Guest Editors:

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working memory while using the natural language interface (NLI).
These techniques mostly stem from state-of-the art research in dialogue interfaces to ontologies that we have expanded and adapted for their use in accessibility. We also demonstrate the integration of techniques that adapt the NLI to the specific needs of blind users, as most current research on NLIs does not focus on accessibility.
Key results: This submission deals with the novel research question of how to enable dialogue-based access to diagrams, and it is the first of its kind we have been able to find in the literature. Heuristic evaluation of our methodology has shown that NLIs are a satisfactory approach to non-visual access to diagrams, their key advantage being the lack of necessary previous training of the users and that it requires no extra software or hardware besides what blind Web users are accustomed to employ for surfing the Web.
Conclusion: Our research shows how natural language interfaces are a promising novel approach to non-visual accessibility of diagrams. We hope that the proposed NLP pipeline will be exploited by other authors fostering future research in accessibility to visually displayed STEM materials.
Keywords: Non-visual diagrams, natural language, accessibility.
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Technology Support for Inclusive STEM Laboratories: State-of-the-Art and Open Challenges

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Background: This research is motivated by the importance of science, technology, engineering and mathematics (STEM), including for many careers, understanding increasingly important public debates and policy formulation on issues such as cybersecurity/privacy management and genetically modified organisms and for personal life e.g. budgeting. STEM accessibility seems to have received less attention than that of other subjects. Particular areas of difficulty/exclusion are laboratories, fieldwork and access to formulae. This presentation will focus on laboratories.
Method: There are three main components:

1. A review of the literature.
2. An examination of the authors' previous work.
3. An evaluation of the issues drawing on the authors' experience as disabled people working in STEM.

Key results: The relatively limited literature dating back to at least the 1980s recognises that disabled students require similar laboratory experiences to other students and that disabled people do not raise particular safety issues despite the use of health and safety considerations as a pretext to exclude them. Both design for all and adaptations for specific individuals and people with particular impairments are required. The former includes an uncluttered layout, wide aisles, good signage, adjustable height tables and seating and commonly used equipment close together. Demonstrators and technicians should have training in working with disabled students and staff and in supporting particular disabled students.Both the increasing capabilities of technology and the role of assistants have been noted. However, technology can support a more independent lab experience. The use of remote computer controlled labs and virtual simulations have been suggested, but should not replace physical lab accessibility. Accessibility of this software can be improved by text labels, keyboard access, personalised settings and auditory feedback, which should have an 'on/off switch'. However, challenges are still available for working remotely and effectively with certain experiments, such as to get back information on what is happening, or on the colour or reaction of particular substances. Talking lab probes were introduced in the 1980s, but not mass produced due to cost. More recently, free script files have been developed to make Vernier lab probes compatible with the JAWS and Window Eyes screenreaders to allow real time access to data by blind and dyslexic people. A handheld computer with screenreader has been developed as a portable data collector. Light microscopes have been made accessible to physically disabled users through a remote viewing web-based application. Mounting a video camera can avoid the need to use the eyepiece. A motorised microscope with an automatic load slider can be used by physically disabled and low vision users. Low-tech adaptations, including easy-grip handles, lower seating and 3D tactile models, could benefit all laboratory users.
Conclusion: Technology has considerable not fully tapped potential in improving lab accessibility. Initial work could focus on:

– Developing a wide range of equipment with speech output and screenreader compatibility.

– Developing precision robot manipulators compatible with a range of equipment which can carry out manual operations and be operated by various assistive devices.
– Using adjustable-height benches and equipment, easy-grip devices, tactile models.

Keywords: STEM, lab accessibility, accessible equipment, low tech adaptations, assistive devices.
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InftyReader Lite: Converting e-Born PDF into Various Accessible Formats

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Background: One of the most serious problems in digitized STEM (science, technology, engineering and mathematics) contents, which are usually provided in PDF, is their poor accessibility. From the viewpoint of computerized processing to convert PDF into an accessible form, PDF can be classified into two types. "E-born PDF" is produced originally from an electronic file such as a document in Microsoft Word, LaTeX, Adobe InDesign, etc. (without copy protection). We refer to all the others as "image PDFąőąŕ. The most significant advantage of e-born PDF is that the information on each character/symbol such as its character code, font type, coordinates on a page is embedded in it.
In ICCHP2016, we reported a method to recognize STEM contents in e-born PDF, in which character information extracted directly from a document was combined with analysis technologies of Mathematical OCR (optical character recognition). It was very effective; however, in the inside of mathematical formulas, a font rectangular-area extracted from e-born PDF by a PDF parser often differs significantly from the graphical area of the original character image. Thus, it cannot be used for mathematical-structure analysis as it stands. To correct that, we still had to use OCR engines in our STEM-OCR software, "InftyReader".
Method: We have recently adopted a new powerful PDF parser that also provides us with "vector-image information" for printing characters/symbols. Using it, we can get the true graphical area of the original character image even in the inside of mathematical formulas. It allows us to develop new software, "InftyReader Lite (IRL)" that does not need any commercial OCR engines for recognizing STEM contents in e-born PDF. Since its recognition process no longer depends on image OCR, accurate conversion into text and mathematical-structure analysis can been done even if characters/symbols have color ornaments or a background image.
Key results: IRL can recognize just e-born PDF; however, IRL can convert it into various accessible formats as same as the standard version of InftyReader. That is, a recognition result can be exported in IML (the original xml in Infty software), LaTeX source, XHTML with MathML, MS Word, Multimedia DAISY ("Digital Accessible Information System": an international standard format for accessible e-books), accessible EPUB3, "ChattyBookąőąŕ, "PDF with TeX", etc. Here, ChattyBook is audio-embedded HTML5 with JavaScript which can be read with a popular browser on various platforms (Internet Explorer, Chrome, Fire Fox, Safari). ChattyBook has the almost-same functionality and operability as DAISY. In Japan, many multimedia-DAISY textbooks are now converted into ChattyBooks, and thousands of print-disabled students (mostly ones with developmental reading disorder) use them. PDF with TeX is a new-type of accessible PDF, in which text information is embedded, in actual reading order, in the background of the original-PDF page image. Mathematical parts are represented in LaTeX, and it is totally accessible for print-disabled people to read STEM contents with a screen reader.
Conclusion: IRL should be a good/low-cost solution for print-disabled people to convert (inaccessible) STEM contents in e-born PDF automatically/easily into various accessible formats.

Keywords: e-born PDF, accessibility, conversion, DAISY, STEM
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An Investigation into Pedagogical and Opportunity Barriers in STEM Education of Visually-Impaired Nigerians: Why Disabled People Must be Involved

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