Dynamic Accessibility: Detecting and Accommodating Differences in Ability and Situation

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Abstract
Human abilities are idiosyncratic and may change frequently. Static one-size-fits-many accessibility solutions miss the opportunities that arise from careful consideration of an individual's abilities and fail to address the sometimes dynamic aspect of those abilities, such as when a user's activity or context causes a "situational impairment." The goal of this workshop is to bring together researchers and practitioners in accessibility, mobile HCI, and interactive intelligent systems who are pursuing agile, data-driven approaches that enable interactive systems to adapt or become adapted to the needs and abilities of a particular individual in a particular context.

Keywords
Assistive Technology, Intelligent User Interfaces, Mobile Devices

ACM Classification Keywords
H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

General Terms
Assistive Technology, Intelligent User Interfaces, Interaction Design, Situational Impairment, Mobile Devices, User Modeling

Introduction

User abilities and needs vary from one individual to the next and may change frequently. Among people with long-term impairments, even individuals with similar medical diagnoses can have very distinct functional abilities. Moreover, these abilities may fluctuate throughout the day due to medication or fatigue, or evolve across days or months following longer-term changes in the underlying medical condition. Among non-disabled users, functional abilities are significantly affected by current activity or context. For example, a person operating a mobile device while walking will experience impaired dexterity, increased cognitive load, reduced visual acuity, and fragmented attention [1,6].

The differences among users and the dynamic nature of functional abilities create a challenge for accessible interfaces. Asking users to customize the interface themselves may not always be the best solution: not all users are aware of their changing needs, and those who are may not know what accommodations they need. Instead, we see a useful solution in automatically detecting user needs as they change, and building software to accommodate these needs.

In prior work, many achievements have been made to better understand why and how user abilities and needs change. Additionally, a large variety of tools have been developed to measure these abilities and needs and even to automatically model them during real-world use. Despite this progress in understanding, measuring, and detecting abilities and needs, there are still many questions about how best to use this information to improve usability. Issues such as "should users be made aware of their changing needs" and "how much control should users have over the accommodations" are crucial to the future of this technology.

This workshop will focus on identifying future opportunities and challenges for systems that assess users' abilities and needs at run time and which facilitate accommodations to the individual and temporal differences in those abilities and needs.

Summary of Workshop Goals and Participants

One of the main goals of this workshop is to bridge cross-disciplinary relationships between researchers and practitioners interested in personalized and dynamic aspects of accessibility. In particular, we hope to bring together the accessibility, mobile interaction design, user modeling, and adaptive systems communities. Through this workshop participants will share experiences and ideas, and discuss design and technology goals for future research.

Some of the specific areas workshop participants may have experience with include:

- Measuring and modeling abilities (motor, perceptual, cognitive) and needs
- Data driven customization
- Automatic adaptation
- Real world data collection
- Field experiments conducted "in the wild" but retaining some degree of experimental control
- Privacy issues surrounding collection and analysis of personal data

Additional workshop goals include:

- Create a list of challenges for this community to guide future research.

- Identify the contexts where we see accommodating ability differences having the most potential.
- Create a wish list for future need finding and enabling technology.
- Identify the obstacles that have prevented us from doing this work sooner, and brainstorm how we can overcome these stumbling blocks.
- Share best practices.

Workshop Topics

The workshop chairs all have experience investigating pointing and/or typing performance: an obstacle for many individuals using a wide variety of interactive systems. However, we also see this work being applicable to any input method including speech, or gesture, and output modalities such as visual, auditory, or haptic.

This workshop will be structured around the following topics: enabling technologies, understanding user needs, case studies, and visions for the future of data driven adaptations. Submissions should address at least one of these topics.

Enabling technologies

Recent technology developments that may provide transformative new capabilities that enable novel personalized adaptations to people's abilities. Examples of areas of this research include, but are not limited to:

- Improve measuring or modeling of abilities
- Automatically assess effectiveness of accessibility interventions
- Automatically design accessibility interventions
- Adaptations that automatically change user interfaces to meet user needs
- Enable powerful user-driven customizations

Understanding user needs

Individuals may experience changes in performance for many reasons including a physical impairment, their context, or their (possibly lack of) experience using an interactive system. We are interested in how individual differences in abilities (due to permanent health conditions or temporary situations) affect people's abilities to interact and what seem to be the most promising strategies for intervention. We have identified four categories of changing performance:

- Improving performance: children, novice computer users become experts
- Decreasing performance: degenerative diseases and aging
- Fluctuation in performance: situational impairments, effect of medicine
- Constant performance: non-degenerative conditions

Case studies of fully built adaptive systems

Past work [5] has demonstrated that it is possible to automatically distinguish between novice and skilled use by observing user actions and not using a task model. These observations can also be used to assess performance and provide real time user assistance. This model was used in an adaptive application that tailored help messages to current expertise.

Measurements of motor abilities have also been used to automatically generate user interfaces adapted to the individual abilities of users with motor impairments [2,8]. Such automatically generated ability-based interfaces resulted in improvements to both performance and satisfaction compared to default user interfaces shipped with today’s software [3].

Rather than adapting the user interface layout, another approach to is to automatically detect pointing difficulty and drop the mouse gain (speed) to ease target selection. Although using somewhat different approaches, the *Angle Mouse* [9] and *PointAssist* [4] both monitor mouse submovements to detect pointing difficulty, and both improve performance for users with motor impairments and older adults, respectively.

Vision papers
The idea of applying automatic adaptation to improve accessibility has been around for several years. Stephanidis [7] provided an overview in 2001 of early work in the area, stressing the potential for automatic adaptation to meet the goals of universal access, but also highlighting the limited amount of work that had so far been done in the area.

Workshop Format

We will begin this one day workshop with select participants giving brief presentations on their past experience in studying, detecting and accommodating changing user needs. Participants will be chosen to synthesize their opinions and work in each focus area. Following these presentations, participants will break into an informal poster session to discuss their specific research experiences. These poster sessions will be organized according to each authors' focus area.

Finally, we will discuss the following topics, and any others that arise throughout the day:

- When do people want to know about changes in performance?
- How much control should automatic systems have?
- How does this differ according to context?
- How should adaptive technologies be evaluated?
- What are alternatives to full system-driven adaptation? Other forms of adaptability?
- How should prediction errors be handled?
- How should one decide between real world and laboratory data collection?

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