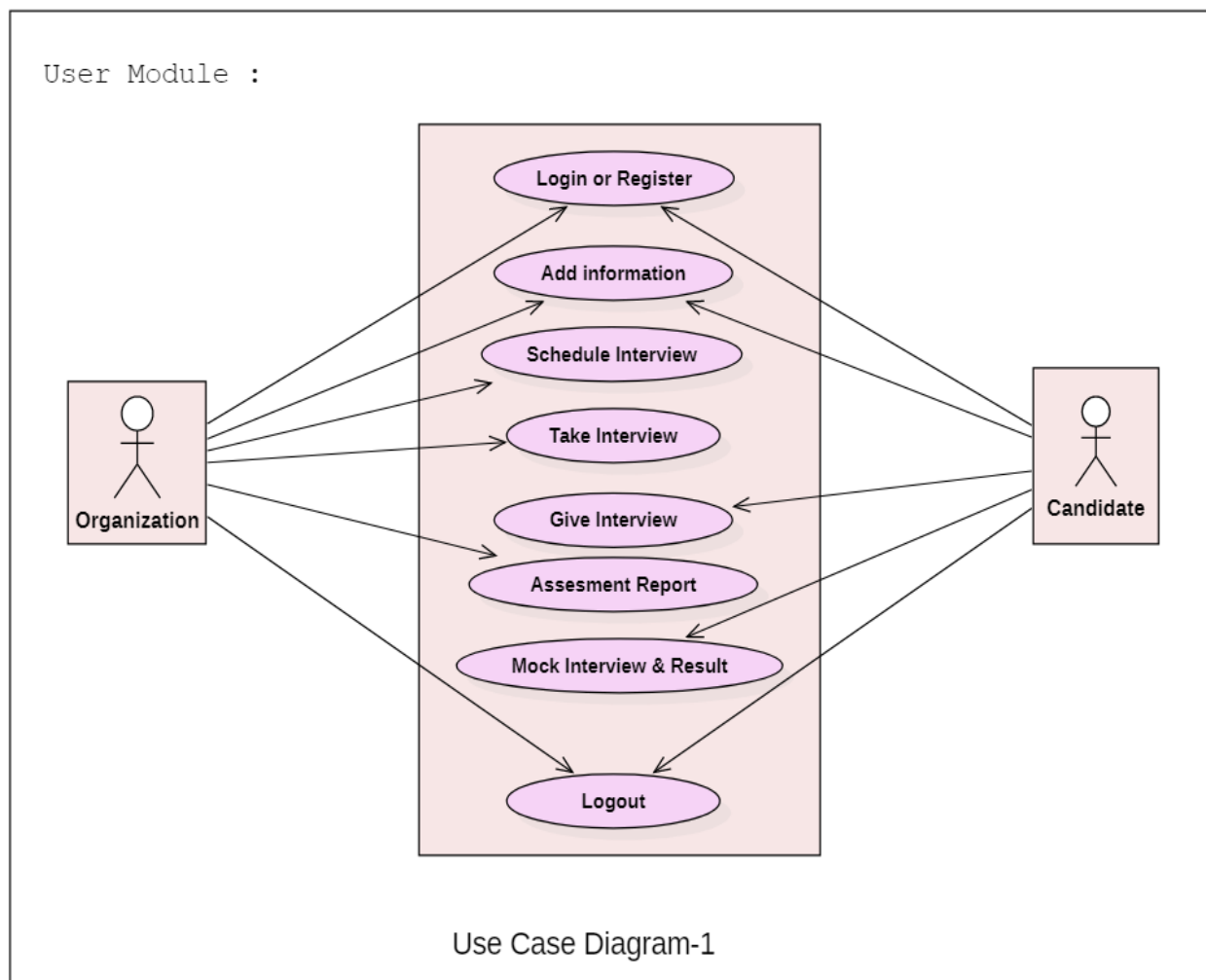
Fig. No. 5.2.1(a).Use Case
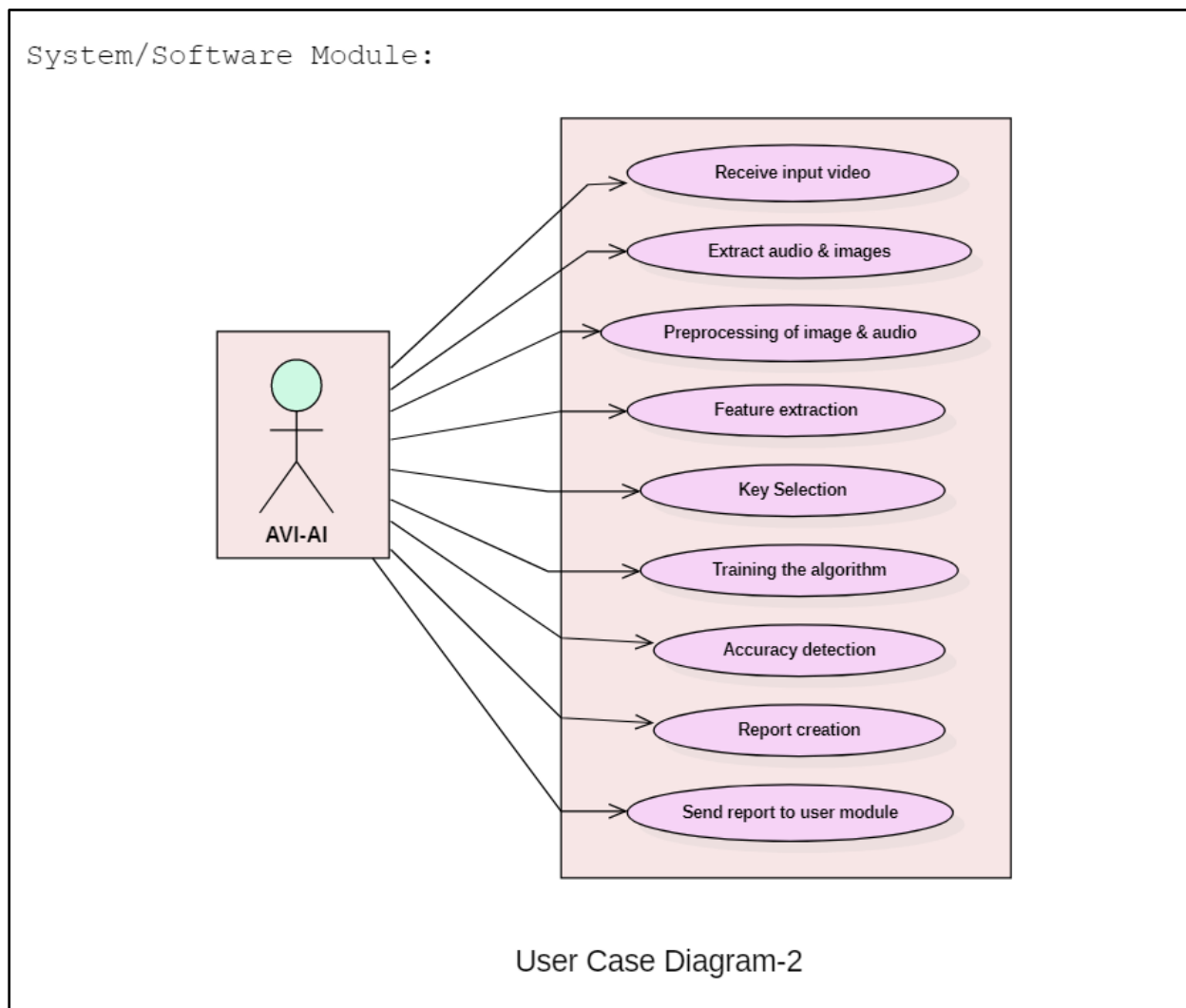
Fig. No. 5.2.1(b).Use Case

A use case diagram is a liberal or performance diagram. In Figure 5.2.1(a), Candidate and organization are Actors. Login/Register, Add information, Schedule interview, Take/Give interview, Assessment report are the use cases. In Figure 5.2.1(b), AVI-AI System is Actor. Extract Images, Pre-processing of images, Feature Extraction, Training the algorithm, report creation are the use cases. Figure suggests the connection between actor and use cases. Use cases are drawn in oval form and relationship shown through arrow.

5.2.2. Class Diagram

The class diagram is a graphical representation of all classes used in the system and their operations, attributes and relations. In this diagram rectangle indicate classes. Rectangle is divided into Different parts namely class name, attribute and operation. Upper elegance has the relation with its subclass which are shown by means of the generalization. The arrow indicates the relationship. Interfaces are connected via the subclass.
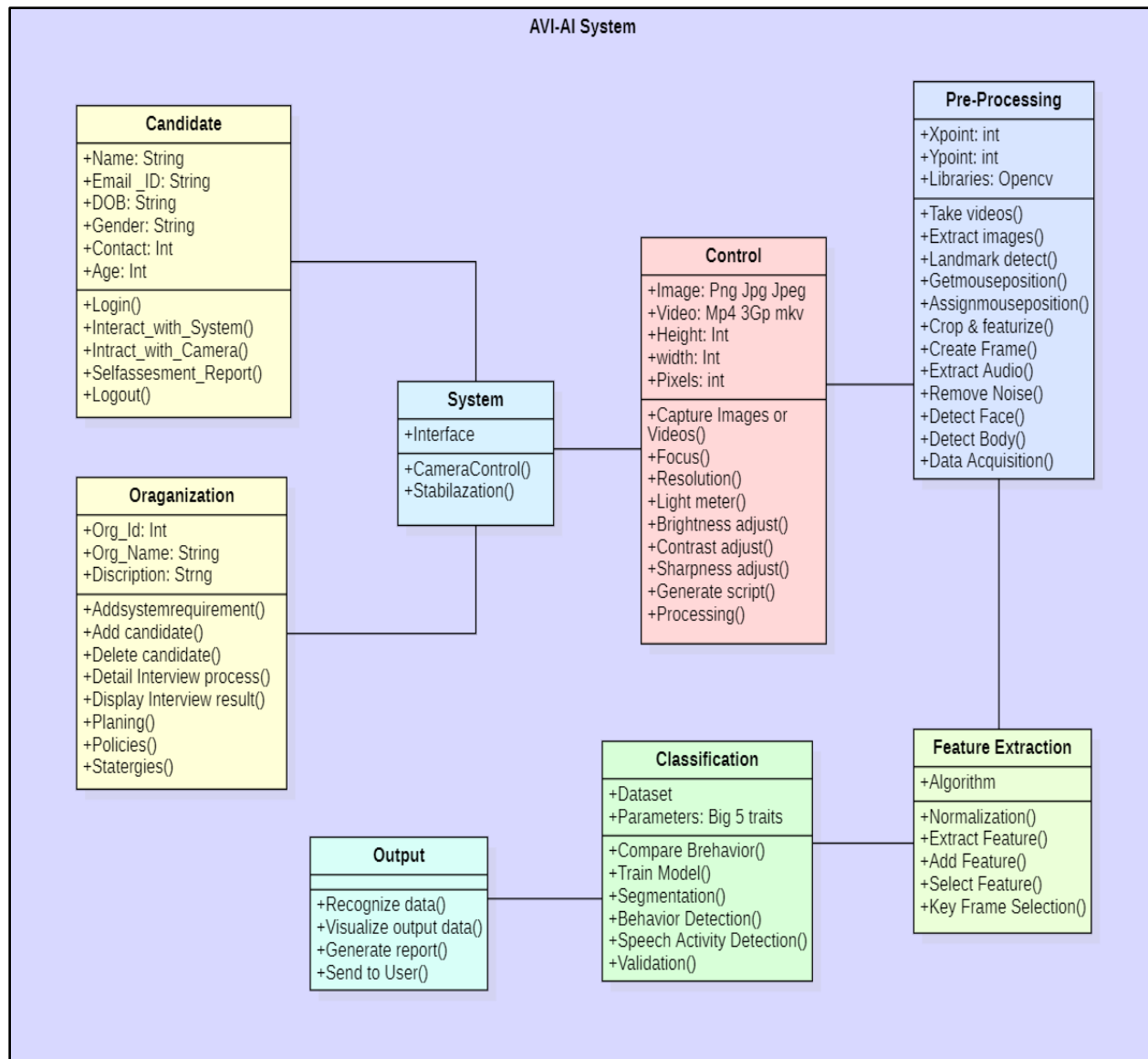
5.2.3. Object Diagram

Object diagrams can be described as an instance of class diagram. Thus, these diagrams are closer to real-life scenarios where we implement a system. Object diagrams are a set of objects and their relationship is just like class diagrams.

User: Candidate
+Name = "Siddhant"
+Email_Id = "1804032@ritindia.edu"
+DOB = 23 July 2000
+Gender = Male
+Contact = 9860829299
+Age = 21

System: AVI-AI
+Interface = web interface

Control: Camera
+Image = C1.jpg
+Video = C1.mp4
+Height = 3"
+Width = 5"
+Pixel = 1080*1920

User: Organization
+Org_id = O123
+Org_name = TCS
+Discription = Company Requirement
+Address = Hinjawadi Pune

PreProcessing
+Xpoint = 5
+Ypoint = 10
+Libraries = OpenCV

Feature Extraction
+Algorithm = CNN

output
+Report: result.pdf

Classification
+Dataset = MS-COCO
+Parameters = mood
eye contact

5.2.4. Sequence Diagram

A sequence diagram shows an interaction arranged in time sequence. It shows object participating in interaction by the message. The exchange arranged in time sequence critical dimension represent time and horizontal dimension represent object.

In the above sequence diagram roles are webcam, pre-processing, feature extraction, database, Trained neural network. Arrow is used to show the communication between the object. The messages on arrow shows the flow of one function to every other function.
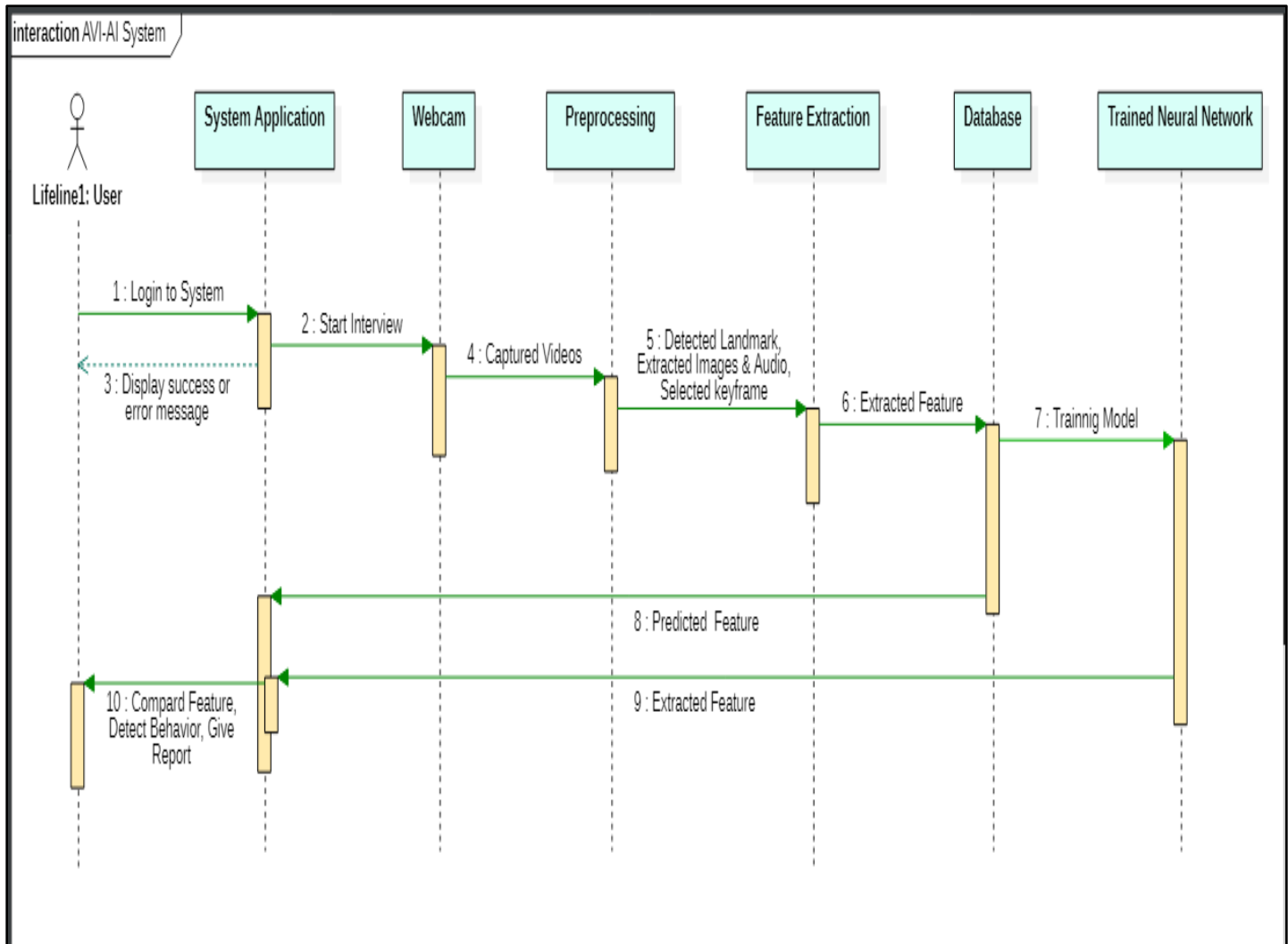
5.2.5 Activity Diagram

The activity diagram shows the activity of the process. Here first login is done when the user is valid the welcome page occurs. Activities are nothing but the functions of a system. Numbers of activity diagrams are prepared to capture the entire flow in a system.

Activity diagram specifies dynamic aspects of system. It gives series of action or flow control. It is similar to flow chart showing activities performed by system.

Activity Diagram
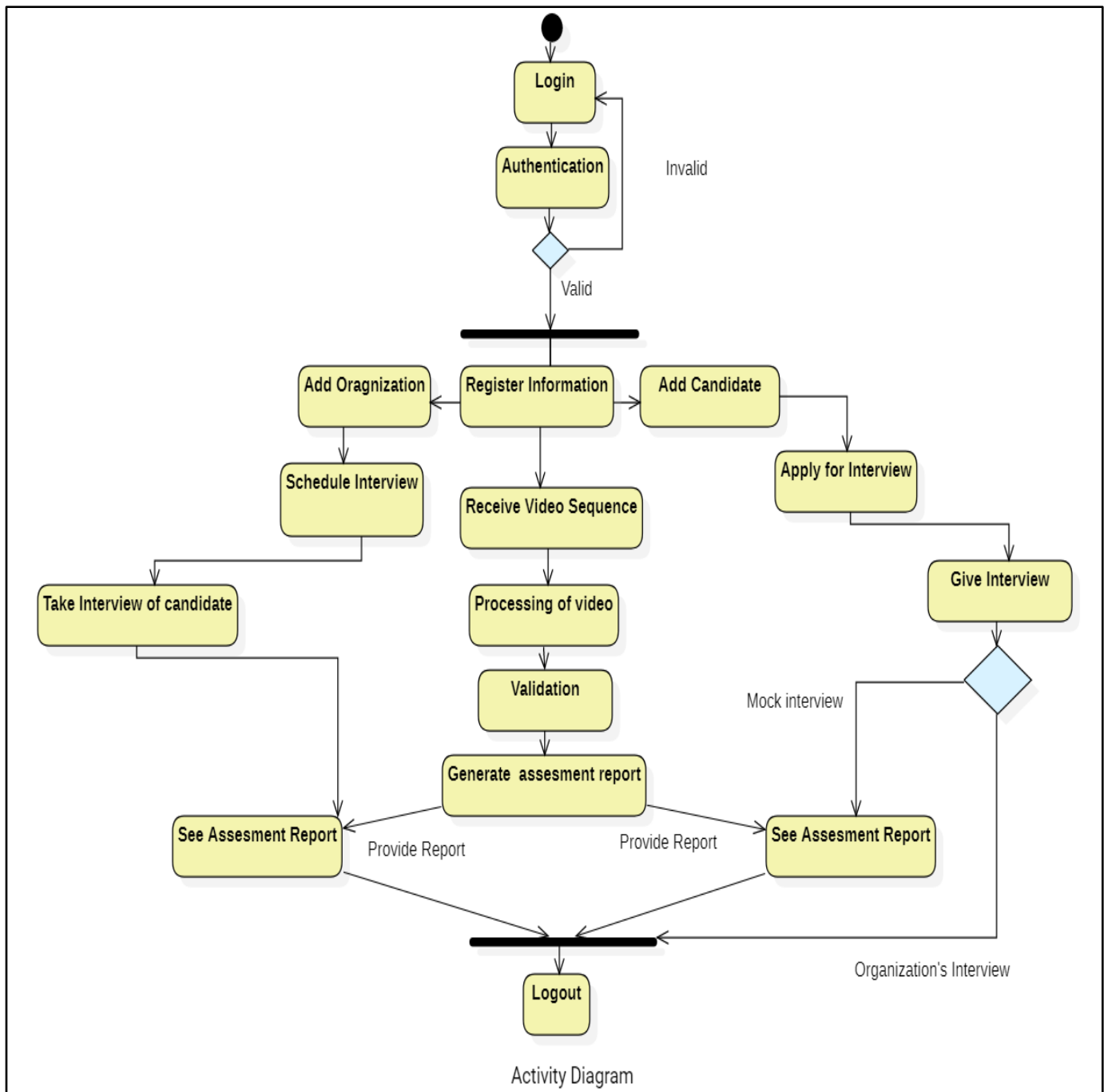
5.2.6. State Machine Diagram

State diagram is a graph of nodes connected by a communication association. It represents the intermediate stages such as login, enter details, Schedule interview, Take or give interview, Assessment result, Sign-Out.

State Machine Diagram
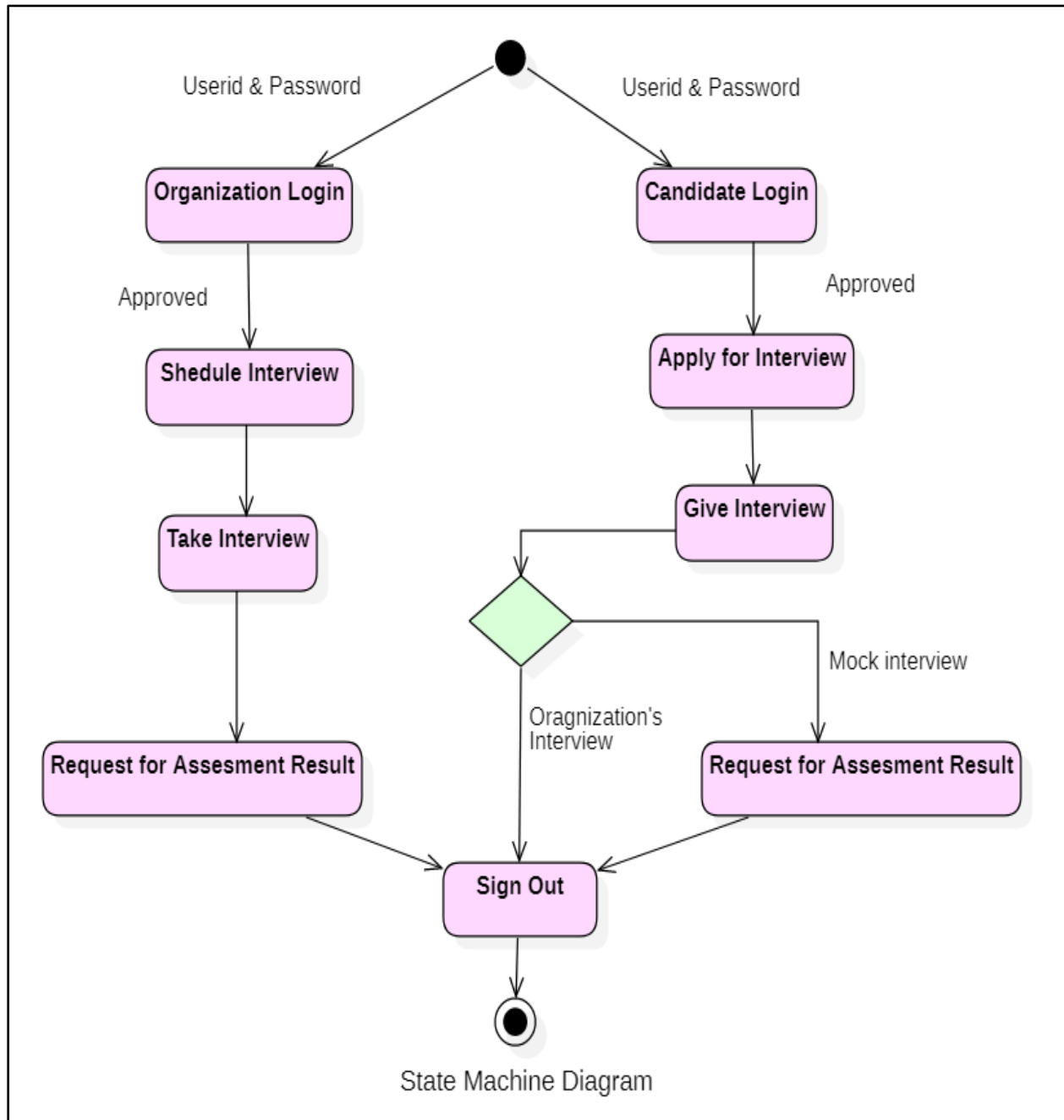
5.2.7. Package Diagram

Package diagrams are structural diagrams used to show the organization and arrangement of various model elements in the form of packages. A package is a grouping of related UML elements, such as diagrams, documents, classes, or even other packages.

Package Diagram
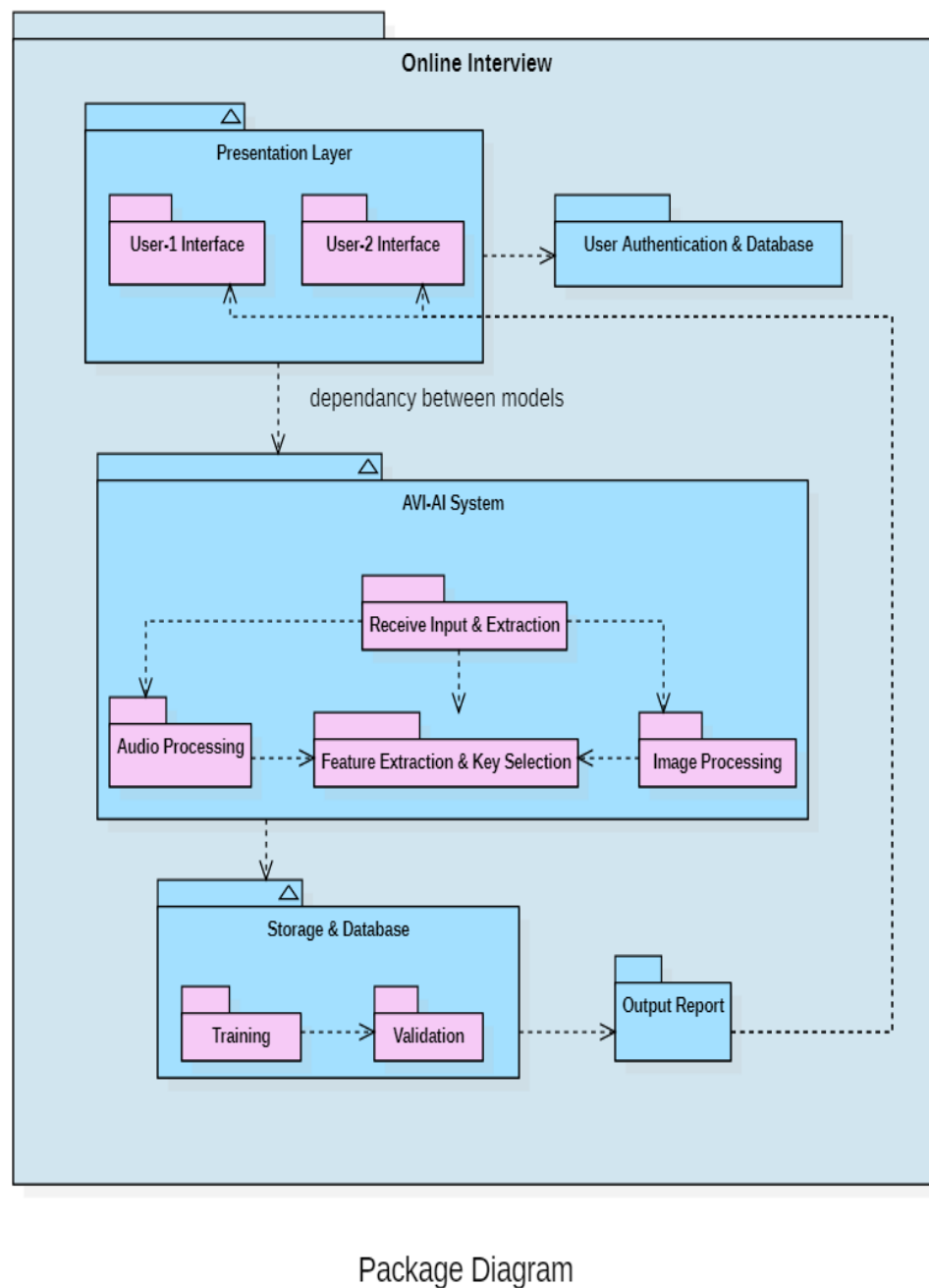
5.2.8. Deployment Diagram

Deployment diagram models the physical aspects of system. It consists of nodes and their relationship. It describe how software is deployed in hardware system.

Deployment diagram is a graph of nodes connected by a communication association. Deployment diagrams are a set of nodes and their relationships. These nodes are physical entities where the components are deployed. Deployment diagrams are used for visualizing the deployment view of a system. This is generally used by the deployment team.

Deployment Diagram
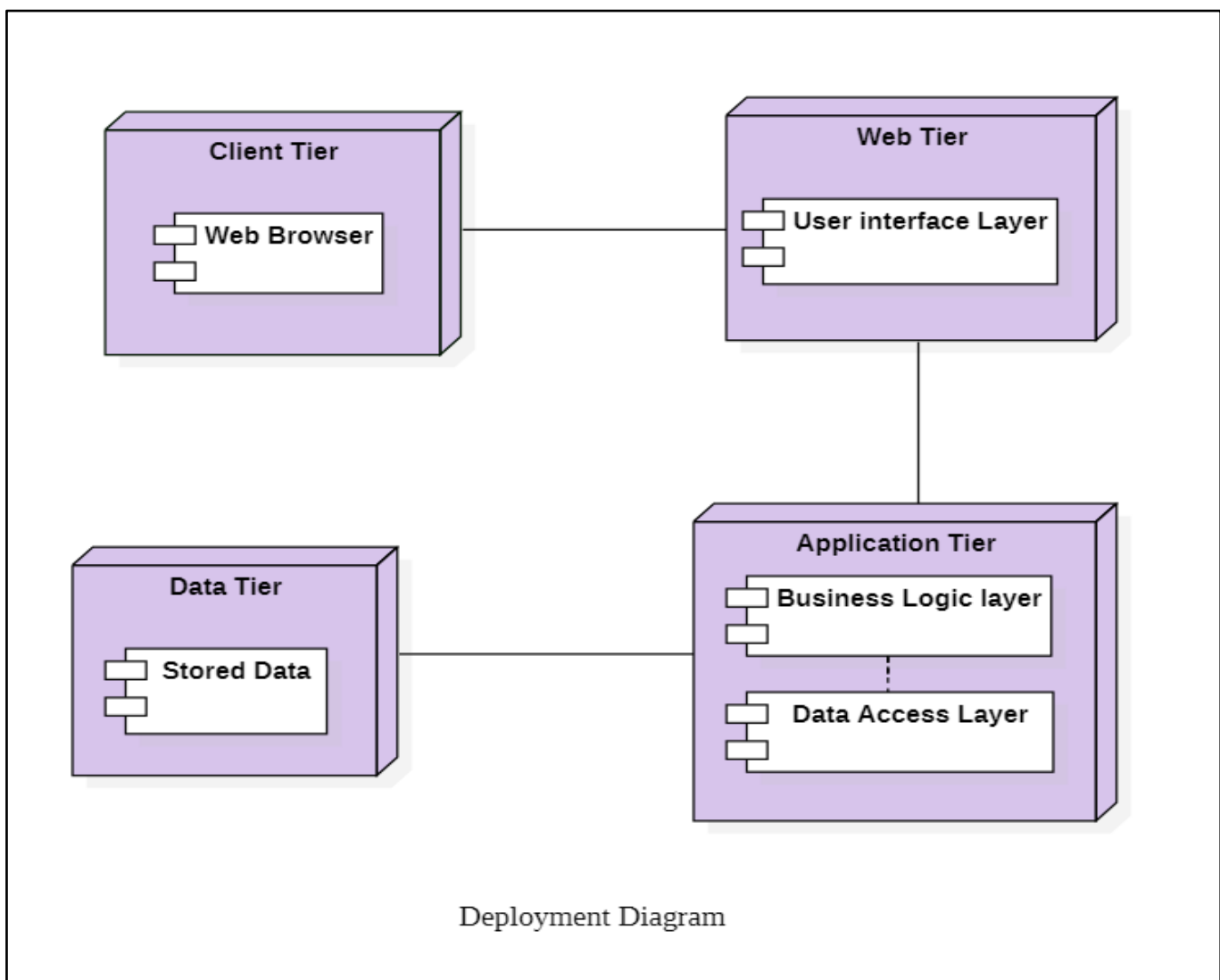
5.2.9. Component Diagram

Component Diagram shows relationship between different components in system. UML component diagram model larger systems into smaller subsystems.

Component Diagram
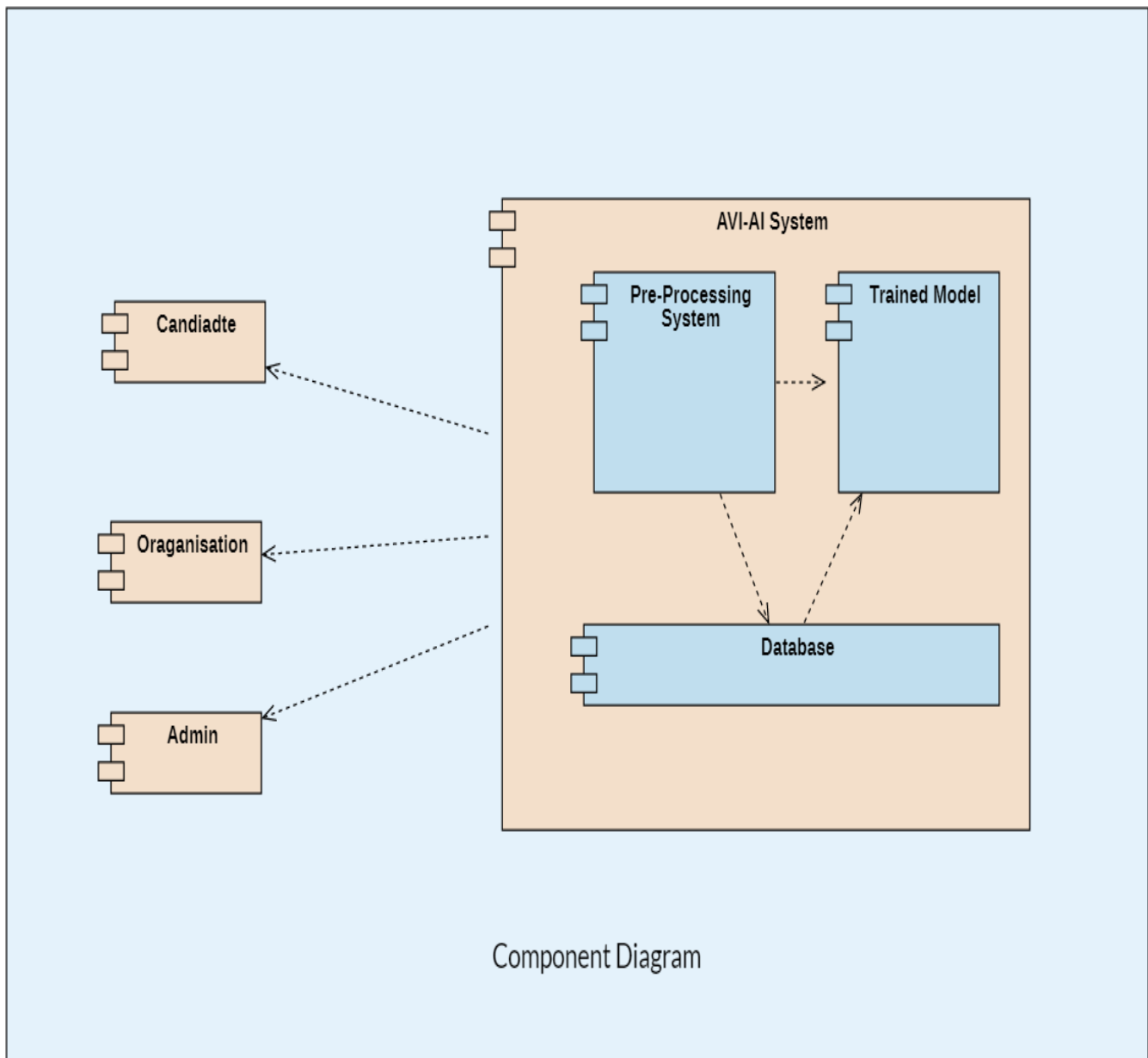
6. Development/Implementation Details

Technology :

a. **Image Processing** - Digital image processing is the use of computer algorithms to perform image processing on digital images. As a subcategory or field of digital signal processing, digital image processing has many advantages over analogue image processing.

b. **Prosodic Analysis** - Analysis of a language based on its patterns of stress and intonation in different contexts. In systemic grammar, prosodic analysis is regarded as an essential foundation for the analysis of syntax and meaning.

c. **Machine Learning** - Machine learning is a field of computer science that gives computer systems the ability to "learn" with data, without being explicitly programmed.

Tools:

Tools and ML libraries:

a. **TensorFlow:**
   TensorFlow is an open-source machine learning library that may be used to solve a variety of problems. It is a symbolic math library that can also be used to create and train neural networks to discover and analyse patterns and correlations, similar to how humans learn and reason.

b. **Keras:**
   Keras is a Python-based open-source neural network library. It can be used in conjunction with MXNet, Deeplearning4j, Tensorflow, CNTK, or Theano. It focuses on being basic, modular, and adaptable in order to facilitate speedy experimentation with deep neural networks. TensorFlow's core library now supports Keras, thanks to a decision made by Google's TensorFlow team in 2017. Keras, according to Chollet, was designed as an interface rather than an end-to-end machine-learning framework. It provides a higher-level, more understandable set of abstractions that make configuring neural networks simple, regardless of the backend scientific computing library used.

c. **CUDA Toolkit:**

Nvidia developed CUDA, a parallel computing platform and application programming interface (API) concept. It allows software developers and engineers to use a CUDA-enabled graphics processing unit (GPU) for general-purpose processing (a technique known as GPGPU) (General-Purpose computing on Graphics Processing Units). The CUDA platform is a software layer that provides compute kernels immediate access to the GPU's virtual instruction set and parallel computational elements.

d. **PRAAT**:

Praat is a free computer software package that allows you to analyse speech scientifically in phonetics. Speech synthesis, including articulatory synthesis, is supported by the programme.

e. **OpenCV:**

OpenCV (Open-Source Computer Vision) is a programming library geared mostly toward real-time computer vision. Intel was the first to develop it. TensorFlow, Torch/PyTorch, and Caffe are among the Deep Learning frameworks supported by OpenCV.

Visual Cues:

During the interview, visual signals include the interviewee's face features. Facial expression, gaze, and head nods are among the facial cues retrieved. The interviewee's face traits are retrieved for each video frame.

The first stage is to recognise the face inside the frames. This task of face detection is carried out using the HaarCascade classifier for face detection. Convolution neural networks are used to recognise various facial expressions such as smiling, surprise, and neutral. The model is trained using a dataset of facial expression recognition.

Head nods are the second visual indication that was discovered. When a Yes or No is signalled during an interview, this is used to detect it. The use of a Hidden Markov Model to identify head nodding has been proposed in studies.

The eye gaze is the third cue in facial feature extraction. Nonverbal communication such as eye contact is crucial since it is utilised to assess feedback and reflect cognitive activity. We calculate how much time the interviewee spends looking at the interviewer while answering a question or during the interview.

Apart from these three indications, we used facial action units to extract a few others. To detect face landmarks, we used the dlib library. Facial landmarks aid in the identification of

various facial features such as the eyes, brows, nose, mouth, and jawline. The dlib employs a pre-trained facial landmark detector, which calculates the location of 68 coordinates that correspond to the face. These 68 locations on the face map the facial structure. These points are then used to determine other 52 facial traits such as brow raise distance from eye, eye-opening distance, lip corner distance, and so on.

Algorithm Used:

- ➢ HaarCascade technique for face detection
- ➢ Convolutional Neural Network for Facial Expression Recognition
- ➢ Optical Flow motion tracking – head tracking
- ➢ Facial Landmark Features - Euclidean Distance is used to calculate the distance between two points of interest. Face Landmarks were used to extract various aspects.

Image preprocessing:

Image quality can be improved by using image preprocessing. Images obtained from preprocessing are pre-processed and enhanced. Images are in the form of CMYK that are preprocessed and converted to RGB form.

Image classification algorithm:

CNN algorithm used to classify image. Image classified into 7 different emotions detected. Classification cannot be done in one step. Image need to pass through layers in CNN. Layers are as follows:

1. Convolutional layer: Convolutional means scanning the images. Machines identifies the images in the form of pixel and a set of pixels is scanned by filter and collects its information. Filters can be any like curve filter or colour filter. Filters can vary in different sizes. Filters contain random values and random values are dot producted with image pixel values and the get new values which helps us to identify the properties of images. Other properties are also stored in filters.

2. Normalization Layer: It passes each pixel in the form of ReLU (Rectified linear units). ReLU activation layer does for every positive pixel intensity value, it lets stay them as it is. But it changes all negative values to the zero. Hence if any image pass through the Normalization layer the all negative values are set to zero. It should be applied after each convolutional layer. Applying ReLU doesn't change the dimension.

3. Pooling Layer: Pooling reduces number of pixels by selecting one value from the pooling window region based on criteria. (maximum, minimum). Max pooling selects maximum value in the region over which pooling window is placed. Pooling window of same size takes from left to right without repeating pixels.

4. Fully Connected Layer: The output is stored into fully connected layer which helps us into image classification. It acts like artificial neural network.

5. Neural Network: Human brain learns something by experience, like this machine learns the things from data. There are two types of data:

a. Test Data- In test data, it sees that how much learning is done by artificial neural network.

b. Train Data- Training data used for training the artificial neural network.

Feature Extraction:

Following features extracted by using CNN algorithm:

- Kernel size-It transforms information encoded into pixels.
- Mean-Mean is the average value of pixels that represents the brightness of the image.
- Entropy- It is used to measure the randomness or disorder of an image.
- Standard Deviation- By using the Standard Deviation can determine a way of analysing what is normal, extra-large or extra small.
- Correlation- Represents correlation between pixel values and its neighbourhood. It indicates a predictive relationship that can be exploited in practice and shows how strongly pairs of variables are related.
- Skewness- It is a measure of the lack of symmetry. The zero value indicates that the distribution of the intensity values is relatively equal on both sides of the mean.
- Contrast- It is a measure of the amount of local variations present in an image.
- Smoothness- It is a function of the colour gradients and enables capturing of important patterns in the data, while leaving out noise in the image.
- Variance- It is defined as the average of the squared differences from the Mean.

7. Testing

Testing is used to evaluate the system and check whether user requirements are satisfied or not. It is used to detect defects/ error/ bugs of the system. Testing is used to check whether the objectives are being met or not.

The framework being developed is destined to produce the following results with respect to the inputs given:

1. Detailed statistics of analysis of the interview

2. Interviewees scores w.r.t the emotional analysis

3. Session details

4. General statistics about the interview

5. Competency report of the entire interview process of all the candidates

Following Testing are performed:

● Unit Testing:

Audio and video capture are subjected to unit testing. When the microphone is put closer to the user, the audio capture module performs better. When the Video Capture Module encounters some expected characteristics, it performs better. If the predicted qualities are not found after a few minutes, the procedure is terminated.

● Integration Testing:

Integration testing is carried out between the Analysis module and the Audio and Video Capture module. The streaming module is put under some strain due to the parallel execution of the module. As a result, the real-time smile score graph is slightly delayed. When the system is under stress, the streaming capability is delayed, which can be seen on the dashboard while the interview is in progress.

● System Testing:

It is the type of black box testing where the whole system is tested. It is based on requirement specification and it covers integrated part of system. The packages are integrated in a single package and then it is executed. In this way we have checked the system is working well and providing all features that are included in the project.

● Acceptance testing :

Acceptance testing is done by the end users. It contains the following: Acceptance test is performed by the end users. Such a test is carried out in organization. We deployed our system in one classroom and collected the data. Such a test is called a User acceptance test (UAT).

● Regression Testing: After modification of single unit of code, it should not affect the complete system.

● Monkey Testing:

Monkey testing is performed by tester. In this testing, tester provides random input without having any knowledge of the application.

● Software testing tools:

➢ Selenium: Selenium is popular automation tested tool. It is specially designed for the automation testing. With the help of selenium, test cases are prepared automatically. Test cases can execute on any OS

8. Deployment

8.1. ReadMe File

User need the updated and higher version of browser, availability of internet and laptop/PC.

8.1.1 Requirements

- Python IDE
- Window OS

8.1.2 Steps

Step 1: Create google colab notebook on drive Save that file with the appropriate name. Mount drive on google colab.

Start installing the required packages.
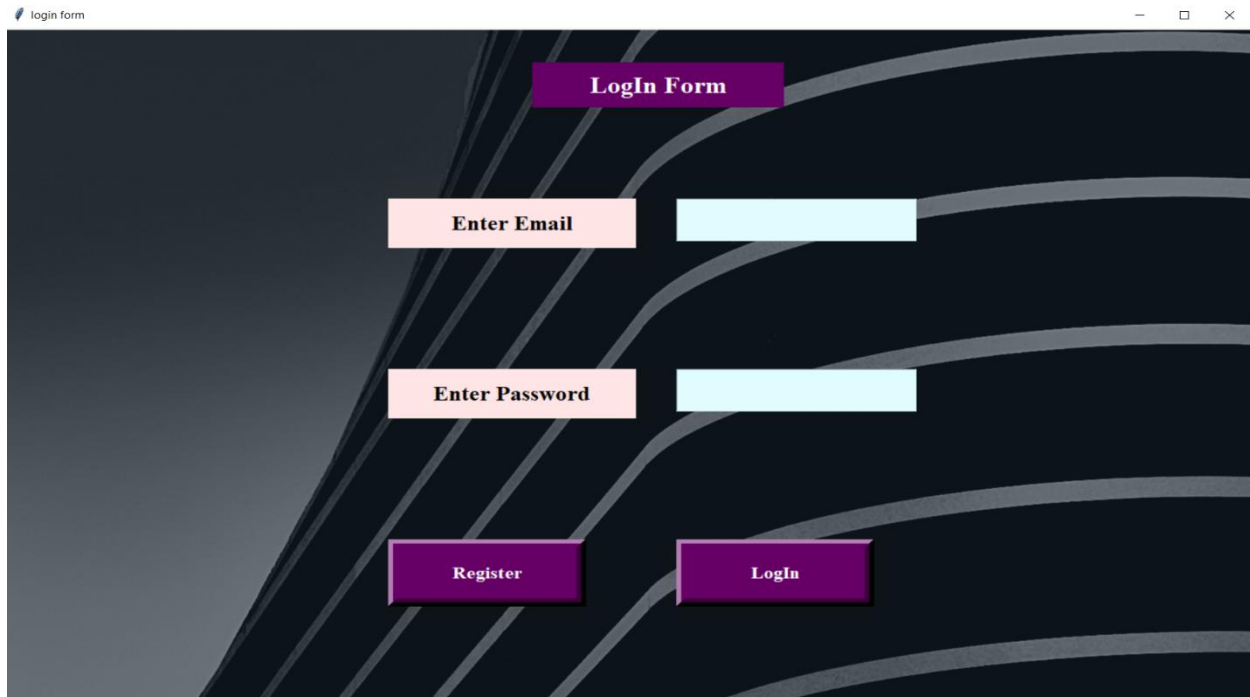
Step 2: Install necessary libraries:

- Dlib
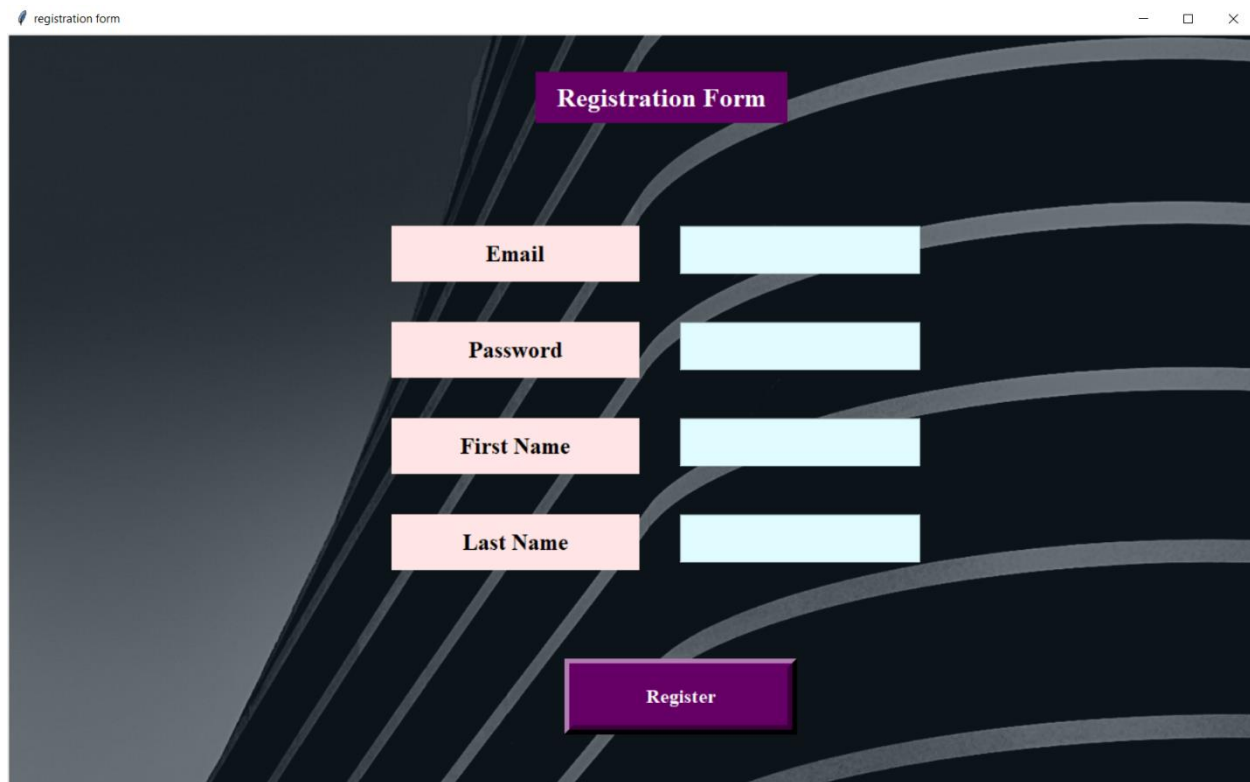- OpenCV
- Keras
- Tensorflow

Step 3: Download and install code

8.1. User Manual

1. This is the first page that users will see when our GUI will open. It consist of LOGIN and Register buttons. If you are already registered on the website than you should click LOG IN to redirect assessment page. If you are new to the platform than you should click SIGN UP button to register yourself on the platform.
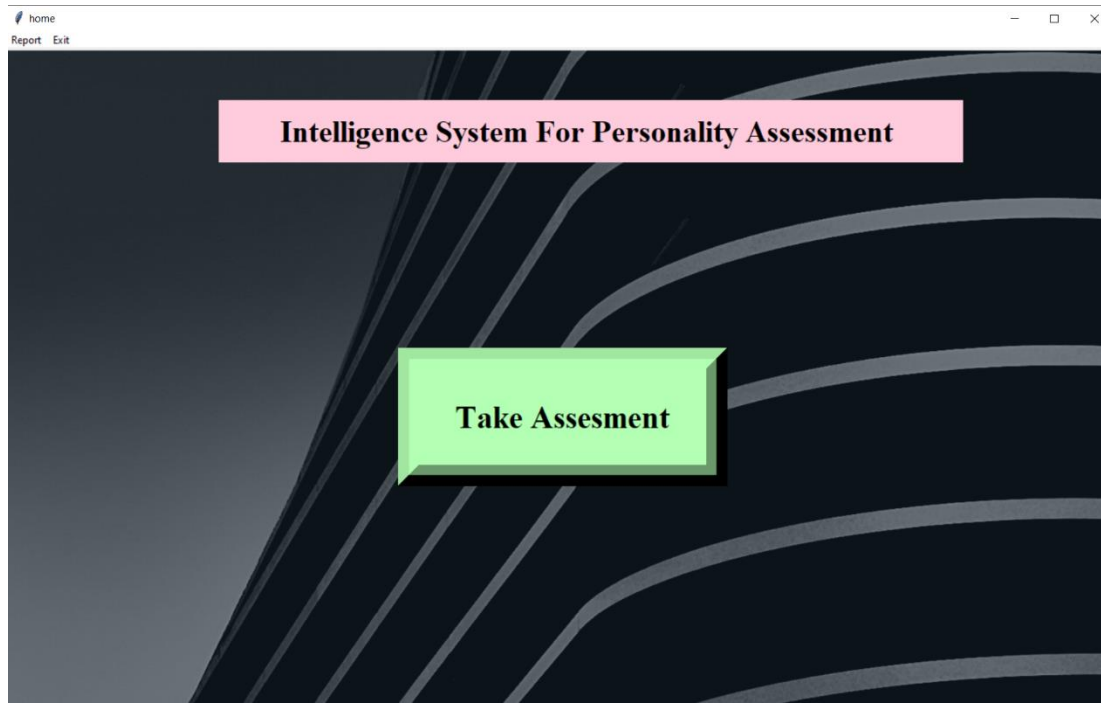
2. To register on the platform you have to enter your name , email and create a strong password. Upon clicking the sign up button you will be redirected to assessment page.

3. After Successfully entering the credentials user will be redirected to this page. This page is a home screen of platform. Here candidate can start their assessment .

4. After Successful completion of assessment result will shown with graph on dashboard. So organization can analyse personality and can decide about hiring.

A	B	C	D	E	F	G	H	I	J
Unnamed: 0	Eye Contact	Confidence	Calm	Smiled	Excited	Focused	NotStressed	NotAwkward	Friendly
0	9	5	4	8	6	4	9	4	9

9. Result and Discussion

The result of system is shown in given fig.9.1, the web camera is able to detect multiple faces. First system needs to store already trained images in system database. A solo face is recognized from video stream. Here the image is stored in database and after recognition of that image in web camera it will shows here.
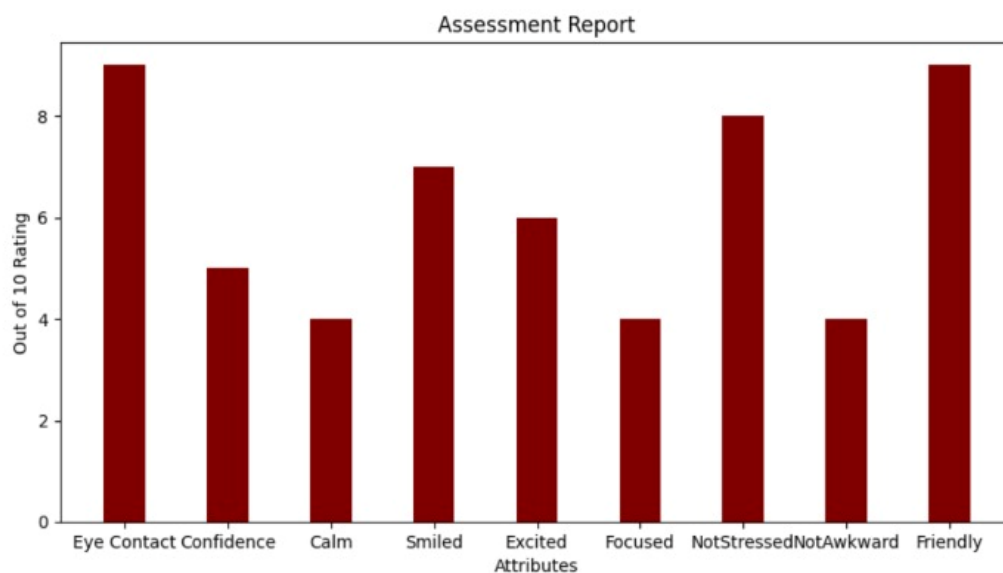

Fig 9.1 Result

The two or more face recognition can be done using this system then it will gets closed. Results are as shown in Fig 9.1. Eye contact, Confidence, Calm, Smiled, Excited, Focused, NotStressed, NotAwkward, Friendly are the parameters will be shown in result. In beginning recognition accuracy was below 50 percentage By improving the tolerance and code optimization the accuracy is improved up to 90 percent.

Here face detection is done with haarcascade haar feature considers adjacent rectangular region at specific location in detection window. It uses adaboost learning algorithm to select features. The .csv file is created after face recognition CSV file is updated time to time.

10. Conclusion & Future Work

10.1. Conclusion

The project primarily focuses on assessing a candidate's personality during an interview. It reduces the organisation time and money with in recruitment process. Also, speed up the recruiting screening process. The organisation can choose the finest applicant for their needs.

• This approach conducts a systematic investigation into job candidate body language in terms of hire ability impressions and self-rated personality.

• Based on real-time interview videos, our system has been trained to anticipate ratings, and real-time feedback can be received at the same time.

• On the interviewer dashboard, you may get real-time feedback on several individual features.

10.2. Future Work

- Multiple Interviewer Environment capability can be added.
- Cloud Based support can be added which enable interviewee to give interview on the go at anytime from anywhere.
- Accuracy of the model need to be improved
- Support for adaptability of the environment can be added which let user to adjust the system according to their workspace.

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