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Organization of Museum Exhibit Information for Ubiquitous Visitors

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Abstract

INTRODUCTION: A wide variety and an increasing amount of exhibit information is often overwhelming for the museum ubiquitous visitors.
OBJECTIVES: In this work, we propose the organization of museum exhibit information to mitigate the information overloading problem of the ubiquitous visitors.
METHODS: The *Introductory Attributes (IA)*, *Functional/Behavioral Attributes (F/BA)*, and *Descriptive Attributes (DA)* which broadly characterize the museum exhibit information are organized as essential and further as elaborated information at the levels of school kids, college students, and professionals ubiquitous visitors.
RESULTS: The results show that the museum exhibit information organization time and the size of the organized information increases with the increase in the understanding levels of the ubiquitous visitors.
CONCLUSION: The organization of Swami Vivekananda exhibit information indicates an example of catering information for the individual requirements of museum ubiquitous visitors.

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1. Introduction

The increasing capacity of museum archives has led to the availability of a large amount of exhibit information. However, from a large amount of exhibit information, mostly a small fraction of information segments might be relevant for the ubiquitous visitors [1–5]. Museum ubiquitous visitors are the visitors who need anywhere, anytime exhibit information according to their individual requirements without any requests or interventions. Thus, providing exhibit information as available from the original sources may lead to offer the same information to the ubiquitous visitors, despite the fact that their individual requirements such as levels of understandings, interests, etc., are different [6–10]. In other words, museum ubiquitous visitors may have different information need [11, 12]. Even with such individual requirements of the ubiquitous visitors, accordingly, the organization of museum exhibit information is not widely discussed. Indeed, from the perspectives of the ubiquitous visitors, organization of exhibit information is useful for both: (i) To alleviate the information overloading problem for the ubiquitous visitors by filtering and managing a large amount of information at different levels; (ii) To provide the most significant exhibit information pertaining to the individual requirements of the museum ubiquitous visitors.

1.1. Proposed Idea

This paper presents the organization of museum exhibit information to cater to the individual needs of the ubiquitous visitors. We organize the museum exhibit information as essential information and further as elaborated information at the levels of school kids, college students, and professionals ubiquitous visitors, respectively. The *Introductory Attributes (IA)*, *Functional/Behavioral Attributes (F/BA)*, and *Descriptive*

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Attributes (DA) which broadly characterize the exhibit information are identified and used to organize the exhibit information. The organized museum exhibit information is maintained at respective URLs to dynamically cater to the individual requirements of the ubiquitous visitors. We present an example of organization of *Swami Vivekananda* exhibit information. The simulation results show that the museum exhibit information organization time and the size of the organized information increase with the increase in the understanding levels of the ubiquitous visitors.

1.2. Organization of the Paper

The rest of the paper is organized as follows. Section 2 discusses some of the related work. Section 3 presents the organization layout of the museum exhibit information. Section 4 provides an example of the organization of *Swami Vivekananda Exhibit Information* at the level of school kids, college students, and professionals ubiquitous visitors. Section 5 presents the simulation results followed by the conclusion and future work in Section 6.

2. Related Work

Providing exhibit information museum services to the ubiquitous visitors introduces new challenges in the organization of exhibit information [6, 7, 12–23]. The key points of concern here are: (i) Maintain the focus of attention of museum ubiquitous visitors and to avoid distractions through information overloading (ii) Provide exhibit information according to the individual requirements of the museum ubiquitous visitors. Katz et al. [6] have presented a methodological approach to design museum presentations in PEACH and PIL projects [7, 8]. For the organization of exhibit information, the whole exhibition, its objects, objectives, and the visitor interested information are considered. Nine steps are used to prepare museum presentation: (i) Finding the main idea of the exhibition (ii) Recording exhibits (iii) Defining fields of interests (iv) Searching and selecting source text (v) Writing text (spoken language) (vi) Choosing images (vii) Selection of cinematographic techniques (viii) Audio generation (ix) Synchronizing audio and images. These steps are used to support museum visitors to obtain museum presentations at their own pace and knowledge level.

MacroNode approach [15] is developed within HyperAudio [24] and HIPS [20] project to dynamically compose the adaptive hypermedia for the museum. The available information is divided into content units (called Macronodes) which are annotated with the required descriptions. The annotations provide an explanation of the main topic of macronodes and the rhetorical relations exists with the other nodes. At the time of interaction of the visitors, the system dynamically designs the nodes of hypermedia with varied pieces of information using rule-based mechanism which encodes strategies according to the user model and the domain model. For textual information, macronode is considered as paragraphs. Moreover, macronode may represent data from different media such as text, audio, images, or any of these combinations.

In [13], effective levels of adaptation support are discussed for the different types of visitors during navigation of museum information. The adaptation support is discussed for: Presentation, where different types of media, layout and the attributes of the perceived components are considered; Information, where a change in the information content of the same topic for a different type of visitors are considered; Navigation, where different links to different locations and modalities are considered. In [25], four components are discussed to improve visitor's museum experience which includes information representations, modeling visitors, matching visitors and content, and providing content to the visitors. These components enable to provide exhibit information according to the individual requirements of the museum visitors.

M-PIRO (Multilingual personalized information objects) [26, 27] project is designed to provide automatic multilingual textual and spoken descriptions of exhibits. The descriptions are generated in several languages and are tailored to the visitor's backgrounds, ages, and their past interaction with the system. The techniques related to the field of natural language generation, user modeling, and speech synthesis are used to develop the information about the exhibits, which is stored in the database to present over the Web. M-PIRO extends ILEX's and HIPS [20, 28] technology by incorporating enhanced multilingual capabilities, higher quality speech output, modular core generation engine, and extended user modeling mechanisms. M-PIRO has discussed four stages within natural language generation for the exhibit information descriptions: (i) Content selection specifies the facts i.e., relations or attributes that the exhibit information should describe; (ii) Document planning which specifies the sequence of facts and their rhetorical relations; (iii) Microplanning specifies how facts expressed as a phrase in each language; (iv) Surface realization produces the final textual form of the descriptions.

The Personal Experience with Active Cultural Heritage (PEACH) [7] project has constructed the suite of interactive and visitor-adaptive technologies for providing individual experience to the museum visitors. For providing an adaptive, intelligent presentation of exhibit information PEACH has implemented all features similar to ILEX [28], and introduced video along with the texts and images. Xscript language is used to provide coherent presentations [29]. The presented

approach expands the range of choices to prepare coherent presentations for the visitors according to their history, interests, and previous knowledge.

PIL (Personal experience with active cultural heritage-IsraeL) is designed as an extension of the PEACH project [30]. PIL project architecture consists of a personal broker which present on visitor device to deliver presentations and enables the visitor to control the system; a spatial information broker observes visitor position; a visitor modeler updates the model of an individual visitor; a presentation composer suggests presentation according to the preferences and locations of the visitors; and a service manager provides context-aware communication for visitors. In order to provide personalized services in museum different aspects are presented in [8], which includes preparation of museum contents, ubiquitous visitor modeling, visitor interface design, and system architectural aspects.

Oppermann et al. [21] has discussed the nomadic information system for automatic selection and presentation of exhibit information. A Web-based client-server approach based on the visitor model provides adaptive selection and presentation of exhibit information. The visitors are allowed to control the adaptation by specifying their interests in a visitor model dialog. Visitor interests are acquired by explicit visitor dialogs where the visitors are allowed to set the languages, choose automatic or manually controlled presentations, and configure the interfaces, etc.

In [16, 31], macronode and cinematic techniques [14, 32] are discussed to provide dynamic presentations in museum. The rhetorical structure theory and the repositories of material are used to provide specific presentations based on the locations of the visitors and the system observations about the visitor's behavior to obtain interests. In [33], SCALEX toolkit is designed to prepare museum exhibitions with digital and personalized content presentations according to the individual interests of the visitors.

Despite of existing approaches available in the literature, the new approach of the organization of museum exhibit information is still needed as providing exhibit information is a compelling future to enhance ubiquitous visitor's experience. The proposed approach of the organization of museum exhibit information improves the relevance of exhibit information for the individual requirements of the ubiquitous visitors.

3. Organization Layout of Museum Exhibit Information

The organization layout of the museum exhibit information is as shown in Figure 1. The proposed layout consists of three levels of exhibit information at the level of *School Kids*, *College Students*, and *Professionals* ubiquitous visitors. The organization layout is needed since depending on the education levels or levels of understandings, etc., different segments of the exhibit information are of different relevance for the museum ubiquitous visitors [11, 21, 22, 34–39]. The segment of the exhibit information which needs to be provided depends on the understanding levels of the museum ubiquitous visitors [13, 14, 40, 41]. Thus, we organize the exhibit information at three levels, as essential information and further as elaborated information according to the understanding levels of the ubiquitous visitors. The organized exhibit information is linked to the specific URLs to provide relevant exhibit information museum services to the ubiquitous visitors.

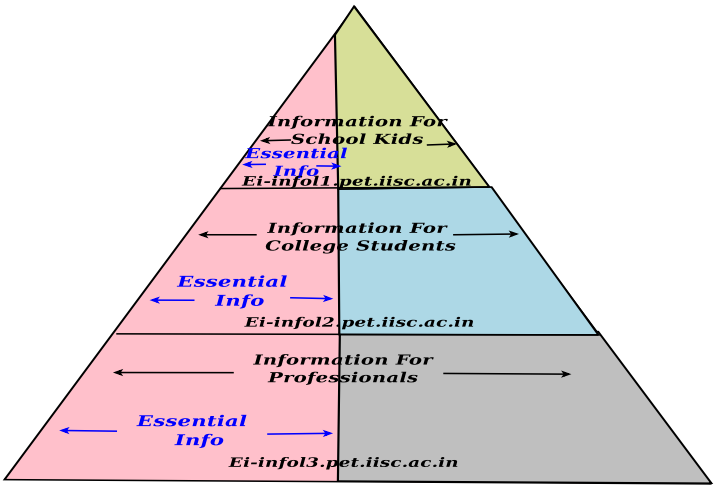

Figure 1. Organization Layout of Museum Exhibit Information

Each exhibit information describes the attributes and facts of the exhibits from multiple points of view depending on the types of exhibits [26]. The exhibit could be a historical statue, scientific exhibits, biological exhibits, zoological exhibits, paintings, historical locations, etc. We consider, the exhibit information broadly characterizes the details about the *Introductory Attributes (IA)* such as identity, type, size, shape, color, texture, place, time, and origin of the exhibits; the *Functional/Behavioral Attributes (F/BA)* such as functions, working, properties, and role of the exhibits; and the *Descriptive Attributes (DA)* such as additional evidence, facts, features, specifications, life cycle, journey, and life history of the exhibits.

The organization layouts are designed based upon the predefined schematic representation of the exhibit information. The layout provides a standard way to describe the exhibit information with a predefined structure of segments, and their orders. The multiple levels of organized exhibit information are obtained by combining the information segments characterizing the attributes of the exhibits, where each information segment adds more details to the preceding information. The set of exhibit information attributes

are organized in advance and then dynamically combined together according to the understanding levels of the museum ubiquitous visitors. At each level, along with the essential information, more detailed information is added based on the understanding levels of the ubiquitous visitors as described below.

Essential Information: *Essential Information* provides the key information of the exhibit to motivate the visitors to explore the rest of the exhibit information. Depending on the understanding levels of the ubiquitous visitors, the essential information includes most common and comprehensive information characterizing different attributes of exhibits such as a key or basic information about the place, origin or formation of the exhibits; key or basic information about functions, properties, working, roles of the exhibits; key or basic information about features or specifications of the exhibits as shown in Figure 2, Figure 3, and Figure 4, respectively. During the visit, whenever, ubiquitous visitors has no/less available time, only the essential exhibit information is provided to the visitors. *Essential Information* about exhibits E_i is organized at respective URLs along with the elaborated information at each level.

Information for the School Kids: *School kids*, along with the *Essential Information*, need elementary and distinguishing information which describes different attributes of the exhibits such as the origin of exhibits, the period of exhibits, size, the shape of the exhibits, etc., with limited descriptions. Exhibit information of each exhibit E_i for the school kids is organized at *Level l1* and linked to URL E_i*-infol1.pet.iisc.in* as shown in Figure 2. The links indicate the relative order of the association between different segments of exhibit information attributes organized for the school kid ubiquitous visitors.

Information for the College Students: *College Students*, along with the *Essential Information*, need additional exhibit information, with the increasing details of description including objects descriptions, features descriptions, evidence about the origin, and so on. Exhibit information of each exhibit E_i for the college students is organized at *Level l2* and linked to URL E_i*-infol2.pet.iisc.in* as shown in Figure 3. The links indicate the relative order of the association between different segments of exhibit information attributes organized for the college student ubiquitous visitors.

Information for the Professionals: *Professionals*, along with the *Essential Information*, need detailed exhibit information which is available for the exhibits. For example, extended descriptions that describe additional facts, evidence about the origin, comparative facts, additional roles, detailed functionality, so on. Exhibit information of each exhibit E_i for the professionals is organized at *Level l3* and linked to URL E_i*-infol3.pet.iisc.in* as shown in Figure 4. The links indicate the relative order of the association between different segments of exhibit information attributes organized for the professional ubiquitous visitors.

The fundamental need of the organization is that the original museum exhibit information is relevantly segmented according to the requirements of the ubiquitous visitors. Indeed, the organization of museum exhibit information is essential for both: (i) To alleviate the information overloading problem for the ubiquitous visitors by filtering and managing the vast amount of information at different levels; (ii) To provide the most significant information pertaining to the individual requirements of the museum ubiquitous visitors. The organized museum exhibit information collates relevant segments of the exhibit information based upon the significance and the meaningful coherence [22, 40, 42]. The exhibit information is organized in advance and used dynamically to cater to the individual requirements of ubiquitous visitors.

4. The Examples of Organization of Exhibit Information

This section presents an example of the organization of *Swami Vivekananda* exhibit information. Different segments of exhibit information are identified depending on the available facts and attributes of the exhibits. We organize three levels l={l_1, l_2, l_3} of the exhibit information for the ubiquitous visitors such as *School Kids*, *college students*, *and professionals* in the succeeding order with each level contain the *Essential Information*. The *Essential Information* covers the most salient information, with each higher level l_1, l_2, and l_3 in succession adds more detailed exhibit information for the ubiquitous visitors. The segments of exhibit information are collated in their temporal order of occurrence, the order of events presented, the perspective with which the exhibit information is narrated, and the amount of information characterizes the exhibits to tailor to the requirements of ubiquitous visitors. The organized exhibit information in its multiple forms preserves the required information for the individual requirements of the ubiquitous visitors.

4.1. Swami Vivekananda Exhibit Information

We consider an example of *Swami Vivekananda* exhibit information as given in Figure 5. Suppose, original exhibit information of *Swami Vivekananda* as available from the server comprises of following points. The exhibit information consists of different segments which provide *Swami Vivekananda* birth details, his relationship with Ramakrishna, lecture tours in India, United Kingdom (UK), and United States (US), Vivekananda philosophy, publications, rock memorial, etc. The links indicate the relative order of the association between different segments

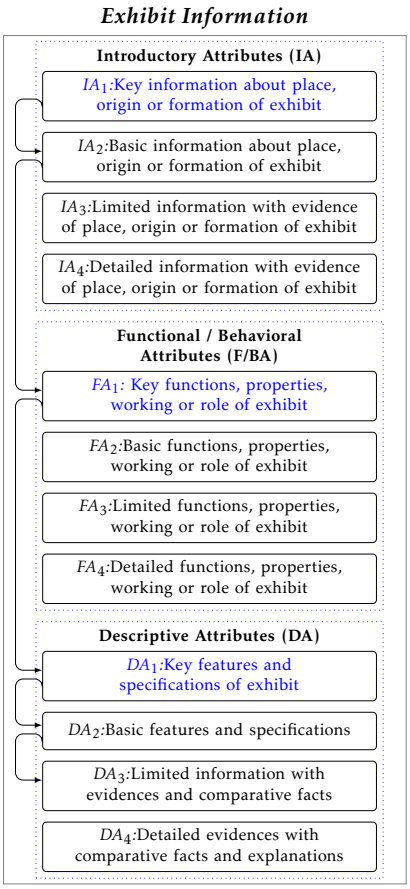

Figure 2. Organization Layout for School Kid Ubiquitous Visitors

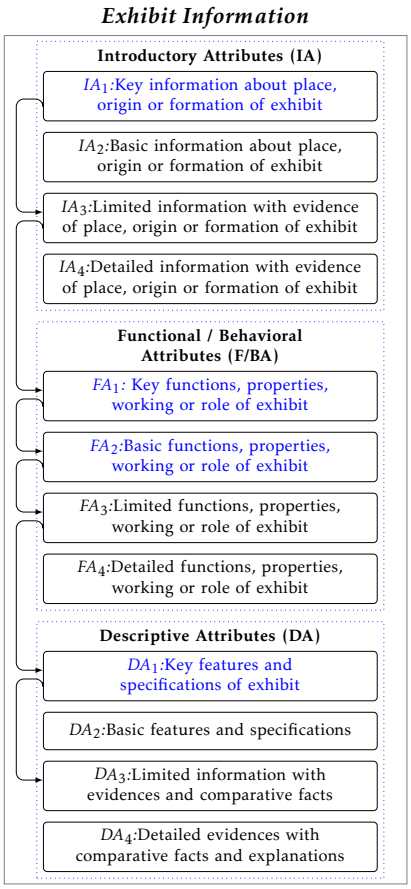

Figure 3. Organization Layout for College Student Ubiquitous Visitors

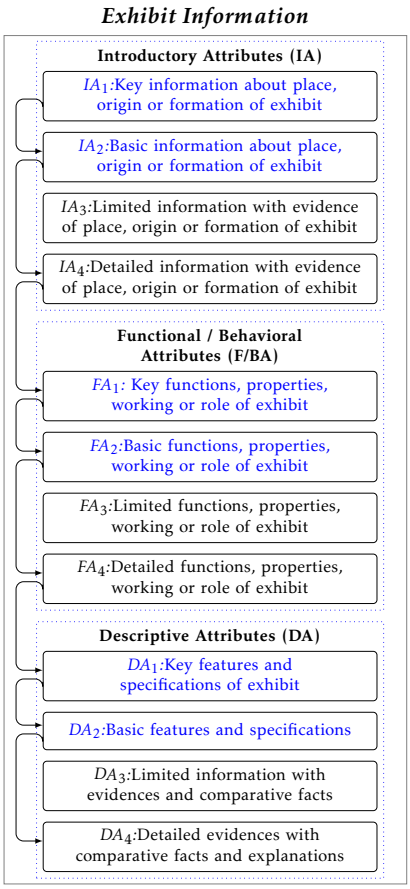

Figure 4. Organization Layout for Professionals Ubiquitous Visitors

of the exhibit information available at URLs. We present the organization of *Swami Vivekananda* exhibit information at three levels of details along with the essential information to cater to the individual needs of ubiquitous visitors as below.

The organization of *Swami Vivekananda* exhibit information for a school kid ubiquitous visitor at level l_1 is as shown in Figure 6. Initially, the information related to identity, origin such as *Swami Vivekananda* birth details, and basic functional and descriptive attributes such as his relationship with Ramkrishna and as Hindu monk are chosen to provide as essential information. Further, for organizing the exhibit information at a basic level l_1 other segments from the introductory, functional/behavioral, and descriptive attributes such as early childhood, his inclination towards Brahmo followers, etc., are chosen based on their order of occurrence for a school kid ubiquitous visitor.

Similarly, the organization of *Swami Vivekananda* exhibit information for a college student ubiquitous visitor at level l_2 is as shown in Figure 7. Initially, the information related to identity, origin such as *Swami Vivekananda* birth details, and basic functional and descriptive attributes such as his relationship with Ramkrishna and as Hindu monk are chosen to provide as essential information. Further, for organizing the exhibit information at the intermediate level l_2 other segments describing additional information about functional/behavioral, and descriptive attributes such as his teachings and philosophy and lecture tours are chosen based on their order of occurrence for a college student ubiquitous visitor.

The organization of *Swami Vivekananda* exhibit information for a professional ubiquitous visitor at level l_3 is as shown in Figure 8. Initially, the information related to identity, origin such as *Swami Vivekananda* birth details, his relationship with Ramkrishna, and functional and descriptive attributes such as his inclination towards Brahmo followers are chosen to provide as essential information. Further, for organizing the exhibit information at advanced level l_3, other segments describing detailed information about introductory, functional/behavioral, and descriptive attributes such as education details, his teachings, and philosophy, his lecture tours, book publications

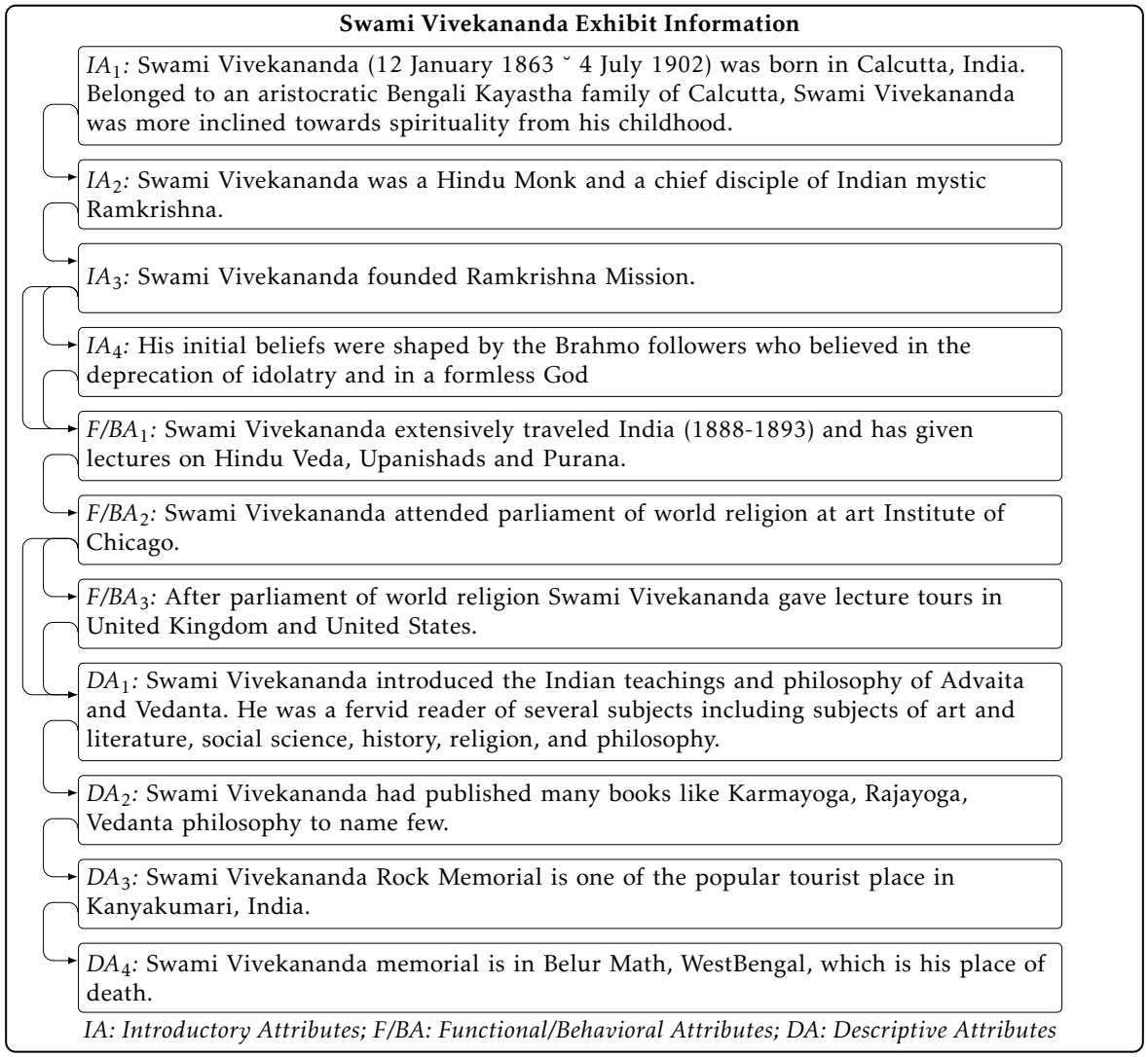

Figure 5. Original Exhibit Information of Swami Vivekananda [43]

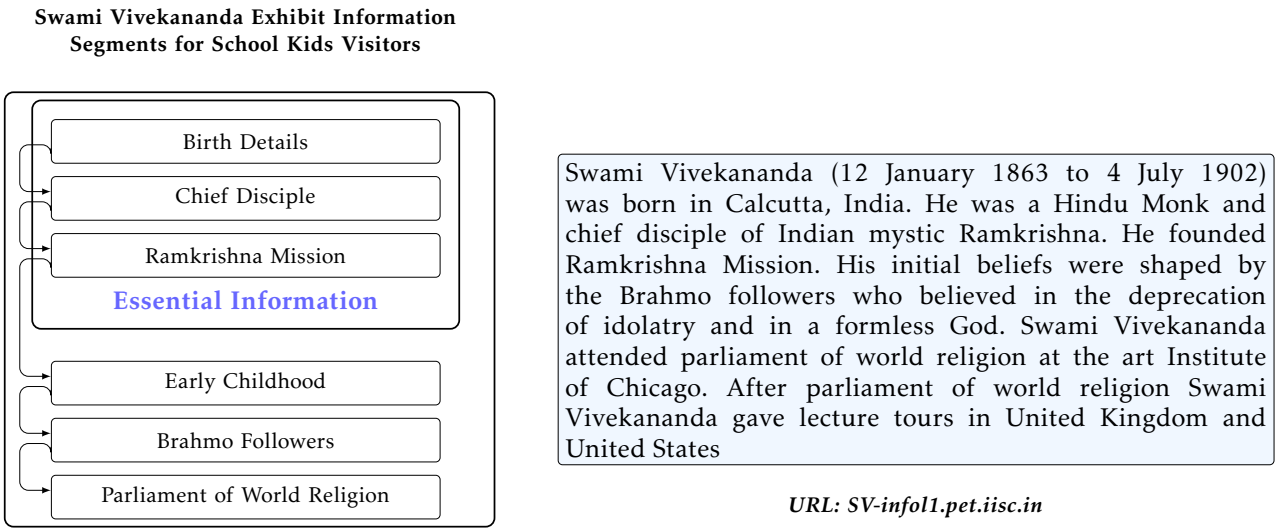

Figure 6. Organized Exhibit Information of Swami Vivekananda at *URL: SV-infol1.pet.iisc.in* for School Kid Ubiquitous Visitors

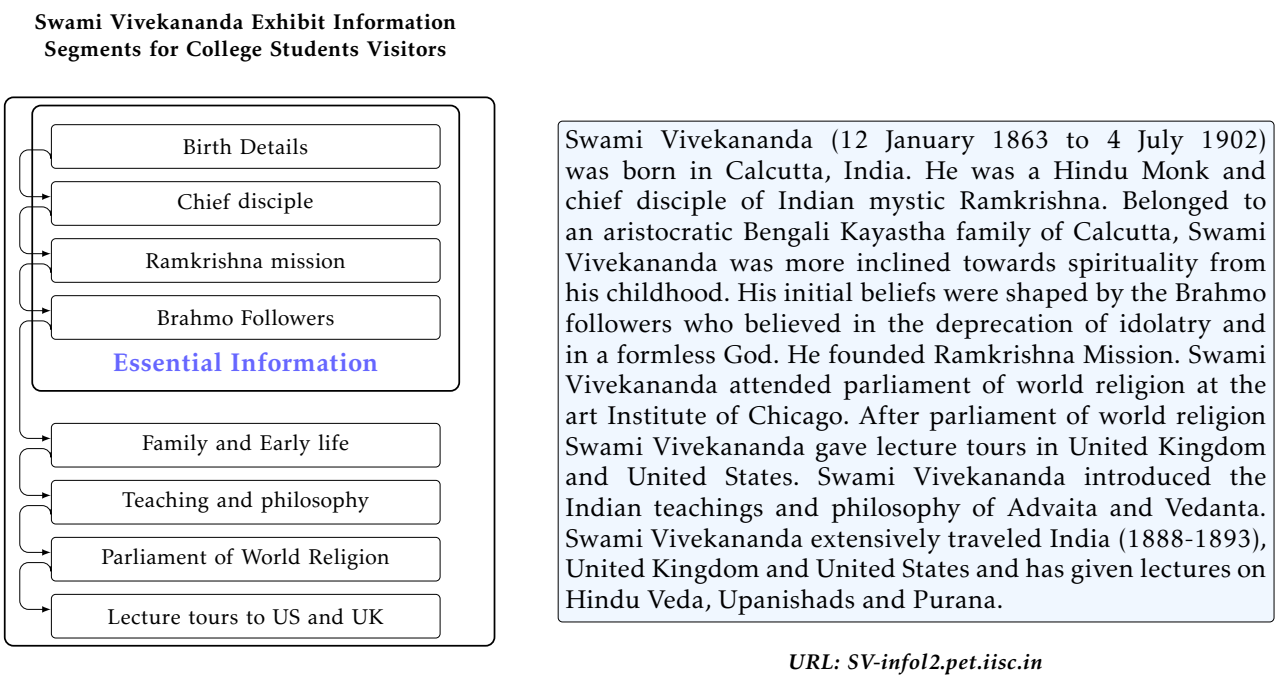

Figure 7. Organized Exhibit Information of Swami Vivekananda at *URL: SV-infol2.pet.iisc.in* for College Student Ubiquitous Visitors

are chosen based on their order of occurrence for a professional ubiquitous visitor.

5. Simulation Results

In this section, we present the simulation experiments for the organization of museum exhibit information for the ubiquitous visitors. We execute the simulation using Python scripts and evaluate the museum exhibit information organization time and the size of the organized information for three different exhibits information based on the understanding level of the ubiquitous visitors. In the simulation, we consider exhibit information of *Swami Vivekananda*, *Moon*, and *DNA* exhibits are available at the museum server with sizes 20 MB, 25 MB, and 30 MB, respectively. In the simulation, we consider the varying size of the exhibit information, with the variation in its essential exhibit information and the available introductory, functional/behavioral, and descriptive attributes. We evaluate the variation in the size of the organized exhibit information with respect to the original exhibit information at the understanding level of the ubiquitous visitors.

As shown in Figure 9, the size of the organized exhibit information of *Swami Vivekananda* decreases with the decrease in details from professional to school kid ubiquitous visitors, which avoids the overwhelming of information. The difference in sizes indicates the levels of details at which organized exhibit information (around 16 MB, 10MB, and 5MB) is provided for the professional, college student and the school kid ubiquitous visitors in comparison to the size of the original exhibit information (20 MB), which may contain excessive and irrelevant for the ubiquitous visitors.

Similarly, the size of the organized exhibit information of *Moon* and *DNA* exhibits decreases according to the understanding level of professionals, college students, and school kids ubiquitous visitors as shown in Figure 10 and Figure 11, respectively. Further, we evaluate the museum exhibit information organization time corresponding to the size of the exhibit information. The simulation is executed with varying essential exhibit information and the available introductory, descriptive, and functional/behavioral attributes, and accordingly exhibit information is organized for the professionals, college students, and school kid ubiquitous visitors. We found that with the increasing size of the exhibit information, and with more availability of essential exhibit information, the museum exhibit information organization time increases with the increase in the understanding levels of the ubiquitous visitors as shown in Figure 12.

6. Conclusion and Future Work

The organization of museum exhibit information is presented to cater to the individual requirements of the ubiquitous visitors. The *Introductory Attributes (IA)*, *Functional/Behavioral Attributes (F/BA)*, *and Descriptive Attributes (DA)* which broadly characterize the exhibit information are identified and used to organize the exhibit information. The exhibit information is

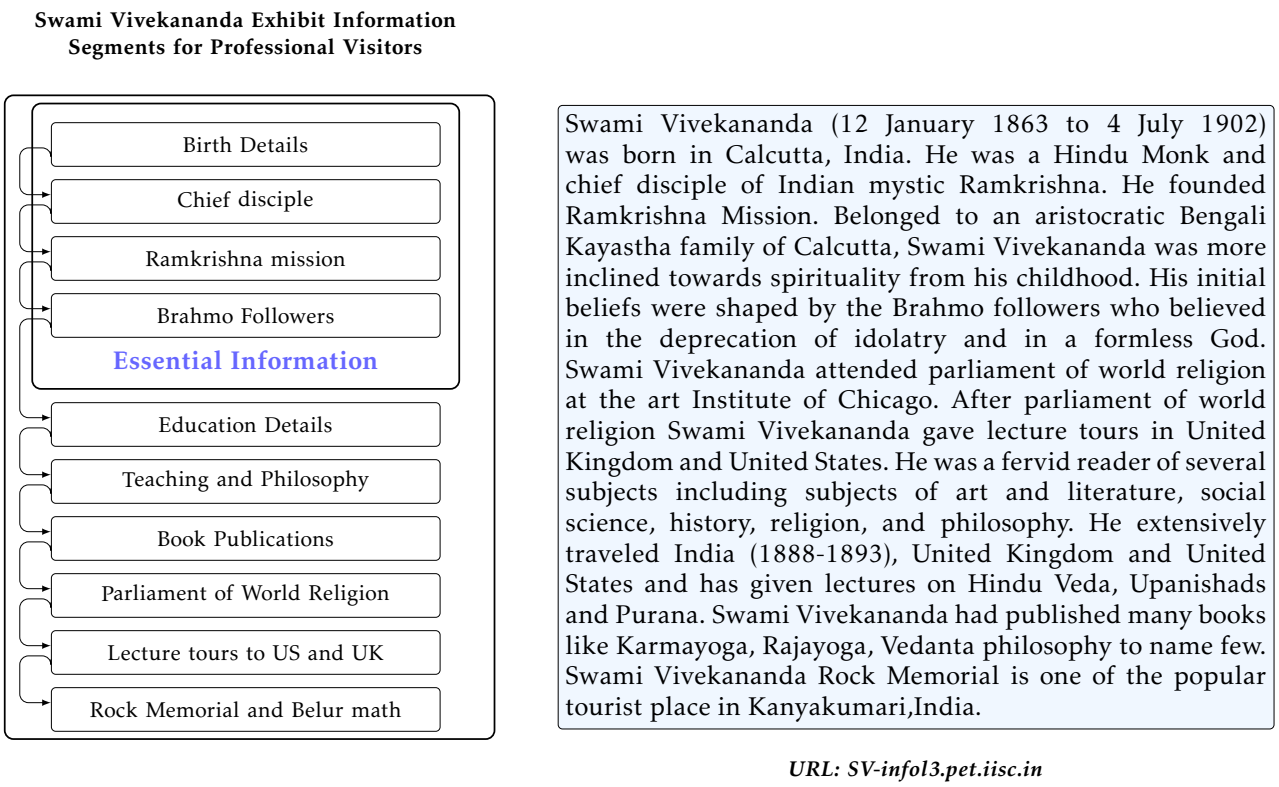

Figure 8. Organized Exhibit Information of Swami Vivekananda at *URL: SV-infol3.pet.iisc.in* for Professional Ubiquitous Visitors

organized as *Essential Information* and further as elaborated information at the levels of school kids, college students, and professionals ubiquitous visitors. We present an example of the organization of *Swami Vivekananda* exhibit information. The organized exhibit information in its several forms maintained at respective *URLs* and is used to cater to the individual requirements of the museum ubiquitous visitors. The simulation results show that the museum exhibit information organization time and the size of the organized information increase with the increase in the understanding levels of the ubiquitous visitors. In the future, we extend the proposed approach for other application domains such as tourist-guides and educational documentaries.

References

[1] John H Falk. Identity and the museum visitor experience. Routledge, CRC Press, Taylor and Francis Group, 2009.

[2] M.Elena Renda and Umberto Straccia. A personalized collaborative digital library environment: a model and an application. In *Information Processing and Management*, volume 41, pages 5 – 21, 2005.

[3] Armelle Prigent and Arnaud Revel. Cite – content interaction time and space: a hybrid approach to model man-robot interaction for deployment in museums. In *EAI Endorsed Transactions on Creative Technologies*, volume 4, Oct 2017.

[4] Pallapa Venkataram and M. Bharath. Context based service discovery for ubiquitous applications. In *International Conference on Information Networking (ICOIN)*, pages 311–316, Jan 2011.

[5] Preeti Khanwalkar and Pallapa Venkataram. A weight based context analysis system to provide a required ubiquitous multimedia service. In *Proceedings of International Conference on Wireless Networks*, pages 153–159, July 2011.

[6] Shahar Katz, Yaacov Kahanov, Nadav Kashtan, Tsvi Kuflik, Ilenia Graziola, Cesare Rocchi, Oliviero Stock, and Massimo Zancanaro. Preparing personalized multimedia presentations for a mobile museum visitors' guide: a methodological approach. In *Proceedings of Museums and the Web*, May 2006.

[7] Oliviero Stock, Massimo Zancanaro, Paolo Busetta, Charles Callaway, Antonio Krüger, Michael Kruppa, Tsvi Kuflik, Elena Not, and Cesare Rocchi. Adaptive, intelligent presentation of information for the museum visitor in peach. In *User Modeling and User-Adapted Interaction*, volume 17, pages 257–304, July 2007.

[8] Tsvi Kuflik, Oliviero Stock, Massimo Zancanaro, Ariel Gorfinkel, Sadek Jbara, Shahar Kats, Julia Sheidin, and Nadav Kashtan. A visitor's guide in an active museum: Presentations, communications, and reflection. In *Journal on Computing and Cultural Heritage (JOCCH)*, volume 3, page 11, March 2011.

[9] Pallapa Venkataram and M Bharath. A method of context-based services discovery in ubiquitous environment. In *Proceedings of the 2nd International*

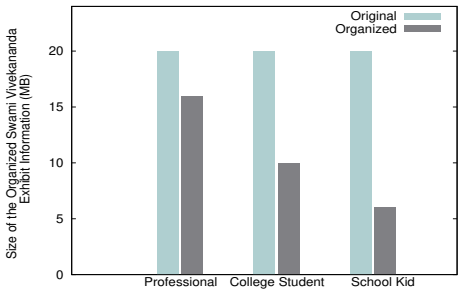

Figure 9. Variation in Size of Organized Exhibit Information of Swami Vivekananda for the Museum Ubiquitous Visitors

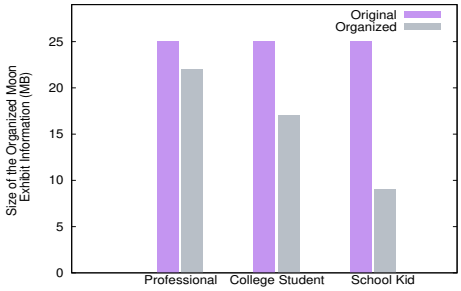

Figure 10. Variation in Size of Organized Exhibit Information of Moon for the Museum Ubiquitous Visitors

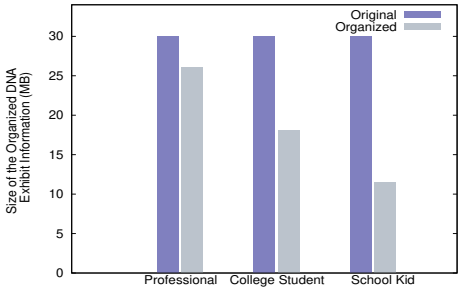

Figure 11. Variation in Size of Organized Exhibit Information of DNA for the Museum Ubiquitous Visitors

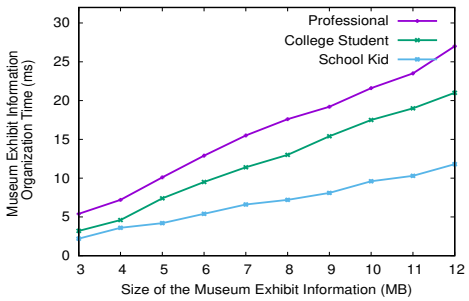

Figure 12. Museum Exhibit Information Organization Time for the Ubiquitous Visitors

Conference on Context-Aware Systems and Applications (ICCASA), November 2013.

[10] Emmanouil Zidianakis, Kalliopi Stratigi, Danai Ioannidi, Nikolaos Partarakis, Margherita Antona, and Constantin Stephanidis. Designing intelligent games adapting to children's playing maturity. In *EAI Endorsed Transactions on Creative Technologies*, volume 4, July 2017.

[11] Andry Rakotonirainy and Nicholas Lehman. Augmenting a museum visitor's tour with a context aware framework. In *1st International Workshop on Ubiquitous Computing, INSTICC Press*, pages 104–112, 2004.

[12] Preeti Khanwalkar and Pallapa Venkataram. Context-based service identification in the museum environment. In *Proceedings of the 4th EAI International Conference on Context-Aware Systems and Applications*, ICCASA, Springer International Publishing, pages 151–164, 2016.

[13] F. Paternó and C. Mancini. Effective levels of adaptation to different types of users in interactive museum systems. In *Journal of the American Society for Information Science, John Wiley and Sons, Inc.*, volume 51, pages 5–13, Jan 2000.

[14] Charles Callaway, Elena Not, Alessandra Novello, Cesare Rocchi, Oliviero Stock, and Massimo Zancanaro. Automatic cinematography and multilingual nlg for generating video documentaries. In *Artificial Intelligence*, volume 165, pages 57 – 89, 2005.

[15] Elena Not and Massimo Zancanaro. The macronode approach: Mediating between adaptive and dynamic hypermedia. In *Adaptive Hypermedia and Adaptive Web-Based Systems, Springer Berlin Heidelberg*, pages 167–178, 2000.

[16] Oliviero Stock, Elena Not, and Massimo Zancanaro. Intelligent interactive information presentation for cultural tourism. In *Multimodal Intelligent Information Presentation, Springer Netherlands*, pages 95–111. 2005.

[17] Fabian Bohnert Timothy Baldwin, Patrick Ye and Ingrid Zukerman. In situ text summarisation for museum visitors. In *25th Pacific Asia Conference on Language, Information and Computation*, pages 372–381, 2011.

[18] Silvia Filippini-Fantoni, Sarah McDaid, and Matthew Cock. Mobile devices for orientation and way finding: the case of the british museum multimedia guide. In *Museums and the Web, Proceedings, Archives and Museum Informatics*. Archives and Museum Informatics, March 2011.

[19] Anita Coleman and Tamara Sumner. Digital libraries and user needs: Negotiating the future. In *Journal of Digital Information*, volume 5, 2006.

[20] G. Benelli, A. Bianchi, P. Marti, E. Not, and D. Sennati. Hips: hyper-interaction within physical space. In *Proceedings IEEE International Conference on Multimedia Computing and Systems*, volume 2, pages 1075–1078, June 1999.

[21] Reinhard Oppermann and Marcus Specht. A context-sensitive nomadic exhibition guide. In *Handheld and Ubiquitous Computing (HUC), Springer Berlin Heidelberg*, pages 127–142, 2000.

[22] Costas Vassilakis, Vassilis Poulopoulos, Angeliki Antoniou, Manolis Wallace, George Lepouras, and Martin Lopez Nores. exhistory: Smart exhibits that tell their own stories. In *Future Generation Computer Systems*,

volume 81, pages 542 – 556, 2018.

[23] M. K. L. Nielsen. A conceptual framework for audio-visual museum media. In *EAI Endorsed Transactions on Creative Technologies*, volume 4, April 2017.

[24] Daniela Petrelli and Elena Not. User-centred design of flexible hypermedia for a mobile guide: Reflections on the hyperaudio experience. In *User Modeling and User-Adapted Interaction*, volume 15, pages 303–338, Aug 2005.

[25] Yidi Zhang. Improving museum visiting: Personalization (revised), cctp-820: Leading by design – principles of technical and social systems, December 2015.

[26] Ion Androutsopoulos, Vassiliki Kokkinaki, Aggeliki Dimitromanolaki, Jonathan Calder, Jon Oberlander, and Elena Not. Generating multilingual personalized descriptions of museum exhibits: The m-piro project. In *CoRR*, volume cs.CL/0110057, 2001.

[27] I. Androutsopoulos, J. Oberlander, and V. Karekaletsis. Source authoring for multilingual generation of personalised object descriptions. In *Natural Language Engineering, Cambridge University Press*, volume 13, pages 191–233, 2007.

[28] Richard Cox, Michael O'Donnell, and Jon Oberlander. Dynamic versus static hypermedia in museum education: an evaluation of ilex, the intelligent labelling explorer. In *Proceedings of the Artificial Intelligence in Education Conference*, pages 181–188, Apr 2001.

[29] Cesare Rocchi and Massimo Zancanaro. Rhetorical patterns for adaptive video documentaries. In *Adaptive Hypermedia and Adaptive Web-Based Systems, Springer Berlin Heidelberg*, volume 3137, pages 324–327, August 2004.

[30] Oliviero Stock and Massimo Zancanaro. *PEACH - Intelligent Interfaces for Museum Visits (Cognitive Technologies)*. Springer-Verlag, Berlin, Heidelberg, 2007.

[31] Oliviero Stock and Massimo Zancanaro. Multimodal intelligent information presentation. volume 27. Jan 2005.

[32] Elena Not, Charles B. Callaway, Cesare Rocchi, Oliviero Stock, and Massimo Zancanaro. Cinematographic techniques for automatic documentary-like presentations. In *PEACH - Intelligent Interfaces for Museum Visits*, pages 23–44, 2007.

[33] Jochen Martin and Christian Trummer. Scalex - personalized multimedia information system for museums and exhibitions. In *First International Conference on Automated Production of Cross Media Content for Multi-Channel Distribution (AXMEDIS)*, pages 332–335, Nov 2005.

[34] E. S. Tan and K. Oinonen. Personalising content presentation in museum exhibitions - a case study. In *15th International Conference on Virtual Systems and Multimedia*, pages 232–238, September 2009.

[35] Areti Damala. Design principles for mobile museum guides using visitor studies and museum learning theories. In *International Association for Development of the Information Society (IADIS), International Conference on Mobile Learning*, pages 277–281, 2007.

[36] Cesare Rocchi, Oliviero Stock, Massimo Zancanaro, Michael Kruppa, and Antonio Krüger. The museum visit: Generating seamless personalized presentations on multiple devices. In *International Conference on Intelligent User Interfaces, Proceedings IUI*, pages 316–318, Jan 2004.

[37] Shlomo Berkovsky, Timothy Baldwin, and Ingrid Zukerman. Aspect-based personalized text summarization. In *Adaptive Hypermedia and Adaptive Web-Based Systems, Springer Berlin Heidelberg*, pages 267–270, July 2008.

[38] Panagiotis Stathopoulos, Stavroula Zoi, Nikolaos Konstantinou, Emmanuel Solidakis, Christos Basios, Anastasios Zafeiropoulos, Panagiotis Papageorgiou, and Nikolas Mitrou. E-museum - a content management system for providing museum visitors with personalized audio-visual information. In *Third International Conference of Museology and Annual Conference of AVICOM Mytilene*, June 2006.

[39] Svebor Karaman, Andrew D. Bagdanov, Lea Landucci, Gianpaolo D'amico, Andrea Ferracani, Daniele Pezzatini, and Alberto Bimbo. Personalized multimedia content delivery on an interactive table by passive observation of museum visitors. In *Multimedia Tools and Applications, Kluwer Academic Publishers*, volume 75, pages 3787–3811, April 2016.

[40] Elena Not, Massimo Zancanaro, Mark T. Marshall, Daniela Petrelli, and Anna Pisetti. Writing postcards from the museum: Composing personalised tangible souvenirs. In *ACM Proceedings of the 12th Biannual Conference on Italian SIGCHI Chapter*, CHItaly, pages 5:1–5:9, 2017.

[41] L. Jonsson. Designing for learning and empowerment: how designbased research can impact education and practice. In *EAI Endorsed Transactions on Creative Technologies*, volume 4, April 2017.

[42] Einat Minkov, Keren Kahanov, and Tsvi Kuflik. Graph-based recommendation integrating rating history and domain knowledge: Application to on-site guidance of museum visitors. In *Journal of the Association for Information Science and Technology, John Wiley and Sons, Inc.*, volume 68, pages 1911–1924, Aug 2017.

[43] *A Short Life of Swami Vivekananda, Advaita Ashrama (A publication branch of Ramakrishna Math, Belur Math)*. 2016.