Routledge
Taylor & Francis Group

LIMES: Borderland Studies
ISSN 2029-7475 print / ISSN 2029-7483 online

2013 Volume 6(1): 64–84
doi:10.3846/20297475.2013.808450

III. IMAGES AND POSSIBILITIES OF IMAGE PROCESSING IN HISTORICAL PERSPECTIVES

CONCERNING A FLOWERY TABLECLOTH AND THE COMPUTER-AIDED ANALYSIS OF A 19TH-CENTURY PHOTOGRAPHIC IMAGE

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Received 20 April 2012; accepted 2 December 2012

The paper introduces some peculiarities of the analysis of the photographic image which emerged in the process of the investigation and preparation for publication of the album of prelate Povilas Januševičius' the end of 19th – beginning of 20th century. Miscellaneous analysis of photograph image is presented. It also introduces how problems of photograph dating could be solved by combining insights of investigator as well as application of information technology. Among other things a technological study is being presented in which similarity of flowered tablecloth was analysed in different photographs. Up-to-date programs for processing and analyzing images open up completely new possibilities leading to automatic recognition and identification of objects, symbols and faces.

Keywords: computer-aided image analysis, dating, image processing, photography of 19th century, object identification.

Reference to this paper should be made as follows: Žaltauskaitė, V.; Žiūrienė, R. 2013. Concerning a flowery tablecloth and the computer-aided analysis of a 19th-century photographic image, *Limes: Borderland Studies* 6(1): 64–84.

Introduction

Although the attitude to photography as only a means of illustration is still popular, it has recently been losing its function as a mere reflection of reality and becoming a record of truth for historians as well. The "pictural turn" (Mitchell 1995: 1–34) has been acknowledged in historical science – in recent decades historians began treating visual material as equivalent to linguistic sources (Romanov, Iarskaia-Smirnova 2007:

146–168; Sokolov 2008: 15–24). Thus photography is valued not only as the illustration of certain obtained statements, but as having the power of creating the narrative *per se* and being an important means of comprehending the social and cultural context. For instance, Igor' Narskii, on the basis of a broad theoretical background of photographic research, thoroughly examined the possibilities of photographic interpretation and produced a text of the mass Soviet culture of the 1960s diversely investigating one photograph (Narskii 2008). In his opinion, photography reflects the socio-cultural changes and rightly claims to be a serious historical source (Narskii 2008: 243).

Working on this assumption – treating photography as a multi-faceted trustworthy and exceptional historical source – an attempt is made here to analyse, comment and prepare for publication a private photographic album of prelate Povilas Januševičius[1] (1866–1948), a Roman Catholic clergyman of the Diocese of Žemaitija (Telšiai)[2]; the album covers the last decades of the nineteenth and the beginning of the twentieth centuries (Januševičius 2010).

The album compiled by the Roman Catholic clergyman is valuable in its entirety. As regards the history of photography, it is important and interesting as a source of photographic images. From the viewpoint of cultural anthropology the album contains lots of material memories illustrating various cultural implications, social expectations and visions. The exchange of photographs, inscriptions on them, their keeping and demonstration create certain social contacts (Biuttner 2008: 59–60; Edwards 1999: 221–236). As regards social history the album indicates the contacts of this particular social group, the flow of communication, the presentation of mobility, hierarchy and values. Important is the very photographic image as well, and the ways its contents could be read: who was photographed, when and where and in what photographic studio, the layout of photographs in the album, the way they reached the owner of the album, their dedications and other inscriptions, the (in)correctness of information, etc.

The aim of this article is to acquaint the reader with some peculiarities of the analysis of the photographic image which emerged in the process of the investigation of Januševičius' album, in the dating of its photographs and in the possibilities of the application of information technologies. Up-to-date programmes for processing and analysing images open up completely new possibilities leading to automatic recognition and identification of objects, symbols and faces.

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[1] Povilas Januševičius (1866 12 17 (29 New Style) – 1948 05 17) studied at the Kaunas Theological Seminary between 1886 and 1890 and at the Imperial Roman Catholic Spiritual Academy in St Petersburg between 1894 and 1898; in Lithuanian historiography he is known as a teacher of the Žemaitija (Telšiai) Theological Seminary in Kaunas, as an author of Lithuanian textbooks, fosterer of the idea of Kaunas as a Lithuanian centre and a priest engaged in social activity; in 1919 he set up a charitable society and was its head for several decades; at the end of 1930s he met with defeat and experienced aggression – modern Lithuanian nationalism did not reconcile with his moderate attitude and his reluctance to abandon altogether additional services in Polish in the Kaunas church of the Holy Trinity.

[2] The double name of the diocese is found in the agreement between the Holy See and Russia in 1847. The name of the seminary remained unchanged after its transfer from Varniai to Kaunas. In historical science the term Žemaitija is more common in the names of the diocese and the seminary.

Historical aspects of the investigation

The dating of photographs is an essential aspect of their characteristic. Photographic historians date photographic prints taking into consideration the technique of their production and their physical features (Reilly 2009). In dating photographs, the historian is concerned with the reconstruction of the socio-cultural context of the activity and the biographical narrative of the person photographed (in particular in the analysis of portrait photographs). The established date of a photograph can revise the data dealing with the social mobility and the space of communication of the person in question. Thus photography verifies the information of other sources and in its turn becomes an independent source of research in its own right. That is why exact dating of the photographs of the discussed album is so important.

The subject of this study is the problems of dating the photographs of the last decades of the nineteenth century created by Vaclovas Zatorskis (1862?–1926), the owner of a photographic studio in Kaunas[3]. They arose rather unexpectedly in the course of the investigation Januševičius'album photographs made in Zatorskis' studio[4]. The views and the texts of the photographs were subjected to critical evaluation, and the data of the history of photography were used. The researcher of old Lithuanian photography Dainius Junevičius maintains that the inscriptions 'opposite the town garden' and 'opposite the girls' secondary school' appeared on Zatorskis' photographic *cartes-de-visite* only when he acquired one more studio from Piotr Kotkovskii in 1891.

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[3] According to Dainius Junevičius, Emilis Zatorskis (Vaclovas Zatorskis' father) took over Juozapas Leonas Jaroslavas Bžozovskis' photographic studio and for some time Bžozovskis' name even figured on Zatorskis' photographic *cartes-de-visite* (Junevičius 1997: 63). On 31 March 1882 Emilis Zatorskis was given permission to open a photographic studio in Kaunas. However, it is interesting that in the 1882 account Zatorskis' name is not found among the owners of Kaunas studios, while the names of the brothers Juozapas Leonas Jaroslavas and Eduardas Bžozovskises are indicated (the 30 November 1882 account of Kaunas' governor of printing houses, lithographic shops and photographic studios in Kaunas gubernia; submitted to the Supreme Board of Printing; Rossiiskii Gosudarstvennyi Istoricheskii Arkhiv (St Petersburg) (henceforth RGIA), f. 776, op. 20, d. 511, fo. 290). Consequently, the studio was taken over not in 1882 but later (our commentary to photograph 8 was not correct (Januševičius 2010: 82)). In later accounts of 1884, 1885, and 1886 Zatorskis' studio was indicated and the Bžozovskis brothers were not mentioned any more ((Januševičius 2010: 82); the 4 October 1884 account of Kaunas' governor of printing houses, lithographic shops and photographic studios in Kaunas gubernia; submitted to the Supreme Board of Printing; RGIA f. 776, op. 20, d. 717, fo. 79; the 17 December 1886 account of Kaunas' governor of printing houses, lithographic shops and photographic studios in Kaunas gubernia; submitted to the Supreme Board of Printing RGIA, f. 776, op. 20, d. 873, fo. 36). Incidentally, some of the inscriptions on the verso of the *cartes-de-visite* of Bžozovskis' studio bear its address: private house on Nikolaevskii prospekt, opposite the town garden (album of Juozapas Liasauskis; Kauno Arkivyskupijos Kurijos Archyvas (henceforth KAKA), alb. 4, fo. 16r; Čiurlionio Dailės Muziejus (henceforth ČDM), Ta 5406 (the photograph of Jonas Vileišis in the uniform of the Šiauliai secondary school; he entered the school in 1884, meanwhile the photograph is on the Bžozovskises' *carte-de-visite* … does that mean that the studio was still in Bžozovskises' possession or had the photograph been made earlier and dedicated later or did Vileišis enter the school earlier? One more photograph on J. Bžozovskis' *carte-de-visite* with the date of 1883 is in the photographic album of Maironis (pseudonym of Jonas Mačiulis) (see Maironio Lietuvių Literatūros Muziejus (henceforth MLLM), MD 2784/15; and with the date 1881; MLLM, MD 2710/9)). In greater detail about the location of Bžozovskis' studio in Kaunas, see (Januševičius 2010: 83).

[4] 14 photographs (nos. 4, 7, 10, 15–19, 21–23, 29, 49, 53) contain verso inscriptions on the *cartes-de-visite* about the studio as formerly located 'opposite the girls' secondary school', and two photographs (nos. 8 and 11) about the studio 'opposite the town garden' (Januševičius 2010).

He allegedly used the inscription ‘opposite the girls’ secondary school’ on the *cartes-de-visite* made in this studio until 1894 (Junevičius 1997: 63–64). This statement is quite a common occurrence in Lithuanian historiography. Consequently, in the last decade of the nineteenth century Zatorskis could have only one studio – ‘opposite the town garden’. Since Januševičius’ album comprised Zatorskis’ photographs with references to both the town garden and the girls’ school, at the beginning of our study we adhered to Junevičius’ findings in dating photographs.

However, soon doubts appeared when the photograph of Jeronimas Kiprijonas Račkauskis in Januševičius’ album caught our attention (Figs. 1, 2; full description, see Januševičius 2010: 67–69). Račkauskis was the rector of the seminary at which Januševičius studied between 1886 and 1890, so it is natural that his photograph appeared in the album. The photograph of Račkauskis bears the inscription ‘opposite the girls’ secondary school’ and according to Junevičius can be dated between 1891 and 1894. However, Račkauskis died in December 1889 and this fact made the dating of photographs open to doubt and required further investigation of Zatorskis’ photographs as well. We took into account the fact that copying old photographs was common practice at that time and such pictures of dead people could be obtained from the studio ‘opposite the girls’ secondary school’. But when could it be done? The questions remain unanswered.

Fig. 1. Jeronimas Kiprijonas Račkauskis. Original *carte-de-visite*. Second half of the 1880s, Photographic album of Povilas Januševičius; KAKA, alb.7, fo. 3 recto, photog. 4
Note: Full description, see Januševičius 2010: 67–69.

Fig. 2. Verso of the photograph

It is worth noting that Maironis'[5] album of photographs includes one more photograph of Račkauskis (Figs. 3, 4). In it the manner of the dignitary's posture, the folds of his clothing, the capitular insignia (*distinctor*) and its chain are identical to those in the photograph of Januševičius' album. However, this *carte-de-visite* differs from the one kept in Januševičius' album. The left side of its recto bears the inscription W. ZATORSKI and the right side – À KOVNO; its verso has a reference to 'opposite the town garden' and beneath: 'Rektor Hieronim Raczkowski 1887' (the last numeral may be corrected)[6]. Such a *carte-de-visite* would indicate that the photograph was done in the other Zatorskis' studio in the 1880s (cf. also footnote 3). However, at that time Zatorskis did not have two studios. Meanwhile the inscriptions on the *cartes-de-visite* are at variance… The date 1887 should also be treated critically, but in the context of other inscriptions in Maironis' album it did not raise serious doubts.

Fig. 3. Jeronimas Kiprijonas Račkauskis. Original *carte-de-visite*. Second half of the 1880s, Photographic album of Maironis; MLLM, KLM 78, MD 2781/15

Fig. 4. Verso of the photograph

[5] Jonas Mačiulis (Maironis) studied at the seminary in Kaunas between 1884 and 1888, that is, during Račkauskis' rectorship.

[6] Photographic album of Maironis; MLLM, KLM 78, MD 2781/15.

There were doubts about other photographs of Zatorskis studio containing references 'opposite the town garden' and 'opposite the girls' secondary school', which, according to Junevičius could be made between 1891 and 1894. The fact that the number of such photographs was relatively numerous added to uncertainty, the more so that at that time Januševičius even did not reside in Kaunas; he graduated from the seminary in 1890. Meanwhile photographic albums contain few if any pictures *carte-de-visite* containing references 'opposite the town garden' and 'opposite the girls' secondary school' of those clergymen who studied in Kaunas in the last decade of the nineteenth century and could have their photographs taken when Zatorskis had two studios – for instance, Kazimieras Bukontas graduated the seminary in 1893, Juozapas Skvireckas – in 1896, or Kazimieras Šaulys – in 1895[7]. At the same time the pictures in the photographic album of Juozapas Liasauskis, who graduated the seminary in Kaunas in 1885, are frequent, in particular those in the studio opposite the town garden.

The aforementioned Liasauskis' album contains photographs[8] identical to those of the pictures of the *cartes-de-visite* of Januševičius' album (cf. photograph 8 of Januševičius' album in which an unidentified clergyman is sitting with his left arm leaning on a table covered with a flowery tablecloth. (Figs. 5, 6; (full description, see (Januševičius 2010: 80)). In the photographic albums of the seminarians of the Seinai Theological Seminary there are photographs with identical *cartes-de-visite* as well[9]. It is noteworthy that some of them bear dedicatory inscriptions and that makes the dating of the photographs easier. Naturally, the dedication should also be treated critically as a conclusive argument, but a dedicated photograph would not be produced later than its dedication. Meanwhile older photographs can be dedicated some times after its production[10].

Among such dedicated photographs that of Vincentas Aleksandravičius[11] should be mentioned. He studied at the Seinai Theological Seminary between 1882 and 1887 and after graduation entered the Imperial Roman Catholic Spiritual Academy in St Petersburg. In the photograph which in December 1886 he dedicated to Konstantinas Liūdžius (also a seminary student in the same years) Aleksandravičius is wearing the dress of the seminarian rather than that of the student of the academy[12]. There is one more photograph dedicated to the same Liūdžius in 1886 (Figs. 7, 8). It is the photograph of the ordinand of the Seinai Theological Seminary Juozapas

[7] Photographic album of Kazimieras Bukontas; Mažeikių Muziejus (henceforth MM), MM 34126/34127–34218; Photographic album of Juozapas Skvireckas; KAKA, alb. 3; Photographic album of Kazimieras Šaulys; KAKA, alb. 2.

[8] Photographic album of Juozapas Liasauskis; KAKA, alb. 4, fos. 6v, 11v, 12v.

[9] Photographs of the priests, seminarians and laymen of the Seinai Theological Seminary; Lietuvos Nacionalinis Muziejus (henceforth LNM), ATV 6092, ATV 6132, ATV 6155.

[10] Such cases are discussed in (Žaltauskaitė 2010: 26).

[11] I am grateful to Dr Algimantas Katilius for the information of the seminarians of the Seinai Seminary.

[12] Photographs of the priests, seminarians and laymen of the Seinai Theological Seminary; LNM, ATV 6092.

Sadauskas; he studied there between 1883 and 1888[13]. In this photograph the property of the studio – the tablecloth – is the same as in photograph 8 of Januševičius' album. Therefore the latter was dated by us to the second half of the 1880s. We also noted that the tablecloth was identical in other Zatorskis' photographs[14], although their versos differed – they referred not to the studio 'opposite the town garden' but to that 'opposite the girls' secondary school' (Figs. 9–12).

Fig. 5. Unidentified clergyman. Original *carte-de-visite*. Second half of the 1880s; Photographic album of Povilas Januševičius; KAKA, alb.7, fo. 3 verso, photog. 8. Note: Full description, see Januševičius 2010: 80–89

Fig. 6. Verso of the photograph

[13] Photographs of the priests, seminarians and laymen of the Seinai Theological Seminary; LNM, ATV 6132.

[14] Photographs of the priests, seminarians and laymen of the Seinai Theological Seminary; LNM, ATV 6129; Photographic album of Juozapas Liasauskis; KAKA, alb. 4, fos. 11v, photog. 4; Kazimieras Čapronas; MM, MM 4842 and MM 34042 (incidentally, Čapronas was Liasauskis' classfellow at the Žemaitian Theological Seminary in Kaunas. Photograph no. MM 34042 bears the date 1 January 1892 in Polish. Bukontas' album comprises one more photograph of Čapronas in which he seems older (see MM, MM 34043). The latter photograph with his dedication and the date 10 November 1892 lead to the conclusion that both photographs do not go back to the same period. The former is earlier. It is noteworthy that the same picture of Čapronas of the earlier period is kept in Liasauskis' album as well (see Photographic album of Juozapas Liasauskis; KAKA, alb. 4, fos. 11v, photog. 2); his verso, however, states that it was made in the studio opposite the town garden. It is plausible that it was created in this studio of Zatorskis and was reproduced later.

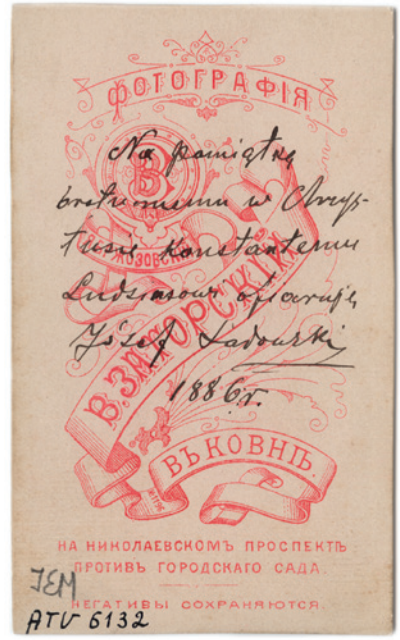


Fig. 7. Photograph of Juozapas Sadauskas, 1886, dedicated to Konstantinas Liūdžius. Original *carte-de-visite*. Second half of the 1880s; LNM, ATV 6132

Fig. 8. Verso of the photograph

Fig. 9. Unidentified clergyman. *Original carte-de-visite*. Second half of the 1880s; LNM, ATV 6129

Fig. 10. Verso of the photograph

Fig. 11. Unidentified clergyman. Original *carte-de-visite*. Second half of the 1880s, Photographic album of Juozapas Liasauskis; KAKA, alb. 4, fo. 11 verso, photog. 4

Fig. 12. Verso of the photograph

Why do inscriptions differ on those *cartes-de-visite* which we attributed to the 1880s when Zatorskis did not have two studios? We presumed that at that time he could be moving from the former Bžozovskis / Bžozovskises' studio on Nikolai Avenue 'opposite the town garden' to the studio in Natan and Roza Natanson' house 'opposite the girls' secondary school[15]. It was built in 1883–1884[16]. Zatorskis is known to have rented until 1914 some rooms (and a temporary wooden outside structure in the yard as a photographic pavilion) in a one-storey brick house belonging to the Natansons. This house stood next to a municipal three-storey brick building – exactly opposite the girls' secondary school[17]. Thus, it seems quite likely that already in the 1880s Zatorskis had a studio opposite the girls' secondary school, and in this studio photographs could be printed from the negatives which had been made in the studio 'opposite the town garden'.

[15] On the location in more detail, see Januševičius 2010: 83, 85.

[16] *Plan gubernskogo goroda Kovno, 1904*, Lietuvos Mokslų Akademijos Vrublevskių Biblioteka (henceforth LMAVB); Rare Books Department, K-337.

[17] Pict. 11 shows the place of Zatorskis' studio (Lukšionytė-Tolvaišienė 2001: 171). It is also seen in the illustrations of some other publications (Miškinis 2006: 65).

In this research we did not discuss the statement that Zatorskis had two studios at one time – we only debated Junevičius' conclusion that the inscriptions on the *cartes-de visite* 'opposite the town garden' and 'opposite the girls' secondary school' go back to the same period, namely 1891–1894. Comparing a number of photographic albums and collections[18] we examined the supposition that the photographs on such *cartes-de-visite* had been made earlier – in the 1880s – so far, at least so far, we have found more arguments supporting this assumption. On the other hand, certain questions also remained, and the issue of dating the photographs still generates discussions (Šenavičienė, Junevičius 2012: 359–366). The arguments are constructed analysing and comparing a number of photographic collections, taking into account the biographies and careers of the photographed persons, critically accepting each statement and admitting that in photography there is no *a priori* knowledge and that pictures and inscriptions must be contextualized, commented, revised and that new data can be expected.

Fig. 13. Unidentified persons. Second half of the 1880s; KTU Library, Rare Books Departament, Iconographic Collection. Verso of the photograph containing reference 'opposite the town garden'

Concerning the tablecloths. We carefully examined the photographs containing tablecloths. As the number of such photographs made in Zatorskis' studio was considerable (and with various tablecloths) (Figs. 13–17), we applied to computer graphics experts. In dating photographs the human factor undoubtedly of immense importance since the researcher formulates questions and analyses possible conclusions. The comparative studies of the historians and computer graphics specialists can correct hypothetical presumptions and revise conclusions. Such investigations can stimulate, for example, the formation of a photographic dating system common for museums and archives. However, the construction of such a system would depend on the openness and accessibility of archives and museums.

[18] Lietuvos Centrinis Valstybės Archyvas, Department of Photographic Documents; Lietuvos Valstybės Istorijos Archyvas; Rossiiskii Gosudarstvennyi Istoricheskii Arkhiv; Lietuvos Dailės Muziejus, Lietuvos Nacionalinis Muziejus. Mažeikių Muziejus, Nacionalinis M. K. Čiurlionio Dailės Muziejus, Vytauto Didžiojo Karo Muziejus; Maironio Lietuvių Literatūros Muziejus; Šiaulių "Aušros" muziejus; Kauno technologijos universiteto biblioteka, Rare Books Department, Iconographic Collection; Lietuvių Literatūros ir Tautosakos Instituto Biblioteka, Manuscript and Photographic Departments, Lietuvos Mokslų Akademijos Vrublevskių Biblioteka, Manuscripts Department, Lietuvos Nacionalinės Martyno Mažvydo Biblioteka, Department of Rare Books and Manuscripts, Vilniaus Universiteto Biblioteka, Manuscripts Deparment. On the analysis of the photographic albums of the Roman Catholic clergymen, see Žaltauskaitė 2010: 19.

Fig. 14. Kazimieras Čapronas. Original *carte-de-visite*. Second half of the 1880s; MM, MM 34042
Note: See also footnote 14

Fig. 15. Verso of the photograph

Fig. 16. Unidentified clergyman. Original *carte-de-visite*. Second half of the 1880s; LNM, ATV 6134

Fig. 17. Verso of the photograph

Technological aspects of the investigation

Thereby one of the hypothetical presumptions, which have been taken to verify using computer science methods, was expressed as follows: do tablecloths, shown in collection of photos are identical? And if so, then we can say that those photos were taken at the same period.

Before solving this task, first it should be noted that on the one hand human and computer system identify objects in the images similarly, but on the other hand, differently. Both human and computer system the new object compares with those who are already in memory or database. It seems for both of them it is the same action, but the human usually do not need much effort to identify various objects in the images despite the fact that objects appears at different view angles, they have different sizes and colors, when they are upside down or rotated. Meanwhile, the task is still a challenge for computer system. On the other hand, human testing has its weaknesses compare to computer. The machine does not get tired and can easily verify large amounts of information. Besides it is possible to keep initial parameters unchanged from beginning till the end of testing, when human factor is eliminated.

At this initial stage of technological investigation the main task was to analyze the technological aspects of the object, to find out how initial data could be interpreted and to check how popular image identification methods acts in a particular situation.

The identification system has four major components: data collection, feature extraction and representation, similarity detection and pattern classification and evaluation. During this process the images are analyzed and compared in order to determine objects or certain parts of the potential matches and similarities.

Identification methods can be classified into two broad groups, known as feature-based (FB) and area-based (AB) methods. FB extracts specific features that are seen in the template and store a set of features as a template of information. FB tolerates rotation, size variations, lens distortions, however, remains low tolerance of light, brightness change and a small noise.

On the other hand AB saves a template of image as an ordered set of pixels with grayscale variables. In order to compare the template with the information of each pixel position usually correlation methods are used. AB's weaknesses: the calculations are intense as well as sensitiveness to rotation, size variations and lens distortions. The strong side of AB's is the resistance to lines brightness changes when correlation methods are used. AB also has higher noise tolerance in the image. The value of correlation coefficient can be used to choose position which corresponds most. Especially AB tolerates cycles and requires a minimum of calculations. FB is ideal for applications when image templates and seeking objects are already known, such as optical character recognition. For simple applications usually the AB methods are used.

The normalized cross-correlation was chosen as the main method for technological investigation. Its working scheme is represented in Figure 18. A cross-correlation coefficient is calculated in order to check, where the small image corresponds the big one most of all. And then this peak is found it shows where two images could be overlapped. According this method a scheme of object identification in image was created (Fig. 19).

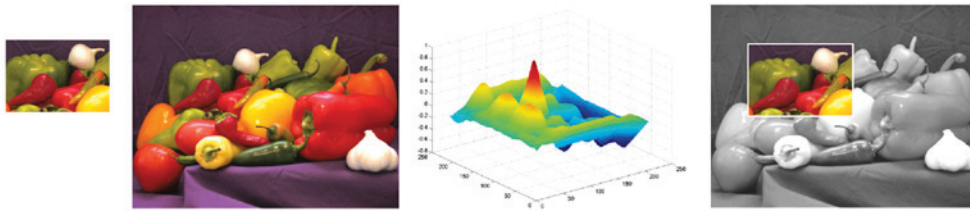


Fig. 18. Normalized cross-correlation (Mathworks 2012)

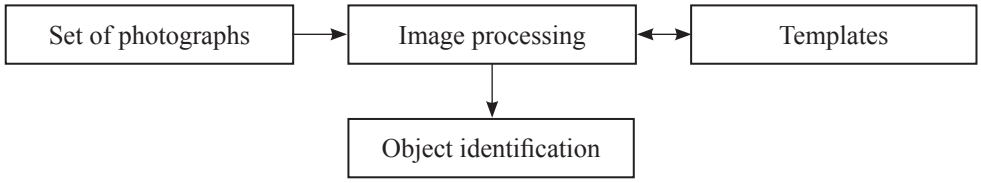


Fig. 19. A scheme of object identification in image

A multi-platform software MathWorks – MATLAB was used for analysis. This software is based on matrix data structure. The MATLAB is used for computer-aided calculations in many scientific and technical fields. This system has been adapted to the various applications for data, signal and image processing, neutral networks, financial – economic calculations and other areas.

A set of photograph was analyzed. The set consists of 11 images (Fig. 20)[19]. Each of them represents portraits taken at photo studio. In each photograph a floral tablecloth can be seen. It was the main object of the investigation.

[19]S1. Vincentas Bogdyšenka [?]. Original *carte-de-visite*. Photographic album of Juozapas Liasauskis; KAKA, alb. 4, fo. 6 verso, photog. 3. Verso of the photograph containing reference 'opposite the town garden'.
S2. Unidentified clergyman. Original *carte-de-visite*. Photographic album of Juozapas Liasauskis; KAKA, alb. 4, fo. 9 recto, photog. 4.
S3. Unidentified clergyman. Original *carte-de-visite*. Photographic album of Juozapas Liasauskis; KAKA, alb. 4, fo. 11 verso, photog. 4.
S4. Kazimieras Čapronas, Original *carte-de-visite*. Photographic album of Juozapas Liasauskis; KAKA, alb. 4, l. 11 verso, photog 2.
S5. Unidentified clergyman. *Original carte-de-visite*; LNM, ATV 6134.
S6. Unidentified clergyman. *Original carte-de-visite*; LNM, ATV 6164.
S7. Unidentified clergyman. Original *carte-de-visite*. Photographic album of Juozapas Liasauskis; KAKA, alb. 4, fo. 8 recto, photog. 4.
S8. Unidentified clergyman. Original *carte-de-visite*. Photographic album of Povilas Januševičius; KAKA, alb.7, fo. 3 verso, photog. 8.
S9. Vladislovas Bortkevičius [?]. Original *carte-de-visite*. Photographic album of Maironis; MLLM, alb. 79, MD 2710/10.
S10. Vincentas Bogdyšenka [?]. Original *carte-de-visite*. Photographic album of Maironis; MLLM, alb. 79, MD 2710/1. Verso of the photograph containing reference 'opposite the girls'secondary school'. See also Žaltauskaitė 2010: 26.
S11. Unidentified clergyman. Original *carte-de-visite*. Photographic album of Juozapas Liasauskis; KAKA, alb. 4, fo. 11 verso, photog. 3.

Fig. 20. A set of photographs used in investigation

In order to set the date of the photographs we need to set the details which will be identified in every image. Most of the photos are relatively good quality considering the age and technology of performance. The photographs have a relatively high noise level, but the chosen method is not very noise-sensitive, so this aspect was not assessed at this stage of investigation. Each photograph has a particular colour tone, but it also was not important, since during the process it was removed.

The most important part of photographs is the flowered tablecloth whose pattern is analysed here. In each of the photographs the tablecloth is oriented differently. The tablecloths also differ in fabric hanging. It makes the task of analysis even more complicated, because the same fragment in each image has the different distortions. Though the drapery lighting in each image is also different, it is not essential for this particular investigation, because the chosen method reacts more to edges than to grey-scale variations. Of course, there are some cases when folds are so dark that particular fragments cannot be identified. The tablecloth pattern is quite large, composed from several separate flower fragments. Usually we can see quite a small area of tablecloth, so some fragments appears only once. A scale of tablecloth in each image is the same, or differs just a little, because the scenes of the portraits in photos are static and quite similar.

The main photograph in the set is S8 (see also Figs. 5, 6). This photograph is from photographic album of Povilas Januševičius. Besides, a pattern of a tablecloth can be seen sufficiently well. It was used as a benchmark. First of all an area of interest was extracted in order to achieve more accurate results of analysis and to reduce the

amount of examined data (Fig. 21). During analysis this part of image will be used as a benchmark. The small fragments (templates) will be extracted from other images and analysed how much they correspond to the main benchmark. For this purpose the normalized cross-correlation method will be used.

As the set of photograph was relatively small, we decided to choose a few templates (Fig. 22) from each photograph in order to get as much precise results as possible. It was clearly visible flowery pattern fragments. From each photograph it was extracted 5 templates. Notations A1, A2,…, A5 are the names of templates.

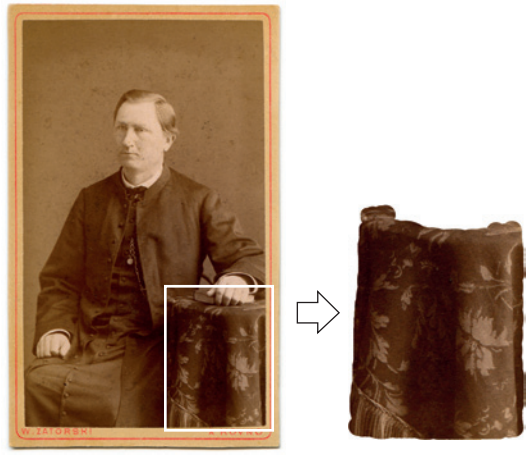


Fig. 21. An extracted region of interest from photo S8 – a benchmark of investigation

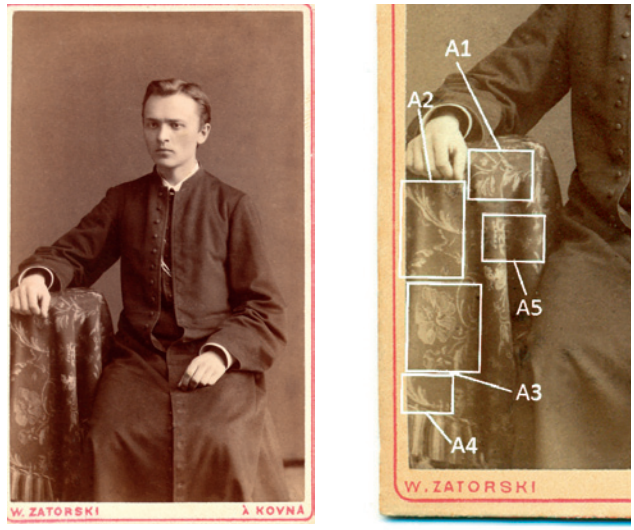


Fig. 22. The chosen templates (A1, A2,…, A5) from particular photograph S1

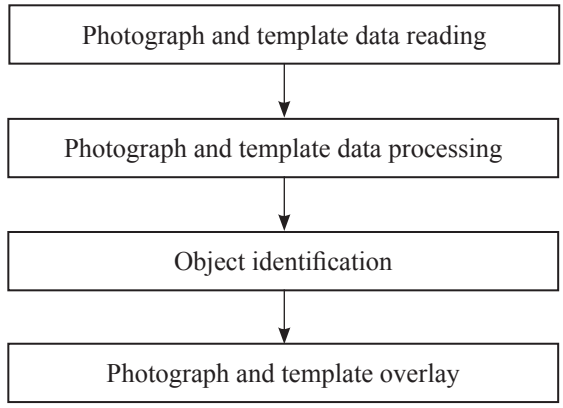


Fig. 23. The workflow scheme

The workflow scheme of technological part of investigation is presented in Figure 23. The process starts with "Photograph and template data reading", it means scanning. The second step is "Photograph and template data processing", it means the benchmark extraction (Fig. 21) and pick out of templates for each investigated photograph (in Fig. 22 – photograph S1). Then the main part of the investigation follows – "Object identification". For this purpose a normalized cross-correlation is used (Haralick 1992).

Using the correlation coefficient (CC) the matching peak value is found (Fig. 24). As we see only templates A3 and A4 has CC higher than 0,75 and only these templates can be used for future investigation.

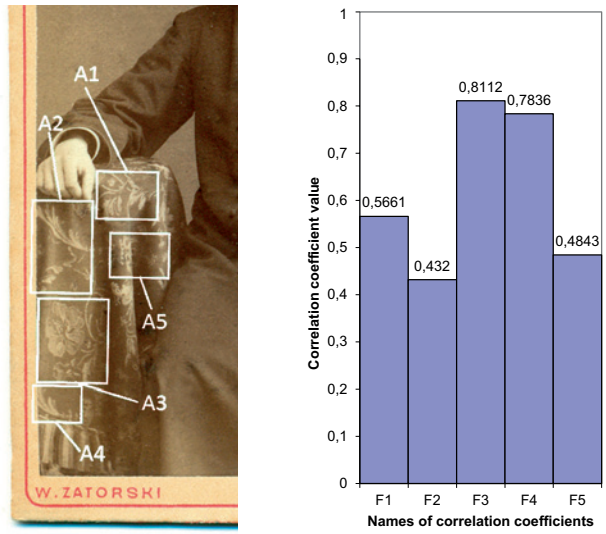


Fig. 24. Correlation coefficient values of the maximum matching

Now we are ready for the last stage "Photograph and template overlay". The maximum of matching peak value shows in which exact place the template should be placed (Fig. 25).

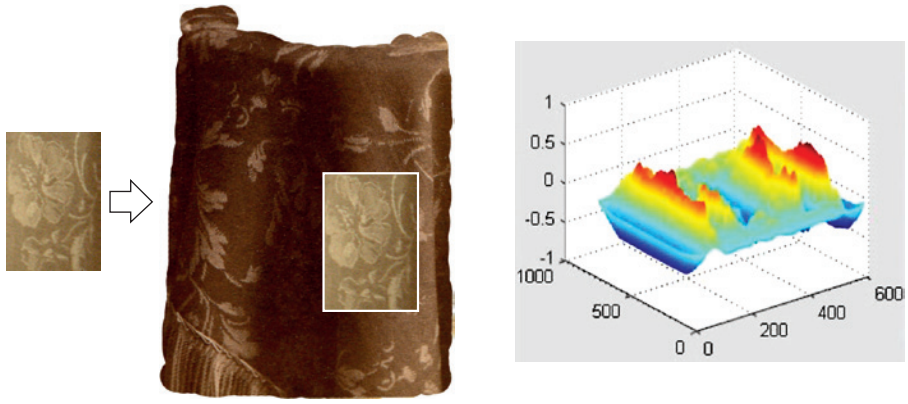
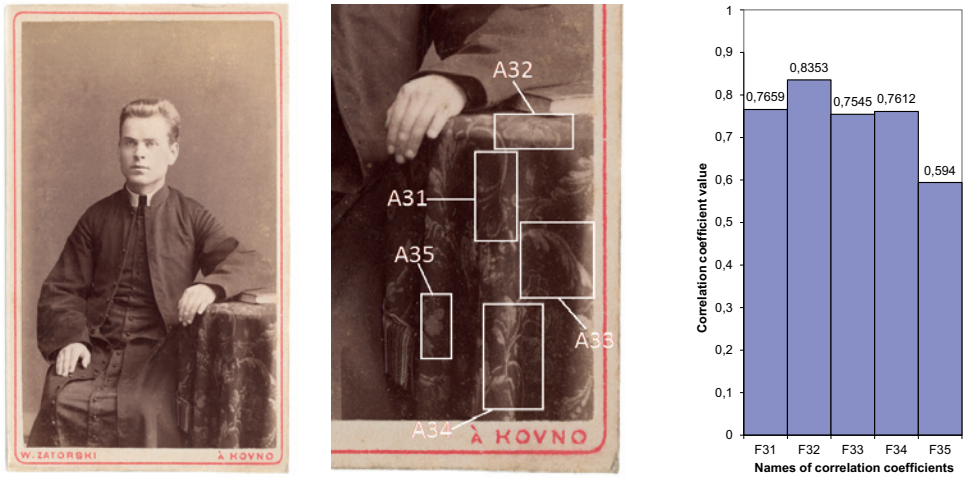


Fig. 25. Left – the template F3 and benchmark overlay, right – the place of overlay

Summarizing the results of photograph S1 testing it should be noted that there are two fragments (A3, A4) which matches benchmark very good, but the average of CC of A1-A5 fragments is only 0,6154, so according this investigation there is too law probability that the tablecloths in S8 and S1 are the same.

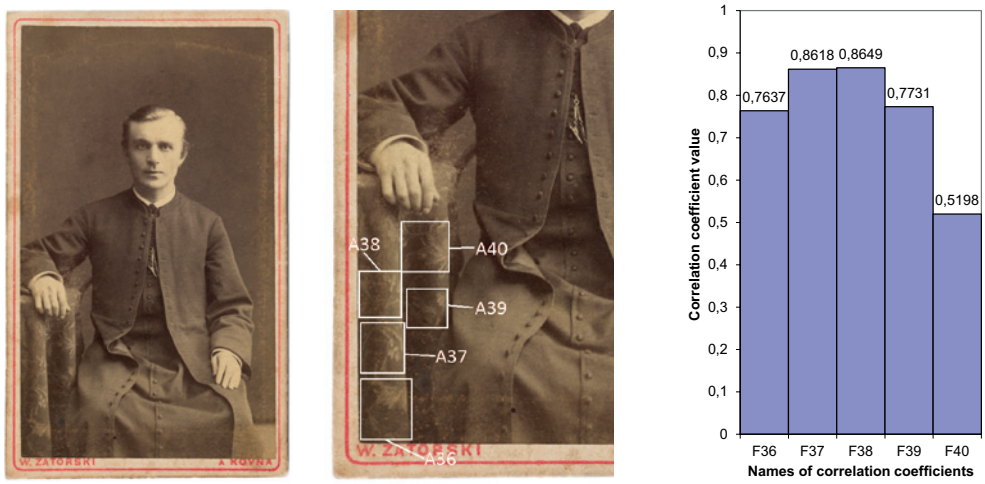
In this way all photographs of the set have been analysed. Based on the correlation coefficient values the diagrams have been created for each of the photographs used in the investigation. According to the results presented in diagrams it is easy to determine how much each template matches the main photograph of the investigation.

Further results of analysis of two photographs are presented. The following diagrams shows the results of templates identification have quite high matching percentage. Labelling A31, A32,..., A35 – the names of templates, which corresponds the names of correlation coefficients F31, F32, ..., F35 (A31 = F31,..., A35 = F35). The results presented in Figures 26 and 27 show that the highest correlation coefficient values are higher than 0,75 – this result can be treated as positive. However, the values F35 (Fig. 26) and F40 (Fig. 27) cannot be considered as positive because their coefficients are rather law. Such a low result could also be obtained by selecting the wrong template. More information about the technological investigation and its results can be found in this work (Tomkus 2011).



a) b) c)

Fig. 26. Analysis of the image S5: a) full image, b) labelling of templates, c) values of correlation coefficients of templates



a) b) c)

Fig. 27. Analysis of the image S6: a) full image, b) labelling of templates, c) values of correlation coefficients of templates

Conclusions

The analysis of pattern of tablecloth in all photograph in the set encountered the same problem – there is visible only part of pattern initial data of the tablecloth. This is because the tablecloth in each photograph has different position, rotation, hanging, lighting conditions and also it is more or less covered by a person or object around. Concluding results of all photographs analysis can be said that part of the templates correspond the pattern of the tablecloth in the main photograph, but many nevertheless are different. The technological investigation did not deny the assumption of researcher about dating of photograph of album of Povilas Januševičius (Figs. 5, 6). The computer-aided image analysis application possibilities and the guidelines of future research were also shown.

In order to obtain more accurate results, this investigation of tablecloth matching could be developed in the following directions. First of all, when the region of interest is extracted from the main photograph (Fig. 21) it could be processed in order to extract more exact details in it. For this purpose the noise reduction, histogram equalization, geometrical transformations, edge detection or similar methods could be used. Second, the selection of templates (A1, A2,…) can also be improved by selecting the larger quantity and diversity. Third, additional methods of object identification should be used. These methods should be resistant to object rotation, size variations, sensitive to greyscale changes and insensitive to irregular noise. Of course, applying those three propositions the scope of calculations would increase, but at the same time more accurate results could be obtained.

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APIE GĖLĖTĄ STALTIESĘ IR XIX AMŽIAUS FOTOGRAFIJOS KOMPIUTERINĘ VAIZDO ANALIZĘ

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Santrauka

Straipsnyje supažindinama su kai kuriomis senosios fotografijos datavimo problemomis, kurios iškilo rengiant publikavimui ir analizuojant bei komentuojant prelato Povilo Januševičiaus XIX amžiaus pabaigos – XX amžiaus pradžios fotografijų albumą. Pateikiama fotografijų vaizdo, fotografijų fotokortelių analizė. Supažindinama, kaip būtų galima spręsti fotografijų datavimo problemas, derinant tyrėjo įžvalgas ir pasitelkiant informacines technologijas. Taip pat pateikiamas technologinio pobūdžio tyrimas, kurio metu buvo tikrinamas gėlėtos staltiesės panašumas skirtingose nuotraukose. Šiuolaikinės vaizdo apdorojimo ir analizės programos suteikia kokybiškai naujas galimybes, kada tampa įmanomas automatizuotas objektų, simbolių ar veidų atpažinimas ir identifikavimas.

Reikšminiai žodžiai: kompiuterinė vaizdo analizė, datavimas, XIX amžiaus fotografija, vaizdų apdorojimas, objekto identifikacija.

Nuoroda į šį straipsnį: Žaltauskaitė, V.; Žiūrienė, R. 2013. Apie gėlėtą staltiesę ir XIX amžiaus fotografijos kompiuterinę vaizdo analizę, *Limes: Borderland Studies* 6(1): 64–84.