

Interaction Models for Digital Inclusion of Low-literacy, Aged and Impaired Users in Brazil

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Abstract. Despite the high prevalence of low-literacy in Brazil, the efforts to promote digital inclusion of semi-literate adults are scarcer than, for example, those directed to persons with disabilities. The purpose of this study is to find innovative interfaces and interaction models that make e-gov applications and services cognitively accessible to low-literacy users. This should consider the central concepts of ICT-mediated communication and combine state-of-the-art UI solutions for overcoming the psychological and cognitive barriers faced by such users and bridge their way to the information society.

Keywords: Accessibility, Cognition, Illiterate Users, Novel User Interfaces

1 Introduction

According to the National Functional Literacy Indicator – NFLI [1], in 2005 nearly three in four Brazilians had low to medium literacy skills. Comparatively, sensory, motor or physical disabilities afflicted 14.5% of the Brazilian population in 2000 [2].

Despite the higher prevalence of illiteracy among the population, initiatives aimed at the digital inclusion of low-literacy adults are clearly scarcer than those directed to people with disabilities, maybe reflecting their respective importance in the developed world¹.

Such disproportion between the magnitude of the problem of low literacy in Brazil and the efforts to remedy its effects on digital inclusion programs is the rationale of this work. After all, limitations resulting from insufficient literacy skills, which affect, in varied degrees, 74% of the population, are also a kind of disability that has effects in daily life. And judging by the present situation of public education and the meager results of the adult literacy programs undertaken in the last five decades in Brazil, the problem of adult illiteracy is a legacy that will endure in the foreseeable future.

Rather than proposing solutions for the social causes of adult illiteracy, the purpose of this study is to induce innovative interface design and interaction models, so that

¹ In the United States, for instance, low-literacy adults are estimated at 14% of the population [3], while 20% have some impairment [4].

they become guidelines for the conception of new applications and services that are cognitively accessible to a low-literacy public, as discussed in [5].

This study will then address central concepts of human communication mediated by ICTs, and investigate the user interface solutions proposed in the literature, so as to evaluate their usability, psychological and cognitive implications for our target-users, and define interface design guidelines based on these and other relevant aspects.

2 Social Aspects of Content Intelligibility

The description of the alternative interaction models supposes a previous discussion on the very essence of human communication and its new dimension, mediated by ICTs. Even though a computer or ATM user may seem to dialog with machines, the communication that underlies these interactions occurs between the user and other human beings, conversational partners in synchronous or asynchronous dialogs, or, in a broader sense, the authors of the accessed contents, and the interface designers.

In 2005, the surveys on functional literacy in Brazil found that 7% of the Brazilians were totally illiterate, 30% had very poor literacy abilities, and 38% were on an intermediate literacy level. Since the usual paradigm for interfaces is heavily based on textual information, this creates barriers in the access of low-literacy users to Web-based services and e-gov, showing the importance of new approaches in interface communication. In the next section the Brazilian illiteracy scenario will be contrasted with India's case, because India is also a developing country and has been extensively cited in the literature on digital inclusion of low-literacy users.

2.1 The particularities of the illiteracy problem in Brazil

In the technical literature on digital inclusion of illiterate persons, the case studies in India are the most varied and frequent. They have been used as an initial reference in our research, but it is crucial to pay attention to what distinguishes Brazil from India.

Similarly to India, Brazil is a vast country with huge social inequalities and whose population still faces the problem of adult illiteracy. But, in spite of these similarities, it is important to understand the differences between both countries so as to appraise the ICT-use solutions proposed in the literature. Whereas in the Indian scenario totally illiterate individuals were about 40% of the population in 2001 [6], in Brazil they totaled less than 10% in that year, indicating a preponderance of functional illiteracy, which opens some possibilities for text-based interactions.

Also in sharp contrast with India, an aspect that could facilitate the digital inclusion of the low-literacy public in Brazil is the country's relative linguistic unity: Portuguese, the official language, is spoken natively by 99%² of the population and is mandatory in the country's educational system. Despite some regional variations, a subset of the current Portuguese vocabulary is valid all over the country, for almost the entire population, what offers a linguistic common ground that allows an ICT's text-based interface solution to be widely applicable. In India, this is not the case,

² Yet, more than 200 minority languages are still in use.

since from nearly 800 languages still in use, most of which locally, two dozens of larger languages have regional influence and official status is the educational system. Distinct scripts and different writing directions hamper the creation of desktop text-based e-gov services and applications to be used by all Indians.

Thus, the multitude of official languages and scripts and the high number of totally illiterate individuals were, along with the lack of infrastructures in small villages, the likely reasons for the option, in some Indian digital inclusion initiatives, for solutions based on simulators: small portable devices with extremely simplified (touch-screen) interfaces, capable of handling distinct virtual keyboards, for different scripts [7]. The linguistic scenario in Brazil, with common language/script and prevailing functional illiteracy, allows for specific solutions that do not necessarily preclude the use of written language or desktop computers, but this use should be mindful of low-literacy.

Since low-literacy is often a cause and a consequence of another social inequity, the income disparity, the study focuses on telecenters, public centers that offer desktop computers with free internet access. Telecenters are already fairly popular among young users in poor communities. However, illiterate and aged persons remain in a disadvantageous position and may face cognitive, psychological and social barriers in their first attempts to use a computer. Cognitive barriers may result from content complexity and sub-optimal interface organization of many of the usual applications, and this also applies to e-gov sites, which commonly employ a formal government parlance and tend to mix heterogeneous information, from daily news to audit results, in an attempt to be comprehensive and cover every aspect of a given government area. For a newbie, this information overload is detrimental and tends to be discouraging. So we believe that innovative interfaces and interaction models should encompass a linguistic adaptation and a content simplification so as to bridge the way for low-literacy non-users to gradually access the informational society by using pertinent and coherent citizen services.

The study aims at evaluating what communication artifacts, such as biometric and speech technologies within new multimodal Web standards, along with assistive tools and iconic/filmic contents, could facilitate the use of the computer by the target-users, while meeting usability and accessibility norms and pursuing a universal design.

3 Research outline and questions to be addressed

Some research lines have been identified in the quest for interfaces and interaction models that minimize digital exclusion by reducing the literacy and usability barriers in ICT-based services. The questions to be answered and the steps taken to address them are listed below:

1. Which language standard is suited, efficient and friendly for the target-users (low-literacy users with little or no technological expertise)? Linguistic tests with groups of representative target-users will be undertaken in different Brazilian localities in order to identify the lexicon (corpus) and syntax guidelines that maximize the understandability of service contents. Test results will be enriched by interviews with officers who often assist the target-users in the conventional access to citizen services. Some key e-gov sites are also being assessed so as to

identify the relevant contents, the used vocabulary, and the adaptations required to adapt them to the linguistic abilities the target-users actually have. Special attention is being paid to the possible use of iconic and filmic modalities of communication in increasing the intelligibility of the services;

2. Which of the mental models the users already have (for other devices such as TV, ATM and fixed or mobile phone) can be capitalized on to facilitate the use of new ICTs (computers) and which ones are reusable in ICT-mediated services, including to facilitate the digital convergence (accessing the same service through any devices or different services through the same device)? Interdisciplinary field surveys will be conducted by distinct research groups, aiming to correlate the use of other ICTs with supposed user's abilities in dealing with computer UI artifacts, in a user-centered design strategy [8]. If a mental model is shared by all target-users, the proposed interface and interaction model will then take advantage of it. The users' psychological biases towards telecenters will also be explored;
3. Which mechanisms for implicit and seamless identification of the user's context and needs can be used to adjust the interface according to the user profile? To address this issue, our envisaged solution will employ a face recognition tool that biometrically identifies the user. This is meant to allow tailoring the interface to the user's (previously identified) specific needs, and thus meet his/her cognitive or assistive needs, adding flexibility to the overall interaction solution. But such approach also opens some promising research avenues in terms of affective/ cognitive mental state estimation (such as discussed in [11], [12] and [13]), what could allow a close and dynamic adjust of the interface, of the interaction and of the content presentation in response to the user's detected reactions;
4. How to captivate the user's attention and focus it on the main objective, besides offering cognitive tracking resources to help in the user's orientation? An evaluation of the current e-gov sites shows that most of the content is irrelevant to our target-users, and then should be avoided in order not to hinder the access to the really pertinent information. This shows the importance of one of our ongoing efforts: a redesign of the service structure so that all the information can be reached as intuitively as possible, within a number of menu options and levels that proves to be optimal for the target-users (see question 5);
5. How many menu options and levels are acceptable in voice-based interactions in order not to overload the short-term memory of semi-literate aged users, usually unable to memorize lengthy instructions [10]? A usability lab was designed and is now being equipped with some state-of-the art assistive and biometric tools, so that subjects representative of the target-users can undergo a comprehensive set of intelligibility, accessibility and usability tests. This will allow us to prototype and evaluate many possible UI solutions, prior to proceeding with the field tests, which will latter occur in specially-built telecenters, conceived for and located in digitally excluded communities;
6. How useful and effective are virtual characters in supporting user interactions and what are the best suited virtual characters in order to maximize content intelligibility and user empathy: real actors or animated characters? To correctly answer this question, we are developing a field test protocol, within a semiotic and anthropological framework, to evaluate what modality of image (graphic/ photographic) is more intelligible to the target-users and which characters (in

terms of age, gender, ethnicity) create more user empathy. Once gathered, the survey results will be further validated during the UI laboratory and field tests;

7. How similar efforts in other countries can be adapted to Brazil? To address this question, an analysis of the existing digital inclusion initiatives in Brazil and abroad has been accomplished [9], with *in-situ* evaluation of the most promising ones. An in-depth study of the pertinent literature is being carried out, and a discussion of the resulting ideas is now being pursued by means of the attendance in the main international HCI conferences.

We hope that the results of all these investigations will underpin the creation of innovative interface solutions and interaction models that effectively bring the low-literacy non-users to participate in the information era.

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