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DIGITIZED AUDIO AND PHOTOGRAPHIC ARCHIVAL MATERIAL - POST-PROCESSING DILEMMA

Siniša Domazet
Archives of Bosnia and Herzegovina, Sarajevo, Bosnia and Herzegovina
domazetsinisa@yahoo.com

Abstract:

Less than ten years ago, working in archives and IT sector did not have much in common. The researchers had to come to the reading room in order to study the inventories and documents, and then to make notes by transcribing or photocopying the document itself.

Today, the rapid development of technology has enabled everything to be done with just a few clicks; the inventory is reviewed online on the archives' website, a request for specific documents is sent, and the requested scans arrive at the researchers' e-mail address. In order to achieve this, it was necessary to digitize a wide variety of archival formats beforehand.

The aricle discusses the post-processing methods used by the Archives of Bosnia and Herzegovina and presents all the advantages and disadvantages that have been demonstrated in practice so far.

Keywords:

digitization, A/V formats, audio, photography, processing techniques

Izvleček:

Digitalizirano zvočno in fotografsko arhivsko gradivo – dileme po digitalizaciji

Še pred manj kot desetimi leti delo v arhivu in v IT-sektorju ni imelo veliko skupnega. Raziskovalci so prihajali v čitalnice arhivov, pregledovali inventarje in dokumente ter delali izpiske oz. fotokopirali same dokumente.

Hiter razvoj tehnologije nam danes omogoča, da mnogo nalog opravimo le s klikom, inventarje je mogoče pregledovati na spletnih straneh arhivov, zahteve za določene dokumente je mogoče poslati elektronsko, digitizirano gradivo pa lahko raziskovalec prejme po elektronski pošti. Da smo to lahko dosegli, je bilo potrebno digitalizirati širok nabor različnih oblik arhivskega gradiva.

Prispevek obravnava metode obdelave gradiva po digitalizaciji, ki jih uporablja Arhiv Bosne in Hercegovine, ter predstavlja prednosti in slabosti, ki so se do zdaj pokazale v praksi.

Ključne besede:

digitalizacija, formati, zvok, fotografija, tehnike obdelave

1. FOREWORD

One of man's oldest preoccupations was to break away from the shackles of time and thus from his own inevitable transience. And while quantum physics found out that by changing parameters in spacetime fabric one theoretically could go into the future, the progress of technology and the privilege of working in the archives make it possible to directly relive the past; not only to read about it firsthand, but also to see it and hear it, as if one were present on the spot.

Less than ten years ago, working in archives and working in IT sector did not have too much in common. Rresearchers had to come to the reading room in order to study the inventories and documents, and then to make notes by transcribing or photocopying the document itself.

Today, the rapid development of technology has enabled everything to be done with just a few clicks; the inventory is reviewed online on the archives' website, a request for specific documents is sent, and the requested scans arrive at the researcher's e-mail address. In order to achieve this significant improvement, it was necessary to digitize a wide variety of archival formats beforehand.

Written documents are the most conventional and their conversion is mostly standardized; however, photographic and audio material is still in the gray zone - there is a huge number of formats and procedures for "enhancing and enriching", which can jeopardize their authenticity and originality.

When it comes to converting traditional archival material to digital format, we live in the period of archival technological breakthrough. Each startup brings certain risks and unavoidable mistakes, and most of the mistakes and errors happen during and after digitizing the not so common original audio and photo physical carriers.

The basic rule is that the digital surrogate should faithfully retain all the characteristics of the original.

However, would the subsequent removal of noise and interference from the audio recording or the correction of the physical damage to the photograph diminish the authenticity of the new/old document or would rather restore its real content?

The Archives of Bosnia and Herzegovina pays close attention to this issue.

It is a generally accepted universal rule that a credible copy is an unaltered copy of the original, including all its defects and imperfections. However, in order to get the best possible research value and transparency of the information stored by the original, it is necessary to clean it of all technical and physical distractions.

This paper will discuss the post-processing methods used by the Archives of Bosnia and Herzegovina, and to present all the advantages and disadvantages that have been demonstrated in practice so far.

2. THE LURE OF DIGITAL ENCHANTMENTS

The basic rule still applies - the digital surrogate should faithfully retain all the characteristics of the original, but in today's digital age it is difficult to resist the temptation to "improve and correct" scanned originals. Some of the damages are obvious and easily removable, such as spots and cracks on the photo or noise due to wrinkled audio tape, while others are more subtle, such as colors and grays that have long since lost their original hue. Does our subsequent, even the most well-intentioned and professional intervention makes that photo or audio document lose its authenticity? Or does it gain additional clarity and credibility of the moment from the past that it preserves?

The Archives of Bosnia and Herzegovina took the most logical approach - as it is easy to duplicate digital surrogates, the high resolution master digital copy is stored separately, without additonal intervention. The copy may be further refined, but only in the case of the major damage or if a certain effect improves the clarity of the scene or tone. In the future, with the development of more sophisticated editing software, it will not be a problem to repeat the process from the beginning with even better results than today.

The need for additional interventions on audio/video files did not arise out of a mere desire for beautification. After years of inadequate storage, careless handling, and especially since the devastating fire in 2014, a large number of negatives and audio tapes have been damaged to such an extent that it is impossible to see and hear what is preserved on them without subsequent physical and software restoration.

3. ADDITIONAL PROCESSING OF DIGITIZED PHOTO MATERIAL IN THE ARCHIVES OF BOSNIA AND HERZEGOVINA

Technically speaking, photography is a scene transmitted by light, focused through a lens and preserved on a photo-sensitive surface.

Initially, this surface consisted of silver iodide coated glass plates, later strips of negatives, and today these are CCD or CMOS chips.

Still, photography is much more than that. It is a preserved moment of transient and inimitable reality and is what makes it one of the most powerful media for documenting people, events and emotions from the first decades of the 19th century to the present day.

Today it is possible to create high-quality digital copies of each original document. The increasing use of personal computers, their connection to an ever-increasing network, the reduction in the cost of creating and maintaining large databases, and the availability of high-quality scanners have made digitization a top priority task for every archives.

A digital photograph is an "electronic photograph", created with a digital camera or scan of its analogue original. When switched to digital, the photo is sampled and mapped as a coordinate grid of dots or pixels. Each pixel has its own tonal value, depending on the level of light reflected from the original onto an electronic photosensitive integrated circuit, called CCD or CMOS. The level of illumination, dimming and/or color is digitally represented by a binary code (zeros and/or ones). The binary units or bits for each pixel are stored in sequences or reduced to mathematical form on the hard disk by the computer. When a command is issued to display a digital photo on the screen, the processor interprets and reads the bits to reproduce the code for display or print.

Digital photographs have huge advantages over their analog duplicates in terms of recording, duplication, storage and transmission. They can be recorded in high resolution with all the information content of the original document and all subsequent copies retain the same quality. They are easy to transfer and at the same time accessible to an unlimited number of users. Manipulation is extremely easy - they can be rotated, zoomed in and processed with numerous processing tools.

Conversion from analogue to digital should ensure the transfer of all information that characterizes the original document. The digital master, intended for long-term preservation, must be done professionally, in the highest prescribed quality and without subsequent interventions, as it will in the future serve as a surrogate for the original, who will then be spared from frequent use. The original itself must not be repeatedly exposed to the process of digitization, because, with all precautions, this process is detrimental to it.

The Archives of Bosnia and Herzegovina has started a program of digitization of photo collections, which is primarily aimed at protecting the originals from damage during overuse and improper handling and easier availability for researchers.

Photo enhancement after digitization is used to improve a scan of the original document and can function even at the pixel level. These improvements include filters, color and hue manipulation, change of lighting and removal of cracks, stains and other visible damage. Caution should be exercised when using these tools as improper or excessive use can compromise the authenticity of the digital copy. If these tools are used, each step must be documented.

Picture 1: An example of simple digital photography processing - the return from sepia (down) to grayscale (up)

Glass negatives are extremely sensitive to rough handling and inadequate storage which causes damage to their emulsion surface layer or breaking the negatives themselves. Unfortunately, some of them are so badly damaged, that they cannot be completely restored to their original condition even by subsequent digital processing:

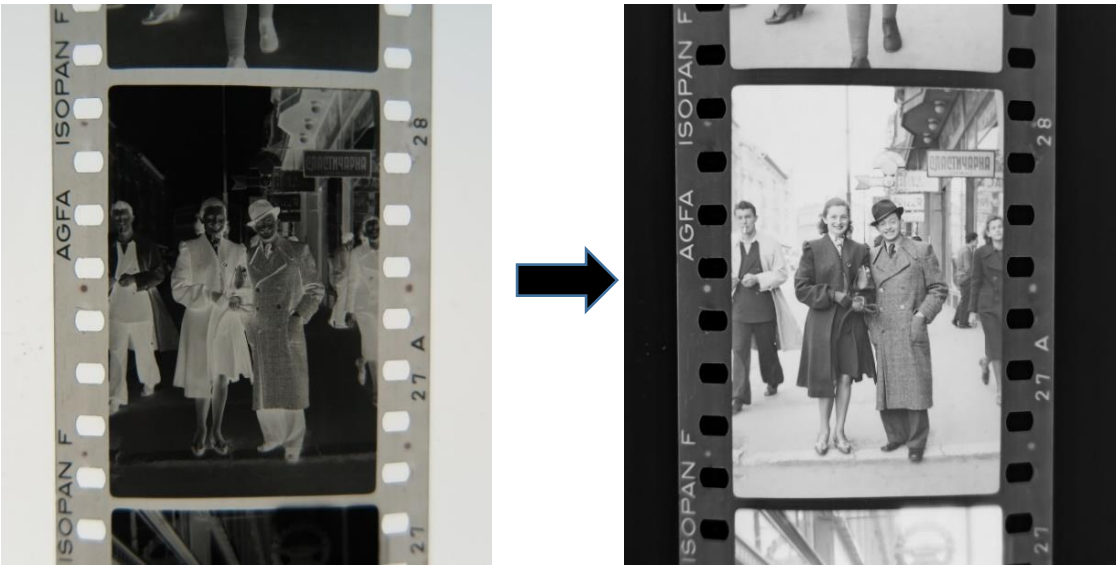
Picture 2: An example of a shattered glass negative, ArBiH, early XX century

The Archives of Bosnia and Herzegovina has a number of developed 35mm photo films, dated up to the end of WWII, whose digitization was performed by direct high-definition frame-by-frame scanning, same as glass negatives (TIFF, 600 dpi)[1], after which they are individually processed with the appropriate software tool.

The negative scan is transferred into positive, than Light EQ and clone tools are applied. The result is a decent positive, and if the need arises, it is possible to do the classic procedure of producing a paper-photo from the negative.[2]

[1] *Accepted values in digitization, Digital photo restoration. (s. d.). Available at: https://www.cambridgeincolour.com/tutorials/digital-photo-restoration.htm.*

[2] *The Archives of Bosnia and Herzegovina does not yet have the appropriate equipment to develop classic paper photographs from the negative on its own.*

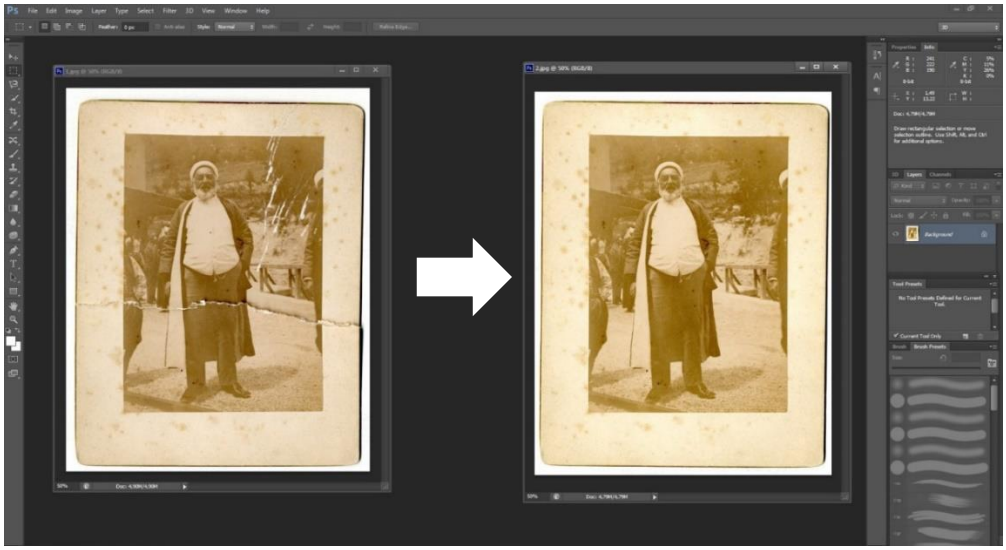


Picture 3: An example of a digitally scanned developed negative, turned into a positive using Photoshop; unknown couple, downtown Sarajevo, circa 1940

Most of the photographs stored in the Archives of Bosnia and Herzegovina are traditionally developed on photo-paper and cardboard. The damages that occur on them are caused mechanically and by chemical processes. Mechanical damages include cracks and fractures resulting from rough handling and bending, as well as soiling (dust, blemishes, spots), while chemical damages include changes caused by the reaction of a photograph with its surroundings (pigment loss or oxidation).

If necessary, the copy of the master scan is handled with appropriate editing software (Photoshop, CorelDraw, AcdSee...), but only to the extent necessary to remove any visible damage and restore the appearance of the original, if possible.

The following example presents the post-processing of the undated photo of Mustaj-beg Fadilpasic, the first mayor of Sarajevo, (*taken at the end of the 19th century, by the photographer Carl M. von Roth*):



Picture 4: Example of post-processing and its results – the first phase

The photo was badly damaged, scratched, faded and soiled (shown left). After its digitization, post-processing was performed in the Photoshop (the scan was done in TIFF format, 600 dpi, color); the first step was to remove major mechanical damage using heal and clone tools (shown right).

The stains and impurities created by the century-old chemical processes were removed (shown left). Eventually, the photo was transferred to the grayscale, what it looked like when it was first developed (shown right).

Picture 5: Example of post-processing and its results – the second phase

Digital post-processing takes much more time than mere scanning. Not all the scanned photos are planned to be restored - for the time being, the Archives of Bosnia and Herzegovina restores photographs selectively, taking into account primarily their historical importance and the degree of damage.

4. ADDITIONAL PROCESSING OF DIGITIZED AUDIO MATERIAL IN THE ARCHIVES OF BOSNIA AND HERZEGOVINA

When it comes to audio archival material, the Archives of Bosnia and Herzegovina cannot boast of a rich collection. Regardless, certain material exists; for the most part it is a tonal record of the sessions of the Human Rights Chamber and the Presidency of Bosnia and Herzegovina[3].

[3] *Since such archival material is restricted and confidential for common researchers, there are certain legal regulations that determine the level of its availability and the manner of use. Bosnia and Herzegovina is a country with a turbulent history and there is a lot of sensitive material that leaves plenty of maneuvering space for manipulation and misuse.*

Although this material is not currently widely available for public, it is an important and indispensable part of the historical and cultural heritage that must be adequately protected, migrated and converted[4]. To do this, one must know the technical characteristics of the audio carrier (in this case, compact cassettes and CDs), its weaknesses and disadvantages, and to track rapid changes in technology in the market. It has been confirmed that audio tapes stored under ideal conditions are usable for reproduction even after many decades, but the devices on which they are used have been discontinued long time ago. *Maintaining awareness of obsolescence and preparation to prevent it can avert loss of content and needless expenditure of resources on responding to emergency situations*. (ARSC Guide to Audio Preservation, 2015, p. 134)

Also, external influences such as light, heat and dust are known to have a much more destructive effect on magnetic tape than on paper, which applies rigorous storage conditions and frequent quality control. (Casey, 2015, p. 15) There is a problem with metadata, which, in addition to standard information about the origin of the document and its creator, must contain relevant technical information. It is much easier to preserve and handle sound after switching to it a digital format, but in order to do this, we need well-preserved analogue carrier and conversion equipment.

What are the best storage procedures? How to save information after the carrier is damaged? What are the accepted standards for digital audio? What are the standards for metadata? There is a lot of archival literature related to working with classic paper material, while the one dealing with A/V material is a bit scarcer. (Library and Archives Canada Audiovisual Migration Strategy, 2009)

5. CHARACTERISTICS OF ANALOG AND DIGITAL SOUND

What we call sound is a continuous series of air pressure waves. When these waves reach the eardrum, the nerves in the ear are stimulated and the impulses are transmitted to the brain and we "hear the sound".

Accordingly, when the air waves hit the diaphragm in the microphone, an electric current is induced that varies according to pressure changes. The record that this current leaves on the tape is also an analog recording.

When an audio recording is digitized, the analog recording is played back through an electronic device where variations of the electrical current generated in the device are sampled at very short intervals. The amplitude of the current that matches the amplitude of the original sound wave is recorded as a number at each sample point. The quality and resolution of digitized audio is determined by two factors:

1. How many times per second is the sound wave amplitude measured
2. Range of numbers used for each measurement

[4] *This became a priority after a fire in 2014 permanently destroyed a number of audio tapes that did not have a digital backup.*

The first factor, the sampling rate, is expressed in kilohertz (kHz) or thousands of readings per second. The more readings, the better the sound quality. Commercial CDs were recorded at a reading rate of 44.1 Khz. This means that every second of the audio is represented as 44100 separate amplitude measurements at the time the wave passes through the reading point. Therefore, a low reading rate results in a lesser authenticity of the original sound wave, and a high reading rate ensures its greater authenticity.

The second factor, bit depth, describes the number of measurements per amplitude. E.g. if each measurement is represented on a scale of 1 to 10, it will be a rougher measurement than to use a scale of 1 to 1000. The sample size is measured in bits. Eight-bit numbers range from 0 to 255, 16-bit 0-65535 and 24-bit from 0 to 16777215. Bit depth is mathematically proportional to the dynamic range of sound, which means greater value of measurement can record higher sound range.

Recording in 16 bits records audio up to 96 decibels, while 24 bits raise that limit to 144 decibels (pain limit is about 125 dB). Thus, greater depth results in a more realistic, smooth reproduction of the original audio source, ie. greater dynamic range.

6. EXISTING RECORDING STANDARDS

The highest frequency that a digital audio recording can record is half the reading rate. Therefore, a 44.1 kHz audio CD can record frequencies up to 22.05 kHz. The 44.1 kHz audio CD rate was chosen because most people cannot hear tones above 20 kHz. It has also been found that the human ear can register a range of 15 to 17 bits per sample. Therefore, not many people notice the difference between a 16-bit and a 24-bit audio. If the difference is detectable, the reason is primarily in the imperfection of the recording. Sometimes, a 16-bit record does not take full advantage of the 16-bit depth and may consist of parts that are 8-bit. This also applies to the 24-bit record, whose imperfections can be manifested in 16-bit sections.

Recording at a reading rate above 44.1 kHz cannot be done on all materials. Vinyl and audio tapes are unable to download a record over 22.05 kHz. Also, the recording equipment does not always meet the highest standards required. Playing audio over 24 bits shows all the imperfections of the equipment used. Although all commercial CDs are recorded at 16-bit depth and 44.1 Khz reading rate, today this is unanimously considered insufficient when it comes to audio preservation. The reading rate and bit depth should primarily be adapted to the nature of the original audio source, not just the range of human hearing. Many sounds produced by animals or electronic instruments have a much higher frequency band than 22.05 kHz and require a higher reading rate than standard. One should be aware of the rapid technological development - it is very likely that in the future, from the saved audio tracks, the untapped potential can be exploited. The International Association of Sound and Audiovisual Archives (IASA), the National Digital Infrastructure and Preservation Program (NDIIPP) and the Council of Library and Information Resources (CLIR) recommend higher readout rates and bit depths to create reproductions that carry more data. This would be analogous to the process of digitizing a photo in as high a resolution as possible.

So, the obvious advantage of such files is that they store more data, but so-called "*rich files*" are more technically demanding. Creating them requires additional (more expensive) equipment and additional storage. The commercial recordings we find on the CD in the store represent only a quarter of the size recommended by the archival community.

The following table shows the approximate differences in the size of one-hour audio tracks at different reading rates, which must be taken into account when planning the required space on the backup server:

Reading Rate (kHz)	**Bit Depth**	**Channels**	**File Size (MB)**
44,1 kHz	16	2 (stereo)	591 MB
44,1 kHz	16	1 (mono)	296 MB
44,1 kHz	24	2 (stereo)	887 MB
44,1 kHz	24	1 (mono)	444 MB
96 kHz	24	2 (stereo)	1931 MB
96 kHz	24	1 (mono)	966 MB

7. TYPES OF AUDIO CARRIERS IN THE ARCHIVE OF BOSNIA AND HERZEGOVINA

Since 1877, sound recording technology has gone through several stages. Currently, in the Archives of Bosnia and Herzegovina sound is stored on compact cassettes and CDs.

Compact Cassette *Type I* *Type II*	1/8 "tape width in solid housing, running speed 1 7/8 inches per second.	from 1965 ~2000
Compact Disc	Audio recorded directly in digital format on an optical disc	1982 - present

The most basic Type I (ferro) cassette tape tends to give more hiss but it can potentailly take high levels. Type II (chrome) traditionally goes for low hiss but most of them cannot take high rec levels.

Compact Discs are definitely more up to date, and the sound preserved on them is already digital, but those discs in the possession of the Archives are mostly unbranded and not of high quality of workmanship, which means that there is a great risk of layer separation, corrosion or oxidation of the metallic layer, laser rot, diminished reflexivity, and organic solvent damage to the polycarbonate layer (Byers 2003, California Audiovisual Preservation Project, 2013), so data migration is essential.

The recording quality will vary depending on the type of device and the quality of the original recording, but it can be "ironed and refined" with subsequent software processing. The bigger problem is finding the right tape player and experienced operator for work with audio files.

8. HARDWARE AND SOFTWARE

The basic digitization process involves four devices: a suitable analogue audio player, an AD converter, a computer with appropriate software, and a digital format storage device. Nowadays, it is increasingly difficult to find a good-quality analogue devices in the perfect working condition. This is not yet such problem with cassette players but a magnetophone or its precursor is the best indication of how fast technology becomes obsolete[5].

It is often the case that digitization teams from one country have to travel to another, or even to another continent, in search of a suitable reader. An AD converter (analogue to digital) is a key component. The quality of the digital signal coming from the converter is the main factor that determines the quality of the final digital record. External converters are generally recommended, although, in recent times, they have been increasingly replaced by internal sound cards.

Of course, the ones with the most affordable price should be avoided, as they generally let in the extra noise into the system, while the more expensive ones (especially external ones) have additional filters that eliminate it completely. When selecting a model, great care must be taken to the technical characteristics stated on the device. These are noise level (in decibels), sampling rate (kHz) and bit depth. All high-end converters have a minimum of 44.1 / 96 kHz and 16/24 bit depth. (IASA, 2009)

The vast majority of computers available on today's market can be directly connected to an AD converter via a sound card or USB / Firewire (IEEE 1394) port. When buying, the power of the processor, the amount of installed memory, and the capacity of the hard disk must be taken into consideration. *The more, the better* rule applies here, and the good news is that today's average configuration far exceeds the technical minimum set at the time when single-core processors were standard. It is advisable to keep the computer unplugged from the network and have no other demanding programs on it, which would unnecessarily waste resources. There is a large selection of great audio software such as Pro Tools, Sound Forge, Adobe Audition (ex Cool Edit Pro), which allow the user to manipulate audio files. They are used to record sound into the system and make the necessary adjustments for optimal recording. Recording levels must be set carefully. If they are too high, overload and distortion will occur. Too low values will result in increased background noise. Each individual recording seeks separate optimal values.

The aforementioned software is also used for optimization - subsequent adjustment of volume levels, channel leveling, removal of blank sections, reduction of background noise, etc. If the final track is stored on a CD audio disc, a program will be required to burn it. Also, a conversion program is required if we have 24-bit master files that need to be converted to 16-bit or WAV format to be converted to compressed MP3. There are a number of these programs that are capable of mass conversion of given files.

Audio records of sessions and meetings of the Presidency and governing bodies kept in the Archives of Bosnia and Herzegovina do not require too much of an audiophile intervention - it mostly comes down to removing background noise, separating tracks, sorting and labeling entities, and eliminating blank parts.

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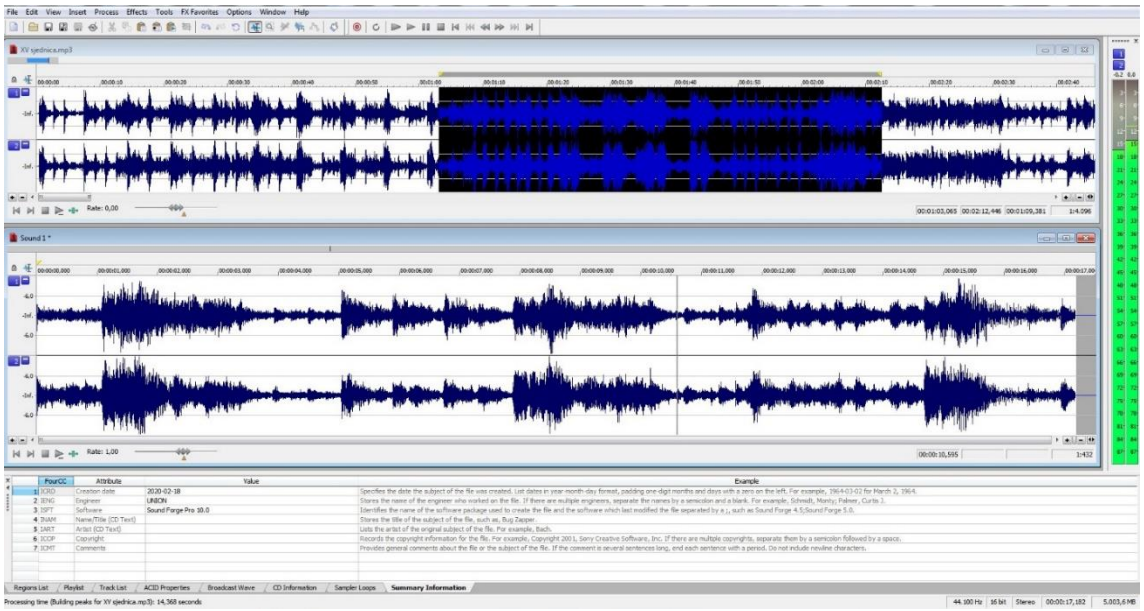
[5] *More about hardware obsolescence: Rothengberg, J. (1995). Ensuring the Longevity of Digital Documents. Scientific American, Vol. 272, No. 1, pp. 42-47, chapter How can we run obsolete hardware?*

In the case of valuable music recordings, sounds made during ethnographic research, or nature sound recordings, the post-processing would be far more demanding.



Picture 6: Sound Forge Pro, one of the most common audio editing tools – processing audio file

With the rapid development of audio technology, an increasing number of so-called born-digital recordings are in circulation (audio recordings originally recorded in digital format). Thanks to their original format, manipulation is greatly facilitated, but nevertheless, all the previously mentioned recommendations regarding reading rate and bit depth need to be kept in mind.

In recent years, there have been three types of recording systems, each with its own advantages and disadvantages.

The first is a *modular system* (where each necessary component is a device for itself) consisting of a PC unit with a CD / DVD burner, an external AD converter that can also serve as a mixer (or high quality internal sound card), a file storage drive and a microphone. This system is best suited for creating archive footage as it allows recording at the highest quality. Due to the fact that it consists of components, it is easy to replace one that at some point in case of obsolescence or malfunction. Its drawback is high cost and robustness; it needs expert knowledge to assemble, maintain and handle it.

The other system is a *compact unit*, with all components packed into a single housing, primarily intended for field recording. This would be the middle class; the advantages of which would be more affordable price, and it is easier to handle and maintain. Also requires minimal adjustments and preparation. The downside is that it provides a limited reading rate and bit depth, usually up to 16, so its hardware and software cannot be upgraded. However, thanks to the development of technology, it is believed that its time is still coming.

Compact mini-recorders, which belong to the third type of direct digital recording system, are not recommended for professional archival use. Numerous disadvantages include small storage space, compressed and exclusive recording formats, fast obsolescence, built-in microphones of poor quality ... Advantages are low cost, portability, require no adjustments and no handling training.

In the case of archiving recordings with such devices, they should be immediately converted to a standard WAV or AIF files, for easy integration into the system.

9. AUDIO FORMATS

Master audio files are stored uncompressed and in standard format, which is widely used. This ensures their long use without the need for frequent migration.

Microsoft has developed the WAV PCM file (Waveform Audio File Format) and is recognized by most audio software. WAV recommends the International Association of Sound and Audiovisual Archives (IASA) in its booklet entitled "TC-04 Guide to Digital Audio Production and Storage". Broadcast WAV (BWF) is an extension of the WAV PCM file format, which contains header metadata and has been adopted by the Eurasian Broadcasting Community (EBU).

Apple has its own AIFF (Audio Interchange File Format), which is widely used in America.

Customer-service copies are in compressed format, allowing faster online transfer. The MP3 format is most commonly used and is acceptable to most players. This type of file was designed to significantly reduce the amount of data the original had, but still sound pretty authentic to the average listener (MP3 at 128 Kbps only has 1/11 of the weight of the original source).

An MP3 file saved in 192 Kbps is recommended for a compressed audio file of solid quality.

In digital multimedia, bit rate indicates the number of bits read per second of playback. Before placing it online, it is advisable to listen to the recording and select the lowest bit rate for which the playback will maintain sufficient quality. Windows Media, Real Audio, VLC, and Apple's Quicktime are most commonly used for online playback.

10. PLANNING OF PHOTO/AUDIO DIGITIZATION PROJECT IN THE ARCHIVES OF BOSNIA AND HERZEGOVINA

Before starting with a photo/audio digitization project, it is necessary to prioritize - which photos / audio tracks are most valuable (by the information they contain or by their uniqueness) and which are most physically vulnerable (carrier obsolescence, sensitivity to external factors, or degree of decay). The same factors are important for eventual digital post-processing.

For successful planning and implementation of the project, it was important to define the following items (shown below in table for easier reference):

1.	CLEAR PURPOSE OF THE PROJECT	*There are many reasons for digitization - is the collection inaccessible to researchers and the public because of its damage, fragility of materials, or its value? Should all recordings or only the most important / wanted parts be processed?*

2.	TARGET GROUP	*Who will use the collection? Will it be used in the archives or will it also be available online? What are the needs of users and how best to meet them?*
3.	THE PHYSICAL CHARACTERISTICS OF THE COLLECTION	*What is the degree of preservation? Is it kept in a proper place? Even the slightest deviation from ideal conditions accelerates decay. What kind of photo formats are there? Are they stored properly? What is the length and format of the tapes? Longer tapes require more careful handling and playback on high quality equipment. Are there recordings on very outdated sound carriers? In this case, cooperation with a specialized company is required.*
	NEED FOR KEEPING THE ORIGINAL	*Can the original be reproduced repeatedly? If this is not possible, the transfer should be carried out under ideal conditions. What is the degree of damage? Is it worth keeping original materials that are almost unusable?*
	EVALUATION OF THE REQUIRED PICTURE AND SOUND QUALITY	*It requires a technician who has the necessary knowledge to work on the process of digitization from carriers of different formats and ages, recorded in different techniques. Will digitization also be used to enhance the original? It is possible to remove damages. This increases the quality but also the cost of the project.*
	TIMEFRAME	*This is especially important for projects funded through grants. It should be remembered that everything takes longer than originally planned. It is necessary to divide the project into stages, with an expected completion date for each.*
	FINANCING THE PROJECT	*Is the source of funding provided? How will this affect the timeline set? How much material can be digitally processed? Is migration anticipated for future technologies? What exactly is funded - hardware, software, networking, staffing, project contractor ...?*
	STAFF FOR EACH PHASE OF THE PROJECT	*Who will make the selection and physical evaluation of the material? Who is responsible for testing the quality of the original? For transfer to another format? To enter metadata? For subsequent digital interventions?*
	LEGAL FRAMEWORK AND PROPERTY RIGHTS	*Audio files can be a complex topic, viewed from a legal perspective. Before digitizing, and especially before putting it online, all copyright dilemmas must be checked and resolved. Some materials may contain sensitive information not intended for public broadcasting and must be taken into account when selecting.*
	LONG-TERM STORING PLAN	*Create a plan for periodic migration and long-term storage.*

Proper metadata entry is very important. There is not one standard that covers all the needs of all types of collections, but the common scheme includes the following information:

Descriptive Metadata	*Describes the intellectual content of the source*
Administrative Metadata	*Contains information about ownership and ownership rights*
Structural Metadata	*Describes links between multiple digital files, e.g. the order of files within a single set or series*
Technical Metadata	*Describes the characteristics of a digital file, format type, bit depth and sample rate, steps of additional interventions*

Incorporating technical metadata into a digital file is very important because current programs do not support all formats (eg WMP does not support 96 kHz). Information about file size or record duration makes it easy for the user to assess whether they have sufficient network bandwidth or sufficient time to access and download. The technical details of the original give an insight into the conversion process and the ability to make even better copies. Also, information about subsequent necessary interventions on an individual document are stored there.

Transferring from one medium to another or from one format to another is basically a simple process. There is enough advanced hardware on the market that is capable of converting within set standards and producing file that will not lose quality in the future.

Before processing begins, the physical condition of the original must be reviewed.

For instance, the magnetic strip consists of two layers - the base and the binder. The basis is the material on which the emulsion of ferromagnetic particles is held in the binder layer and thus makes a physical carrier of sound. The most common problem that occurs is hydrolysis.

This happens when the tape absorbs moisture from the air over a long period of time, resulting in a "sticky" tape, so rewinding is not possible and tearing occurs. This problem is most pronounced in polyester tapes that were manufactured from 1972 to 1982, but can also occur in other types, especially if not stored properly[6].

If the tape or photo is found to be damaged, a conservator should be consulted. It is important to know that the items must be digitized immediately after restoration. When not in use, they should always be in cases / boxes that protect them from moisture, dust, mechanical damage, and partly from fire and water. They are stored in cold and dry rooms, in areas with a minimum of dust and other harmful agents.

[6] *To make the problem even worse, a lot of audio tapes were soaked in water during the 2014 fire.*

11. CONCLUSION

Digitizing and digital post-processing of audio and photo material is in itself a demanding, expensive and time-consuming process that can only be supervised and performed by professional and responsible employees. Post-processing is more recommended as an in-house project, as opposed to mass digitization, where often a better solution is to select a vendor. The set of rules and limits that cannot be crossed, when removing the damage and imperfections that the original carries with it, must be clearly defined.

It is important to note that the raw digital master should always be stored separately, so in the case of „over-zeal“ during repair, restoration can always start from the beginning.

Well done subsequent digital intervention serves primarily to show the original in all its authenticity, if possible as it was on the day of its creation. One should be aware that the original was not perfect even at the day of its creation, given the imperfect audio/photo equipment used in the past.

However, the subsequent digital restoration process does not take precedence over the basic high resolution scanning process or entering the metadata, but is more like an additional procedure in the case that subsequent intervention turns out to be necessary due to major damage and loss of essential information from the original.

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POVZETEK

DIGITALIZIRANO ZVOČNO IN FOTOGRAFSKO ARHIVSKO GRADIVO – DILEME PO DIGITALIZACIJI

Siniša Domazet
Arhiv Bosne in Hercegovine, Sarajevo, Bosna in Hercegovina
domazetsinisa@yahoo.com

Še pred manj kot desetimi leti delo v arhivu in v IT-sektorju ni imelo veliko skupnega. Raziskovalci so prihajali v čitalnice arhivov, pregledovali inventarje in dokumente ter delali izpiske oz. fotokopirali same dokumente.

Hiter razvoj tehnologije nam danes omogoča, da mnogo nalog opravimo le s klikom, inventarje je mogoče pregledovati na spletnih straneh arhivov, zahteve za določene dokumente je mogoče poslati elektronsko, digitizirano gradivo pa lahko raziskovalec prejme po elektronski pošti. Da smo to lahko dosegli, je bilo potrebno digitalizirati širok nabor različnih oblik arhivskega gradiva.

Medtem ko je konverzija najbolj pogostih, pisnih dokumentov precej standardizirana, je fotografsko in zvočno gradivo še vedno v „sivi“ coni. Obstaja namreč veliko oblik in postopkov za njihovo „izboljšanje“, ki pa lahko ogrozijo njihovo avtentičnost in izvirnost.

V zvezi s konverzijo klasičnega arhivskega gradiva v digitalno obliko lahko rečemo, da živimo v obdobju tehnološkega preboja. Vsak začetek pa s seboj prinese določena tveganja in napake, ki se zgodijo med digitizacijo ne tako pogostih zvočnih in fotografskih gradiv in po njej. Glavno pravilo pri tem je, da digitalni nadomestek ohranja vse značilnosti originala.

Sprašujemo se, ali nadaljnje odstranjevanje šumov in motenj iz zvočnih posnetkov ali popravki fizičnih poškodb fotografij zmanjšujejo avtentičnosti novega/starega dokumenta ali izboljšujejo njegovo vsebino. Arhiv Bosne in Hercegovine je temu namenil veliko pozornosti, saj je splošno pravilo, da je verodostojna le nespremenjena kopija originala z vsemi njegovimi defekti in nepopolnostmi. Vseeno pa je za opravljanje raziskav in jasnosti informacij v originalu potrebno kopijo očistiti vseh tehničnih in fizičnih motenj.

Prispevek opisuje metode obdelave gradiva po digitalizaciji, ki jih uporablja Arhiv Bosne in Hercegovine, ter predstavlja prednosti in slabosti, ki so se do zdaj pokazale v praksi.