Image recognition of coastal environment and aerobics sports based on remote sensing images based on deep learning

Min Liu

Received: 27 March 2021 / Accepted: 1 August 2021
© Saudi Society for Geosciences 2021

Abstract
When analyzing the environmental development of coastal areas, the main basis used by researchers for analysis is the data information collected by remote sensing sensors. In the process of research and analysis, experts divided the areas displayed by remote sensing images into three types based on the characteristics of ocean areas, land, and intermediate zones, namely, sea areas, coastal beaches, and land areas. Today, with the continuous development of science and technology, people can choose the most appropriate image research method according to the development characteristics of different regions to better study the spatial distribution and geographic distribution of images. In the current era of development, the level of development of robot services is constantly improving. In order to improve the intelligence of robot service functions, people have begun to study the ability of machines to recognize human activities, and strive to meet the needs of development in all aspects. This article analyzes the characteristics of robot visual action recognition, compares and analyzes three different action representation methods, and uses deep learning related technologies to improve the level of action recognition.

Keywords
Deep learning - Remote sensing image - Coastal area - Aerobics

Introduction
In the overall development of society, human beings are the main body inventing and creating various advanced technologies. Only humans can transform the living environment. Humans have very powerful perception capabilities and can make judgments about the surrounding environment in a short period of time, so the most activity that people perform in life is interaction (Kose and Turk, 2019). In the process of interacting with others, 80% of the conditions and information that people judge interactive activities are provided by the visual network, so vision is the most powerful part of people’s perception. In the development of robotic services, the use of human vision capabilities to improve the intelligent level of robots is the main goal that researchers have been pursuing.

Analysis of aerobics and its sports cultural connotation
With the continuous improvement of people’s living standards, people’s awareness of pursuing healthy development is also increasing. Aerobics is a kind of aerobic exercise that can improve physical fitness, and it is gradually becoming popular in people’s daily life. Aerobics requires a certain amount of music. People can relax and exercise their bodies while enjoying music (Kumar and Anbalagan, 2016). This can not only improve people’s physical fitness, but also relieve people’s mood. In the long-term development process, the influence of aerobics has become wider and wider, and the national education department has also included aerobics in the education curriculum system of various universities. There are three different types of aerobics. The specific classifications are shown in the figure below:

The diversity and artistry of aerobics in the sports culture of a college
By analyzing the development of sports culture in various colleges and universities in a certain province, it can be known that the development of sports culture in various colleges and
universities is inseparable from the constructions of local national culture (Lee and Talib, 2005). In the long-term development process, the ideology of practical application in a certain region is deeply rooted, which has laid a solid foundation for the development of a strong sports culture in various universities (Ambrosio et al. 2019). In the process of carrying out educational activities in various colleges and universities, the thought of applying the world has always run through the entire process of teaching activities, which to a certain extent allows many college students to develop a good habit of focusing on practice. In the process of learning, the development of practical activities is an effective supplement to the study of theoretical knowledge. Students forming such a habit can quickly improve their own various qualities, improve the level of education and teaching in universities, and promote the long-term development of my country’s education.

The styles and characteristics of aerobics are diverse, mainly because the people involved in aerobics are very different and the purpose of participation is also very different, so there will be a variety of design styles. The dance movements of aerobics itself are rigid and flexible, with a unique artistic quality (Mathew et al. 2007). In addition to its characteristic dance moves, aerobics will also add a lot of pleasing music, allowing the audience to experience a beautiful feast from both visual and auditory perspectives. The unique style of aerobics can relax people’s body and mind and enhance people’s love and interest in art. Aerobics attracts people with its unique style and artistry. The aerobics with great Hunan culture developed by college students in a certain province reflects their changeable thinking mode. People can also see Huxiang from their performances. Spectacular view of the earth.

The integration and diversity of a college’s campus sports culture and aerobics

Observing the process of cultural development in various countries, we can see that each different culture has to accept the culture of other nationalities while protecting its own cultural connotation during the development process. This is an important issue facing cultural development. If the culture of a nation refuses to communicate and integrate with the culture of other nations, the culture of that nation will lack vitality and it will be difficult to achieve long-term development. In the development process of various regions in a certain province, people have always regarded Huxiang culture as the main content of development and inheritance (Arseni et al. 2019). In the long-term development of Chinese culture, Huxiang culture not only maintains its own cultural characteristics, but also enriches its own cultural content through exchanges and collisions with other ethnic cultures, promotes the cultural heritage of a certain area, and improves the educational level of national culture in colleges and universities.

Aerobics first emerged in Western countries. With the continuous development of my country’s social economy, aerobics began to be introduced into my country and became the main leisure and entertainment activity for most people in my country. The rapid spread and development of aerobics in our country are inseparable from its own development characteristics. First of all, aerobics combines Eastern and Western sports cultures. It is not only acceptable to Westerners, but also conforms to Eastern values. Secondly, aerobics can be promoted together with the physical education programs of Chinese colleges and universities (Oh et al. 2018). The beautiful music contained in aerobics can promote the improvement of students’ esthetic ability. Chinese martial arts can also demonstrate its charm through music. Therefore, aerobics education and the content and goals of China’s physical education are the same.

The constant self-improvement and the courage to be the first in the sports culture of a college campus

Analyzing the construction of campus culture in colleges and universities in a certain area, it can be seen that many schools have always adhered to the great concept of caring about national affairs and committed to building the country. Each college has always actively guided students to establish a good faith in loving the country and the people, which promotes our country the work on socialist core values provides strong support. In the early development process, a certain area had not yet undergone large-scale development and construction. Many ancient peoples would looting in a certain area. This inspired the bravery of the people in a certain area to defend their hometown. The character is also relatively tough, and the folk style is also very tough. Although the folk customs of a certain area are formed in the long-term development, it is very likely that this kind of folk customs may make it difficult for the people in a certain area to accept foreign ideas and culture, which is not good for the economic development of the new era. In the future development, the cultural construction of a certain area should focus on cultivating people’s hard work spirit and guiding people to accept new things.

The mass and life-long nature of people-oriented and aerobics in the sports culture of a college campus

People’s livelihood is an important link in the creation of a harmonious society. The main characteristic of Huxiang culture is to focus on people’s livelihood issues, pay attention to people’s sentiments, be sympathetic to people’s sentiments, and achieve common prosperity (Bandini et al. 2020). Paying attention to people’s livelihood issues and understanding people’s sentiments have always been the key concerns of all dynasties and generations in our country. Only the people’s
happiness in life can guarantee the long-term stability of the country.

Aerobics is different from track and field and other sports that improve survival skills. It is also not as competitive as ball sports and does not have high environmental requirements for the venue. Aerobics can be performed in any open area, such as indoors and outdoors, and there is no exact requirement for the number of people in this sport. The number of people can be large or small, and the exercise time can be long or short. This requirement is low and practical. Strong movement is unmatched by other sports. Aerobics is a sport suitable for all people, men, women, and children can participate in it, and this sport has certain adaptability. It can change the difficulty of dance movements according to the characteristics of the people involved, so that people can exercise scientifically and reasonably. Enhance physical fitness. Moreover, this sport can improve people’s social skills. This is the starting point and entry point for solving people’s livelihood problems in the Huxiang area. It can free the people from the pressure of work and study and relax their minds and bodies.

The defects of campus sports culture in a college and the contemporary and entertaining nature of aerobics

Analyzing the development process of Huxiang culture, we can see that this culture has both advantages and disadvantages in the development process. In order to improve the development advantages of Huxiang culture, it is necessary to summarize and improve the shortcomings in the development. Through specific analysis, the shortcomings in the development process can be summarized as follows: First, the construction content of Huxiang culture is biased toward the development of political life. It has no obvious promotion effect on related activities of economic development; secondly, Huxiang culture overemphasizes the idea of applying the world to practical use, which causes many people to practice only based on the experience of the predecessors, and will not innovate new development models by themselves.; Finally, the folk customs in a certain area are relatively strong, which leads to a lot of people with extreme personalities, and it is easy for them to maintain a conservative attitude or be more aggressive.

Extremely cold and extremely hot economic and political tendencies In the early stage of cultural construction in Huxiang, people always regarded the development of political life as one of the main contents of cultural construction in Huxiang (Bio et al. 2020). This is because in the early construction process, the main task faced by a certain area was to oppose imperialism and the rule of feudalism is caused by historical development. Under the current development background, the Huxiang culture advocating the construction of political life is not good for the long-term economic development.

Excessively strengthen the role of experience The traditional culture of a certain culture is mainly based on people’s livelihood issues, practical application of the world, and all-inclusive. It has become the basis of the values and thinking mode of the people in Huxiang. Sports in a certain area mainly have strictly regulated actions, which restricts the ideological development of the people in Huxiang area, and makes people in other provinces and other countries prejudice against people in a certain area. It seriously affects a certain area in the new era. The image of the people will also damage the cultural self-confidence and ideological concepts inherent in the people of a certain area.

Conservative and radical coexistence In the development of the new era, the tough character of the people in a certain area can create good development prospects for them in the process of economic development. However, some people are more radical in doing things, and often lack calm thinking. This is not good for their current development. People should pay attention to this aspect.

The contemporary and entertaining nature of aerobics complements the Huxiang cultural trend of thought In the development of socialist culture in our country, the development of sports culture has injected more vitality into the development of socialist culture. The construction and development of sports culture need to rely on the development of social economy and politics to provide material guarantee and policy support. Observing the specific process of the development of sports, we can see that there has been a trend of establishment and development of sports culture when sports activities occur, but the related concepts of sports culture only gradually appeared in the development of modern times. In the development of my country’s sports industry, sports activities before the founding of New China were mainly specific activities aimed at building the quality of soldiers in the army (Chen et al. 2019). For a long time after the founding of New China, sports activities in my country were similar to those carried out in the liberated areas. The training items are similar. However, with the continuous development, people have gradually realized that the original sports activities cannot meet the needs of people’s physical fitness development after the founding of New China. Therefore, in the continuous development, my country is also constantly learning and borrowing from the Soviet Union and other countries. The specific content of the development of national sports activities has gradually developed sports culture with my country’s socialist characteristics. In the development of sports, as people’s regulations on sports activities and people’s collective activities and manifestations in the development of sports are increasing, sports culture has gradually formed. Sports culture is developed on the basis of cultural development. It is essentially related to specific culture, but there are certain...
differences. After the introduction of aerobics to our country, it provides a new way of leisure and entertainment for the people of our country. It also provides a good reference for the construction of sports culture in a certain area of our country and the physical education in colleges and universities.

**The influence of aerobics on sports culture**

**The influence of aerobics on the sports spirit and culture of college students in a certain province**

In the process of developing physical education in colleges and universities, cultivating students’ sportsmanship is the main goal of developing educational activities. Cultivating sportsmanship is the main measure to improve the quality and effectiveness of physical education in colleges and universities, and it will directly affect the construction of sports culture in colleges and universities.

**The influence of aerobics on sports concepts of college students in a certain province**

The esthetic standards, qualities, and attitudes of teachers and students to sports in colleges and universities will affect the sports concept of college students. A good sports concept is conducive to improving the teacher’s ability to guide sports. This study conducted a survey of teachers and students in dozens of colleges and universities in a certain province (Csabragi et al. 2017). The results of the survey showed that most college teachers and students have a correct understanding of the sport of aerobics, and most teachers and students believe that bodybuilding. The exercise of aerobics helps to promote thinking and learning, which proves that most of the teachers and students of colleges and universities in a certain province can recognize the role of aerobics in promoting learning ability and improving learning efficiency: the moderating role of thinking ability. The specific survey results are shown in the figure below. However, from the overall survey results, it can be concluded that the role of teachers and students in colleges and universities for aerobics is still mainly on the surface, and the great role of aerobics in promoting people’s ideological quality has not been fully realized, and college students’ concept of sports. The specific content is not well understood, but the teacher group can deeply realize the importance of sports concepts and sports (Raja et al. 2017). On the whole, it can be seen that the sports concepts of teachers and students are correct, but the understanding is not deep enough. It is necessary to further strengthen the understanding so that students can improve their physical fitness while also promoting the cultivation of other qualities and abilities.

**The influence of aerobics on the sports style of college students in a certain province**

In the process of carrying out physical education activities in colleges and universities, some sports behavior habits and sportsmanship that college physical education teachers and students develop in carrying out educational activities are important contents of sports fashion. The better the school’s sports style, the higher the school’s sports culture construction level, and the more easily students are affected by sports culture construction and develop good habits.

This research conducted actual visits and surveys to a number of universities in a province. The results of the survey are shown in the table below. From the results collected from the survey, we can know that the sports style of most colleges and universities in a certain province has been greatly improved than in the past, but the actual effect is still not ideal. Through the survey, we can know that the number of people participating in aerobics exercise is constantly increasing. Many people can consciously participate in aerobics exercise activities and have a more comprehensive understanding of their physical health (Ramesh and Anbazhagan, 2015). By analyzing the composition of people participating in aerobics, it can be known that girls consciously participate in aerobics exercises, and many boys are not particularly concerned about aerobics. Since aerobics exercises do not have fierce competition and large-scale publicity by the media, the promotion of aerobics has not yielded good results. Therefore, the relevant departments of colleges and universities should pay attention to the publicity of aerobics and let more people understand aerobics, to stimulate the enthusiasm of students to participate in aerobics exercise.

**The influence of aerobics on the sports spirit of college students in a certain province**

In the development process of our country, our country’s economic development has gone through a period of downturn before reform and opening up, as well as a period of rapid economic development after reform and opening up. In the process of continuous economic development, my country’s social development is constantly changing, and more and more important results have been achieved. For the development of our country, the nature of the socialist society determines that we will continue to adhere to the construction of socialist culture in our country in the future development, create a good atmosphere for the development of socialist culture for the people, and create a socialist culture (Das et al. 2016). In a situation in which material civilization, socialist political civilization, socialist spiritual civilization, socialist civilization, and ecological civilization develop together. In the process of building and developing socialist culture with Chinese characteristics, the sports culture derived from the development of sports is also a content that needs to be promoted in the future development of socialist culture with Chinese characteristics. In the development of sports, people pay more and more attention to providing theoretical support and guarantee for the development of sports by building a rich sports culture. In the current development, there have been many
theories about the construction of sports culture and some theories have also been confirmed in the actual development, which is of great significance to the construction and development of sports culture. College students should cultivate their own sportsmanship while receiving physical education. Sportsmanship can enable college students to form a tough character and improve their confidence in facing difficulties. Observing the table below, we can know that participating in aerobics exercise can make students develop strong qualities and promote students to cultivate a good sense of innovation.

The impact of aerobics on the sports ethics of college students in a province In addition to promoting the development of economy, technology and knowledge, modern society must also promote the cultivation of people’s moral qualities. Therefore, the cultivation of moral qualities of college students is of great significance (Elbisy 2015). The moral quality of college students is a manifestation of college students’ ideological concepts of sports. Sports must be harmonious, mutually supportive, trusting, and united with teammates, and at the same time respect the rules of the game. In college studies, we should not only emphasize academic performance, but also focus on the cultivation of humanistic qualities. Aerobics in a certain province can reflect good moral quality and sports concepts. College students can abide by the rules of the game, help each other with teammates, and attach importance to the concept of “friendship first, competition second”. The sense of collective honor and cohesion reflected in the exercise.

The influence of aerobics on the physical culture of colleges and universities in a certain province

The dissemination and development of aerobics activities in colleges and universities has promoted the construction of college sports culture, and has further improved the construction of college sports facilities. There are also more and more books on sports. This is to a certain extent for college sports. Practical activities provide strong support.

Investigation and analysis of the status quo of sports facilities in colleges and universities in a province

This research conducted actual visits and surveys to a number of universities in a province (Shahabi et al. 2014). The specific survey results are shown in the figure below. Through the analysis of the data in the table, it can be known that the construction of sports equipment and sports facilities in many schools cannot meet the basic needs of students for sports activities, and students do not have high satisfaction with the construction of school sports facilities. Physical education activities in colleges and universities need to rely on the support of perfect sports facilities. Only by improving students’ satisfaction with sports facilities can students’ enthusiasm for consciously participating in physical exercise be improved.

Materials and methods

Remote sensing data source and preprocessing

Remote sensing image data

The remote sensing images collected in this study are mainly provided by a comprehensive experimental area in a certain place. There is not much cloud cover during the imaging period of remote sensing images. The collected images are very clear and can provide help for research activities (El-Diasty et al. 2018). This article also analyzes the vector map of the administrative area of the experimental area, which is as follows:

Remote sensing image preprocessing

In the imaging process of remote sensing images, the position of the sensor and the angle at which the image is collected, the nature of the sensor itself, the movement of the earth, and the degree of terrain undulation will all affect the quality of the image (Fijani et al. 2013). The use of orthorectification can eliminate some factors on the image: the impact of imaging. Calculating the absolute calibration of linear sensors can clarify the relationship between atmospheric radiation and other values. The calculation formula is as follows:

\[ L = Gain \times DN + Offset \]  

This study also uses the absolute atmospheric correction method to reduce the impact of atmospheric changes on remote sensing images. Using this method can directly use the physical parameters of the atmosphere on the basis of studying the atmospheric radiation transmission mode, which can improve the accuracy of the analysis: Sex. The formula used in this article for geometric correction of remote sensing images is as follows:

\[
\begin{align*}
x &= f_x(u, v) = \sum_{i=1}^{\infty} \sum_{j=0}^{\infty} a_{ji} u^i v^j \\
y &= f_y(u, v) = \sum_{i=0}^{\infty} \sum_{j=0}^{\infty} b_{ji} u^i v^j
\end{align*}
\]
In the calculation process, if the order of the polynomial is calculated to be 3, then the above formula can be transformed into a third-order polynomial equation, the equation is as follows:

\[
\begin{align*}
x &= a_{00} + a_{01}u + a_{02}v + a_{10}u^2 + a_{11}uv + a_{20}v^2 + a_{21}uv^2 \\
y &= b_{00} + b_{01}u + b_{02}v + b_{10}u^2 + b_{12}uv + b_{20}v^2 + b_{21}uv^2 + b_{30}u^3 + b_{31}uv^3
\end{align*}
\]

(3)

Through specific calculations and combined with the knowledge of linear theory, it can be known that a lot of control points are needed to obtain the result of the equation (Sidle and Ochiai, 2006). During the analysis process, the number of control points can be appropriately increased to improve the accuracy of data calculation. In the process of image processing, after cropping the image, a new remote sensing image file can be obtained.

**DEM data clipping and terrain factor extraction**

This research uses the clipping function of ArcGIS 10.2 to clip the DEM data in the study area, and the clipping results are shown in the figure above.

When analyzing the remote sensing image of an area, altitude is a very important data. It is mainly used to describe the vertical distance of a certain place or something on the ground higher or lower than sea level. The altitude will affect the distribution of vegetation and soil composition in an area (Galavi et al. 2013). This study divided the altitude into four different levels according to certain standards. The classification is shown in the figure below Fig. 1, 2, 3 and 4.

The aspect diagram of the study area is shown in the figure below Fig. 5, 6, 7, 8, 9, 10, 11 and 12.

**Statistical analysis of ground features’ spectral characteristics**

When analyzing the information received by the remote sensing sensor, it is necessary to segment the high-resolution images just collected, and the images after the multiscale segmentation process will become multiple polygonal objects. The analysis of the segmented images can first classify the related images, and divide the images of the same type into a group. By analyzing the images of the same nature, the polygons contained in the overall image can be specifically analyzed (Thanh et al. 2020). Through analysis, the specific shape, location, distribution of pixel spectrum, and texture information of the polygon can be grasped. When analyzing the images of the study area, corresponding classification standards can be established, which can improve the ability of remote sensing technology to extract information. When analyzing the object characteristics of remote sensing images, the relevant features contained in the images of a certain topic can be studied, and the thematic element information needed by people can be extracted through analysis. The information collected by the remote sensing sensor has certain fixed characteristics, and all the information can extract certain physical data, including the spectrum of the image, the shape of the polygon, and the texture of the image (Ghorbani et al. 2017). In the process of image analysis, the image needs to be fused and analyzed. Through the fusion analysis, it is convenient for people to find the different features contained in the image information in a short time and improve the speed of people analyzing images. In the process of image fusion, not only the data contained in the image information needs to be superimposed, but also the spectral images contained in different images and high-resolution panchromatic effects need to be fused to a certain extent, which can improve the spatial distribution of the images rate. This study compared and analyzed the bands contained in remote sensing images. The analysis results are shown in the following table Tables 1, 2, 3, 4, 5, 6, 7, 8 and 9.

The correlation analysis method can effectively analyze the relationship between the various bands in the remote sensing
image, and the formula can calculate the correlation degree between the bands, remove some irrelevant bands, and improve the accuracy of image analysis. The calculation formula as follows:

$$R_{ij} = \frac{S_{ij}^2}{S_i \cdot S_j}$$

(4)

Using the OIT index to analyze the correlation between bands can calculate the correlation between a single band and all other bands. The smaller the calculated correlation coefficient value, the less useless information is contained in the image where the band is located. The calculation formula is as follows:

$$OIF = \frac{\sum_{i=1}^{3} S_i / \sum_{i=1}^{3} |R_{ij}|}{\sum_{i=1}^{3} S_i}$$

(5)

Aerobics sports image recognition method based on deep learning

In order to better analyze the image changes when people are doing aerobics, this study uses deep learning methods to analyze people’s behavior recognition and motion detection (Hanting et al. 2013). In the process of determining the threshold, the resolution of the images in each database is different, so this study defines the threshold as the mean value obtained by projecting along the x-axis and y-axis directions. The mean value of the projection can be as follows formula to calculate:

$$T_X = \frac{\sum_{x=1}^{m} P_x}{m}$$

(6)

$$T_Y = \frac{\sum_{y=1}^{n} P_y}{n}$$

(7)

Results

Analysis of the research results of the spectral characteristics

The spectral information used in this study was obtained by direct query in the data. The data after sorting is shown in the following table:

Through specific calculations and analysis, we can know that some bands in the image have strong correlation, which means that the information contained in these bands has a certain repetition phenomenon. Try not to choose these bands
Analysis of land use dynamic changes

The change of land use type is a manifestation of the adjustment of land use structure in a region. Use professional software to analyze the land use data. The analysis results are shown in the figure below (Hipni et al. 2013). It can be seen that the area of cultivated land, construction land, etc. occupies a large area, and the water area occupies a small area. In addition, the area of construction land has increased in recent years, and the area of urban greening land has also increased. The specific land area changes are shown in the figure below.

According to the above formula, the land use type and utilization rate of the area can be calculated and studied. The specific calculation results are shown in the following table. The land type of the coastal zone in this area has changed greatly, and the rate of change is rapid. However, on the whole, there are also certain differences in the rate of change of land use types at different times and locations in this region.

Analysis of experimental results of motion detection based on deep learning

This research mainly analyzes the images of people performing aerobics from the perspective of analyzing gradient transformation characteristics. Therefore, the researchers use the images captured by the camera as the main basis for motion data detection. The effect of data detection is shown in the following figure:

This study also analyzed the effects of different algorithms on data detection. The results of the analysis are shown in the following table:

Observing the effect of motion detection in the figure below, you can know that the algorithm used in this article can improve the scientificity of data analysis, and it can also detect the effect of data.

The efficiency of the different algorithms used in this research in the KTH database is shown in the following table:

The following figure is the effect diagram of the algorithm for detecting multiple moving targets. Through specific analysis, it can be known that the projection detection method based on the gradient conversion feature is an effective method for data detection and analysis.

Discussion

Macro-theoretical analysis of the driving mechanism of environmental changes in coastal areas

The earth provides people with a living environment, and the composition of different systems on the earth provides people with conditions for development (Vapnik 1998).
development of the earth system is inseparable from the changes in human activities. The relationship between the two is as follows:

For human development, coastal changes may bring a lot of uncertainty to people’s daily lives. The coast’s ability to cope with environmental changes is very weak. Many environmental problems can only be handled by its own self-healing ability (Kayastha et al. 2012). People needs to pay timely attention, otherwise it will seriously affect people’s survival and development. It is very obvious that my country’s coastal areas are affected by climate change, and many changes will be affected by climate change. Even if climate change will have a serious impact on the development of coastal areas, the impact of climate change on coastal areas is long-term. People can effectively construct coastal areas by grasping the laws of climate change (Wang et al. 2020). By observing the development of various regions around the world, we can know that the population activities and socio-economic development of many regions depend on the construction of coastal areas. The environment around the coast has a very important impact on the survival and development of human beings in this area of.

Fig. 6. Changes in the total amount of land use in a certain coastal zone from 1999 to 2019

| Year | Inter tidal zone | Riparian dyke | Waters | Building land | Woodland | Garden land | Cultivated land |
|------|------------------|---------------|--------|---------------|----------|-------------|-----------------|
| 2019 | 10%              | 32%           | 17%    | 32%           | 5%       | 1%          | 2%              |
| 2015 | 13%              | 30%           | 17%    | 30%           | 3%       | 4%          | 3%              |
| 2011 | 22%              | 24%           | 18%    | 26%           | 1%       | 6%          | 3%              |
| 2007 | 29%              | 19%           | 19%    | 20%           | 2%       | 9%          | 3%              |
| 1999 | 30%              | 19%           | 20%    | 19%           | 2%       | 9%          | 2%              |

Fig. 7. The annual rate of land use change in a certain coastal zone from 1999 to 2019

![Graph showing the annual rate of land use change](image-url)
Fig. 8. Original image of aerobics action database

Fig. 9. Motion detection effect diagram in KTH
Analysis of driving factors of environmental changes in coastal areas

Through specific research and analysis, we can know that the long-term changes in the coastal zone are mainly caused by changes in environmental development, while the short-term changes in the coastal zone are mainly caused by human activities. By analyzing the various factors that affect the changes in the coastal zone, it can be seen that the development of the coastal zone is affected by many factors. These factors do not work alone. Many factors have a common effect. The specific situation is shown in the following figure:

The driving effects of various factors are mainly manifested in the following aspects:

1. Natural factors

   Excessive rain water will form rivers, which carry sand left by rain erosion, and the rivers carry sand into the sea,
causing more and more sand to accumulate in coastal areas. This will cause coastal areas to be eroded by seawater due to the lack of sediment accumulation, and the location of the coast will gradually move toward the land. In most cases, the topographical areas that rivers must pass through to reach the ocean are relatively complex, and a certain amount of sediment is necessary (Kayastha et al. 2013). Coastal areas usually have a lot of sediment. Under the influence of a cold and dry climate, the reduction of precipitation may cause the coast to suffer long-term seawater erosion, and the area of the coast will decrease.

(2). Economic factors

The economic development of coastal areas will cause the government and related enterprises to pay great attention to coastal areas, and encourage relevant entities to participate in

Table 1 Landsat-8 band comparison

| Band       | Band name                        | Wavelength (nm) | Resolution (m) | Data usage                     |
|------------|----------------------------------|-----------------|----------------|--------------------------------|
| 1          | Aerosol                          | 433–453         | 30             | Coastal Aerosol                |
| 2          | Blue                             | 450–515         | 30             | Base color/scattering/coast    |
| 3          | Green                            | 525–600         | 30             | Base color/coast               |
| 4          | Red                              | 630–680         | 30             | Base color/coast               |
| 5          | Near Red                         | 845–885         | 30             | Plants/coast                   |
| 6          | SWIR1                            | 1560–1660       | 30             | Plant                          |
| 7          | SWIR2                            | 2100–2300       | 30             | Mineral/hay/no scattering      |
| 8          | Panchromatic                     | 500–680         | 15             | Image sharpening               |
| 9          | Cirrus                           | 1360–1390       | 30             | Cirrus determination           |
| 10         | TIRS thermal infrared sensor 1   | 10300–11300     | 100            | Surface temperature            |
| 11         | TIRS thermal infrared sensor 2   | 11500–12500     | 100            | Surface temperature            |
### Table 2  
Statistics of image spectral characteristics in a comprehensive experimental area in 2014

| Band number | Average value | Standard deviation | Band number | Average value | Standard deviation |
|-------------|---------------|--------------------|-------------|---------------|--------------------|
| OLI 1       | 755.443       | 461.477            | OLI 5       | 3065.144      | 867.589            |
| OLI 2       | 715.242       | 499.521            | OLI 6       | 2350.219      | 881.810            |
| OLI 3       | 1051.336      | 600.965            | OLI 7       | 1533.713      | 809.878            |
| OLI 4       | 1102.054      | --                 |             |               |                    |

### Table 3  
Correlation coefficient matrix table of various bands in a comprehensive experimental area in 2014

| Band number | OLI 1 | OLI 2 | OLI 3 | OLI 4 | OLI 5 | OLI 6 | OLI 7 |
|-------------|-------|-------|-------|-------|-------|-------|-------|
| OLI 1       | 1     | 0.9976| 0.9691| 0.9470| 0.1093| 0.7120| 0.8512|
| OLI 2       | 0.9986| 1     | 0.9789| 0.9607| 0.1137| 0.7311| 0.8687|
| OLI 3       | 0.9691| 0.9789| 1     | 0.9879| 0.2074| 0.7984| 0.9052|
| OLI 4       | 0.9470| 0.9607| 0.9879| 1     | 0.1743| 0.8252| 0.9306|
| OLI 5       | 0.1093| 0.1137| 0.2074| 0.1743| 1     | 0.5527| 0.3251|
| OLI 6       | 0.7120| 0.7311| 0.7984| 0.8252| 0.5527| 1     | 0.9477|
| OLI 7       | 0.8512| 0.8687| 0.9052| 0.9306| 0.3251| 0.9477| 1     |

### Table 4  
A comprehensive experimental area in 2014 each band combination OIF index and ranking

| Band combination | Standard deviation sum | Correlation coefficient and OIF Index | OIF sort | Band combination | Standard deviation sum | Correlation coefficient and OIF Index | OIF sort |
|------------------|------------------------|---------------------------------------|----------|------------------|------------------------|---------------------------------------|----------|
| 123              | 1561.963               | 2.946                                 | 530.270  | 35 237 1910364   | 2.753                  | 693.971                              | 29       |
| 124              | 1719.656               | 2.905                                 | 591.903  | 34 246 237998    | 2.517                  | 850.214                              | 21       |
| 125              | 1828.587               | 1.221                                 | 1498.105 | 26 247 2068057   | 2.760                  | 749.296                              | 27       |
| 126              | 1842.808               | 2.441                                 | 755.033  | 24 256 242920    | 1.398                  | 1609.245                             | 7        |
| 127              | 1770.876               | 2.718                                 | 651.656  | 25 256 250022    | 2.753                  | 850.214                              | 21       |
| 134              | 1821.100               | 2.904                                 | 627.101  | 33 257 2176988   | 1.308                  | 1665.000                             | 4        |
| 135              | 1930.031               | 1.286                                 | 1501.035 | 13 267 2191209   | 2.548                  | 860.141                              | 18       |
| 136              | 1944.252               | 2.480                                 | 784.131  | 24 345 227212    | 1.370                  | 1626.177                             | 6        |
| 137              | 1872320                | 2.726                                 | 686.964  | 30 346 2241433   | 2.612                  | 858.293                              | 19       |
| 145              | 2087.724               | 1.231                                 | 1696.509 | 3   347 2109501  | 2.824                  | 768.319                              | 25       |
| 146              | 2101.945               | 2.484                                 | 846.126  | 22 356 2350364   | 1.559                  | 1508.094                             | 12       |
| 147              | 2030.013               | 2.729                                 | 743.922  | 28 357 2278432   | 1.438                  | 1584.776                             | 9        |
| 156              | 2210.876               | 1.374                                 | 1609.080 | 8   367 2292653  | 2.651                  | 864.728                              | 17       |
| 157              | 2138.944               | 1.286                                 | 1663.771 | 5   456 2450346  | 1.552                  | 1578.628                             | 10       |
| 167              | 2153.165               | 2.511                                 | 857.527  | 20 457 2436125   | 1.430                  | 1703.584                             | 1        |
| 234              | 1859.144               | 2.928                                 | 635.062  | 32 467 2450346   | 2.704                  | 906.361                              | 16       |
| 235              | 1968.075               | 1.300                                 | 1513.904 | 11 567 2559277   | 1.826                  | 1401.959                             | 15       |
| 236              | 1982.296               | 2.508                                 | 790.263  | 23 -- -- --       | --                     | --                                   | --       |

### Table 5  
The change table of the total amount of various types of land in a certain coastal zone from 1984 to 2004. Unit: hm²

| Years   | Arable land | Garden | Woodland | Construction land | Waters | Marina Embankment | Tidal zone | The total area |
|---------|-------------|--------|----------|-------------------|--------|-------------------|------------|----------------|
| 1984    | 3871.20     | 2370.11| 2489.79  | 2374.43           | 201.35 | 1100.00           | 304.03     | 12710.89       |
| 1992    | 3653.48     | 2432.62| 2465.56  | 2555.15           | 197.64 | 1085.46           | 320.46     | 12711.38       |
| 1996    | 2831.27     | 3105.55| 2255.51  | 3292.70           | 191.24 | 720.07            | 362.70     | 12759.04       |
| 2000    | 1670.88     | 3837.33| 2125.50  | 3871.84           | 435.83 | 480.98            | 348.93     | 12771.28       |
| 2004    | 1330.25     | 4167.30| 2154.11  | 416142            | 591.91 | 161.19            | 310.04     | 12875.22       |
| Net increase or decrease | −2540.95 | 1797.19 | −335.68 | 1785.99 | 390.56 | −938.80 | 6.02 | 164.33 |
the development and construction of coastal areas, which will lead to changes in the shape and development environment of coastal areas to a certain extent.

(3). Demographic factors

In the development process of a region, the number of population determines to a certain extent the impact of human activities on the environment of the region (Yadav et al. 2017). The greater the population of coastal areas, the more people will develop and construct coastal areas, which may increase the pressure on environmental development in coastal areas.

(4). Technical factors

With the continuous development of science and technology and the continuous progress of society, people skillfully use some advanced science and technology in the development process of coastal areas. On the one hand, the continuous advancement of technology can improve people's ability to deal with environmental development problems in coastal areas.

Table 6: The annual rate of land use change in a certain coastal zone from 1984 to 2004 (%)

| Research period | K (Arable land) | K (Garden) | K (Woodland) | K (Construction land) | K (water area) | K (Landbank) | K (Intertidal zone) | LC |
|-----------------|-----------------|------------|--------------|-----------------------|----------------|--------------|-------------------|----|
| 1984–1992       | −0.70           | 0.12       | 0.96         | −0.23                 | −0.17          | 0.68         | 0.26              |    |
| 1992–1996       | −5.63           | 6.92       | −2.13        | 7.20                  | −0.81          | −8.42        | 3.30              | 2.81|
| 1996–2000       | −10.25          | 5.89       | −1.44        | 4.40                  | 31.97          | −8.30        | −9.05             | 3.04|
| 2000–2004       | −5.10           | 2.15       | 0.34         | 1.86                  | 8.95           | −16.62       | −2.79             | 1.47|
| 1984–2004       | −3.28           | 3.79       | −0.67        | 3.76                  | 9.70           | −4.27        | 0.10              | 1.53|

Table 7: Comparison of the efficiency of different detection methods in Weizmann database

| Video length (sec) | Number of screens (/) | Bit rate (/) | GMM algorithm (sec) | Video coding algorithm (sec) | Algorithm of this paper (sec) |
|--------------------|-----------------------|--------------|---------------------|-----------------------------|-------------------------------|
| 1                  | 25                    | 15552        | 2.13                | 1.18                        | 0.72                          |
| 2                  | 25                    | 15552        | 3.27                | 1.99                        | 1.12                          |

Table 8: Comparison of the efficiency of different detection methods in KTH database

| Video length (sec) | Number of screens (/) | Bit rate (/) | GMM algorithm (sec) | Video coding algorithm (sec) | Algorithm of this paper (sec) |
|--------------------|-----------------------|--------------|---------------------|-----------------------------|-------------------------------|
| 12                 | 25                    | 980          | 95.46               | 56.36                       | 35.30                         |
| 13                 | 25                    | 822          | 83.44               | 42.13                       | 30.91                         |
| 14                 | 25                    | 695          | 78.61               | 39.48                       | 30.15                         |
| 15                 | 25                    | 945          | 120.29              | 77.93                       | 45.15                         |
| 15                 | 25                    | 854          | 107.52              | 70.06                       | 41.04                         |
| 17                 | 25                    | 931          | 139.47              | 88.25                       | 50.54                         |
| 21                 | 25                    | 883          | 158.96              | 96.36                       | 62.96                         |
| 21                 | 25                    | 256          | 68.05               | 30.28                       | 23.33                         |
| 26                 | 25                    | 701          | 157.37              | 92.34                       | 61.37                         |
| 26                 | 25                    | 684          | 144.47              | 86.36                       | 59.17                         |

Table 9: Comparison of test results of different test methods

| Method | Overall accuracy | Recall rate | False positive rate |
|--------|-----------------|-------------|---------------------|
| Huang and Wang | 0.72       | 0.70        | 0.019               |
| Mahmoudi et al. | 0.69       | 0.74        | 0.047               |
| Stauffer and Grimson | 0.60       | 0.68        | 0.025               |
| Haines and Xiang | 0.74       | 0.78        | 0.018               |
| Algorithm | 0.76       | 0.79        | 0.016               |
areas, and on the other hand, it may also increase people’s desire to over-exploit coastal areas. Therefore, it is necessary to rationally use advanced technology to promote the long-term development of coastal areas.

(5). Policy factors

In the early development process, people did not have a correct understanding of resource development and utilization, and some resource development policies and regulations were not perfect, leading to the over-exploitation of many precious resources. As people’s awareness of building an ecological civilization has increased, the government and relevant departments have begun to issue relevant policies and regulations to restrict people’s behavior in developing and using resources, and to protect existing resources to a certain extent.

Conclusion

Today, with the continuous development of science and technology, people can choose the most appropriate image research method according to the development characteristics of different regions to better study the spatial distribution and geographic distribution of images. In the current era of development, the level of development of robot services is constantly improving. In order to improve the intelligence of robot service functions, people have begun to study the ability of machines to recognize human activities, and strive to meet the needs of development in all aspects. This article analyzes the characteristics of robot visual action recognition, compares and analyzes three different action representation methods, and uses deep learning related technologies to improve the level of action recognition. This article also analyzes the characteristics of robot service development, designs feasible operating software for the specific development of robot service, and uses effective methods to verify the feasibility of the software. During the development of coastal areas, human activities and changes in the natural environment have had a significant impact on the development of coastal areas. This article extracts and analyzes the data contained in remote sensing images and uses geographic information technology to imitate them. The actual situation in the coastal area has proved that the methods used in this study are all feasible.

Declarations

Competing interests The authors declare no competing interests.

References

Ambrosio KJ, Brenton BM, Herrera M, Luvizuto E Jr, Ribeiro L, Izquierdo J (2019) Committee machines for hourly water demand forecasting in water supply systems. Math Probl Eng 2019:11p–111p. https://doi.org/10.1155/2019/9765468
Arseni M, Voiculescu M, Georgescu LP, Iticescu C, Rosu A (2019) Testing different interpolation methods based on single beam echosounder river surveying. Case study: Siret River. Int J Geo-Inf 8(11):507. https://doi.org/10.3390/ijgi8110507
Bandini F, Sunding TP, Linde J, Smith O, Jensen IK, Koppl CJ, Butts M, Bauer-Gottwein P (2020) Unmanned Aerial System (UAS) observations of water surface elevation in a small stream: comparison of radar altimetry, LIDAR and photogrammetry techniques. Remote Sens Environ 237:111487. https://doi-org.proxy2.cl.msu.edu/10.1016/j.rse.2019.111487
Bia O, Goncalves JA, Magalhaes A, Pinheiro J, Bastos L (2020) Combining low-cost sonar and high-precision global navigation satellite system for shallow water bathymetry. Estuar Coasts. https://doi.org/10.1007/s12237-020-00703-6
Chen W, Panahi M, Khorasavi K, Pourghasemi HR, Rezaie F, Parvimehzad D (2019) Spatial prediction of groundwater potentiality using ANFIS ensemble with teaching-learning-based and biogeography-based optimization. J Hydrol 572:435–488. https://doi.org/10.1016/j.jhydrol.2019.03.013
Casabragi A, Molnar S, Tanos P, Kovacs J (2017) Application of artificial neural networks to the forecasting of dissolved oxygen content in the Hungarian section of the river Danube. Ecol Eng 100:63–72. https://doi.org/10.1016/j.ecoleng.2016.12.027
Das M, Ghosh SK, Chowdary VM, Sakirishnaveni A, Sharma RK (2016) A probabilistic nonlinear model for forecasting daily water level in reservoir. Water Resour Manag 30(9):3107–3122. https://doi.org/10.1007/s11269-016-1334-6
Elbisy MS (2015) Support vector machine and regression analysis to predict the field hydraulic conductivity of sandy soil. KSCE J Civ Eng 19(7):2307–2316. https://doi.org/10.1007/s12205-015-0210-x
El-Dusty M, Al-Harbi S, Pagiatakis S (2018) Hybrid harmonic analysis and wavelet network model for sea water level prediction. Appl Ocean Res 70:14–21. https://doi.org/10.1016/j.aplОРe.2017.11.007
Fijani E, Nadiri A, Moghaddam AA, Tsai FTC, Dixon B (2013) Optimization of DRASTIC method by supervised committee machine artificial intelligence to assess groundwater vulnerability for Maragheh–Bonab plain aquifer, Iran. J Hydrol 503:89–100. https://doi.org/10.1016/j.jhydrol.2013.08.038
Galavi H, Mirzaei M, Teang Shui L, Valizadeh N (2013) Klang River–level forecasting using ARIMA and ANFIS models. Am Water Works Assoc 105(9):496–506. https://doi.org/10.5942/jawwa.2013.105.0106
Ghorbani MA, Deo RC, Karimi V, Yaseen ZM, Terzi O (2017) Implementation of a hybrid MLP-FFA model for water level prediction of Lake Egirdir, Turkey. Stoch Env Res Risk A 32(6):1683–1697. https://doi.org/10.1007/s00477-017-1474-0
Hanting Z, Hao W, Yufei C (2013) Application of osculating value method based on entropy weight in the groundwater quality evaluation. Int J Environ Res Perspect 2013.105.0106
Hunting Z, Hao W, Yu-fei C (2013) Application of oscillating value method based on entropy weight in the groundwater quality evaluation. Int J Environ Res Perspect 2013.105.0106
Hunting Z, Hao W, Yu-fei C (2013) Application of oscillating value method based on entropy weight in the groundwater quality evaluation. Int J Environ Res Perspect 2013.105.0106
Hunting Z, Hao W, Yu-fei C (2013) Application of oscillating value method based on entropy weight in the groundwater quality evaluation. Int J Environ Res Perspect 2013.105.0106
Hunting Z, Hao W, Yu-fei C (2013) Application of oscillating value method based on entropy weight in the groundwater quality evaluation. Int J Environ Res Perspect 2013.105.0106
Hunting Z, Hao W, Yu-fei C (2013) Application of oscillating value method based on entropy weight in the groundwater quality evaluation. Int J Environ Res Perspect 2013.105.0106
Hunting Z, Hao W, Yu-fei C (2013) Application of oscillating value method based on entropy weight in the groundwater quality evaluation. Int J Environ Res Perspect 2013.105.0106
study from the Tinau watershed, west Nepal. Comput Geosci 52: 398–408
Kose DD, Turk T (2019) GIS-based fully automatic landslide susceptibility analysis by weight-of-evidence and frequency ratio methods. Phys Geogr 40:481–501
Kumar R, Anbalagan R (2016) Landslide susceptibility mapping using analytical hierarchy process (AHP) in Tehri reservoir rim region, Uttarakhand, J Geol Soc India 87:271–286
Lee S, Talib JA (2005) Probabilistic landslide susceptibility and factor effect analysis. Environ Geol 47:982–990
Mathew J, Jha VK, Rawat GS (2007) Weights of evidence modelling for landslide hazard zonation mapping in part of Bhagirathi valley, Uttarakhand. Curr Sci 92(5):628–638
Oh HJ, Kadavi PR, Lee CW, Lee S (2018) Evaluation of landslide susceptibility mapping by evidential belief function, logistic regression and support vector machine models. Geomat Nat. Hazards Risk 9: 1053–1070
Raja NB, Çiçek I, Türkoğlu N, Aydin O, Kawasaki A (2017) Landslide susceptibility mapping of the Sera River Basin using logistic regression model. Natural Hazards 85(3):1323–1346
Ramesh V, Anbazhagan S (2015) Landslide susceptibility mapping along Kolli hills Ghat road section (India) using frequency ratio, relative effect and fuzzy logic models. Environ Earth Sci 73:8009–8021
Shahabi H, Khezri S, Ahmad BB, Hashim M (2014) Landslide susceptibility mapping at central Zab basin, Iran: a comparison between analytical hierarchy process, frequency ratio and logistic regression models. Catena 115:55–70
Sidle RC, Ochiai H (2006) Landslides: processes, prediction, and landuse. In: American Geophysical Union, 18th edn. Water Res Monograph, Washington, p 31
Thanh DQ, Nguyen DH, Prakash I, Jaafari A, Nguyen VT, Van Phong T, Pham BT (2020) GIS based frequency ratio method for landslide susceptibility mapping at Da Lat City, Lam Dong province, Vietnam. Vietnam J. Earth Sci. 42:55–66
Vapnik VN (1998) Statistical Learning Theory. John Wiley, New York
Wang B, Wang Bi WW, Xi C, Wang J (2020) Sea-water-level prediction via combined wavelet decomposition, neuro-fuzzy and neural networks using SLA and wind information. Acta Oceanol Sin 39:157–167. https://doi.org/10.1007/s13131-020-1569-1
Yadav B, Mathur Sh CHS, Adamowski J (2017) Assessing the suitability of extreme learning machines (ELM) for groundwater level prediction. J Water Land Dev 32:103–112. https://doi.org/10.1515/jwld-2017-0012