

## Research Article

# Digital Technology of Image Acquisition System of Microscope and Its Application in Digital Protection of Grottoes Art

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Received 26 May 2022; Revised 2 July 2022; Accepted 9 July 2022; Published 12 August 2022

Academic Editor: Imran Shafique Ansari

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Grottoes are the cultural heritage left by ancient people to modern people, and murals in grottoes can leave a lot of information. In order to further improve the relevant information of grottoes and meet the needs of various applications of images, this paper studies the application of digital technology of image acquisition system of microscope in the digital protection of grottoes art. In this study, the digital technology of the image acquisition system of the microscope is used to collect the photos of the grottoes, and then, the photos without the microscope image acquisition system are compared. At the same time, the electronic equipment is used to carry out local measurement and real scene shooting to supplement the scanning data, establish the grottoes database, and then carry out a questionnaire survey on the development of the popularity of grottoes art on the social network. The results of this study show that more than 90% of the people do not know much about the art of grottoes, but they have a positive attitude towards its value and interest. In addition, this study uses different splicing methods to get the panorama of the two grottoes, with the reduction degree of 80%, 89.4%, and 78%, respectively, which better shows the art of the panorama of the grottoes sculpture. It can be seen that the digital technology of the image acquisition system of the microscope can better collect the photos of the grottoes, improve the accuracy and splicing accuracy of the photos, better restore the status quo of the grottoes, establish the art database of the grottoes, achieve the purpose of spreading and promoting the art and culture of the grottoes and digital protection of the grottoes, and inject a helping hand into the internationalization of the folk art of our country.

## 1. Introduction

Grottoes are a special carrier of Chinese cultural information. However, many grottoes have been eroded because of their age and exposure to the outdoors. After years of baptism, they have become art treasures of human civilization. Therefore, we must protect the art of grottoes effectively. In recent years, with the rapid development of China's tourism industry, many grottoes have been deformed and damaged in varying degrees under the influence of human factors and natural damage, and the existence of grotto art is facing severe situation and challenges.

Through this study, we understand the development situation of digital technology, solve the problem of information preservation, make information records more comprehensive, and provide information resources for the protection of grottoes art in different regions. This study not only opens up a new way to protect the grottoes, but also

creates favorable conditions for the long-term preservation and comprehensive record of the grottoes information. On the basis of respecting the authenticity of the grottoes, it helps us better complete the protection and display of the grottoes, which is of great significance to the digital protection of the grottoes art.

In order to understand the impact of Mogao grottoes on the environment, Shang used PHOENICS software to simulate the Mogao grottoes and compared the wind environment belts in front of the Mogao grottoes forest and the whole green space in the forest, so that people can further understand the relevant information of the grottoes. The research of Shang is lack of powerful data results, which is of little reference value [1]. In order to realize the digital protection of cultural heritage of Mogao grottoes in Dunhuang, Tu uses a three-dimensional modeling time design method of real scene based on four-camera vision system. Aiming at the problem of low matching accuracy of feature

points in the binocular stereo vision system, it proposes a four-camera stereo vision system and its high-precision stereo matching strategy design, and redundancy of using four-camera vision system design and self-check function to obtain high-precision spatial point cloud data. This study proves the importance of digital protection in grotto art protection, but it lacks certain economy [2]. In order to solve the optical alignment problem of slit lamp drum, Hua used the principle of transmission alignment system to add cross lines before and after the detection of optical path, judges the alignment quality by observing the imaging of two cross lines in the charge coupled device (CCD) image, and extracts the midpoint coordinates of the two cross lines. To some extent, this research has important reference significance for the digital method of how to use image processing technology to transform alignment information into digital information [3]. Rashidzadeh-Hiva used three-dimensional simulation technology to study the color of ancient murals, and his research method can make the restoration degree of murals reach more than 80% [4]. It can be found that their acting skills focus on using digital equipment to collect and restore the information of grotto murals. But few scholars highlight more details through microscope equipment.

This study makes full use of modern technology and digital technology, through the research of digital technology of image acquisition system of microscope, using electronic equipment to carry out local measurement and real scene shooting to supplement scanning data and establish the grotto database. At the same time, through the collection of relevant information at home and abroad, a questionnaire survey on the development of grotto art popularity meter was carried out on social networking sites to observe how to better digital protection of grotto art.

## 2. Related Theories of Grottoes

*2.1. Concept of Grotto Art.* As a form of Buddhist architecture, grottoes refer to Buddhist temples that cut out grottoes on hillsides and cliffs. They are places where people carry out religious activities. At first, Chinese grottoes were carved in imitation of Indian grottoes, and most of them were built in the Yellow River valley in northern China. China's grottoes have a long history and are widely distributed, mainly in 20 provinces and regions including Xinjiang, Ningxia, Gansu, Shaanxi, Shanxi, Inner Mongolia, Liaoning, Henan, Hebei, Shandong, Jiangsu, Zhejiang, Fujian, Jiangxi, Hubei, Guangxi, Yunnan, Sichuan, Qinghai, Tibet, etc. Longmen grottoes, Mogao grottoes, and Yungang grottoes are also called the three major grottoes in China, and later Maijishan grottoes are called the four major grottoes. The number of Longmen Grottoes not only ranks first among the major grottoes in China, but also is rated as "the highest peak of Chinese stone carving art" by UNESCO. However, the grotto art in different places has its own particularity. For example, due to the geological conditions, the Buddhist grotto frescoes mainly appear in Xinjiang and Gansu areas where grotto carving cannot be carried out. After comparison, we found that there are two main types of cave murals: Kizil grottoes in Xinjiang and Mogao grottoes

in Gansu. Their rich contents are of high artistic and historical value, showing rich aesthetic, wonderful, and profound concepts.

### 2.2. Characteristics of Grotto Art

*2.2.1. Grotto Art Tends to Secularity.* Buddhist believers are often very serious about making statues of Buddha statues and grottoes, and their themes are often carried out in strict accordance with certain norms. Generally speaking, the highest norms are Buddhist classics. Buddha's eyes, ears, mouth, nose, eyebrows, canopies and lotus seats, human body lights and object lights, etc. must be created in strict accordance with the Sutra. With the development of society, people's ideological understanding and emotional state are constantly changing. In order to better connect Buddhism with people's specific living conditions and give full play to the role of "spiritual unity" of Buddhism, people have gradually changed the lofty situation of Buddhism, made great changes to grottoes statues, made the artistic style increasingly materialized, and began to secularize Buddhism. And the process of nationalization reflects the trend of secularization, which is the inevitable result of the development of Buddhist art to a certain stage. In the early grottoes, the external characteristics are very strong, with a clear trend of secularization of the Chinese nation. After the end of Tang Dynasty, the rise of Dazu grottoes, on the basis of the deep accumulation in the past, has a new development and transcendence, making the nationalization and secularization of Chinese grottoes to a peak [5]. It absorbs the essence of Indian Gandhara art, integrates the traditional techniques and aesthetic taste of Chinese painting and sculpture, reflects the Buddhist thought and its sinicization process, and is a precious material for studying the history of Chinese society, Buddhism, art, and cultural exchanges between China and foreign countries.

*2.2.2. The Strong Scientific Nature of Grotto Art.* The grotto art serves religion, but it is precisely because of the foundation of religious science that the grotto art is more exquisite. The most outstanding grotto statues were developed on the basis of the excellent grotto art in the past. They absorbed those successful artistic creation methods seriously, and at the same time, combined with their own local characteristics, the spirit of the times, and the pursuit of religious ideas, they carried out new exploration and innovation of religious art. First of all, in terms of artistic modeling, human body modeling is more in line with the principles of physiological anatomy and closer to reality than before. When Buddhism was introduced into the world for the first time; it completely changed the rough description of human body, structural imbalance, and the lack of form and spirit. It also transcended the situation that the flourishing divinity of Tang Dynasty was equal to or even greater than human nature. It makes religious art rich in human nature and greatly enhances the affinity of religious art. Secondly, sculpture emphasizes the plot and has rich artistic expression, among which Baoding large-scale group painting cattle

painting should be a model. Thirdly, it explores the theme of sculpture and produces new artistic forms. For example, Confucianism, Buddhism, and Taoism are all unique. Although the theme of “thousand hands Guanyin” is not new, it is a masterpiece of its kind. Secondly, the height of the thousand handed Avalokitesvara is no more than meters. The Avalokitesvara hands are as dense behind it as peacocks open their screens. Each of them is carved in exquisite, beautiful, and unusual ways. It is a rare work of art, which shows that the secret religion of the Han emperor did not develop into a crazy religion at the beginning. Fourth, the artistic expression field of “hell change” is extraordinary and unique. When we roam in the wide and profound grotto art world and think deeply and rationally about all kinds of masterpieces, we can easily find that the extraordinary artistry of grottoes has always been closely combined with the lofty scientific spirit, and there is a strong science behind the main artistic expression of many classic works, which is the fundamental reason why caves have been colorful for thousands of years, and as time goes on, they are more and more amazing [6].

*2.2.3. Planning and Flexibility of Grotto Art.* The most planned and flexible grotto in the grottoes is a cliff statue mainly in charge of by Zhao Zhifeng, a monk of the Southern Song Dynasty. It is called “infinite advantages and virtues” in Baoding grottoes. In general, all the statues are well-designed, rich in content, and large in scale, just like a huge picture. Although there are hundreds of grottoes in China, so far, no other grottoes have been found that can achieve such an effect except for the Dazu Baoding grottoes, which have not been built by a person from the beginning to the end according to a certain overall design. As the center of Buddha statues, the big Buddha and the small Buddha are the inner and outer Daoists of the tantric Daoists, respectively. From the conception of statues to the concrete modeling, the small Buddha statues are almost the “blueprint” of the big Buddha statues, which can clearly reflect the macrodesign of Dazu grottoes art. On the other hand, these statues show considerable flexibility in the specific development process. First of all, the contents of the extremely rich grottoes are arranged in groups according to different properties, which are organically linked with each other, and they are very careful in starting, bearing, turning, and closing details, while most statues are extremely exquisite in terrain selection. From the aspect of design and creation techniques, Dafuwan statue is suitable to use the natural environment and cliff stone scenery and construct according to the situation. The statue carved on the high cliff has completely exceeded the propaganda scope of Buddhism feudalism superstition. This is a unique sculpture consciously created by sculptors and also an art masterpiece of Baoding statue, especially the flute performance part. Carving is bold, thoughtful, and imaginative, dares to create and break through Buddhist rituals, and closely integrates with the reality of life. From a certain point of view, this is the embodiment of the organic unity of planning and flexibility [7].

### 3. Image Acquisition System and Digital Protection

*3.1. Digital Image Acquisition System.* The main functions of the image acquisition and processing system include SCM controlling ISP-PLD device to realize high-speed image acquisition and storage of the camera, image compression of SCM, and serial communication of PC to realize image data transmission and image processing and display on PC. Digital image acquisition system is the front-end part of image signal processing system, which is widely used in industry, agriculture, military, and medicine. As the core part of the digital microscope, the quality of the digital image acquisition system will directly affect the quality of the final image and the performance of the digital microscope. Its resolution, field of view, and other performances as an important index of the performance of the digital microscope will also affect the size and clarity of the image collected by the digital microscope. At the same time, the image acquisition system can realize the image acquisition, display, and storage functions of the digital microscope and expand the functions of the system by loading the corresponding application programs, such as obtaining images through the network, remote control of the system, image processing, etc., with the characteristics of high integration, high cost performance, small volume, small power consumption, low cost, etc. And it can reflect the digital, video, and network development trend of the new microscope.

In the image acquisition and processing system, the system design usually follows three design modes: hardware acquisition and software processing mode, separated hardware acquisition and processing mode, and integrated hardware acquisition and processing mode. The three schemes have their own characteristics and are suitable for different occasions. The image acquisition and test system is mainly to complete the test of infrared tracking device, including the acquisition of high-speed infrared image data generated by infrared tracking device, various analog signals, and state control signals. In the actual development and test process, the image signal, state signal, and analog signal are generated independently, so it is necessary to be able to synchronously collect the image data generated by the seeker and the state control signal of the product and display and store the image and state in real time with the help of the powerful calculation and storage capacity of the industrial control computer and provide a complete postevent data analysis function. The image acquisition system mainly uses pxi-1422 high-speed image data acquisition card combined with image data format converter to complete high-speed image acquisition and transmits high-speed digital image to computer through optical fiber. Because the acquired counterpart is high-speed digital image, the average transmission rate is more than 7 MB/s, and the continuous storage time of image is more than 100 min according to the design requirements. In the process of data storage, through virtual memory technology, image data and state data are saved in a unified time scale, which successfully completes the long-term storage of massive data without losing frames. At the

same time, the system can separate and combine the image data and the product state signal. In addition, RS-422 serial port communication is configured. The system can test the product state signal independently through the computer, including collecting the state signal and issuing the control and motion instructions. In the combined test, the image data and the state data are combined into a unified data frame. In the form of LVDS serial data collection, the industrial control computer and PXI front-end chassis realize real-time data transmission through optical fiber, real-time display, and storage of image data and state data; in the software system, the image data can be transformed with different gray levels through specific algorithms, and the state data can also be decoded, in order to achieve flexible transformation between different product test modes [8].

### 3.2. Digital Protection

*3.2.1. The Reason of Digital Protection.* With the rapid development of global digitalization, the application field of digital technology is becoming more and more extensive. The application of digital technology in the field of art has made great changes in the traditional forms of artistic expression. A variety of forms of artistic expression quickly come to people's eyes through the spread of the network, which greatly improves people's artistic feelings in life. With the rapid development of information technology, digital image art is also making continuous progress. The application of digital technology in the field of art, especially digital image art, is widely known. However, with the development of production technology, the acceleration of social modernization, and the continuous development of urbanization, fundamental changes have taken place in the mode of production and lifestyle. The mode of production, lifestyle, folk customs, and farming culture/folk art are disappearing rapidly. These phenomena spread all over the world, causing widespread concern, which makes people's awareness of folk culture protection gradually enhanced, for example, in recent years, the rise of "intangible cultural heritage protection." From the central government to the folk researchers, everyone has invested a lot of energy in the protection of folk culture, explored various ways to protect folk culture, and summed up the experience for reference. As a treasure of human civilization, folk art attracts many researchers' attention on how to protect them. Therefore, after the arrival of the era of "all media," a new protection method of folk art came into being, Digital Protection [9]. It is precisely because of the characteristics of digital protection, such as transmissibility and replicability of data, that the protection of grotto art has gradually changed into digital protection.

*3.2.2. The Role of Digital Protection.* At present, the folk art in our country is facing a severe situation and needs to be protected urgently, but the traditional means of protection can not meet the actual needs of today's cultural and art protection. With the rapid development of science and technology and computer technology, digital protection is

replacing the traditional technical means and becoming a new way of folk art protection. The so-called digital protection is to apply digital information technology to the rescue and protection of folk art. With the help of digital photography, three-dimensional information acquisition, virtual reality, multimedia, and network technology, a comprehensive digital system based on computer network is established to realize the protection, inheritance, and development of art and culture. Digital protection is a new way to protect material and intangible cultural heritage. Different from traditional cultural heritage, it presents a variety of ways of thinking, such as the following: It uses digital information to save data, which greatly reduces the complexity of preservation. In the past, traditional techniques such as writing, recording, photographing, and video recording have been playing an important role in the protection of folk art for a long time, and much valuable cultural heritage has been preserved for human beings. However, the effective digital protection technology like the present will make the storage of modern data safer, more efficient, more reliable, and longer. As long as we copy at a specific time, we can get the same digital files or articles and have practical operability and technical basis, which will play an effective role in promoting the preservation and inheritance of grotto art [10].

*3.2.3. Digital Development.* With the rapid development of information technology, the international digital information standards are becoming more and more mature, the integration technology of digital resources has made a breakthrough, and the technical problems of folk art digitization have become increasingly simple and standardized. The purpose of digitalization is to better preserve and spread folk art, so that more audiences can appreciate and develop it. Therefore, the digitalization of folk art can only meet this requirement if it is produced and preserved according to certain norms and unified technical standards. The state has issued relevant standards on digital issues, which is the first thing to be paid attention to in the digital protection of folk art [11].

*3.3. Digital Protection Measures of Folk Art.* In the process of digital protection, we strive to achieve complete protection, so we need to use different digital methods to protect different types of folk art. For space folk art, it is mainly recorded with pictures and then processed and saved digitally. For civil architecture, sculpture, paper cutting, weaving, embroidery, etc., it can be saved digitally with pictures. If the video data of production process can be collected, the effect will be better. Use video data to save dynamic folk art, such as facial sculpture, shadow play, lion dance, folk opera, etc. Language arts such as folktales, riddles, and fables can be transformed into text data, which can then be stored digitally. Although digitalization is the main measure to protect folk art, in fact, digitalization is not omnipotent to protect folk art, and there are many difficulties and problems in the process of protection, which can only let our future generations see brilliant image and sound

materials. Folk art is different from the experience of folk culture. If we do not invest a lot of manpower, material, and financial resources to protect the survival soil and cultural space of folk art, we will lose the foundation of folk art. Therefore, we need to strengthen the foundation for the survival of folk art, not only the support of the government and the protection of the society, but also the wide demand of the art market. Therefore, let folk art become a part of our life, which is the real key [12].

## 4. Experimental Design

### 4.1. Test Form

*4.1.1. Questionnaire Investigation.* A questionnaire survey on the development of the popularity of grottoes art was carried out on the social networking site. The distribution object is randomly distributed to the net names who love the grotto art and those who do not. Whether you love grotto art or not is judged by whether you pay attention to one or more grotto art-related self-media accounts on social networking sites. There are 10 questions in the survey, which mainly focus on the attitude and understanding of everyone to grottoes art, the future of grottoes art, and the value of today's society.

*4.1.2. Digital Technology of the Image Acquisition System of Microscope.* By using the digital technology of image acquisition system of microscope to collect the photos of grottoes, then compare the photos without using the image acquisition system of microscope and, at the same time, use electronic equipment to carry out local measurement and real scene shooting to supplement the scanning data. Use the portable scanner to scan and draw the local position and hidden part of the cave. When the scanning angle of the cave is too small or the elevation angle is too large, use the handheld photoelectric distance meter to measure the specific size of the feature points as the supplementary data and point cloud data of the map, so as to facilitate the postprocessing, processing, and modeling of the data. These data can be used as a reference for data modeling, as well as a library resource for color and texture matching of point cloud data. Using the same postsplicing, processing, and compositing techniques, two new digital panoramic images of grottoes can be obtained. At the same time, the hard disk camera is used to capture the scanning scene and target, so as to record the scanning process and scanning scene. Finally, the influence data of grottoes art is analyzed.

### 4.2. Data Acquisition Method in the Early Stage of the Experiment

*4.2.1. Literature Search.* According to the determined research direction and object, consult a large number of literature about grottoes, collect cases of grottoes art protection at home and abroad, during the writing process, collect relevant information through the network, timely understand the domestic and foreign dynamics and development

in this field, collect and sort out relevant theories, clear the research purpose, and lay a solid theoretical foundation for the research. Consult related books on architecture, history, legend, local chronicles, and art as theoretical support. And understand the history and major events of Buddhism and related religions, so as to better understand the grotto art.

*4.2.2. Data Collection and Field Investigation.* In addition to on-site data collection, historical data related to grottoes should be collected, including building age, maintenance records, defects, historical data, folk stories and legends, customs, national characteristics, and religious beliefs. Collect and sort out the previous research and mapping results of grottoes digitization, proofread the previous results, accumulate first-hand and second-hand data, and finally form a complete digital information database of national buildings after the later data processing.

*4.3. Experimental Equipment.* In order to make full use of our existing photographic equipment and take high-quality images in a limited space, after careful calculation after all-round and multiangle analysis and measurement of the East-West depth and North-South transverse width of the cave, the final selected photographic equipment is as follows: the digital camera is Canon EOS-1 dsmarklll. The film camera is horsemam45fa. The film is a light 120-color reverse film with a film size of 6 cm × 9 cm. This choice can maximize the preservation of some details of the grotto art, and the camera used in this paper is also a device with more accurate tone.

### 4.4. Key Points of Experiment Process

*4.4.1. Experimental Alignment and Pointing.* Fixed-point photography is a way to photograph the grottoes with the same camera standing in the same place and direction. Alignment and fixed-point shooting are the important foundation of high-quality splicing in the later stage. First of all, in order to ensure the accuracy of shooting and the consistency of various data, and to ensure the accurate splicing of individual images, the photographer laid a 15 m long track parallel to the statue in the center of the cave and placed the camera on the track while keeping the height and angle of the camera consistent. Considering the need of later splicing, the exposure time, focal length, and aperture must also be completely consistent. Secondly, the vertical view can cover the body of the statue and the upper edge of the Buddha platform and has a smaller range span. According to the light intensity required for the statue shooting, we use 3200 K reflective artificial light source. The direction of light distribution is similar to the natural light of caves. In order to fully display the level and texture of the statue, better reflect the details and three-dimensional sense of the statue, and create the space atmosphere where the statue is located, we choose and set the angle, height, and intensity of the reflector according to the characteristics of the statue, and the angle of the light source adopts the side light source.

**4.4.2. Choosing the Best Aperture for the Lens.** The function of aperture is to determine the amount of light entering the lens. The smaller the value behind  $f$ , the larger the aperture and the more the amount of light entering. In the collection of image information, if the local information is lost and deformed and the definition of detail information is reduced, the quality and available value of image works will be affected. Therefore, it is very important to select the best aperture, improve the resolution, and control the depth of field. The aperture size plays a decisive role in controlling the depth of field of the statue. Although the depth of field of the statue can be well controlled by reducing the aperture, the diffraction of light will have a negative impact on the reduction of the aperture. Therefore, when photographing sculpture, we should not only consider its depth of field, but also use too small aperture to affect the resolution of the image.

**4.4.3. Improving Image Quality.** Noise reduction is another factor that affects image quality. In order to further improve the image quality, in the early shooting and postprocessing, the noise reduction ratio continues to improve. The storage format used by the camera in the early shooting is the original format, and the noise reduction function in the camera has no effect on the original file. How can the problem of noise reduction be solved? We have looked up the relevant data and conducted many experiments on the spot. We have come to the conclusion that it is better to use special post software instead of using the camera's own noise reduction processing, because the noise reduction function of post software has greater adjustment space. The following process can be used to process digital image denoising: first, the original format image is converted into JPEG and TIFF format by the corresponding manufacturer using the original format processing software; secondly, the converted image is denoised by software; finally, a more ideal image is obtained. Moreover, based on modern deep learning technology, high-quality noise reduction can be carried out on photos through software.

## 5. Analysis and Discussion of Experimental Results

### 5.1. Analysis of Questionnaire Results

**5.1.1. An Analysis of the Understanding Degree of the Public Grottoes Art.** Is the grotto art known to the public? The results of the questionnaire survey on the understanding degree of the contemporary society are shown in Table 1 and Figure 1. From Table 1 and Figure 1, it can be seen that the number of people who understand grotto art and the number of people who generally understand grotto art are far lower than the number of people who don't understand grotto art, and the proportion of people who don't understand is also lower than the proportion who understand. Through the results of the questionnaire, we have basically understood the public's understanding of the grotto art. Among the 550 people who took part in the questionnaire survey, 10, that is, 1.82%, said they knew the art of grottoes very well, 50 said they just knew it

TABLE 1: Public understanding of grotto art.

Understanding	Number of people	Proportion (%)
Very well understood	10	1.82
General understanding	50	9.09
Basically do not understand	390	70.91
Do not understand	100	18.18

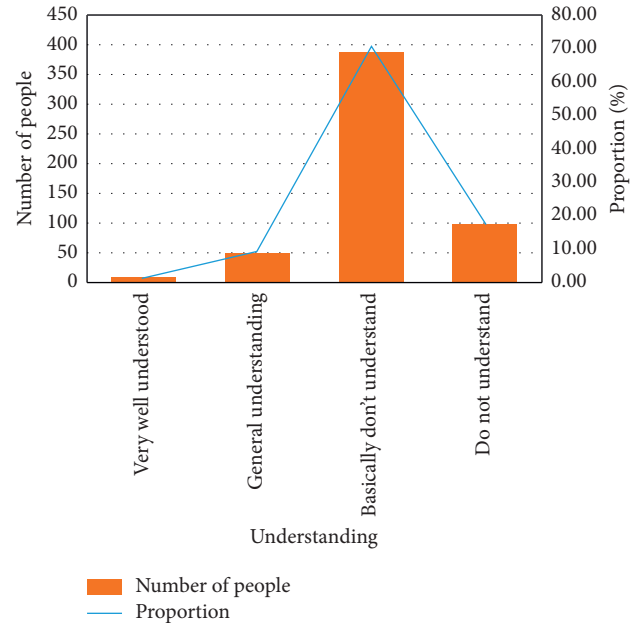


FIGURE 1: The trend of understanding of grotto art among the public.

in general, 390, that is, 70.91%, said they did not know the art of grottoes, and 100 said they could not understand it directly or even never heard of it. This shows that everyone has a low understanding of grotto art, so we should promote and publicize grotto art more, so as to better promote the implementation of its protection work.

**5.1.2. Attitudes and Views on Grotto Art.** The data of attitudes and views on grotto art are shown in Figure 2. It can be seen from Figure 2 that, from the perspective of the citizens participating in the survey, their attitudes towards the art of grottoes are as follows: 50% of the citizens are very interested and 50% are more interested; for their views on the future of the art of grottoes, they all say that the art of grottoes will gradually be promoted and respected by the Chinese people and even people around the world: for the current social application value of the art of grottoes, 100% of the citizens say it has practical value and also express that if they have the opportunity to experience and learn the art of grottoes in person, they will be very honored. Understanding the spiritual value of Chinese Grotto Art is not only conducive to the correct understanding and practice of contemporary Chinese mainstream cultural standards, but also conducive to the common efforts of the whole nation, the establishment of modern art value system, and the continuous development of the value of traditional art spirit in the spiritual civilization construction of modern society. Today, the development of

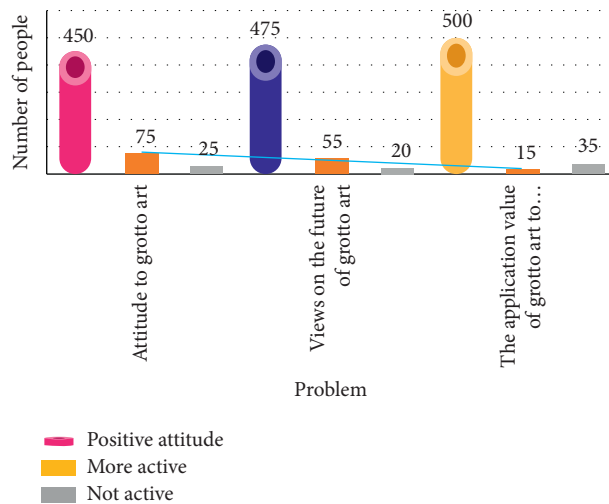


FIGURE 2: People's views and attitudes towards grotto art.

grotto art still has important practical significance, because it inherits and develops the traditional mainstream values.

## 5.2. Application Analysis of Digital Technology Research of the Image Acquisition System of Microscope in Digital Protection of Grottoes Art

**5.2.1. Shooting and Protection of Grotto Art.** In order to show the panorama of the three grottoes to the audience, meet the various application needs of the image, and make the color of the grottoes murals and sculptures stable and accurate in the later stage, we set up the color space of the digital camera in the early stage of shooting, control the exposure, and identify the color of the color card obtained by the computer software. When the average value of white RGB in the color card is 235–245, white is the normal visible pure white, which means that the exposure of the camera under the field light source is accurate, and the color of the picture can be really displayed. We will add Kodak standard color card to every photo we take, so as to provide accurate color temperature basis for the conversion of original documents in the future. Only by recording the grottoes and understanding their actual situation can we better protect them digitally. The specific data parameters are shown in Table 2.

**5.2.2. Influence of the Image Acquisition System of Microscope on Virtual Simulation Restoration of Grottoes.** In order to strengthen the digital protection of grottoes, we should actively restore the virtual simulation of grottoes and select appropriate simulation technology to restore or copy the grottoes according to the actual situation, so as to realize the digital protection of grottoes art. Therefore, we need to copy and restore the real situation of the grottoes, through the use of the digital technology of the image acquisition system of the microscope to collect the photos of the grottoes and then compare the photos without the use of the microscope image acquisition system. The

photos using the digital technology of the microscope image acquisition system are shown in Figure 3, and the photos generally collected are shown in Figure 4.

It can be seen from Figures 3 and 4 that the photos using the digitalization technology of the microscope image acquisition system are clearer and have a higher degree of reduction, while the photos without the digitalization technology of the microscope image acquisition system are blurred and unclear in color and details. The color management of image processing is closely related to the color management in the process of preshooting and post-processing. Although the color is the response of the human eye to the light, in the digital works of grottoes cultural relics, the human eye cannot process the subjective impression, so it needs to accurately and objectively carry out the image collection and processing through the digital technology and color management of professional microscope image collection system. In this way, the grottoes can be repaired better, the virtual simulation restoration of grottoes can be completed actively, and the digital protection of grottoes art can be realized better.

**5.2.3. Grotto Art Splicing.** Because the statues and murals are not on the same plane, which can not show the art of the panorama of grottoes sculpture well, we use digital technology to splice the grottoes, and the splicing accuracy and restoration of various projects are shown in Figure 5. It can be seen from Figure 5 that the splicing accuracy of Buddha statues is 2 mm, the splicing accuracy of murals is 4 mm, and the splicing accuracy of facade is 7 mm. According to the different splicing accuracy of various types, the splicing accuracy of Buddha statues, murals, and facade is, respectively, 2, 4, and 7. We use different splicing methods to accurately find out the position of the overlapped part in the adjacent two images, determine the transformation relationship between the two images, and finally carry out local alignment, global adjustment, and mosaic fusion to get more intuitive picture data than other methods and get the



TABLE 2: Shooting parameters.

Camera type	Aperture	Shutter speed	Color temperature	Photographing distance	Camera lens	Sensitivity
Film camera	f/15–f/20	1 s	3200 k	4 m	85 cm	65
Digital camera	f/17	3 s	3200 k	4 m	40 cm	99

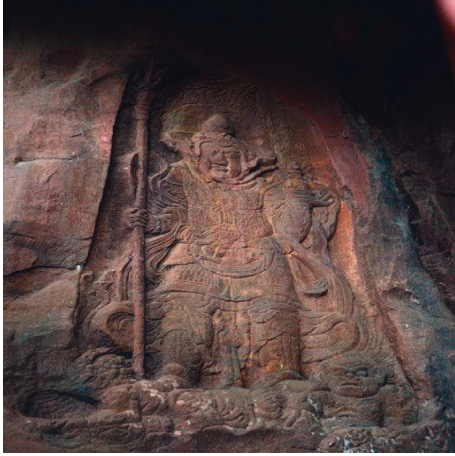


FIGURE 3: Photos with digital technology of the microscope image acquisition system.

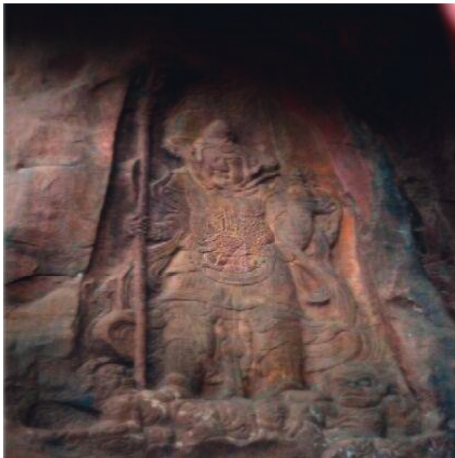


FIGURE 4: General collected photos.

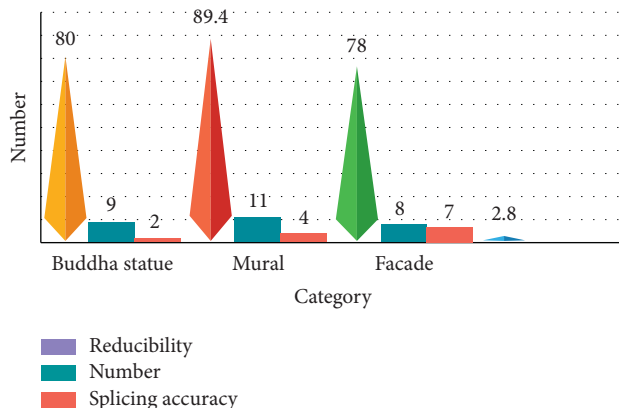


FIGURE 5: The splicing precision of grotto art projects.

panorama of the two grottoes statues, with the reduction degree of 80%, 89.4%, and 78%, respectively, which better shows the grotto carving, the art of creating a panorama.

## 6. Conclusions

Grottoes have a high artistic achievement and scientific value, with lofty status and various types, but with the acceleration of urbanization process and the continuous development of township construction, many grottoes in the world are damaged by man-made wars, natural disasters, the passage of time, and historical changes. How to effectively protect the existing grottoes, through the hard historical test, is a very important task to make these national architectural treasures glow. Therefore, we must study how to better protect the grotto art through research.

A questionnaire survey on the development of the popularity of grotto art was carried out on the social network, focusing on everyone's attitude and understanding of grotto art, the future of grotto art, and the value of today's society. At the same time, by using the digital technology of microscope image management system, electronic equipment was used for local measurement and real scene shooting to supplement the scanning data, so as to facilitate the construction and preservation of grotto art database.

Through the research, it is found that most people still do not know much about the grotto art, but they have a positive attitude towards its value and interest. Because of the protection of national architecture and cultural heritage, there is no need to have a scientific record file as the basis. We can also establish the grottoes database through the technical support of graphic management collection technology, dimension laser scanning technology, etc., to better realize its digital protection.

## Data Availability

This article does not cover data research. No data were used to support this study.

## Conflicts of Interest

The author declares that there are no conflicts of interest.

## Acknowledgments

This work has been supported by the Social Development Project of Tackling Key Scientific and Technological Problems of Henan Provincial Department of Science and Technology in 2022.



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