Software Requirements Specification

For

PSYCHOMETRIC ANALYSIS WEB TOOL

Prepared By:

Apurva Bhargava(BE/25022/15), Pallavi Jain(BE/25001/15)

Birla Institute of Technology, Mesra, Jaipur Campus

12 March 2019

Table of Contents

Revision History

Name	Date	Reason For Changes	Version

1. Introduction

1.1 Purpose

This document describes the software requirements specification (SRS) for the application software that enables the psychometric analysis of an individual. Psychometric Analysis Web Tool looks at measuring the psychological characteristics of an individual: an online tool that powers assessment based on mental and emotional state of an individual. It can be used widely by companies for recruitment purposes. The software aids in faster evaluation, avoiding the necessity of an extra psychologist who assesses the emotional state of interviewee. Also, a virtual psychologist can use it for measuring and quantifying a range of different metrics and personal characteristics through the use of psychometric testing. This is achieved by various modules that analyze the responses of the interviewee in the form of text, speech, facial emotion, question answering, etc.

1.2 Document Conventions

There are no special highlighting Font sizes 18 for headings and 14 for sub-headings has been used throughout the document for maintaining uniformity. Bullet list is used in case of listing the features and similar.

1.3 Intended Audience and Reading Suggestions

- The document is intended for researchers, software developers, advanced practitioners, documentation writers, users, testers and evaluators. The SRS contains the requirements and perspective of the software in an elaborated and organized manner which should be read in the same sequence as it is written.
- In the next section, system features with their functional requirements are presented to highlight the major services provided by the intended product. Then the external interface requirements highlighting the logical characteristics of each interface between the software product and the users are discussed. Finally, this specification is concluded with the reference documents on which this document is based on.

1.4 Product Scope

We describe what features are in the scope of the software and what are not in the scope of the software to be developed:
In the scope:
• Test administrator can create, modify and delete tests, as well as specify test takers and see their responses and results.
• Test administrator can add, remove or modify images and questions for tests.
• Test taker can select test, give test and see responses and results.
• Administrators and users have different account types in terms of access and functionality.
• Face detection for facial emotion recognition

- Speech recording for speech emotion recognition
- Response as input by test giver in the form of speech, mouse click and text through keyboard

Out of the scope:
- Remember-old response in forms.
- Communication interface for test administrators and test takers.

2. Overall Description

2.1 Product Perspective

The word 'psychometric' conflates the word 'psyche', which is defined as 'mind', with the word 'meter', which means 'measure'. So, psychometric testing and psychometric assessments are effective tools that quantify a person's psychological characteristics in a way that can be measured and analyzed. For example, psychometric tests and psychometric assessments can be used to measure with a great degree of accuracy the characteristics of a person like their personality, cognitive abilities, behavior patterns as well as a wide range of other factors. Psychometrics is the science of assessment. Psychometric Analysis Web Tool is a tool that powers judgment based on the mental assessment and emotional state of an individual. It is of similar utility as existing interviewers and/or psychologists, who tend to deduce the state of mind of a person by various observations and analysis. Our website aims at provisioning solutions to administer the same in the absence of a human interviewer and/or psychologist. It acts as the interface between the two interacting parties, one of which evaluates the other using the various modules provided by the software as mentioned further.

2.2 Product Functions

- Administrator and User accounts have different access and functionalities
- Provision for setting up test and interview
- Provision for selecting test takers and viewing responses and results
- Emotion recognition from facial expressions
- Emotion recognition from speech
- Sentiment Analysis of the image based description to test the attitude of a person
- Adaptive Chatbot for holding conversations and interviewing user
- Result as the analysis of the various inputs to each individual function

2.3 User Classes and Characteristics

There are two user classes: test administrators and test takers. Test administrator can create, modify and delete tests, as well as specify test takers and see their responses and results. Test administrator can add, remove or modify images and questions for tests. Test taker can select test based on test name and test administrator, give test and see responses and results. The most common among the test administrators are the recruiters of various small companies, who avail this service of the website remotely. The other prospective test administrators are the psychologists who could take advantage of our image description based sentiment analysis and

the emotion recognition features. Test takers may be interviewees or people seeking psychological evaluation.

2.4 Operating Environment

This is a tool available on a website and hence will require any compatible browser on any operating system. A modular implementation approach would be useful to perform testing on modules at different stages to ensure correct implementation. It is anticipated that the tool will work seamlessly in any functional environment provided the complete and standard configuration and installation of the hardware (webcamera and microphone).

2.5 Design and Implementation Constraints

This system is provisioned to be built using Bootstrap for UI, ReactJS for frontend and NodeJS and Django (Python) for backend. It exploits technologies like machine learning and deep learning models, and natural language processing which are implemented in python. Decision regarding the database is taken considering the fact that data being stored is hierarchical, and hence, file system is used for images and questions. For the adaptive Chatbot, sqlite database and JSON files have been used for storing structured data.

2.6 User Documentation

Along with the software product, a user manual would be written to help people understand the working methodology and usage of the developed prototype system. It would be written for nontechnical individuals and the level of content or terminology would differ considerably from, for example, a System Administration Guide, which is more detailed and complex. The user manual would follow common user documentation styles capturing purpose and scope of the product along with key system features and operations; step-by-step instructions for using the system including conventions, messaging structures, quick references, tips for errors and malfunctions; pointers to reference documents; and glossary of terms.

2.7 Assumptions and Dependencies

• For face and speech emotion classification, the seven classes are anger, disgust, fear, surprise, sadness, happiness and neutral.
• For text, the sentiment classes are positive, negative and neutral.
• Webcamera and microphone (inbuilt or otherwise) are available.
• The combined observations from different modules are enough to reach to a conclusion.
• There are no dependencies that the project has on external factors.

3. External Interface Requirements

3.1 User Interfaces

This section describes the logical characteristics of each interface between the intended software product and the users. For user interface design, common UI standards will be followed along with the presence of keyboard shortcuts, error message display standards, pop-up notifications, alerts, etc., and standard buttons and functions will appear on every screen. The website has a simplistic design and no prior experience is required to make use of it. The common pages, register and login options are available on the top navigation bar. Exploring only requires using labeled tabs.

3.2   Hardware Interfaces

Reliable software device drivers usually handled by the OS distributors are required to run the webcamera, keyboard, mouse, and microphone for recording responses. All devices compatible with modern computing systems are supported.

3.3   Software Interfaces

The Psychometric Analyzer has different types of software interfaces (this term is used in a very broad meaning) to external packages, depending how the interaction is realized:
i. User Interface: The various functionalities of the application can be accessed by the means of simple buttons, tabs and forms.
ii. Message Interface: Since automation is the goal, methods have been implemented to run the various functionalities and communicate among different objects (instances of different classes) using APIs.
iii. Database Interface: The test administrator can create and modify test and add, remove or modify images and questions-answers in the file system.

4. Functional Requirements

The major services and functional requirements for the product can be illustrated by system features. In the following, necessary description is provided for each module in the system. Each description provides information of the associated actors, triggering condition, preconditions, postconditions, response sequences, exceptions and functional requirements (assumptions). Being a major important section of the SRS, this section is expected to go through iterative improvement to make the most logical sense for the intended product.

4.1   FACE AND SPEECH EMOTION RECOGNITION

4.1.1 Introduction

This module provides the main emotion recognition function of the first phase of test where facial expressions and speech is captured and recorded in fixed intervals and sent to the emotion recognition models for classification. The user is given a question or prompt for the recording. The web camera is handled by react-webcam library and microphone by react-mic library for

capturing and saving images and audio for the classification models to recognize the emotional state.

4.1.2 Input

  i. Audio feed from microphone

  ii. Video feed from webcamera

4.1.3 Output

The result of the analysis of the same is displayed on the webpage itself, and at the end of test. It includes the percentages of the strongest detected emotions among the seven, and a brief analysis. This exploits the CNN model for Facial Emotion Recognition and LSTM model for Speech Emotion Recognition using Keras.

4.2 SENTIMENT ANALYSIS OF IMAGE BASED DESCRIPTION

4.2.1 Introduction

This analysis requires the responder to input a description for an image that is displayed to him/her within a pre-specified word limit. This text is then sent to the sentiment analysis model for estimation of the positive, negative and neutral perception percentages of an individual in response to the respective images. The result is immediately displayed on the webpage and at the end of the test.

4.2.2 Input

  i. Text input from keyboard

4.2.3 Output

The percentages of the individual's response being positive or negative is displayed, as well as a brief analysis. This exploits NLP (Natural Language Processing) and the ANN Keras model in Python for classification.

4.3 ADAPTIVE INTERVIEW CHATBOT

4.2.1 Introduction

Generalized Chatbot is trained using .yml files containing conversations, and later consults sqlite database generated from the .yml files. Q/A system parses .json file to select questions and match responses. A confidence value (using context) is used to decide which system responds. It chooses questions according to difficulty and user's performance.

4.2.2 Input

> i. Questions, answers, difficulty and maximum score from file system (in build phase)

> ii. User response (while working)

4.2.3 Output

Response to the user and calculated user score.

4.4 WEBSITE FRONTEND

4.2.1 Introduction

The client-side implementation uses ReactJS and NodeJS frameworks. There are four page types- Home page, Register and Sign-in page, Logged-in page and Dashboard page. All the functions including the clicks, registration, signing up, navigation, inputs on the website are actions that are of importance in determining the behaviour, responses and updates made to the database and this is how they move forward in their journey.

4.2.2 Input

> i. Not applicable.

4.2.3 Output

Three-tier client server architecture is used because data is stored in database (File System) can be accessed and modified by the admin, the client with the help of the GUI between them. Frontend output is the response to any event or action performed on the website that can be seen in the form of routing to different pages, the change of questions or images on next and previous buttons, starting, submitting and moving through the phases of the test, etc.

4.5 WEBSITE BACKEND

4.2.1 Introduction

The server-side implementation uses NodeJS and Django (Python) frameworks. The file system interaction is handled by the NodeJS, for example, saving the images in folders, question-answers in .json files in separate folders for each user for each test. The processing of inputs and their responses in terms of score is generated by the python server and returned to the frontend.

4.2.2 Input

> i. Questions and their expected answers as text entered by the admin

ii. Images chosen by the admin

iii. Responses of the user in different phases of the test

4.2.3 Output

All the inputs to the NodeJS server result in either publishing the data to files and folders or fetching it from there. The question-answers are saved as .json file, images are saved in the folder inside Admin→Test. The responses of the user in different phases are also saved in the .json files. These responses are sent to python server for evaluation and determination of score by using ML models or Chatbot system.

5. Other Nonfunctional Requirements

5.1 Performance Requirements

The tool will be interactive and the delays are dependent on speed of network. In every action-response of the system, there are no immediate delays. In case of saving the settings or making submissions, there is delay much below 1 second. In case of changes made to database or file systems, sorting questions and evaluations there are no delays and the operation is expected to be performed in less than 1 second.

5.2 Security Requirements

Information transmission shall be securely transmitted to server/ database without any changes in information. Test administrators and users or test takers have different account types. This allows for different functionalities, restricts access to file systems and preservation of settings of a particular administrator or user.

5.3 Software Quality Attributes

Availability: The tool runs on a webpage and is independent of network connections pertaining to the node system on which it is installed. It can be run on any compatible browser on any operating system environment.
Usability: The web tool is easy to handle and navigates in the most expected way with no delays. The built is responsive. The APIs and server handle requests swiftly.

Appendix A: Glossary

- **ANN:** Artificial Neuron Network. A computational model based on the structure and functions of biological neural networks. Information that flows through the network affects the structure of the ANN because a neural network changes - or learns, in a sense - based on that input and output.

- **Chatbot:** A computer program designed to simulate conversation with human users, especially over the Internet.

- **CNN:** Convolutional Neural Network or ConvNet. A class of deep, feed-forward artificial neural networks, most commonly applied to analyzing visual imagery. Network learns through using filters for extracting features and requires little pre-processing.

- **CPU:** Central Processing Unit. The unit which performs most of the processing inside a computer. To control instructions and data flow to and from other parts of the computer, the CPU relies heavily on a chipset, which is a group of microchips located on the motherboard.

- **Emotion Recognition:** The process of identifying human emotion, most typically from facial expressions as well as from verbal expressions. An application of classification performed by machine learning models.

- **GPU:** Graphics Processing Unit. A specialized electronic circuit designed to rapidly manipulate and alter memory to accelerate the creation of images in a frame buffer intended for output to a display device.

- **GUI:** Graphical User Interface. A form of user interface that allows users to interact with electronic devices through graphical icons and visual indicators such as secondary notation, instead of text-based user interfaces, typed command labels or text navigation

- **LSTM:** Long short-term memory network. A common LSTM unit is composed of a cell, an input gate, an output gate and a forget gate. The cell remembers values over arbitrary time intervals and the three gates regulate the flow of information into and out of the cell.

- **NLP:** Natural Language Processing. A subfield of computer science, information engineering, and artificial intelligence concerned with programming computers to process and analyze large amounts of natural (human) language data.

- **Sentiment Analysis:** The process of computationally identifying and categorizing opinions expressed in a piece of text, especially in order to determine whether the writer's attitude towards a particular topic, product, etc. is positive, negative, or neutral.
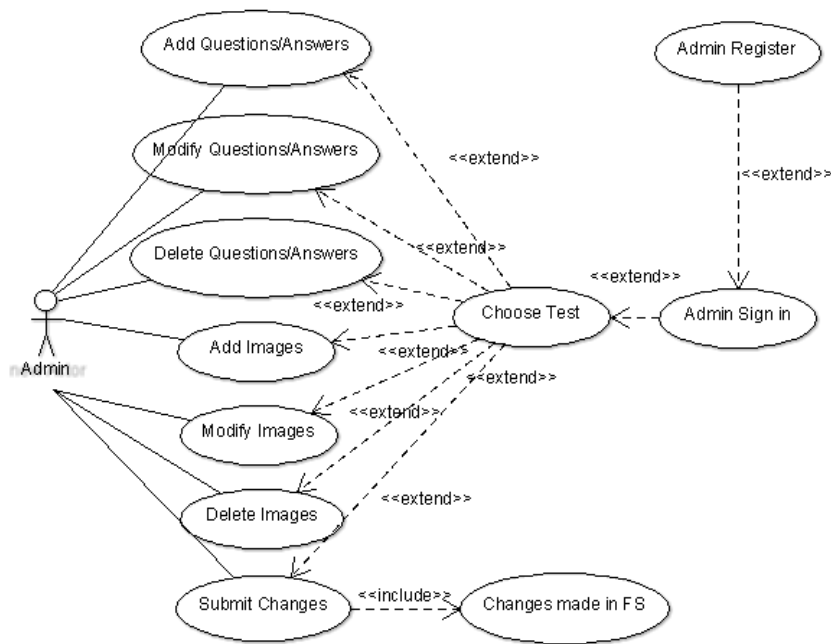
Appendix B: Use Case Diagrams

1. Functionality: Register and Sign in
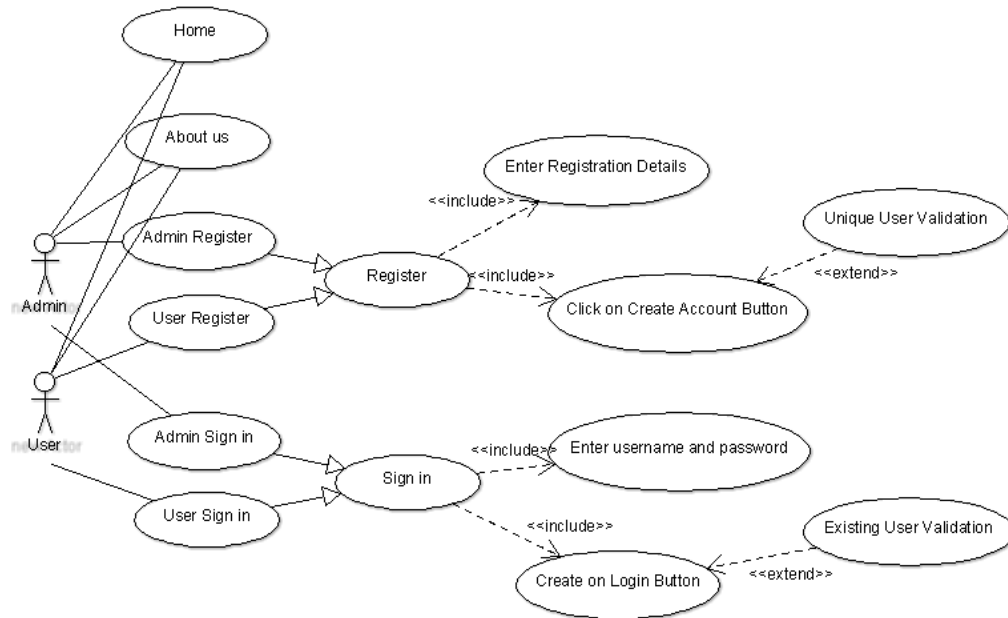
2. Functionality: Create Test
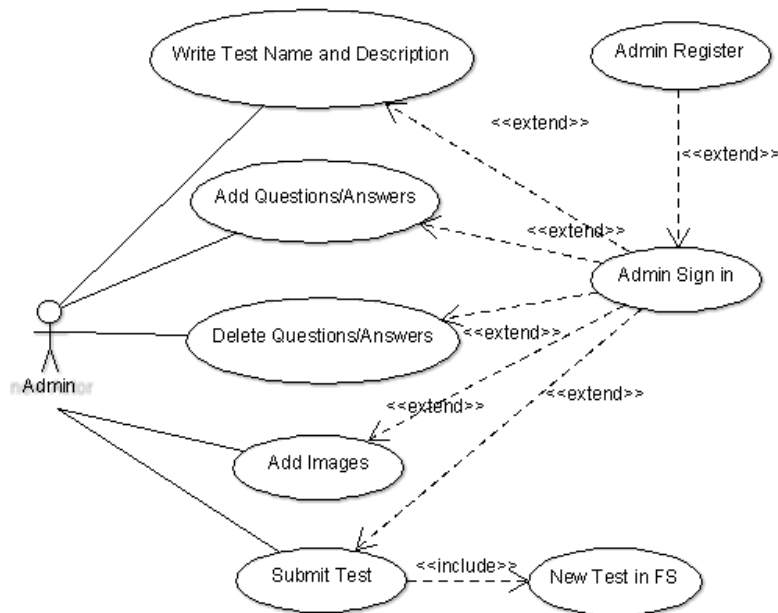
3. Functionality: Modify Test

4. Functionality: Take Test