Enhanced Font Features for Future Multilingual Digital Typography with Sound-Script-Language Attribute Integration

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Abstract

Digital technology has the potential to deliver the 'integrated sound value of the script symbol of a selected language' in one media platform, in an interactive, multimodal way. This is the feature of the 'primary digital document', that needs to be delivered by the digital typography, in the multi-lingual, multi-modal pervasive computing environment of the users of the digital/hybrid library. In its current state, typography is dependent on the strengths and trends of the programming languages, technologies and related standards. These are designed with the 'font/character based paradigm' at their foundation. The study points out as to how the limitations of the current programming languages and the related standards affect the future of 'digital typography' in delivering its stated goal in the digital/hybrid library scenario. The importance of shifting from the current level to the proposed 'integrated sound-script-language' feature of the 'font-character' in the 'digital typography for pervasive computing' is highlighted. The advantageous position of the model of Indic language Vedic Sanskrit for the above paradigm shift is indicated. The critical nature and benefits of this paradigm shift from the digital/hybrid library scenario for the assimilation of the current technology trends is demonstrated by a 'digital book model' developed by the author. The digital book deals with content related to the Vedic phonetics.

Résumé

La technologie numérique a le potentiel de délivrer le «son intégré du symbole écrit de la langue choisie» sur une même plate-forme, de manière interactive et multimodale. C'est une propriété du «document numérique primaire» que l'on souhaite transmettre par le biais de la typographie numérique, dans l'environnement informatique multilingue, multimodal et universel des utilisateurs de la bibliothèque numérique hybride. Dans l'état actuel, la typographie dépend des forces et des tendances des langages de programmation, des technologies et des standards. Ceux-ci ont été conçus en se basant sur le paradigme «fonte-caractère». Notre étude démontre à quel point les limitations des langages de programmation actuels et des standards affectent l'avenir de la «typographie numérique» et sa capacité d'atteindre son but dans le scénario de bibliothèque numérique/hybride. Nous soulignons l'importance de passer de l'état actuel à la propriété d'intégration du son, de l'écriture et de la langue du couple «fonte-caractère» dans la «typographie numérique pour informatique universelle». Nous indiquons la position avantageuse du sanskrit védique dans ce changement de paradigme. Nous démontrons la criticalité et les avantages de ce changement de paradigme par un «modèle de livre numérique», développé par l'auteur. Le contenu de ce livre numérique traite de phonétique védique.

Introduction

As computers increasingly permeate our daily lives, and influence the way we place our (creative — expressive — communicative and responsive) communications in the digital media, 'digital typography' plays a critical role in these aspects linked to data and its utility for 'creating — formatting — handling — storing — distributing — accessing — archiving'. These are the various issues related to the 'digital document'.[1] At the current level of technology and usage, the word 'digital document' covers very many dimensions and formats — from plain ASCII text to a web page with multimedia content. The future digital document[2] in the digital/hybrid library will

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[1]. This is the vision expressed in the MIT projects, http://oxygen.lcs.mit.edu.

[2]. The Digital Library Federation (DLF) was founded in 1995 to establish the conditions for creating, maintaining, expanding, and preserving a distributed collection of digital materials accessible to scholars, students, and a wider public. The Federation is a leadership organization operating under the umbrella of the Council on Library and Information Resources. It is composed of participants who manage and operate digital libraries. Hybrid Libraries of the Future delivers both print and electronic services. In considering changes in academic libraries, including integration with computing services, this model seems more useful than the pure digital library concept. The HYLIFE project is about how

feature hybrid multilingual multimodal communicative data, accessed by the users in unscheduled interactive ways. The critical issues currently being considered in the scenario of digital/hybrid libraries are the following: (a) (Text — Script — language related) — Monolingual, cross lingual and multilingual. (b) (Speech related) Spoken document retrieval; spoken document corpora, music. (c) (Interface creation — storage — distribution — access) Multimodal interfaces for text and spoken document, inter-operability. (d) (OS — Software-platform-network hardware device related) Recognition algorithms, techniques for spoken audio indexing, retrieval models, web interface, metadata; algorithms and protocols — Human Computer Interfaces — Digital library interface (e) (Utilities — solutions related) Library catalogue, collations, data mining, special purpose libraries and services.[3]

Digital document

Digital documents have, related to their origin and format, a background of very many issues such as: software programs, operating systems, hardware encoding, character related standards, file formats, memory requirements, color handling, font resolution related to the display screen resolution. All these have a bearing on 'document portability-compatibility-effective usability'; and therefore on 'user satisfaction'. In the present state of the document creation in the digital media, controlling many of these are beyond the 'author-user' abilities.

Digital typography Compared to the conventional print media output, to which the earlier phase of typography was dedicated, the output in a digital environment has different challenges to address. The advancement of the technologies is in the direction of integrating the 'speech and vision' modes of human interaction with the computer for better effectiveness in a pervasive computing environment. Therefore the focus of the digital typography must cover a larger ground than the conventional typography approach, to be in tune with the trends of the technological innovations.

Literate Programming By definition, it is the "combination of documentation and source together in a fashion

suited for reading by human beings". In general, literate programs combine source and documentation in a single file. Literate programming tools then parse the file to produce either readable documentation or compilable source. If we extend our understanding of the word 'reading' to cover not only visual text oriented reading, but also the speech mode of reading, this defines the directions in which TeX has to look for the future. The 'typographic font' which served the 'print media needs' and the 'display media needs' has now to stretch itself to the level of the 'Sound-Script-Language attribute integrated font' as it was in the original design of 'script logic', the mother of typography.

LaTeX, as a document preparation system, also needs to focus on the scope of 'right content' along with the 'right mode of presentation, storage and distribution' in such a scenario. In order to make the 'digital document' effective, the design of the document, which was earlier in the control of the 'designers' must allow for contributions from the 'author of the document'. The media in which the author was bound to position the 'content' (= the 'data' and the thought expressive process) has undergone a paradigm shift and a total upgrade. The limitation of the 'paper-print-text media' is overcome in the 'integrated digital media'.

What is the expectation from digital typography for a digital document?

It is at this stage that the limitations preventing 'typography' from delivering the desired goal of 'digital document' as above surface. The human paradigm of communication-documentation has been that the 'Script symbol is always associated with a sound value in a given language'[4] environment. So far in the machine paradigm, the approach towards the 'language and the sound value of the script symbol' has been the isolated juxtaposition[5] of the script symbol with the 'sound value'[6] with a 'language'[7] attribute.[8]

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best to deliver the mixture of print and electronic services likely to be required of higher education libraries in the foreseeable future.

3. DESIRE Project — DESIRE was a European information gateway project (1998–2000): Development of a European Service for Information on Research and Education. Among many other resources, DESIRE produced free software and some publications, including the excellent DESIRE Information Gateways Handbook; Library of Congress (U.S.) digital library resources and projects LOC Standards for Digital Library Projects; international standard, ISO 14721:2002; Metadata Standards: Dublin Core (Stuart Weibel: OCLC, USA).

4. This language environment is again a deep rooted issue with operating systems and the standards which needs to be elaborated. The language environment is in many cases defined by the OS at the time of installation.

5. SALT (Speech Application Language Tags) is the latest in this series, http://www.w3.org.

6. For the details look at the functioning of the TTS programs and the speech recognition process in the documentation for Microsoft's .NET Speech SDK 1.0 Beta 2.

7. Feature tags and language tags: Features provide information about how to use the glyphs in a font to render a script or language. Language system tags identify the language systems supported in an Open Type font. See information at the Microsoft Typography site.

8. The concept and criticality of the 'code page' throughout the issues related to the fonts, multilingual software and the Unicode standards is a vast and involved topic that needs to be carefully read. For details, refer to http://www.unicode.org.

For over forty years, the design paradigm of computation has centered on machines and not people. Our own creations in terms of machines, networks, programming languages, software and the program interfaces have required us to interact with them on their terms, inputting their languages and manipulating their keyboards or mice. The entire edifice is pinned on one design principle paradigm — the ability of the visual scripted 'character'[9] (and character sequences) to provide a communication link between the humans and the machines. With this 'character oriented' design philosophy built into the core of the operating systems, software, programming languages, instruction sets[10] and the various standards which cover these aspects, we have not been able to 'define' what we really need to the 'machines' as projected in our visions and goals. When the vision is to deliver 'natural language processing', the nature of the natural language has not been defined. What we have is a 'structured query language' (SQL). When the vision is of 'speech recognition', the vital element of 'sound' is totally missing from consideration in all the reference standards and programming languages. 'Audio' is treated as an 'external add on/markup reference', which is not the appropriate paradigm. The language choice, which should remain under user selection, presently resides in the scope of the OS.

If we find a solution for this issue, then we will able to automate many repetitive and logically describable tasks presently carried out by humans in typography. The technology has advanced to a far greater level compared to the days when the original 'character based paradigm' was built at the core of the machines and the standards. There are newer techniques of rendering the characters on the display devices. But, the very fundamental limitation of the 'character based paradigm' of the communication interface itself, has never been revisited. The applications which propose to deal with the 'speech' and other aspects of human interaction communication and interface, are still relying upon the 'character based linking paradigm' to deliver the solutions in

these areas.

In pursuit of the above approach, we notice that the critical speech interface for human interaction is built by the industry as an 'extension, markup' feature over the 'character'; and not as an integrated feature on the paradigm of human communication. This is the key area that needs to be addressed in the area of digital typography to meet the deliverable goals for the digital document of the digital/hybrid library. In the envisaged digital/hybrid library environment, digital documents will come in multiple volumes and a variety of data forms through real time online resources and offline databases in multiple media, multilingual formats and modes, addressing the visual and auditory modes of reception. The digital typography environment is presently heavily preoccupied with the Roman alphabet character set, widespread on the keyboards of modern computers. The world is not just limited to the 'English/Latin/Roman alphabet' and character set. Due to the deep positioning of the Roman alphabet character set represented in the ASCII and other code standards for digital programming, the other languages of the world need to be represented through these character sets only in digital space. This is the place where the 'accentuation markings', diacritics, considered in the IPA convention come into consideration.

Why should there be an integrated voice interface in a digital document?

Users generally do not have equal language skills for understanding and appreciating a 'document' in a language. The skills related to language are — reading, writing, speaking. The outpouring from a contemporary 'search' provides informative documents, mainly in the form of 'text mode'; all of which the user may/may not be able to read, understand or need help to understand properly. In such cases the 'voiced output' speech interface becomes more effective and meaningful. Present-day typography is not in a position to deliver this solution in an integrated way with the text. Text readers have serious limitations, as do ASR's. The proposal for the enhanced font features with Sound-Script-Language attribute integration aims at providing this solution. The goal of this proposal is to get a unifying ground of 'communication-documentation' that needs to be held as an integrated 'digital hybrid document.'

Interface design for human paradigm vs. machine paradigm — integrated sound-script-language

In the present state of technology, such a hybrid data entity is seen in the 'interactive-multimedia content' created through the use of special multimedia authoring software. This needs a minimum level of hardware power. Even here, there are serious limitations for user

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9. The character related standards right from the earliest standards considered in the early programming languages to the current discussion focus on the IPA and Unicode are all focused on 'visual character' — the non-agglutinating, non-phonetic, Roman alphabet character set and does not deal with the 'phonetic value' of the script symbol. Check the ISO 639 standards and related RFC's for more information in this regard, including ISO/IEC 10646. The reference point these standards take is primarily the typewriter pattern of characters or a calligraphy based approach. They have never entered into the realm of 'script logic' itself, as to what the symbol stands for in the 'language'.

10. In the final level of programming where a voice interface is needed, it is a set of code based on the 'characters', which calls on a 'library/data base of the speech'. But it is not capable of integrally linking itself to a sound value. The final code written as XML/SGML for SALT Version 1.0 may be referred to.

interactivity with relation to the possible permissible modes of interaction. The focus is still on keyboard input and the mouse clicks.

In current technology trends, the effort has been to create human interfaces with the machine in various modes. The objective is to have an integrated speech and vision interface. The goal is to have a technology which will enable the user to communicate with the machine in multi-modal, interchangeable, intelligent modes of interaction, ideally in much the same way that humans communicate with other humans. In order to realize this goal, there is a need to identify some common ground between the 'human and the machine styles of communication handling'.

At the present state of the art and philosophy of the computer science and technology, such a 'common ground' between the 'human speech/natural language communication process' and the 'machine's programming language oriented task/output delivery' is identified and limited to the level of the 'script character'(-font) of 'language' (as a code page), in the digital media. This is brought into the issues of the standards. The integrated relation of the 'script character' in human linguistic audio mode communication has not been represented properly in the standards, programming languages and industry practices. What is happening in the 'core system level processing' may be termed as 'table matching (by filtering and elimination mainly) and super fast routing/couriering ending with mono-modal unidirectional deliverance — display on predetermined paths and frames', giving an illusion of compatibility with human communication due to the speed of the system and the complexity of the program. Thus, with only a partial non-integrated ground being established and standardized between the 'man and the machine' in the area of 'communicative interaction', the stated objectives for digital document creation continue to remain a separate area of study.

Vedic Sanskrit as a model of human language providing the integrated sound–script–language concept

It is acknowledged that the Indic language identified as 'Vedic Sanskrit' is the most ancient human language which continues to have a living tradition in India. This uses a non-Roman script, which was in its almost final shape a thousand years ago. The script called 'devanagari Sanskrit' is used by many Indian languages. The devanagari script is the script adopted for the Hindi language, which is the national language of India. The philosophy and grammar of Vedic Sanskrit provides the guidelines in the formation of the concept of 'integrated sound-script-language'. The grammar of Sanskrit language authored by Panini (circa 500 B.C.E) and the related living tradi-

tion is available even to this day. The linguistic design and philosophy of this language is developed purely in the 'human linguistic communication mode, especially in the aspect of speech'. There is a well laid down rule base, which can be adopted in to the 'speech mode of communication of any language of the world, irrespective of the script they intend to use'. The script logic of this language, the agglutinating structure of the script which enables the representation of combined sounds in terms of basic phonetic units, the accent marking conventions to mark the prosody, and the phonetic alphabetical order on the human voice mechanism are some of the features of this language which can be used for 'fonts' developing the integrated sound-script-language paradigm as indicated.

The benefits of the enhanced font features

This 'integration' is seen as the key interface that is needed for the creation of the digital document of the future and needs to be demanded of digital typography. Namely, the integration of the 'script' symbol character with a 'pronounced as' feature. Thus, the dictionary functionality gets truly integrated in the multilingual scenario through this paradigm shift.

Scope for newer applications through this paradigm

There are many users (literate as well as semi-literate and non-literate) who are familiar with more than one language in their spoken aspect; but they can not write/read the script. Such users can 'listen' to a 'multilingual document' (a reality at the global level) because the 'sound value' of the script and the language would be available. And this makes the document more intelligible.

The content creator can always bring in the 'multilingual' content without being limited by the 'fonts-display-phonetic value-diacritical marks' issues and focus on the primary task. Language education can become much more effective through this paradigm of typography. This paradigm can also be used for language specific dictation machines. This makes digital document creation simpler, faster and more reliable. The proofing of the text is facilitated to ensure the right reading for the right meaning. Proofing in multilingual documents can become better. The multilingual transliterations can become more practical and effective because of this 'reading of the text', especially in the spelling oriented languages of the world. The demand for this upgrade of the 'font' has to come from digital typography, as it would be the primary beneficiary of such integration.

Conclusion

In conclusion, it is seen that digital typography should push for enhanced features of 'fonts' with the 'sound and

the 'language' attributes in an integrated way to meet the goal of 'literate programming' and the demands of digital hybrid libraries. Failure to reach this target will just leave every document another 'graphic' on a 'media' which is no better than an unintelligible picture or a scribbling.

The theme of 'back to typography' actually becomes meaningful when the 'sound value of the script of the language' is brought back 'live' in the digital media. Digital typography should not be happy just transferring the 'visual image' created by the human author in a media of his/her time and context to a 'cyber document'; it also has to capture, preserve and deliver all that really makes that 'document' significant and meaningful. This will go a long way toward preserving the typographical heritage in the digital era, for not only the print media book production process, but also digital books. By making this demand for the integrated feature of sound and language value in the 'character-font', there will be a new impetus for literate programming in the digital typography of the production of digital/hybrid documents.

The following product is a scaled down version of a digital hybrid document. The content is an advanced topic relating to the phonetics of the Vedic Sanskrit language and the Vedic recitation in a special mode. This is sacred and historically significant content. This rule base of the Vedic Sanskrit phonetics was found documented in a paper manuscript in the private collections of a Sanskrit scholar, Professor K.T. Pandurangi, Bangalore, India.

Vision of a digital book

In order to port the totality of the contents of this paper media handwritten manuscript document to a 'digital hybrid document', a search was made for the appropriate software and tools. Multimedia authoring technology and CD-ROM media was the best we could find to meet the needs. Based on the level of expertise and the resources that were available to us, a scaled down version of the product has been prepared. Apart from the focus of this product as a digital/hybrid document preserving the heritage document, for the purpose of this presentation we also focus on the need to work toward the enhancement of 'font features' for future multilingual digital typography with sound-script-language attribute integration.

The benefits of the 'integration of the sound-script-language attributes' on one digital platform for the effective utilization of the 'digital document' is the message intended to be conveyed through this presentation.

This product also addresses some other issues, including survival of heritage documents in the digital era. It is a direction in which digital typography can help.

Nature of the document

The heritage document on hand which was to be brought to the digital library environment was a paper manuscript, 36 folios of approximate size 4x6 inches, about one hundred fifty years old, containing unpublished information. It needs to be preserved for future studies. This manuscript was in the private collection of a religious professor. There was only one copy of this document, which he was not willing to spare for public use. Upon study of the manuscript at the holder's location, it was noticed that the text, written in devanagari script of 19th century (the writing style in the Maharashtra-Karnataka border region in India) deals with a critical issue related to the Vedic phonetics. As per the information in the manuscript, the original work was composed in the period prior to 16th century A.C.E.

The contents of the book are useful for the advanced study of Vedic phonetics. The small booklet contains about three hundred illustrations drawn, in a cryptic way, from the entire Rig Vedic lore. To explain this, the text script reading alone is not sufficient. The accented intonation of the passages indicated by the first two or three words in the specific mode needs to be supplemented by a proficient scholar trained in the traditional mode of chanting the Vedas, Vedic phonetics, and grammar. The book does not have commercial publication value because it is a very advanced level reference, which would be utilized only by researchers. The present manuscript is a replicated copy, which has seen careful correction by the scribe-author. The corrections carried out by the author can be noticed only on careful observation of the manuscript.

The challenge

The challenge is to port this heritage manuscript to a digital hybrid library document, using the single copy available, which would not be spared for circulation. Further, the challenge is to get a good image of the manuscript and make it available for online and offline researchers, including a facility to take to print media when the time comes. The issues involved were broadly identified in the work area as follows. The technical and academic solutions that were practical within our resources at the time of production were put into use as indicated below.

Document imaging

The available middle range level scanner which could capture the image of the basic document was used to get a reasonably good 'electronic image of the text'. Judgment was exercised on the resolution with reference to the output file size, the color balance, and like factors. The first level image was obtained. The image did not have the requisite clarity. The primary image was retained as

such. Then this image was processed through image enhancement software to enhance the picture quality, improve the contrast, reduce the color noise, etc., all with one intention — that the 'text' can be read with better clarity on the screen. Thus, the first level of 'content extraction' at its primary level — in the form of an image — was completed.

In the product, which is a scaled down version of the final book, you will see the original image and also the digitally enhanced image. The digitally cleansed image has much improved clarity for reading, compared to the original image. This was the first phase of the transfer of the manuscript paper media to 'digital media'. At this stage, we had achieved the ability to port and deliver/carry the original image (unclear and difficult) and also the digitally enhanced image (clear for reading) together to any place throughout the world where there were scholars able to help with the next level of content evaluation.

Content management in non-computer media and lack of computer awareness/access environment

The subject dealt with by the manuscript is a very specialized topic. Many of the subject experts in this area are not computer savvy, nor have computer access. Therefore we had to discover a way to have the content in a deliverable print media. The ordinary printing through the printers were tried out; but the outputs even at their best resolutions were not of acceptable quality. Therefore, the technology group recommended the use of digital photo imaging output technology. We produced the Kodak photo print of the original and the digitally enhanced image together on a photo grade quality paper. And this was found to be extremely satisfactory in terms of quality and acceptance by the scholars for further work.

The success at this stage was the decision to switch to digital photo production technology on 'photographic quality paper', giving up on conventional color printer output. Accordingly, the appropriate digital image editing software and formats were re-identified and the output was obtained. This is one of the ways that could be adopted for 'hardcopy delivery' in the digital hybrid library environment in view of the output quality. The digital imaging needs to be appropriate for the working result.

Getting to the phonetic value of the script and the text

Once we were able to take an acceptable quality image of the original to the scholars for help, they were able to read the 'script' in which the text was written. It was noticed that the conventions of writing the original text

with the devanagari script had its own peculiarities of that historic period, as well as regional uniqueness; and also the 'scribe's unique stamp in terms of the calligraphic style'. The plain character based reading was not sufficient to properly understand the text. The reading aloud of the text and comparison with the 'voice tradition' became a necessity. Fortunately, we had the scholarly resources at hand and with their help, the proper reading of the text was completed. Thus the correlation of the voice tradition with the scripted text was accomplished, which lends more firmness, authenticity, and useful content value. The voice output of the text was also brought in to the digital media and placed alongside the text as tagged data, through our software programming.

Actual technical content of the text

The scholars in the content evaluation were able to furnish useful information. A part of this information is placed on the CD. More of this can be integrated in the desired way. This area has not posed much of a problem.

Content evaluation of the text

The difficulties in getting the knowledgeable scholars in the most advanced area of the Vedic knowledge described in this text with the requisite voice training, voice clarity with a technical teaching expertise and demonstration capability was difficult. However, we were able to identify them, and get the additional information. Thus, a sample of the final voice was placed on the CD.

Transcription of the traditional handwritten text with the help of modern digital fonts

Now began the next phase of the work — presenting the heritage document in the fonts of the 'modern digital era' using 'digital typography'. Based on the combination of voice and text that was made available to the text publishing agency, the new text was received as an output based on the available software.

It is at this point that the real hidden problems with the fonts, encoding, software compatibility, proofing, media and other issues cropped up. The absence of the 'integration of the phoneme value' on the 'script symbol' in the digital typography environment, in sharp contrast to the human paradigm of 'scripting', was a glaring handicap at this point.

Issues related to the multilingual transliteration

The problems of transliteration highlighted the limitation of digital typography multilingual software and the standards related to it in meeting the needs of the content being handled, to provide truly acceptable output. Other issues were similar — divergence of the transliteration standards followed by the software, portability

and compatibility, the relative problems that are yet to be resolved regarding IPA and Unicode compatibility, the deep rooted problems in language related matters dealt with at the code page level of the OS, and version and upgrade problems of the software. The scholars were not totally satisfied with the software related transliteration outputs. The publishing software which handled many of the transliteration related fonts and symbols were not able to give us related softcopy compatible for our program integration in our multimedia presentation. We had to settle for the final 'image output of the transliterated text', as our purpose was to deliver the content. This necessity to go by the 'image mode' output of the text does limit on 'text-search' by character approach. Voice based search is still a far dream.

Voice part of the content

We recorded only part of the text reading to manage within our resources. The work of really having the illustrated voice explanation with the technicalities explained in the work is yet an unfinished task, presently beyond our resources.

Database indexing of the folios

The indexing of the folios has been completed. Only the first two and last two folio links are activated.

Providing online digital facilities for notes and online access

CD-ROM media was chosen as the output, so that the product can be used offline. The built-in facility within the product provides for calling an editor for making the user notes. The product is made with a Windows-compatible feature. Thus when this CD-ROM is open in one window, the user has the option of calling up any word processor (regular or multilingual) installed on the machine and make their own personal notes. The Windows-compatible feature also helps in having another window opened up in which the second digital book provided along with this primary work can also be accessed. CD navigation is structured through the use of original multimedia software.

Enhancing the utility of the product

Supplemental information in the form of links to dictionaries and reference books has been planned for the CD navigation structure. We considered providing the reference book of 'Rig-veda' on the same CD with the same facilities and interfaces, as a model so that the study experience would be integrated and complete. On the CD you would notice the availability of the work 'Rig-veda', which can be simultaneously accessed by opening the CD in another window.

Technology utilization for content illustration and appreciation

It is planned to achieve this goal by providing the appropriate video and the graphics, animations, and pictures, as considered necessary by the scholars. A planned provision is indicated in the present version of the product. This will enhancem the utility of the digital document.

Technology issues

In the absence of the single platform where we can completely fulfill our needs at reasonable cost levels, the technical team did a tremendous amount of experimentation and the current product structure is the result. It is during this study that the need for the enhanced font features brought out in this paper became apparent for the digital typography environment. Live voice is needed (as traditional), in contrast to the concept of 'text readers' (which heavily depend on the character oriented programming and just give a mechanical voice output) which are not sufficient at this level of content. The deliverable product was made in a form suitable for online and offline reference so as to fall under the category of 'digital/hybrid document'. The interface has been designed to meet user requirements for studying in script mode and in voice mode; the interface provides for access to the requisite references in all the modes including the web. The facility to use multilingual, multimodal methods, depending upon the user hardware facilities, is open for integration.

What does this product mean for digital typography?

When there are already a number of programs for publishing, imaging, text readers, OCR products, TTS and ASR solutions, multimedia authoring, web based education, and so on, why should this issue be so critically highlighted?

It is true that all these technologies are available in isolation, but integration of these using the paradigm of the human conventions of communication and learning is the challenge. The technologies mentioned above fail to achieve a smooth and satisfactory integration and deliver an acceptable cost effective output from the point of view of an author-scholar and user. On close scrutiny of the issue, the remedial measure is best initiated at the level of the 'font' character concept used in current digital technology solutions. This paper highlights the issue through an application of the current technologies to deliver a model product for the future digital hybrid library as a digital document with significant heritage content. The present product is a result of many technologies, resulting from the interfaces that the user needs in digital documents and digital/hybrid libraries. For the production of such end user friendly multilingual-multimodal

digital books, the digital typography has to shift from its present paradigm of 'character based' programming techniques to the proposed 'enhanced font features with sound-script-language attribute integration'.

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[11] HTML 4.0. World Wide Web Consortium. Massachusetts Institute of Technology, Institute National de Recherche en Informatique et en Automatique, Keio University, 1997.