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Extracting Graphical Information from Arabic e-Documents for Visually Impaired People

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Abstract— Information graphics play a crucial role in a variety of multimodal documents, especially when the concern is about Arabic language which is widely used by many people in the world for communication. Alas, visually impaired people who utilize screen reader software's to steer through such electronic documents have restricted access to the graphics. This research work facilitates blind users to put on access to information graphics that materialize on web pages of Arabic websites and electronic documents. The interface is put into operation as a browser adjunct that instigate by a key hit combination. The result of this research work is a textual synopsis of the graphic, the basic content of which is the hypothesized message of the graphic creator. The textual synopsis of the graphic is then passing on to the end user by screen reader software. The carried work has the following benefits 1) not entails any action on the side of the website developer, and 2) giving the end user with the message that individual can gain the knowledge from viewing the graphics. Overall this work results in a system interface which is easy to handle and an effective way of communicating the informational content of graphics to the visually impaired people in Kingdom of Saudi Arabia.

Index Terms— Accessibility, Information Graphics, Multimodal Documents, Visually Impaired.

I. INTRODUCTION

Accessibility of electronic documents such as newspapers, reports etc refers to access information by all individuals, regardless of technological or physical discrimination [1]. Accessibility for web based interaction with blind users refers to making the content perceivable, operable, understandable, robust and easy to navigate and interact with. It is treated as a technical construct that allows the use of assistive technologies such as screen readers etc., in order to give necessary access to interface elements of a system. Due to their efficacy in illustrating quantitative data and the relations amid them, information graphics such as bar charts, line graphs are extensively used and these image appearances give stern information access ultimatums for visually impaired users. This work mainly focuses on Arabic information graphics from well-liked media and electronic documents which are accessed by worldwide web (WWW). The greater part of such graphics is aimed to convey a message. The primary goal of [2] was to develop mechanisms for providing visually impaired persons with alternative access to the content of information graphics. Especially, individuals with sight impairments have deficit access to multimodal documents.

The World Health Organization (WHO) estimated that there were 161 million persons worldwide with visual impairment, in the year 2002 [3, 4]. The majority of them resided in developing countries, including Saudi Arabia [5].

Various projects in the past have strived to make images accessible to visually impaired users by regenerating the image in an different medium, such as sound [6-8], touch [9] or a amalgamation of the two [6, 9]. Extended plan inference techniques[10] are deployed successfully in recognizing the intention of natural language utterances to the novel realm of information graphics. The research work done by Kurze [11] generates verbal description from text using the graphic properties to convey the content of a graphic by taking into consideration style of the graphics, data sets, labels on X-axis, Y-axis etc . Ferres et al. [12], presented the inspectGraph system, which has the aim of providing accessibility for blind users to the graphs published in Statistics Canada's "The Daily." Yu and Brewster [13] investigate the progress and utility of web-based multimodal graphs which use haptic devices and auditory output to convey the contents of the graphs to the users. In [14], the technical details and approaches are described thoroughly for the problem of generating a graphical element required for realizing the intended message of a graphic. Different systems [15-19] are developed for identifying the intended message of graphics. The text summary is also generated by successfully extracting the text caption from graphics and giving input to the screen reader. Image Processing is used for analyzing the graphic's image file and producing an XML representation [20]. Many text extraction algorithms exists in the past and one such algorithm is discussed in [21]. A text extraction algorithm based on thinning [22-24] and dataset comparison technique is explained in [25]. Once the message has been inferred by the Bayesian inference system [26], each category of high-level goal is represented by a node in the tree, and instances of these goals appear as children with inhibitory links [27]. Each goal is broken down further into subtasks and a tree is built dynamically. An XML representation of the visual graphic [28] that specifies the components of the graphic such as the number of bars and the heights of each bar etc. A Bayesian system [29] for recognizing the intended message and content identification rules for line graphs is presented in [30].

Generally visually impaired users browse for particular items on the page using the TAB key [31]. The user interface of the system is implemented as a Browser Helper Object (BHO) [32] that runs inside the Microsoft Internet Explorer. A set of propositions that capture information that someone might extract by looking at a simple bar chart is proposed in [33].

A better overall experience for handling pie charts, grouped bar charts and composite graphics is explained in [34-37]. How to present bar charts using a tactile presentation is explored in [38]. A system [39] to collect the drawings from visually impaired people by finger movement on Braille devices or touch devices, such as tablets is proposed. When the drawing data is collected, the system will automatically generate the graphical XML data, which are easily accessed by applications and web services. The graphical XML data are stored locally or remotely. The work [40] suggests a method to extract implicit information of Bar chart, Pie chart, Line chart and math's graph components of an electronic document and present them to vision impaired users in audio format. The proposed frame work methodology is efficient and faster when compared to the earlier work [41, 42]. In addition, the lack of guidance as to how information graphics is properly presented to visually impaired users is still a limitation [43].

Apart from this, the above discussed systems are only developed for graphics in English electronic media and as such no work has done for the graphics in Arabic documents which is most widely used language in the Arabian Peninsula. This research is independent with respect to others in order to achieve the goals. The overall aim is to generate a succinct coherent summary of a graphic contained in Arabic electronic documents which can hypothesize to the visually blind people through JAWS screen reader software.

II. METHODOLOGY

The following are the major phases outlined to achieve the research objectives. The first phase entails browser extension which let visually impaired users to access textual precis of information graphics. The second phase entails implementation issues that come across in research work. Image Processing Module (IPM) is the third phase and the next phase concerns with generating the summary and the last phase guidelines preparation. All steps presented below are inter-related that will lead to the design and implementation of proposed system.

A. Phase I: The Browser Extension

Since the research work mainly focuses visually impaired people, the users must be able to launch the application from the keyboard. Intended for browser extension the research work is carried on distinctively for JAWS 14.0 and Internet Explorer 9.0 or later. When finding the way through a web page, JAWS clients have many alternatives. So other than the existing navigation commands in JAWS, CONTROL+Z is selected as the key coalition for launching the project interface. However, this work requires a very taut coupling flanked by the system and the web browser, because the system needs to determine the currently focused graphic in the web browser. The apt level of integration can be attained by implementing the user interface as a Browser Helper Object for Internet Explorer. If the item in focus emerges to be a graphic containing a bar chart, the system then attempts to surmise the intended message of the bar chart. The resultant textual summary is presented to the user in a new window. The text in that new-fangled window is then read to the user by JAWS as depicted in Fig. 1.
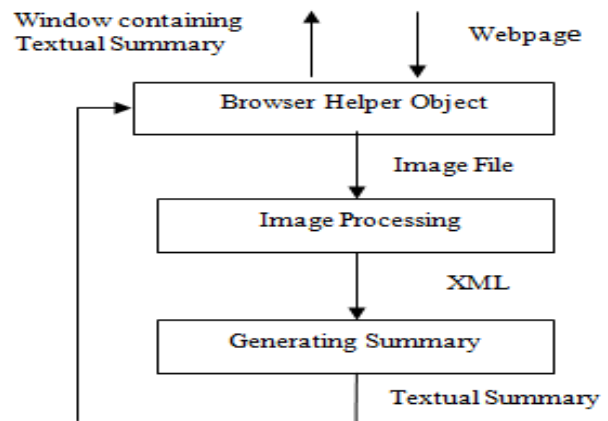
Fig. 1 Block Diagram

B. Phase II: Implementation Issues

In this work the BHO is operating inside Internet Explorer, and in order to avoid the confusion that the user may try to launch the system to process a graphic that is not a bar chart. As a result, when the CONTROL+ Z keystroke is detected, the BHO runs a pithy image processing algorithm to determine whether the chosen graphic has particular attributes that identify it as a possible bar chart, such as whether the graphic has 20 or smaller number of gray levels, and with a common commencement row or column. In case, if the graphic does not resemble to be a bar chart, the message

"في الرسم المحدد لا يظهر انه مخطط شريطي"

"The focussed graphic does not appear to be a bar chart," is read to the user by JAWS.

Users hits CONTROL+Z upon JAWS arrive at the graphic, the BHO is activated. If the graphic materializes to be a bar chart, the BHO will insert that graphic into the tab order of the page, and will append

"هذا الرسم يظهر انه مخطط شريطي"

"This focused graphic appears to be a bar chart" to the alt text.

C. Phase III: Processing the Image

The Image Processing Module IPM is responsible for analyzing the graphic's image[20, 26] file and producing an XML representation containing information about the components of the information graphic. The processing of an image can be done as follows which is depicted in Fig. 2.
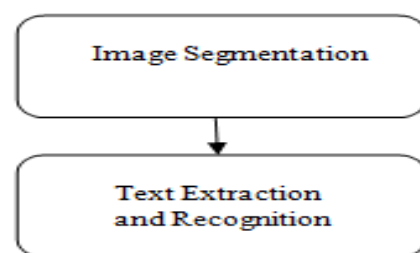
Fig. 2 Image Processing Block Diagram

The purpose of image segmentation is to bunch pixels into salient image regions, i.e., regions analogous to individual surfaces, objects, or natural parts of objects.

In the text extraction and recognition step each individual segment received from step 1, is tested for text regions and object regions. Only the shots with text regions are considered further for text extraction. In this step we will start reading the pixel from the initial position (x_1, y_1) for the RGB values=(0,0,0) and copy those pixels and create another image which consists of only text with white background. And this process is repeated for every segment which has text region. We use the following data sets as shown in figure 3 for Arabic text extraction and recognition. Arabic character set has 28 characters and each character is written in any one of the four forms such as standalone, initial, medial and terminal. The blank fields for the characters in Fig. 3 (a) represents those forms are not available for that characters. Few characters can be omitted due to similarity and the character set used in this implementation is as shown in figure 3 (b). This work uses the same methodology as used in [25] for text extraction and recognition process.

In the next phase the shots with objects are considered and based on their boundary information, color etc., the bars in the graphic are compared and the necessary information is stored in a text file. The system identifies a number of ways in which a unit in a bar chart becomes salient. For a bar chart, the depiction includes the number of bars, the tags of the axes, and facts associated with every bar in the graph for example the label, altitude, color of the bar, and so forth [2]. This work currently handles only electronic images formed with a prearranged set of fonts and no overlapping characters.

D. Phase IV: Generating the Summary

Image Processing Module results is an XML file that describes the graphic and all of its components. The XML file is analyzed to build the appropriate Bayesian network. Each category of high-level goal is represented by a node in the network as shown in Fig. 4 and instances of these goals appear as children with inhibitory links capturing their mutual exclusivity. Each goal is broken down further dynamically into subtasks in order to append the nodes to the network.
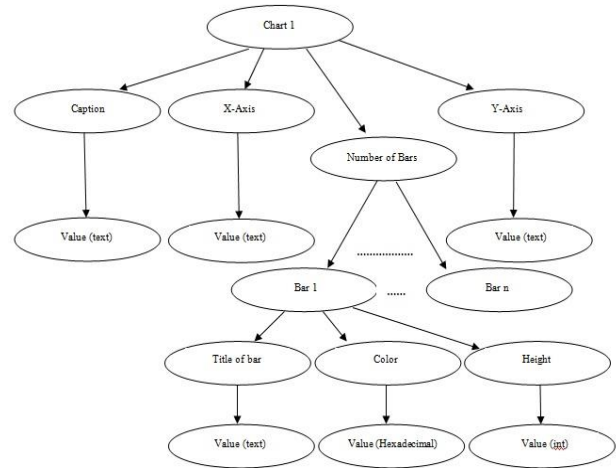

Fig. 4 Bayesian Network

E. Phase V: Guidelines Preparation

Image Processing Module (IPM) extracts the text and based on the appearance of the text **"الشكل 1"** the extracted text is added under the node "caption" in the Bayesian network, followed by the text extracted horizontally is added under the X-axis node and vertically extracted text is added under the node of Y-axis. The IPM module process the graph and based on the different colors appearing adjacent to one another count the number of bars, and for each bar its height, hexadecimal color code and title appearing adjacent to it and constructs the Bayesian Network. Conditional probability tables in Bayesian Network capture the probability of each of the values of a child node given the value of its parent(s). A spread sheet is constructed based on the Depth First Search (DFS) technique and record the values into the spreadsheet as shown in Table 1. This spread sheet can be given as an input to one of the screen reader software's so that the visually impaired people understand the intended message in the graphic.

III. RESULTS

The research work is conducted on 50 randomly selected graphics from electronic media. This work is implemented in Java using NetBeans IDE 8.0.1 and mySQL database. Intel i5 × 32 processor with 8 GB RAM and 1 TB hard disk is used for testing purpose. The input image and dataset samples are in jpeg format. For example, if the user bumps into the graphic shown in Fig. 5, the user thump CONTROL+Z and the summary of the graphic come into sight in a new window. For this picky graphic, this work generates the summary as shown in Table. 1.

S.No	Standalone	Terminal	Medial	Initial	S.No	Standalone	Terminal	Medial	Initial
1	ا	ـا			1	ا	ـا		
2	ب	ـب	ـبـ	بـ	2	ب			بـ
3	ت	ـت	ـتـ	تـ	3	ت			تـ
4	ث	ـث	ـثـ	ثـ	4	ث			ثـ
5	ج	ـج	ـجـ	جـ	5	ج	ـج		جـ
6	ح	ـح	ـحـ	حـ	6	ح	ـح		حـ
7	خ	ـخ	ـخـ	خـ	7	خ	ـخ		خـ
8	د	ـد			8	د			
9	ذ	ـذ			9	ذ			
10	ر	ـر			10	ر			
11	ز	ـز			11	ز			
12	س	ـس	ـسـ	سـ	12	س			سـ
13	ش	ـش	ـشـ	شـ	13	ش			شـ
14	ص	ـص	ـصـ	صـ	14	ص			صـ
15	ض	ـض	ـضـ	ضـ	15	ض			ضـ
16	ط	ـط	ـطـ	طـ	16	ط		ـطـ	
17	ظ	ـظ	ـظـ	ظـ	17	ظ		ـظـ	
18	ع	ـع	ـعـ	عـ	18	ع	ـع	ـعـ	عـ
19	غ	ـغ	ـغـ	غـ	19	غ	ـغ	ـغـ	غـ
20	ف	ـف	ـفـ	فـ	20	ف		ـفـ	فـ
21	ق	ـق	ـقـ	قـ	21	ق		ـقـ	قـ
22	ك	ـك	ـكـ	كـ	22	ك			كـ
23	ل	ـل	ـلـ	لـ	23	ل			لـ
24	م	ـم	ـمـ	مـ	24	م	.		
25	ن	ـن	ـنـ	نـ	25	ن			نـ
26	ه	ـه	ـهـ	هـ	26	ه	ـه	ـهـ	هـ
27	و	ـو			27	و			
28	ي	ـي	ـيـ	يـ	28	ي	ـي		يـ

(a)   **(b)**

Fig. 3 (a) Arabic character set (b) Arabic character set for the research

الشكل 1: مستخدموا Linkedin في منطقة الخليج
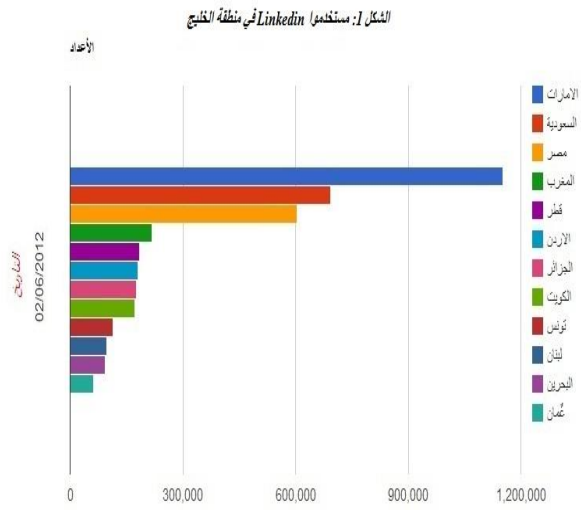
Fig. 5 Example Graph

Table. 1 (a) Summary of Graph in Arabic

التسمية التوضيحية			ينكدين المستخدمين في منطقة الخليج		
محور-X			الاعداد		
محور-Y			التاريخ 02/06/2012		
عدد الاشرطة			12		
شريط 1	عنوان	الإمارات	لون	0000FF	طول	1180000
شريط 2	عنوان	السعودية	لون	FF8C00	طول	740000
شريط 3	عنوان	مصر	لون	DAA520	طول	600000
شريط 4	عنوان	المغرب	لون	228B22	طول	270000
شريط 5	عنوان	قتر	لون	800080	طول	245000
شريط 6	عنوان	الاردن	لون	7B68EE	طول	213000
شريط 7	عنوان	الجزائر	لون	F08080	طول	191000
شريط 8	عنوان	الكويت	لون	32CD32	طول	179000
شريط 9	عنوان	تونس	لون	B22222	طول	130000
شريط 10	عنوان	لبنان	لون	0000CD	طول	110000
شريط 11	عنوان	البحرين	لون	BA55D3	طول	100000
شريط 12	عنوان	عمان	لون	20B2AA	طول	80000

Table. 1 (b) Summary of Graph in English

Caption		LinkedIn users in the Gulf region				
X-axis		Numbers				
Y-axis		Date 02/06/2012				
Number of Bars		12				
Bar 1	Title	Emirates	Color	0000FF	Height	1180000
Bar 2	Title	Saudi Arabia	Color	FF8C00	Height	740000
Bar 3	Title	Egypt	Color	DAA520	Height	600000
Bar 4	Title	Morroco	Color	228B22	Height	270000
Bar 5	Title	Qatar	Color	800080	Height	245000
Bar 6	Title	Jordon	Color	7B68EE	Height	213000
Bar 7	Title	Algeria	Color	F08080	Height	191000
Bar 8	Title	Kuwait	Color	32CD32	Height	179000
Bar 9	Title	Tunisia	Color	B22222	Height	130000
Bar 10	Title	Lebanon	Color	0000CD	Height	110000
Bar 11	Title	Bahrain	Color	BA55D3	Height	100000
Bar 12	Title	Oman	Color	20B2AA	Height	80000

IV. CONCLUSION

The developed framework has the following benefits

- High user satisfaction.
- Less complexity.
- Natural Language Processing not required.
- The proposed frame work is efficient and faster when compared to the earlier work [41, 42].

This work can be extended to the other types of charts like, pie chart, line chart, column chart, area chart etc.

REFERENCES

[1] S. Henry, "*Web Accessibility Web Standards and Regulatory Compliance*," 1st ed., 2006.

[2] S. Carberry, S. Elzer and S. Demir, "Information Graphics: An Untapped Resource for Digital Libraries," In Proc. of 29th annual International ACM SIGIR Conference on Research and Development in Information Retrieval, Seattle, WA, USA, 06-10 Aug., 2006, pp. 581-588.

[3] S. Resnikoff, D. Pascolini, D. Etyáale, I. Kocur, R. Pararajasegaram, G.P. Pokharel, et al., "Global Data on Visual Impairment in the Year 2002," *Bull. World Health Organ*., vol. 82, 2004, pp. 844–851.

[4] D. Pascolini, S.P. Mariotti, G.P. Pokharel, R. Pararajasegaram, D. Etyáale , A.D. Negrel, et al., "2002 Global Update of Available Data on Visual Impairment: A Compilation of Population-Based Prevalence Studies," *Ophthalmic Epidemiol*, vol. 11, issue 2, 2004, pp.67–115.

[5] K. F. Tabbara, "Blindness in the Eastern Mediterranean Countries," *Br. J. Ophthalmol*., vol. 85, issue 7, 2001, pp.771–775.

[6] P. B. Meijer, "An Experimental System for Auditory Image Representations," *IEEE Transactions on Biomedical Engineering*, vol. 39, issue 2, 1992, pp.112–121.

[7] A. R. Kennel, "Audiograf: A Diagram-reader for the Blind," In Proc. *Second Annual ACM Conference on Assistive Technologies*, Vancouver, BC, Canada, 11-12 Apr., 1996, pp. 51–56.

[8] J. L. Alty and D. Rigas, "Communicating Graphical Information to Blind Users Using Music: The role of context," In Proc. of *CHI-98, Human Factors in Computer Systems*, Los Angeles, CA, USA, 18-23 Apr., 1998, pp. 574–581.

[9] S. Ina, "Computer Graphics for the Blind," *ACM SIGCAPH Computers and the Physically Handicapped*, vol. 55, Jun.1996, pp. 16–23.

[10] E. Charniak and R. P.Goldman, "A Bayesian Model of Plan Recognition," *Artificial Intelligence*, vol. 64, issue 1, 1993, pp. 53–79.

[11] M. Kurze, "Giving Blind People Access to Graphics (example: Business Graphics)," In Proc. *Software-Ergonomie '95 Workshop*, Darmstadt, Germany, 22 Feb.,1995.

[12] L. Ferres, P. Verkhogliad, G. Lindgaard, L. Boucher, A. Chretien and M. Lachance, "Improving Accessibility to Statistical Graphs: The Inspectgraph System," In Proc. of *Ninth International ACM SIGACCESS Conference on Computers and Accessibility (ASSETS)*, Tempe, AZ, 14-17 Oct., 2007, pp. 67–74.

[13] W. Yu, D. Reid and S. Brewster, "Web-based Multimodal Graphs for Visually Impaired People," In Proc. of the *1st Cambridge Workshop on Universal Access and Assistive Techn*., Cambridge, UK, 2002, pp. 97–108.

[14] S. Demir, S. Carberry, and S. Elzer, "*Issues in Realizing the Overall Message of a Bar Chart*," John Benjamins, 5th ed. Amsterdam, 2009, pp. 311–320.

[15] M. Corio and L. Lapalme, "Generation of Texts for Information Graphics," In Proc. of the *7th European Workshop on Natural Language Generation*, Toulouse, 1999, pp. 49–58.

[16] S. Elzer, S. Carberry and S. Demir, "Communicative Signals as the Key to Auto-mated Understanding of Bar Charts," *LNCS*, vol. 4045, 2006, pp. 25-39.

[17] S. Demir, S. Carberry and S. Elzer, "Effectively Realizing the Inferred Message of an Information Graphic," In Proc. of the *International Conference on Recent Advances in Natural Language Processing (RANLP)*, Borovets, Bulgaria, 27-29 Sep., 2007, pp. 150–156.

[18] R. Burns, S. Elzer and S. Carberry, "Estimating Effort for Trend Messages in Grouped Bar Charts," *LNCS*, vol. 5223, 2008, pp. 353–356.

[19] S. Demir, D. Oliver, E. Schwartz, S. Elzer, S. Carberry, K. F. McCoy and D. Chester, "Interactive sight: Textual Access to Simple Bar Charts", *The New Review of Hypermedia and Multimedia*, vol. 16, issue 3, 2010, pp. 245–279.

[20] A. K. Jain and B. Yu, "Automatic Text Location in Images and Video Frames," *Pattern Recognit*., vol. 31, issue 12, 1998, pp. 2055–2076.

[21] M. B. Halima, H. Karray and A.M. Alimi, "A Comprehensive Method for Arabic Video TextDetection, Localization, Extraction and Recognition," *LNCS*, vol. 6298, 2010, pp. 648–659.

[22] M. Sudarma and N. P. Sutramiani, "The Thinning Zhang-Suen Application Method in the Image of Balinese Scripts on the Papyrus," *International Journal of Computer Applications*, vol. 91, 2014, pp. 9–13.

[23] G. Kumar and A. Oberoi, "Improved Parallel Thinning Algorithm for Numeral Patterns," *International Journal of Research In Commerce, IT & M*, vol. 3, 2013, pp. 43–47.

[24] T. Abu-Ain, et al., "A Fast and Efficient Thinning Algorithm for Binary Images," *Journal ICT Research Application*, vol. 7, 2013, pp. 205–216.

[25] A. K. J. Saudagar, H. V. Mohammed, K. Iqbal and Y. J. Gyani, "Efficient Arabic Text Extraction and Recognition using Thinning and Dataset Comparison Technique," In Proc. of *International Conference on Communication, Information & Computing Technology (ICCICT)*, Mumbai, India, 15-17 Jan., 2015, pp. 1–5.

[26] S. Elzer, S. Carberry and I. Zukerman, "The Automated Understanding of Simple Bar Charts," *Artificial Intelligence*, vol. 175, issue 2, 2011, pp. 526–555.

[27] M. Huber, E. Durfee and M. Wellman, "The Automated Mapping of Plans for Plan Recognition," In Proc. of *Tenth Conference on Uncertainty in Artificial Intelligence*, Seattle, WA, 29-31 Jul., 1994, pp. 344–351.

[28] D. Chester and S. Elzer, "Getting Computers to See Information Graphics so Users do not have to," *LNCS* , vol. 3488, 2005, pp. 660–668.

[29] W. Peng, S. Carberry, S. Elzer, and D. Chester, "Recognizing the Intended Message of Line Graphs," *LNCS*, vol. 6170, 2010, pp. 220–234.

[30] C. F. Greenbacker, S. Carberry and K. F. McCoy, "A Corpus of Human-Written Summaries of Line Graphs," In Proc. of the *EMNLP 2011 Workshop on Language Generation and Evaluation*, Edinburgh, 31 Jul., 2011, pp. 23–27.

[31] B. Leporini and F. Paterno, "Applying Web Usability Criteria for Vision-Impaired Users: Does It Really Improve Task Performance?," *International J. of Human-Computer Interaction*, vol. 24, issue 1, 2008, pp. 17-47.

[32] S. Elzer, E. Schwartz, S. Carberry, D. Chester, S. Demir, and P. Wu, "A Browser Extension for Providing Visually Impaired Users Access to the Content of Bar Charts on the Web," In the Proc. of *WEBIST*, Barcelona, Spain,3-6 Mar., 2007, pp. 59–66.

[33] S. Demir, S. Carberry and K. F. McCoy, "Generating Textual Summaries of Bar Charts," In Proc. of *Fifth International Natural Language Generation Conference*, Salt Fork, Ohio, USA, 12-14 Jun., 2008, pp. 7–15.

[34] R. Burns, S. Carberry and S. Elzer,"Visual and Spatial Factors in a Bayesian Reasoning Framework for the Recognition of Intended Messages in Grouped Bar Charts," In Proc. of the *AAAI 2010 Workshop on Visual Representations and Reasoning*, AAAI Press, Atlanta, 11-12 Jul., 2010, pp. 6–13.

[35] L. Ferres, G. Lindgaard and L. Sumegi,"Evaluating a Tool for Improving Accessibility to Charts and Graphs," In Proc. of the *12th International ACM SIGACCESS Conference on Computers and Accessibility. ASSETS '10*, ACM, Orlando, 25-27 Oct., 2010, pp. 83–90.

[36] C. F. Greenbacker, K. F. Mccoy, S.Carberry and D. D. Mcdonald, "Semantic Modeling of Multimodal Documents for Abstractive Summarization," In Proc. of the *Canadian AI 2011 Workshop on Automatic Text Summarization*, University of Ottawa, St. John's, Newfoundland, 24 May 2011, pp. 29–40.

[37] R. Burns, S. Carberry, S. Elzer and D. Chester, "Automatically Recognizing Intended Messages in Grouped Bar Charts," *LNCS*, vol. 7352, 2012, pp. 8–22.

[38] C. Goncu, K. Marriott and J. Hurst, "Usability of Accessible Bar Charts. In Proc. of the *Sixth International Conference on the Theory and Application of Diagrams*," *LNCS*, vol. 6170, 2010, pp. 167–181.

[39] X. Hao, "*A Support System for Graphics for Visually Impaired People*," Master of Science Thesis, The School of Graduate and Postdoctoral Studies, The University of Western Ontario London, Ontario, Canada, 2013.

[40] N. Azadeh and M. Iain, "A Method to Provide Accessibility for Visual Components to Vision Impaired," *International Journal of Human Computer Interaction*, vol. 4, 2013, pp. 54–69.

[41] S. Elzer, S. Carberry, I. Zukerman, D. Chester, N. Green and S. Demir, "A Probabilistic Framework for Recognizing Intention in Information Graphics," In Proc. of 19th International Joint Conference on Artificial Intelligence, Edinburgh, Scotland, UK, 30 Jul. - 05 Aug., 2005, pp. 1042–1047.

[42] S. Elzer, S. Carberry, D. Chester, S. Demir, N. Green, I. Zukerman and K. Trnka, "Exploring and Exploiting the Limited Utility of Captions in Recognizing Intention in Information Graphics," In Proc. *43rd Meeting of Association for Computational Linguistics*, Michigan, 25-30 Jun., 2005, pp. 223–230.

[43] H. K. Ault, J. W. Deloge, M. J. Morgan and J. R. Barnett, "Web Accessibility of Statistical Data for Blind and Low Vision Users," In Proc. of *CWUAAT*, Cambridge, UK, 25-27 Mar., 2002, pp. 25–32.

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