PROJECT REQUIREMENTS ANALYSIS DOCUMENT

TEIA

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VERSION: 0.1.0

31/10/2024

VERSION HISTORY				
VERSION	**APPROVED BY**	**REVISION DATE**	**DESCRIPTION OF CHANGE**	**AUTHOR**
0.1	Martin Cameron	31/20/2024	First alpha prototype	Martin Cameron

PROJECT RAD
Authorization Memorandum

I have carefully assessed the Project Requirements Analysis Document (RAD) for the TEIA project.

MANAGEMENT CERTIFICATION - Please check the appropriate statement.

☑ The document is accepted.

_____ The document is accepted pending the changes noted.

_____ The document is not accepted.

We fully accept the changes as needed improvements and authorize initiation of work to proceed. Based on our authority and judgment, the continued operation of this system is authorized.

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Project Manager

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1.0 INTRODUCTION

1.1 Purpose

Teia is a visual assistant designed to support people with visual impairments. Its primary goal is to provide real-time, relevant information that increases users' external awareness and independence.

2.0 BUSINESS REQUIREMENTS OVERVIEW

2.1 Overview

The Teia project will fulfill the need for an accessible, user-friendly visual assistant for people with visual impairments. It addresses a gap in visual assistance technologies to provide real-time environmental awareness and situational context through audio feedback, increasing user confidence and independence.

The application will aim for device ubiquity, integrating with existing mobile, embedded AI and laptops. While making use of universal camera sources to ensure compatibility across a wide range of devices.

2.2 Assumptions and Constraints

- **Assumptions**:
  - Users will have access to a Tensor, CUDA, AI inferencing, or cloud-enabled device.
  - Users will have access to a suitable bone conduction or other appropriate audio device.
  - Users will have access to a waterproof webcam.
  - Users will have waterproof carrying equipment for the system device.
  - Users have functional hearing.
  - Users or their assistants will have a minimal understanding of how to set up an accessible system.
  - Users will have access to appropriate and established visual aids, including NHS medical support.

- **Constraints**:
  - Teia is not intended to replace medically recommended visual aids.
  - The Teia mobile cloud service cannot always guarantee control flow stability or consistency.
  - Teia cannot guarantee inference accuracy or an absence of hallucinations.
  - Teia must feature an accessible, DDA (Disability Discrimination Act) compliant interface.
  - Teia must perform adequately across a wide range of devices.
  - Teia must be easy to install and uninstall, requiring minimal technical skill.

o   Dedicated path model must be bespoke, with consideration to the experience and concerns of those with visual impairment.

3.0 FUNCTIONAL REQUIREMENTS AND USER IMPACTS

3.1   USABILITY REQUIREMENTS

- **Accessibility Compliance**:
  - o   Teia will feature an interface that meets DDA standards, ensuring all interface elements are accessible to users with visual impairments, including during the setup process.

- **Intuitive Design**:
  - o   Teia's interface should be easy to understand and operate, requiring little to no formal training. Users should feel confident using the system independently.

- **Guided Setup and Documentation**:
  - o   A DDA-compliant setup, README and user tutorial will be provided to guide users through installation and initial configuration steps. This documentation will be accessible and easy to follow, allowing users to get started with minimal support.

- **Mode Switching**:
  - o   Teia's modes should be easily and intuitively toggled, allowing users to switch between assistance modes seamlessly without needing complex navigation or extra setup.
  - o   Teia must have a silent mode, for when the user wants direct focus away from the application

3.2   PERFORMANCE REQUIREMENTS

- **Reliability**:
  - o   Teia should operate consistently across a wide range of devices without crashing.
  - o   Critical exceptions should be handled safely, with immediate notifications to inform the user if Teia is unable to perform its services reliably.

- **Speed**:
  - o   Teia should complete path model inference within 2-3 seconds and caption model inference within 30-40 seconds.

- **Safety**:
  - o   All exceptions should be managed to immediately inform the user of any system unreliability.
  - o   Teia should automatically attempt to restart following any error.
  - o   The system should notify the user when the device's battery is low.
  - o   Teia should restrict access to the designated user only.
  - o   Redundancies should be in place within Teia's mobile cloud service to handle network interruptions, ensuring continuity in poor network conditions.

- **Precision**:
  - o   Teia's inference modes must meet a minimum accuracy threshold, consistently providing relevant, helpful information to the user.

- **Scalability**:
  - o Teia must be adaptable across a diverse range of devices, from high-end to low-end models, adjusting installation and operational processes to align with each device's hardware and dependencies.

3.3   SUPPORTABILITY REQUIREMENTS

- **Training**:
  - o Minimal to no training should be required for users to operate the system effectively. However, clear guidance will be provided for the setup process to ensure users can configure Teia independently.

- **Documentation**:
  - o Comprehensive and accessible documentation must be provided, including a README, setup tutorial, and instructional videos. All materials should meet DDA compliance standards to accommodate users with visual impairments.

- **Staff**:
  - o Minimal maintenance staff should be necessary if the setup process is intuitive and accessible. However, cloud services must be monitored and maintained continuously. Any issues related to Teia's mobile cloud service will require immediate attention from appropriately skilled staff.

- **Equipment**:
  - o **Waterproof Webcam:** A universal camera source that can capture images in various environments.

  - o **Audio Device:** A water-resistant bone conduction earpiece or other suitable audio device for delivering audio feedback to the user.

  - o **Carrying Solution:** A waterproof rucksack or satchel for transporting the embedded or laptop solution.

  - o **Device Specifications:** A laptop or embedded device capable of running Cuda, TensorFlow, or other AI frameworks. Alternatively, a mobile device that can efficiently handle API calls, image uploads, and WAV downloads.

  - o **Device Recommendations:** Suggested device specifications and recommendations should be included in the production documentation to guide users in selecting compatible equipment.

3.4   SECURITY REQUIREMENTS

- **User Authentication**: Teia's cloud services should employ OAuth 2.0 authentication, specifically Google OAuth, to provide a secure and accessible sign-in method that minimizes manual data entry, particularly on mobile devices. This authentication ensures that only authorized users can access the application and its cloud services.

- **Data Privacy**: User data, including captured images and audio responses, should be handled with strict adherence to privacy standards. Any data processed through cloud services should be encrypted during transit and not stored locally beyond session requirements, ensuring data is not accessible outside its intended use.

- **Device Security**: Teia will implement user-specific access controls, ensuring that only the designated user can engage with the application interface to prevent unauthorized access.

- **Security Audits and Monitoring**: Teia's cloud service infrastructure should undergo periodic security audits to identify and mitigate potential vulnerabilities. Regular monitoring and logging of access and service usage will ensure compliance with security best practices.

- **Network Security**: Data transmission between the device and cloud service should use HTTPS to secure communication. In case of poor network conditions, Teia should have redundancy protocols to ensure secure reconnections.

- **API Key:** API key for the inference service should be obscured within the application or more likely a lightweight server can add the key to the request, if this does not increase the time between frame and audio response. Use of hashed keys and secrets. More research is need into this tricky topic.

3.5   INTERFACE REQUIREMENTS

- **Navigation**:
  - o **Model Switch Event Trigger:** The model switch should be triggered via the play/pause media event, allowing users to seamlessly toggle between inference modes.

  - o **Voice Activation:** Exploration of voice-activated event triggers is encouraged; however, this must address security concerns to prevent unauthorized individuals from accidentally triggering events.

  - o **Setup Process:** The setup should be designed for ease of use, requiring only a single button click or a "click once" setup using a setup.exe installer for straightforward installation.

  - o **Application Execution:** The main application should be initiated using a run.exe executable, designed for one-click operation without a graphical user interface (GUI), enhancing accessibility for users with visual impairments.

  - o **Mobile:**
    - Start application button.

    - Sign in/sign out button.

    - DDA compliant user login screen, using google oAuth2.0.

- **Functionality**:
  - o **Frame Capture**: The system will capture a frame from a universal camera source to ensure compatibility across a variety of devices.

  - o **Inference Execution**: The captured frame will undergo inference processing, utilizing a multi-classification path model and an image caption model as needed.

  - o **Audio Output**: The text response generated from inference will be converted to an audio file, which will then be played back to the user.

  - o **Model Switching**: Users can switch between the path classification model and the image caption model using the play/pause event trigger, facilitating dynamic interaction.

  - o **Indefinite Looping**: The system will loop through the frame capture, inference, and audio file playback process indefinitely, ensuring continuous operation.

  - o **Silent Mode**: A silent mode will allow the loop to continue running without producing inference results or audio output, which can be beneficial in certain contexts.

  - o **Headless Mode**: The application will support a headless mode, enabling it to run automatically on device startup without requiring user intervention.

  - o **Cloud Integration**:
    - **API Interaction**: The application will make API calls to a cloud service, uploading the captured frame in the request body.

    - **Text Retrieval**: The system will retrieve the text response from the cloud service after processing and running inference on the uploaded frame.

    - **Audio Conversion**: The text response received from the cloud service will be converted into audio output for user playback.

    - **Sign in:** Authenticate user for API calls to cloud service.

- ▪ **Register User:** Using Play store or other platform dependent store, use oAuth2.0 to register without manually creating an account.

- **Display:**
  - o All services outside of the mobile cloud application will not have display requirements or GUI (Graphical User Interface), unless the setup process migrates from terminal or .exe background process, to GUI.

  - o **Mobile:**
    - ▪ Start button covering 50% of screen 1.

    - ▪ Sign in/sign out button covering 50% of screen 1.

    - ▪ Store oAuth2.0 sign-in covering entirety of screen 2.

    - ▪ Must apply responsive design principles and dynamically scale for any mobile device screen size.

3.6   ASSUMPTIONS / CONSTRAINTS

- **Assumptions**:
  - o Users will have access to compatible equipment, including a waterproof camera, audio device, and carrying solution, as specified in the documentation.

  - o Users will possess functional hearing, allowing them to interpret the audio output.

  - o Basic technical understanding or assistance will be available for initial setup and troubleshooting, as Teia may not include physical setup support.

- **Constraints**:
  - o **Functional Scope**: Teia is designed to augment but not replace medically recommended visual aids, and its functionality is limited to providing supplemental environmental awareness.

  - o **Device Compatibility**: Teia must be operable across a wide spectrum of devices; however, performance may vary based on hardware limitations, particularly on low-end devices.

  - o **Inference Accuracy**: While Teia aims to maintain high accuracy in its inferences, it cannot guarantee a complete absence of inference errors or "hallucinations."

  - o **Cloud Dependency**: The mobile cloud service may face intermittent performance issues in low-network areas, potentially impacting real-time feedback.

4.0 COMPLIANCE REQUIREMENTS

4.1   Assumptions / Constraints
Detail all assumptions / constraints related to Compliance Requirements.

APPENDIX A: REFERENCES

Listed below are all documents referenced in this Functional Requirements document.

REFERENCES		
DOCUMENT NAME	DESCRIPTION	LOCATION

APPENDIX B: KEY TERMS

Listed below are definitions for terms relevant to this Functional Requirements document.

KEY TERMS	
TERM	**DEFINITION**