Modeling Content Accessibility Service Provision in Higher Education

Georgios Kouroupetroglou
National and Kapodistrian University of Athens, Greece,
Department of Informatics and Telecommunications,
Speech and Accessibility Laboratory
koupe@di.uoa.gr

Abstract

Despite the progress that has been made in Assistive Technologies and digital accessibility, not only in the technological field but also in the relevant legislation, today many print-disabled students in Higher Education Institutions still do not enjoy equal access to educational materials. We present the model we have developed for the efficient content accessibility service provision for students with disability. The workflow for the management and distribution of accessible textbooks is given first. Then, we briefly describe the general framework of the accessibility services provided, along with the following innovative methodologies and systems we have investigated to support the academic educational material accessibility service: meaningful high-quality alt-text image descriptions, inventories for free mobile Assistive Technology applications, Document-to-Audio advanced accessibility, data tables' accessibility, evaluation methodologies for Math-to-Speech, 8-dot braille code systems and braille embossed graphics with variable dot elevation. Finally, we present the actions we have taken in the context of three EU projects to disseminate the above know-how to 26 HEIs in eight countries at the regions of North Africa, West Balkans and Near East.

1 Introduction

The number of students with disabilities (SwD) in higher education institutions (HEI) has been steadily increasing over the past two decades [1-2]. The Convention on the Rights of Persons with Disabilities [3], which has been ratified by 183 countries, highlighted the obligation to ensure that persons with disabilities have access to tertiary education without discrimination and on the same terms as those without disability. A significant number of students with disabilities in HEIs are characterized as print-disabled as they cannot read effectively conventional print content of information because of a visual, physical, perceptual, developmental, cognitive, or learning disability. Print disabilities include

students with low vision/partially sighted, color vision deficiency, blindness, motor impairment of the upper limbs (including manual dexterity), or dysanagnosia.

Printed or digital academic resources in HEIs include mainly textbooks, teaching notes, handouts, teaching presentations, workbooks, paper assessments, scientific journals or periodicals, webpages, reports, or articles. In some cases, they include complex mathematical expressions, symbols and formulas of physics and chemistry, or even music notations and partitures. During the past four decades, the evolution of computer science and information technology brought out new perspectives for educational resources [4]. Nowadays, the vast number of them is edited and stored in a digital or electronic format. Moreover, print educational resources of the past can be digitized using common scanners and optical character recognition (OCR) software.

Print-disabled students can use software or hardware Assistive Technology (AT) [5-7] to read printed or digital academic content, which can encompass a variety of different methods including braille, large print, audio formats, screen readers, text-to-speech, or a combination of multiple formats, e.g. audio-tactile.

Assistive Technology alone does not ensure content accessibility. Content accessibility refers to the design and delivery of content in a way that allows everyone to access and use it. Digital accessibility refers to the design and delivery of content in a way that allows everyone to access and use it. In practice, digital accessibility is a process which aims to ensure that content is presented in formats that can be easily accessed by persons with disability. Digital accessibility is processing the content to ensure that it has become compatible with the computer-based Assistive Technology of the user, under the condition that both of them follow the relative international standards, e.g. User Agent Accessibility Guidelines (UAAG) for AT and Web Content Accessibility Guidelines (WCAG) for content.

Despite the progress that has been made in Assistive Technologies and digital accessibility, not only in the technological field but also in the relevant legislation, today many print-disabled students still in Higher Education Institutions do not enjoy equal access to educational materials. This paper focuses on the model we have developed with the synergies of the Speech & Accessibility Research Laboratory and the Accessibility Unit of the National and Kapodistrian University of Athens (NKUA) for the efficient content accessibility service provision for SwD. We first present the workflow we follow for the management and distribution of accessible textbooks. Then, we briefly describe the general framework of the accessibility services provided in NKUA along with the following innovative methodologies and systems we have investigated to support the academic educational material accessibility service: meaningful high-quality alt-text image descriptions, inventories for free mobile Assistive Technology applications, Document-to-Audio advanced accessibility, data tables' accessibility, evaluation methodologies for Math-to-Speech, advanced 8-dot braille code systems and braille embossed graphics with variable dot elevation. Finally, we present the actions we have taken in the context of three EU projects to disseminate the above know-how to 26 HEIs in eight countries at the regions of North Africa, West Balkans and Near East.

2 Workflow Management of Accessible Textbooks

The provision of educational material in alternate formats for students with print-based disabilities is challenging and often time-consuming, expensive, and requires special knowledge and training of staff [10]. Legislation, universal guidelines [11] and universal standards [12] play an important role in providing accessible learning material provision (in either traditional or e-learning settings) within a HEI. Academic Accessibility Units or Disability Services' Offices undertake the role for the production and delivery of accessible academic educational content [13]. Standards of provision of accessible textbooks vary from place to place even in the same country and often require new workflows from

inquire to access [14]. Moreover, copyright protection of textbooks in connection with the disability rights is another challenging issue [15] that varies across countries.

The HERMOPHILOS web-based Information Technology (IT) system has been designed and developed to automate and accelerate the accessible textbooks' production, workflow management, and delivery in NKUA [8]. It is based on a user-centric approach, i.e. it does not just highlight the individual students' needs with regards to skills and abilities, but also considers localization issues in terms of language and cultural differences [16].

The functional architecture of HERMOFILOS includes two main subsystems:

A. Users and Requests Management Subsystem

- *Users sign up service*: Three main user groups are using the web services: students, publishers, and the Accessibility Unit staff. Students can use the same credentials they use for all other online University services like MYSTUDIES (the secretariats' system where students declare the courses they will take) and EUDOXUS (where students register their preferred books for each course).
- *User authentication service*: Only the print-disabled students are entitled to the accessible digital textbooks and the web services, so this service ensures that only accredited students, personnel, and publishers will access the system.
- *User rights management service*: A general administrator, member of the Accessibility Unit staff, manages all user rights for all three user groups.
- *Students' accessible textbooks request service*: All new requests are made online, and no physical presence of the student at the Accessibility Unit's office is required.
- *Digital textbook requests to publishers' service*: A secure system for electronically sending new requests for textbooks to the publishers.
- *Requests' progress monitoring service*: Both students' requests to Accessibility Unit and the Unit's applications to the publishers are monitored and displayed online.
- *Requests' statistics service*: All stages of the procedure are logged, and executive reports are offered in real time.

B. Digital Content Management Subsystem

- *Scanning service*: A high-resolution scanner with a page feeder is connected to the IT system, and the scanning and storing process can be managed remotely.
- *Original digital textbook copy submission service*: This service is for the publishers that must send large files and they get an official receipt proving that they fulfilled a request.
- *Optical Character Recognition (OCR)*: runs on the high-speed server accelerating the process. We also use systems for math formulas recognition, as well as optical music recognition for partitures.
- *Version management service*: Many volunteers and the Accessibility Unit's staff contribute to OCR correction, document formatting, image description, math and science transcription, tactile graphics preparation, etc. All these produce a huge amount of data and numerous versions of intermediate documents managed online by administrators.
- *Accessible formats archive management service*: HERMOPHILOS supports the creation of multiple accessible formats: plain text (.txt), rich text (.rtf), accessible markup (.xml, .xhtml, and .html), large print (.doc), audio books (.mp3), DAISY 2&3 (text only or full text-full audio), Braille (.brf or .brl), MS-Word (.docx), portable document format (.pdf), ePUB 3, and LaTex (.tex). The required storing capacity is offered by the repository PERGAMOS provided by the central digital library system of the NKUA.
- *Copyright management service*: Digital IDs, electronic signatures, and watermarks are produced and managed centrally, offering a high degree of security and confidence to all stakeholders.
- *Accessible digital textbooks distribution service*: As soon as the preferred accessible format is ready, the student is informed that he or she can immediately download it.
- *Digital content usage statistics service*: File transfer reports and upload/download statistics are offered by HERMOPHILOS for all stages of preparation and distribution of the digital content.

3 Services of the Accessibility Unit

Accessible digital academic material production and distribution described above is one of the core services that the Accessibility Unit of the NKUA has undertaken to benefit students with print-disabilities. The accessibility services provision model of the NKUA [9] follows a student-oriented approach. It is based on the requirements' analysis of the students with disabilities during their studies. Moreover, this model influences their academic environment and the accessibility policy inside and outside the educational institution. The main pillar of this model is the Accessibility Unit which provides several supportive services, arranged in a three-tier architecture according to their "proximity" to the student (*we mark with italics the services that are related with content accessibility service provision*):

(i) Accessibility services addressed directly to the student:
- *Activity and participation restrictions' Registration*
- *Abilities Evaluation Service*
- *Personal Assistive Technologies Service*
- Transportation Service
- Accessible Academic Educational Material Service
- *Accommodations Service*
- Psychological Counseling Service
- Video Relay Service / Remote Sign Language Interpretation
- *Accessibility Support Voluntary Service*

(ii) Accessibility services applied to the student's environment:
- Buildings' Accessibility Service
- *Library Workstations for SwD*
- *Accessibility Guidelines & Tools*
- *Staff and Volunteers Training Service*

(iii) Accessibility promoting services:
- Web Accessibility Evaluation Service
- Events Service
- *Know-How Dissemination Service*
- *Research Service.*

4 Relative Innovative Actions

In the framework of the Research Service of the Accessibility Unit, numerus innovative methodologies and systems have been developed to support the Accessible Academic Educational Material Service, such as the following:

4.1 Meaningful high-quality alt-text image descriptions

Even though considerable efforts have been made to provide effective image descriptions for digital accessibility, a large portion of STEM images, especially complex STEM images, nowadays remains inaccessible to people with visual disability. We notice that It's important to note that having alt text, and having useful alt text are not the same thing. The quality of alt text is much more critical for university STEM textbooks as image descriptions must be accurate and detailed but not tire out the reader. We have created a large corpus of hierarchically classified STEM images from university

textbooks [20] that are used in our internal guidelines for meaningful non-automatic high-quality alt-text image descriptions.

4.2 Inventories for free mobile Assistive Technology applications

The search process for mobile AT applications that fulfill specific user needs is not an easy task for the persons with disability, their facilitators, as well as the professionals in rehabilitation. Even, when they finally find what they are looking for, several questions are raised relative to the reliability, stability, compatibility, and functionality of the AT applications. These questions can be answered safely only by a team of AT experts. We have design and developed the ATHENA [17] and mATHENA [18] web-based inventories, for desktop/laptop computers and mobile devices (for smartphones and tablets) respectively, that aim to make the search and selection of freeware and Open-Source mobile AT applications simple and sound. The methodology we followed is based on the consistent and well-documented presentation of the information for each mobile AT application, after it is tested in an AT lab [19]. Both these inventories include a plethora of document accessibility AT applications that make easy for the user to read, listen, produce, and edit electronic texts of various kinds, such as plain text, rich text, text with mathematical and/or diagrams.

4.3 Document-to-Audio advanced Accessibility

We have developed the Document-to-Audio (DtA) advanced accessibility approach for supporting the accessibility of the text signals, i.e. the writing devices that emphasizes aspects of a text's content or structure, such as bold, italics, tables, or bullets [21-25]. DtA essentially constitutes the next generation of Text-to-Speech. DtA relies on two pillars: a) extraction methodologies we have developed for the formatting metadata on structured documents for enhancing their accessibility through prosody modeling and their augmented audio representation [26-35], and b) the emotional-based mapping methodology we have introduced for rendering typographic signals to the auditory modality [36-43].

4.4 Data Tables Accessibility

The semantics involved in simple and complex data tables result in poor and ambiguous text-to-speech synthesis. We first performed an in-depth analysis of the visual and semantic characteristics of data table structures to determine the types of attributes that should be taken into consideration for their aural rendering. After processing the acquired speech data from the most preferred human spoken renditions, we have introduced a corresponding prosody specification, including phrase accent and pause break information. The evaluation results showed that a degree of semantic structure essence is retained in the resulting speech synthesized tables, thus making the content easier for the listener to comprehend [44-47].

4.5 Evaluation methodologies for Math-to-Speech

First, we have introduced three approaches to calculate structure- and content-based performance metrics for user-based evaluation of math audio rendering systems: Syntax Tree alignment, Baseline Structure Tree alignment, and MathML Tree Edit Distance [48]. Then, we have proposed EAR-Math, a methodological approach for user-based evaluation of math rendering against a baseline. EAR-Math measures systems' performance using fine-grained error rates based on the structural elements, arithmetic operators, numbers, and identifiers in a formula [49]. Finally, we have developed a methodology to evaluate in a systematic way the correctness of the Math-to-Speech rendering by investigating specific steps during the production and rendering phases for non-English DAISY Digital Talking Math Books.

4.6 Advanced 8-dot Braille Code Systems

We have introduced a language-independent methodology for the systematic development of an 8-dot braille code. It includes a set of design principles that focuses on achieving an abbreviated representation of the supported symbols, retaining connectivity with the 6-dot representation, preserving similarity on the transition rules applied in other languages, removing ambiguities, and considering future extensions [51]. This methodology was successfully applied for: a) the development of an 8-dot literary Greek braille code that covers both the modern and the ancient Greek orthography, including diphthongs, digits, and punctuation marks [52], b) the rendering typographic signals [53-54], and c) the Nemeth code [55-56].

4.7 Braille Embossed Graphics with Variable Dot Elevation

Most of the braille embossers incorporate a mode for the creation of braille embossed graphics (BEG). Some of them can produce dots in different elevations, but also various dot densities. We have investigated the extent of what blind individuals can identify embossed lines and square areas in eight dot elevations H1–H8 and two dot densities [57-58]. The analysis of the results indicated that the participants classify with better accuracy the stimuli with the three lower dot elevations (between 0.03 mm and 0.15 mm) for both types of stimuli and in both dot densities of 10 and 20 dpi. Better classification accuracy is achieved with the combination of four only dot heights H1, H2, H4, and H8. These results constitute the first recommendations for the designers of braille embossed graphics in applying textures with variable dot height and dot density for educational purposes or for producing tactile maps to benefit users who are blind.

5 Dissemination actions

During the period 2019-2023 we have taken actions to disseminate the know-how described above to 26 HEIs in eight countries at the regions of North Africa, West Balkans and Near East in the context of the following three ERASMUS+ projects of the EU:

- InSIDE - Including Students with Impairments in Distance Education [59],
- Edu4ALL - Disability as Diversity: The Inclusion of Students with Disabilities in Higher Education [60],
- IDEA - Inclusive Tertiary Education in the Western Balkans [61].

The three projects included the following main activities: training (including workshops) of the academic and administrative personnel through study visits to NKUA and teaching visits of experts from the NKUA to the 26 partner universities, development and delivery of training material, purchase of Assistive Technologies and hardware/software for the production of accessible academic educational materials and establishment and pilot operation of an Accessibility Unit in each one of the 26 universities.

References

[1] Leake, D. W., & Stodden, R. A. (2014). Higher education and disability: Past and future of underrepresented populations. *Journal of Postsecondary Education and Disability*, *27*(4), 399-408.

[2] Newman, L. A., Madaus, J. W., Lalor, A. R., & Javitz, H. S. (2021). Effect of accessing supports on higher education persistence of students with disabilities. *Journal of Diversity in Higher Education*, *14*(3), 353. https://doi.org/10.1037/dhe0000170

[3] United Nations (2006). *Convention on the Rights of Persons with Disabilities and Optional Protocol*: Paris. https://www.un.org/disabilities/documents/convention/convoptprot-e.pdf

[4] Kouroupetroglou, G. (2015). Accessibility of Documents. In *Encyclopedia of Information Science and Technology*, 3d Edition, published by IGI Global, Hershey, Pennsylvania (USA), 563-571. https://doi.org/10.4018/978-1-4666-5888-2.ch437

[5] Kouroupetroglou G. (2013). *Assistive Technologies and Computer Access for Motor Disabilities*. IGI Global, Hershey, Pennsylvania (USA). ISBN: 9781466644380.

[6] Fellbaum, K., & Kouroupetroglou, G. (2008). Principles of Electronic Speech Processing with Applications for People with Disabilities", *Journal Technology and Disability*, 20(2), 55-85. https://doi.org/10.3233/TAD-2008-20203

[7] Freitas, D., & Kouroupetroglou, G. (2008). Speech Technologies for Blind and Low Vision Persons, *Journal Technology and Disability*, 20(2), 135-156. https://doi.org/10.3233/TAD-2008-20208

[8] Pino, A., Kouroupetroglou, G., & Riga, P. (2016). HERMOPHILOS: A Web-Based Information System for the Workflow Management and Delivery of Accessible eTextbooks. *Lecture Notes in Computer Science*, 9758, 409-416. https://doi.org/10.1007/978-3-319-41264-1_56

[9] Kouroupetroglou, G., Pino, A., & Kacorri, H. (2011). A model of accessibility services provision for students with disabilities in higher education. In *Proceedings of the International Conference Universal Learning Design*, (pp. 23-33). https://access.uoa.gr/Unit%20Publicity%20Files/Kouroupetroglou_Brno_2011.pdf

[10] Christensen, L. B., Keegan, S. J., & Stevns, T. (2012). SCRIBE: A model for implementing robobraille in a higher education institution. *Lecture Notes in Computer Science*, 7382, 77-83. https://doi.org/10.1007/978-3-642-31522-0_12

[11] Seale, J. (2013). *E-learning and disability in higher education: accessibility research and practice*. Routledge.

[12] Crombie, D., Lenoir, R., McKenzie, N., & Calvo, F. M. (2006). Identifying Trends in Accessible Content Processing. *In Proc. of ELPUB Conference on Electronic Publishing* (pp. 113-122).

[13] Eskay, M., & Chima, J. N. (2013). Library and information service delivery for the blind and physically challenged in University of Nigeria Nsukka Library. *European Academic Research*, 1(5), 625-635.

[14] Beisler, A., & Kurt, L. (2012). E-book workflow from inquiry to access: Facing the challenges to implementing e-book access at the University of Nevada, Reno. *Collaborative Librarianship*, 4(3), 3. https://doi.org/10.29087/2012.4.3.04

[15] Harpur, P., & Suzor, N. (2013). Copyright protections and disability rights: turning the page to a new international paradigm. *The University of New South Wales Law Journal*, 36(3), 745-778.

[16] Draffan, E. A., McNaught, A., & James, A. (2014). eBooks, Accessibility and the Catalysts for Culture Change. *Lecture Notes in Computer Science*, 8548, 543-550. https://doi.org/10.1007/978-3-319-08599-9_80

[17] Pino, A., Kouroupetroglou, G., Kacorri, H., Sarantidou, A., & Spiliotopoulos, D. (2010). An open source/freeware assistive technology software inventory. *Lecture Notes in Computer Science*, 6179, 178-185. https://doi.org/10.1007/978-3-642-14097-6_29

[18] Kouroupetroglou, G., Kousidis, S., Riga, P., & Pino, A. (2015). The mATHENA inventory for free mobile assistive technology applications. *Lecture Notes in Computer Science*, 9416, 519-527. https://doi.org/10.1007/978-3-319-26138-6_56

[19] Kouroupetroglou, G., Pino, A., & Riga, P. (2017). A methodological approach for designing and developing web-based inventories of mobile Assistive Technology applications. *Multimedia Tools and Applications*, 76, 5347-5366. https://doi.org/10.1007/s11042-016-3822-3

[20] Antonakopoulou, T., Riga, P., & Kouroupetroglou, G. (2022). Developing a Corpus of Hierarchically Classified STEM Images for Accessibility Purposes. *Lecture Notes in Computer Science*, 13341, 56-62. https://doi.org/10.1007/978-3-031-08648-9_8

[21] Kouroupetroglou, G. (2015). Text signals and accessibility of educational documents. In *Proceedings of the 11th Intern. Conf. on Educational Technologies: EDUTE* (pp. 45-51). http://www.wseas.us/e-library/conferences/2015/Dubai/EDUTE/EDUTE-05.pdf

[22] Kouroupetroglou, G., & Katsoulis, Ph. (2016). How Blind and Sighted Individuals Perceive the Typographic Text-Signals of a Document. *Lecture Notes in Computer Science*, 9737, 81-90. https://doi.org/10.1007/978-3-319-40250-5_8

[23] Stavropoulou, P., Spiliotopoulos, D., & Kouroupetroglou, G. (2011). Acoustic modeling of dialogue elements for document accessibility. *Lecture Notes in Computer Science*, 6768, 175–184. https://doi.org/10.1007/978-3-642-21657-2_19

[24] Kouroupetroglou, G. (2013). Incorporating Typographic, Logical and Layout Knowledge of Documents into Text-to-Speech. In *Proc. of the 12th European Conference on Assistive Technologies (AAATE),* (pp. 708-713). https://doi.org/10.3233/978-1-61499-304-9-70

[25] Argyropoulos, V., Sideridis, G., Kouroupetroglou, G., & Xydas, G. (2009). Auditory Discriminations of Typographic Attributes of Documents by Students with Blindness. *British Journal of Visual Impairment*, 27(3), 183-203. https://doi.org/10.1177/0264619609106360

[26] Xydas, G., Spiliotopoulos, D., & Kouroupetroglou, G. (2003). Prosody prediction from linguistically enriched documents based on a machine learning approach. In *Proceedings of the 6th International Conference of Greek Linguistics* (pp. 135-138). Retrieved from https://speech.di.uoa.gr/sppages/spppdf/web-xydas_icgl2003.pdf

[27] Xydas, G., Spiliotopoulos, D., & Kouroupetroglou, G. (2003). Modelling emphatic events from non-speech aware documents in speech based user interfaces. Proc. Human-Computer Interaction-HCII 2003, Theory and Practice, 2, 806-810. Retrieved from https://shorturl.at/uvUX8

[28] Xydas, G. & ,Kouroupetroglou, G. (2001). Augmented Auditory Representation of e-Texts for Text-to-Speech Systems. *Lecture Notes in Artificial Intelligence*, 2166, 134-141. https://doi.org/10.1007/3-540-44805-5_17

[29] Xydas, G., Argyropoulos, V., Karakosta, T., & Kouroupetroglou, G. (2005). An experimental approach in recognizing synthesized auditory components in a non-visual interaction with documents. In *Proceedings of the 11th International Conference on Human-Computer Interaction*. Retrieved from https://shorturl.at/vxMS7

[30] Fourli-Kartsouni, F., Slavakis, K., Kouroupetroglou, G., & Theodoridis, S. (2007). A Bayesian network approach to semantic labelling of text formatting in XML corpora of documents. *Lecture Notes in Computer Science*, 4556, 299-308. https://doi.org/10.1007/978-3-540-73283-9_34

[31] Tsonos, D., Xydas, G., & Kouroupetroglou, G. (2007). Auditory accessibility of metadata in books: a design for all approach. *Lecture Notes in Computer Science*, 4556, 436-445. https://doi.org/10.1007/978-3-540-73283-9_49

[32] Spiliotopoulos, D., Petasis, G., & Kouroupetroglou, G. (2008). A framework for language-independent analysis and prosodic feature annotation of text corpora. *Lecture Notes in Artificial Intelligence*, 5246, 517-524. https://doi.org/10.1007/978-3-540-87391-4_66

[33] Kouroupetroglou, G. (2015). Acoustic Mapping of Visual Text Signals through Advanced Text-to-Speech: the Case of Font Size. *WSEAS Transactions on Computers*, 14, 559-569. Retrieved from http://www.wseas.us/journal/pdf/computers/2015/b105805-098.pdf

[34] Katsoulis, F., & Kouroupetroglou, G. (2015). How Sighted and Blind Students Perceive Relational Similarity between Font-Size and Loudness in Text-To-Speech. *The Turkish online Journal of Educational Technology*, 245-251. Retrieved from https://rb.gy/s9ngek

[35] Kouroupetroglou, G., & Tsonos, D. (2015). Rendering web-content text signals through advanced Text-to-Speech. In *Proc. of the International Conference on Internet Studies*, Tokyo, Japan, pp. 1-8. Retrieved from https://shorturl.at/ehrsW

[36] Tsonos, D., & Kouroupetroglou, G. (2011). Modeling reader's emotional state response on document's typographic elements. *Advances in Human-Computer Interaction*, Article ID 206983, 1-18. https://doi.org/10.1155/2011/206983

[37] Tsonos, D., & Kouroupetroglou, G. (2016). Prosodic Mapping of Text Font Based on the Dimensional Theory of Emotions: a Case Study on Style and Size. *EURASIP Journal on Audio, Speech, and Music Processin*8, 1-16. https://doi.org/10.1186/s13636-016-0087-8

[38] Tsonos, D., Kouroupetroglou, G., & Deligiorgi, D. (2013). Regression Modeling of Reader's Emotions Induced by Font Based Text Signals. *Lecture Notes in Computer Science*, 8010, 434-443. https://doi.org/10.1007/978-3-642-39191-0_48

[39] Kouroupetroglou, G. Tsonos, D., & Vlahos, E. (2009). DocEmoX: A System for the Typography-Derived Emotional Annotation of Documents. *Lecture Notes in Computer Science*, 5616, 550-558. https://doi.org/10.1007/978-3-642-02713-0_58

[40] Tsonos, D., Ikospentaki, K., & Kouroupetrolgou, G. (2008). Towards modeling of Readers' Emotional State response for the automated annotation of documents. In *IEEE International Joint Conference on Neural Networks (IEEE World Congress on Computational Intelligence)* (pp. 3253-3260). IEEE. https://doi.org/10.1109/IJCNN.2008.4634260

[41] Tsonos, D., & Kouroupetroglou, G. (2008). A Methodology for the Extraction of Reader's Emotional State Triggered from Text Typography. In *Tools in Artificial Intelligence*, In-Tech Publishing, (pp 439-454). https://doi.org/10.5772/6071

[42] Tsonos, D., Xydas, G., & Kouroupetroglou, G. (2007, October). A Methodology for Reader's Emotional State Extraction to Augment Expressions in Speech Synthesis. In 19th IEEE International conference on tools with artificial intelligence (ICTAI 2007) (Vol. 2, pp. 218-225). IEEE. https://doi.org/10.1109/ICTAI.2007.127

[43] Tsonos, D., Stavropoulou, P., Kouroupetroglou, G., Deligiorgi, D., & Papatheodorou, N. (2014). Emotional prosodic model evaluation for greek expressive text-to-speech synthesis. *Lecture Notes in Computer Science*, 8514, 166-174. https://doi.org/10.1007/978-3-319-07440-5_16

[44] Spiliotopoulos, D., Xydas, G., Kouroupetroglou, G., Argyropoulos, V., & Ikospentaki, K. (2010). Auditory universal accessibility of data tables using naturally derived prosody specification. *Universal Access in the Information Society*, 9, 169-183. https://doi.org/10.1007/s10209-009-0165-0

[45] Spiliotopoulos, D., Stavropoulou, P., & Kouroupetroglou, G. (2009). Acoustic rendering of data tables using earcons and prosody for document accessibility. *Lecture Notes in Computer Science*, 5616, 587-596. https://doi.org/10.1007/978-3-642-02713-0_62

[46] Spiliotopoulos, D., Xydas, G., Kouroupetroglou, G., & Argyropoulos, V. (2005, July). Experimentation on spoken format of tables in auditory user interfaces. In *Proceedings of the 11th International Conference on Human-Computer Interaction (HCII'05)* (pp. 361-370). Retrieved from https://speech.di.uoa.gr/sppages/spppdf/UA.pdf

[47] Spiliotopoulos, D., Xydas, G., & Kouroupetroglou, G. (2005). Diction Based Prosody Modeling in Table-to-Speech Synthesis. *Lecture Notes in Computer Science*, 3658, 294-301. https://doi.org/10.1007/11551874_38

[48] Kacorri, H., Riga, P., & and Kouroupetroglou, G. (2014). Performance Metrics and Their Extraction Methods for Audio Rendered Mathematics. *Lecture Notes in Computer Science*, 8547, 614-621, 2014. DOI 10.1007/978-3-319-08596-8_95

[49] Kacorri, H., Riga, P., & Kouroupetroglou, G. (2014). EAR-Math: Evaluation of Audio Rendered Mathematics. *Lecture Notes in Computer Science*, 8514, 111-120, 2. https://doi.org/10.1007/978-3-319-07440-5_11

[50] Riga, P., Kouroupetroglou, G., & Ioannidou, P. (2016). An Evaluation Methodology of Math-to-Speech in Non-English DAISY Digital Talking Books. *Lecture Notes in Computer Science*, 9758, 27-34. https://doi.org/10.1007/978-3-319-41264-1_4

[51] Kacorri, H., & Kouroupetroglou, G. (2013). Design and Developing Methodology for 8-dot Braille Code Systems. *Lecture Notes in Computer Science*, 8011, 331-340. https://doi.org/10.1007/978-3-642-39194-1_39

[52] Argyropoulos, V., Martos, A., Sideridis, G., Kouroupetroglou, G., Nikolaraizi, M., & Papazafiri, M. (2015). Reading comprehension issues and Individuals with visual impairments: the effects of using 8-dot and 6-dot braille code through a braille display. *Lecture Notes in Computer Science*, 9176, 71-81. https://doi.org/10.1007/978-3-319-20681-3_7

[53] Argyropoulos, V., Kouroupetroglou, G., Martos, A., Nikolaraizi, M., & Chamonikolaou, S. (2014). Patterns of Blind Users' Hand Movements: The Case of Typographic Signals of Documents Rendered by Eight-dot and Six-dot Braille Code. *Lecture Notes in Computer Science*, 8547, 77-84, https://doi.org/10.1007/978-3-319-08596-8_12

[54] Argyropoulos, V., Martos, A., Kouroupetroglou, G., Chamonikolaou, S., & Nikolaraizi, M. (2014). An experimental approach in conceptualizing typographic signals of documents by eight-dot and six-dot braille code. *Lecture Notes in Computer Science*, 8514, 83-92. https://doi.org/10.1007/978-3-319-07440-5_8

[55] Martos, A., Kouroupetroglou, G., Argyropoulos, V., & Deligiorgi, D. (2014). Towards the 8-dot Nemeth braille code. *Lecture Notes in Computer Science*, 8547, 533-536. https://doi.org/10.1007/978-3-319-08596-8_83

[56] Martos, A., Kouroupetroglou, G., & Argyropoulos, V. (2015). 8-dot Braille Code for Complex Nemeth Symbols. In *Proceedings of the International Conference on Enabling Access for Persons with Visual Impairment*, (pp. 115-119). Retrieved from https://access.uoa.gr/ICEAPVI-2015/proceedingsFiles/117-121.pdf

[57] Kouroupetroglou, G., Martos, A., Papandreou, N., Papadopoulos, K., Argyropoulous, V., & Sideridis, G.D. (2016). Tactile Identification of embossed raised lines and raised squares with variable dot elevation by persons who are blind. *Lecture Notes in Computer Science*, 9759, 77-84. https://doi.org/10.1007/978-3-319-41267-2_11

[58] Martos, A., Kouroupetroglou, G., Argyropoulos, V., & Papadopoulos, K. (2021). Tactile identification of embossed lines and square areas in diverse dot heights by blind individuals. *Universal Access in the Information Society*, *20*, 333-342 https://doi.org/10.1007/s10209-020-00729-4

[59] InSIDE - Including Students with Impairments in Distance Education. https://www.inside-project.org/

[60] Edu4ALL-Disability as Diversity: The Inclusion of Students with Disabilities in Higher Education. https://edu4all.psdpal.org/

[61] IDEA - Inclusive Tertiary Education in the Western Balkans. https://idea-cbhe.com/