Evaluation Framework towards All Inclusive Mainstream ICT

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Abstract. The current paper presents the evaluation framework and plans developed for the evaluation of the applications to be developed in the context of the ÆGIS Integrating Project (Grant Agreement: 224348) of the 7th Framework Programme, which aims to embed support for accessibility through the development of an Open Accessibility Framework, upon which open source accessibility interfaces and applications for the users as well as accessibility toolkits for the developers will be built. Within ÆGIS, three mainstream markets are targeted, namely the desktop, rich Internet applications and mobile devices/applications market segments. Upon the basis of an overall user-centred approach, the developed evaluation framework will involve all types of targeted end-users, namely persons with disabilities as well as experts in Assistive Technology, trainers/tutors and developers as well as a series of other related stakeholders. Evaluation will be held in three iterative phases and across 4 Pilot sites (Belgium, Spain, Sweden and in the UK), providing in-between each phase, feedback to the development teams for debugging and optimization.

Keywords: Evaluation, accessibility, iterative testing, user-centred approach, mainstream ICT, Open Accessibility Framework.

1 Introduction

The ÆGIS project (Open Accessibility Everywhere: Groundwork, Infrastructure, Standards; http://www.aegis-project.eu) of the 7th European Framework Programme seeks to determine whether 3rd generation access techniques will provide a more accessible, more exploitable and deeply embeddable approach in mainstream Information and Communication Technologies (ICT). This approach is developed and explored with the Open Accessibility Framework (OAF) through which aspects of the design, development and deployment of accessible mainstream ICT are addressed. The OAF provides embedded and built-in accessibility solutions, as well as toolkits for developers, for "engraving" accessibility in existing and emerging mass-market ICT-based products, thus making accessibility open, plug & play, personalised & configurable, realistic & applicable in various contexts; ÆGIS is placing users and their needs at the centre of all ICT developments. Based on a holistic User Centred Approach (UCD), ÆGIS identifies user needs and interaction models for several user groups (users with visual, hearing, motion, speech and cognitive impairments as well

C. Stephanidis (Ed.): Universal Access in HCI, Part I, HCII 2009, LNCS 5614, pp. 480–488, 2009.
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as application developers) and develops open source based generalised accessibility support into mainstream ICT devices/applications:

- desktop,
- rich web applications, and,
- Java-based mobile devices.

All developments will be iteratively tested with a significant number of end users, developers and experts in 3 phases and 4 Pilot sites Europe wide (in Belgium, Spain, Sweden and the UK).

The project includes strong industrial and end user participation (the participating industries are among the market leaders in the corresponding mainstream ICT markets). The project results' uptake is promoted by strong standardisation activities, as well as the fact that much of the technology results will be either new open source applications or will be built into existing and already widely adopted open source ICT.

2 Overall Approach

The whole ÆGIS project is driven by a User Centred Design approach, and the extraction, based on it, of representative Use Cases. According to ISO 9241-11, User Centred Design stands for "*The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use*", where (1) effectiveness is the accuracy and completeness with which users can achieve their goals; (2) efficiency of an application stands for the resources expended in relation to the accuracy and completeness of goals achieved and (3) concept satisfaction stands for the comfort and acceptability of the work system to its users and other people affected by its use [10, 11].

When using the user centred design approach we start from the users, determine their present needs and expectations and convert them into an appropriate user interface design [6] (see the following figure). The interface of an application will offer different levels of access (e.g. simple and expert search) always trying to morph into a self explanatory interface characterized by minimal usage of technical language.

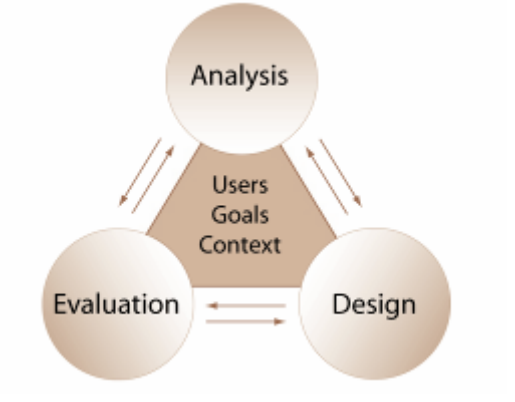

Fig. 1. The user centred design approach

One of the key challenges addressed by ÆGIS is to provide appropriate design solutions that will contribute to reducing the 30% of the European population currently not using ICT. In order to address this issue effectively, ÆGIS is committed to develop solutions that will receive wide acceptance from intended users. For this purpose, the project will define and follow an appropriate user-centered development process, in which needs, wants, and limitations of the end user are given extensive attention at each stage of the development process. The ÆGIS approach requires designers to analyse and foresee how users are likely to use a design solution, as well as to test the validity of their assumptions with regards to user behaviour in real world tests with actual users.

A number of models of a user-centered design process have been made available to allow user requirements to be considered right from the beginning and included into the whole product cycle. For defining the ÆGIS integrated approach, various relevant models will be taken into account, including, but not limited to, Cooperative design [5], Participatory design, Contextual design [2], INCLUDE, Universal Design [4], COST219 [3], and other ISO (see footnote[1]) compliant approaches. Finally, additional user-oriented issues shall be explored as research suggests that, for instance, different forms of behaviour and pleasure should be included in a user-centered approach in addition to traditional definitions of usability and accessibility (e.g., see Emotional Design [12], User-orientation framework [9]).

Experience has demonstrated the important role that distributed project settings play in Participatory Design. This is particularly true of many of the applications proposed in relation both to selecting relevant users for the design process, and where distributed groups of developers and users are engaged in a design process. The problems of geographical distribution will be explored though the development of best practice in relation to Distributed Participatory Design. This is likely to include the proposal of a number of approaches to bridge geographic division, including: use of groupware; technical or personal media to gather feedback; surveys to involve unknown users; video-based interaction analysis; e-prototypes or electronic paper prototypes to get feedback from distant users; and combining distributed and non-distributed phases.

Based on the ÆGIS user centered approach, a conduct of interviews, focused questionnaires and observations made in the user's context of use will follow. It is important to take under consideration that the social behaviour of a user group is different in situations where the key end user is alone. The prime focus of the User workshops and field studies will be on collaborative activities, user to user communication and situations where multiple users share some resources (e.g. shared computer in a lab, communication devices). Such activities are typical in situations like schools, nursing homes-houses, day centres and during communication with care-givers. The workshops will consist of meetings with user groups, seminars and focus groups. Both national and a pan-European workshop are planned.

The data collected from field studies and workshops will also be used for the assessment of the User Centered Approach, as well as for the modeling of the user needs. For each user segment identified,a procedure for assigning a user to a particular segment will be created. User needs will be categorized by user segments (based on the kind of impairment). The user needs will be summarized according to [6]:

[1] http://www.usabilitynet.org/tools/r_international.htm#9241x (ISO 9221-11).

- What the user is trying to achieve and how?
- How users are influenced by their context of use, their previous knowledge and experience?
- What the users appreciate most when using ICT (e.g. speed, accuracy, error recovery, fun)?

Usability goals and objectives will be defined, in order to be able to assess the success of the Open Accessibility Framework (OAF) during testing.

The Open Accessibility Framework is a comprehensive, holistic approach to programmatic support for assistive technologies. This is in stark contrast to the 2nd generation approach to accessibility via assistive technologies on the proprietary Windows platform. Building on the pioneering 3rd generation of the state of the art Open Desktop in UNIX and GNU/Linux systems, the Open Accessibility Framework extends the concepts of programmatic accessibility in two directions: "upstream" into the developer tools for creating accessible applications, and "downstream" into further use and deployment – into Internet technologies and mobile devices.

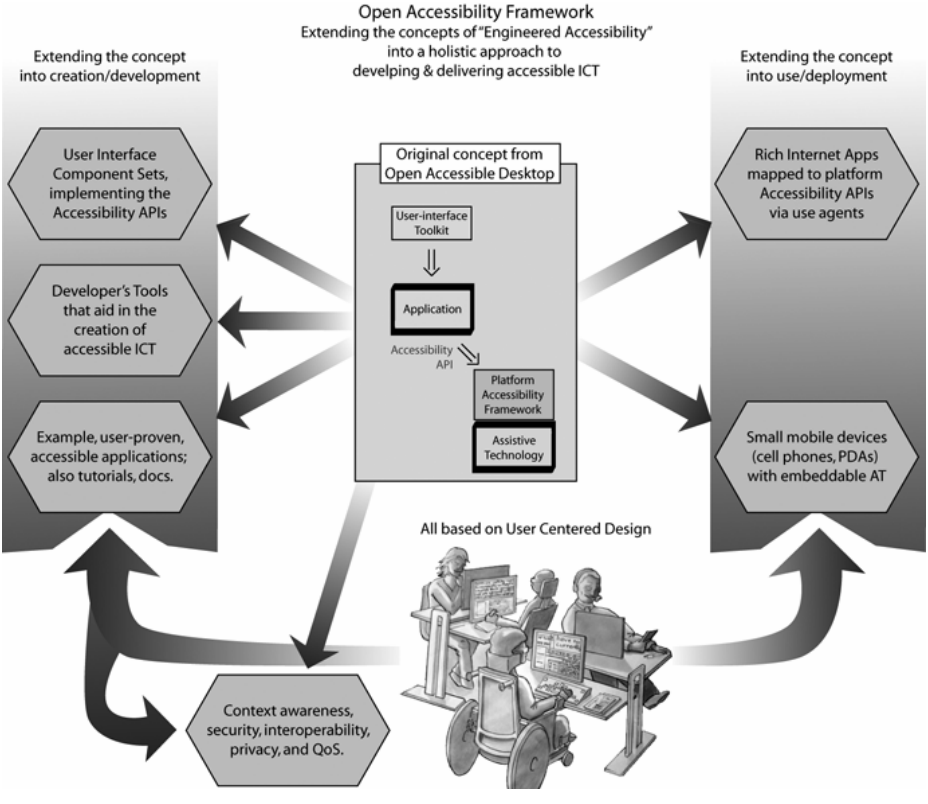

Fig. 2. Open Accessibility Framework of ÆGIS: Extending the concepts of "Engineered Accessibility" into a holistic approach to developing & delivering accessible ICT

All developments of the project, namely the Open Accessibility Framework as well as the research prototypes of all application areas domains will be finally evaluated, across three phases. More specifically, ÆGIS is committed to build evaluation with sample users and user-based validation into all stages of the development lifecycle, from the very first prototypes till the pre-release stage. It should be noted that evaluation in ÆGIS focuses on both user- and expert-based evaluation, including also technical validation of the prototypes and the Open Accessibility Framework.

Regarding evaluation, ÆGIS will review traditional evaluation approaches, methods and tools and develop improved means for assessing the prototypes and applications in question, including a generic framework for the evaluation of inclusive ICT-based solutions. Evaluation criteria will include, but not be limited to: the quality of the user experience of the ÆGIS applications under validation, the desirability and utility of the project results.

Clearly this approach will provide valuable feedback to various design and development teams of the project; nonetheless, the experience to be gained by a number of spread evaluation groups will be consolidated and documented appropriately in order to serve as reliable, yet raw, input to standards and exploitation plans.

In summary, ÆGIS has developed a horizontal evaluation plan, involving several sequential evaluations that shall involve both experts and users, as appropriate, at various stages of the development lifecycle of all the proposed prototypes and applications. As implied by its name, sequential evaluations involve a series of evaluation techniques that run in sequence (see following figure), such as cognitive walkthrough [14], heuristic evaluation [11], formative and summative evaluation [13].

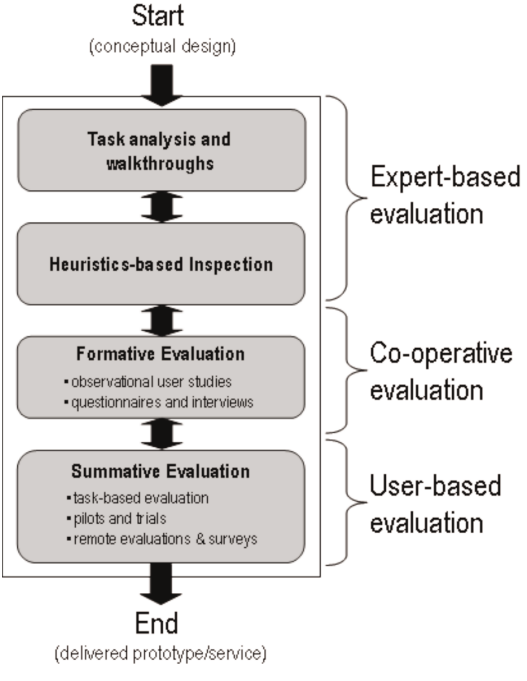

Fig. 3. Example of sequential evaluation to be followed within ÆGIS

The plan will be realised from several independent and multidisciplinary evaluation specialists at various partner sites, and monitored centrally in order to minimise contingencies. An example of the sequential evaluation to be followed within ÆGIS is reflected in the following figure.

3 Evaluation in ÆGIS

Four distinct pilots are planned in Belgium, Spain, Sweden, and the UK within the project. As described in the previous chapter, the User Centred Design model adopted will have three distinct evaluation iterations following the initial defining of essential functionality:

- Initial concept testing (using simulation and storyboarding) with end users and other related stakeholders.
- Creating some tentative content & user interfaces for initial baseline testing.
- Full testing and trialling of the demonstrators and applications by end users and experts.

Each pilot will undertake evaluation across the aforementioned 3 phases and aims to involve people with vision, mobility, cognitive, hearing and speaking impairments. Experts, tutors and developers will also be involved. All feedback received from each of the 3 evaluation phases will be brought back into the development process that will take place in the project period following the respective evaluation phase.

The first phase will focus on Wizard of Oz trials and trials with mock-ups. The Swedish Pilot site will involve the following users:

- 10 persons with cognitive impairments
- 10 persons with motor impairments
- 10 persons with speech impairments
- 5 experts
- 5 tutors

The Pilot site in the UK will involve the following users:

- 10 blind/low vision users
- 10 with motor impairments
- 10 with speech impairments
- 5 experts
- 5 tutors

The Pilot site in Belgium will involve the following users:

- 10 blind/low vision users
- 10 with motor impairments
- 10 with cognitive impairments
- 10 with hearing impairments
- 10 with speech impairments

- 5 experts
- 5 tutors

The Spanish Pilot site will involve the following users:

- 10 blind/low vision users
- 10 with motor impairments
- 10 with cognitive impairments
- 10 with hearing impairments
- 10 with speech impairments
- 5 experts
- 5 tutors

The second phase of the evaluation will focus on the assessment of the early prototypes produced until then. The same numbers and types of users will be engaged in each case with the addition of 5 developers in each Pilot site. The third phase, which constitutes the evaluation of the final prototypes will engage 5 more experts and tutors in each case in comparison to the 2nd phase.

A series of novel tools and methods will be developed, not excluding traditional methods like log files, questionnaires, event diaries, etc., to ensure the recording of the measurements, objective (users' performance) and subjective (usability and user acceptance aspects), collected during each evaluation phase and during the evaluation of any type of application (mobile, desktop, rich Internet).

4 User Selection, Involvement and Recruitment in ÆGIS

ÆGIS efforts occur in the following important domains:

- Desktop and mobile user agents and web browsers
- "Web 2.0" applications - rich Internet applications built with technologies like AJAX, DHTML, JavaScript, and JavaFX
- Mobile applications and devices (e.g. smart phones, PDAs, etc.)
- Developer's tools
- Document authoring applications
- Communications products

In this context, ÆGIS addresses 2 main categories of end users:

- Developers of ICT infrastructure, applications and services –referred to hereinafter as "developers"
- People with disabilities –referred to hereinafter as "end users"– who experience one or more of the following mild to severe impairments:
    - Blind and low-vision users
    - Motor impairment users
    - Cognitive impairment users
    - Hearing impairment users
    - Speech impairment users

It is worth noting that the target end user groups include also the elderly, given that the vast majority of elderly people experiences one or more of the above impairments.

Individual end users (people with disabilities) as well as various other stakeholders such as accessibility assessors and developers, service providers, and where applicable relevant accessibility units within public bodies, will actively participate in the project's User Centered Approach and iterative evaluations and will be recruited through Partner networks and contacts of the end user representatives in the Consortium (RNIB, FONCE, EPR, ACE, SUDART) and key individual specialists working with people with disabilities.

It should be noted that a participants pool has been created from the early beginning of the project, which will enable the Pilot sites to engage the same participants (all categories of them), as far as possible, throughout the whole evaluation cycle, even since the initial field trials conducted before the first evaluation phase.

From the pool of end users and experts of the project, a "hard core" of ten end users and experts will be identified. At least two of them experts will also be classified as "expert end users" – that is they have a lot of knowledge both as end users of Assistive Technology (AT) and as experts in the field of AT. This "hard core" will engage in the process of rapid, iterative testing based on home/school/work visits and via workshops. Some equipment and demonstrators will also be loaned out for short periods of time, once they are robust and useful enough for this to happen. As each significant change is made in the development cycle of an demonstrator or application prototype, individual visits will be made to the "hard core" test team, some of whom will be switch users with very complex needs and who may require novel tools and evaluation methods to elicit their opinions. This group will also need a great deal of time and support in order to be genuinely and actively engaged in the iterative test cycle. The remaining end users and experts within the pool will be engaged and consulted during the iterative pilot testing through annual workshops where small group testing, discussion groups and plenary meetings will ensure a breadth and range of feedback from this bigger pool of end users, experts and developers.

5 Conclusions

This paper presented the approach and plans of the evaluation activities to be followed within ÆGIS FP7 Integrating Project. ÆGIS is anticipated to constitute a breakthrough in the eInclusion area, embedding accessibility support by default in mainstream ICT applications (desktop, mobile, rich Internet). In the context of the overall User Centred Approach to be adopted in the project, evaluation of the Open Accessibility Framework to be developed and all research prototypes will take place in three iterative phases and in 4 Pilot sites across Europe (Belgium, Spain, Sweden and the UK). In addition to the testing that will take place in a laboratory environment (pilot sites), close observation of user interaction with technology is a critical component of "real usability testing", and forms the cornerstone of the pilot programs in the project. That said, many of the ÆGIS-developed prototypes and technologies are designed explicitly for use outside of a "lab environment". These include a part of the open desktop work (including the realtime-text application), part of the rich Internet applications being developed, and the accessible mobile devices. Towards the end of

the project (when the technologies are in their second iteration cycle), prolonged end-user evaluation of usage scenarios and sample applications (over a period of weeks, used as part of the related daily life activities) will be scheduled, gathering feedback during and after the trial period. The open desktop and a number of rich Internet applications will be evaluated in this extended trial, and will do so at least with vision and hearing impaired end-users. The possibility of including longer term evaluation of mobile device accessibility will be further explored (to the extent that secure cell phone connectivity where the end-user trials are taking place is secured; otherwise existing end-user cell phone connectivity will be re-used). In addition, the possibility of longer term evaluations by people with cognitive impairments will be explored, to the extent that ethical safeguards are taken on-board.

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