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Digitalizacija kulturne baštine na terenu: metodološki pristupi i primjena 2D i 3D tehnologija u etnologiji

Digitalizacija donosi značajne promjene u savremenu etnografsku praksu, omogućavajući, između ostalog, nove načine bilježenja, analize i prezentacije kulturne baštine. Ovaj rad istražuje kako digitalne tehnologije, poput dvodimenzionalnog (2D) prikaza i trodimenzionalnog (3D) modela, mogu poboljšati etnografska istraživanja kroz precizniju dokumentaciju i time doprinijeti boljem očuvanju kulturnog naslijeđa. Upotreba ovih metoda olakšava prikupljanje podataka, ali omogućava i dublje razumijevanje kulturnih konteksta kroz interaktivne i vizuelno bogate prikaze, npr. u sklopu virtualne stvarnosti (VR) ili proširene stvarnosti (AR). Rad će se ukratko fokusirati na predstavljanje digitalizacije općenito i njen odnos s kulturnom baštinom, a potom preći na praktične primjere 2D i 3D digitalizacije. Cilj rada je predstaviti njihov potencijal za dugoročno (digitalno) očuvanje kulturne baštine.

Ključne riječi: digitalizacija, 2D, 3D, kulturna baština, vizuelna antropologija, etnologija, kulturna antropologija, interdisciplinarni pristup.

Uvod

Digitalizacija kulturne baštine predstavlja složan proces koji zahtijeva tehnološku pismenost, odgovarajući hardver, resurse,

Digitisation of Cultural Heritage in the Field: Methodological Approaches and the Application of 2D and 3D Technologies in Ethnology

Digitalization brings significant changes to contemporary ethnographic practice, enabling, among other things, new methods of recording, analysing, and presenting cultural heritage. This paper explores how digital technologies, such as 2D representations and 3D models, can enhance ethnographic research through more precise documentation and cultural preservation. The use of these methods facilitates data collection while also enabling a deeper understanding of cultural contexts through interactive and visually rich displays, for example, within virtual reality (VR) or augmented reality (AR). The paper will briefly focus on introducing digitalisation in general and its relationship with cultural heritage, before moving on to practical examples of 2D and 3D digitalisation. The aim of this paper is to present their potential for the long-term (digital) preservation of cultural heritage.

Keywords: digitalisation, 2D, 3D, cultural heritage, visual anthropology, ethnology, cultural anthropology, interdisciplinary approach.

Introduction

The digitisation of cultural heritage is a complex process that requires technological

vrijeme i sl., ali zauzvrat daje vizuelno bogat prikaz određenog aspekta kulturne baštine. S tim u vezi, ovaj vid vizuelnog bilježenja i očuvanja zbog svojih prednosti i nedostataka mora biti opravdan.

Digitalizacija je postala ključna riječ savremenog društva kroz višedecenijski razvoj (od 1970. do danas), od tehničkog procesa pretvaranja analognog u digitalni oblik, do sveobuhvatne transformacije društvenih i ekonomskih struktura.¹ Ona nije samo tehnički proces, već i društveno-ekonomski fenomen koji mijenja način na koji radimo, komuniciramo i živimo.² Konstantni napredak tehnologije i samim tim digitalizacije donosi brojne prednosti i izazove. Među njima se mogu između ostalog spomenuti etička pitanja vezana za obradu i arhiviranje podataka korisnika, *cyber* bezbjednost i sl. Dok se buduće inovacije nastavljaju, jasno je da digitalizacija ostaje jedan od temelja napretka oblikujući svijet u kojem živimo.

S tim u vezi, razvoj digitalnih tehnologija mijenja načine na koje doživljavamo i dokumentujemo stvarnost, samim tim i kulturnu baštinu. Te promjene su se odrazile između ostalog i na etnologiju i kulturnu antropologiju. Mogućnosti prikupljanja, analize i prezentacije podataka omogućavaju etnoložima, ali i općenito etnografima, da na inovativne načine pristupe baštini. Općenito, etnologija i kulturna antropologija su se kao discipline tradicionalno oslanjale na riječi i tekst, kao što su terenske bilješke (Mid, 2014: 11–12). Međutim, ograničenja

literacy, appropriate hardware, resources, time, etc., but in return, it provides a visually rich representation of a specific aspect of cultural heritage. In this regard, this form of visual recording and preservation must be justified due to its advantages and disadvantages.

Digitalisation (and digitisation) has become a keyword of modern society through multi-decade development (from 1970 to the present), evolving from the technical process of converting analogue to digital form, to the comprehensive transformation of social and economic structures.¹ It is not merely a technical process, but also a socio-economic phenomenon that changes the way we work, communicate, and live.² The constant advancement of technology, and consequently digitisation, brings numerous advantages and challenges. They can include ethical issues related to the processing and archiving of user data, cybersecurity, and the like. As future innovations continue, it is clear that digitisation remains one of the foundations of progress, shaping the world in which we live.

In this context, the development of digital technologies is changing the ways we experience and document reality and consequently, cultural heritage. These changes have, among other things, impacted ethnology and cultural anthropology. The possibilities of data collection, analysis and presentation enable ethnologists, as well as ethnographers in general, to approach heritage in innovative ways. Generally, ethnology and cultural anthropology as disciplines have traditionally relied on words and text (Mid, 2014:

¹ Company in Clouds, Od preživljavanja do uspjeha: Zašto je digitalizacija ključna za uspjeh mikro, malih i srednjih preduzeća, <https://www.companyinclouds.com/blogs/od-prezivljavanja-do-uspjeha>, pristupljeno 25. 5. 2025.

² CCNET, Historical Development of Digitalization: How It All Began, <https://www.ccnet.de/en/blog/dav4-historical-development-of-digitalization-how-it-all-began/>, pristupljeno 25. 5. 2025.

¹ Company in Clouds, From Survival to Success: Why Digitization is Crucial for the Success of Micro, Small and Medium Enterprises, <https://www.companyinclouds.com/blogs/od-prezivljavanja-do-uspjeha>, accessed May 25, 2025.

² CCNET, Historical Development of Digitalization: How It All Began, <https://www.ccnet.de/en/blog/dav4-historical-development-of-digitalization-how-it-all-began/>, accessed May 25, 2025.

tekstualnih metoda u bilježenju vizuelnih i senzornih aspekata kulture dovela su do potrebe za novim i naprednim tehnologijama, kao što je audio, ali za ovaj rad bitnije i vizuelno bilježenje. S tim u vezi, bitno je naglasiti da upotreba digitalnih vizuelnih medija nije nužno vizuelna antropologija, već više predstavlja odraz metodologije specifične za ovu granu antropologije. Prema Sarah Pink, vizuelna antropologija bavi se “vizuelnim i o vizuelnoj komunikaciji”, naglašavajući da slike nisu samo dokumentacija već aktivni učesnici u stvaranju znanja (Pink, 2007: 131). El Guindi dodaje da vizuelna antropologija nije ograničena samo na ono što je vidljivo, već uključuje i dublje, skrivene kulturne i društvene odnose koji se mogu manifestovati kroz vizuelne forme (El Guindi, 2004: 17).

Vizuelni mediji nude korisno sredstvo za bavljenje kulturom koje je teško adekvatno opisati samo riječima. U suštini, dva pristupa, zasnovan na riječima i vizuelni, veoma dobro se nadopunjuju i u njihovoj kombinaciji leži veliki potencijal. (Mid, 2014: 11–12). Kako tvrde Marcus Banks i Howard Morphy, vizuelne metode omogućavaju naprednije bilježenje uočljivi fenomena i promjena, čime se suprotstavljaju tradicionalnoj akademskoj naklonjenosti koja pisani tekst stavlja ispred vizuelnih i opservacijskih podataka. Ključno je to što oni naglašavaju kako vizuelno bilježenje omogućava odvajanje prikupljanja podataka od neposredne analize i interpretacije stvaranjem trajnih vizuelnih dokaza, što istraživačima omogućava da zabilježe detalje izvan granica pamćenja ili terenskog bilježenja za kasniji pregled i ponovnu analizu (Banks i Morphy, 1997: 13–14).

Upravo u ovoj metodološkoj pretpostavci leži jedan od temelja ovog rada, a to je korištenje savremenih tehnologija za digitalno

11–12), such as fieldwork notes. However, the limitations of textual methods in recording the visual and sensory aspects of culture have led to the need for new and advanced technologies such as audio, and more importantly for this paper, visual recording. In this regard, it is important to emphasise that the use of digital visual media is not necessarily visual anthropology in itself, but rather reflects a methodology specific to this branch of anthropology. According to Sarah Pink, visual anthropology is concerned with “the visual and visual communication”, emphasising that images are not merely documentation but active participants in the creation of knowledge (Pink, 2007: 131). El Guindi adds that visual anthropology is not limited only to what is visible but also includes deeper, hidden cultural and social relations that can manifest through visual forms (El Guindi, 2004: 17).

Visual media offer an essential framework for engaging with aspects of culture that are difficult to capture through words alone. In essence, text-based and visual approaches complement each other, and significant potential lies in their integration (Mid, 2014: 11–12). As Marcus Banks and Howard Morphy argue, visual methods enable a more comprehensive recording of observable phenomena, counteracting a traditional academic bias that elevates written text over visual and observational data. Crucially, they emphasise that visual recording allows for the separation of data collection from immediate analysis and interpretation by creating permanent visual evidence, which allows researchers to capture details beyond the limits of memory or fieldwork notebooks for later inspection and re-analysis. (Banks and Morphy, 1997: 13–14).

Precisely in this methodological premise lies one of the foundations of this paper: leveraging modern technologies to digitally record and preserve fragile or fleeting aspects

bilježenje i očuvanje krhkih ili prolaznih aspekata kulturne baštine prije nego što nestanu u današnjim društvima koja su sklona se brzom mijenjanju. Naravno, ove promjene ujedno stvaraju i “materijal” za istraživanje, ali bilo bi poželjno zabilježiti elemente onoga što nestaje.

U skladu sa svim navedenim, u ovom radu istražuje se kako se savremene tehnologije, poput 2D i 3D digitalizacije, mogu integrisati u metodologiju vizuelne antropologije (radi naprednijeg pristupa vizuelnim istraživanjima i razumijevanju svijeta oko nas upotrebom novih tehnologija), muzejsku praksu i srodne discipline. Posebna pažnja usmjerena je na očuvanje kulturne baštine, dok se kroz praktične primjere digitalnih rekonstrukcija ukazuje na potencijal ovih metoda za njenu dugoročnu zaštitu. Dok primarni fokus rada jeste na metodologiji i tehničkim aspektima procesa 2D i 3D digitalizacije, čime se uviđa dalji potencijal tehnološkog razvoja i njegov utjecaj na način na koji se razumijevaju i predstavljaju kulturni identiteti, te kako savremeni alati mogu unaprijediti etnografska istraživanja i interpretaciju društava.

Digitalizacija kulturne baštine

Digitalne tehnologije igraju značajnu, ali složenu ulogu u očuvanju kulturne baštine, nudeći i prednosti i izazove. One omogućavaju kreiranje digitalnih arhiva, virtuelnih muzeja, kao i digitalnu rekonstrukciju kulturnih artefakata, što pomaže u zaštiti i očuvanju informacija koje bi inače bile izgubljene. Također omogućavaju prenošenje umjetnina u digitalni oblik, čime se uz klasične izložbene prostore razvijaju portali i virtuelni muzeji (Nikonova i Biryukova, 2017: 169–170). Stručnjaci pritom ističu dva glavna pravca primjene digitalnih

of cultural heritage before they disappear in today’s rapidly changing society. Naturally, these changes also create “material” for research, but it would be desirable to record the elements of what is disappearing.

In accordance with all the above, this paper explores how modern technologies, such as 2D and 3D digitisation, can be integrated into the methodology of visual anthropology (for a more advanced approach to visual research and understanding the world around us through the use of new technologies), museum practice, and related disciplines. Special attention is directed to the preservation of cultural heritage, while practical examples of digital reconstructions highlight the potential of these methods for its long-term protection. While the primary focus of the paper is on the methodology and technical aspects of the 2D and 3D digitisation process, it simultaneously recognises the further potential of technological development and its impact on how cultural identities are understood and represented, as well as how modern tools can advance ethnographic research and the interpretation of societies.

Digitisation of Cultural Heritage

Digital technologies play a significant yet complex role in preserving cultural heritage, offering both advantages and challenges. They enable the creation of digital archives, virtual museums, as well as the digital reconstruction of cultural artifacts, which helps protect and preserve information that would otherwise be lost. They also enable the transfer of artworks into digital form, thereby developing websites and virtual museums alongside traditional exhibition spaces (Nikonova and Biryukova, 2017: 169–170). In doing so, experts highlight two main avenues for applying digital technologies in the preservation of cultural heritage: the creation of electronic copies of traditional cultural collections and the development

tehnologija u očuvanju kulturne baštine: izradu elektronskih kopija tradicionalnih kulturnih zbirki i razvoj novih elektronskih oblika kulturnih objekata (Nikonova i Biryukova, 2017: 170).

Sama digitalizacija kulturne baštine podrazumijeva sistematsko skeniranje, fotografisanje i modeliranje dokumenata, umjetničkih djela, arhitekture i drugih fizičkih artefakata radi njihove zaštite, ali i radi lakšeg pristupa istraživačima i široj javnosti. Prema UNESCO-voj Povelji o očuvanju digitalnog naslijeđa (2003), digitalno naslijeđe obuhvata “kulturne, obrazovne, naučne i administrativne materijale, kao i druge oblike informacija stvorene digitalno ili prenesene iz analognog u digitalni oblik” (UNESCO, 2003: 1). Time se nastoji osigurati trajna dostupnost vrijednih izvora za buduće generacije, bez rizika od propadanja izvornih predmeta uslijed starenja materijala ili nepovratnih oštećenja (Ibid).

Proces digitalizacije kulturnog naslijeđa obuhvata više faza:

- 1) Priprema i selekcija: odabir dokumenata ili artefakata od najveće kulturne i historijske važnosti (IFLA, 2002: 20–21);
- 2) Digitalizacija: tehničko snimanje, odnosno 2D ili 3D skeniranje artefakata, uz primjenu standarda koji osiguravaju visoku rezoluciju i vjernost originalu;
- 3) Obrada i metapodaci: dodavanje opisa, hronologije, geolokacije i drugih metapodataka prema međunarodnim smjernicama, omogućava precizno pretraživanje i interoperabilnost među bazama podataka (UNESCO, 2003: 3);
- 4) Pohrana i dostupnost: arhiviranje u digitalnim depoima uz planiranje redovnih migracija formata i izrade sigurnosnih kopija (IFLA, 2002: 35–46).

of new electronic forms of cultural objects (Nikonova and Biryukova, 2017: 170).

The digitisation of cultural heritage involves the systematic scanning, photographing, and modelling of documents, artworks, architecture, and other physical artifacts for their protection, as well as to enable easier access for researchers and the general public. According to UNESCO’s Charter on the Preservation of the Digital Heritage (2003), digital heritage embraces “cultural, educational, scientific and administrative materials, as well as other forms of information created digitally or converted from analogue into digital form” (UNESCO, 2003: 1). This aims to ensure the lasting availability of valuable resources for future generations, without the risk of original items deteriorating due to the aging of materials or irreversible damage (Ibid).

The process of digitising cultural heritage involves several phases:

- 1) Preparation and selection: selecting documents or artifacts of the highest cultural and historical importance (IFLA, 2002: 20–21);
- 2) Digitisation: technical recording, 2D or 3D scanning of artifacts, applying standards that ensure high resolution and fidelity to the original;
- 3) Processing and metadata: adding descriptions, chronology, geolocation, and other metadata in accordance with international guidelines, which enables precise searchability and interoperability across databases (UNESCO, 2003: 3);
- 4) Storage and accessibility: archiving in digital repositories along with planning for regular format migrations and creating backup copies (IFLA, 2002: 35–46).

The application of these steps not only preserves the physical integrity of artifacts but also opens new possibilities for their analysis and presentation, such as virtual

Primjena ovih koraka ne samo da čuva fizički integritet artefakata nego i otvara nove mogućnosti za njihovu analizu i prezentaciju, poput virtuelnih izložbi muzejskih zbirki, 3D rekonstrukcija historijskih lokaliteta i srodnih sadržaja. Međutim, izazovi kao što su visoka cijena opreme, tehnološka zastarjelost formata te etička pitanja u vezi s pravima na reprodukciju i pristup zahtijevaju kontinuirano strateško planiranje i međunarodnu saradnju (UNESCO, 2003: 4).

Prema UNESCO-voj Povelji o očuvanju digitalnog naslijeđa, ključni koraci u procesu digitalizacije i dugoročne zaštite digitalnih resursa mogu se sažeti u sljedećim tačkama:

1) digitalni kontinuitet (životni ciklus)

Da bi se digitalna baština sačuvala, mjere moraju obuhvatiti cjelokupan informacijski životni ciklus, od nastanka građe ili njenog prelaska iz analognog u digitalni oblik do osiguranja dugoročnog pristupa. To podrazumijeva uspostavljanje pouzdanih sistema i procedura koje osiguravaju autentičnost i stabilnost resursa tokom vremena (UNESCO, 2003: 2);

2) razvoj strategija i politika

Potrebno je izraditi nacionalne i institucionalne strategije, politike i standarde za očuvanje digitalne građe, uzimajući u obzir lokalne potrebe, resurse i buduće projekcije. Saradnja svih aktera ili nosilaca autorskih prava, arhiva, izdavača i industrije olakšava stvaranje kompatibilnih rješenja i dijeljenje resursa. (UNESCO, 2003: 3).

3) selektiranje materijala za čuvanje

Budući da je digitalni sadržaj često obiman i prolazan, ključna je selekcija prema trajnoj kulturnoj i naučnoj vrijednosti. Izvorno digitalne datoteke (*born-digital*)

exhibitions of museum collections, 3D reconstructions of historical sites, and related content. However, challenges such as the high cost of equipment, the technological obsolescence of formats, and ethical issues regarding reproduction and access rights, require continuous strategic planning and international cooperation (UNESCO, 2003: 4).

According to UNESCO's Charter on the Preservation of the Digital Heritage, the key steps in the process of digitisation and the long-term protection of digital resources can be summarised in the following points:

1) Digital continuity (life cycle)

In order to preserve digital heritage, measures must encompass the entire information life cycle, from the creation of the material or its conversion from analogue to digital form, to ensuring long-term access. This entails establishing reliable systems and procedures that ensure the authenticity and stability of resources over time (UNESCO, 2003: 2);

2) Development of strategies and policies

It is necessary to formulate national and institutional strategies, policies, and standards for the preservation of digital material, taking into account local needs, resources, and future projections. Collaboration among all stakeholders, including copyright holders, archives, publishers, and industry facilitates the creation of compatible solutions and resource sharing (UNESCO, 2003: 3).

3) Selection of materials for preservation

Since digital content is often vast and fleeting, selection based on lasting cultural and scientific value is crucial. Born-digital files take priority, and preservation decisions should be transparent, documented, and based on clear criteria (Ibid).

4) Protection and legal framework

Establishing an appropriate archival and legal framework for mandatory or voluntary

imaju prioritet, a odluke o čuvanju trebaju biti transparentne, dokumentovane i zasnovane na jasnim kriterijima (Ibid).

4) zaštita i pravni okvir

Uspostavljanje odgovarajuće arhivske i zakonske strukture za obavezni ili dobrovoljni depozit u javnim ustanovama (biblioteke, arhivi, muzeji) osigurava trajno čuvanje digitalnih zapisa. Tehnički i pravni mehanizmi za provjeru autentičnosti sprečavaju neovlaštene izmjene (Ibid).

5) osiguranje pristupa

Cilj je da digitalna baština ostane dostupna javnosti bez nerazumnih ograničenja, pri čemu se istovremeno štite osjetljive i lične informacije. Pravična ravnoteža između prava autora i interesa javnosti mora se poštovati u skladu s međunarodnim normama (UNESCO, 2003: 2).

Kada je riječ o prednostima digitalizacije i očuvanja građe, na osnovu UNESCO-vog izvještaja može se zaključiti da ovaj proces značajno doprinosi zaštiti baštine. U tom pogledu naglašava se da digitalna građa ostaje dostupna budućim generacijama, čime se sprječava gubitak važnih historijskih i naučnih zapisa. Osim toga, osiguravanje globalne i univerzalne dostupnosti od ključnog je značaja ne samo za kulturnu baštinu nego i za obrazovanje. Digitalna baština nije ni geografski ni kulturno ograničena, te omogućava međusobnu komunikaciju i razmjenu znanja širom svijeta. Ta činjenica sama po sebi podstiče inovacije i dalji napredak. Iako navedeni pristup može zvučati pomalo “utopijski”, od presudne je važnosti nastojati sačuvati kulturnu i naučnu baštinu za buduće generacije, uz istovremeno zadržavanje njene autentičnosti, pri čemu jasni tehnički i pravni okviri štite integritet digitalnih resursa (UNESCO, 2003: 2–3).

deposit in public institutions (libraries, archives, museums) ensures the long-term preservation of digital records. Technical and legal mechanisms for verifying authenticity prevents unauthorised alterations (Ibid).

5) Ensuring access

The goal is to keep digital heritage accessible to the public without unreasonable restrictions, while simultaneously protecting sensitive and personal information. A fair balance between the rights of authors and the public interest must be respected in accordance with international norms (UNESCO, 2003: 2).

When it comes to the advantages of digitisation and the preservation of materials, based on the UNESCO report, it can be concluded that this process significantly contributes to the protection of heritage. In this regard, it is emphasised that digital materials remain accessible to future generations, thereby preventing the loss of important historical and scientific records. Furthermore, ensuring global and universal accessibility is of crucial importance not only for cultural heritage but also for education. Digital heritage is neither geographically nor culturally limited, and it enables communication and the exchange of knowledge worldwide. This fact in itself fosters innovation and further progress. Although this approach may sound somewhat “utopian”, it is of paramount importance to strive to preserve cultural and scientific heritage for future generations while simultaneously maintaining its authenticity, with clear technical and legal frameworks protecting the integrity of digital resources (UNESCO, 2003: 2–3).

On the other hand, the disadvantages of digitisation are characterised by several key challenges, among which the rapid obsolescence of technology particularly stands out (UNESCO, 2003: 2). This process has been easily noticeable in everyday life over the

S druge strane, nedostatke digitalizacije karakteriše nekoliko ključnih izazova, među kojima se posebno ističe brza zastarjelost tehnologije (UNESCO, 2003: 2). Taj proces lako je uočljiv u svakodnevnom životu tokom posljednje tri decenije, posebno u pogledu medija za prenos informacija, od audio-kaseta i flopi diskova, preko CD-ova i USB-a, pa sve do bežičnog prijenosa podataka, interneta i Bluetootha. To ne znači da se pojedini od navedenih medija i danas ne koriste, ali je njihov značaj se promijenio. Pored toga, prvenstveno kod većih, ali i kod manjih projekata, javljaju se visoki troškovi i obimni zahtjevi za resursima. Implementacija i održavanje sistema za dugoročno čuvanje zahtijevaju značajna finansijska i kadrovska ulaganja. S time je povezan i “digitalni jaz”, odnosno nejednakost u pristupu tehnologiji i stručnosti, što otežava ravnomjernu primjenu mjera zaštite širom svijeta (UNESCO, 2003: 3). Također, posebnu cjelinu čine pravni i autorskopravni izazovi: usaglašavanje interesa nosilaca prava i šire javnosti izuzetno je složeno i zahtijeva pažljiv pristup kako nijedna strana ne bi bila oštećena (UNESCO, 2003: 2–4).

Osim UNESCO-vih procjena, Nikonova i Biryukova naglašavaju da kreiranje virtuelnih (digitalnih) kulturnih repozitorija ponekad ne odražava autentično pamćenje, historiju i tradiciju, što može dovesti do gubitka vrijednosnog značenja baštine (Nikonova i Biryukova, 2017: 171). Masovna kultura i internetske kompilacije mogu zamaglit granicu između izvornih umjetničkih djela i digitalnih reprodukcija, čime se narušava kulturna komunikacija zasnovana na neposrednom doživljaju. (Nikonova i Biryukova, 2017: 171)

3D rekonstrukcija, kao savremena tehnologija koja se aktivno koristi u zaštiti kulturne baštine, obuhvata izradu virtuelnih

last three decades, especially regarding information transfer media, from audio cassettes and floppy disks, through CDs and USBs, all the way to wireless data transmission, the Internet, and Bluetooth. This does not mean that some of these media are not still in use today, but their significance has changed. In addition, primarily in larger, but also in smaller projects, high costs and extensive resource demands arise. The implementation and maintenance of long-term preservation systems require significant financial and human resource investments. Connected to this is the “digital divide”, that is inequality in access to technology and expertise, which complicates the uniform application of protection measures worldwide (UNESCO, 2003: 3). Furthermore, legal and copyright challenges constitute a separate issue: harmonising the interests of rights holders and the general public is extremely complex and requires a careful approach so that neither party is disadvantaged (UNESCO, 2003: 2–4).

In addition to UNESCO’s assessments, Nikonova and Biryukova emphasise that the creation of virtual (digital) cultural repositories sometimes fails to reflect authentic memory, history, and tradition, which can lead to the loss of the heritage’s intrinsic value (Nikonova and Biryukova, 2017: 171). Mass culture (POP culture) and internet compilations can blur the boundary between original artworks and digital reproductions, thereby disrupting cultural communication based on direct experience (Nikonova and Biryukova, 2017: 171).

3D reconstruction, as a modern technology actively used in the protection of cultural heritage, involves the creation of virtual objects that provide visual and informative material for the research of cultural heritage sites. Although these reconstructions offer a new method for modelling historical processes, their “helping” nature can affect the perception of cultural assets, often

objekata koji pružaju vizuelni i informativni materijal za istraživanje lokaliteta kulturne baštine. Iako ove rekonstrukcije nude novu metodu za modeliranje historijskih procesa, njihov pomoćni karakter može utjecati na percepciju kulturnih dobara, često zahtijevajući od posmatrača dodatno historijsko znanje ili maštu (Nikonova i Biryukova, 2017: 170–171). Razvoj 3D rekonstrukcija odvija se u dva pravca: kroz “prezentacijske” rekonstrukcije namijenjene turizmu i rekreaciji te “istraživačke” rekonstrukcije usmjerene na interdisciplinarne zadatke (Nikonova i Biryukova, 2017: 171).

Uprkos mnogobrojnim prednostima, autorice naglašavaju da autori digitalnih rekonstrukcija ponekad zanemaruju “smrt autentičnosti” koju donose digitalne tehnologije. Pojam “smrt autentičnosti” označava proces u kojem digitalne reprodukcije gube ili čak potiskuju izvornu, materijalnu i kontekstualnu vrijednost kulturne baštine. (Ibid) Prvo, karakteristični detalji spomenika ili artefakata u virtuelnim rekonstrukcijama često bivaju neutralizirani, npr. pukotine, tragovi habanja i druge “nesavršenosti” prema autoricama brišu se, pa vizuelni prikaz postaje sterilan ili bezdušan. Time se, kako je naglašeno ne gubi samo autentični doživljaj nego i važni slojevi informacija zapisanih u samom originalu (Ibid.).

Drugo, cijeli složeni proces istraživanja i sinteze izvora ostaje “iza kulisa”. Korisnik internetskih ili multimedijalnih rekonstrukcija vidi tek gotov proizvod, poput filma, slike ili aplikacije bez uvida u metode prikupljanja, arhivske rasprave ili tehnoloških ograničenja (Ibid). To “zamagljivanje” procesa dovodi u pitanje mogućnost provjere autentičnosti i pouzdanosti digitalnih zapisa i otvara prostor za falsifikovanje, plagijate i druge oblike manipulacije (Nikonova i Biryukova, 2017: 172). Na kraju, Nikonova i Biryukova naglašavaju da bi dugoročno, s daljim napretkom

requiring additional historical knowledge or imagination from the observer (Nikonova and Biryukova, 2017: 170–171). The development of 3D reconstructions unfolds in two directions: “presentation” reconstructions intended for tourism and recreation, and “research” reconstructions aimed at interdisciplinary tasks (Nikonova and Biryukova, 2017: 171).

Despite the numerous advantages, the authors emphasise that the creators of digital reconstructions sometimes overlook the “death of authenticity” brought about by digital technologies. The concept of the “death of authenticity” refers to the process in which digital reproductions lose or even suppress the original, material, and contextual value of cultural heritage (Ibid). One of the first aspects of this is that the characteristic details of monuments or artifacts in virtual reconstructions are often neutralised. For instance, cracks, traces of wear, and other “imperfections” are erased, according to the authors, causing the visual representation to become sterile or soulless. As emphasised, this results in the loss not only of the authentic experience but also of important layers of information embedded in the original itself (Ibid).

Second, the entire complex process of research and source synthesis remains “behind the scenes”. The user of the internet or multimedia reconstructions sees only the finished product, such as a film, image, or application, without insight into the collection methods, archival debates, or technological limitations (Ibid). This “blurring” of the process calls into question the ability to verify the authenticity and reliability of digital records and opens the door to falsification, plagiarism, and other forms of manipulation (Nikonova and Biryukova, 2017: 172). Finally, Nikonova and Biryukova emphasise that in the long term, with the further advancement of technology, digital virtual representations of cultural heritage sites and objects could surpass their physical

tehnologije digitalni virtuelni prikazi lokaliteta i predmeta kulturne baštine u našoj kolektivnoj svijesti mogli nadmašiti njihove fizičke, “analogne” verzije (Ibid).

Navedenim koracima i procjenom prednosti i nedostataka nastoji se osigurati da bogato i raznoliko digitalno naslijeđe ostane živo, dostupno i pouzdano za sve generacije. Sve što je ovim predstavljeno prvenstveno se odnosi na sveobuhvatne projekte očuvanja kulturnog naslijeđa, što se može, ali i ne mora direktno primijeniti na manje projekte institucija i pojedinaca, kako je i prikazano u nekoliko primjera u zborniku *Digitization in the Real World* (ur. Kwong Bor Ng i Jason Kucsma, 2010).

Pored svega navedenog, digitalizaciju kulturne baštine prate i brojni etički izazovi, posebno kada je riječ o digitalizaciji na terenu. Pojedini problemi već su naznačeni u UNESCO-voj povelji, dok se u pogledu etike ključni izazovi odnose na autorska prava i intelektualno vlasništvo. To predstavlja jedan od osnovnih problema u procesu digitalizacije, do te mjere da može ugroziti rad institucija i pojedinaca, pri čemu se pitanje nadležnosti i nasljeđivanja prava proteže i u dugoročnoj perspektivi (IFLA, 2002: 52). Ključno pitanje predstavlja autentičnost, koja se u najužem smislu odnosi na potvrdu da je dokument upravo ono što se tvrdi da jeste, bez naknadnih manipulacija ili izmjena (IFLA, 2002: 53). Zatim se javlja i pitanje obaveznog primjerka originalnog dokumenta (IFLA, 2002: 55–56). Osim toga, na terenu se i dalje moraju primjenjivati opće-prihvaćena etička načela istraživanja, kao što su: uzdržavanje od činjenja štete, transparentnost, osiguranje informisanog pristanka i drugih nužnih dozvola, održavanje profesionalnog odnosa, dostupnost rezultata, zaštita i čuvanje građe i sl. (Potkonjak, 2014: 55–57).

“analogue” versions in our collective consciousness (Ibid).

Through the aforementioned steps and the assessment of advantages and disadvantages, efforts are made to ensure that the rich and diverse digital heritage remains alive, accessible, and reliable for all generations. Everything presented here primarily applies to comprehensive cultural heritage preservation projects, which may or may not be directly applicable to smaller projects by institutions and individuals, as shown in several examples in *Digitisation in the Real World* (ed. Kwong Bor Ng and Jason Kucsma, 2010).

In addition to all the above, the digitisation of cultural heritage is accompanied by numerous ethical challenges, especially regarding digitisation in the field. Certain problems have already been indicated in the UNESCO charter, while in terms of ethics, the key challenges relate to copyright and intellectual property. This represents one of the fundamental problems in the digitisation process, to the extent that it can jeopardise the work of institutions and individuals, wherein the issue of jurisdiction and the inheritance of rights extends into a long-term perspective (IFLA, 2002: 52). A key issue is authenticity, which in the narrowest sense refers to the confirmation that a document is exactly what it is claimed to be, without subsequent manipulations or alterations (IFLA, 2002: 53). Then, there is also the question of the mandatory copy (legal deposit) of the original document (IFLA, 2002: 55–56). Furthermore, generally accepted ethical principles of research must continue to be applied in the fieldwork, such as: avoiding harm, transparency, securing informed consent and other necessary permissions, maintaining professional relationships, ensuring the accessibility of results, and the protection and preservation of materials, etc. (Potkonjak, 2014: 55–57).

According to Ruby, in the production and use of “images”, there are four separate but

Prema Ruby, u proizvodnji i korištenju “slika” postoje četiri odvojena, ali povezana moralna problema (što se odnosi i na digitalizaciju), koji kada se spoje u profesionalnu aktivnost postaju etički stav:

- 1) “lični moralni ugovor autora da proizvede sliku koja je na neki način tačan odraz njegove ili njene namjere pri stvaranju slike uopće – odnosno, da upotrijebimo kliše, to znači biti vjeran sebi;
- 2) moralna obaveza autora prema svojim sudionicima;
- 3) moralna obaveza autora prema institucijama koje obezbjeđuju sredstva rada – tj. da plaćaju sviraču;
- 4) moralna obaveza autora prema publici kojoj je namijenjena.” (Ruby, 2000: 141)

Teorija u praksi - 2D digitalizacija

Nakon prvobitne faze teorijske pripreme o procesima digitalizacije, prvi dio praktičnog primjera istraživanja fokusiran je na 2D (dvodimenzionalnu) digitalizaciju. Polazeći od bazične definicije digitalizacije kao procesa pretvaranja analognih informacija u digitalni oblik za jedan dio potrebe rada iskorišten je materijal u vidu digitalnih fotografija *street art-a* ili ulične umjetnosti. Prikupljanje ove građe započeto je u okviru akademskih obaveza, a potom nastavljeno kroz lični interes (hobi), što je preraslo u naučno interesovanje, sa specifičnim fokusom na grafite i murale.

Tokom procesa prikupljanja i javne prezentacije građe putem digitalne platforme (Instagram profil “Vizuelno Sarajevo”), uočena je promjenjiva priroda ulične umjetnosti. S obzirom na to da su djela u javnom prostoru izložena stalnim promjenama, ona po mogućnosti zahtijevaju kontinuiranu

interconnected moral problems (which also apply to digitisation) that, when combined into a professional activity, become an ethical stance:

- 1) “the author’s personal moral contract to produce an image that is in some way an accurate reflection of his or her intention in creating the image in the first place, that is, to use a cliché, meaning to be true to oneself;
- 2) the author’s moral obligation to their participants;
- 3) the author’s moral obligation to the institutions that provide the means of work, i.e. paying the piper;
- 4) the author’s moral obligation to the intended audience.” (Ruby, 2000: 141)

Theory in Practice – 2D

Digitisation

After the initial phase of theoretical preparation regarding digitisation processes, the first part of the practical research or field-work example focuses on 2D (two-dimensional) digitisation. Starting from the basic definition of digitisation as the process of converting analogue information into digital form, material in the form of digital photographs of street art was utilised for a portion of the paper’s needs. The collection of this material began within the framework of academic obligations and then continued through personal interest (a hobby), which evolved into a scientific interest with a specific focus on graffiti and murals.

During the process of collecting and publicly presenting the material via a digital platform (Instagram profile “Vizuelno Sarajevo”), the changing nature of street art was observed. Given that works in public spaces are exposed to constant changes, they ideally require continuous ethnographic

etnografsku pažnju kako bi se spriječio njihov trajni nestanak.

Proces nestajanja, odnosno zaboravljanja, prekrećavanja i zamjene postojećih djela potvrđen je i kroz analizu baze podataka (npr. sl. 4 – M08, sl. 2 – M12, sl. 3 – M13 i sl. 6 – G07). Ova kolekcija, koja trenutno obuhvata približno 1000 fotografija i pet videozapisa, premašuje okvire privatne zbirke posmatrača te se predstavlja kao relevantan digitalni arhiv istraživanja ulične umjetnosti. Vrijednost ovog arhiva, iako nije jedini ove vrste, ogleda se u njegovom kontinuitetu i strogoj prostornoj lokalizaciji. Upravo zbog prolazne prirode i nestabilnosti predmeta istraživanja, čin vizuelnog bilježenja dobija status primarne etnografske i konzervatorske prakse.

Za potrebe ovog rada, iz cjelokupnog skupa prikupljene građe izdvojeno je nekoliko reprezentativnih primjera (u vidu studija slučaja), kroz koje se analiziraju ključne lokacije, transformacije i značaj ovog oblika umjetničkog izražavanja, dok primarni fokus ostaje na metodologiji i tehničkim aspektima procesa 2D i 3D digitalizacije.

Metodologija i tehnički okvir terenskog rada

Dokumentovanje ulične umjetnosti realizovano je primjenom pristupa zasnovanog na mobilnoj fotografiji i videosnimanju, što teorijski odgovara konceptu niskobudžetne digitalizacije. Ovaj pristup odlikuje visoka mobilnost na terenu, fleksibilnost i minimalno tehničko opterećenje istraživača.

U pogledu hardvera, prikupljanje podataka vršeno je naprednim mobilnim uređajima opremljenim senzorima visoke rezolucije (do 48 MP), što omogućava visok stepen očuvanja detalja i tekstura. Materijal je arhiviran u sljedećim formatima:

attention in order to prevent their permanent disappearance.

The process of disappearance, namely the “forgetting”, painting over and replacing of existing works has also been confirmed through the analysis of the database (e.g., Fig. 4 – M08, Fig. 2 – M12, Fig. 3 – M13, and Fig. 6 – G07). This collection, which currently comprises approximately 1,000 photographs and five video recordings, exceeds the boundaries of an observer’s private collection and presents itself as a relevant digital archive for street art research. The value of this archive, although it is not the only one of its kind, is reflected in its continuity and strict spatial localisation. Precisely because of the transient nature and instability of the research subject, the act of visual recording acquires the status of a primary ethnographic and conservation practice.

For the purposes of this paper, several representative examples (in the form of case studies) have been selected from the entire body of collected material. Through these examples, the key locations, transformations, and significance of this form of artistic expression could be analysed and some are, the primary focus remains on the methodology and technical aspects of the 2D and 3D digitisation processes.

Methodology and Technical Framework of the Fieldwork

The documentation of street art was carried out using an approach based on mobile photography and video recording, which theoretically corresponds to the concept of low-budget digitisation. This approach is characterised by high mobility in the fieldwork, flexibility, and minimal technical burden on the researcher.

In terms of hardware, data collection was conducted using advanced mobile devices equipped with high-resolution sensors (up to 48 MP), enabling a high degree of

- 1) fotografije: dominantno standardni format (JPEG), uz sporadičnu upotrebu sirovih formata (RAW i RAW MAX) za prikaze od izuzetne dokumentarne i estetske važnosti;
- 2) video: standardna visoka rezolucija (HD, 1080p), i Ultra HD (4K) format za ključne primjere.

Postupak prikupljanja i prostorno-vremenski obuhvat

Prilikom terenskog snimanja primjenjivan je unaprijed utvrđeni standard. Primarno je korištena glavna (*wide*) kamera, uz nastojanje da se pri optičkom i hibridnom zumiranju (2x–3x) ne naruši oština prikaza, dok je za veće udaljenosti primjenjivana telefoto kamera. Za široke panoramske kadrove i murale većih dimenzija korištena je ultra-širokouglova kamera (0,5x).

Svjetlosni uslovi terenskog dokumentovanja obuhvatali su dnevno i noćno snimanje. Dnevne fotografije pri prirodnom svjetlu (sunčano ili oblačno vrijeme) dominiraju zbirkom, dok je građa u noćnim i otežanim vremenskim uslovima (kiša, snijeg) dokumentovana ad hoc, uz oslanjanje na automatski noćni režim rada mobilnog uređaja.

Građa prikupljena tokom izrade rada obuhvata vremenski raspon od 24. 10. 2023. do 3. 8. 2026. godine. Primarni geografski fokus istraživanja jeste Sarajevo, sa težištem na općinama Centar, Stari Grad i Novo Sarajevo. Dodatno, u bazu su uvršteni i uzorci iz drugih gradova u Bosni i Hercegovini (Mostar, Travnik, Konjic, Neum, Stolac), kao i međunarodni primjeri iz Njemačke (Bremen, Bremerhaven, Braunschweig i Oldenburg) i Nizozemske (Amsterdam). Hronološka i prostorna evidencija osigurana je automatskim GPS metapodacima

preservation of details and textures. The material was archived in the following formats:

- 1) Photographs: predominantly standard format (JPEG), with sporadic use of raw formats (RAW and RAW MAX) for depictions of exceptional documentary and aesthetic importance;
- 2) Video: standard high definition (HD, 1080p), and Ultra HD (4K) format for key examples.

Data Collection Procedure and Spatiotemporal Scope

A predetermined standard was applied in the fieldwork. The main (*wide*) camera was primarily used, with an effort to ensure that optical and hybrid zooming (2x–3x) did not compromise image sharpness, while the telephoto camera in the mobile phone was utilised for greater distances. For wide panoramic shots and larger murals, an ultra-wide-angle camera (0.5x) was used.

The lighting conditions of the fieldwork documentation included both daytime and night-time recording. Daytime photographs in natural light (sunny or cloudy weather) dominate the collection, whereas material captured at night and under unstable weather conditions (rain, snow) was documented ad hoc, relying on the mobile device's automatic night mode.

The collected material which will be used for this paper covers the time span from October 24, 2023, to August 3, 2026. The primary geographical focus of the research is Sarajevo, centred on the municipalities of Centar, Stari Grad, and Novo Sarajevo. Additionally, the database includes samples from other cities in Bosnia and Herzegovina (Mostar, Travnik, Konjic, Neum, Stolac), as well as international examples from Germany (Bremen, Bremerhaven, Braunschweig, and Oldenburg) and the Netherlands (Amsterdam). Chronological

integriranim u aplikaciju *Photos*, uz unakrsno referenciranje s ručno vođenim terenskim bilješkama u aplikaciji *Notes*.

Terensko istraživanje strukuisano je kroz dva pristupa: nesistematsko dokumentovanje - kontinuirano bilježenje djela uočenih tokom svakodnevnog kretanja kroz urbani prostor i ciljano terensko izlaženje – provođenje terenskih istraživanja na lokacijama koje su prepoznate kao čvorišta ulične umjetnosti u Sarajevu, kao što su “pješački tunel” na Ciglanama i bob-staza na Trebeviću.

Obrada i organizacija

Nakon faze prikupljanja, materijal je podvrgnut minimalnoj obradi kako bi se u potpunosti očuvala autentičnost i dokumentarna vrijednost stanja na terenu. Korekcije su vršene pomoću lokalnih aplikacija za obradu fotografija na operativnim sistemima *iOS* i *Windows*, a obuhvatale su:

- a. uređivanje ivica (*cropping*): uklanjanje vizuelnog šuma i elemenata koji odvlače pažnju s ciljem izolacije samog street art djela;
- b. podešavanje položaja: korekcija perspektive i postizanje simetričnosti kadra;
- c. osnovna fotometrijska nivelacija: minimalne korekcije po potrebi ekspozicije (+/-5% do +/-10%) i kontrasta (+/-3% do +/-10%) radi kompenzacije loših svjetlosnih uslova na terenu.

Organizacija i kategorizacija (metapodaci) prikupljenog materijala je vršena pomoću *Excel-a* (tab. 1 i 2), kao osnovni alat za katalogizaciju, a platforma za širu prezentaciju, kao vrsta prozora u kolekciju je na Instagram profilu “Vizuelno Sarajevo”. Unutar baze pored dodijeljenog ID broja (npr. M01), kategorizacija je vršena prema datumu prikupljanja, tipovima (grafiti

and spatial records were ensured by automatic GPS metadata integrated into the *Photos* app, cross-referenced with manually kept fieldwork notes in the *Notes* app.

The fieldwork research was structured through two approaches:

- 1) unsystematic documentation – the continuous recording of works observed during everyday movement through the urban space;
- 2) targeted fieldwork visits – conducting fieldwork research at locations identified as street art hubs in Sarajevo, such as the “pedestrian tunnel” Ciglane and the bobsled track on Trebević Mountain.

Processing and Organisation

Following the collection phase, the material underwent minimal processing in order to fully preserve the authenticity and documentary value of the fieldwork conditions. Corrections were carried out using native photo editing applications on *iOS* and *Windows* operating systems, and included:

- a. cropping: removing visual noise and distracting elements in order to isolate the street art piece itself;
- b. positioning adjustment: perspective correction and achieving frame symmetry;
- c. basic photometric levelling: minimal adjustments as needed for exposure (+/-5% to +/-10%) and contrast (+/-3% to +/-10%) to compensate for poor lighting conditions in the fieldwork.

The organisation and categorisation (metadata) of the collected material were carried out using *Excel* (Tables 1 and 2) as the primary cataloguing tool, while the Instagram profile “Vizuelno Sarajevo” serves as a platform for broader presentation and a window into the collection. Within the database, alongside the assigned ID number

ili murali), poznatim autorima, opis, stanja predmeta i dodatnim napomenama. Uočena je metodološka pravilnost da je identifikacija autora znatno lakša kod murala (koji mogu biti i institucionalno podržani ili potpisani), dok grafiti često ostaju u anonimnosti, ili u sveri tagova autora.

Svrha 2D digitalizacije

Formiranje ove baze podataka nameće pitanje njene uloge. Ulična umjetnost predstavlja dinamičan oblik vizuelnog izražavanja u javnom prostoru koji ukazuje na društvene, političke i kulturne tokove određene zajednice. Međutim, uslijed urbanističkih transformacija, atmosferskih uticaja, institucionalnih promjena (sl. 2 - M12 i sl. 3 - M13) ili unutrašnjih pravila same subkulturne scene (sl. 4 - M08 i sl. 6 - G07) ova djela su izrazito podložna propadanju i trajnom nestanku (sl. 5 - M11, možemo uočiti prirodno habanje, ali i promjene u samoj subkulturnoj sceni).

U tom kontekstu, 2D digitalizacija prestaje biti samo tehnički proces reprodukcije slike i postaje čin kontekstualizacije i očuvanja unutar šire kulture. Metapodaci i terenske bilješke daju strukturu vizuelnom materijalu, pretvarajući ga u konkretan naučni izvor za etnologiju i kulturnu antropologiju, kao i druge društvene nauke.

Ova metodologija omogućava analizu savremenih oblika urbanog izražavanja, mapiranje alternativnih društvenih narativa i sl. Vežanost vizuelne građe za specifične topografske tačke, poput spomenutog tunela na Ciglanama ili bob-staze na Trebeviću, pruža uvid u isprepletenost prostora i umjetnosti i njenu interakciju sa prolaznicima. Digitalni arhiv na taj način (ako bi bio u potpunosti javan) postaje etnografski trag o uličnoj umjetnosti u ovom slučaju prvenstveno

(e.g., M01), categorisation was performed based on collection date, type (graffiti or murals), known authors, description, condition of the object and additional notes. A methodological regularity was observed: author identification is significantly easier in the case of murals (which may be institutionally supported or signed), whereas graffiti often remain anonymous or within the realm of author tags.

The Purpose of 2D Digitisation

The formation of this database raises the question of its role. Street art represents a dynamic form of visual expression in public space that indicates the social, political, and cultural trends of a specific community. However, due to urban transformations, atmospheric influences, institutional changes (Fig. 2 - M12 and Fig. 3 - M13), or the internal rules of the subcultural scene itself (Fig. 4 - M08 and Fig. 6 - G07), these works are highly susceptible to deterioration and permanent disappearance (in Fig. 5 - M11, we can observe natural wear and tear, as well as changes within the subcultural scene itself).

In this context, 2D digitisation ceases to be merely a technical process of image reproduction and becomes an act of contextualisation and preservation within the broader culture. Metadata and fieldwork notes provide structure to the visual material, transforming it into a concrete scientific source for ethnology and cultural anthropology, as well as other social sciences.

This methodology enables the analysis of contemporary forms of urban expression, documenting of alternative social narratives, and the like. The connection of the visual material to specific topographical points, such as the aforementioned pedestrian tunnel Ciglane or the bobsled track on Trebević Mountain, provides insight into the intertwining of space, art and its interaction with passers-by. In this way, the digital archive (if

Sarajeva, koji bi bez adekvatne digitalne konzervacije ostao trajno nedostupan budućim istraživanjima i entuzijastima.

Dok 2D digitalizacija uspješno rješava pitanje očuvanja “pločastih” vizuelnih prikaza i njihovog prostornog konteksta, kompleksniji oblici materijalne kulture zahtijevaju naprednije metodološke pristupe i sa time dolazimo do 3D digitalizacije.

Teorija u praksi - 3D digitalizacija

U kontekstu savremene vizuelne antropologije, ali i savremene etnografije općenito, 3D (trodimenzionalna) digitalizacija predstavlja naredni korak tehničkog napretka i nameće se kao neophodan metod očuvanja, interpretacije i prenošenja kulturne baštine. Budući da su ljudi, posebno u savremenom društvu izrazito vizuelno orijentirani, u skladu s tim se iziskuju adekvatni odgovori u naučnoj i muzeološkoj praksi. Vizuelni prikaz kulturne baštine (putem 2D i 3D formata) olakšava kognitivnu percepciju predmeta, ali istovremeno posjeduje potencijal za dublje emocionalno povezivanje s kulturnim sadržajem unutar savremenih institucionalnih okvira. Analizirajući digitalne strategije kulturnih institucija, poput Zemaljskog muzeja Bosne i Hercegovine (npr. PR praksa/rubrika “Predmet sedmice”, u okviru koje se na sedmičnom nivou izdvaja i publicira određeni muzejski predmet na društvenim medijima uz prateće informacije), uočeno je da fotografije muzejske građe stimuliraju direktnu participaciju publike (u vidu komentara koji se često odnose na lična iskustva). Digitalno prisustvo olakšava interakciju, potičući prvenstveno starije generacije na dijeljenje ličnih sjećanja i narativa, čime se uspostavlja dvosmjerni proces očuvanja kolektivne memorije.

it were to be made fully public) becomes an ethnographic trace of street art in this case, primarily of Sarajevo, which without adequate digital conservation, would remain permanently inaccessible to future research and enthusiasts.

While 2D digitisation successfully addresses the issue of preserving “flat” visual representations and their spatial context, more complex forms of material culture require more advanced methodological approaches, and this brings us to 3D digitisation.

Theory in Practice – 3D Digitisation

In the context of contemporary visual anthropology, as well as contemporary ethnography in general, 3D (three-dimensional) digitisation represents the next step in technical advancement and emerges as a necessary method for the preservation, interpretation, and (digital) future-proof of cultural heritage. Since people, especially in modern society, are highly visually oriented, adequate responses are consequently required in scientific and museological practice. The visual representation of cultural heritage (through 2D and 3D formats) facilitates the cognitive perception of objects, but at the same time, it possesses the potential for a deeper emotional connection with cultural content within contemporary institutional frameworks. Analysing the digital strategies of cultural institutions, such as the National Museum of Bosnia and Herzegovina (e.g., the PR practice “Object of the Week” on social media within which a specific museum object is highlighted and published weekly with accompanying information), it has been observed that photographs of museum material stimulate direct audience participation (in the form of comments often related to personal experiences). Digital presence facilitates interaction, encouraging primarily older generations to share personal memories and

Ipak, primjena 3D tehnologije dobija na posebnoj važnosti kada su u pitanju predmeti koji posjeduju visoku simboličku vrijednost, a nalaze se izvan zvaničnih institucionalnih okvira. Digitalizacija omogućava da se takvi predmeti barem u digitalnom obliku zaštite od propadanja, dok istovremeno, oslanjajući se na teoriju Margaret Mead (Mid, 2014: 12) o potrebi kombinovanja vizuelnog i pisanog etnografski pristup obezbjeđuje očuvanje njihove nematerijalne dimenzije (konteksta, narativa i takozvane “duše” predmeta).

Kao primarna studija slučaja za primjenu 3D digitalizacije odabran je simpatična višenamjenska porodična konoba u Sarajevu. Prema riječima vlasnika i kazivača (A. M.), prostor je dizajniran tako da podsjeća na abijent “stare bosanske kuće”, a funkcioniše kao privatni muzej i mjesto okupljanja. Zbirka unutar konobe je sklop naslijeđenih porodičnih predmeta, kao i spašeni ili poklonjeni artefakti.

Za razliku od institucionaliziranih praksi u depoima u kojima se predmeti nalaze pod konzervatorskim nadzorom, privatne zbirke izložene su mikroklimatskim fluktuacijama, i samim tim su podložnije degradaciji materijala, što 3D digitalizaciju čini ključnim instrumentom zaštite građe u digitalnom obliku.

Metodologija terenskog 3D rada

U okviru 3D digitalizacije provedena su dva paralelna pritupa. Prvi se zasnivao na tzv. nisko budžetnoj verziji korištenjem mobilnog telefona i aplikacija za 3D skeniranje, dok je drugi pristup uključivao napredniju opremu i podršku stručnjaka. Na taj način omogućena je ne samo efikasna terenska dokumentacija, već i upoređivanje kvaliteta i mogućnosti različitih tehnologija digitalizacije. Nisko

narratives, thereby establishing a two-way process for preserving collective memory.

However, the application of 3D technology gains special importance when it comes to objects that possess high symbolic value and are located outside official institutional frameworks. Digitisation allows such objects to be protected from degradation, at least in digital form, while simultaneously relying on Margaret Mead’s theory regarding the need to combine the visual and the written (Mead, 2014: 12). This ethnographic approach ensures the preservation of their intangible aspects (context, narrative, and the so-called “soul” of the object).

As the primary case study for the application of 3D digitisation, a charming multi-purpose family tavern in Sarajevo was selected. According to the owner and informant (A.M.), the space is designed to resemble the ambiance of an “old Bosnian house”, and functions as a private museum and a gathering place. The collection inside the tavern is a combination of inherited family objects, as well as salvaged or gifted artifacts.

Unlike institutionalised practices in repositories where objects are under conservational supervision, private collections are exposed to microclimatic fluctuations and are therefore more susceptible to material degradation, making 3D digitisation a crucial instrument for protecting materials in digital form.

Methodology of 3D Fieldwork

Within the framework of 3D digitisation, two parallel approaches were implemented. The first was based on the so-called low-budget version using a mobile phone and 3D scanning applications, while the second approach involved more advanced equipment and expert support. This enabled not only efficient fieldwork documentation but also a comparison of the quality and capabilities of different digitisation technologies.

budžetni pristup realizovan je pomoću naprednog mobilnog telefona, u kombinaciji sa aplikacijama za 3D skeniranje:

- a. *RealityScan*: korišten za detaljniji rad (npr. predmet kasica – Napredak. sl. 8 (3D-2);
- b. *Scaniverse*: korišten za većinu predmeta, zbog jednostavnosti i brzine;
- c. *Polycam*: dodatna aplikacija korištena za nadopunu prilikom nepredvidljivih problema sa *RealityScan* aplikacijom.

Ukupno je napravljeno pet nisko budžetnih 3D modela. Tri uz pomoć *RealityScan* aplikacije (koja koristi *mesh* pristup, sl. 8 - 3D-2, sl. 13 - 3D-7), a ostala dva pomoću *Scaniverse* (koristeći *splat* pristup, sl. 10 - 3D-4, sl. 12 - 3D-6).

S druge strane, u sklopu drugog pristupa iskorištena je prilika da uz pomoć tehnologije i pomoći od Handwerksmuseum Ovelgönne, Njemačka i Armana Džaferagića MA se urade nekoliko istih modela, ali na većem nivou, tj. koristeći prenosive i naprednije uređaje za 3D modeliranje. U sklopu navedenog višeg nivo ili prema riječima Armana Džaferagića “srednjo budžetnog nivoa” korištena su dva uređaja za kreiranje modela, a to su skener EinScan H2 i laptop MSI. U ovom režimu izrađen je jedan dodatni model (bešika, sl. 7 - 3D-1) i tri ista predmeta kao u niskobudžetnoj verziji (npr. kasica sl. 9 - 3D-3 i opanci sl. 11 - 3D-5), kako bi se omogućila komparativna analiza kvaliteta.

Intervju i selekcija predmeta

Odabir predmeta za skeniranje izvršen je na osnovu njihovog simboličkog značaja za kazivača i vlastitog naučnog interesa. Izdvojeni su: drvena bešika (simbol porodičnog kontinuiteta, 3D-1), oštećena kasa “Napredak” (sl. 8 – 3D-2 i sl. 9 – 3D-3),

The low-budget approach was realised using an advanced mobile phone, in combination with 3D scanning applications:

- a. *RealityScan*: used for more detailed work (e.g., the Napredak piggy bank object, Fig. 8 (3D-2);
- b. *Scaniverse*: used for most objects, due to its simplicity and speed;
- c. *Polycam*: an additional application used as a backup during unpredictable issues with the *RealityScan* app.

A total of five low-budget 3D models were created - three using the *RealityScan* application (which uses *mesh* approach, Fig. 8 - 3D-2, Fig. 13 - 3D-7), and the remaining two using *Scaniverse* (using *splat* approach, Fig. 10 - 3D-4, Fig. 12 - 3D-6).

On the other hand, as part of the second approach, the opportunity was taken to create several of the same models, but at a higher level, i.e. using portable and more advanced 3D modelling devices with the technology and assistance from the Handwerksmuseum Ovelgönne, Germany, and Arman Džaferagić, MA. Within this higher level, or in the words of Arman Džaferagić, the “medium-budget level”, two devices were used to create the models: the EinScan H2 scanner and an MSI laptop. In this mode, one additional model was created (a cradle, Fig. 7 - 3D-1) along with three of the exact same objects as in the low-budget version (e.g., the piggy bank, Fig. 9 - 3D-3, and opanci - traditional footwear, Fig. 11 - 3D-5), in order to enable a comparative quality analysis.

Interview and Object Selection

The selection of objects for scanning was carried out based on their symbolic significance to the informant and my own scientific interest. The following items were selected: a wooden cradle (bešika - a symbol of family continuity, Fig. 7 - 3D-1), a damaged “Napredak” piggybank (Fig. 8 – 3D-2 and Fig. 9 – 3D-3), traditional footwear (opanci)

tradicionalni opanci (sl. 10 – 3D-4 i sl. 11 – 3D-5), analogna kamera (kao simbol tehnološkog razvoja) i vodijer. Skeniranje je realizirano primjenom niskobudžetnog pristupa pomoću dvije aplikacije: *Scaniverse* i *RealityScan*, pri čemu oba softverska rješenja pokazuju određene prednosti, ali i nedostatke.

Proces prikupljanja podataka vođen je metodom polustrukturiranog intervjua u samom prostoru konobe. Kako bi se premostio izazov prethodnog poznanstva između istraživača i kazivača (koje je rezultiralo prešutnim podrazumijevanjem određenih informacija), primijenjena je i metoda elicitacije. Direktno usmjeravanje razgovora na fizičke predmete potaknulo je detaljnije odgovore.

Prikupljeni kontekst je potvrdio izuzetan značaj predmeta. Za drvenu bešiku staru preko 65 godina kazivač ističe ličnu povezanost: “U njoj me moja mama ljuljala... našao sam je u našoj rodnoj kući.” (A. M.) Etnografska vrijednost zbirke dodatno se ogleda u motivu spašavanja kulturne baštine uslijed ratnih razaranja ili društvenog nemara (spašavanje kase “Napredak” oštećene eksplozivnom napravom tokom rata i pronalazak opanaka prilikom njihovog odbacivanja na otpad na Koševskom brdu kako naznačava kazivač).

Dokumentovanje i organizacija podataka

Katalogizacija 3D podataka (metapodtci) vršena je u *Excel-u* (tab. 3 i 4) prateći strukturu uspostavljenu tokom 2D digitalizacije, čime je osiguran kontinuitet pristupa. Uneseni podaci uključivali su sljedeće kategorije: ID (npr. 3D-01), datum, lokacija, naziv predmeta, opis i namjena, metod digitalizacije (uređaj koji je korišten), softver i aplikacije

(Fig. 10 – 3D-4 and Fig. 11 – 3D-5), an analogue camera (as a symbol of technological development), and a traditional “whetstone holder” (vodijer). The scanning was realised by applying a low-budget approach using two applications: *Scaniverse* (Fig. 12 – 3D-6) and *RealityScan* (Fig. 13 – 3D-7), with both software solutions exhibiting certain advantages, but also disadvantages.

The data collection process was conducted using a semi-structured interview method within the tavern space itself. To overcome the challenge of prior acquaintance between the researcher and the informant (which resulted in implied assumption of certain information), the elicitation method was applied. Directing the conversation specifically toward the physical objects prompted more detailed responses.

The collected context confirmed the exceptional significance of the objects. Regarding the wooden cradle, which is over 65 years old, the informant highlights a personal connection: “My mother rocked me in it... I found it in our old family home.” (A.M.) The ethnographic value of the collection is further reflected in the motif of salvaging cultural heritage in the wake of war destruction or social negligence (such as rescuing the “Napredak” piggybank damaged by an explosive device during the war, and discovering the opanci as they were being discarded in the trash in the Koševsko Brdo neighbourhood, as noted by the informant).

Documentation and Organisation of Data

The cataloguing of 3D data (metadata) was carried out in *Excel* (Tables 3 and 4), following the structure established during the 2D digitisation, thereby ensuring a continuity of approach. The entered data included the following categories: ID (e.g., 3D-01), date, location, object name, description and

korištene za obradu, informant ili kazivač, stanje predmeta i dodatne napomene.

Za prezentaciju modela korištena je online platforma *Sketchfab*. Ova platforma omogućava interaktivnu prezentaciju (rotiranje, skaliranje, detaljan pregled). Međutim, problem kod ove platforme je što podržava samo *mesh* 3D modele, a ne i *splat*, što znači da analogna kamera i niskobudžetna verzija opanaka ne mogu biti objavljene na stranici, ali mogu na aplikaciji sa kojom su napravljene *Scaniverse*. Takođe za *Sketchfab* postoji i problem dozvoljene veličine datoteke, koji je 200 MB, a bešika prekoračuje to sa 251 MB. Na taj način, *Sketchfab* i *Scaniverse* su za 3D modele imali ulogu sličnu onoj koju je Instagram imao za 2D, tj. vizuelna arhiva dostupna i van akademskog okvira.

Svi sirovi (*raw*), *mesh* i *splat* podaci, zajedno sa audio-zapisima intervjua, dugoročno su pohranjeni na offline eksternom hard disku u skladu s etičkim standardima i potpisanom saglasnošću kazivača.

Svrha 3D digitalizacije

Primjena 3D digitalizacije ispunila je dvostruku funkciju. Prvenstveno, kreirana je preventivna niskobudžetna digitalna arhiva za ugrožene predmete materijalne kulture koji postoje izvan institucionalne zaštite. S druge strane, testirana je funkcionalnost spajanja savremenih tehnologija s tradicionalnim etnografskim pristupom. Kroz praktičnu primjenu 3D tehnologije nastojalo se ispitati na koji način ovakve metode mogu doprinijeti etnološkom dokumentovanju i interpretaciji predmeta, kao i da li one nude dodatnu vrijednost u odnosu na klasične metode vizuelne antropologije. 3D digitalizacija (digitalizacija u pokretu) pruža mogućnost da se predmeti vizuelno dokumentuju, a i

purpose, digitisation method (device used), software and applications used for processing, informant, condition of the object, and additional notes.

The online platform *Sketchfab* was used for the presentation of the models. This platform enables interactive presentation (rotating, scaling and detailed viewing). However, the problem with this platform is that it only supports *mesh* 3D models and not *splat*, which means that the analogue camera and the low-budget version of the opanci cannot be published on the site, although they can be presented in the application with which they were created, *Scaniverse*. Furthermore, there is an issue with *Sketchfab* regarding the allowed file size limit, which is 200 MB, and the cradle exceeds this at 251 MB. In this way, *Sketchfab* and *Scaniverse* played a role for 3D models similar to that which Instagram had for 2D, that is, serving as a visual archive accessible outside the academic framework.

All *raw*, *mesh*, and *splat* data, along with the audio recordings of the interview, are stored long-term on an offline external hard drive in accordance with ethical standards and the signed consent of the informant.

The Purpose of 3D Digitisation

The application of 3D digitisation fulfilled a dual function. Primarily, a preventive low-budget digital archive was created for endangered objects of material culture that exist outside institutional protection. On the other hand, the functionality of merging modern technologies with a traditional ethnographic approach was tested. Through the practical application of 3D technology, the aim was to examine how such methods can contribute to the ethnographic documentation and interpretation of objects, as well as whether they offer added value compared to classical methods of visual anthropology. 3D digitisation (on-the-go digitisation)

prostorno interpretiraju i prezentuju na način koji omogućava interaktivno iskustvo, što otvara nova pitanja o potencijalima digitalnih alata, ali i problema prvenstveno etičkih u savremenoj etnologiji i kulturnoj antropologiji. Ova pitanja su posebno značajna u kontekstu razvoja digitalnog svijeta, sve češće integracije novih tehnologija u društvene nauke i multidisciplinarnog pristupa istraživanju i prezentaciji.

Iako su korištene tehnologije pokazale određena ograničenja, naročito u kontekstu budžetnih rješenja i terenskih uslova, pokazalo se da i ovakvi pristupi mogu biti dovoljno funkcionalni za potrebe etnološkog istraživanja. Naravno, postoje mogućnosti za dodatna unapređenja u tehnološkom i naučnom smislu, ali u zavisnosti od specifičnih istraživačkih ciljeva i dostupnih resursa, ovakav metod se pokazao kao koristan i primjenjiv.

Zaključak

Kroz praktičnu primjenu 2D i 3D digitalizacije, ukazano je da savremene tehnologije omogućavaju arhiviranje materijalne kulture i njihovu kontekstualizaciju u novim i interaktivnim formatima. Oslanjajući se na ljudsku vizuelnu prirodu, prelazak sa tradicionalnih oblika na riječi zanovane ili tekstualne dokumentacije na bogat, višedimenzionalni prikaz daje mogućnost dubljeg emocionalnog povezivanja sa predmetima, čuvajući, pritom, uz pomoć pisanih zapisa njihovu “dušu”, odnosno kontekst koji im zajednica pripisuje.

Analiza dvaju metoda ukazala je na specifična ograničenja svake od njih u okvirima istraživanja. Kod 2D digitalizacije ulične umjetnosti, naglasak je bio na bilježenju vizuelnog izraza koji je po svojoj prirodi prolazan i nestabilan. U tom smislu, prikupljena

provides the opportunity to visually document objects and also to spatially interpret and present them in a way that enables an interactive experience. This opens up new questions about the potential of digital tools, and also highlights problems, primarily ethical ones, in contemporary ethnology and cultural anthropology. These questions are particularly significant in the context of the development of the digital world, the increasingly frequent integration of new technologies into the social sciences, and a multidisciplinary approach to research and presentation.

Although the technologies used exhibited certain limitations, especially in the context of budget solutions and fieldwork conditions, it has been shown that even these approaches can be sufficiently functional for the needs of ethnographic research. Naturally, there are possibilities for further improvements in both a technological and scientific sense, but depending on specific research goals and available resources, this method has proven to be useful and applicable.

Conclusion

Through the practical application of 2D and 3D digitisation, it has been shown that modern technologies enable the archiving of material culture and its contextualisation in new and interactive formats. Relying on human visual nature, the transition from traditional forms of word-based or textual documentation to a rich, multidimensional representation offers the possibility of a deeper emotional connection with objects, while preserving, with the help of written records, their “soul”, that is the context attributed to them by the community.

The analysis of the two methods highlighted the specific limitations of each within the scope of the research. In the 2D digitisation of street art, the emphasis was on recording a visual expression that is, by

zbirka fotografija ne predstavlja samo estetski arhiv, već i etnografski trag savremenih kulturnih praksi i društvenih komentara prisutnih u urbanom prostoru. Pritom se neizostavno otvara i etičko pitanje privatnog vlasništva naspram slobode umjetničkog izražavanja u urbanim prostorima, što dodatno potvrđuje složenost i značaj ovakvog istraživanja, iako primarni fokus rada ostaje na prikazu same metode. S druge strane, 3D digitalizacija porodičnih predmeta iz kobre otvorila je drugačiju dimenziju rada s materijalnom kulturom. Zahvaljujući mogućnosti interakcije s modelima i očuvanja trodimenzionalne forme, 3D digitalizacija omogućava bogatiji prikaz predmeta, što je od posebnog značaja za građu koja se nalazi izvan institucionalnih zbirki i muzeja.

S metodološkog aspekta, istraživanje je ukazalo na nekoliko ključnih izazova terenskog rada. Prvi se odnosi na poziciju istraživača kao "insajdera". Prethodno izgrađen odnos povjerenja s porodicom kazivača omogućio je intiman pristup prostoru, ali je istovremeno stvorio prepreku u vidu podrazumijevanog znanja. Ovaj izazov je uspješno premošten upotrebom metode elicitacije.

Drugi, potpuno nepredviđeni metodološki uvid odnosi se na samu dinamiku interakcije tehnologije i kazivača na terenu. Za razliku od trenutnog klasičnog fotografisanja, proces 3D digitalizacije zahtijeva značajno vremensko ulaganje. Opservacija je pokazala da je to dugotrajno skeniranje izazvalo uočljivu nelagodu i do određene mjere "zasićenost" kod kazivača, uprkos prethodnom objašnjenju procedure. Ovaj fenomen otvara važno pitanje za buduća istraživanja, tj. kako tehnološki kompleksne procedure približiti starijim ili tehnološki manje pismenim kazivačima? Kao potencijalno rješenje nameće se vizuelna demonstracija skraćenog primjera prije samog rada, kako bi se razjasnio proces i opravdao vrijeme.

its very nature, fleeting and unstable. In this sense, the collected photo collection represents not merely an aesthetic archive, but also an ethnographic trace of contemporary cultural practices and social commentary present in urban space. At the same time, the ethical question of private property versus freedom of artistic expression in urban spaces naturally arises, which further confirms the complexity and significance of such research, even though the primary focus of the paper remains on demonstrating the method itself. On the other hand, the 3D digitisation of family objects from the tavern opened up a different dimension of working with material culture. Thanks to the possibility of interacting with models and preserving the three-dimensional form, 3D digitisation enables a richer representation of objects, which is of particular importance for materials located outside institutional collections and museums.

From a methodological standpoint, the research highlighted several key challenges of fieldwork. The first relates to the position of the researcher as an "insider". A previously established relationship of trust with the informant's family allowed intimate access to the space, but simultaneously created an obstacle in the form of assumed knowledge. This challenge was successfully overcome through the use of the elicitation method.

A second, entirely unforeseen methodological insight concerns the very dynamics of interaction between technology and the informant in the fieldwork. Unlike instant, conventional photography, the process of 3D digitisation requires a significant investment of time. Observation showed that this lengthy scanning caused noticeable discomfort and, to a certain degree "fatigue" or "saturation" in the informant, despite prior explanation of the procedure. This phenomenon raises an important question for future research: how can technologically complex procedures be made more approachable for older or less technologically literate informants? A visual demonstration of a brief

Na kraju, cjelokupan rad nedvosmisleno dokazuje da je interdisciplinarni pristup najveća prednost savremenog prikupljanja podataka, kako unutar društvenih nauka, tako i u širem sistemu zaštite kulturne baštine. Sinergija tehnologije i klasičnih etnografskih metoda pruža najpotpuniji uvid u istraživanu temu, ali istovremeno stvara bazu podataka koja je direktno iskoristiva za druge stručne discipline.

Odličan primjer za to je proces fotogrametrije: rad s aplikacijama poput *RealityScan-a* zahtijeva izradu velikog broja fotografija visoke rezolucije iz različitih uglova (najčešće preko 70 fotografija po jednom modelu) kako bi algoritam generisao trodimenzionalni prikaz. Ovaj “nusproizvod” procesa digitalizacije (veliki skup sirovih fotografija u kombinaciji sa gotovim 3D modelom) predstavlja neprocjenjiv resurs za konzervatorsku i restauratorsku praksu. U tom smislu, etnolog i kulturni antropolog na terenu prestaje biti isključivo samo naučnik svoje nauke i postaje resurs vizuelnih podataka neophodnih za npr. procjenu oštećenja, preventivnu konzervaciju ili buduću restauraciju materijalnih dobara.

Kada su na ovaj način integrisane u etnografski okvir digitalne tehnologije prestaju biti samo alat za tehničko evidentiranje, one postaju jedan od mogućih ključnih instrumenta za dokumentaciju baštine i interdisciplinarnu saradnju za očuvanje baštine. Međutim, moramo uzeti i u obzir da navedenih pristup zahtijeva resurse i vrijeme, a i sa sobom nosi određene probleme, pa sam cilj rada mora opravdati njegovu implementaciju.

example prior to the actual work emerges as a potential solution, in order to clarify the process and justify the time required.

Ultimately, the work as a whole unequivocally proves that an interdisciplinary approach is the greatest advantage of modern data collection, both within the social sciences and in the broader system of cultural heritage protection. The synergy of technology and classic ethnographic methods provides the most complete insight into the researched topic, while simultaneously creating a database that is directly usable for other professional disciplines.

An excellent example of this is the process of photogrammetry: working with applications such as RealityScan requires taking a large number of high-resolution photographs from various angles (typically over 70 photographs per model) so that the algorithm can generate a three-dimensional representation. This “byproduct” of the digitisation process is a large dataset of raw photographs combined with the finished 3D model and it represents an invaluable resource for conservation and restoration practice. In this sense, the ethnologists and cultural anthropologists cease to be solely scientists within their own discipline and become a resource of visual data essential for, for instance, damage assessment, preventive conservation, or the future restoration of material cultural assets.

When integrated into an ethnographic framework in this manner, digital technologies cease to be merely a tool for technical recording, they become one of the potentially key instruments for heritage documentation and interdisciplinary collaboration for heritage preservation. However, we must also take into account that this approach requires resources and time, and carries certain problems with it, so the very goal of the work must justify its implementation.

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Prilog

2D digitalizacija

2D metapodaci

Tab. 1

ID	Datum fotografisanja/ digitalizacije	Datum unosa	Lokacija	Tip	Autor
Mural					
M01	24.10.2023.	25.5.2025.	Musala bb, Sarajevo, BiH	Mural	Aleksandar Breza, Boris Stapić, Mensur Demir
M11	6.11.2023.	25.5.2025.	Zmaja od Bosne 90, Sarajevo, BiH	Mural	Caleb Neelon i mladi BiH umjetnici (studenti)
M12	12.12.2024.	25.5.2025.	Grbavička 6a, Sarajevo, BiH	Mural	/
M13	11.2.2025.	25.5.2025.	Grbavička 6a, Sarajevo, BiH	Mural	Obojena klapa
Grafiti					
G07	13.11.2023.	30.5.2025.	Bob staza – Trebević, Sarajevo, BiH	Grafiti	TWEk

Tab. 2

ID	Opis	Stanje predmeta	Informacije o uređaju	Tehničke specifikacije predmeta	Dodatne napomene
Mural					
M01	Mural je posvećen književniku Karimu Zaimoviću, a oblikovan je s vizuelnim motivima iz njegove zbirke pripovedaka “Tajna džema od malina”.	Odlično	iPhone 14 Pro Max	Rezolucija: 5118 x 6180, 6.1 MB, 72 dpi, 24 -bitni	U periodu fotografiranja (2023.) mural se nalazio u odličnom stanju. Situiran je na raskrsnici ulica Musala i Mis Irbina. U sklopu terenske dokumentacije izrađen je i dopunski snimak iz drugog ugla pod oznakom M01.1.
M08	Na fotografiji su zabilježena dva murala radena u maštovitom animiranom stilu. Na lijevoj strani nalazi se motiv zelenog kaktusa u obliku mačke u saksiji (prvi mural). U centralnom dijelu prikazan je crtani lik djeteta iznad kojeg se pružaju stilizirane biljne forme, dok desnom stranom dominira antropomorfni cvijet s naglašenim očima i zubatim osmijehom (drugi mural). Kompozicija odiše dinamičnom atmosferom s elementima fantastike i estetikom horora.	Odlično	iPhone 14 Pro Max	Rezolucija: 8064 x 6048, 11 MB, 72 dpi, 24-bitni	Murali su oslikani u sklopu <i>Fasada Festa</i> 2023. godine u pješačkom tunelu u naselju Ciglane. Zbog dinamike i karakteristika same lokacije kao čvorišta ulične umjetnosti, navedeni rad u međuvremenu je preslikan novim muralom, što potkrepljuje prolaznu prirodu ove vrste građe.

Appendix

2D Digitisation

2D Metadata

Tab. 1

ID	Date of Photographing / Digitisation	Date of Entry	Location	Type	Author
Murals					
M01	24.10.2023.	25.5.2025.	Musala bb, Sarajevo, BiH	Mural	Aleksandar Breza, Boris Stapić, Mensur Demir
M11	6.11.2023.	25.5.2025.	Zmaja od Bosne 90, Sarajevo, BiH	Mural	Caleb Neelon and young BiH artists (students)
M12	12.12.2024.	25.5.2025.	Grbavička 6a, Sarajevo, BiH	Mural	/
M13	11.2.2025.	25.5.2025.	Grbavička 6a, Sarajevo, BiH	Mural	Obojena klapa
Graffiti					
G07	13.11.2023.	30.5.2025.	Bobsled track – Trebević, Sarajevo, BiH	Graffiti	TWEk

Tab. 2

ID	Description	Condition of the object	Device information	Technical specifications of the object	Additional notes
Mural					
M01	The mural is dedicated to the writer Karim Zaimović and is designed with visual motifs from his short story collection “The Secret of Raspberry Jam” (“Tajna džema od malina”).	Excellent	iPhone 14 Pro Max	Resolution: 5118 x 6180, 6.1 MB, 72 dpi, 24-bit	During the period of photographing (2023), the mural was in excellent condition. It is located at the intersection of Musala and Mis Irbina streets. As part of the fieldwork documentation, a supplementary photograph was taken from another angle under ID - M01.1.
M08	The photograph captures two murals painted in an imaginative animated style. On the left side, there is a motif of a green cactus in the shape of a cat in a pot (the first mural). The central part features a cartoon character of a child above whom stylized plant forms extend, while the right side is dominated by an anthropomorphic flower with prominent eyes and a toothy smile (the second mural). The composition exudes a dynamic atmosphere with fantasy elements and a horror aesthetic.	Excellent	iPhone 14 Pro Max	Resolution: 8064 x 6048, 11 MB, 72 dpi, 24-bit	The murals were painted as part of the Fasada Fest 2023 in the pedestrian tunnel Ciglane neighbourhood. Due to the dynamics and characteristics of the location itself as a street art hub, this work has since been painted over with a new mural, which corroborates the fleeting nature of this type of material.

ID	Opis	Stanje predmeta	Informacije o uređaju	Tehničke specifikacije predmeta	Dodatne napomene
Mural					
M11	Mural - projekat realiziran u saradnji s Ambasadom SAD-a u BiH. Rad prikazuje apstraktni 3D trokut sastavljen od tri povezana cjevasta elementa s teksturom cigle. Na krajevima strukture nalaze se tamne, bodljikave forme s motivom očiju, čime se postiže nadrealistički vizuelni dojam. Pozadina je izvedena u šarenim smeđim i žutim tonovima s tačkastim uzorcima različitih dimenzija.	Oštećeno	iPhone 14 Pro Max	Rezolucija: 2048 x 1536, 769.2 KB, 72 dpi, 24-bitni	Na muralu su uočljiva fizika oštećenja i pukotine na fasadi objekta (Veterinarski fakultet Univerziteta u Sarajevu). Donji dio radova prekriven je novijim grafitima ili tagovima, što ilustrira dinamiku potkulturnih intervencija i slojevitost zidnih površina u urbanom prostoru.
M12	Mural prikazuje realistički naslikanog konja u pokretu, postavljenog u centru zida na žutom trokutu (koji podsjeća na žuti trokut na zastavi BiH) koji ga vizualno izdvaja iz pozadine. Konj je naslikan u toplim smeđim tonovima. Pozadina murala je zeleno-bijela, sa stiliziranim slovima latinice i ćirilice koja ispisuju riječ "SJAŠITE", ponavljajući se oko figure konja.	Dobro	iPhone 16 Pro Max	Rezolucija: 1618 x 1940, 1.3 MB, 72 dpi, 24-bitni	Mural je pronađen u dobrom, skoro odličnom stanju, sa porukom koja se može smatrati kao društveno nezadovoljstvo trenutnim stanjem u državi ili svijetu. Najvjerovatnije poruka je političkog tipa, pošto naznačena riječ se između ostalog koristi i u tom kontekstu u BiH društvu.
M13	Mural prikazuje portret Milana Mladenovića, muzičara i frontmena grupe EKV (Ekatarina Velika), naslikanog u crno-bijelim tonovima na šarenoj pozadini Sarajeva. Grad je prikazan stilizovano, s prepoznatljivim brdima i zgradama u pozadini, uz tople nijanse narandžaste i zelene koje dominiraju muralom. Lijeva strana murala sadrži stihove pjesme "Sarajevo".	Odlično	iPhone 16 Pro Max	Rezolucija: 2048 x 1536, 1.3 MB, 72 dpi, 24-bitni	Idejno rješenje murala je urađeno od strane umjetnika Rijana Hadžića. Ovaj mural je na istoj lokaciji kao prethodni, M12, što ga čini njegovom izmjenom.
Grafiti					
G07	Na fotografiji je prikazan zid, dio bob staze na Trebeviću. Na samom grafitu dominiraju nijanse plave, tirkizne, crvene i ljubičaste, s naglašenim crnim linijama koje razdvajaju <i>pixele</i> (stil djela). Na nekoliko mjesta pojavljuju se i bijele zvjezdaste forme koje dodatno naglašavaju dinamiku kompozicije. Iznad se vidi mali natpis "TWEK" u zelenoj boji, najvjerovatnije tag.	Dobro	iPhone 14 Pro Max	Rezolucija: 2048 x 1536, 1.4 MB, 72 dpi, 24-bitni	Grafit je upečatljiv primjer <i>pixel art-style</i> pristupa ili stila u street artu. Umjetnik koristi kvadratne forme i jake kontraste boja kako bi stvorio efekt digitalnog prikaza, podsjećajući na estetiku starih video-igara ili kompjuterske grafike iz 80-ih.

ID	Description	Condition of the object	Device information	Technical specifications of the object	Additional notes
Mural					
M11	A project realized in collaboration with the US Embassy in BiH. The work depicts an abstract 3D triangle composed of three connected tubular elements with a brick texture. At the ends of the structure, there are dark, spiky forms with an eye motif, achieving a surrealistic visual impression. The background is executed in colourful brown and yellow tones with dotted patterns of various dimensions.	Damaged	iPhone 14 Pro Max	Resolution: 2048 x 1536, 769.2 KB, 72 dpi, 24-bit	Physical damage and cracks are noticeable on the mural, which is on the building's facade (Faculty of Veterinary Medicine, University of Sarajevo). The lower portion of the artwork is covered with newer graffiti or tags, illustrating the dynamics of subcultural interventions and the layering of wall surfaces in urban space.
M12	The mural depicts a realistically painted horse in motion, positioned in the centre of the wall on a yellow triangle (resembling the yellow triangle on the flag of BiH) that visually isolates it from the background. The horse is painted in warm brown tones. The background of the mural is green and white, with stylized Latin and Cyrillic letters spelling out the word "SJAŠITE" (get off), repeating around the figure of the horse.	Good	iPhone 16 Pro Max	Resolution: 1618 x 1940, 1.3 MB, 72 dpi, 24-bit	The mural was found in good, almost excellent condition, bearing a message that can be viewed as an expression of social dissatisfaction with the current state in the country or the world. Most likely, the message is political in nature, as the indicated word is used, among other things, in that context within BiH society.
M13	The mural depicts a portrait of Milan Mladenović, musician and frontman of the band EKV (Ekatarina Velika), painted in black and white tones against a colourful background of Sarajevo. The city is depicted in a stylized manner, with recognizable hills and buildings in the background, alongside warm orange and green shades that dominate the mural. The left side of the mural features lyrics from the song "Sarajevo".	Excellent	iPhone 16 Pro Max	Resolution: 2048 x 1536, 1.3 MB, 72 dpi, 24-bit	The conceptual design of the mural was created by the artist Rijan Hadžić. This mural is at the exact same location as the previous one, M12, making it an alteration/replacement of it.
Graffiti					
G07	The photograph shows a wall, a section of the bobsled on Trebević. The graffiti itself is dominated by shades of blue, turquoise, red, and purple, with pronounced black lines separating the pixels (the style of the artwork). In several places, white star-like forms appear, further emphasizing the dynamics of the composition. Above, a small inscription "TWEk" can be seen in green, most likely a tag.	Good	iPhone 14 Pro Max	Resolution: 2048 x 1536, 1.4 MB, 72 dpi, 24-bit	The graffiti is a striking example of a pixel art style approach or style in street art. The artist uses square forms and strong colour contrasts to create the effect of a digital display, reminiscent of the aesthetics of old video games or 80s computer graphics.

2D primjeri



sl.1 (M01)



sl. 2 (M12)



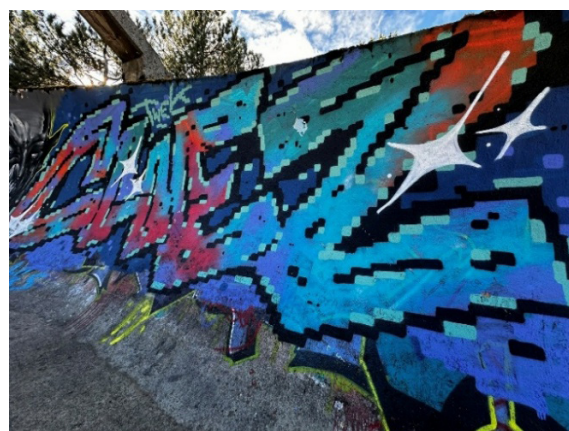
sl. 3 (M13)



sl. 4 (M08)



sl. 5 (M11)



sl. 6 (G07)

2D Examples



Fig.1 (M01)



Fig. 2 (M12)



Fig. 3 (M13)



Fig. 4 (M08)



Fig. 5 (M11)

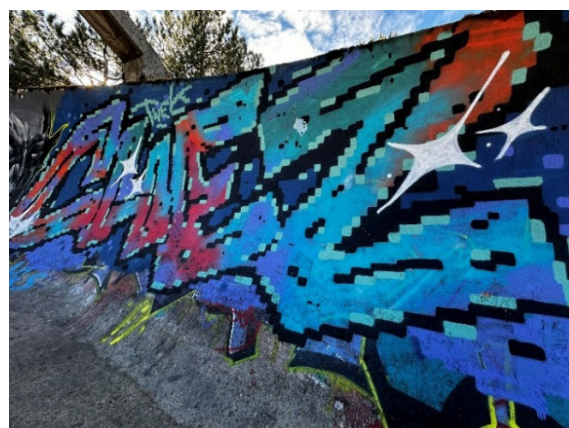


Fig. 6 (G07)

3D digitalizacija

3D metapodaci

Tab. 3

ID	Opis i namjena	Metod digitalizacije	Softver i aplikacije	Dodatne napomene
3D-1	7.6.2025.	14.6.2025.	Stup, Sarajevo, BiH	Bešika
3D-2	7.6.2025.	14.6.2025.	Stup, Sarajevo, BiH	Kasica
3D-3	7.6.2025.	14.6.2025.	Stup, Sarajevo, BiH	Kasica
3D-4	12.6.2025.	14.6.2025.	Stup, Sarajevo, BiH	Opanci
3D-5	7.6.2025.	14.6.2025.	Stup, Sarajevo, BiH	Opanci

Tab. 4

ID	Opis i namjena	Metod digitalizacije	Softver i aplikacije	Dodatne napomene
3D-1	Drvena bešika jednostavne tradicijske konstrukcije iz 20. stoljeća, namijenjena za uspjavanje i odmor novorođenčeta. Odlikuje se karakterističnim zakrivljenim nogarima koji omogućavaju blago ljučenje.	EinScan H2 i MSI laptop	EXScan H	Predmet je djelimično oštećen, s vidljivim tragovima habanja i početnim raspadanjem drvene konstrukcije uslijed starosti i dugotrajne upotrebe. Pripada porodičnoj historiji i privatnom mikromuzeju kazivača.
3D-2	Metalna štedna kasica izvedena u obliku zgrade Hrvatskog kulturnog društva "Napredak" u Sarajevu, s detaljno prikazanim fasadnim reljefima i natpisima. Gornji i bočni dijelovi predmeta značajno su deformirani i oštećeni.	iPhone 16 Pro Max	RealityScan	Prema navodima kazivača, kasica je nasilno otvorena tokom Drugog svjetskog rata (upotrebom eksplozivnog sredstva/gelerom granate) radi vađenja novčanog sadržaja. Predmet posjeduje dokumentarnu, historijsku i simboličku vrijednost. Model predstavlja niskobudžetnu verziju izrađenu radi testiranja pristupačnosti fotogrametrije u terenskim uslovima.
3D-3	Metalna štedna kasica u obliku zgrade HKD "Napredak" u Sarajevu (isti predmet kao pod oznakom 3D-2).	EinScan H2 i MSI laptop	EXScan H	Alternativni 3D sken istog predmeta izrađen pomoću profesionalnog 3D skenera. Model je kreiran radi komparativne analize preciznosti geometrije i teksture u odnosu na niskobudžetni fotogrametrijski model (3D-2).
3D-4	Tradicionalna ručno rađena obuća – opanak sa šiljatim vrhom i bogato dekoriranim gornjim dijelom. Ukrašen je višebojnim trakama u crvenoj, plavoj i bijeloj boji s ornamentalnim pletenim dodacima, dok je ivica opanka obrubljen debelim šavom.	iPhone 16 Pro Max	Scaniverse	Dobro očuvano. Digitalizacija je izvršena primjenom splat tehnologije. Model predstavlja niskobudžetni primjerak izrađen s ciljem usporedbe s modelom načinjenim profesionalnim 3D skenerom (3D-5).
3D-5	Tradicionalni ručno rađeni opanak (desna noga. Isti predmet kao pod oznakom 3D-4) sa šiljatim vrhom i pletenim ornamentima.	EinScan H2 i MSI laptop	EXScan H	Alternativni 3D sken predmeta izrađen pomoću profesionalnog 3D skenera radi komparativne analize odstupanja u detaljima geometrije, boji i pletenim teksturama u poređenju s mobilnom splatt metodom (3D-4).

3D Digitisation

3D Metadata

Tab. 3

ID	Description and purpose	Digitisation method	Software and applications	Additional notes
3D-1	7.6.2025.	14.6.2025.	Stup, Sarajevo, BiH	Cradle
3D-2	7.6.2025.	14.6.2025.	Stup, Sarajevo, BiH	Piggybank
3D-3	7.6.2025.	14.6.2025.	Stup, Sarajevo, BiH	Piggybank
3D-4	12.6.2025.	14.6.2025.	Stup, Sarajevo, BiH	Traditional footwear (opanci)
3D-5	7.6.2025.	14.6.2025.	Stup, Sarajevo, BiH	Traditional footwear (opanci)

Tab. 4

ID	Description and purpose	Digitisation method	Software and applications	Additional notes
3D-1	A wooden cradle of simple traditional construction from the 20th century, intended for soothing and resting a new-born. It is characterized by curved legs that allow for gentle rocking.	EinScan H2 and MSI laptop	EXScan H	The object is partially damaged, with visible signs of wear and initial decay of the wooden structure due to age and prolonged use. It belongs to the family history and the private micro-museum of the informant.
3D-2	A metal savings box designed in the shape of the Croatian Cultural Society "Napredak" building in Sarajevo, featuring detailed facade reliefs and inscriptions. The upper and side sections of the object are significantly deformed and damaged.	iPhone 16 Pro Max	RealityScan	According to the informant, the savings box was forcibly opened during World War II (using an explosive device/shell shrapnel) to retrieve its monetary contents. The object possesses documentary, historical, and symbolic value. The model represents a low-budget version created to test the accessibility of photogrammetry under fieldwork conditions.
3D-3	A metal savings box in the shape of the HKD "Napredak" building in Sarajevo (the same object as under designation 3D-02).	EinScan H2 and MSI laptop	EXScan H	An alternative 3D scan of the same object produced using a professional 3D scanner. The model was created for a comparative analysis of geometric and texture precision in relation to the low-budget photogrammetric model (3D-2).
3D-4	Traditional handmade footwear – opanak - with a pointed toe and a richly decorated upper part. It is adorned with multi-coloured straps in red, blue, and white with ornamental woven additions, while the edge of the opanak is bordered with a thick seam.	iPhone 16 Pro Max	Scaniverse	Well preserved. Digitization was performed using splat technology. The model represents a low-budget specimen created for the purpose of comparison with a model made by a professional 3D scanner (3D-5).
3D-5	Traditional handmade footwear - opanak (right foot, same object as under ID 3D-4) with a pointed toe and woven ornaments.	EinScan H2 and MSI laptop	EXScan H	An alternative 3D scan of the object produced using a professional 3D scanner for a comparative analysis of deviations in geometric details, color, and woven textures compared to the mobile splat method (3D-4).

3D primjeri

sl. 7 (3D-1)



sl. 8 (3D-2)



sl. 9 (3D-3)



sl. 10 (3D-4)



sl. 11 (3D-5)

3D Examples



Fig. 7 (3D-1)



Fig. 8 (3D-2)



Fig 9 (3D-3)



Fig. 10 (3D-4)



Fig. 11 (3D-5)