Assignment 3

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1 Planning of the human-centred design process

In this section is proposed a human-centred design (HCD) process tailored for SmaWat, based on the concepts presented in the ISO 9241-210 standard [1] and in the book by Rogers et al.[2], focusing on iterative development, prototyping and evaluation as key pillars of user experience design.

1.1 Implementation of HCD principles

The SmaWat process implements the six core principles from ISO 9241-210, Clause 4 [1]:

Principle (Clause)	Implementation in Practice
Design based on explicit understanding of users, tasks, environments (5.2)	Consider schools, home and playgrounds, create child user profiles and research main cognitive and physical abilities, understand risks.
Users involved throughout design and development (5.3)	Include children in co-design workshops, have parent meetings for safety oversight and their needs, and involve teachers in the context of school.
Design driven and refined by user-centred evaluation (5.4)	Perform inspection-based evaluations based on children before prototyping, and then conduct user-based testing with children at low and also high-fidelity stages, producing iterations until requirements are met.

Table 1: Implementation of ISO 9241-210 HCD principles in SmaWat process

Principle (Clause)	Implementation in Practice
Process is iterative (5.5)	Implement feedback loops from evaluation back to context/requirements/design activities, until requirements are met.
Design addresses whole user experience (5.6)	Consider emotional objectives (playfulness, safety perceptions), physical interactions (durability, wearability), social context (parent-child context).
Multidisciplinary team with diverse skills and perspectives (5.7)	Assemble team including UX researchers, interface designers, child psychologists, engineers, and even safety experts.

Table 1: Implementation of ISO 9241-210 HCD principles in SmaWat process

1.2 Initial considerations and planning

Before planning the project (ISO 9241-210, Clause 6.2) [1], it is essential to consider the relative importance of human factors for our main user group, children, to select the right HCD methods in order to reduce human system risks such as poor usability, low acceptance or lack of parental trust, as highlighted also by Rogers et al. [2]. As well, is important to consider responsibilities, implement project management and timing constraints, and setting milestones.

1.3 Human-centred design process model

Following ISO 9241-210, Chapter 7 [1], the HCD process consists of four interdependent, iterative activities shown in Figure 1.

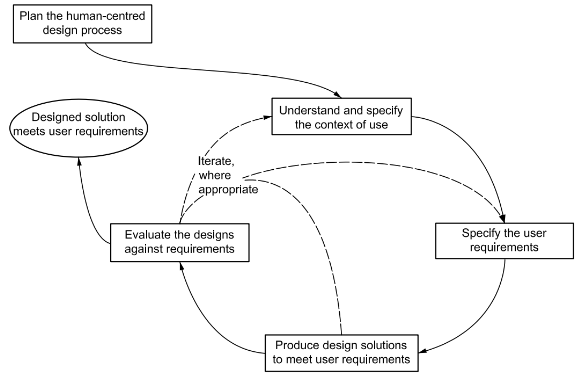

Figure 1: Interdependence of human-centred design activities

Iteration strategy: Evaluation results feed back to earlier activities, as shown in Figure 1, creating cycles of refinement. The process exits iteration when user requirements are met.

1.4 HCD activities and methods

Activity	Key Methods
Understanding and specifying the context of use (7.2)	Research, observations and field study such as in schools and playgrounds, parent/guardian interviews.
Specifying the user requirements (7.3)	Co-design workshops, taking into account the context and our users. Examples of requirements such as large icons/minimal text and simplified language.
Producing design solutions (7.4)	Wireframes, low/high-fidelity prototyping taking into account playful interactions, durable materials for outdoor use.
Evaluating the design (7.5)	Inspection-based (heuristics, checklists), user-based testing (lab & field), with shorter evaluation sessions in comfortable settings.

Table 2: HCD activities, methods, and child-specific adaptations

1.4.1 Understanding and specifying context of use (Clause 7.2)

Primary users: Children aged 6–12 with diverse cognitive abilities, preference for playful interactions.
Secondary stakeholders: Parents or guardians, as well as teachers and caregivers.
Environment: Schools, playgrounds, homes, and outdoor areas. Important to consider parental influence and supervision.

1.4.2 Specifying user requirements (Clause 7.3)

User requirements must be explicit, verifiable, and aligned with the context of use [1]. Some examples could be:

- The smartwatch should be designed for outdoor use, with the right protection against impact and water.
- The UI should include large icons/images, and minimal text considering children's cognitive abilities and preferences.
- At least 90% of children should complete core tasks such as viewing time and answering calls within 15 seconds without adult assistance.
- The system should include parental controls and comply with EU child data regulations.

1.4.3 Producing design solutions (Clause 7.4)

Design solutions should be informed by prior analysis, usability guidelines (ISO 9241-110), and multidisciplinary collaboration [1]. These solutions include designing the interaction, user tasks and UI to meet requirements by creating scenarios, prototypes, and mock-ups for early validation, as well as refining designs by iterations via evaluation, and communicating solutions effectively to implementation teams.

1.4.4 Evaluating the design (Clause 7.5)

Evaluation should be done iteratively through development [1], with resources allocated for formative (early feedback) and summative (final validation) testing.

Inspection-based evaluation:
Conducted before user testing to eliminate major issues by using checklists and usability heuristics.

User-based testing:
Applied at any stage of the design process, where early stages use functional MVP prototypes in controlled environments, while later stages involve field testing in real-world contexts.

2 Prototyping and Evaluation as Part of Iterative Development

2.1 First Prototype: Paper Prototype

The first prototype is developed on paper, creating a low-fidelity draft of the smartwatch interface, including the main screens that allow the user to accomplish the main tasks [2].

2.1.1 Dario's Prototype

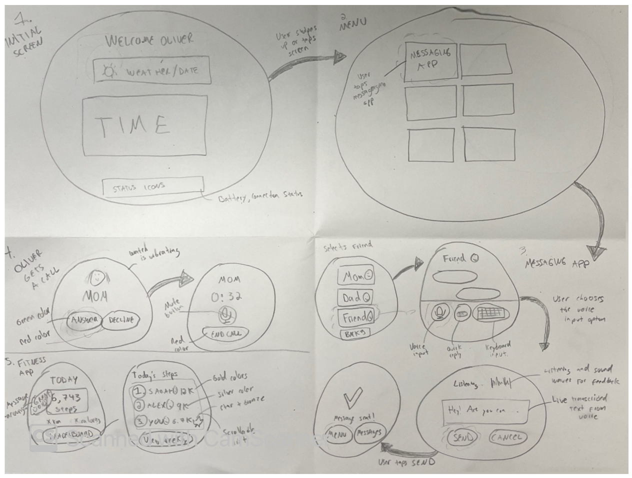

Figure 2: First Prototype of SmaWat key screens

This first prototype shows the user flows from left top to right, going then from right to left.

1. Welcome Screen / Standby

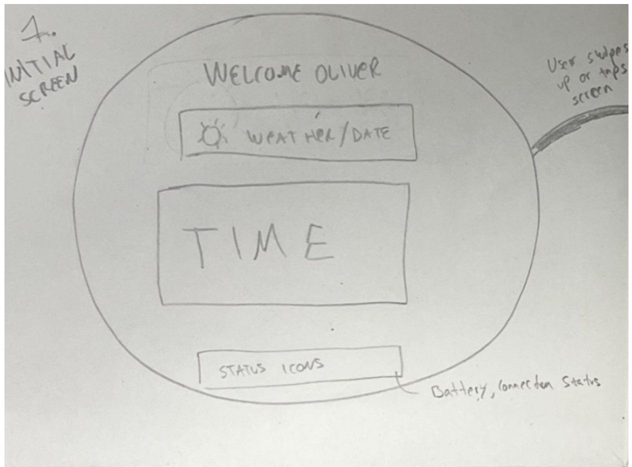

Figure 3: Welcome Screen

We see at first a small welcoming message for Oliver creating a friendly tone for kids. Below it is the weather and date component, and in the center and the primary function is a time display for quick scanning. At the bottom, minimal status icons are present for quick information. This layout follows Nielsen's principle of "Aesthetic and minimalist design" [3] and clear visual hierarchy with most important information (time) most prominent.

2. Sending a message to a friend

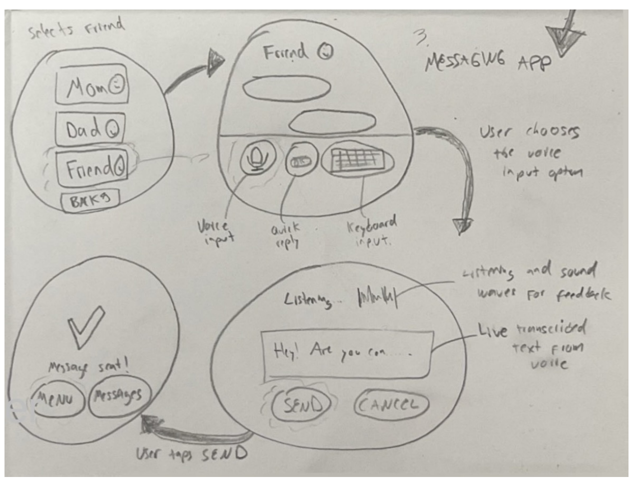

Figure 4: Sending a Message

To send a message to his friend, the smartwatch shows the menu of apps, which contain large, touch friendly rectangles with symbols, making it easy for kids to select the app they need. After this, a screen of a contact list with name and avatar/profile picture shows and a back button following Nielsen's "User control and freedom" principle [3]. Here, Oliver clicks his friend, opening the screen for messaging. Here, kids see the contact name, 2 message bubbles to not clutter the space, and 3 options for input (voice, quick replies, keyboard) applying Nielsen's "Flexibility and efficiency of use" principle [3]. Conversation bubbles provide familiar messaging context, live transcription and clear send/cancel buttons ensure user maintains control and receives immediate feedback, based on the principle by Nielsen "Visibility of system status" [3].

3. Receiving a call

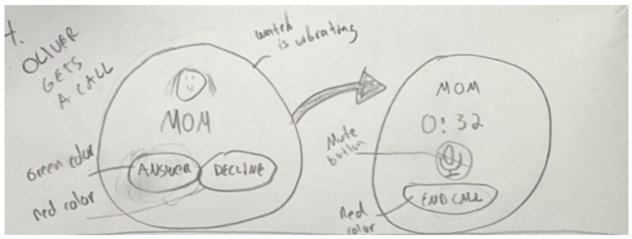

Figure 5: Receiving a Call

Full-screen incoming call display with large contact name and photo ensures immediate recognition, while big accept and decline buttons with color coding (green/red) support quick decision making and reduce cognitive effort. Vibration indicates haptic feedback for important notification and then if accepted, the screen shows timer, mute and a large end call button, focusing on core functionality and "Aesthetic and minimalist design" principle [3].

4. Comparing daily steps with friends

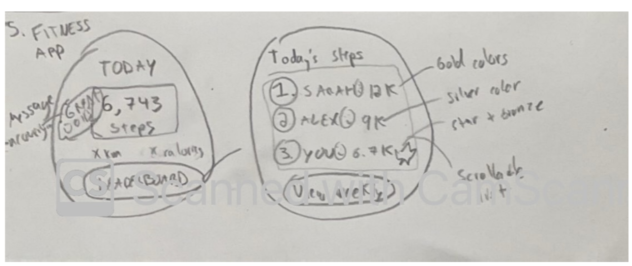

Figure 6: Comparing daily steps

Fitness data emphasize a single metric (steps) to avoid information overload on a small screen. An encouraging message is shown. The leaderboard uses a visual ranking system (medal colors (gold, silver, bronze), numbered list) and makes competition gamified. The users position is highlighted and shown with a star symbol creating clear visual grouping and aids quick scanning.

2.1.2 Matteo's Prototype

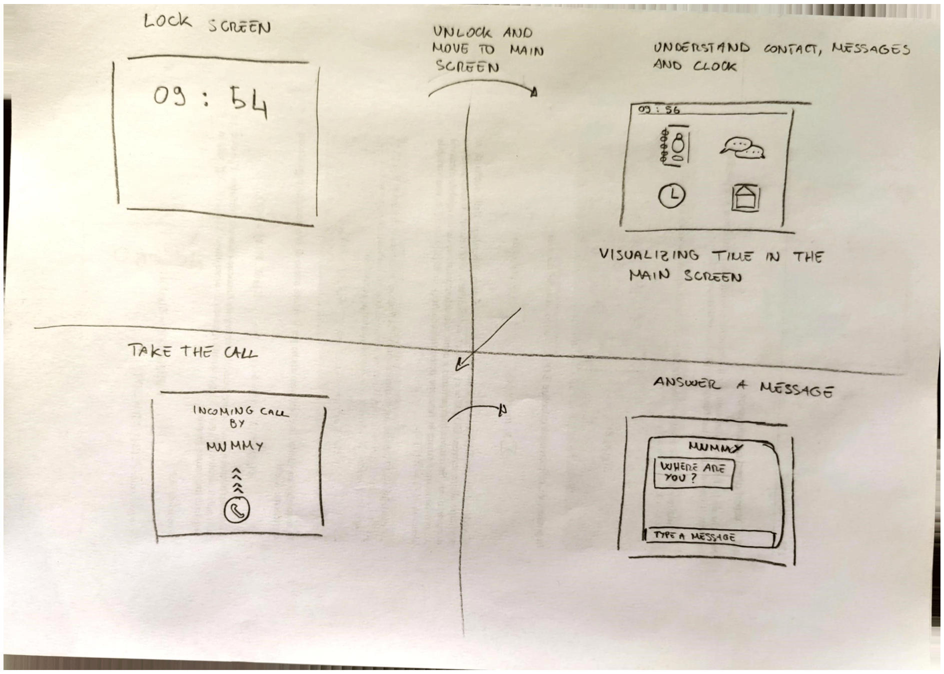

Figure 7: First Prototype of SmaWat key screens

This first prototype presents the main screens that implement the key functionalities. The goal is to test whether our assumptions about the user align with reality. In this specific case, this means understanding, for example, whether the amount of written information is confusing to children and whether the main information is visually understandable from a child's perspective.

1. Lock Screen / Standby

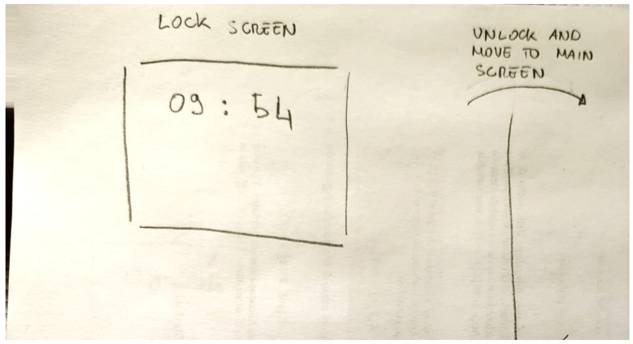

Figure 8: Welcome Screen

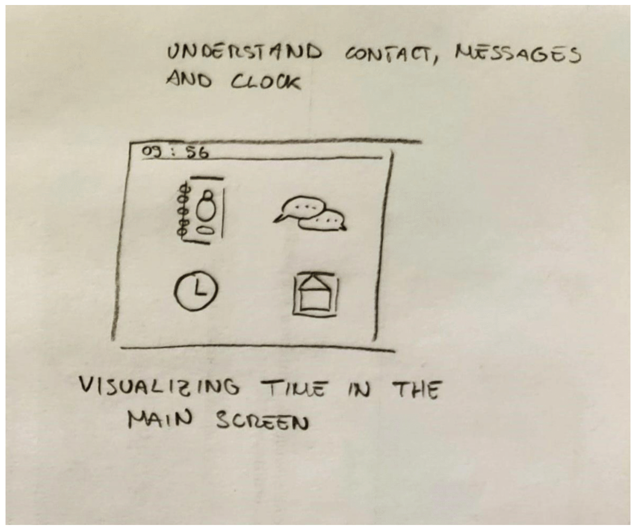

Figure 9: Welcome Screen

In this first phase, the aim is to understand how a child would react to a lock screen and what kind of gesture they would use to unlock the smartwatch. Then, on the main screen, we want to test whether the different icons are understandable and if the child can select the correct one for each task.

2. Sending a message

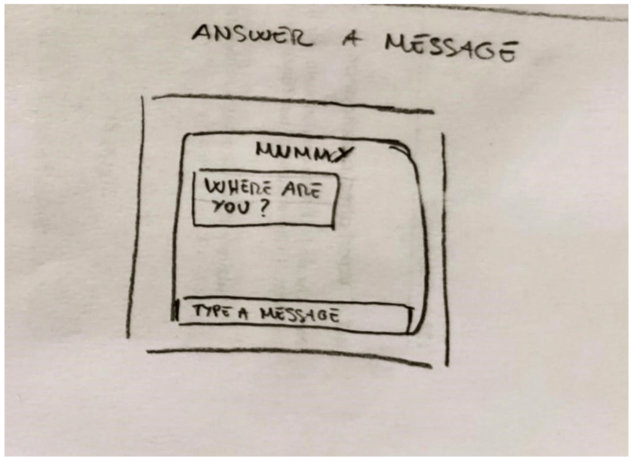

Figure 10: Sending a Message

If the child is able to select the correct message icon from the main screen, we then move to the message screen where the child sees a received message. The goal of this section is to verify if the child can understand who sent the message, what the message is about and how to reply. The results will help verify that the UI is simple enough, if predefined answers could be useful and if the interaction is clear.

3. Receiving a call

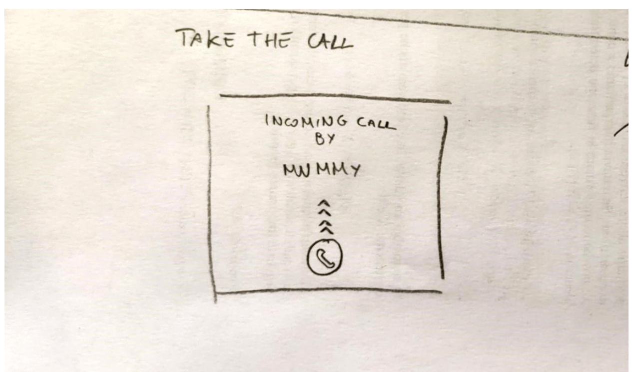

Figure 11: Receiving a Call

In this last phase, we want to simulate an incoming call and test whether the child understands how to interact with the user interface. We also want to determine whether it is better to display the caller's name in text or use an image.

This prototype does not include the interface for comparing statistics, as this functionality is considered, from my point of view, too advanced for the first design phase, and, instead, it has been inserted in the second prototype.

2.1.3 Comparison

Design Element	Dario's Prototype	Matteo's Prototype
Number of Screens	9	4
Frame Style	Circular frames representing round smartwatch	Standard rectangular frames
First Screen	Welcome screen with personalized greeting and basic components such as time and weather	Lock screen with time display
App Menu Design	Apps are represented by rectangles	Big illustrated icons with annotated titles
Incoming Call Interface	2 buttons for accepting or declining with annotations for the colors, along with a contact photo and name	Swipe up to accept, showing only the contact name
Messaging Interface	Screens transitions and annotated interaction responses	Simplified single screen with a message displayed and a "Type a message" button
Level of Detail	Mid-level by showing complete task sequences and annotations	Low: focuses on essential screens and primary actions
Interaction Annotations	Annotations for each transition such as taps, colors, and user actions	Minimal annotations

Table 3: Comparison of Low-Fidelity Smartwatch Prototypes

The same scenario can lead to completely different design choices mostly depending on what we prioritize. Matteo's design focused on simplicity and keeping things minimal, while Dario's design showed more detail. Neither approach is wrong, it just depends on whether you're trying to quickly test a concept or thoroughly evaluate a complete user flow.

2.2 First Evaluation: Plan for Evaluation of the First Prototype

Aspect	Description and Justification
Objectives	The goal of this first evaluation phase is to gather early feedback on basic tasks in order to better understand how children perceive usability and interaction with the prototype, supporting the design process [2].
Setting and Method	The evaluation should take place in an environment that is familiar to the children, such as a school or home, ensuring comfort and more accurate results while reducing pressure and anxiety for kids. [1]. We consider a qualitative approach such as a low-fidelity Wizard of Oz combined with observation to be the best method for this phase and for the context of our child users. [2]
Conducted by	One researcher acting as the wizard while another researcher observes and takes notes on children's interactions. [2]. They would need to be supported by an educator, parent or guardian to ensure the comfort, privacy, and safety of the children.
Participants	5–10 children aged 6–10 and 2–5 secondary users such as parents or guardians. Optionally, children may participate in pairs, since an Aalto study successfully used pair testing with 34 children in WoZ testing, finding it reduced shyness and increased talkative behavior [4].
Procedure / Phases	1. Introducing the evaluation process and collecting consents from kids and guardians. 2. Setup explanation by ethically explaining the wizard and observant roles to children and describing tasks in simple, child friendly language. 3. Allowing children a minutes to freely explore the paper prototype before tasks begin. 4. Task based evaluation by completing simple tasks framed as scenarios (e.g., "Your friend is calling, how do you answer?"). 5. Post-test interview to understand how to improve the evaluation ("What did you like?, What was hard?"). 6. Data analysis and reporting for the design process (Video analysis, observation notes).
Features Tested	The basic tasks tested will include viewing the time, receiving and answering calls and messages, and navigating between the main screens or statistics.

Table 4: Plan for the first (formative) evaluation of the paper prototype

Aspect	Description and Justification
Rationale	The Wizard of Oz method was chosen at this early stage because it enables testing of interaction behavior and user expectations without the need of digital implementation, while observation captures children's natural gestures and interactions that may not be verbalized [2, 4].

Table 4: Plan for the first (formative) evaluation of the paper prototype

2.3 Second Prototype: Interactive Digital Prototype

Following evaluation of the paper prototype, the next iteration would be developed as an interactive mid to high fidelity digital prototype made in Figma.

2.3.1 Dario's Prototype

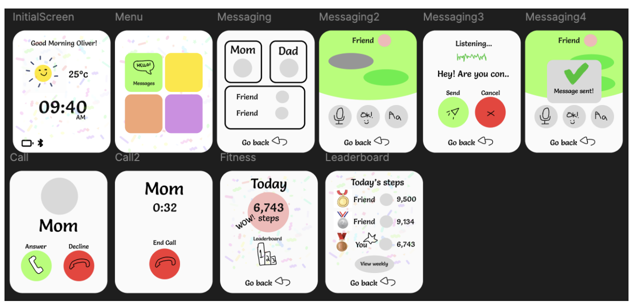

Figure 12: Second Prototype of SmaWat key screens

Functionalities
The digital prototype should contain clickable interactions that simulate the actual smartwatch functionality, including:

- Tap and swipe gesture navigation between screens and scrollable content.
- Interactive buttons.
- Animated transitions between slides or buttons.

- Simulated voice input with typing animation and text appearing in real time.

Interaction Design
This version enables users to physically interact with the interface mimicking real smartwatch gestures as well as providing feedback mechanisms such as button state changes and loading animations that were not demonstrable in paper form.

UI Design
The visual design introduces aesthetics for children:

- **Color scheme**: Bright colors with contrast for outdoor readability.
- **Typography**: Playful and clear sans serif font, big size.
- **Iconography**: Custom and playful icons in a ”hand drawn style”.
- **Visual feedback**: Colors and fun animations (checkmark, confetti effects).
- **Spacing and sizing**: Larger touch targets accounting for children’s motor skills.

How It Differs from Paper Prototype
By working on this more advanced prototype, the main changes were introducing elements such as color palette, typography, iconography, and overall ”drawing style”. Screens such as the contact list screen and the sent message confirmation screen were slightly changed in layout. I realized is important to give emphasis in the parents contact, as well as annotate to maybe include a physical button for calling them if an emergency comes up, which is why the buttons for them are bigger compared to friends contacts. As well, I realized its better to after successful message, show a small popup message of confirmation, but return to the conversation if the user wants to send another and prevent extra clicks.

2.3.2 Matteo's Prototype

Figure 13: Second Prototype of SmaWat key screens

The second prototype represents a digital version developed in Figma. In this phase, considering the mid-high fidelity prototype, the focus shifts more on interactions, design, and the implementation of more advanced tasks.
For these reasons, the main screens include:

- a home screen with large icons, including an app store, a statistics app, and some games;
- a timer allowing children to set the time by rotating a wheel and including a colored button to start it;
- a chat screen, showing elements such as the contact name, the message, and input options (text or voice);
- a gamified statistics section to visualize data from a child's perspective. Instead of showing the number of steps, the data is presented in the form of a monkey reaching some food (meaning reaching the step goal for the day). There are also sections to track social statistics and studying statistics (possibly relating to the number of other children encountered and the amount of time spent studying).

The interface has been thought to have rounded shapes, warm colors, and simplified symbols suitable for children. It aims to balance usability and engagement, according to human-centred design principles from ISO 9241-210 and Nielsen's heuristics.
This prototype is different from the previous in several key aspects. It moves from paper to a digital simulation (including interactions), then it introduces advanced features such as activity tracking and gamification, and helps assess whether the smartwatch design supports both the functional and motivational needs of young users.

2.4 Second Evaluation: Plan for Evaluation of the Functional Prototype

Aspect	Description and Justification
Objectives	The goal of this second evaluation phase is to test most thoroughly our digital interface, gather more complete data by including quantitative methods, and in general receive feedback on effectiveness, efficiency, and satisfaction, as well as introducing more advanced tasks for evaluation [1].
Setting and Method	Controlled environment, such as a usability lab or a school computer room, in which both qualitative and quantitative data can be collected, using specific tools to measure valuable data such as success rate, common errors, and time on task [2].
Conducted by	Two to three researchers, where one primary moderator is used to guide children and explain procedures, one observer to take detailed notes on behaviors and errors, and one technical assistant to manage recording and tools. As well, an educator or parent/guardian should be present to ensure the comfort, privacy, and safety of the children.
Participants	Five to ten children aged 6-10, different from those in the first evaluation, to avoid learning effects.
Procedure / Phases	1. Before the process: define quantitative metrics (success rate, errors, time on task) and create five scenario based tasks testing advanced features. 2. Explain the process to children and guardians and obtain consent, overall familiarizing them with the basic smartwatch interactions. 3. Start recording. 4. Evaluation: children complete tasks based on scenarios while researchers observe without interference. 5. Apply UX questionnaire suitable for children. 6. Gather quantitative metrics and qualitative observations.
Features Tested	Setting alarms, sending voice messages, downloading apps, and viewing personal statistics.

Aspect	Description and Justification
Rationale	Since we have this new digital and more interactive prototype, we can leverage gathering quantifiable information on efficacy, efficiency, and satisfaction under controlled circumstances. Overall by combining quantitative and qualitative data we can guarantee a more accurate comprehension of usability and user experience, confirming design choices and hinting at potential enhancements for the finished prototype. [2].

Table 5: Plan for the second (summative) evaluation of the functional prototype (continued)

2.5 Third Iteration and Evaluation

For the third round of our SmaWat prototype, following our evolutionary prototyping approach [2] and having received valuable feedback from our previous two rounds of evaluation, this high fidelity prototype would be implemented on actual hardware as an MVP (Minimum Viable Product) smartwatch device. This would allow us to determine whether the chosen solutions from past feedback and design decisions are successfully implemented. As well, for measuring usability and user experience, it should be tested in real world contexts, primarily through qualitative methods such as field observation, diary studies, and interviews with kids and parents, as well as quantitative methods such as surveys. [1].

3 Reflection

In the actual human-centred design process applied in the industry, many challenges are presented which may affect all aspects of design planning. Constraints such as timing, financial and people resources, and business goals could limit the full capacity of designers.

In real companies, the main challenge is trying to integrate the HCD process with an agile development approach. Usually business practices tend to rapidly launch a solution and leave little time for iterative processes, causing usability insights to arrive too late.
However, HCD brings significant benefits to organizations. By focusing on real user needs, companies can improve customer satisfaction and loyalty, leading to brand equity, increased revenue and competitive advantage, as well as reducing development costs and error handling later on in the process.

As for skills needed for the human-centred design process, it is crucial to have strong user research skills, where empathy is essential to truly understand and provide real solutions for users. As well, having communication and collaboration skills is critical, as HCD requires working across not only the design team, but multiple stakeholders. Finally, developers should also understand HCD principles, have good communication with designers, and be willing to adopt iterative development.

It is important to have a team of designers, as having one person responsible would limit all aspects of the design process, from research and insights to ideation and design solutions, as well as evaluation. Human factors are extremely important while gathering insights, and it is crucial to have co-design processes in a way that limits either cultural, habitual, and overall personal biases, as well as challenging ideas and generating a collaborative and improved approach in all areas.

3.1 Additional Special Considerations for Child-Centered Design

Beyond the ISO 9241-210 framework implemented in Section 1, SmaWat should consider important aspects when designing for children as our main users by

- Obtaining guardian/parent consent and institutional approval.
- Recognizing that children may try to please or be scared "to fail" adult researchers.
- All settings should require parental permission. Data such as location, access to internet and harmful or not age appropriate information should be carefully reviewed.
- Designing for ADHD, autism, dyslexia, and other conditions.
- Adapting design to user's literacy, cognitive, and emotional growth.

3.2 Pair Reflection

Working on different solutions allowed us to compare them and obtain different perspectives on the same topic. We discovered how two prototypes could be very different while both providing valuable insights into the design process.

We initially developed low-fidelity paper prototypes, which helped us identify different interpretations and points of view. Then, we both designed mid-high fidelity prototypes in Figma and compared the results again. This iterative comparison highlighted how iteration improves the process, as we were forced to question each other's work and to justify our decisions. In some cases, you can even realize that your choices may have weaknesses you weren't aware of.

At this point, the next step would be to combine the strengths of both, achieving a balanced design that allows testing all the tasks while combining accessibility and pleasantness. This whole process demonstrates how collaboration leads to more robust solutions and reduces bias.

References

[1] *Ergonomics of human-system interaction – Part 210: Human-centred design for interactive systems*, International Organization for Standardization Std. ISO 9241-210:2019, 2019.

[2] Y. Rogers, H. Sharp, and J. Preece, *Interaction Design: Beyond Human–Computer Interaction*, 6th ed. Hoboken, NJ, USA: Wiley, 2023.

[3] J. Nielsen, "10 usability heuristics for user interface design," Feb 2024. [Online]. Available: https://www.nngroup.com/articles/ten-usability-heuristics/

[4] J. Höysniemi, P. Hämäläinen, and L. Turkki, "Wizard of oz prototyping of computer vision based action games for children," in *Proceedings of the 2004 conference on Interaction design and children: building a community*, 2004, pp. 27–34.