Engineering Design Specification

Document Number	Project Title
1.0	Glasses for the Visually Impaired

Revision History

Revision Level	Description of Revision	Person	Date
0.1	Functional and non-functional specifications for DPR2	Waleed Ahmed	July 16, 2021
0.2	-Reduced scope of the project based on Bluetooth constraints, can no longer do everything purely offline -Split requirements up into subsections for better organization -Added a few extra software and hardware requirements	Waleed Ahmed	August 5, 2021
0.3	-Got rid of bluetooth requirements -Added color and money detection -Added more explicit server requirements -Added a button to glasses to switch modes -Added verification plan for each specification	Martin Ethier	November 3, 2021
1.0	- Got rid of iOS requirement to support switching operation modes - Text-to-speech multi-language support - Reworded intended application - Glasses casing requirements	Waleed Ahmed	April 7th, 2022

Intended Application:
The design shall extract, decode, and communicate information from an image (optical character recognition, color detection, and money classification) to a visually impaired user through audio transcription.

Requirements Specification:

1 General

No.	Characteristic	Relation	Value	Units	Verification Method	Verification Plan	Comments
1.1	The design shall extract, decode, and communicate information from an image to a visually impaired user through audio transcription.				Demonstration, Test		Primary function.
1.2	The design shall be inexpensive for users to purchase.	<	200	USD	Analysis	Track costs for each part and add them up.	Primary constraint.
1.3	The design shall be capable of performing optical character recognition (OCR) from an image.				Demonstration, Test		Functional requirement.
1.4	The design shall be capable of performing color detection from an image.				Demonstration, Test		Functional requirement.
1.5	The design shall be capable of performing money detection from an image.				Demonstration, Test		Functional requirement.
1.6	The glasses device shall be connected to the internet using WiFi.				Demonstration		Functional requirement. Internet connection is required to send data to the backend server.
1.7	The iOS device shall be connected to the internet using WiFi.				Demonstration		Functional requirement. Internet connection is required to receive data from the backend server.
1.8	The iOS device needs to be in close proximity to the glasses at all times.				Demonstration		Non-functional requirement. Not needed for operation, but the device becomes useless if the user cannot hear the audio from the phone.
1.9	The iOS app needs to be kept actively open during device usage.				Demonstration		Functional requirement. Would not be required if we had an MFI chip.

2.1 Software - General

No.	Characteristic	Relation	Value	Units	Verification Method	Verification Plan	Comments
2.1.1	The design's user interface (UI) and user experience (UX) shall be optimized for accessibility.				Demonstration, Test, Expert Opinion	Have an assistive technology instructor verify UI/UX.	Non-functional requirement. VoiceOver, colorblind friendly colors, not too many buttons.
2.1.2	The processing server shall have a sufficiently high uptime.	>=	99	%	Test, Analysis	Utilize server monitoring tools to track this.	Non-functional requirement.

2.2 Software - iOS

No.	Characteristic	Relation	Value	Units	Verification Method	Verification Plan	Comments
2.2.1	The iOS app shall be capable of communicating with the server to receive and post data.				Demonstration, Test		Functional requirement.
2.2.2	The iOS app shall be able to take images and send it to the server for computer vision processing.				Demonstration, Test		Functional requirement.
2.2.3	The iOS device shall perform text to speech synthesis of any text data received from the server.				Demonstration, Test		Functional requirement. Text can include computer vision results or when mode has switched (or any other feedback that is useful to the user).
2.2.4	The iOS device shall be capable of text-to-speech synthesis in multiple languages.	>=	5	languages	Demonstration, Test		Non-functional requirement.

2.3 Software - Artificial Intelligence

No.	Characteristic	Relation	Value	Units	Verification Method	Verification Plan	Comments
2.3.1	The machine text OCR algorithm shall have a Word Error Rate (WER) on a custom test set.	<	10	%	Test, Analysis	Test set will be collected using the PI and will reflect targeted use cases.	Non-functional requirement.
2.3.2	The handwriting OCR algorithm shall have a Word Error Rate (WER) on a custom test set.	<	25	%	Test, Analysis	Test set will be collected using the PI and will reflect targeted use cases.	Non-functional requirement.
2.3.3	The text-in-the-wild OCR algorithm shall have an F-score on a custom test set.	>	60	%	Test, Analysis	Test set will be collected using the PI and will reflect targeted use cases.	Non-functional requirement.
2.3.4	The money classification algorithm shall have an accuracy on a custom test set.	>	80	%	Test, Analysis	Test set will be collected using the PI and will reflect targeted use cases.	Non-functional requirement.
2.3.5	The color detection algorithm shall have an accuracy on a custom test set.	>	90	%	Test, Analysis	Test set will be collected using the PI and will reflect	Non-functional requirement.

						targeted use cases.	

3 Hardware

No.	Characteristic	Relation	Value	Units	Verification Method	Verification Plan	Comments
3.1	The glasses shall have a dedicated physical button that can be pressed to initiate the current mode's processing pipeline.				Demonstration, Test		Functional requirement.
3.2	The glasses shall have a dedicated physical button that can be pressed to switch processing modes (OCR, color detection, money detection).				Demonstration, Test		Functional requirement.
3.3	The glasses shall include a small piezoelectric buzzer that can play sounds to give feedback to the user.				Demonstration, Test		Non-functional requirement. The buzzer can be used to indicate an error has occurred, or processing is currently being done.
3.4	The design shall be able to clip onto an existing pair of glasses.				Demonstration, Test		Functional requirement.
3.5	The design shall be 3D printable using a rigid material such as PLA, ABS, or PETG.				Test		Functional requirement.
3.6	The device shall have an operating device voltage.	=	5	Volts	Test	Using a multimeter.	Functional requirement.
3.7	The device shall have a maximum current draw from the battery.	≤	250	mA	Test	Using a multimeter.	Functional requirement.
3.8	The piezoelectric buzzer shall have a maximum current draw.	≤	10	mA	Test	Using a multimeter.	Functional requirement.
3.9	The device shall have a power source that allows it to run for a usable period of time.	≥	4	hours	Analysis, Test		Non-functional requirement.

4 Safety & Regulatory

No.	Characteristic	Relation	Value	Units	Verification Method	Verification Plan	Comments
4.1	The device shall not have exposed any electrical components that may harm the user.				Demonstration, Examination		Non-functional requirement.
4.2	The device shall inform the user if any error occurs.				Demonstration, Test		Non-functional requirement.
4.3	The design shall have a fail-safe mechanism that prevents loss of device in the case it falls from the user's face.				Demonstration, Test		Non-functional requirement.