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INTRODUCING ACCESSIBILITY ON LIREX LIBRARY OF REMOTE EXPERIMENTS

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Abstract: *LiReX - Library of Remote experiments was successfully implemented as cross-universities network of remote engineering laboratories that offers unified access to real laboratories or virtual experiments for teachers, university students and students of secondary vocational schools. The manner in which students can access LiReX remote experiments relies mostly on the Remote Desktop access programs to the lab computer, where the experiment is hosted, thus providing users to control experiment. The increase in the number of users leads to accessability issues that need to be considered. The following issue is analyzed: how to include students with special educational needs, and if the platform as well as experiments design could meet the accessibility requirements of different users, in order to avoid obstacles. In this paper an analysis of platform and its content is performed aiming to give insight on further accessibility integration.*

Keywords: *Distance learning, Remote experiments, Engineering Education*

1. INTRODUCTION

LiReX (Library of Remote experiments) is developed as cross-universities network of remote engineering laboratories in order to enhance engineering education at Serbian HE institutions. Also in order to promote engineering education attractiveness to prospective engineering students, an extensive training is performed for teachers working in secondary vocational school classrooms, and platform and resources are being used in schools across Serbia.

Set of new remote experiments, developed by several Serbian universities, UNIKG, UB, UNINI and UNS, are included into LiReX. LiReX were used by students of partner universities as well as by students of secondary vocational schools in the last school year.

As platform and library of experiment are being more widely used, by many university students and also secondary vocational schools students, another issue is becoming more important: to analyze content and system, and make it more accessible, primarily for learners with disabilities - but also for user agents, including different devices.

2. CONTENT ACCESSIBILITY - PRINCIPLES, GUIDELINES, STANDARDS AND LEGISLATION

Accessibility is defined as a standard by the ISO 9241-171:2008 “Ergonomics of human-system Interaction” which provides the usability for systems intended for all, regardless the type of impairment and environment. It can also be used for educational web resources, where the multimedia learning material, delivering lectures and interactively testing the knowledge has to be suitably accessible for all [1]. Accessible design is focussed on principles of extending standard design to people with some type of performance limitation to maximize the number of potential customers who can readily use a product, building or service.

There are three main strategies for accessibility: design for most users without modifications, design for easy adaptation to different users, and design with a view to connect seamlessly to assistive devices.

Learning materials content creators and teachers can basically face with the following types of disabled

students: deaf, hard of hearing, visually impaired, mobility disabled and persons with mental disorders.

Many people use assistive technologies to allow them, for example, to access content in easier-to-read colours, with larger fonts or as spoken text, or to navigate around a site using the keyboard only.

Generally, elements that affect accessibility include:

- Can't see very well: the colours and the contrast between colours; the size of text; the choice of fonts
- Blind people: how a screenreader interprets the elements on a page (for example, alt tags for images, and title tags for links); the inclusion of audio description for video content
- Can't hear very well: how any audio content is represented graphically (for example, including subtitles or signing on video content)
- A keyboard or mouse is hard to use: the ease with which someone can navigate to parts of the page (for instance, by tabbing); auto-completion of forms
- Find words difficult: the length of sentences and paragraphs; the complexity of the vocabulary; the choice of fonts and size of text; the availability of spelling checkers and word prediction; the opportunity to have text read out loud [2].

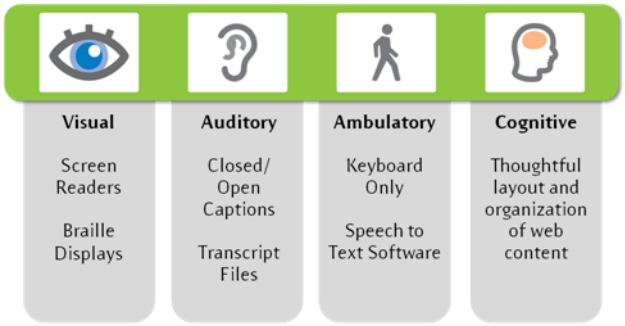

Image 1: Abilities Affect Digital Access

Web Content Accessibility Guidelines (WCAG) are developed by World Wide Web Consortium (W3C). The current version of WCAG – WCAG 2.0, was published in 2008 and standardised in 2012 by the standard ISO/IEC 40500. WCAG is primarily intended for web content developers, web accessibility evaluators and others who need a standard for web accessibility. WCAG 2.0 covers a wide range of recommendations for making Web content more accessible. Following these guidelines will make content accessible to a wider range of people with disabilities, including blindness and low vision, deafness and hearing loss, learning disabilities, cognitive limitations, limited movement, speech disabilities, photosensitivity and combinations of these. Several layers of guidance are provided including overall principles, general guidelines, testable success criteria and a rich collection of sufficient techniques, advisory techniques, and documented common failures with examples, resource links and code [3]. It includes 12 guidelines organised in 4 principles that should be followed:

- Perceivable: considering all three main sense organs which we need for interactive work: eye sight, hearing and feeling. It includes 22 success criteria.
- Operable: defining the manners of management (navigation and user inter-face) for persons with disabilities. It includes 20 success criteria.
- Understandable: defining the ways of correct interpretation of the content. It includes 17 success criteria.
- Robust: defining compatibilities with present and future technologies. It includes 2 success criteria.

The standard includes 61 success criteria, organised according to the three different levels of conformance, form lowest (A) to highest (AAA) priority.

The US Rehabilitation Act prohibits discrimination on the basis of disability in programs conducted by Federal agencies, in programs receiving Federal assistance, in Federal employment, and in the employment practices of Federal contractors. Several sections of this act involve digital accessibility: Section 503, Section 504, Section 508. Section 504 claims that “No otherwise qualified individual with a disability in the United States... shall, solely by reason of her or his disability, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving Federal financial assistance.” That way, any programs receiving federal funds must have accessible digital access. This includes all government agencies, K-12 schools and higher education institutions.

3. USERS’ FEEDBACK AND EVALUATION ON LIREX USAGE

So far, LiReX library was evaluated by real users and also by external expert evaluators. The real user case validation was carried out by involving students of upgraded curricula on their realistic feedback on strengths and weaknesses of using remote experimentation regarding achievement of learning outcomes. External evaluation, where quality control and monitoring of developed remote experiments and curricula improvements, are carried out within the project NeReLa [4] by leading experts from EU partner universities. The evaluation of developed remote experiments was focused in 6 different aspects [5]:

- General and technical aspects of remote experiments
- Usability
- Quality of media feedback
- Documentation and help
- Data Collection Quality
- Educational aspects

In “Usability“ the issues like intuitiveness of the user interface/software, interactivity of the experiments and response time after the user action was investigated. It was not performed by classical usability testing as was executed by evaluators skilled in remote experiments and not by the end users. However based on the rich experience of evaluators some issues that may show later with the end users could be revealed and thus resolved before putting the experiments into real use.

Also the real user case validation will be carried out by involving students of upgraded curricula on their realistic feedback on strengths and weaknesses of using remote experimentation regarding achievement of learning outcomes.

In order to solve the problem of transition of learning materials and platform to more accessible ones, it is necessary to consider the following four steps [6]:

- Step 1: Awareness
- Step 2: Analysis and evaluation
- Step 3: Implementation
- Step 4: Accessibility integration

4. LIREX LIBRARY – PLATFORM AND CONTENT ANALYSIS FOR ACCESSIBILITY IMPLEMENTATION

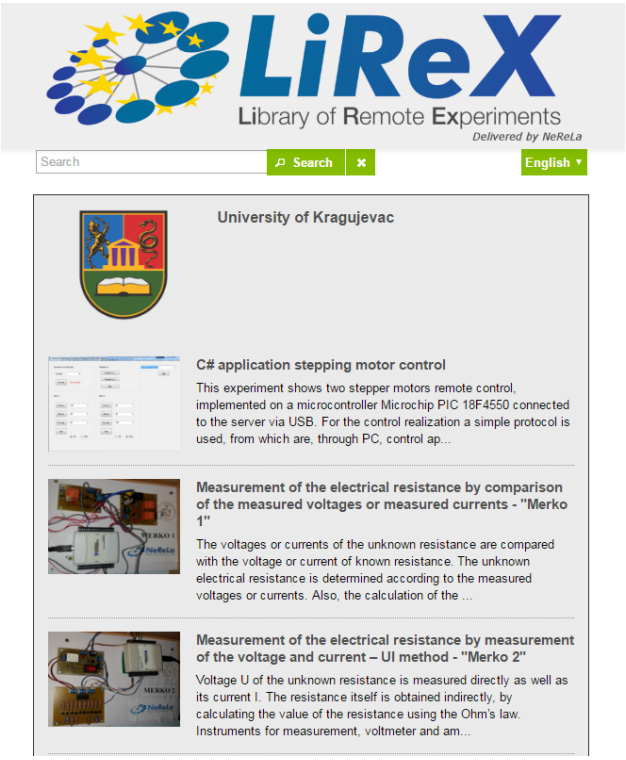

Image 2: LiReX library UNIKG web page with list of experiments (lirex.ftn.kg.ac.rs)

LiReX library of remote experiments is delivering a number of laboratory exercises, implemented and controlled over the Internet and accessed from remote locations. This means that these exercises are available not only to students and pupils who are working in the lab, but also to others who are able to perform the experiments without owning the actual equipment in their institution, by means of a platform for remote experiments.

The exercises access is realized using three different technical solutions, that enables access to the corresponding laboratory exercises over the internet by reserving the necessary apparatus and software for a limited period: 1) CEyeClon 2) the WebLab Deusto platform and 3) Remote Desktop.

The standard Remote Desktop access is used just for few exercises and for few labs that are enable to use other platforms. Most of experiments currently included in LiReX library are being remotely accessed by using CEyeClon and it is required that users have installed CEyeClon viewer. The next step is to choose the wanted exercise and the platform will allow the reservation of the desired experiment for a limited time period. In case someone else is trying to use the same experiment at the time, the platform will inform the student that he/she should wait.

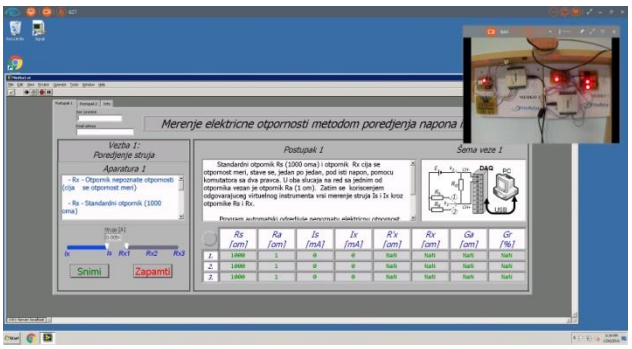

Image 3: Remote experiment in the field of electrical measurement

CEyeClon is similar to standard remote desktop connection, but with useful additional administration tools, like integrated camera and pdf file report generation about user’s experiment usage and results. User management is performed by administrators, who give access code to users for the specific total usage time and till specific code expiration date.

WebLab-Deusto is Open Source and can be used by any lab that has certain equipment and wants to put it online. It already provides plenty of features like authentication, authorization, scheduling mechanisms, administrative tools or integration in Learning Management Systems (such as Moodle). And also sharing of the lab resources and experiments between universities world wide.

Experiments might be designed as virtual or real equipment exercises.

The most of experiments are created with LabVIEW, as an integrated development environment and also because most of lab equipment in use is made by National Instruments. Some experiments are made on FPGA board Altera DE2 and software used for programming is Quartus II. The BigPic 5 is also another microcontroller and MicroC is used as programming language. For an experiment that is made for stepping motor control programming is made using C# language (image 5).

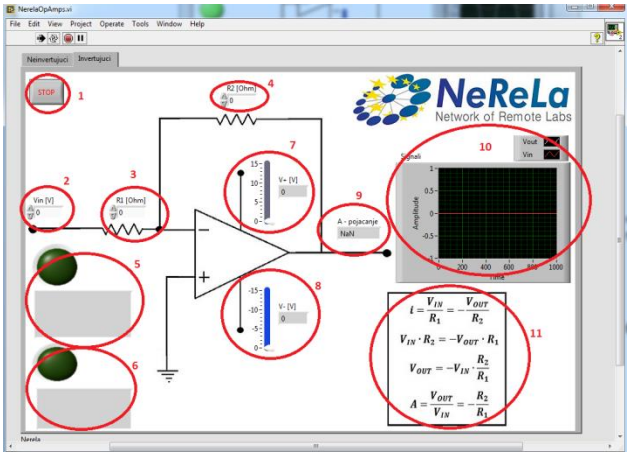

Image 4: LabVIEW virtual experiment workbench

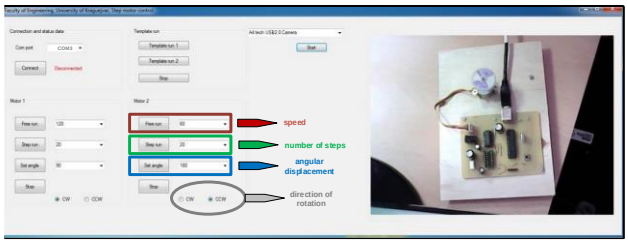

Image 5: The user interface for remote experiment with stepper motor [7]

Basically some tools are graphic developing environment with built-in functionality for simulation, data acquisition, instrumentation, measurement analysis and data presenting, others are exclusively or more code oriented.

In order to determine if platform and experiments were developed in a way that makes it accessible by a large group of users, accessibility plan has to be well prepared and some test conducted.

- Determine if accessibility is a priority – the experiments have started to be more widely used, by a large number of students, so it is needed not to exclude any student with special educational needs. Determine the level of accessibility to conform to – conduct an audit of priority use cases against web accessibility standards
- To create a culture of accessibility through training & education of team members – regular summer schools and education for experiments creators and teacher will include accessibility awareness and instruct them on further steps to make experiments' user interface accessible.
- Accessibility review of designs & templates – check for things like keyboard accessibility of navigation, colour contrast of design, alt tags on images, template structure, etc.
- Accessibility review of other content – videos, PDFs, etc.
- Correct accessibility violations in site designs/ templates and other digital content
- Plan for sustainability and monitor compliance

After analysis of technical details of experiments and platform in order to achieve some level of accessibility on LiReX library experiments, activities to follow are:

- Since all experiments are not only web (html, text) based, and they are limited by user interface design of software used for experiment development, creators of experiments should be more familiar with accessible design principles.
- In the next school year students questionnaire that is already used for evaluating students' experience (containing the level of technical preparation of the experiments, the performance of the equipment, the quality of the user interface and ability to obtain the experimental results), will be extended to include questions that will assess special educational needs and students with difficulties.
- Results of that survey should identify the exact needs and number of students with disabilities and if they found that LiReX is not usable and accessible enough or at all.

5. CONCLUSION

In this paper we presented that LiReX experiments, are already developed and used by a significant number of students, and that the increase in number of users results in an awareness - to try to make content accessible, for all students that might need special requirements. This initial analysis of platform and content, as well as overview of legal aspects and reasons to provide better support for students with disabilities, will lead to setting and implementing the accessibility plan, that will provide a level of some conformance to standards and guidelines. Also a survey will follow that will determine what type of disability is priority and what are the opportunities to change or adjust experiments' design to correct accessibility non-conformance of content.

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