Designing Food Information Systems for Rural Africa
User-Centric Design Methods for Complex Contexts

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Abstract. This research presents user-centered design methods for complex contexts. It explores two particular problems that hinder the interface design process: (i) The difficulty of the communication between developers and users, by defining the most appropriate requirements elicitation tools for users in low-resource environments. (ii) Determining the user's perceived utility of the proposed artifact. To this end, the process of designing a seed information system for the Seed Value Chain in Mali is explored, and the in-between artifacts we use to scope the functionalities of the interface are evaluated by the prospective users. The results and knowledge obtained are then generalized into an appropriate method that engages the user from the beginning of the design to the implemented prototype.

1 Introduction

Despite the broad potential of ICTs to transform societies and drive growth in the global economy, their benefits are not evenly distributed. A major indication of this assertion is the actuality of constrained environments. Low-resource countries face concerns and struggles that are far from conceptualized in parts of the northern world. In the African Sahel specifically, acute vulnerability to food insecurity is a challenge that affects about 4,6 million civilians and requires effective interventions [1]. The good news is there have been continuous attempts to reduce inequality, generate innovation and potentialities for enhancement, even where it has been seen as challenging. The Information and Communications Technologies for Development initiative aims to foster economic development by ensuring equitable access to modern communication technologies. To address this, many of the ICT4D projects, programs and policies have focused on identifying the needs of envisioned users through many extensive types of on-the-ground research and multiple workshops [2].

The complex Seed Value Chain in Mali is one pertinent case where these ongoing works have shown promising results, in serving the needs of the local agrarian communities, which are mainly made up of farmers [1]. These approaches

[1] Anna Bon, "Supporting the Seed Value Chain in rural Mali", W4RA, https://w4ra.org/2020/04/13/how-to-enhance-the-seed-value-chain-in-rural-mali/, accessed May 23, 2021

and the information gathered have facilitated the understanding of the context in ways that can be crucial in advancing the social and economic development of poor regions. However, there is a continuous need to assess the circumstances and further contribute to ICT services in these regions, mainly because these communities have difficulty understanding even the simplest system presented to them. This is partly due to the diversity of backgrounds and cultural differences between the user and the developer, which disrupt the process of eliciting the needs of these communities [3]. This is a very important obstacle to overcome. In addition to infrastructural shortcomings, other contextual constraints must also be considered when developing and implementing innovative systems. These include the user's lack of understanding and the developer's lack of knowledge about the requirements of the intended users. To find a solution to this problem, it is essential to focus on finding the prerequisites for bridging the communication gap between the parties involved. Therefore, this study attempts to address these challenges by presenting an adequate method for designing user interfaces in low-resource countries.

2 Related work on ICT in constrained environments

The emergence of ICTs in developing countries offers a wide range of technologies that enable better use of information and explicit knowledge and provide opportunities to enable improvements in infrastructure and living standards.

However, the impact of these technologies differs fundamentally in terms of the framework of implementation and is strictly tied to the local context [4]. In general, it is evident that an abundant amount of ongoing projects and organizations working on ICT-based solutions in poor regions emphasize the importance of improving agricultural production and enhancing food security in these areas [5] [6] [7] [8]. Most research also shows that underprivileged communities are mostly characterized by a wealth of mobile services capabilities to improve people's livelihoods, particularly food supply and production systems [9] [10] [11]. That is mostly due to an increasing number of people who have become dependent on mobile phones from the year 2000 in most developing countries; they own and use mobile phones continuously for voice communication purposes [5]. Therefore, the innovative use of web-related technologies that involve speech or language and the opportunities afforded by the widespread use of cell phones and radio have also enabled necessary information sharing and knowledge transmission efficiently in many low-resource countries like in rural Africa, Mali [12] [13].

2.1 User Interface design in constrained environments

As mentioned above, even though ICTs are bringing positive impact and improving the quality of life, their introduction in low-resource countries encounters challenges that become evidently clear when users need to interact with the design of ICT systems. For instance, Indrani Medhi [14] identifies and elaborates on

issues that arise when designing user interfaces; the low levels of formal education and textual non-literacy, the difference in cognitive abilities and socio-cultural aspects. Hence, further existing works also emphasize that using speech and dialog interaction when needed to implement interfaces, displaying non-linguistic graphics, adapting to the user's literacy level, and accepting input via a microphone and touch screen are well suited in constrained environments [15]. It is also evident that the text-free designs are strongly preferred by inexperienced and illiterate users over the standard text-based systems [16]. Next, to facilitate the challenging process of requirement elicitation for communities that are characterized by illiteracy [17] presents a technique that combines storytelling with digital tools. The purpose of this is to define the necessary information in terms of what these users need before starting with the system's design process. Lastly, the work of Langton and Biswas [18] briefly describes user surveys and studies conducted in two specific countries and their applications to the development of adaptive user interfaces through user modeling. However, this is only one element of the overall process of interface and interaction design for developing countries.

3 Contributions of this research

It is evident that in terms of user interface design, the vast majority of research tackle technical aspects and suggest what features should be implemented based on that. Little research is available on the optimal detailed techniques to introduce unaccustomed platforms to users coming from a completely different background that emphasize the identification and consideration of process requirements and uncertainties. For example, the study Medhi et al. [16] provides a good overview of the text-free components that need to be incorporated for adequate systems in low-resource countries, by describing an actual ethnographic design process. However, less attention is paid to the actual roadmap of a design process, which involves multiple aspects and can be standardized for extensive use. The research by Pitula and Radhakrishnan [17] has contributed to a better understanding of user requirements for interface design in a limited context, but the focus is only on facilitating the elicitation process. A practical application on how to actually design ICT systems/interfaces is missing for the users in low-resource contexts. Therefore, in my research, I contribute to the existing work in the field by presenting a method that describes the process of developing interfaces in detail and also provides a good set of tools on how to do that. It focuses on the ability of individuals in constrained settings to comprehend and use information and communication technologies. This approach is not necessarily aimed at an illiterate audience, but one that encounters many limitations.

For this purpose, the following research question was formulated:

How can we compose an inclusive method for user interface design of ICT systems that aim to serve the goals of people in a low-resource environment? In order to fully address the question, the research project looks at two sub-questions:

(i) What are the most appropriate tools or techniques to elicit user-centered requirements for user interface design, given the cultural distance between developers and intended users?

(ii) What is an appropriate method for user-centered evaluation of the effectiveness or perceived utility of the proposed artifact (i.e. user interface)?

By answering the main research question, this project aims to influence the dynamics of collaboration between the developers and the target audience by finding the right manner to overcome the disparities of cultural values between them and the users' difficulty in comprehending ICT systems. A four-step approach that engages the user from the beginning of the design process is presented and evaluated using a real-life case study.

3.1 Selected case study

For this research, the selected case study is the Seed Value Chain in Mali. I present the design and implementation of a user interface that meets the information needs of local smallholder farmers.

By using this actual design process, I present a general method that takes into account both the above aspects of research on the optimal techniques for eliciting user requirements and the user-perceived benefits of the envisioned system. Additionally, it is important to highlight that the practical contribution of this study tackles the interest and benefits of people in Mali in regard to the Seed Value Chain. As ICT systems in low-resource settings aim to drive innovation, particularly in agriculture [7] [8], providing a method that amplifies the importance of users' needs, will promote adoption of these platforms and consequently will increase food security. Although the case we consider in this research is specific, the goal of this work is to be beneficial for similar scenarios in developing countries.

4 Research strategies and research methods

This research is part of a broader ongoing action research at VU Amsterdam (in collaboration with W4RA) that addresses food security in low-resource settings. In addition to this research, other students will conduct studies on related topics, but tackle them from a different perspective, e.g. ethical, socio-technical, or business-technical. Exploratory and design science research are used to answer the main research question. This research strategy has a very similar approach to the grounded theory methodology as it involves the collection and analysis of information and the subsequent construction of a method based on that information.

4.1 Research Strategy 1: Exploratory Research

Context analysis and needs assessment is conducted, which draws on previously published data and information from various researchers who have been in Mali.

These are two essential steps in the ICT4D Field research methodology [4]. The goal is to understand the context in depth, adopting the same type of perspective and bridging cultural distances with the environment in which the project will take place. In addition, it entails finding out what users want from the system, how they can work with it, and what benefits it provides them. Previous work includes concrete ICT4D project efforts such as service development and deployment (e.g., voice-based mobile web system). Therefore, I make use of the available resources that include articles written by scientists and professionals from W4RA, and reports from the communication with the involved stakeholders. Unstructured interviews are conducted with farmers in Mali, in order to clarify any doubts or questions encountered. Furthermore, to answer the first sub-question, I consider literature from separate case studies and other researchers in the field of ICT4D that have addressed the importance of the needs elicitation aspect in low-resource countries. Through these sources, the communication barriers in terms of complexity and the ability of users to express their specific needs are analyzed. Elicitation tools and their use are discussed in order to reflect on some optimal techniques that best fit users in low-resource countries. This research strategy allowed me to obtain a unified view and identify some useful means for bridging the cultural divide.

4.2 Research Strategy 2: Design Science Research and Action Research

The second research sub-question is approached by using both design science research and action research strategies, as they fit well in a real-world study. The goal of design science research (DSR) is to find a solution to a problem that improves something for stakeholders in a particular context, while the subject of design science research is an artifact in a real-world context. Similarly, action research (AR) focuses on generating new knowledge to improve and learn from a social, real-world situation. Because of the shared notation of generating knowledge by intentionally changing a real-world situation and evaluating the results of the actions, a combination of both types can provide a flexible design approach [2]. This combination is mostly used for international development projects to implement change. Considering that it is a well-suited strategy, a "real-world research" will be conducted, consisting of design science and action research, with a twofold objective:

(i) First, to serve users with an interface design.This design is completed by creating various models such as UML diagrams, storyboarding illustrations, dashboard mock-ups, and eventually a working prototype of the user interface. The designs are focus on addressing the users' difficulties in understanding ICT systems and tackle the most essential features of the envisaged Seed Value Chain dashboard. For the final prototype of the user interface, I worked in collaboration with Betul Yildiz; another student of this broad research topic.

(ii) The second objective is to generalize my findings into a new method that defines how to properly design ICT systems for users in low-resource countries, with a focus on examining the user-perceived utility of the artifact.

In order to develop the definitive method and attainment, it will be studied how the implemented in-between artifacts interact with their real-world context, using technical action research that allows testing in real-world conditions by using it to solve a real-world problem. The users will have a critical role in the assessment of the in-between artifacts. The target user group includes both people with basic technical knowledge and those who have no such knowledge. Their input helps to better understand the capabilities and effectiveness of the models, but also to identify what needs to be improved or revised.

The participation in this collaborative, long-standing project on "ICT for Food security in rural Africa" provides an exceptional and privileged opportunity to present future efforts to research partners in Mali and also to receive their feedback. As a result, the circumstances of this project not only allow for actual evaluation but are also a principal motivation for choosing this combined research strategy, which serves to make this work more interesting, relevant, and valuable both from a real-world and from a scientific perspective.

5 What has already been done to improve the Seed Value Chain in Mali?

Mali is a landlocked country in West Africa, where the majority of the population (about 75 percent) depends on agriculture. Food security is therefore a significant concern and the government has implemented an agricultural development initiative aimed at reducing poverty while maintaining diversity in food production [19]. There are several ongoing works that aim at intensifying food production by exploring different viewpoints that facilitate and improve this chain. Since the development of new communication channels is the fundamental dilemma of this system, it has become the main objective of W4RA. This is an interdisciplinary network that brings together professionals from the fields of information and computer sciences, software development, organizational science, business and communication, with the aim of supporting people living in poverty or in rural areas. W4RA's approach to ICT development puts local stakeholders and their information at the forefront. The extent of W4RA's research is not limited to the Seed Value Chain in Mali only, on the contrary, it tackles multiple ICT4D approaches, frameworks and distinct use cases, mainly in Africa. In terms of Seed Value Chain and its vulnerabilities, there are also several supported efforts, like agent-based systems that advise on decisions to optimize the current value chain [2].

Additionally, in terms of this specific case, another research assists by presenting a basic seed system network modeling that promotes the main actors to work together to analyze the dynamics of resources produced from interactions

[2] W4RA, accessed June 28, 2021, https://w4ra.org/

between actors and the types of resources according to different environments [19]. There are also value-added contributions to showcase good design practices that consider sustainability as a key factor for successful digital platforms [20].

5.1 The stakeholders and the actual concerns

As mentioned earlier, increasing agricultural productivity is vital for the country. The use of improved seeds for food production is thus one of the most prominent paths to solving this problem, but it is also a rather intensive and time-consuming process. Initially, the Institute of Rural Economy produces and supplies farmers with basic seeds, called semences de base. In the whole process, these seeds are used as the basis for producing R1 seeds, R1 seeds are used by farmers to harvest R2 seeds, which are needed for regular seed production. Then, the certification of these R1 and R2 seeds is an essential step and can take a few months. It must be done by a government institution within the Malian Ministry of Agriculture called LaboSem. An important role in this Seed Value Chain is played by farmers' cooperatives, which buy R1, R2, and common seeds from farmers, store them and certify them. In this way, these cooperatives can also sell the seed at a negotiable price to the farmers who grow the grain using it. The Association of Professional Farmers' Organizations (AOPP) is an umbrella organization that governs the Seed Value Chain and aims to unite farmers' cooperatives [21].

The problem of the seed value chain in Mali lies in its complexity and organizational inefficiencies, which primarily affect the involved stakeholders. Seed distribution is not uniform, and demand and supply often do not match; in one region there are multiple types of seeds, while in another there may be a shortage. Farmers do not have access to market information; they have difficulty finding customers and many of their products may remain unsold when there is a good rainy season and therefore a good harvest. They are often not informed of market prices and there is also a lack of transparency in terms of the certification process; the quantity of certified seed. In addition, the relationship between buyers and sellers/producers lacks trust due to episodes where farmers are victims of dishonesty and corruption. All of these challenges are driven by a lack of information and ineffective communication channels, making it difficult to make deliberate and informed decisions [21].

5.2 The current system

Through the analysis and integration of stakeholder needs, a Seed Information System (SIS) was developed to link customers and agricultural cooperatives and bridge the gap between supply and demand. Through the SIS, farmer cooperatives indicate the variety and quantity of seed they have available and customers request the variety and quantity of seed they want. If the quantity requested is in stock, the contact information for the cooperative(s) involved is displayed.

However, the results of the implementation of this application are not as expected, as access to the application is low. It has not been adopted by users

STAKEHOLDER	OPERATIONAL GOAL
National Agriculture Division (Part of the Malian government)	Serve society and improve the food security in the country.
LaboSem	Provide service to farmers by ensuring the seed quality.
Umbrella farmer's organization (AOPP)	Improve the seed value chain by informing cooperatives and supporting farmers.
Farmer cooperatives (OPs)	Support farmers in selling their seeds and make profit by reselling the seeds.
Farmers	Produce seed and make profit by selling them.
Local customers	Produce cereals using the bought seeds from the farmer cooperatives and farmers.
Large buyers/ Agrodealers	Negotiate with AOPP, cooperatives, farmers and purchase a large quantity of high-quality seed at a fixed price in advance.

Fig. 1: An overview of the relevant stakeholders of the Seed Value Chain.

and the necessary data is still missing, as the number of cooperatives using it to add data is minimal. [21].

The necessary improvements After the analysis of the context and the current SIS, a context-sensitive SIS is proposed, in which the concerns of the identified stakeholders are addressed. The context-sensitive SIS involves many operational components, crucial for further improvement. The objective of the SIS is to link all the data to a single database that can be accessed through various interfaces, such as the telephone service but also through the currently available web interface. Therefore, a project called SEVOSEM in collaboration

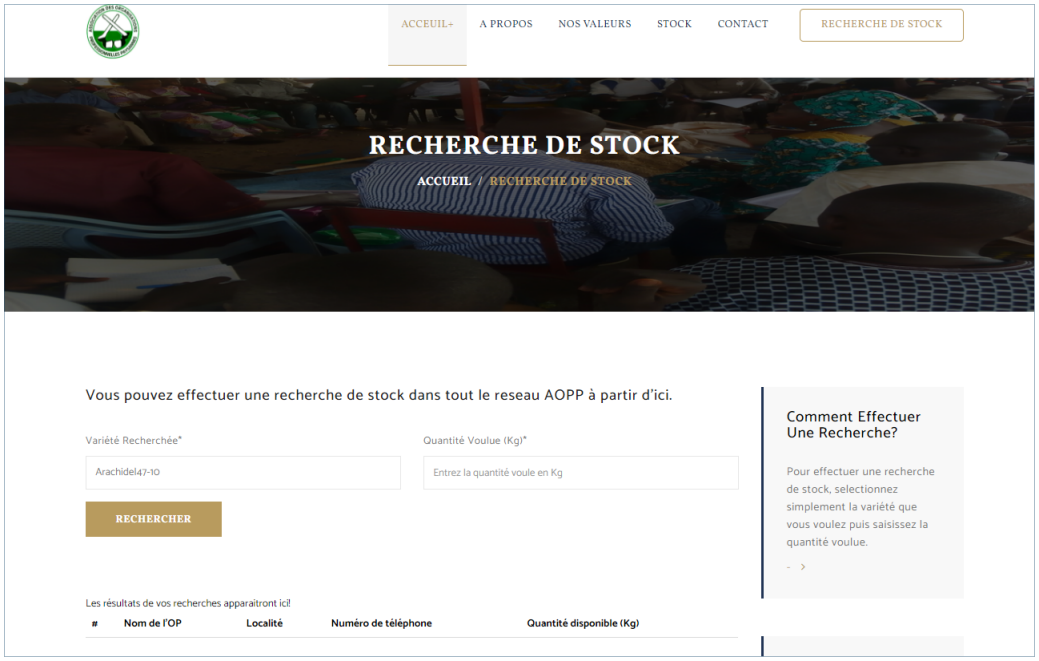


Fig. 2: Screenshot of the current Seed Information System.

with the AOPP and the VU researchers aims to improve communication in the seed sector in Mali, by implementing the necessary changes[22].

As discussed, the main objective of the project is to provide a context-sensitive system that allows for use on simple cell phones, in locations without a strong Internet connection, that uses the local language, and that has fewer (digital) literacy requirements. There are three identified tasks or activities that need to be carried out to achieve the objectives. Firstly, a voice system for entering seed data for illiterate users that also considers the lack of internet connection and a voice system for radio offerings. Secondly, an easy-to-navigate dashboard for the AOPP, where relevant information regarding the seeds can be visible, but can also be used as data entry for the users that have enough literacy.

Currently, a voice-based application prototype is being implemented by André Baart, whereas the design and presentation of an adequate user interface idea is a pivotal part of this research and will be discussed in section 6.

6 Requirements' elicitation

6.1 Communication challenges and cultural differences

Requirement elicitation is a fundamental process that aims to determine what the product should do through a good understanding of the demands and needs

of the various stakeholders. It is also a crucial step in the proposed ICT4D 3.0 framework, which covers the entire life cycle of ICT service innovation [4]. This iterative process distinguishes not only the requirements but also the issues and concerns. Therefore, finding the most effective elicitation techniques certainly helps in implementing a successful final artifact. On the other hand, requirements elicitation can affect the entire software development activity if not properly executed. An overemphasis on technical success, without inadequate attention to end-user needs and the social development aspect of the projects, is among the common factors why software projects fail [17]. There is a gap between requirements elicitation in the developed world and many areas in developing countries where the mindset may be different. There is still a lot of research to be done in many specific places to find the ideal method, but overall, one thing is clear: Culture profoundly affects the technique that is chosen for requirements elicitation, especially in low-resource environments [23]. This is in contrast to ICT/software development projects in the Global North, where developers and users are more likely to share the same language and culture. For many end-users in these regions, ICT4D initiatives are the first time they have encountered ICTs such as the Internet and the Web, thus the significant background disparity between users and developers is yet one more challenge to overcome. Breaking down cultural, physica, and language barriers between these two parties must be a top priority if useful technologies are to be developed.

6.2 The most appropriate tools and methods to elicit requirements in ICT4D

Overall, the elicitation techniques are divided into 6 types; traditional, collaborative, prototyping, modeling, cognitive and agile [24]. Traditional elicitation techniques imply that end-users are able to understand and articulate their problems and needs. However, expressing and describing problems and needs correctly is a learned skill. Due to their socioeconomic status, people living in disadvantaged areas may not be able to understand and articulate their requirements in a thoughtful way [25]. For example, they would have difficulty communicating those through traditional interviews or questionnaires. Therefore, as noted above, previous reviews and studies emphasize the role of context in recommending the situations in which a technique works best. There are situations [24] where : 1.The stakeholders are not able to describe their needs properly (because of multiple reasons). 2.The envisaged system seems complex to the users. 3. Stakeholders have more familiarity with the domain than the developers and the other professionals. 4.It is necessary to closely involve users to get quick feedback and appropriate results. These cases, which are more difficult than others, can benefit from the use of two specific elicitation techniques: storyboarding and prototyping. Prototyping can be useful for understanding communications with the system, and also for taking adequate details of the graphical interface and can help to understand and clarify requirements, while storyboarding can simplify the system as much as possible, and make it more appealing [24]. These results are very relevant when it comes to identifying appropriate elicitation techniques

in low-resource countries, especially because the characteristics mentioned above are quite common there. Users do not know how to express their needs due to language barriers, illiteracy, or even if they are not illiterate, they have difficulty finding the right words. They may feel overwhelmed by the idea of ICT systems in general, and the proposed solution in particular. However, they have a better understanding of the field and the obstacles encountered since they experience it, so their involvement is crucial.

During actual requirement workshops regarding the Seed Value Chain in Mali, developers and farmers participated to facilitate communication on the selected key ideas. Many collaborative elicitation techniques were used as a first step to bridge the gap between the user's narrative (mainly diffuse) and a fully specified formal model for the envisaged ICT system [2]. Rapid prototyping for instance, as an agile method, allows the users to give feedback and evaluate the prototype while avoiding delays and miscommunication. Storyboarding, as a great instrument for ideation. It presents a linear sequence of illustrations, arrayed together to visualize a story, by shaping the user journey. Communicating design decisions with a storyboard really come in handy, as it allows the users to interfere and contribute to it. Conceptual modeling, that may involve informal models like scenarios or sketches and formal ones that usually tackle technical aspects. This allows key points to be made clear by providing a detailed specification across differing views of the system. Contextualization of demonstrations and models that assist in the elicitation and validation of system requirements. An example provided in the case was a visual call flow diagram for a voice information system in the local language, to explain the basic idea of the system and the different menu options.

In addition, given the elicitation tools mentioned, an innovative new technique that approaches elicitation as a part of it is the structured storytelling method. This method captures and structures key ideas and user stories. It captures complex unstructured information and presents it in a structured format. This method is not limited to requirements elicitation, but can also provide a uniform description of all information obtained from users. This method is very detailed and consists of 11 simple steps by ensuring that no relevant information is left unanswered. A concrete application of this method is in rural Mali[2].

Finally, another relatively new elicitation technique that also combines a wide range of tools is the structured digital storytelling methodology that builds on the concept of storytelling and is specifically modeled to address limited literacy. By adding a structured dialogue multimedia interface to digital storytelling technology, it helps people express their information needs through stories that can then be shared in the community. This method emphasizes the potential of storytelling as a pathway to accessing needs in areas where access to end- users and the actual usage setting is limited. After the elicitation phase, the collected stories are processed, analyzed, and categorized. Since the stories are told in the local language of the people, the first step after data collection is to translate the stories into English. Then, a qualified qualitative analysis is needed to identify the different problems and the factors or conditions related to them. The

stories are collected using an electronic tool, and then the information is used to construct a step-by-step diagram. The final outcome goal diagram is derived from the others [17] [25].

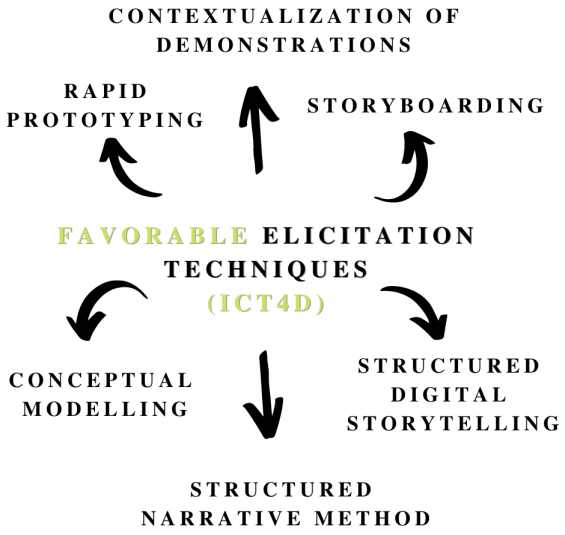


Fig. 3: Some of the most useful elicitation techniques in the field of ICT4D.

All in all, the use of conventional needs elicitation techniques alone is often insufficient. On the other hand, all of the aforementioned elicitation techniques can be used in ICT4D because they solve the communication and comprehension problems encountered, as many of the considered real-world research studies have concluded. Additionally, due to the deficiencies of low-resource environments, the oral communication method is more prevalent in these communities, so these elicitation techniques emphasize its importance and include it in the process. The use of one elicitation approach does not exclude the use of other elicitation techniques, on the contrary, in the last two approaches mentioned, it is considered necessary to use several of them in a complementary way.

So, to conclude: When choosing a particular elicitation technique or combination of methods, it is imperative to involve end-users from the beginning to minimize the number of problems that may arise. In my case and in my specific research direction, there has been a lot of material and research conducted that concluded with the identification of user needs for an ICT system that aims to improve the Seed Value Chain. The main functionalities that will help the users of the envisaged system are mentioned and discussed. However, I make use

of some elicitation techniques such as storyboarding, informal templates, and UML diagrams to present the interface idea to the users. In addition, a detailed visual user design was created using a vector graphics editor and prototyping tool. These models are used not only to retrieve additional requirements from users but also to gain a better understanding of how to test the user-perceived usefulness of the proposed system design.

7 Designing the user interface

The SEVOSEM project, as mentioned in Section 4, aims to expand the existing Agrosoft platform by addressing the underlying factors that prevent the platform from being widely adopted. The voice system will offer the trading functionality as it will serve as a data entry tool for illiterate users and those without an internet connection, as well as for seed offerings. Second, the dashboard, which will primarily be of benefit to the AOPP, can serve as a data entry tool, but in this case for the literate. The dashboard will also provide relevant information on seed offerings and availability. Both, the voice system and the dashboard will record the data entered into a common database. In virtual meetings with Anna Bon, a member of the W4RA research team at the Vrije Universiteit, the idea and some of the preliminary questions about the dashboard were discussed.

1. Who will be using the dashboard? The Association of Professional Farmers' Organizations (AOPP).
2. Who is involved in the AOPP, what is their level of literacy? In general, AOPP involves farmers and also people who have sufficient technical background information.
3. What is the main objective of the dashboard? To provide easily accessible information on seed availability.
4. What would be a key feature of this design? The locations and use of a map to show the outlets is a useful addition, to address the lack of this type of information in the current system.
5. What language should we use for the design? French is the best option, as most AOPP members speak French.
6. Do they have access to a good internet connection there? There is an internet connection, but it is not optimal.

7.1 Storyboards

The visual design of the user interface is essential to better understand what is and is not feasible for the prototype, to integrate the necessary functionality but also to provide a presentation to the intended users. As a starting point for this iterative process, two simple storyboards are devised to capture the main idea of the user interface and make it easier for users to comprehend it. Since it is one of the most effective elicitation techniques in the ICT4D field of study and not everyone involved in the project shares a solid understanding of how

the product should be designed, storyboards can facilitate not only the overview of the concept but also its evaluation. The entire interface is modeled for two potential users: sellers who are part of farmers' organizations and buyers who are interested in purchasing seeds. Therefore, the first storyboard presents the seller's perspective while the second one presents the buyer's perspective.

Fig. 4: Storyboard showing a use case scenario for an envisaged user that adds his available seeds into the system with the purpose of selling them. Storyboard by Spiridhula Zguri.

Fig. 5: Storyboard showing a use case scenario for an envisaged user that navigates the system to find seeds and buy them. Storyboard by Spiridhula Zguri.

7.2 Models

Two other models are presented in this section that show the possible scope of the system and its users. The first model shows the key idea of having two diverse flows based on the type of user; the AOPP user who wants to add seed information into the system, and the buyer who wants to explore the possibilities of purchasing seeds.

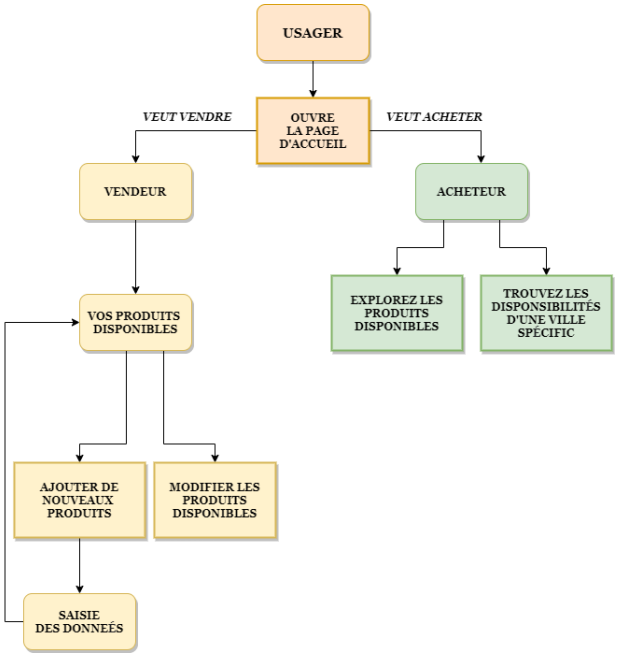


Fig. 6: Informal model that presents the scope of the interface to the user.

The second model is created on both perspectives as well but it is more detailed, presenting states, state transitions and variables for each state.

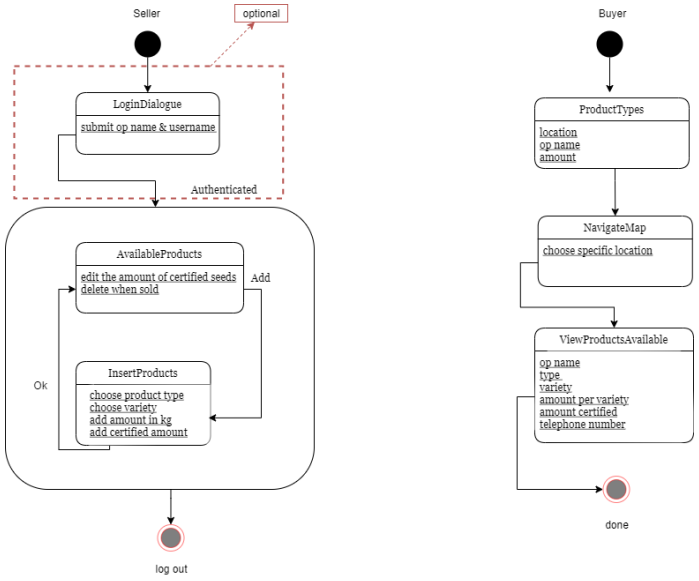


Fig. 7: Formal model in UML: State diagram presenting the scope of the interface more technically.

7.3 Visual design of the dashboard

Draft version of the first design The most notable feature of this dashboard is the visual information of available seeds and their location, but before designing it, a simple input form is presented where the user can insert the type of seed they are offering, the variety and the quantity. Since the AOPP involves people who can write and read, they can use this system also to insert the data easily. In this layout, we include radio buttons to select the seed, a scroll box that displays the varieties of the selected seed, and a text box to insert the amount. The second part of the dashboard is a details page where the user can be redirected after inserting the information. From this page, the user can also access the input form by clicking the add new product button. This layout consists of a table with the details of the specific products, their variety and the amount that the envisaged user has inserted. It gives the possibility to modify the amount or to delete the product. Lastly, the idea was to present a simple way of searching for the seeds and their location, without a search engine. It was decided on two main features; A grid with the common type of seeds and for each of them, the location and the amount. For a more specific search, a map is presented with markers on the selected locations for the pilot prototype.The concept is to navigate the map and click on the desired location to explore the available seeds, the varieties, amount, and the number of telephones. See Figure 14 for a complete overview of the initial visual layouts.

Evaluation of the first model The preliminary design of the proposed interface consists of these three mockups, most of the features of which were decided during the brainstorming session and experimentation with the online tool "Figma". After a meeting session with Anna Bon, the feedback was quite positive, and we discussed some components of this design.

1. The layout that can be used to navigate and explore seed availability and locations looks engaging with a nice combination of features (map and grid with seed types). It does, however, need some additional tweaking.
2. In addition to the input form, the details page where the AOPP user can see the products they have inserted is a thoughtful addition. For this feature to make sense, we discussed a simple login form, where the AOPP user can add their credentials like a phone number.
3. Therefore, the dashboard must be viewed from two perspectives: the AOPP seller and the buyer. After being authenticated, the user (seller) is redirected to the details page, and from there they can access the input form to add new seeds. The buyer does not need to be authenticated, and can only navigate to the main page where the information about where to find available seeds is.
4. A suggestion for future work is to keep track of certified seeds in the overall stock. As mentioned before, seed certification is a very intense process, so it would be advantageous for the user to have this aspect incorporated into the current design.

After this session, we had the opportunity to meet some of the AOPP members at a zoom meeting where the voice system (part of the SEVOSEM project) was being evaluated. By participating, we had the opportunity to understand how real-world evaluation and testing takes place, even in virtual conditions. Anna Bon introduced us and explained that the scope of our research included among others, the design of a responsive and easy-to-use dashboard for the Seed Value Chain. We displayed the three layout models, briefly explaining their intended focus, as Anna translated our explanations into French as an introduction. The people we talked to showed great enthusiasm for the idea and appreciation for our work. It was an orientation meeting, not a detailed evaluation session, and most of the questions were aimed at understanding some minor doubts about the layouts. The suggestions from their part included linguistic correction and use of other terms.

Final version of the visual design Most of the changes in this final version are in visual presentation rather than functionality, and all previous suggestions are incorporated. Based on the first evaluation iteration, a simple login page is designed to have a logical flow of actions that can be performed in the user interface. Since a login feature can be considered complex in the context we are working in, we held several brainstorming sessions and a discussion with other students working on Solid Linked Data research in the ICT4D domain. We wanted to know if they could suggest the use of SOLID for authentication

features. However, at this time and stage of their research, it does not seem to be a good approach, as it might complicate the work further. So we decided to propose a simple form of authentication, which would identify users based on the name of their organization name and a particular username. This could work if a list of approved users with their details is manually added to the database beforehand. However, the authentication function is a challenge in itself, so it will need to be analyzed in more detail later to decide whether it is feasible or not. This will be done in collaboration with the other researchers working on the SEVOSEM project.

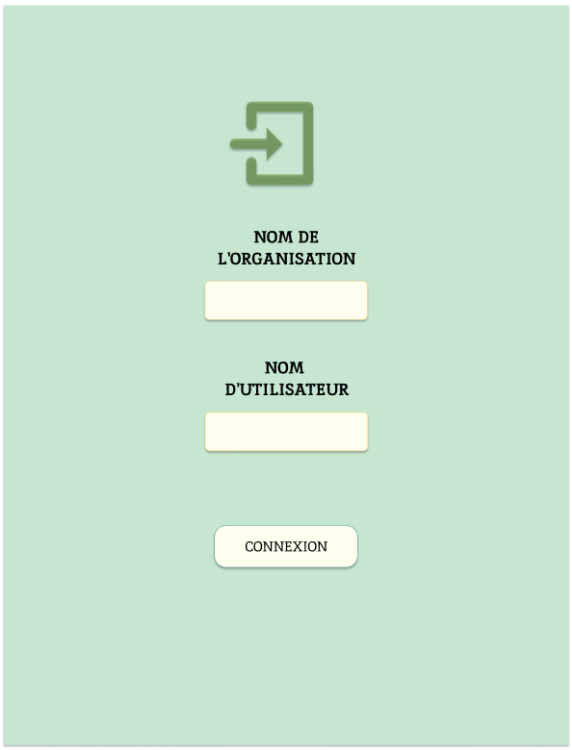


Fig. 8: The basic authentication layout where AOPP users fill in the name of the organization they are part of and their unique username.

After the presumed login, the user is redirected to the details page where the list of added products (seeds) can be found. The layout includes a welcome message for the logged-in user. In addition to the type and variety, there is the total amount of stock of a specific seed and also the amount of certified seed in this stock. This is the new feature that allows following the certification process. The other features remain the same, users can edit or delete a specific line. If another amount of seeds gets certified, the user can edit the existing info easily.

If the user wants to add more information about their current seed, the "new product" button will take them to the data entry form.

Fig. 9: Final version of the details layout, where the user can view what the added products are, and make small adjustments.

In this final version of the data entry layout, another textbox is added where the user can specify how much of the total amount of seeds is a certified amount. In this way, the information is added and visible on the details layout as mentioned previously.

Fig. 10: Final version of the input layout where the user can add their data, and save everything into the database.

The main layout, which serves as a home page where users interested in purchasing seeds can explore availability and locations, is easily accessible without authentication or other requirements. In this final design, we make only minor changes to the layout. For example, if users interested in buying want to know if the seeds are certified or not, a small icon indicating that certification has been performed is inserted next to the available seeds offered by an organization. This feature is presented next to the map so that when clicking on a specific location, such as Kayes, the user can check which organization is offering seeds there, what type of seeds, how much, and whether they are certified.

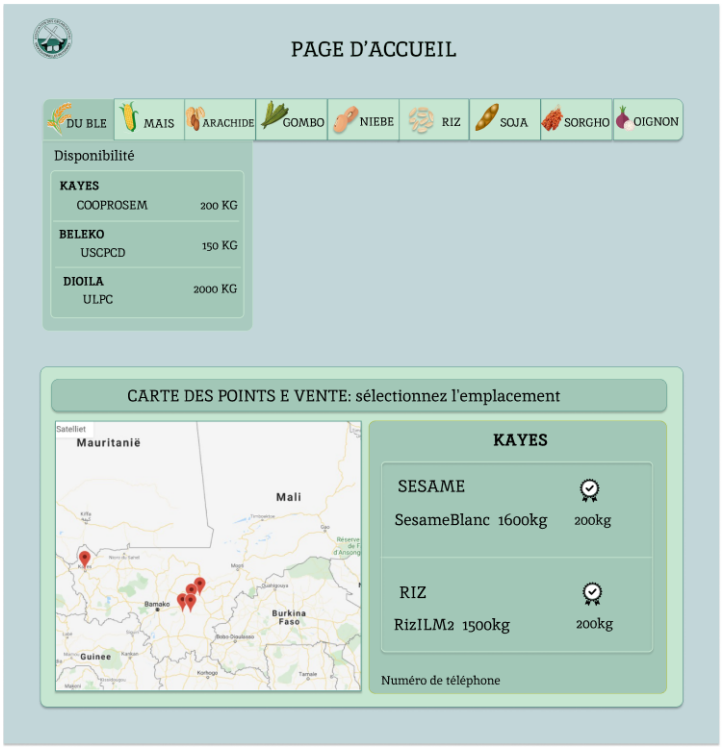


Fig. 11: Final version of the main layout where the user can search according to the type of seed, but also on the basis of preferential locations.

7.4 The user interface prototype

All models designed aim to clearly present the purpose of the dashboard and its simple capabilities, but without a working prototype, this is almost unattainable. To allow the user to grasp the functionality of the system, but also to evaluate it by giving additional suggestions, a prototype is necessary. The idea was to develop the prototype of the user interface based on the Figma final design since it was considered appealing by the AOPP users and received overall positive feedback in one of the preceding sessions. To develop the prototype, we decided to use a framework with basic layouts, and where needed make our personalized adjustments.

On April 7, in a subsequent review session with Anna Bon and André Bart, who are both working on the voice application part of the SEVOSEM project, two main things were discussed and decided upon.

1. The authentication part at this stage of the process is not yet needed. Therefore, the vendor functionalities, which allow products to be inserted and their details to be displayed once logged in, can be addressed later, due to lower priority.

2. The most prominent feature that users should be able to reach at this stage is the home page/dashboard, where the map shows the location of farmers' organizations and their product specifics.
3. The objective of this dashboard is to present adequate and easily accessible information, with two main components where users can find information; the seed grid and the map.
4. The map will show the locations of 3 farmers' organizations considered for this pilot version; ULPC in Dioila, Cooperative Dunkafa de yeregneton in Tissala, and USCPCD in Beleko.
5. By clicking on a specific marker, a modal window will appear with the name of the location and organization. Below this information, the user will have the option to explore the seeds the organization offers, the varieties, and the quantity. Another addition will be the certified stock and the total quantity of stock for a specific variety.

On May 7, during an evaluation session with AOPP, we had the opportunity to show the progress of the prototype and explain the type of data we want to display on the homepage. It was mentioned by some AOPP members that this dashboard can be very useful when considering large buyers and their need to conveniently find available products.

Below is the completed release of the homepage with the two possible navigation functions and the existing data displayed. It includes some additional adjustments and changes to the previously proposed drafts. These changes regarding the seed grid or the modal in the map, are implemented based on their feasibility. In addition, the content is presented in a more clear way in terms of navigation. To test the prototype, we use real data from the three farmers' organizations, which are also used for the prototype of the language application of the SEVOSEM project.

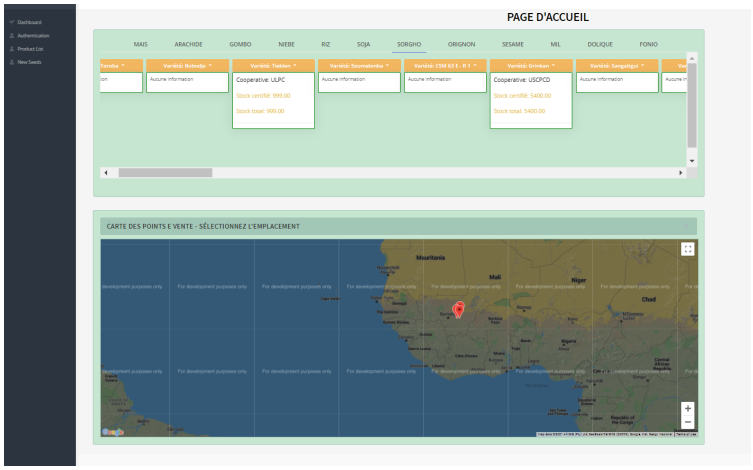


Fig. 12: The grid illustrates all seed types and specifics of any existing seed.

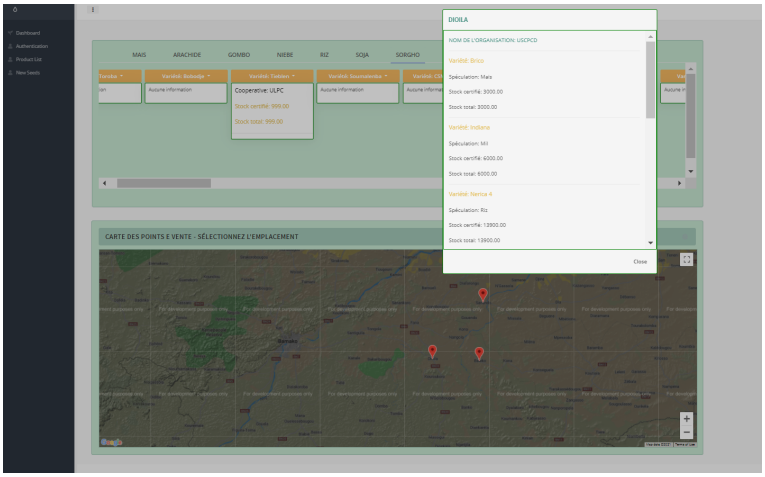


Fig. 13: The map illustrates the three sites being considered for the pilot project. By clicking on the map, information about each location is displayed.

8 A METHOD for designing user interfaces in low-resource countries

In contexts where resources are limited, culture is essential to distinguish the world of the South from that of the North. Particularly in terms of ICT prosperity, culture directly affects users' confidence in computing artifacts. Since

users in developing countries have different views, priorities, and cultural habits, these variables influence the users' perception of the utility of these systems. For a project to be considered successful and sustainable in the long term, it is imperative that users understand how the system works and, more importantly, that they can perceive the usefulness of the artifact. Testing the effectiveness or user-perceived utility of an artifact is closely related to requirement elicitation, not because they are both essential steps in the implementation of ICT4D solutions, but also because some techniques can be used effectively in both of these processes.

Once user needs have been identified and assessed and use cases have been specified, the deployment and evaluation process requires special attention. In the specific case of the Seed Value Chain in Mali, most of the requirements were already documented through the ongoing SEVOSEM project, so the design and implementation of the system began immediately. And while users have been involved throughout the process, it is crucial to evaluate their ability to use the system and their perception of its usefulness.

To this end, I propose a method for conducting the design process of an ICT system that is oriented toward evaluating the effectiveness of the proposed artifact. In terms of the target audience, a small group of users can be selected for this part. The users should have different backgrounds and skills, ranging from those who have some understanding of technical concepts to those who have none.

8.1 Four iterative steps

(i) First, to start with: Simple sketches to capture the scope and functionality of the system. These can be straightforward paper drawings or a variety of different types of diagrams that illustrate what has already been discussed with the users. UML modeling diagrams can be used with personalized adjustments that display activity, use cases, communication and interaction concepts in an easier way. However, structural UML diagrams are not an optimal choice as they are used extensively in documenting the software architecture of software systems, a complex aspect that a simple user may have major difficulties grasping.

(ii) In the second iteration, these sketches will be translated into comics to tell the overarching story, and then storyboards to work on the individual interactions that compose that story. These presentations define how the user will interact with the system. It is crucial to show scenarios or actions that capture specific usage patterns of the system, as the goal is to see if the workflow/stories make sense for what users need in solving their problems. At this point, it is critical that the user understands what is being illustrated. However, if there are uncertainties, there will be further iterations to modify the comics and storyboards. Necessary changes may be images or icons that better show the intention and usefulness of the system.

(iii) Next, online visual design tools should be used to simultaneously create and collaborate on a single document to design the user interface layout. After the final version that is based on the previous contributions, users will have the

opportunity to evaluate the design and give feedback on the actual components. This way, it will be easier to identify what the user does not understand in terms of the selected design elements, and how to use them. For example, if a scroll box is not perceivable by users or does not look appealing to them, it can be replaced with a more simple form. This tests their ability to actually understand segments of a system, such as a user interface.

(iv) In the fourth phase, a prototype should be developed based on the visual designs used during the interface ideation. This initial prototype design will be presented to the users after incorporating all possible suggestions from the previous phases. This is the most crucial part that concludes whether the user has perceived the usefulness of the artifact with the help of the previous phases. In order to fully test the artifact, a sub-stage of this part will consist of a session in which some of the intended users will be asked to perform tasks to determine if they have understood the practical purpose of the artifact. The system must be hosted externally or a way must be found to make it easily accessible to users. The user will have specific tasks that may be: launching/opening the user interface, finding information on the dashboard layout of the interface, creating a new entity, retrieving information, adding additional data, modifying existing data, etc. It is important that at least 80 percent of the actions are completed successfully. In addition to the tasks, there will be some feedback questions regarding the prototype where the users' answers can be within the range of 1-10. The questions can be in terms of readability, whether the to-do list was feasible or if they would like to use the interface again.

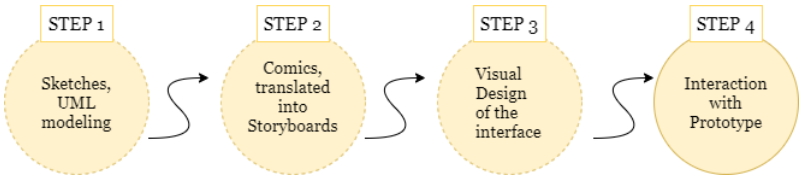


Fig. 14: The method proposed by this research on how to design user interfaces in constrained settings.

8.2 How does this method compare to existing related approaches?

In recent years, there has been a substantial amount of research on how to conduct requirements analysis and interface design for low-resource environments, particularly in the area of Human-Computer Interaction for development.

For instance, the work by Pitula and Radhakrishnan [17] elaborates on how the software design in developing countries requires more than conventional requirement elicitation tools. Thus, the Structured Digital Storytelling (SDS) methodology is proposed to overcome the barriers of language, social class and

literacy to elicit input from end-users from disadvantaged socioeconomic backgrounds. With this method, the users express their needs through storytelling.

Next, Matt Huenerfauth[15] demonstrates a new conceptual interface design approach, the Hypothetical User Design Scenarios (HUDS) that is used from the designers to specify a potential user of the system with a detailed information/application need and a particular set of environmental factors. Additionally, Matt Huenerfauth [15] mentions also the non-experimental approaches that have been used to structure the design tasks such as requirements gathering, conceptual design, functional analysis, prototyping, and implementation in an ordered process. Among these, some examples are: The task analysis approach, the structured design, and the visual and holistic design.

Another research by Kentaro Toyama [26] describes how Indrani Medhi et al pursued the problem of illiteracy in interface use by presenting design alternatives such as the Text-Free UI rather than a standard method of how to get there.

On the other hand, the simplistic method this research proposes, as an original approach, is a new contribution to the existing HCI4D literature that discusses user interface design approaches for the developing world. What primarily differentiates this method from the abovementioned approaches, is that it establishes the roadmap for user interface design after the initial requirements have been assessed. It focuses specifically on including the user from the ideation phase to the end, when a prototype is ready to be tested. Several in-between models are presented to the users and are continuously evaluated, through the first three iterative steps. The final step tests whether the requirements and feedback are incorporated well enough, by observing how the users complete the tasks and interact with the system.

METHOD	DESCRIPTION
Method proposed by this research	Based on 4 steps that involve iterative processes. Uses needs assessment to begin interface ideation. The first two stages include sketches, diagrams, and visual design to capture the scope and functionality of the interface. Feedback sessions are scheduled to make modifications. The final step emphasizes the perceived utility of the users by testing their interaction with a working prototype.
Structured digital storytelling	Uses an electronic tool. Structured dialogue multimedia interface combined with digital storytelling technology. Obtain requirements by analyzing data and identifying problems. Create a step-by-step diagram. Specifically addresses limited literacy.
Hypothetical User Design Scenarios	Based on an iterative scriptwriting process. Simulates situations with all factors and constructs a script for the interaction. Analyzes the issues that arise from the script and addresses them by making changes to the script for a clearer version of the interface.
Task analysis	Based on tasks. The designer identifies and maps the tasks and subtasks that the user must perform in order to interact with the interface. Individual domain "objects" and "procedures" that the user will need to interact with conceptually, are listed.
Structured design	The designer composes grammar for the interaction between the user and interface. Involves finer levels of detail: the task itself, the semantics of the interaction parts, the syntax of those interaction steps, and the exact interaction steps performed.
Visual or holistic design	Visual sketches and brainstorming are used to present a model, image, or initial idea of what the system should look like. Several alternative designs are constructed and compared, and the designs are made available to others for review. The creative process and critique cycles result in the final design.

Fig. 15: A comparison of the method proposed by this research with existing related efforts in designing ICT systems for the developing world.

Most importantly, it doesn't only address the elicitation of needs or illiteracy of the intended users, but takes into account other limitations such as semi-literacy, non-traditional computing environments, and a diverse or inexperienced audience. It is obvious that most of the current techniques focus on a few aspects, specific phases of the overall design process or on applicable components to be used in the design of an interface. On the contrary, this approach is more high-

level and extensive, so it employs all the "procedures" that aim at ensuring a successful final artifact and eventually wide adoption.

8.3 Evaluation : Testing the effectiveness of the prototype with the AOPP members

In the specific case of the Seed Value Chain in Mali, users were involved in the design process from the beginning and the first three steps are already integrated. In addition to designing the necessary models, the objective was to test the perceived usefulness of specific artifacts in each iteration. Users were presented with storyboards, informal models, and a visual design of the interface. All feedback, evaluation, and degree of comprehension are described in Chapter 6. For the last and most crucial step, the prototype must be fully tested. Because of the current situation, a virtual session will be organized. To demo the website without deployment, Ngrok is used to expose the web server by setting the URL to public. The idea is to provide a link to the users so they can access the interface. Users are then assigned certain tasks related to finding information in the dashboard, including the following:

1.How many different Fonio varieties are listed on the website?
2.How many varieties of corn does "cooperative: ULPC" have in stock?
3.How many KGs of corn in the Brico variety is available?
4.How many locations are available on the map?

For a complete overview of the demo tasks and questions, see Figure 15.

This last session was organized at 08/07/2021, lasted almost two full hours with an attendance of eight AOPP members and farmers. This meeting has clearly shown that cultural awareness is very important to ensure effective and meaningful interaction with members of another cultural group. The participants consider it very valuable to build and maintain relationships and make sure to show their appreciation for each of the involved members. During the first part of the meeting, André Bart made a presentation on the SEVOSEM project and the voice application that has been implemented. There was a lot of discussion and remarks from some members who were also attending these sessions for the very first time.

During the second part of the session, we wanted to test the effectiveness of the interface by inviting the users to interact with it. However, this was not possible for many reasons. First, and most significantly, it should be noted that the envisaged users are not only participants in a research or study, but real people with their own concerns, priorities and limitations. The participating members had problems with their Internet connection, some could not navigate as well on the zoom, didn't have enough time to answer all our questions or really focus and complete the required tasks.

Therefore, the best approach at this stage was to present the final version of the prototype with the available data and demonstrate how to find all the Seed Value Chain information according to the pilot locations and the type of seed. At the same time, we sent them the link so they could try the website for themselves. Overall, the feedback was very positive and participants expressed a

strong interest in an interface with this type of visible information. It was clear to them that this approach was an improvement over the current system design.

Other comments concerned the content of the interface, missing speculations, or inconsistent amounts. We tried to explain that all information was extracted from data that members had added themselves using the voice application and that it depended on how often they used the system.

Finally, it was mentioned the content of the interface is tailored specifically to the needs of the intended users, but the way of accessing this type of interface is something they would prefer differently. Instead of an easily accessible web-based interface, some members mentioned that having this data and information on a mobile app would be the most expedient approach. This is because most of them only use cell phones that have two or three apps installed on them usually from the beginning when they purchase their basic smartphones from the vendor.

Organizing the session as we expected, in order to test the last phase with the AOPP participants, turned out to be quite unmanageable and did not allow us to get accurate answers to our questions. The main, but not only problem in this scenario is the online approach, which unfortunately affected the whole evaluation and assessment process. However, in terms of functionality, users did not question any aspect and did not feel disoriented by the system, which is a solid indicator of its perceived usefulness.

Our efforts to translate their needs and concerns into action, by providing an appropriate way to visualize relevant information on an easy-to-use system, were greatly appreciated.

9 Discussion

The design of ICT systems in complex environments has always been a challenge, and much research and work is being done to facilitate this process. There are several aspects that can be addressed and improved when deciding to implement a service, system or user interface in low-resource countries. An essential part to consider is setting an appropriate communication mode to identify and obtain the needs of the target users, who come from a diverse area of the world. It is not only a matter of a distinct geographical region, but also of cultural backgrounds, socio-economic development and, most certainly, technological maturity.

Requirements elicitation can involve a variety of tools and methods, especially when dealing with intended user groups that are digitally aware, but on the other hand, when dealing with users who have a disadvantaged background, there is a great need to filter between these tools. Thus, as a starting point, this research selects some relevant key needs elicitation tools that can be used when launching ICT for development projects in limited contexts. In these contexts, which are characterized by several previously identified barriers and constraints, there are six needs elicitation tools that are recommended and well suited. Storyboarding, Contextualization of Demonstrations, Rapid Prototyping, Conceptual Modeling, Structured Digital Storytelling, and finally, Structured Narrative Method, all focus on the difficulty for an intended user to express what they truly need and

expect from a system, and aim to make this process as simple as possible. These tools or methods use a visual representation of the service that is going to be implemented in several ways, but all of them aim at extracting the information easily, without any specific language being necessary.

On the other hand, some of these requirements elicitation tools can play a crucial role in another process of presenting a new service to the user, that of effectiveness testing. Storyboards, informal diagrams as part of conceptual modeling, and visual designs of the desired interface not only serve to elicit users' requirements or suggestions, but also to assess whether they understand the functionalities presented with these intermediate artifacts.

Testing the effectiveness of the artifact is a very important but at the same time a difficult step, as it shows the likelihood that it will be widely adopted by the intended users after its implementation. If the user perceives the usefulness of the artifact, then the entire work can be considered an accomplishment. In order to test the perceived usefulness in a way that is feasible and relevant for this type of context, this research proposes a method that involves the user from the beginning and takes into account the user's input and reaction to the system.

The final stage of the method is a key indicator of the user's perceived usefulness of the interface, because with a prototype implemented, the user's ability to interact with the interface can be properly tested.

The complexity of assessing accurately the users' ability to understand the system can be impacted by many factors that arise from cultural diversities, so it is also important to embrace cultural awareness and not be hindered by barriers.

Although this step can be challenging, it is possible and preferable to set up field workshops where these activities can take place. Users can participate and try to use the artifact, exploring and interacting with it. The most essential point is to make sure that they provide their input, even if it is not what is expected or if it comes at the issue differently.

In such demanding contexts, this is quite common and may give the impression that the objective has not been achieved. However, what really showcases the success is ensuring that what has already been done can be perceived and managed by the users. Limitations will most likely be present, but as long as the methods and ways of working continually facilitate the various aspects of this process, it means that change and improvements are taking place.

In the end, the envisaged users can easily grasp more and more technological concepts.

9.1 Conclusion

This research presents a user-centered design method for complex contexts that answers the main research question: "How can we compose an inclusive method for user interface design of ICT systems that aim to serve the goals of people in a low-resource environment ?"

This research describes the process of a user interface design that has been implemented to serve the user's needs of the Seed Value Chain in Mali as the selected case study. In order to fully address the question, the research project

explores two aspects: (i)The most appropriate tools or techniques to elicit user-centered requirements for user interface design given the cultural distance between developers and intended users. (ii) User-centered assessment of the perceived utility of the proposed artifact. The most appropriate requirements elicitation tools are identified based on existing literature and then used during the design process. The design process also serves as a basis for obtaining knowledge about how to evaluate the users' perceived utility of the proposed interface.

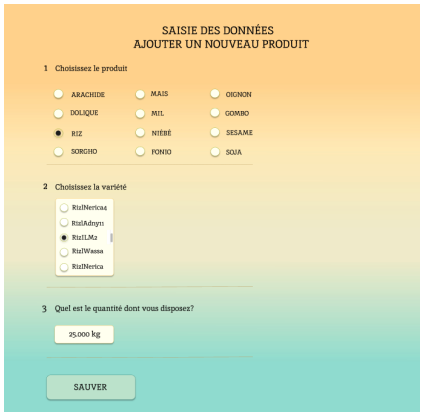
Finally, all these findings and the in-depth knowledge derived from the validation through the selected case study are used to propose a standard four-step method for designing user interfaces in these challenging settings. Limitations are encountered in applying the last step of the method, which focuses on testing the effectiveness or perceived usefulness of the artifact with the user, mainly due to the online environment. Minor limitations include also the difficulty (lack of contact) in receiving continuous input from the user during each step. Therefore, as mentioned above briefly, future research can be conducted in local workshops by aligning more closely the user interface design method with the users. In addition, future work can focus more on exploring possible approaches to evaluate the users' perceived usefulness of a proposed artifact that can be similar but more extensive than the last step of the method proposed in this research.

10 Acknowledgments

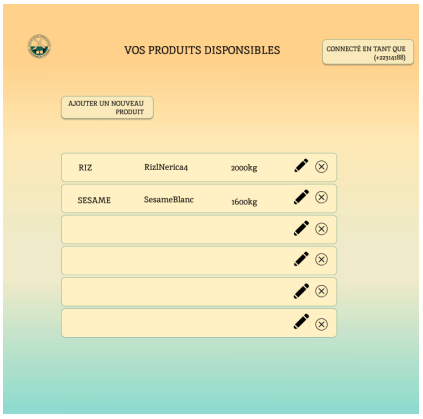
The completion of this thesis was a unique learning experience that became reality with the kind support of many individuals. I would like to express my special gratitude and thanks to my supervisor, Anna Bon for imparting her knowledge and expertise in this study. Many thanks to my second assessor, Hans Akkerman for the valuable suggestions during my thesis presentation. Last but not least, I would like to thank my family for being a financial and emotional support during this challenging academic year.

11 APPENDIX

11.1 A EXTRA FIGURES



(a) The first layout where the user can add their data and save everything into the database.



(b) The second layout where the user can view what the added products are and make small adjustments.

(c) The main layout of the dashboard, where the user can search according to the type of seed but also on the basis of preferential locations.

Fig. 16: Initial designs of the user interface.

Demo seed website (EN)

Introduction

This demonstration is aimed to investigate the usability of the designed platform. With the help of this demo, we will be able to understand the usability of the website and can alter certain elements when it's unclear to the users. The success rate of this demonstration will be measured as follows: the participants will be handed a to-do list of actions to perform on the website. If 80% of the actions have been fulfilled successfully, the usability test will receive a high score. However, if the participants are not able to get a score above 80%, a part of the website will be redesigned.

Please answer the following question:

1. How many different Fonio varieties are listed on the website?
2. How many varieties of corn does “cooperative: ULPC” have in stock?
3. How many KGs of the Brico variety of corn are available?
4. How many locations are available on the map?
5. Add 1000 kg of corn in the Sotubaka G4 variety in the website (all certified)

Feedback questions:

1. Was the site readable? (give a grade between 1 - 10)
2. How easy was the to-do list? (give a grade between 1 - 10)
3. How would you rate the website? (give a grade between 1 - 10)
4. Would you recommend this website to a friend? Yes / No
5. Do you have any improvement suggestions?

Site de démonstration de semences (FR)

Introduction

Cette démonstration vise à étudier la facilité d'utilisation de la plate-forme conçue. À l'aide de cette démo, nous pourrons comprendre la convivialité du site Web et pourrons modifier certains éléments lorsque cela n'est pas clair pour les utilisateurs. Le taux de réussite de cette démonstration sera mesuré comme suit: les participants se verront remettre une liste d'actions à effectuer sur le site. Si 80% des actions ont été réalisées avec succès, le test d'utilisabilité recevra un score élevé. Cependant, si les participants ne parviennent pas à obtenir un score supérieur à 80%, une partie du site sera repensée.

Merci de répondre aux questions suivantes:

1. Combien de variétés différentes de Fonio sont répertoriées sur le site Web ?
2. Combien de variétés de maïs la coopérative ULPC a-t-elle en stock ?
3. Combien de KG de maïs de la variété Brico sont disponibles ?
4. Combien d'emplacements sont disponibles sur la carte ?
5. Ajouter 1000 kg de maïs de la variété Sotubaka G4 sur le site (tous certifiés)

Questions de rétroaction

1. Le site était-il lisible ? (donner une note entre 1 et 10)
2. La liste des choses à faire était-elle facile ? (donner une note entre 1 et 10)
3. Comment évalueriez-vous le site Web ? (donner une note entre 1 et 10)
4. Recommanderiez-vous ce site à un ami ? Oui / Non
5. Avez-vous des suggestions d'amélioration?

Fig. 17: English and French version of the DEMO.

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