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Applications of image processing algorithms on the modern digital image processing technology

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Abstract
Digital image processing technology is one of the most vital areas of computer science discipline. Its application areas involve computer-aided design, Fourier transformation, three-dimensional simulation technique, applied physics and other industries. With the help of advanced computer hardware performances processing algorithms are taking a vital role in the advancement of up-to-date digital image processing technology. Findings of this research article focuses on the up-to-date digital image processing technology and its applications status through appropriate mathematical transformations and allied supporting tools.

Keywords: Digital Image Processing, Fourier Transformation, Three-Dimensional Simulation, Applied Physics

1. Introduction

Digital image processing is the application of computer technology embedded with appropriate mathematical transformations to sharpen an image, enhancement, recovery, segmentations and so on. The advancement of computer network technology has led to the improvement and modernization of digital image processing. To sharpen an image high frequency component, need to be emphasized more. The wise implications of mathematical transformations and constant demand of digital image processing technology from different industries across the globe has brought new opportunities for digital image technology and provided advancement in society. For the first time digital image processing technology was used in 1920. Those days cables were used to transfer photos between the U.K. and U.S.A. However, the quality of transmitted images on those days was not very good. Thus, the requirement of quality improvement and optimization of transmitted images pursuit. Until 1970 the digital image processing technology had not been so improved to catch the eye. The study of digital images in this era was also incorporated with a pattern recognition system. The continuous development of technology and its applications to various fields helps to increase the requirements of appropriately developed image processing algorithms to accelerate the development of digital image processing technology.

1.1 Outline of digital image processing technology

Digital image processing refers to the process of transforming an image signal into a digital signal and finally processing through a computer. This process involves image enhancement, reduction of noise, segmentation, encoding, compression, restoration, acquisition and extraction of features. Digital image processing cannot be developed without developing the image processing algorithms. In 1960 digital image processing technology began to be applied more scientifically and used to perform idealized processing of output images. Modern digital image processing technology due to advancement in image processing algorithms has better reproducibility. Comparatively to the traditional analog image processing technology, digital image processing is more acceptable not because of storage, copying or transmission in image processing, the cause is the change of image quality. Here the occupied frequency band is wider. Another important characteristic of digital image processing technology is the acceptable applicable width. Here data sources can be found from various sources. Digital images can be processed from microscopes to astronomical telescopes. Due to the high flexibility provided through appropriate image processing algorithms, digital images can be used as long as they can be expressed through mathematical transformations and mathematical logic.

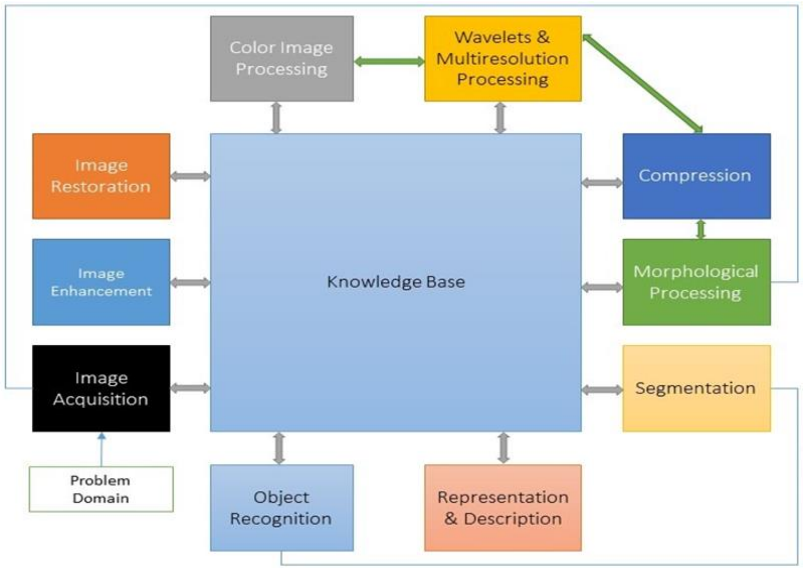

Fig 1: A schematic diagram of digital image processing (Outputs are the image attributes)

2. Characteristics of digital image processing technology

Reproducibility is good: It saves and records image information in binary format. If the original information is exact, the processing of copying the image will not have any influence on the indigenous image, and hence could lead to the real information.

High processing resolution: It differs from analog technology, in analog technology it records information in the form of pixel lattices. Thus, the storage correctness of an image mainly depends on the number of quantization bits used in the conversion and the current digital image. It can have 8, 12, 16, or higher.

Wide range of applications: It can be derived from a variety of sources, from microbes to space images, from human skeletons to lakes and mountains. Without being limited to the target's environment, they can correctly reflect their objective appearance and size. All these images can be processed by the same processing method.

Flexible processing: Traditional analog images are limited by the optical principles they generate, and hence cannot be processed analogously to people's wishes, and can only be processed linearly; whereas digital images are different, they can be used for any operation including linearity. Operations and non-linear operations greatly increase the pliability of processing and make processing much more easily.

Large compression space: Since it records and preserves information in the form of pixels, the pixel points of the brother-in-law image are not uplifting by each other, but there is some kind of relationship. As long as this link is identified, a certain means of recording can be used, without recording pixel by pixel, henceforth compressing the storage space. Especially for large images, the contents of the two frames before and after are often not very different, with more than 90% of the data being the same, and the compression ratio can be very large.

3. The acquaintances of digital image processing technology

Acquisition of Images: From the image point of view we must first obtain the image. From the outlook of the imaging sensor, there is a general TV camera that can obtain general visible light image signals; there is an infrared camera that captures infrared specifically the image that has a high practical value in the military; there are acoustic wave imaging, the use of material acoustic parameters on the impact of acoustic wave propagation, can obtain information and images of the internal structure of the opaque object; with x-ray imaging, the use of objects to the penetration of x-rays, different sex, obtain information on the internal shape of the object; have γ-ray imaging, use the imaging of γ-particles in the isotope to obtain information on the function of human organs, detect normal or abnormal function of human organs, and use nuclear magnetic resonance imaging to take advantage of the curve changes of different substances NMR (Nuclear Magnetic Resonance), Get information on changes in human organs and more. These imaging techniques are very easy to use 2D imaging information, using tomography and other technologies, into 2D and 3D images. The development of these technologies has an extremely important role in the medical, military, and industrial development.

Image Enhancement and Recovery: The acquired images often have various distortions and disturbances. For example, there are defects in the imaging device. For example, if the bandwidth limitation causes image blur, and the inevitable thermal noise in the imaging process and various interference noises from other interference sources, etc., in order to obtain good quality images required for people's observation processing, it is necessary to introduce image processing. This includes image enhancement and image restoration. The enhancement of the image is the use of enhanced contour edges for grayscale and color transformations, making the image more suitable for people's needs of observation and processing. The complex principle of the image is to eliminate or reduce the damage and degradation of the image caused during image acquisition and transmission. This includes image blur, image interference, and noise, and the original image is obtained as much as possible. Image restoration is often a difficult and complex inverse filtering process. Especially when the process of causing image degradation is more complicated and difficult to predict, image restoration is more difficult to perfect. Regardless of whether the image is enhanced or restored, all the pixels of the entire image must be calculated. The computational complexity of the image pixel is also enormous.

Image Compression: Another crucial issue in image processing is the compression of image data. Especially after acquiring a large number of static and dynamic images, the greatest difficulty encountered when transferring them to the user terminal or storing the images for future use is the huge amount of data of the images. For example, a frame of color image has a data amount of approximately 768 KB. If no image compression processing is performed, it is difficult to store a large amount of image data. At the same time, this problem also exists in the image transmission process, a large amount of image data is difficult to quickly transfer, or the transmission of image quality requirements are very high (such as digital TV transmission rate to 100Mb / s), these are difficult transmission systems to suffer. The compression of image information is a crucial issue in the storage and delivery of images, and even in the multimedia technologies mentioned later. Research on image compression coding has a long history. Up to now, new technologies and methods are still being explored. The image compression coding method mainly eliminates a large amount of data redundancy generated in the image storage process. For better results, high-definition image compression coding methods such as predictive coding, transform coding, and entropy coding can be used.

4. Development of Digital Image Processing

Technology since the United States began to obtain a large number of moon pictures via satellite and processed it using digital technology since 1964, more and more corresponding technologies have begun to be applied to image processing. Digital image processing also occupies an independent position as a science. The status of disciplines has begun to be used in scientific research in various fields. Another leap-forward development of image technology appeared in 1972. The sign was the birth of CT medical technology. Under the guidance of this technology, an X-ray computed tomography device was used. According to the projection of the human head, the computer processed the data. Reconstructing cross-sectional images, this image reconstruction technique was later extended to a whole-body CT device and made contributions to human development across the times. Subsequently, digital image processing technology was used in more fields and developed into a new discipline of unlimited prospects. Ten years later, digital image processing technology also developed in a deeper direction. People began to build digital human vision systems through computers. This technology is called image understanding or computer vision. Many countries have invested a lot of research energy in this area and have made profound research results. Among them, the visual computing theory proposed at the end of the 1970s provided the guiding ideology for the later theoretical development of computer digital image technology, but theoretically as such, there are still many difficulties in practical operation. China began research on computer technology after the founding of the People's Republic of China. Since the reform and opening up, China's development in computer digital image processing technology has been very large. Even in some theoretical studies, it has caught up with the world's advanced level. With respect to the ability to collect imaging data, China successfully obtained a series of sensors and launches of Earth observation satellites to obtain timely and effective data on wind, sea, resources, and environmental disaster reduction, and achieved effective data. In addition, representatives of digital image processing technology in a wider range of fields are construction, traffic engineering and biomedical engineering. The application of digital image processing technology in these aspects can best reflect the current development of the technology. In the construction industry, digital image processing technology can convert the height, density, and other information that may affect building quality and the built environment into the image of the building or group of buildings to be constructed, so as to enable designers to plan more rationally. In the field of engineering, digital image technology and voice, text and other factors constitute the basic content of modern multimedia. In the process of transferring images, encoding technology is used to compress the bit amount of information. The current development content of this technology includes transform coding, etc. What may also play a role is wavelet transform image compression coding, branch coding and so on. In biomedical engineering, book image technology can objectively present the mechanism of human activities to researchers in the form of images, which has an irreplaceable role in the future development of medicine.

5. Application of Digital Image Processing Technology

Digital image processing technology has made great progress in all walks of life. The application fields of digital image processing are shown in table 1. In remote sensing and aerospace, many countries have dispatched reconnaissance aircraft to take aerial photographs of target areas, and then used image processing techniques to analyze photographs. This saved manpower and physics, and could also obtain other useful information from pictures. Since the 1960s, the United States and other countries have launched resource remote sensing satellites. Due to the very poor imaging conditions, the quality of the image itself is not high, and digital image processing technology is required, such as scanning with a multi-band scanner. Imaging, image resolution is 30m and these images are converted to digital signals and processed. Digital image processing technology has been widely used in various sectors, such as forest surveys, disaster monitoring, resource exploration, and urban planning.

Table 1: Application analysis table of digital image processing

Field	Application
Physics and Chemistry	Spectrum Analysis
Biology and Medicine	Cell analysis; CT; X-ray analysis
Environment Protection	Research of atmosphere
Agriculture	Estimation of plants
Irrigation works	Lake, river and dam
Weather	Cloud and weather report
Communication	Fax; TV; phone
Traffic	Robot; products
Economics	IC-card
Military	Missile guidance; training

The application of digital image processing technology to the aviation field can use JPL to better process the images returned by the Moon and Mars. It is used in aircraft remote sensing and satellite remote sensing technologies, mainly through reconnaissance aircraft to a certain area of the Earth. In aerial photography, after the required photos are processed by the image, the digital code can be stored in the air, and then the satellite can pass through the processing

center when the satellite passes over the area with the receiving station. The image is analyzed in real time, and judgment reading can be processed in this process using multiple digital image processing techniques. Digital image processing technology first came from the medical field. Therefore, in the field of biomedical engineering, digital image processing technology has also played a huge role. In addition to the above-mentioned CT, there are still some microscopic image processing technologies, mainly to identify red blood cells, white blood cells, and chromosome analysis that have played an important role in medical diagnosis and treatment of X-ray image enhancement, electrocardiogram analysis, and ultrasound image processing techniques. Digital image processing is applied to the medical field and is mainly used in image processing technologies such as medical ultrasound imaging and X-ray angiography. Digital image processing technology plays a very important role in the further diagnosis of diseases. The digital image processing technology is applied to the actual medical field. The process is to use the image overlay technology to carry out the non-destructive test; the use of image processing technology to analyze the intelligent material has played a positive role in human exploration of the microscopic properties of the material. In communication engineering, the main development trend of current communications is integrated multimedia communications, i.e., televisions, computers, and telephones are combined and transmitted on digital communications networks. The most complex and difficult areas in the transmission process focus on images. In processing, for example, if the color television signal rate is more than 100 Mbit/s, the amount of bits needed to compress the information needs to be transmitted. Therefore, the key to the success of the technology is code compression. At present, new coding methods that the advanced countries are vigorously developing, such as wavelet transform image compression coding and adaptive image network coding, etc. In addition, digital image processing technology is often applied in communications engineering. The application of communication mainly focuses on the design of sound words and the analysis of image data. It is an organic combination of television, telephone and computer. Digital image technology is particularly important in this process. It is code compression. The current coding techniques include transform coding, adaptive network coding, and wavelet transform image compression coding. In industrial and engineering, the main applications are focused on the quality of parts in automatic equipment wiring, stress analysis of elastic-mechanical photographs, and automatic sorting of postal letters, etc., as well as applications in intelligent robots. In military and public security, the application of digital image processing technology mainly focuses on precision guidance of missiles, investigation photographs, and transmission and display of images. In the area of public security, it is mainly used in the identification of human faces, fingerprint identification, and picture restoration. In addition to the application areas described above, the digital image processing technology has also been widely used in television image editing, costume design, hairstyle design, and restoration of cultural materials. Digital image processing technology can also be applied to the military and public security fields, and has played an active role in these two aspects. The application in military affairs is mainly applied to the transmission of images, the storage and display of images, etc., and is most commonly used in the application of automated command systems. The application in the public security field is applied to the public security personnel to analyze and interpret the pictures sent back, and has played a good effect. The most important in the public security system is the recognition of faces and the repair of incomplete images. The biological field is also using digital image processing technology. The biological treatment technology in agricultural production can be applied to this technology. During the process of sowing and harvesting of crops, it is bound to produce some pests and diseases, which will directly affect the farmers' harvest and economic income. The use of digital processing technology to identify and analyze pests and diseases, and extract their characteristics, to achieve the effect of intelligent identification, so as to find the common deadly substances, to reduce pests and diseases so that agriculture can be better developed.

6. Conclusion

Findings of this research inspect the research stature and major application fields of digital image processing technology and the maturing trend of digital image technology through appropriate mathematical transformations and allied supporting tools.

Presently digital image processing technology is extensively used in various fields of human's life e.g., remote sensing, CT scans, mobile phones, applications in networks etc., the development of digital image processing technology is firmly related to people's lives. With the continuous development of technology digital image processing technology will continue to be accomplished.

7. References

1. Abdelgawad Mohamed, Watson Michael W L, Wheeler Aaron R. Hybrid microfluidics: a digital-to-channel interface for in-line sample processing and chemical separations. Lab on a Chip. 2009; 9(8).
2. Chen Bingquan, Liu Hongli, Meng Fanbin.: Current Status and Development Direction of Digital Image Processing Technology. Journal of Jishou University (Natural Science Edition). 2009; 1:63-70.
3. Cui Yang, Kong Dali: Research Status and Development Direction of Digital Image Processing Technology. Shandong Institute of Water Conservancy. 2012; 4:11-14.
4. Ding Ke. Research and Development Direction of Digital Image Processing Technology. Economic Research Guide. 2013; 18:246-270.
5. Elham Yousef, Kalafi, Wooi, Boon Tan and Christopher Town: Automated identification of Monogeneans using digital image processing and K-nearest neighbor approaches. BMC Bioinformatics. 2016; 17(19).
6. Lu Gejing. Discussion on the status quo and development of digital image processing technology. Computer Knowledge and Technology. 2019; 33:8035-8036.