

Software Requirements Specifications

SentiCare

Project Code: EWZ473254

Internal Advisor: Dr. Saad Razzaq Saad...

External Advisor: Dr. Mohsin Atta

Project Manager: Dr. Muhammad Ilyas

**Project Team: Esha Gulzar (BSCS51F22S047)
 Wajeeha Ijaz (BSCS51F22S032)
 Muhammad Zain UI Abidin (BSCS51F21S054)**

Submission Date: 20/10/2025

Project Manager's Signature

Document Information

Category	Information
Customer	Department of Computer Science, University of Sargodha
Project	SentiCare
Document	Requirement Specifications
Document Version	1.0
Identifier	
Status	Draft
Author(s)	Esha Gulzar (BSCS51F22S047) Wajeeha Ijaz (BSCS51F22S032) Muhammad Zain ul Abidin (BSCS51F21S054)
Approver(s)	Dr. Muhammad Ilyas
Issue Date	Oct 17,2025
Document Location	
Distribution	1. Dr. Saad Razzaq 2. Dr. Muhammad Ilyas 3. Dr. Mohsin Atta

Definition of Terms, Acronyms and Abbreviations

Term	Description
STT/TTS	Speech-to-text/ Text-to-Speech
RL	Reinforcement Learning
NLU	Natural Language Understanding
MFCC's	Mel-Frequency Cepstral Coefficients
BERT	Bidirectional Encoder Representations
PPO	Proximal Policy Optimization
API	Application Programming Interface
CBT	Cognitive Behavioral Therapy

Table of Contents

1. INTRODUCTION	4
1.1 <i>Purpose of Document</i>	4
1.2 <i>Project Overview</i>	4
1.3 <i>Scope</i>	4
2. OVERALL SYSTEM DESCRIPTION.....	5
2.1 <i>User characteristics</i>	5
2.2 <i>Operating environment</i>	5
2.3 <i>System constraints</i>	5
3. EXTERNAL INTERFACE REQUIREMENTS	5
3.1 <i>Hardware Interfaces</i>	5
3.2 <i>Software Interfaces</i>	6
3.3 <i>Communications Interfaces</i>	6
4. FUNCTIONAL REQUIREMENTS	6
5. NON-FUNCTIONAL REQUIREMENTS	8
5.1 <i>Performance Requirements</i>	8
5.2 <i>Safety Requirements</i>	8
5.3 <i>Security Requirements</i>	8
5.4 <i>User Documentation</i>	9
6. ASSUMPTIONS AND DEPENDENCIES.....	9
7. REFERENCES.....	9
8. APPENDICES.....	9

1. Introduction

1.1 Purpose of Document

This Software Requirements Specification document will outline SentiCare, a bilingual chatbot for accessible psychological assistance to users. Developers, project managers and other stakeholders participating in the platform's development will be the target audience for this document.

1.2 Project Overview

SentiCare is an AI-powered bilingual (English/Urdu) mental health chatbot designed to provide accessible, stigma-free emotional support through intelligent conversation. The platform will operate as a 24/7 accessible system that preserves user privacy while delivering personalized mental health assistance.

The interaction flow will begin when users engage through voice input via a web-based interface. The system will capture the user's voice and perform dual-channel analysis: (1) extract acoustic features through voice biomarkers and use MFCC (Mel-Frequency Cepstral Coefficients) to detect emotional states from speech patterns, pitch, and tone, (2) converting speech to text using STT (Speech-to-Text) technology for linguistic analysis.

The system will conduct structured mental health assessments using dialogue-based questionnaires. The questionnaires will guide users through self-evaluation. Both the extracted voice features and transcribed text will process through a Natural Language Understanding (NLU) pipeline powered by mBERT (multilingual BERT), which perform real-time emotion detection and sentiment analysis to classify the user's emotional state (e.g., anxious, depressed, stressed, neutral).

Based on the detected emotional state and assessment results, a Reinforcement Learning mechanism will use Proximal Policy Optimization (PPO). Then select and deliver contextually appropriate responses from a library of 30-45 structured Cognitive Behavioral Therapy (CBT) templates. The outputs will include evidence-based therapies and exercises. The system will track emotional progress over time, continuously refining its responses to maximize therapeutic effectiveness.

Finally, generated responses will convert to natural-sounding speech through TTS (Text-to-Speech) technology. The system will enable users to receive support in their preferred language through an intuitive and voice-driven experience.

1.3 Scope

Using SentiCare, Users will be able to easily assess their mental health via dialogue-based assessment. System will make use of AI-powered features and provide responses like therapies and exercises. The system will use Cognitive Behavioral

therapy (CBT) techniques and user's emotional progress over time to provide responses.

It will not replace professional psychiatrists, prescribe medications or clinical diagnoses. It will be used as a proactive approach just before appointment. It will not share user's data with third parties. It will not provide medical advice beyond emotional support.

2. Overall System Description

2.1 User characteristics

SentiCare will be designed for developers, professionals and students for improvement. Basically, it will be for customers to improve their mental well-being. SentiCare will provide a simple, intuitive web interface and generate easy-to-understand responses. So, non-technical users can quickly grasp it without any technical knowledge.

2.2 Operating environment

SentiCare will operate in a web-based environment and be accessible through modern browsers like Google Chrome, Firefox, and Edge. The backend will be cloud-hosted along with AI model using relevant Python libraries. Tools (e.g., Google Collab, mBERT) were used during development to ethically assess mental health on users. Basic hardware with a stable internet connection will be sufficient for smooth operations.

2.3 System constraints

a. Software Constraints:

SentiCare will require modern browsers (Google Chrome, Firefox, Edge) for accessing mental health. The backend will depend on Python-based libraries which must be supported by the hosting environment.

b. Legal Constraints:

SentiCare will be designed solely for emotional support and self-assessment purposes. Unauthorized use will be prohibited to ensure ethical and legal compliance.

c. User Constraints:

SentiCare will be designed to be user-friendly, avoiding complex jargon. It will provide simple voice responses so that non-technical users can easily understand.

3. External Interface Requirements

3.1 Hardware Interfaces

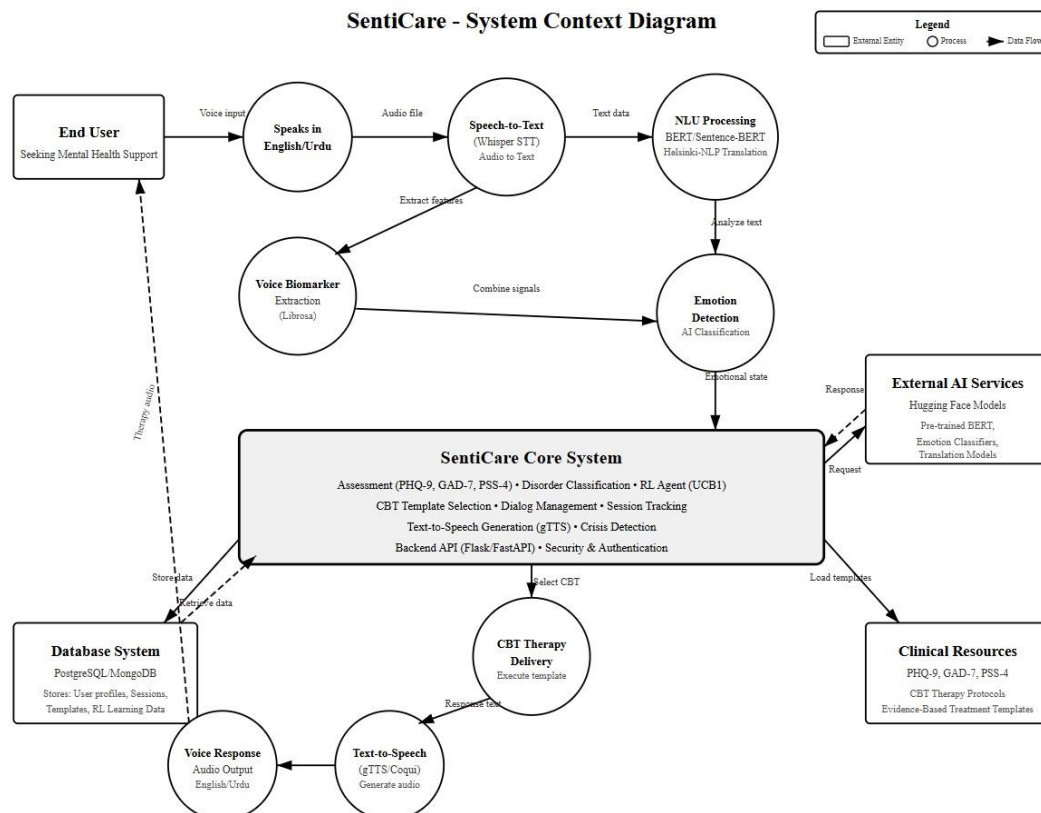
Certain hardware interfaces will be essential for smooth execution, efficiency and security. It will require a dedicated or cloud-based server to process data, handle user requests and generate responses. High-performance CPU/GPU can significantly enhance processing speed and accuracy. Faster computation will reduce detection time and enable efficient deep-learning analysis.

3.2 Software Interfaces

SentiCare will interact with external tools and components. It will use Python as the primary programming environment along with relevant libraries. During analysis, voice biomarkers and mBERT will be used. Backend database (e.g. MongoDB) will be used. SentiCare will operate efficiently on a standard local environment. The final responses will be generated that allow users to interact with the system via user-friendly interface.

3.3 Communications Interfaces

In SentiCare, communication will be facilitated primarily through the web interface. When a user will interact for assessment, the system will communicate with the backend over HTTPS to ensure secure transmission of data. The user's input will be received in the form of an HTTP request, which will contain the target data. User's interaction will be conducted via secure web requests to ensure data confidentiality. For communication security, SSL/TLS encryption will be employed to protect data.



4. Functional Requirements

(1) User Authentication

The system will provide secure user registration and login functionality. It will create and maintain unique user sessions for each interaction, storing session data including timestamps, interaction history, and assessment scores.

(2) Voice Input Capture

The system will provide a web-based interface accessible through modern browsers (Chrome, Firefox, Edge). It will support bilingual input in English and Urdu languages and capture voice input through the user's microphone for dialogue-based mental health assessments.

(3) Speech-to-Text (STT) Processing

The system will convert voice input to text using STT processing with real-time transcription capabilities. It will maintain audio quality for accurate transcription.

(4) Voice Biomarker Analysis

The system will extract acoustic features through voice biomarkers and use MFCC (Mel-Frequency Cepstral Coefficients) to detect emotional states from speech patterns, pitch, and tone. It will store voice biomarker data for emotional pattern tracking and detect emotional states from voice characteristics.

(5) Natural Language Understanding (NLU)

The system will process user text input using mBERT (multilingual BERT) for understanding context in both English and Urdu. It will extract intent and sentiment from user messages and identify keywords and emotional indicators.

(6) Emotion Detection & Sentiment Analysis

The system will perform real-time emotion detection from combined voice and text analysis. It will classify emotional states (anxious, depressed, stressed, neutral), track emotional progress over time, and generate sentiment improvement scores.

(7) CBT Template Matching

The system will retrieve appropriate CBT (Cognitive Behavioral Therapy) templates based on detected emotions from a library of 30-45 structured templates in English and

Urdu. It will match templates to the user's specific mental health needs and adapt selection based on user's emotional progress.

(8) Reinforcement Learning Optimization

The system will use Proximal Policy Optimization (PPO) for response generation and to learn from user interactions in order to improve response quality. It will store reward data for continuous improvement and adapt therapeutic techniques based on effectiveness metrics.

(9) Response Generation & Delivery

The system will generate contextually appropriate responses based on detected emotions, conversation history, selected CBT templates, and emotional progress. Responses will include evidence-based CBT exercises and therapies tailored to the user's condition in the user's selected language (English or Urdu).

(10) Text-to-Speech (TTS) Conversion

The system will convert generated text responses to speech and provide voice output in the user's selected language. It will maintain natural-sounding voice quality and deliver audio responses in real-time.

Non-functional Requirements

5.1 Performance Requirements

SentiCare should be able to assess and analyze mental health quickly, without long delays. Up to 10-30 users can utilize the system at once, without experiencing any performance issue.

5.2 Safety Requirements

SentiCare must follow ethical guidelines and avoid harmful actions. Any potentially harmful actions, like unauthorized data access or changes, must be strictly prevented. It should comply with legal and institutional safety regulations to avoid misuse or unintended consequences.

5.3 Security Requirements

User's data must be encrypted. Proper authentication mechanisms will stop unwanted access. Any stored data should be handled securely and kept confidential. It will follow best practices relevant to domain and comply with relevant privacy standards to maintain data integrity and user trust.

5.4 User Documentation

To support users of all technical levels, the system will include clear and helpful documentation. This will include a user manual, step-by-step guide and online help resources.

5. Assumptions and Dependencies

Assumptions

SentiCare is based on several assumptions. First, we assume that the datasets collected during development will remain valid and representative of real-world scenarios. If these datasets change significantly or become outdated, the performance of model might be affected. Next, we assume that users of the system have basic internet access and a modern web browser to interact effectively. We also assume that users have access to a microphone for clear voice.

Dependencies

There are also some dependencies on which the project relies on. For example, the project will depend on the availability of third-party tools and libraries such as AI algorithms for machine learning, Flutter for web interaction and Google Collab for training and testing the model. Any major changes or downtime in these tools could delay development or affect system performance. Since SentiCare is planned to be deployed online, it will rely on stable hosting services and internet infrastructure. Any disruption in these services could impact the system's accessibility and reliability.

7. References

Ref. No.	Document Title	Date of Release/ Publication	Document Source
1.	Project Proposal	Oct 06, 2025	https://github.com/sheikh-zain786/SentiCare-Capstone/tree/main/proposal
2.	Dataset Description	Oct 10,2025	https://github.com/sheikh-zain786/SentiCare-Capstone/tree/main/Datasets

8. Appendices

1. UI Mockups: Visuals of key interfaces (Homepage, Language Selection, Voice Input Screen, Assessment Questionnaire, CBT Exercise Interface, Progress Dashboard).

2.Database-Schema: Tables for Users, Sessions, Assessment-Scores, Voice-Biomarkers, CBT-Templates, RL-Rewards, and Crisis-Detection-Logs.

3. API Documentation: Key API endpoints (User Authentication, Voice Upload, STT Processing, Emotion Detection, CBT Template Retrieval, Session Storage, TTS Generation).

4. Compliance:

- Data Privacy: GDPR compliance, data protection laws, user consent protocols
- Ethical Guidelines: Mental health data handling, crisis referral procedures, anonymization standards

5. System Requirements: Hardware/software specifications (Server: 4-8 GB RAM, 2 CPU cores; Client: Browser with microphone access; Python 3.9+, MongoDB, required libraries).

6. CBT Template Library: Complete collection of 30-45 structured CBT templates in English and Urdu with clinical references.

7. Evaluation Metrics: Success measurements (User engagement rate, sentiment improvement scores, technique effectiveness by disorder type, RL convergence metrics).