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Detailed requirements

Stakeholders:
Children and adults who guide them in their handwriting learning process
(such as parents, teachers, and therapists).

Functional requirements:

1. User Registration:
   - Adults can register by providing their email, username, and password.
   - Childrens can register by providing their name, username, and a unique PIN code assigned to the adult who guides them (their accounts will be “linked” to the adult account).

2. User Authentication:
   - Both childrens and adults can log in to their accounts using their username and password.

3. User Authorization(roles and permissions):
   - Childrens can access handwriting exercises. They will be forbidden from viewing their progression tracking, the content about correct handwriting, or managing other accounts.
   - The adults don't have access to handwriting exercises, they would be able to access detailed progress tracking, content about correct handwriting and managing other accounts.

4. Handwriting Guidance:
   - During exercises, animated GIFs are available for each letter in the child’s language to guide proper handwriting.
   - Provides content about correct handwriting for adults to help them guide the children.

5. Handwriting Exercises:
   - The system will generate exercises based on past performance metrics, focusing on weaker areas identified by the OCR.
   - Prompt childrens with category-based words (e.g., "Name an animal"), or specific letters and words to write.

6. Handwriting recognition:
   - Childrens can upload or capture their handwriting (on a blank page) using the device's camera or the device’s gallery.
   - Provide cropping and adjustment tools for the uploaded/captured image to focus on their handwriting.
   - The system will use an OCR model to detect and evaluate handwriting directly from images.

7. AI feedback:
    - The OCR model will give a confidence score for each character detected in the child's handwriting.
    - Provides the child with simple feedback on their handwriting based on the OCR evaluation.
    - The feedback will be mostly positive - telling the child what they got right rather than what they got wrong, to encourage him to keep exercising.

8. Language support:
    - Children can exercise in multiple languages while writing and receiving handwriting feedback in his chosen language.

9. Data stored in the database:
    - The users of the system will be saved in it, each with their own role. For the child we will also save the parent who is guiding him.
    - After a handwriting exercise has been practiced we will save in the db: the practiced word, the expected one(if there is one), its category, and the overall confidence score. In addition - each child will have as many entities in the db as letters in the practiced alphabet, each representing a letter in it, the overall score of the child in the practiced letters will also be updated in there accordingly.

10. Progression tracking:
    - Adults guiding each child will be allowed to view their progression, displaying the information saved in the database in several ways:
        - Success rate by each letter in their alphabet, calculated from the confidence score the ORC model will provide. These rates will allow them to spot difficulties the child encounters with specific letters.
        - Improvement over time.
        - Success rate per word categories.
    - Visual representation of data such as graphs and charts.

Non-functional requirements:

1.Security:
- The user's authentication process will be done under a secure protocol.
- The user's information will be saved in a secured database.

2. Performance:
- The content the child will be requested to write will be generated in 3 seconds or less at least 95% of the time.
- The handwritten capture submitted by the child will be analyzed in 5 seconds or less at least 90% of the time.

3. Portability:
- Support popular browsers such as Chrome, Safari, and Edge
- Responsive design for Android, iOS, and PC resolutions.

4. Accessibility:
- Clear, understandable UI with large buttons and minimal text, thus easy to learn and use by children ages 5-12.
- Ensure adults can easily access and interpret progress tracking data.

5. Extensibility:
- The amount of effort required to add support to a new language to be recognized will be as low as possible - requiring a model that supports the language, and a word generator for that language.
- Minimum UI text as possible will help to fulfill this cause.

6. Safety:
- The word generator won't generate any harmful or inappropriate words that the children will be requested to write.

Use Case: Exercise Handwriting

Goal in context:

A child practices handwriting by uploading handwritten input and receiving feedback.

Scope: Handwriting practice app.

Level: Primary task.

Pre-conditions:

The child has logged into the application.

Success end condition:

The child has scanned the written and received suitable feedback, his handwriting data (scores, progression tracking, image) is updated on the DB.

Failed end condition:

The child scans the written input but does not receive feedback,
and his handwriting data is not updated.

Primary actor: The child.

Trigger: The child selects the handwriting exercise option from the application menu.

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Main success scenario:

1. The system displays an options menu.
2. The child selects the "Exercise Handwriting" option.
3. The system displays a letter for the child to write and asks him to write and upload it.
4. The child writes on a piece of paper and uploads a photo of it.
5. The system evaluates the writing using an OCR model.
6. The system provides suitable feedback based on the evaluation.
7. The system updates the child's data in the database.

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Extensions:

4.a The format of the file uploaded isn't an image type that is supported

    4.a.1 The system asks the child to re-upload a file with a correct format

5.a The ocr model failed to recognize anything from the written:

    5.a.1 The system asks the child to re-upload a correct image

5.b The uploaded image is unclear/blurry:

    5.b.1 The system asks the child to re-upload a correct image

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Sub-variations:

3.a. The system may display words for practice.

3.b. The system may display a category of words to write from(like fruits etc.).

4.a. The child uploads his handwriting by taking a photo using the device's camera.

Use-case diagram: