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# **Software/Hardware Requirements Specification**

**for**

## **FontScribe Pen**

**Version 1.0 approved**

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## **Revision History**

<b>Name</b>	<b>Date</b>	<b>Reason For Changes</b>	<b>Version</b>

# **1. Introduction**

## **1.1 Purpose**

The purpose of this specification is to outline the requirements for the first version of the FontScribe product. The FontScribe product is composed of the smartpen and digital phone application. The intention of the document is to provide insight into the functions of the product. This includes its ability to achieve its primary goal of conversion of handwriting into text using machine learning.

## **1.2 Document Conventions**

*Not Applicable*

## **1.3 Intended Audience and Reading Suggestions**

*Not Applicable*

## **1.4 Product Scope**

This product is a combination of an electronic pen and native application. They work together to convert and store the user's handwriting in a standard font via digitization.

### **In-Scope:**

- Writing mode: translates users' handwriting to a standard font
- Drawing mode: transfers a digital copy of users' drawing
- Edit the digital document in software (font-size, color, update, delete)

### **Out of Scope:**

- Writing mode
  - Automatic spell check
  - Recognize languages other than English
- Edit notes in real-time
  - Replacing incorrect words

## **1.5 References**

*Not Applicable*

## 2. Overall Description

### 2.1 Product Perspective


This product solves the problem of taking notes under time pressure. It also solves the problem of bad handwriting, because it creates a digital font.

**Target users:** heavy note-takers (students, teachers, journalists, etc.)

### 2.2 Product Functions

- Writing mode
  - Translates users' handwriting to a standard font
  - Recognize special text (bold, underline, double underline)
- Drawing mode
  - Transfers digital copy of users' drawing
- General feature: delete writing/drawing (live) by crossing the writing/drawing out
- User authentication on the software
- Edit the digital document in software (font-size, color, update, delete)
- Download and send the converted PDF/image

### 2.3 User Classes and Characteristics

	Name: Annabelle Santangelo	
	Age: 23	Sex: Female
	Marital Status: Single	
	Education: Bachelor's degree in journalism from Northwestern University	
	Occupation: Investigative reporter	
	Hobbies: Hiking, biking, soccer, and cooking	
	Annabelle is the winner of the William C. Fyffe Award during her time as an undergraduate student. She is recognized for her extensive coverage of corruption within the university's administration.	

## Product Relevant Information:

- Fast-pace work environment.
  - Writing can be difficult to read.
- Submission of draft reports by deadlines.
- Needs safe backup of writing.
  - Information could be incriminating, confidential in nature.

Annabelle is a very ambitious individual. She puts in her best effort in all the endeavors she pursues. This is especially obvious while she is working. After completing her college education, she works as a journalist for the Chicago Times.

As an investigative reporter, she is often very busy. Annabelle spends many working hours preparing interview questions and writing draft reports. She also frequently travels from place to place within Chicago as she receives news updates. Even as she retires to her apartment in the evening, Annabelle reviews the progress made at work.

Since her days are fluid and unpredictable, Annabelle often misplaces her papers. She sometimes forgets them at the office, at home, or even when going from one part of the city to another. She attempts to solve the problem by taking notes on a tablet. This results in her having to worry about the device's charge and making sure she never drops it.

Due to the high intensity nature of her job, Annabelle often writes as quickly as she can. She does this to make sure she writes down everything that is relevant to the story. Unfortunately, this results in her and her colleagues having to decipher her messy handwriting later. That process takes valuable time that can be spent better elsewhere.



Name: Ross Schwimmer

Age: 20

Sex: Male

Marital Status: Single

Education: Sophomore in college, pursuing a BS in Paleontology in NYU

Occupation: Student

Hobbies: Dinosaurs, Puzzles

Ross is a science geek who wants to become a professor in Paleontology. He also loves to chill with his friends at the coffee house.

## Product Relevant Information:

- There is a lot of note-taking in Ross' lectures.
- Needs to write many papers for his assignments.
- Needs to draw timelines with specific details in his lecture notes.
- Prefers to take notes by hand.

Ross Schwimmer is not having a good sophomore year in college. It is only the third week into the semester, and the notetaking in his paleontology class is driving him nuts.

Ross strongly prefers to take notes by hand. When he tries taking notes with this laptop, he can never organize his notes in time as he is typing them.

Unfortunately for Ross, his professor talks just a bit faster than he can write the important points down. Nevertheless, being a paleontology lover, he squeezes his pen and clenches his teeth to fight through the sore in his hand. The writing gets messier as he gets more tired, but it is better than nothing.

The pain in his hand kicks in after the lecture. He looks at his writing hand, and there lays a puddle of sweat in his palm. It is still not the end of his note-taking though. He has to type his written notes on his laptop before he forgets his scribbles.

After a long period of typing and structuring his notes on his laptop, he has his complete set of class notes. Now, Ross finally has all the material he needs to start on his 12-page paper that is due this weekend.



Name: Kris London

Age: 24

Sex: Male

Marital Status: Married

Education: Bachelor's degree in Business Administration from the University of Southern California

Occupation: Product Manager at Microsoft

Hobbies: swimming, weight lifting, coding, cooking

Kris regularly wins hackathons throughout his high school and college career, even though he never actually studies coding in a classroom environment. He strictly does it for fun, which is

	what makes him so good at it.
<p>Product Relevant Information:</p> <ul style="list-style-type: none"><li>• Lot of note-taking during work meetings</li><li>• Likes to take notes by hand but doesn't have neat handwriting</li><li>• Tired of carrying his device around everywhere</li><li>• Oftentimes prefers a safe backup for his ideas</li></ul>	
<p>Kris is a very innovative person. He wants to change the world and aims to do so by being perfect with his work ethic. He is that one person who will put in an extra ten or twenty hours a week to achieve the goal.</p> <p>After receiving his degree from USC, Kris landed a job at Microsoft as the product manager. His days in this role are very repetitive as most of them are spent in meetings. He tends to take a lot of notes during these meetings as his bosses usually have a lot of new ideas every day.</p> <p>Unfortunately, Kris is always traveling from place to place to attend meetings. Some of the meetings are in the main Microsoft campus, but a majority of the meetings take place in other areas. So he prefers to take notes by hand because he does not want to carry his device around.</p>	

## 2.4 Operating Environment

*Not Applicable*

## 2.5 Design and Implementation Constraints

*Not Applicable*

## 2.6 User Documentation

*Not Applicable*

## 2.7 Assumptions and Dependencies

*Not Applicable*



### 3. External Interface Requirements

#### 3.1 User Interfaces

*Not Applicable*

#### 3.2 Hardware Interfaces

*Not Applicable*

#### 3.3 Software or Hardware Interfaces

*Not Applicable*

#### 3.4 Communications Interfaces

*Not Applicable*

### 4. System Features/Functions

This section describes the features and functions of the product.

#### 4.1 Writing Digitization (Writing Mode)

##### 4.1.1 Description and Priority

**What:** The FontScribe pen seamlessly converts Annabelle's handwriting into a standard font.

**Why:** The pen immediately saves Annabelle's work and makes it clean and organized.

**How:** Machine learning A.I recognizes input from the pen's camera and digitizes the writing.

**Possible Error(s):** The A.I initially transfers Annabelle's writing incorrectly. It may also fail to recognize writing entirely.

\*There is already a large database of letters and words. The chance of an error is unlikely.

**Solution to Error:** Implementation of a feedback system. Annabelle can inform the program that it converted her handwriting incorrectly. She can then "teach" the A.I what the intended letters/words are.

##### **Priority 1**

##### 4.1.2 Stimulus/Response Sequences

<i>Action</i>	<i>Result</i>
Annabelle starts writing with the pen.	FontScribe pen uses machine learning to recognize handwriting.
	FontScribe pen sends the converted writing to the app.

#### 4.1.3 Functional Requirements

- REQ-1: FontScribe pen's camera must be functional.  
 REQ-2: FontScribe pen's cap must be taken off to start any activity.  
 REQ-3: FontScribe pen must have a connection to the application via Bluetooth.  
 REQ-4: The machine learning A.I must be functioning properly.  
 REQ-5: FontScribe pen's battery must be functioning properly.

## 4.2 Bold/Italicize/Underline through Writing

### 4.2.1 Description and Priority

**What:** The machine learning A.I recognizes Annabelle's bolding and underlining of text.

**Why:** The digital font includes bolded, italicized, and underlined words.

**How:** Machine learning A.I recognizes special input from the pen's camera. This includes darkening letters with more ink. Annabelle can have her digital text underlined by drawing a line underneath words. She can also italicize words by writing underscores ( \_ ) in between them.

**Possible Error(s):** The A.I initially fails to recognize Annabelle's input as a BIU command.

**Solution to Error:** More development and testing with the A.I. The machine learning method means the program will improve over time.

**Priority 4**

### 4.2.2 Stimulus/Response Sequences

<i>Action</i>	<i>Result</i>
Annabelle emphasizes a word by writing it very dark.	The A.I translates the darker writing to bold font.
Annabelle underlines a phrase as she takes notes.	The A.I transfers the line to the digitized font.
Annabelle places underscore symbols before and after a book title.	The A.I italicizes the book title in the digital version of the text.

#### 4.2.3 Functional Requirements

- REQ-1: FontScribe pen's camera must be functional.
- REQ-2: FontScribe pen's cap must be taken off to start any activity.
- REQ-3: FontScribe pen must have a connection to the application via Bluetooth.
- REQ-4: The machine learning A.I must be functioning properly.
- REQ-5: FontScribe pen's battery must be functioning properly.

### 4.3 Drawing Mode

#### 4.3.1 Description and Priority

**What:** The FontScribe pen can transfer a direct copy of Annabelle's writing to the app.

**Why:** The pen can save work other than text (drawings, diagrams) without digital conversion.

**How:** The pen's camera recognizes Annabelle's drawings and transfers them in their original form. The function is similar to a scanner.

**Possible Error(s):** The pen fails to correctly interpret Annabelle's input.

**Solution to Error:** Attempting to draw again will generally fix the issue.

#### Priority 1

#### 4.3.2 Stimulus/Response Sequences

<i>Action</i>	<i>Result</i>
Annabelle draws a pie chart in her notes.	The pen saves the drawing.
	The pen sends the drawing directly to the app without digitization.

#### 4.3.3 Functional Requirements

- REQ-1: FontScribe pen's camera must be functional.
- REQ-2: FontScribe pen's cap must be taken off to start any activity.
- REQ-3: FontScribe pen must have a connection to the application via Bluetooth.
- REQ-4: FontScribe pen's battery must be functioning properly.

### 4.4 Auto Start (Pen Cap)

#### 4.4.1 Description and Priority

**What:** The FontScribe pen turns on with the removal of its cap.

**Why:** The use of the cap to turn the pen on and off removes the need for a physical button to activate it.

**How:** Removal of the pen cap turns the pen on, and replacing it turns it off.

**Possible Error(s):** The pen fails to turn on after the removal of the cap.

**Solution to Error:** The issue would most likely be a result of a weak battery requiring charge.

### **Priority 2**

#### 4.4.2 Stimulus/Response Sequences

<i>Action</i>	<i>Result</i>
Annabelle removes the pen cap.	The FontScribe pen turns on.
Annabelle replaces the pen cap.	The pen shuts off..

#### 4.4.3 Functional Requirements

REQ-1: FontScribe pen's battery must be functioning properly.

## 4.5 Sleep Mode

#### 4.5.1 Description and Priority

**What:** The FontScribe pen enters a low-power mode if it is on for a certain period of time without seeing use.

**Why:** This allows Annabelle to benefit from the pen for longer due to the conservation of the battery's charge.

**How:** The pen automatically enters sleep mode after ten minutes of inactivity.

**Possible Error(s):** N/A

### **Priority 3**

#### 4.5.2 Stimulus/Response Sequences

<i>Action</i>	<i>Result</i>
Annabelle leaves the pen without its cap for ten minutes without using it..	The FontScribe pen enters sleep mode.

#### 4.5.3 Functional Requirements

REQ-1: FontScribe pen's camera must be functional.

REQ-2: FontScribe pen's cap must be taken off to start any activity.

REQ-3: FontScribe pen's battery must be functioning properly.

## 4.6 Editing Tool

### 4.6.1 Description and Priority

**What:** The FontScribe app allows edits to be done on converted files.

**Why:** Ross may want to add additional information to the files when he reviews the material

**How:** The edit mode functions similarly to editing in common word processors.

**Possible Error:** N/A

**Solution to Error:** N/A

**Priority 5**

### 4.6.2 Stimulus/Response Sequences

<i>Action</i>	<i>Result</i>
Ross opens the FontScribe app, opens a file and goes into edit mode.	The file changes from view mode to edit mode.
Ross changes a word.	The file changes accordingly in edit mode.
Ross saves the change and exits the edit mode.	The file returns to view mode. All changes are saved.

### 4.6.3 Functional Requirements

REQ-1: The file that is going to be changed must be stored in the FontScribe app.

REQ-2: The edit mode must be functional.

## 4.7 Download to Local in App

### 4.7.1 Description and Priority

**What:** The files in the FontScribe app are transferable to Ross's local machine, where he runs the app.

**Why:** Ross wants to submit a file for his class assignment. Therefore he has to submit it locally.

**How:** The FontScribe app makes a request to the database. It then retrieves the file and moves a copy of it to the local machine.

**Possible Error:** File may fail to download when the internet connection is lost.

**Solution to Error:** The FontScribe app caches the action and waits until the internet connection is back up, and then executes the download function.

**Priority 4**

#### 4.7.2 Stimulus/Response Sequences

<i>Action</i>	<i>Result</i>
Ross opens a FontScribe app.	The download button appears on the overview section of the file.
Ross clicks the download button.	The file path dialog box appears..
Ross selects the desired path and clicks "Confirm."	A copy of the file is stored in the designated location on Ross' local machine.

#### 4.7.3 Functional Requirements

REQ-1: Ross must allow the FontScribe app file system access.

REQ-2: There must be an internet connection.

REQ-3: The file(s) of interest must exist in the app.

### 4.8 Send in App

#### 4.8.1 Description and Priority

**What:** Ross can send a copy of his FontScribe file to Annabelle's FontScribe app.

**Why:** Ross wants to share his notes with Annabelle.

**How:** Ross's FontScribe app sends a copy of the selected file to Annabelle's FontScribe app.

**Possible Error:** This process can be interrupted by a poor internet connection.

**Solution to Error:** The FontScribe app caches the action and waits for it to be back up, then executes the action.

**Priority 3**

#### 4.8.2 Stimulus/Response Sequences

<i>Action</i>	<i>Result</i>
Ross opens the FontScribe app.	The share button appears on the overview section of the file.
Ross clicks the share button.	The app prompts the recipients' emails.
Ross enters the emails of the recipients and clicks "Confirm."	A copy of the file is sent to each recipient's FontScribe app.

#### 4.6.3 Functional Requirements

REQ-1: There must be an internet connection.

REQ-2: The to-be-shared file must exist.

## 4.9 Toggle Between Modes

### 4.9.1 Description and Priority

**What:** The FontScribe pen can change between writing and drawing mode.

**Why:** To convert text or transfer the user's drawings directly, respectively.

**How:** The FontScribe pen switches between writing/drawing mode after holding down the mode button for 2 seconds.

**Possible Error:** N/A

**Solution to Error:** N/A

### Priority 1

### 4.9.2 Stimulus/Response Sequences

<i>Action</i>	<i>Result</i>
Ross starts writing with the pen in writing mode.	FontScribe pen recognizes the text and sends the converted text to the app.
Ross holds the mode button for 2 seconds.	FontScribe pen changes from writing mode to drawing mode.
Ross draws with the pen in drawing mode.	FontScribe pen scans the drawing and sends it to the app.

### 4.9.3 Functional Requirements

REQ-1: Mode button must work.

REQ-2: Pen must be on.

## 4.10 Water-Resistance

### 4.10.1 Description and Priority

**What:** The pen has a water-resistant rating of 30 minutes.

**Why:** To protect the pen from potential water damage.

**How:** The battery and camera housing are completely sealed.

**Possible Error:** Manufacturing error results in a defective product that allows water to leak through.

**Solution to Error:** More rigorous testing of pens to prevent the error.

### Priority 5

#### 4.10.2 Stimulus/Response Sequences

<i>Action</i>	<i>Result</i>
Ross accidentally spills water on the pen.	Water-resistance protects the pen.
Ross dries the pen in 30 minutes.	The pen is not damaged.

#### 4.10.3 Functional Requirements

REQ-1: Camera and battery must be completely sealed.

REQ-2: Pen material will be made of metal (aluminum).

### 4.11 User Authentication

#### 4.11.1 Description and Priority

**What:** The FontScribe phone app requires Kris to sign up and create an account.

**Why:** The app makes sure that only Kris has access to his documents.

**How:** Kris creates a username and password before being able to enter the application.

**Possible Error(s):** Someone other than Kris guesses the username and password of his account enabling him or her to access Kris' documents.

**Solution to Error:** There is a two-step authentication when opening the app every 6 hours. A text with a code will be sent to a phone number or email address after signing in with the username and password. The app will require Kris to enter this code to ensure that it is indeed the correct user.

#### Priority 2

#### 4.11.2 Stimulus/Response Sequences

<i>Action</i>	<i>Result</i>
Kris signs up and creates an account on the FontScribe app.	FontScribe pen registers him as a member within the database.
Kris logs into his account for the first time to use the pen.	FontScribe pen gives Kris access to his saved documents.

#### 4.11.3 Functional Requirements

REQ-1: FontScribe app's member database must be functional.

REQ-2: FontScribe app's login screen must be set up properly.

REQ-3: FontScribe app's account creation/registration system must be set up properly.



## 4.12 Replaceable Ink Cartridges

### 4.12.1 Description and Priority

**What:** The FontScribe pen requires Kris to replace old ink cartridges with new ones manually.

**Why:** Ink cartridges that are out of ink prevent Kris from actually writing anything. This prevents the machine learning algorithm from recognizing any handwriting.

**How:** Kris will purchase new ink cartridges and place them in the valve of the pen meant for ink cartridges.

**Possible Error(s):** Kris may incorrectly place the carriage in the pen causing ink to leak out and cause the pen to malfunction.

**Solution to Error:** FontScribe pen ink cartridges are double sealed, so they prevent any leaking issues.

### Priority 3

### 4.12.2 Stimulus/Response Sequences

<i>Action</i>	<i>Result</i>
Kris' current ink cartridge is running out of ink.	FontScribe pen cannot properly pick up his handwriting and translate into a digital document.
Kris purchases a new ink cartridge and places it into the FontScribe pen.	FontScribe pen is now able to digitize his handwriting.

### 4.12.3 Functional Requirements

REQ-1: FontScribe pen's reservoir/valve must be functioning properly (piercing open the cartridge properly to allow ink to go through).

## 4.13 Deleting Text in Real Time

### 4.13.1 Description and Priority

**What:** The FontScribe app allows Kris to delete his writing or drawings by putting a line through the words or scribbling on top of an image.

**Why:** It is easier for Kris to delete things as he is taking notes rather than going in the app.

**How:** The machine learning algorithm will recognize a line or scribble through text and ignore this. It will start translating the text after the line or scribble into the digital document on the app.

**Possible Error(s):** The machine learning algorithm does not properly recognize the scribble or line through text and adds the writing into the document.

**Solution to Error:** Implementation of a feedback system. Kris can inform the program on the app that the machine learning AI correctly or incorrectly notices his deletions in real time.

#### **Priority 4**

##### 4.13.2 Stimulus/Response Sequences

<i>Action</i>	<i>Result</i>
Kris is taking notes, makes a mistake, and scribbles through his error.	FontScribe will recognize his scribble and ignore this part of his notes .
Kris continues on with the rest of his notes.	FontScribe will not include his error within the digital copy of his notes on the app.
	FontScribe will continue the process of machine learning after his error.

##### 4.13.3 Functional Requirements

REQ-1: FontScribe pen's camera must be functional.

REQ-2: The machine learning A.I must be functioning properly to recognize user's scribbles/lines through text.

## **4.14 LED Notification**

### 4.14.1 Description and Priority

**What:** The FontScribe pen has a LED notification button that changes colors or blinks for certain reasons.

**Why:** If Kris wants to know how much charge is left for the camera on the pen, he will tap the LED button three times and the color of the button will let him know the charge status.

**How:** The FontScribe pen's LED button will either turn green (signalling more than 50% charge left) or orange (less than 50% charge). When the pen has run completely out of charge, the LED button will automatically start blinking red signalling that the pen needs charge.

**Possible Error(s):** After Kris checks the pen's charge, the LED turns a certain color and stays that color for a long period of time. This can cause the pen to waste power.

**Solution to Error:** The LED button is programmed so that when Kris checks charge status, the button will light up in either green or orange color for strictly five seconds. It will then turn off.

#### **Priority 4**

##### 4.14.2 Stimulus/Response Sequences

<i>Action</i>	<i>Result</i>
Kris clicks the LED button three times.	FontScribe pen's LED button turns either green or orange if there is still enough charge.
	FontScribe pen's LED button will blink red if there is no charge left.

##### 4.14.3 Functional Requirements

REQ-1: The FontScribe pen button must be functioning properly.

REQ-2: FontScribe pens's LED notification button must be working properly.

## **4.15 Rechargeable battery**

### 4.15.1 Description and Priority

**What:** The FontScribe pen allows Kris to charge the battery once it is out of charge.

**Why:** This is the most ideal model for this device. Using replaceable batteries would be tedious for Kris.

**How:** The FontScribe pen has a rechargeable battery. Kris can charge the battery with the adaptor that comes with the pen. It takes two hours to fully charge it.

**Possible Error(s):** The pen somehow does not charge properly.

**Solution to Error:** The LED on the pen turns blue when the pen is successfully charging. If the button is not blue, the pen is not charging.

#### **Priority 3**

### 4.15.2 Stimulus/Response Sequences

<i>Action</i>	<i>Result</i>
Kris realizes his pen has run out of charge (LED notification).	FontScribe pen is not able to translate his writing into digital format anymore.

Kris attaches the provided charger to the pen and a power outlet.	FontScribe pen's LED button turns blue.
	After two hours, the FontScribe pen is fully charged again.

#### 4.15.3 Functional Requirements

REQ-1: The FontScribe pen's charging port must be functional.

REQ-2: The FontScribe pen's battery must be functioning properly.

REQ-3: The FontScribe pen's LED must be working properly.

## 5. Other Nonfunctional Requirements

### 5.1 Performance Requirements

*Not Applicable*

### 5.2 Safety Requirements

*Not Applicable*

### 5.3 Security Requirements

*Not Applicable*

### 5.4 Software or Hardware Quality Attributes

*Not Applicable*

### 5.5 Business Rules

*Not Applicable*

## 6. Other Requirements

*Not Applicable*

## Appendix A: Glossary

*Not Applicable*

## **Appendix B: Analysis Models**

*Not Applicable*

## **Appendix C: To Be Determined List**

*Not Applicable*