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DIGITIZATION OF TYPOGRAPHIC CULTURAL HERITAGE AND ITS APPLICATION IN INTERACTIVE WEB PRESENTATION

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Abstract: *Much of the literature on history and cultural heritage is available exclusively in physical (printed) form. The traditional approach towards education still values this type of media more than digital methods of learning and information distribution. This often takes place in communities where people have difficulty accessing this information. Digitization can contribute to solving the problem of accessibility and general interest. This paper discusses the issues of cultural preservation and technical knowledge necessary for the implementation of cultural heritage in modern multimedia. Examples selected for this paper include typical monuments and a writing system from the 14th to 16th century from the area of Bosnia and Herzegovina, specifically the culture of "stećak" (tombstone) and the alphabet called "Bosančica". The paper explores the possibilities of using widely available programs and tools for the promotion of cultural heritage in the digital world integrated in the form of a website. Through several examples, various tools were used to digitize the most prominent characteristics of these monuments: their writing, iconography and relief. The material was used to assemble an interactive educational web platform. Unlike traditional sources, the digital resources reproduced on the website visually complement the textual information and thus complete the learning experience. Fonts and illustrations are presented together with historically relevant contextual information, thus enhancing the learning experience. Together with a special transliterator that was made to directly translate user input text (in Latin alphabet) to "Bosančica" writing, it allows for a personalized and interactive experience.*

Key words: cultural heritage, digitization, fonts, website

1. INTRODUCTION

In today's era of digitization, every branch of human knowledge is gradually moving from the physical form (i.e. paper) to the digital one, where it is being archived and distributed. The digital medium allows for a much faster distribution of knowledge than previous traditional methods. Despite its advantages and existing technology, the effort of existing institutions to digitize their own material was rather lacking, especially in the realm of formal education. The process was sped up during the COVID-19 pandemic as the traditional models of education and knowledge distribution had proven to be inflexible. Chitambo et. al. state that "The value gained from the preservation of human knowledge lies not with the preservation of the past but rather with the way in which this information can be accessed by individuals today." (Chitambo et. al., 2016). Digitization allows better accessibility through easily distributable platforms, and therefore to a wider audience. "Both cultural consumption and production are enhanced and facilitated by new technologies, and digitization of culture brings about better and faster access to and dissemination of the creative output." (Fanea-Ivanovici, 2018). Along with the potential for conservation, the benefits of digitized cultural resources can be seen amongst scientific research, education, the economy, and connecting communities (Tanner, 2010), especially when creatively integrated into the formal school systems (Tzima et. al., 2020).

1.1 Digitization in education and culture

In 2020, the investment in digital education technologies in the world was 227 billion USD, and the figure is predicted to reach 404 billion USD in 2025. Although these are significant amounts, they represent less than 4% of the total investment in education (HolonIQ, 2021). According to a UNICEF report (Vashchenko, 2024) in Bosnia and Herzegovina schools often lack internet connection and an average of 20 students share one computer device, compared to the OECD average of 1.2 students. It is evident that the entire digital education sector still has a lot of room for growth. In the context of sustainable

development, various international declarations (Unesco Istanbul Declaration, 2016; The Hangzhou Declaration, 2013) and conferences (CoMoCoSEE, 2017) emphasize the importance of widely available cultural education. With its own documents (European Commission, 2021; European Commission, 2011), the European Commission encourages the processes of using new technologies in digitization through financial and legal endeavors, highlighting the value of sustainable tourism and education. The largest undertaking in this field was launched by the European Union through the Europeana platform, which contains digital archives from over 3,000 cultural institutions in Europe (European Commission, 2022).

Companies, institutions, and individuals are all creating different digital cultural platforms through their own initiatives, but there is still no unilateral agreement on the best practices for presenting cultural content. As pointed out by Taylor and Gibson, there is an ethical conflict regarding the digitization of cultural heritage that diminishes its positive effects on the process of democratization of culture (Taylor & Gibson, 2016). The problem originates from the selective approach of displaying cultural content, where often due to limitations only a small part of cultural assets is digitized, while the selection of what is displayed is decided by a small number of people (Gorman, 2003), thus undermining the democratic motive of the entire process. Although the digitization qualities of cultural heritage are highlighted, it is important to structure the presented content in a transparent way that opens the possibilities for users to explore the topic further, beyond the limits of what was originally presented, so that more interpretations of the collective knowledge are considered. Otherwise, the content of the cultural heritage will be an object of the same moral dilemma that scientific publications (Eve, 2013) were in during their own digitization, where distribution was limited by private ventures charging access to information.

The responsibility in the process of digitizing the content belongs mostly to the institutions that own its physical copies. However, given the bureaucratic and financial constraints of the public sector (Adane et. al., 2019), this transformation from physical to digital is taking place quite slowly compared to the great advances in widespread technological literacy and the use of digital resources by consumers. “Individuals with a personal interest in technology can collectively and collaboratively, in a distributed and largely unregulated space, provide useful public resources” (Brady, 2005). Since the mid-2000s, users have been creating their own collections of content from general culture through image-sharing platforms and making them publicly available. It has been shown that such ventures, compared to the projects of traditional institutions, enable better mutual interaction between the interested audience and those who manage the platform, but also greater integration of individual users into the cultural community (Terras, 2011). Terras indicates that such initiatives have the potential to inform institutions about the most efficient ways of compiling online resources and finding relevant audiences in the process (Terras, 2010).

Due to a lack of institutional support for the undertakings of individuals, doubts arise regarding the responsibility for providing accurate information without misinterpretation of content. However, it can be argued that individual endeavors don’t challenge the work of experts in the field, but rather attract public awareness to the culture itself which is necessary for their work to be better recognized in the public discourse. This is especially relevant in cases where the goal is to preserve large numbers of geographically scattered artifacts, requiring widespread public engagement on the issue. This implies a basic level of knowledge about the subject among stakeholders on all levels. It requires educational content that can be easily distributed even though it may be simplified in regard to the expert literature.

Audience participation in content digitization can enrich its contextual background. Thereby, cultural heritage can be shared, promoted, recreated easily, and used to inspire new changes in the field of collective culture. Contrary to the criticism of amateur ventures, Bachi et. al argue that “mass culture is, therefore, quality culture” (Bachi et. al., 2014).

1.2 The cultural heritage of Stećak and Bosančica

The digitization project described in this paper focuses on the cultural heritage of the Middle Ages (14th to 16th centuries) on the territory of Bosnia and Herzegovina. Specifically, the culture of the *Stećak (*pl. *stećci)* and the writing system *Bosančica* (Bosnian Lapidary Cyrillic). *Stećci* are medieval stone monuments that are largely found on the territory of Bosnia and Herzegovina, as well as Croatia (Dalmatia), the north of Montenegro, and southeastern Serbia (Wenzel, 1965). They are most often clustered in necropolises, i.e. medieval cemeteries. The first specimens date from the 12th century, while most were made between the 14th and 15th centuries (Dizdar, 2018). Their exact number is difficult to determine due to their wide spatial distribution, land sedimentation, and human activity over the centuries. According to the source

(Bešlagić, 2020), there are 59,593 *stećak* tombstones in B&H, 4,447 in Croatia, 3,049 in Montenegro, and 2,267 in Serbia. It is believed by some that at their peak they numbered over 100,000 specimens (Imamović, 1995). They first received worldwide attention starting in the 19th century through archeological expeditions in Bosnia and Herzegovina by various international researchers. In 2016, 28 *stećak* necropolises were included in the UNESCO World Heritage List (UNESCO, 2016).

Bosančica is the most widely accepted name for the Cyrillic medieval Bosnian script inscribed on the *stećci* monuments. Some authors claim different names, assigning the script to other regional languages. As Bešlagić explains: "It has not been determined what it was called at the time, nor is there an agreement on how it should be called today, the script used to write medieval Bosnian books, official documents, and epigraphic Cyrillic monuments. From the existing literature, in this regard, there are not only inconsistent but also very different and even controversial viewpoints" (Bešlagić, 2020). Currently, 350 epigraphic monuments have been discovered in Bosnia and Herzegovina that contain the *Bosančica* script. 328 are found on *stećak* monuments and 22 on other stone monuments. Including the region outside of B&H, a total of 386 *stećci* with typographic inscriptions were discovered. Since *stećci* were used as tombstones, their inscriptions are categorized as epitaphs (Bešlagić, 2020).

Most of the scientific research and conservation efforts concerning *Stećci* and *Bosančica* were conducted after the 1950's, because of the aggravating historical circumstances and a lack of institutional interest (Bešlagić, 1971). Although the theory of their origin is more complete today, there is still no agreed explanation for a significant part of their cultural context, leaving much room for further scientific discussion. The best sources related to *stećci* can still be found in print in specialist publications. Although those publications are the most valuable, due to the limited distribution of such literature, it is difficult to include them in traditional teaching, because of the advanced academic language that limits it to a more professional community.

In recent years there have been some educational and artistic initiatives that try to bring the topic closer to a wider audience. There is a digitized collection of old Bosnian texts (DIJAK - *Digitalni jezički anotirani korpus starih bosanskih tekstova*) created by the University of Sarajevo Language Institute (https://www.e-bosanski.ba/dijak/). This project includes a database of all discovered epitaphs on *stećci*, searchable by keywords, and a simple transliterator for calligraphic *Bosančica*. The project under the name "Pišem ti bosančicom" by Amra Zulfikarpašić and Lejla Nakaš in collaboration with other artists, was realized to actively promote the script by developing fonts, organizing exhibitions and workshops, which resulted in a published book (Zulfikarpašić & Nakaš, 2016). Fonts used in both projects were made by artist Miomira Mila Melank. Current online sources on the topic include Stećak.map by the Mak Dizdar Foundation (https://stecakmap.info/) and Nekropola.ba by Edin Bujak (https://www.nekropola.ba/bs), both of which mainly focus on geographically mapping the necropolises, but also provide some background information about the culture itself.

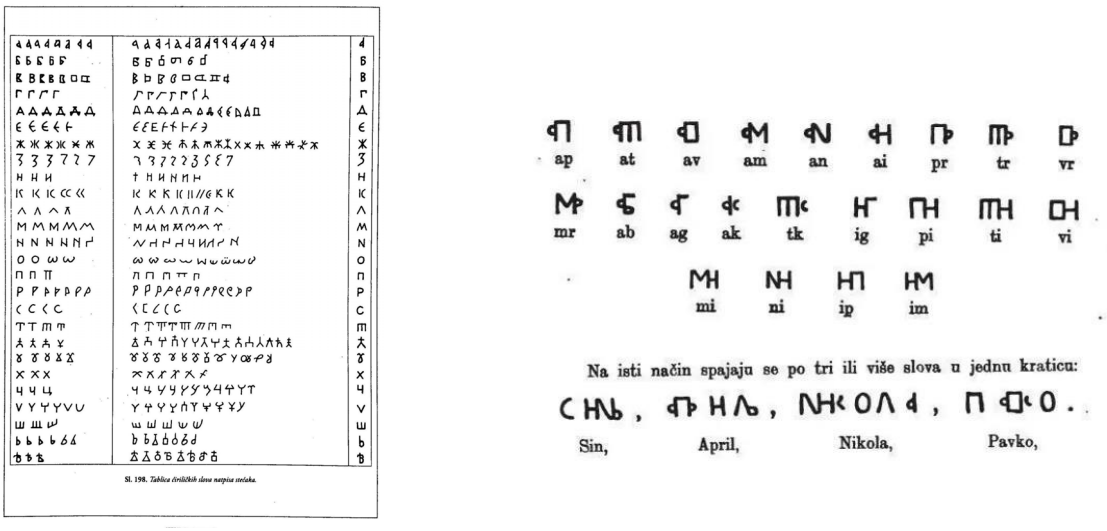
2. METHODS

This project is divided into two main phases:

- digitization of the *Bosančica* script and creation of three stylized fonts with full sets of characters including ligatures and alternative characters, and
- developing a web transliterator with the function of translating Latin text into *Bosančica* with full support for all additional functions of the font.

The digitization process began with the selection of content that would concisely represent the culture and provide a good introduction to its artistic reach. Although there are over 6,000 *stećci* with relief decorations (Dizdar, 2018), many symbols are repeated and can therefore be tentatively categorized. In the *Bosančica* script, there are two distinguished styles based on the way of use: handwritten and lapidary. The definition of lapidary represents all typography found on carved stone medium. Character differences exist between these two categories, but also within them. In this paper, the focus is on the lapidary form of *Bosančica* because of its connection with the *stećak* culture. The sources of typography used in the literature are the works of Marko Vego (Vego, 1964), Amra Zulfikarpašić and Lejla Nakaš (Zulfikarpašić & Nakaš, 2016), Ćiro Truhelka (Truhelka, 1889), Šefik Bešlagić (Bešlagić, 2004; Bešlagić, 2020) (Figure 1a), and Mehmed Kardaš (Kardaš, 2015) (Figure 1b).

The *Bosančica* script was used for several centuries, and in distant localities with their specific linguistic differences. As a result, the glyphs representing the same grapheme can have vastly different styles of writing depending on the region and time period. Taking that into consideration multiple glyph versions of each character were included across all font styles to accommodate these differences, providing separate user choices for each character alternate. *Bosančica* writing also has specific ligature features, where some glyphs unite to form larger symbols representing multiple characters at once. (Figure 1b) Every ligature is assembled from the core identifying shapes of included glyphs, while some elements of the original characters are lost during ligature formation. In reality, these ligatures were used only on certain occasions so their inclusion into the font is purely for education and technical demonstration. Therefore, the goal was to create a font that can automatically assemble the ligatures by itself, while still allowing users control of whether they want to use the ligature feature or not.



a) b)

Figure 1: a) Glyph variations (Bešlagić, 2004.), b) Ligature variations (Truhelka, 1889.)

2.1 Glyph creation

First, vectors were created using Adobe Illustrator according to the lapidary *Bosančica* script. The forms of characters were constructed using curves and were subsequently transformed into vector shapes. By connecting the shapes through the *Pathfinder tool*, final glyphs were formed to be used in the font. To make the complete font more adaptable to the current Latin script keyboard, the letters F and J were subsequently added to the existing list of characters, which originally did not appear on stone monuments but only later in some versions of the calligraphic script. To complement the glyph diversity of this script, three alternates of every character were created where possible, showcasing opportunities for further expansion. These glyphs were then interpreted through three different styles, Lapidary (closest to source) and digitally adapted Regular and Bold versions, which amounted to 297 glyphs in total for this demonstration. To showcase the multi-letter ligature functionality, 25 symbols were chosen from literature (Truhelka, 1889) (Figure 1b) to be used in the fonts. Three separate Latin script-based fonts were created in FontLab 8, one representing each style. The glyphs were then imported from Adobe Illustrator to FontLab, where each *Bosančica* glyph was assigned to a value corresponding to its equivalent in the *Gaj's Latin alphabet,* used today by modern Slavic languages in the countries of localities. After importing the glyphs, the core vectors were optimized through path simplification, and kerning spaces were established for each character.

2.2 Alternates and ligatures

As mentioned, there are three character alternates for each letter in a given font, as well as ligatures combining multiple letters into a singular glyph. Both font features were executed through ligature

functions in the OpenType language (Microsoft Typography, 2024), considering future interactive HTML implementation. Character alternates were defined through the *Standard ligatures* (*liga)* function, where every letter has a set default glyph that forms a ligature with an empty unused value. As these fonts have no glyphs representing numbers, we used code spaces of numbers 1 and 2 for up to two character alternates per letter. Character alternates are output each time either number comes after a letter (e.g. A+1), substituting the original for the new glyph (e.g. A_one). The other type of ligatures that contain multiple letters at once, were assembled through the *Discretionary ligatures* (*dlig)* function (Figure 2) allowing manual control of their use while not impacting chosen alternate characters functioning through *liga*. The final font needed to also retain functionality if both alternate characters and other ligatures were used at the same time. This was done by including each scenario of potential combinations that should result in a certain ligature (e.g. A1+K2=A_K).

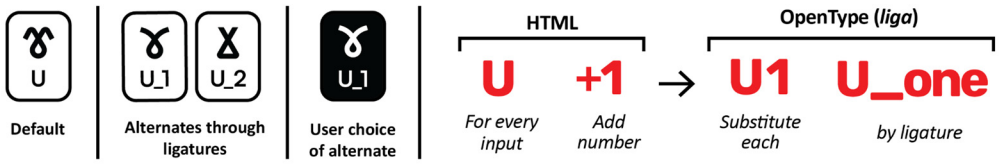


Figure 2: Character alternates expressed through Standard ligatures function

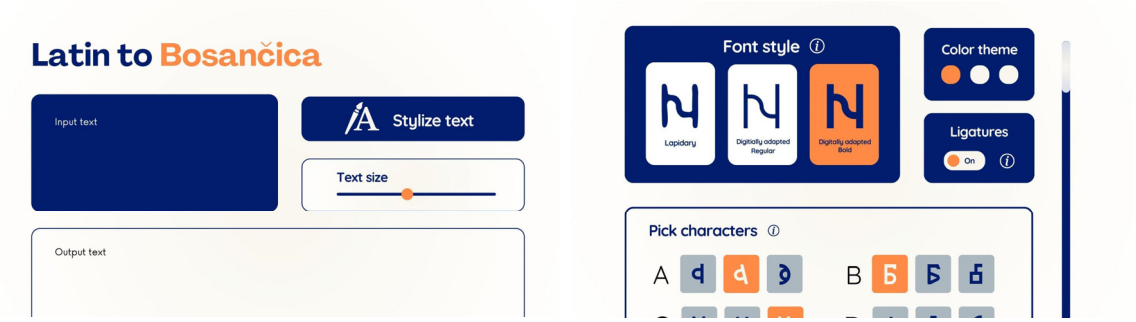
2.3 HTML integration and presentation

A web-based transliterator was created to showcase this digitized heritage in a widely available and interactive medium. It allows Latin to *Bosančica* transliteration with added features for customization of output text. The starting interface (Figure 3a) consists of an input-output box layout with a slider for the sizing of output text and a customization menu option. Upon opening the menu (Figure 3b), the first submenu allows for changing the font style, which switches between three different font files in HTML. There is a ligature On/Off switch for multi-character ligatures that controls if *dlig* features are toggled in CSS. Users can also choose alternate characters for each letter in a table of all glyphs. By selecting a certain alternate, HTML sets a function that types out its corresponding ligature number each time that letter is input. Since it is applied immediately each time, the user just sees their newly chosen glyph as a character alternate and not the ligature itself forming. Because the Discretionary i.e. multi-letter ligatures include all possible combinations of character alternates, the user's unique choices do not influence the regular formation of larger ligatures if their option is activated in the menu.

3. RESULTS

The final website concept opens with a functioning transliterator and adds customization options further through a menu button and output size slider. The menu allows for choosing the font style, color theme, ligature control and choice of alternate characters that stay saved as users' preferences. In terms of visual characteristics, a simplified website structure provides a high-contrast interface that is then adaptable for better visual accessibility by using appropriate color combinations.

Three form styles of glyphs are available, each contained within a separate font while all offer the same ligature functionality regardless of style. The characters and their alternates are presented in the table below (Figure 4), where each row represents one character marked first by its Latin equivalent, followed by groups of alternates categorized through different styles. Using the same order principle, the other table lists all ligatures marked by appropriate letter combinations that comprise them (Figure 5).



a) b)

Figure 3: a) Website interface, b) Customization options menu

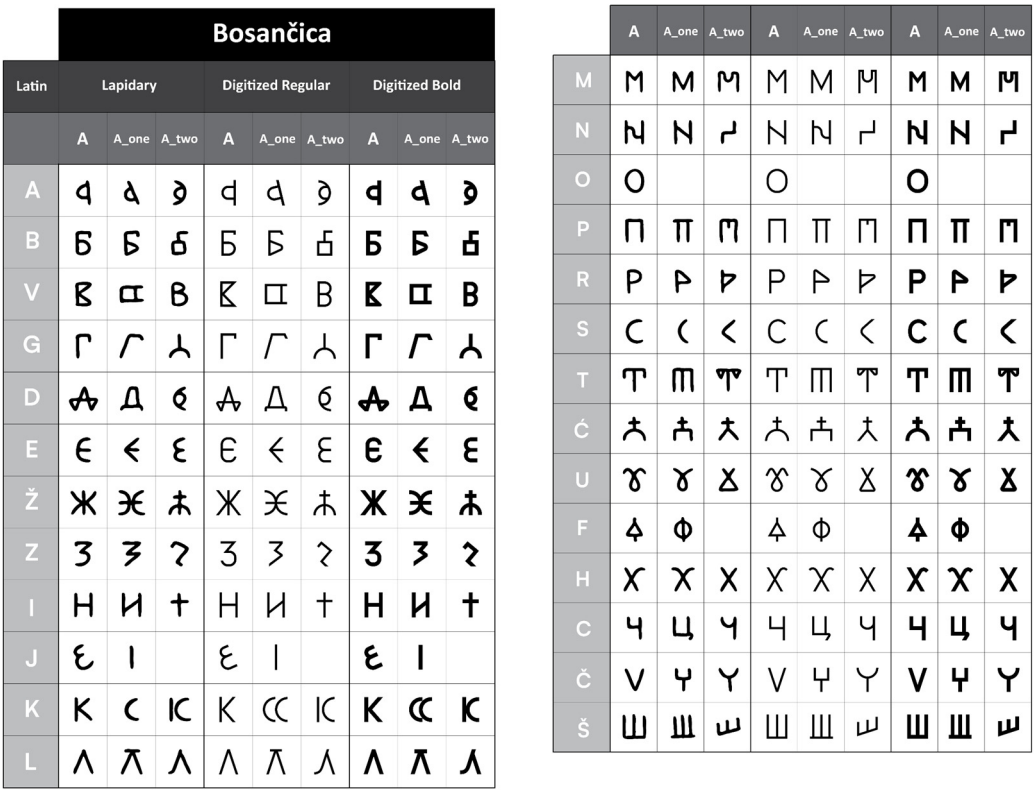


Figure 4: Glyphs of characters and character alternates sorted by font values

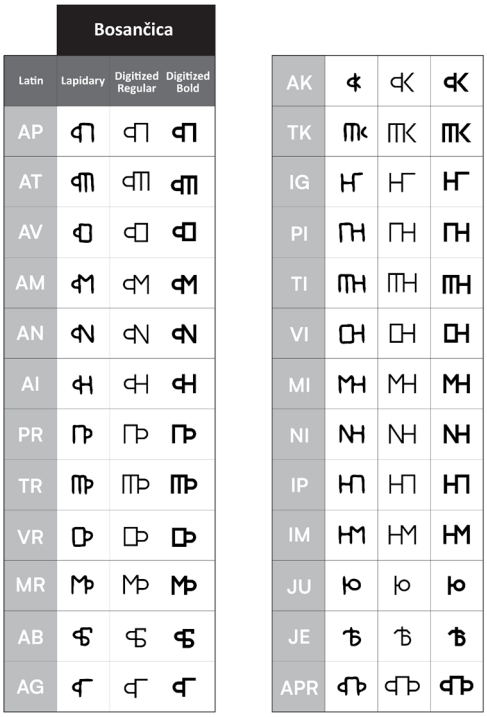


Figure 5: Glyphs of ligatures

4. DISCUSSION

The rich collection of character variations in this script poses a significant challenge in the effort of digitization, especially when making a functioning digital writing system. It is difficult to concisely present this script without compromising on some glyphs and ligature scenarios, undermining historical accuracy. Previous efforts to create digital versions center around two different core principles. The first is for professional editorial purposes of the literature on the subject, whereby some artists attempted to create a full range of all discovered character forms in one font. These have the highest historical accuracy but lack in terms of technical practicality and options for further integration besides professional literature. The other, like the one in this paper, focus on educational and entertainment purposes where compromises are made to balance accuracy with technical adaptability. As we have showcased, through prioritizing HTML integration and creatively using OpenType features, this way of digital interpretation can offer better variety in terms of functionality and adaptiveness. By simplifying the font manipulation process through a user-friendly interface, it allows regular users to further engage with the writing system without the need for prior technical knowledge. A system like the transliterator can easily be integrated with other website sections that offer more detailed cultural information which would allow natural learning progression. This emphasizes its potential for adaptation in educational content and general use as a widespread public digital resource.

5. CONCLUSIONS

In today's digital age, the undisputable next step forward in cultural conservation, participation and education on the matter is the process of digitization of national cultural heritage. Digital platforms allow for broader accessibility of such cultural materials to global masses but hold an obligation to structure the content in a precise and transparent manner while offering the opportunity to its users to further explore said material. The potential interactivity that digital platforms offer with cultural material aids in understanding complex concepts and connecting deeper with the subject at hand.

By using the example of the cultural heritage of Bosnia and Herzegovina, this paper shows an innovative way in which culture, specifically a writing system can be digitized and preserved to appease many of its different variations, adapting it to the environment of today's learners.

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