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Intangible Heritage and Sustainable Development Strategies

Dziedzictwo niematerialne a zrównoważony rozwój

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Abstract
This paper analyses in detail the problems of protecting cultural heritage in rural regions and small towns, in traditional rural landscapes and in the context of the revival of rural settlements. The paper substantiates the necessity and possibility of measures for the preservation of tangible and intangible cultural heritage by measures of both organisational and technical nature. The international experience of safeguarding cultural heritage by organisational measures and digital preservation is considered; the need to correct this experience in accordance with local specifics is substantiated. The existing technical approaches to the digital preservation of cultural heritage are analysed. An original approach is proposed that most fully simulates complex objects such as artistic reliefs with painting – the method of synchronised laser triangulation, combined with the method of laser-induced breakdown spectroscopy.

Key words: digital preservation, preservation of cultural values, protection, modern technologies, the Middle East region
Słowa kluczowe: konserwacja cyfrowa, zachowanie wartości kulturowych, ochrona, nowoczesne technologie, region Bliskiego Wschodu

1. Introduction
Traditional agricultural landscapes are rapidly disappearing around the world, and the Middle East is no exception. Previously, this was a consequence of accelerated industrialisation and urbanisation. However, attempts to reverse the industrialisation through various projects of revitalising rural regions also pose a threat to traditional culture in recent decades. The environmental and food security implications of this trend are enormous. Politicians at the international and national levels have recently recognised this pressing issue. For example, the Food and Agriculture Organisation of the United Nations (FAO) launched the Globally Important Agricultural Heritage Systems (GIAHS) project in 2002 to mobilise global awareness and support for the dynamic conservation and adaptive management of agricultural systems (Fakhouri and Haddad, 2017). Likewise, Japan's Ministry of the Environment and the United Nations University's Advanced Research Institute jointly launched the Satoyama Initiative in 2010 to promote and support the conservation of socio-ecological production landscapes that have evolved over time through mutually beneficial collaboration, the interaction between humans and nature (Jamhawi and Hajahjah, 2017). The GIAHS project and the Satoyama Initiative represent positive steps towards harmonising the relationship between conservation and development (Zalloom and Tarrad, 2020).
At the local level, however, it is difficult to maintain a balance, as rapid socio-economic changes pose challenges for cultural heritage sites. The UNESCO global report (Culture: Urban Future..., 2016) notes that the situation with intangible cultural heritage is generally characterised by a difficult situation. There are threats to cultural heritage, and, although the problem is recognised and attempts are made to preserve the intangible cultural heritage, in the light of the growing speculation of land and the widespread privatisation of territories in settlements, public places have become the focus of efforts to preserve and restore small towns. An example is the case of the Ifugao Rice Terraces. A difficult lesson learned from the degradation of the Ifugao Rice Terraces is the lack of participation of local communities in the design and implementation of tourism development plans (IMPACT: The Effects…, 2008). As custodians of the rice terraces on which tourism is based, the share of host communities in the economic benefits of the tourism industry is disproportionately small. This has accelerated the migration of farmers, resulting

in a shortage of labor to grow and maintain rice terraces (The Ifugao Rice Terraces…, 2008). In addition, uncontrolled tourism has also caused irreversible damage to physical and cultural heritage resources (Alazaizeh et al., 2019a; Alazaizeh et al., 2019b).

In Banaue, the first tourism destination developing in Ifugao, unplanned construction projects have destroyed large areas of muyong (traditional private/clan forest areas that support irrigation water to the terraces), causing soil erosion and river pollution (IMPACT: The Effects..., 2008). In addition, the growing demand for traditional wood products has led to deforestation at the watershed. The depletion of water supplies in the rice terraces has contributed to the infestation of giant earthworms that erode the walls of the terraces and dams. The cultural heritage is also being commoditised. To satisfy the curiosity of tourists, agricultural rituals are performed at the wrong time of the year (IMPACT: The Effects…, 2008). Ethnic cultural performances are exclusively aimed at tourists and are not necessarily faithful reproductions of the culture of the host community. This confirms that tourism is in fact an *existential authenticity* experienced by tourists, not the authenticity of the places visited (Shqairat et al., 2018). Most of the performers are local residents, but only a small number of young, pretty villagers qualify for them. Other contributors to tourism-related activities include casual guides and those who run family guesthouses and gift shops. Together, they represent less than 5% of the total population of a region like Qingkou, in which the Chinese authorities have attempted to revitalise rural settlements by stimulating local tourism and exploiting local intangible cultural heritage (Cozzolino et al., 2019).

Souvenir shops are mostly owned by migrants from Dali, a well-developed tourist destination in northwest Yunnan. Few souvenirs are produced locally, indicating a lower level of community participation. Tourists who visit Qingkou are mostly of the *take photos and go* type, without much interaction with the host community. This is a key challenge for the sustainable development of rural areas of national minorities, namely, how to balance the need to preserve traditional cultural landscapes and the need to improve living standards in rural areas. Therefore, the challenge is to adopt a new strategy that will enable local residents not only to participate and benefit economically from tourism development, but also to maintain the physical and cultural landscape. Since the discussed rural communities will inevitably face challenges to the traditional way of life, it is necessary to immediately carry out digital preservation of intangible cultural heritage objects. This includes the development of new organisational approaches to continue cultural traditions also in architecture, with the development of regions.

2. Materials and methods

In the field of tangible cultural heritage, a number of studies have already addressed the potential of technology not only for conservation but also creation of innovative learning environment. And in the intangible cultural heritage sector – the number of studies related to the potential of technologies for teaching and learning is very limited. In 1990, the Digital Michelangelo project, launched at Stanford University in the United States, prioritised the digital protection of cultural heritage (Bodzek et al., 2019). Recent advances in laser rangefinder technology, combined with algorithms for combining images with multiple ranges and colours, now allow the shape and surface characteristics of many physical objects to be accurately digitised. Laser triangulation technology is a non-contact measurement method that overcomes the limitations of traditional measurement technology, offering fast scan speed, high real-time accuracy, high precision and intelligence. It has been widely used to create digital models of cultural relics. The use of laser triangulation technology is one of the most common 3D measurement methods, which usually includes a point laser and a line laser. There are two kinds of point cloud acquisition methods such as probe movement and laser wobble. The method of moving the probe consists in fixing the laser triangulation probe in the moving parts and scanning the object along the spatial movement of the moving parts. The laser swing method implements two-dimensional scanning by laser movement, rotating a vibrating mirror and other methods. However, when measuring a large-scale scene, the probe must be fixed in large moving parts; thus, the accuracy of the moving parts affects the final measurement accuracy; and if the laser oscillation method is used, the horizontal and vertical scan areas are mutually limited, which will significantly affect the scan range.

To solve the horizontal and vertical scanning limitation of traditional triangulation B. Dweik and I. Abdelkhaleq (2020) propose a synchronised scan measurement method. The receiving light and the transmitted light are synchronised by placing the scanner on both optical paths. When the scanner rotates an angle, the receiving light and the transmitted light have the same angle change. Due to this mechanism, the depth of field and the measuring range are greatly expanded. Following this technique, in the literature (Bala'awi and Mustafa, 2017; Richard et al., 2019; Kersel and Hill, 2020; Zhang et al., 2018), the characteristics of a laser synchronised scanning triangulation system were additionally studied and the general meaning of the equation of the trajectory circle, as well as the parameters of the system maximum and minimum range, distance resolution and other system parameters. In (Drzewiecki and Arinat, 2017) the accuracy of the synchronised scan triangulation system was studied and errors caused by the deviation of the system parameters, such as the mirror angle, were obtained. The authors (Cozzani et al., 2017) have developed a laser triangulation system based on synchronised scanners with LiDAR, which takes full advantage of triangulation. Triangulation can be very accurate at close range, while Pulse Ladar technology is capable of very long-distance measurements. D. Tu, P. Jin and X. Zhang (2018) proposed a new method using a prismatic optical structure to correct the nonlinear problem of measuring the displacement of laser triangulation, and the results showed that the nonlinear problem was greatly improved. Moreover, A. Ababneh (2018) has developed a three-dimensional shape measuring system with linear structure and light based on laser triangulation with automatic synchronous scanners that reduce the weight and size of the system. The above study establishes a 3D scan path circle model which is of great importance for describing a synchronised sweep triangulation measurement mechanism.

3. Results and discussion

3.1. Analysis of methods for protecting the intangible cultural heritage of Jordan

Jordan has a UNESCO-listed Intangible Cultural Heritage Region, a Bedouin cultural space in the Petra and Wadi Rum regions. To understand what may appear to be a contradiction in cultural heritage preservation policies due to the overlap of tangible and intangible heritage in Petra, we need to focus on cultural heritage as a practice first and foremost, a practice that consolidates Petra as the epicentre of the Jordanian heritage, not as an object as such. To preserve the appearance of traditional rural culture and its cultural heritage, we believe it is correct to interpret the entire set of cultural artefacts as intangible cultural heritage, since after the adoption in 2003 of the *Convention for the Safeguarding of the Intangible Cultural Heritage* a clear definition of intangible cultural heritage was given, that is, intangible cultural heritage is considered by all communities, groups and sometimes individuals as its cultural heritage. *Intangible cultural heritage* means customs, representations and expressions, knowledge and skills – and associated tools, objects, artefacts and cultural spaces – recognised by communities, groups and, in some cases, individuals as part of their cultural heritage. Such a verbose interpretation can be briefly expressed as a *way of life*, namely the way of life of the people in all its originality. It includes samples of material culture, social rituals, and industrial practices aimed at reproducing the society under discussion in time and reproducing material and intangible culture of society is intangible cultural heritage.

This intangible cultural heritage, passed down from generation to generation, is continually recreated by communities and groups depending on their environment, their interactions with nature and their history, and gives them a sense of identity and continuity, thereby promoting respect for cultural diversity and human creativity. The composition of various social practices, ideas, expressions, forms of knowledge, skills and related tools, objects, crafts and cultural objects is thus now recognised as such that it requires preservation, what has been said is also true for the cultural space of the Bedouins in the regions of Petra and Wadi Rum. The Bedouin tribes around Petra, which were resettled under the slogan of developing and protecting the UNESCO heritage in 1985, were inscribed on the UNESCO List of Masterpieces of the Oral and Intangible Heritage of Humanity in 2005. Along with the Bedouin tribes around Wadi Rum, they were chosen for their particularly rich oral traditions, nomadic pastoral skills and landscape-based religious practices, rooted in the landscape and impossible without the landscape they (especially in the case of Petra) no longer inhabit, due to the *UNESCO material heritage*. This process of using Bedouin culture or attributes in discussions about identity rather than way of life has become widespread in the Arab world in recent years, and thus the very way of life and the cultural space of the Bedouin now requires protection.

There are two types of methods for safeguarding *intangible cultural heritage*, namely revitalisation protection and development protection. Revitalisation is carried out as a government initiative, and therefore gravitates towards large-scale, iconic objects, it lacks a *community* standard of living. Therefore, intangible cultural heritage projects that relate to the daily cultural life of members of local communities should be included in the model of development protection. Since every ancient rural house, and even more so a nomad's dwelling, cannot be recognised as an architectural monument with a corresponding protected status, and the development of a settlement may require the restructuring of areas with traditional architecture, in order to preserve the cultural heritage, such an architectural tradition should be interpreted as an intangible cultural heritage.

Moreover, the traditional dwellings of the Bedouins and other nomadic tribes over the centuries have undergone a significant influence of Arab culture, but they find their individual appearance in the traditional patterns of wall painting or wood carving. Of course, models of cultural objects appeared long before digital copies. This was done as part of a simple copying of text, descriptions and images for distribution. As early as the 1970s, researchers and scientists used technologies such as photography and sound recording to record and preserve various cultural heritage sites (such as cultural relics and archaeological discoveries) (Cozzani et al., 2017). However, an image, description or even a photograph cannot capture the complex shape of such an object as carved wood, a pattern can be depicted, but the image will not convey its full shape. Also, photography will tell nothing about the chemical nature of pigments in the case of pattern recognition in wall paintings. Since the analysed object is native art, cultural heritage objects in this case can have an extremely multifaceted structure.

Historically, copies of volumetric reliefs were made by hand from the original material, but later technologies appeared based on the manufacture of a plaster model, followed by casting a copy from a corresponding material, including polymer concrete. This technology has a number of significant disadvantages. In the process of work, the original relief is exposed to significant chemical, physical, and mechanical impact. This is manifested in the fact that after the manufacture of the mould, moulding material often remains on the surface of the original, to remove which it is necessary to use alkaline washes or mechanical cleaning methods. In addition, when removing the form, damage to individual relief elements is not excluded, which can manifest itself in the form of chips or fractures of small and thin parts. In this situation, a question arises: are there any more modern, *non-traumatic* methods of copying? Recently, rapid and progressive advances in technology have opened new ways of protecting intangible cultural heritage. They allow for new user interactions, potentially going beyond the encyclopaedic approach that has so far characterised most of the ongoing projects aimed at safeguarding intangible cultural heritage.

3.2. Developing a method for digital preservation of Jordan's intangible cultural heritage

This paper proposes, as a toolkit for digital preservation of intangible cultural heritage, a synchronised scanning trigonometric model of geometric parameters based on an unfolded light path combined with a chemical analysis of the surface. The angular and absolute coordinates of various parts of the processed object are accurately described by 14 system parameters, and then the relationship between three-dimensional points in space and the system parameters is expressed. In simulation, the system error can reach 400 mm when the thickness of the double-sided reflector is 2 mm. The results of this analysis confirm the importance of the thickness of the rotated mirror. The parameters are then ranked in terms of their influence on measurement accuracy, which is instructive for system design. Finally, the experimental results show that the system can scan an object and display its point cloud. According to the triangulation principle, the coordinates are determined by the position of the converging image spot on the camera. M3 and M4 are driven by a motor to perform plane scanning. When M3 oscillates around the axis, the light spot Q scans the surface of the measured object along the X-axis; Likewise, light spot Q scans in the Y-axis direction and M4 oscillates around the axis (Figure 1). The surface of the object to be measured can be scanned when the two motors are running synchronously (Tu et al., 2019).

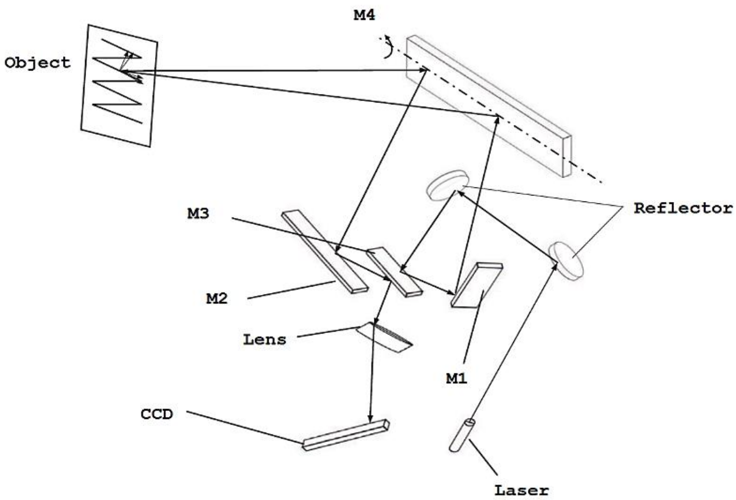

Figure 1. Schematic diagram of synchronised laser triangulation; compiled by the author

The chemical analysis method is based on measurements of the secondary emission spectrum excited during the formation and development of plasma as a result of exposure of matter to the radiation of a powerful pulsed laser. At typical plasma temperature values (10.000 ... 20.000 °K), the substance is atomised and ionised. As a result, almost all of its atomic and ionic transitions are excited. The first stage of this process coincides in time with the action of laser radiation on the plasma, in addition to the intense continuous spectrum of thermal radiation that covers the entire visible, ultraviolet, and near-IR region, the spectrum of the laser spark contains lines corresponding to multiply ionised atoms, including lines located in the x-ray area. After the termination of the laser pulse, the plasma expands and cools down for several microseconds, and then it emits the spectra of neutral and/or one- and two-fold ionised atoms. This radiation can be registered with a spectrometer, and the elemental composition of the substance can be determined from the results of the analysis of the obtained spectra. To create a laser spark on the surface of the materials under study, Q-switched solid-state Nd: YAG lasers with very short pulse duration (about 10 ns) are usually used. By using nanosecond pulses, it is possible to avoid significant heat transfer over the volume of the sample under study (there is only local heating in the focusing zone of the laser beam) and screening of laser radiation by plasma, the formation of which occurs after the end of the laser pulse.

Using the LIBS method, it is possible to determine the elemental composition of the base material of the monument, the coatings on it (for example, polychrome) or surface contamination practically without contact. The method allows studying various objects made of metal, stone, glass, ceramics, minerals, as well as paintings. Recently, interest in this method of conservation has increased significantly, mainly due to the emergence of compact portable universal instruments capable of analysing any samples with a size of 10 microns and determining chemical elements with almost any atomic number. Such analysers have high spatial resolution (both over the surface and depth), and the study itself can be carried out without any preliminary sample preparation in real time. The shape of the craters formed provides additional information on the composition of the surface layer. LIBS is an express, relatively inexpensive method of analysis and allows the registration of emission spectra within a few seconds. Moreover, in comparison with XRF, it has a higher sensitivity and allows the identification of elements with a low atomic weight. The proposed hybrid combination of laser-induced breakdown spectroscopy and synchronised laser triangulation allows to create the most complete picture of extensive historical relics, with information not only about the colour, shape of the surface of the paintings/reliefs, but also about their chemical composition, which allows to reproduce these objects in the future, even if the original structures/sculptures/murals are lost. Thus, the proposed approach most fully corresponds to the content of the practice of digital preservation of cultural heritage sites.

4. Conclusions

The present paper stated the need for digital preservation of the Bedouin cultural space in the Petra and Wadi Rum regions. Along with the need for protection, the technical possibilities for digital preservation were analysed. The authors considered the international experience of digital preservation and substantiated the need to correct this experience in accordance with local specifics. The existing technical approaches to digital preservation of cultural heritage are analysed, an original approach is proposed that most fully simulates complex objects such as artistic reliefs with painting – the method of synchronised laser triangulation, combined with the method of laser-induced breakdown spectroscopy (LIBS method). The authors believe that the laser spark spectroscopy method makes it possible to reproduce the composition of dyes with the accuracy of IR spectrometry methods with selective sample preparation, which is very good for an express method that allows automated data collection from large and numerous objects, such as rural architecture, native decorative household items, other items of native art and decoration of the cultural space of nomadic peoples. Having tested the elements of the proposed approach, the subsequent studies will involve a large-scale field data collection, but in view of the vastness of the work front, the authors want to encourage other researchers to join the work.

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