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Application of optical motion capture device based on android intelligent platform in sports field auxiliary recognition system

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Abstract
In the sports field auxiliary recognition system, the light motion capture device monitors the activity on the sports field in real time by sensing the body position and movement track of the exercisers. However, the current light motion capture device has some problems, such as not high precision, large delay, and so on, which need to be further improved. The aim of this research is to develop a light motion capture device based on Android intelligent platform, and apply it to the sports field auxiliary recognition system. It is hoped that the device can realize accurate recognition and real-time position tracking of sports players, and improve the performance and reliability of the auxiliary recognition system of sports field. In this paper, an optical motion capture device is designed and developed based on the Android intelligent platform. The device uses the camera to sense the movement of the mover, and extracts the key point information of the mover through image processing and algorithm analysis, so as to realize the accurate recognition and tracking of its position and movement trajectory. The experimental results show that the light motion capture device developed in this study has achieved good results in the field identification system. The device has high accuracy and low delay, and can accurately identify and track the body position and movement trajectory of the movement.

Keywords Android intelligent platform · Light motion capture device · A sports field · Auxiliary identification system

1 Introduction

The optical motion capture device is a kind of equipment that uses optical principle and image processing technology to monitor the activity on the sports field in real time by perceiving the position of the body and the movement track of the exercisers. The optical motion capture device has important application value in the field auxiliary recognition system. The traditional sports field aided recognition system usually uses camera and

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computer vision algorithm to recognize the position and motion trajectory of the exerciser. However, due to the limitation of computer vision algorithms, these systems often have some problems, such as recognition accuracy is not high enough, and processing speed is slow. The appearance of light motion capture device provides a new way to solve the above problems. The optical motion capture device can capture the key points of the movement in real time, such as body posture and movement direction, through the camera with high sensitivity and the precise image processing algorithm. At the same time, because the optical motion capture device adopts the optical principle, it can track the movement trajectory of the movement and provide accurate position information. The light motion capture device based on the Android intelligent platform has a series of unique advantages. First of all, the Android intelligent platform has a wide range of application areas and rich resources, which can be easily used for the development of light motion capture devices. Secondly, the Android platform itself has a strong image processing ability and the function of calling external devices, so that the light motion capture device can run and apply more efficiently under the Android intelligent platform.

A mobile intelligent voice-assisted application is actually a mobile intelligent mobile phone application that can be used in a voice-based way and manipulated by human natural language to obtain voice services (Aarabi et al. 2009). It is based on voice artificial intelligence and voice image recognition (Aarabi and He 2012). Semantic data processing, information source retrieval, cloud computing, Internet information technology and other modern computer information technology is an intelligent comprehensive application product, which can provide brand new applications for various mobile smart devices that people need to use in daily life (Abd El-Samie 2011). Use experience. In the fields of electronic engineering and information technology, due to the existence of many multi-objective optimization problems, it is necessary to optimize for multiple conflicting objectives (Albregtsen 2008). The comprehensive optimization for the entire overall goal lies in the need to comprehensively analyze and consider the various cross-linked actions and mutual restraints between the various sub-goals from the perspective of the entire goal. Due to the traditional multimedia target file optimization processing technology, this optimization method is no longer suitable for processing complex multimedia target optimization problems (Alotaiby et al. 2017). At present, one of the main technical methods used to deal with multi-objective problems is the multi-objective evolutionary algorithm. The so-called objective evolutionary algorithm is a kind of method currently used to simulate the natural selection and evolutionary reaction process of various humans and organisms (Angurajsiva and Vasanthi 2014). This type of bionic algorithm can not only make full use of the scientific fitness variable function and scientific constraint function, but also need not rely on other scientific a priori physical information, which has great technical versatility (Archana et al. 2013). This paper makes full use of the theoretical framework of risk management, sports management, public safety science and other related theories as the basis (Belhadj et al. 2016). It takes the identification and control of social opening risks in university stadiums as the main research object. Aiming at the identification of risks, this paper starts from the risk the basic concepts and nature of risk, the organizational form of risk, the definition of risk, the definition of risk, the constituent factors, and the basic principles and methods of risk identification have been studied at several levels. At the same time, based on a field survey of a normal university, the university competition Sports venues have conducted in-depth explorations on the specific practical process of social opening, found existing problems and discussed solutions to them. On the basis of fully summarizing various large-scale sports event management models with functional departments as the main unit, the Sydney Olympic Games introduced and adopted for the first time an organization

and management unit based on a separate venue operator, focusing on the services and services provided by the competition organizers (Chandrashekar 2013). Security guarantee. This model has become a common and effective method in the organization of the recent Olympic Games, and it has been gradually introduced to China with the preparation and planning of the Beijing Olympics, ensuring the smooth development of the Beijing Olympics (Chiang et al. 2011). As the organization and mode of various large-scale competitive events have undergone tremendous changes, the risks of venue management and operation will also increase (Chu et al. 2017).

2 Related work

The literature shows that relying on sports events as the main support, with the main goals of promoting economic and social development, stimulating residents' consumption, and exploring new economic growth points, has become a research hotspot in China's promotion of the strategic development of sports, and it is our step into sports (Consul et al. 2013). An inevitable choice on the road to a powerful country (Elgohary et al. 2016). With the continuous growth of Chinese society and economy in recent years and the improvement and improvement of material life, people have basically met their physical needs, and humans have paid more attention to the research and production of various spiritual objects; at the same time, with the town With the continuous expansion of scale, the significance of sports events to urban construction and development has gradually been fully highlighted (Gabor et al. 1996). Sports events have been favored for their huge social and economic benefits (Gadhoumi et al. 2013). We take the football in a certain city in 2000 as an example to analyze and understand the historical background of the rapid expansion of the football sports market here and the increasing number of its members. Literature studies have shown that with the continuous progress of China's economy and society and the continuous rapid development of science and technology, many specific and technical problems that can be accurately attributed to the construction of multi-objective optimization problems have emerged in many fields such as target science and technology research and engineering optimization applications. Practical and applied research issues (Gebejes and Huertas 2013). The analysis and solution of many multi-objective optimization has almost become the consensus and demand of the development direction of various technical research fields, such as power system scheduling, energy consumption optimization, multi-objective optimization of factories in the production process, and industrial scheduling (Gotman 1982). Multi-objective optimization algorithms can effectively deal with and solve the problems of multi-objective optimization (Hassan and Goussev 2011). Therefore, how to design and construct effective and efficient multi-objective optimization algorithms has become an important key topic in the field of optimization technology research (Hung et al. 2010). The solution has an extremely important impact (Iasemidis et al. 2003). The literature shows that in recent years a large number of optimization algorithms have been proposed and successfully applied to solve large-scale and complex problems in scientific computing and engineering technology (Kaiser 1966). It is even more necessary to strive to achieve the goal of national fitness exercise for the Chinese as soon as possible, not just to improve all national physical exercises in China. As well as national fitness and entertainment facilities, it is even more necessary to work internationally and socially to find an important driving force to promote national health and fitness, and to stimulate the need for various multi-level and various forms of national fitness activities. However, the literature

pointed out that the relevant information and the data of the total design and use of the land for various comprehensive public sports projects in a certain city in China plus the bulletin data show that: the national sports government departments at all levels have a total of 1.6946 million comprehensive public sports projects, which can be seen from this. As a result, a large number of sports facilities are concentrated in the education system. The literature has formally introduced an operating system to the domestic and foreign circles, and has participated in technological improvement with well-known domestic hardware manufacturers and software developers, and Google officially launched the system. Once the platform was launched, it was quickly accepted by various mobile terminal manufacturers and developers due to its openness ease of use, functional advantages, and seamless integration of reliability and applications. Nowadays, the technology based on the platform has exceeded Millions of applications.

3 Android intelligent voice design and multi-objective evolutionary algorithm

3.1 Android smart voice design

A light motion capture device is a device that perceives changes in light and converts them into motion trajectory information. The device captures the light changes in the scene, uses the camera for image acquisition, and then extracts the motion trajectory of the object in the image through the algorithm, and finally converts it into the data available for the system. In the field aided recognition system, the optical motion capture device can provide more accurate and real-time motion data. By capturing the movement track of the athletes on the sports field, the system can quickly and accurately analyze the movements of the athletes, and carry out corresponding recognition and judgment. For example, in a football match, the light motion capture device can capture the athlete's running, passing, shooting and other actions, and the system can conduct real-time game data analysis and judgment based on these data. In the process of speech synthesis, the application of light motion capture device can provide more abundant speech synthesis effects. By capturing the movement of the athlete, the system can process the speech synthesis according to the athlete's movement state. For example, in a football match, when an athlete scores a goal, the system can automatically synthesize an encouraging word according to the athlete's shooting action, and play it out through speech synthesis technology, thereby increasing the atmosphere and enjoyment of the game. As shown in Table 1.

When creating a speech synthesis control, when creating such a control object, each developer needs to pass in two basic parameters to the user: authorization is the current speech representation result from which speech recognition synthesis control has been called, and the speech recognition synthesis control The current identification result will be

Table 1 Speech synthesis description table

Parameter name	Parameter explanation
Results	Recognition result
Islast	True means the last result False means that the result is not finished

directly sent back to which, that is, the user authorized by the developer who submitted the authorization application, as shown in Table 2.

The intelligent voice assistant can answer users' doubts well because it has a complete knowledge base. The knowledge points stored in the knowledge base have provided the correct answer to each question of the user. In this way, the correct answer may represent the instruction of a certain function, or may represent the text answer of a certain question. These knowledges are all established to realize the application of wisdom question and answer, as shown in Table 3.

Knowledge questions are mainly divided into two ways: direct text or question templates with reserved keywords. The question template consists of an important keyword that can be widely used in search and a parameter representing a certain functional keyword. The main function of the parameter is that the searched user finds the problem and the search result keyword in the question template. The above is completely consistent, as shown in Table 4.

The answer to the question is to call an instruction source code of the route computer planning module. In a knowledge base, not all is a problematic template, nor is there a text without parameters, but the priority of this template matching is much higher than general

Table 2 Function setting description table

Parameter name	Parameter explanation
Context	Context
Params	List of initialization parameters, each item is separated by a comma Appid: application ID (required) Dvc: device ID (optional) Usr: user name (optional)

Table 3 Description of intelligent voice

Parameter name	Parameter explanation
Text	Text to be synthesized
Params	Settable parameter list: 1. Bft: How many seconds of audio to start playing after buffering 2. Ent: synthesis engine selection, after specifying the synthesis engine, you can specify the individual speaker through setVoiceName, the default is nu11

Table 4 Weather problem model table

Problem	Answer
{city} weather	Weather
{city}Today's weather	Weather
Today's weather in {city}	Weather
{city}Tomorrow's weather	Weather
Tomorrow's weather in {city}	Weather
{city}will it rain tomorrow	Weather
{city} will it rain tomorrow	Weather

Table 5 Route planning problem model table

Problem	Answer
Go to[endpos]	Route Search
I'm going to [endpos]	Route Search
I want to go [endpos]	Route Search
How to get to [endpos]	Route Search
How to get from [startpos] to [endpos]	Route Search
Route from [startpos] to [endpos]	Route Search
I want to go from [startpos] to [endpos]	Route Search

Table 6 Music search problem template table

Problem	Answer
I want to hear [music]	Music
I want to listen to [music]	Music
Play [music]	Music
Search for [music]	Music
I want to listen to [name]'s song	Music
I want to listen to [name]'s song	Music
Play [name]'s song	Music
Search for songs by [name]	Music
I want to listen to [music] from [singer]	Music
I want to hear [music] from [singer]	Music

knowledge. Table 5 shows details of the call instruction number codes of each function module.

The intelligent voice assistant can answer users' doubts well because it has a complete knowledge base. The knowledge stored in the knowledge base provides users with methods and ways to solve problems. These solutions are likely to be some kind of functional instructions. The problem template is shown in Table 6.

3.2 Multi-objective evolutionary algorithm

Using modern optical technology and motion capture algorithm, the optical motion capture device can accurately capture the movement track and action details of the athletes on the sports field, and provide rich motion data for the system. Through the light motion capture device, the system can capture the various movements of the athletes on the sports field in real time, such as running, jumping, turning and so on. Through high-speed image acquisition and image processing algorithm, the device can accurately extract the athlete's motion trajectory and convert it into numerical data. These data can be used by the system to identify, analyze and judge the movement of athletes, so as to evaluate and improve the athletic status and technical level of athletes.

Figure 1 shows a schematic diagram of the hypervolume index in a two-dimensional target space, where the gray part represents a hypervolume surrounded by a combination of non-dominated solution sets and reference points. The larger the number of indicators, the better the characteristics and performance of the algorithm.

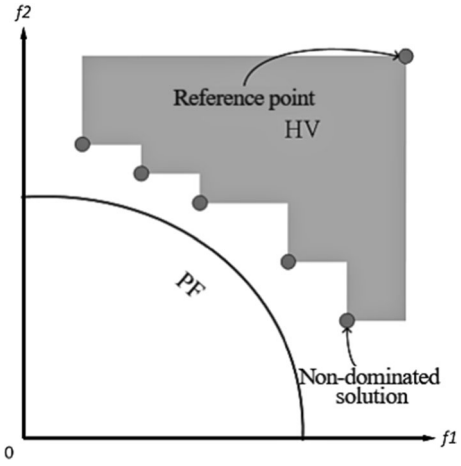

Fig. 1 Schematic diagram of super volume index

The problem of high-dimensional multi-objective optimization: The problem of high-dimensional multi-objective optimization mainly refers to the number of multi-dimensional and multi-objective optimization problems that the number of objectives is greater than, and its description is as follows:

$$\min F(x) = \left(f_1(x), f_2(x), \ldots, f_M(x)\right)^T \tag{1}$$

The definition of frontier, the optimal vector solution set is generally composed of a target space vector corresponding to a target vector space. This kind of optimal solution set is defined as: Pareto frontier, as shown in formula (2):

$$PF = \{F(x^*) = \left(f_1(x), f_2(x), \ldots, f_M(x)\right) x^* \in PS\}| \tag{2}$$

Because of its good theoretical and technical support, it has developed into a more common and widely used evaluation index. The main idea is to calculate a space super-volume value enclosed by a non-dominated solution set and a reference point in order to realize the evaluation of the comprehensive characteristics. Among them, there is the calculation formula (3):

$$HV = \delta\left(U_{i=1}^{|S|} v_i\right) \tag{3}$$

The generation distance is similar. The generation distance refers to the average distance from all the dominant individuals in the non-dominated decomposition set obtained by the algorithm to the individuals in the optimal solution set obtained by the algorithm, while the anti-generation distance refers to the use of It is represented by the average distance from the individual in the optimal decomposition set to the algorithm, that is, reverse mapping, and its basic calculation formula (4) is defined as:

$$IGD(P^*, \Omega) = \frac{\sum_{x \in P^*} dis(x, \Omega)}{|P^*|} \tag{4}$$

The smaller the IGD index, the better the performance of the algorithm.

$$Givenz = \left\{z_1, ..., z_k, z_{k+1}, ..., z_N\right\} \tag{5}$$

The test function was first proposed in 2006. This test function set contains problems, such as fraud, deflection, multi-mode, etc., as well as a set of functions containing a variety of different geometric and structural shapes. All test problems conform to the form (6):

$$wherex = \left\{x_{1,...,}x_M\right\} \tag{6}$$

x represents the set of basic parameters of the number of targets is the basic distance parameter, the front and back working parameters are parameters related to position and distance, respectively, and the response coefficient is the dimensionality minus of the optimal frontier of the test problem.

$$t^{\rho} = \left\{t_1^{\rho}, ..., t_M^{\rho}\right\} \tag{7}$$

The parameters ensure that the value range on each target is different, and that the test problems other than those are non-degenerate problems. It means that the value range on the nth dimension of the decision variable is worth noting that all domains are also test the mathematical expression of the function.

$$Z_{[0,1]} = \left\{z_{1[0,1]}, ..., z_{N,[0,1]}\right\} \tag{8}$$

Some commonly used high-dimensional multi-objective evolutionary algorithm evaluation indicators are introduced in detail, and then two commonly used high-dimensional multi-objective optimization test function sets are listed. Finally, a detailed introduction to the new dominance relations proposed in recent years is given. These dominance relations provide valuable guiding ideas for the new dominance relations proposed in this article.

$$con(x) = \max_{i=1}^{M}\left(\frac{f_i(x) - z_i^*}{\omega_i}\right) \tag{9}$$

Although the norm distance is a useful metric for evaluating the convergence of an individual, it is important to consider the shape of the front as it can greatly influence the performance of this distance. The primary concept behind the convergence index discussed in this section is to assess the maximum value of each dimension distance component from the solution to the ideal point. Given that the weight assigned to each target value may vary, it becomes crucial to assign a weight to each objective function value. This can be done by calculating it in the dominance relationship using Eq. (10).

$$\omega_i = \frac{f_i(x)}{\sum_{j=1}^{M} f_j(x)} \tag{10}$$

Another aspect of the dominance relationship is diversity maintenance, which plays a crucial role in ensuring a diverse population. Grid dominance is commonly employed to control diversity, wherein grids are utilized to separate different solutions. Additionally, in order to promote diversity, evenly distributed weight vectors are incorporated into the θ parameter. The underlying concept shares similarities with niches, specifically in smaller habitats where the most convergent solution is preserved while ensuring a diverse representation. Indexes that rely on angle information are employed to mitigate the impact of individual convergence, thereby facilitating a more comprehensive assessment of diversity.

$$\lambda = \max\left(1, \frac{\partial(x,y)}{\bar{\partial}}\right) \tag{11}$$

The angle between the two solutions is the acute angle calculation formula (12):

$$\theta(x,y) = \arccos\left(\frac{f(x)\cdot f(y)}{f(x)\times f(y)}\right) \tag{12}$$

Only one solution can dominate other solutions, thus maintaining the diversification of the non-dominated solution set. In the same niche, a set of solutions with the highest degree of convergence is selected to ensure the reliability and convergence of the non-dominated solution set.

Assuming that the two solutions are not in the same niche, if the degree of convergence is much worse, there is still the possibility that the solution dominates the solution. The convergence of the non-dominated solution set can still be guaranteed.

$$AD(x) = \frac{\max\left(d_1, ..., d_M\right)}{\frac{1}{M} sum_{m=1}^{M}\left(d_1 +, ..., +d_M\right)} \tag{13}$$

The distance between the solution and the adjacent weight vector serves as an indicator to measure their proximity. In the case of a dual objective problem, two adjacent weight vectors are considered, while for an M objective problem, there will be a single adjacent weight vector. As per Eq. (14), it is evident that the angular distance decreases as the solution gets closer to the center of the angle formed by the adjacent weight vector.

$$d_i = f(x)\cdot\sqrt{1-\cos^2\left(\alpha_i\right)} \tag{14}$$

When calculating the convergence characteristics of the solution, each target is usually aggregated into a coordinate quantity index. The cumulative sum is the simplest and most famous aggregate function to estimate the convergence performance of the solution, as shown in Eq. (15):

$$f_{con}(x) = \sum_{m=1}^{M} f_m(x) \tag{15}$$

In the cumulative sum, solutions near the front often have better evaluation results, while solutions that are far away, such as extreme solutions, often have poor estimation results. Poor performance on a target will lead to the entire solution. The quality is poor, so the evaluation function tends to ignore the extreme points. In the proposed method, another evaluation method similar to the performance scalar function is used, as shown in Eq. (16):

$$f_{con}(x) = max_{m=1}^{M}\left(\frac{f_i(x) - z_i^*}{\omega_i}\right) \tag{16}$$

Among them, i is an ideal point, x represents the lowest value of the objective function value of each dimension, and represents the calculation method of the weight vector corresponding to the solution (17):

$$\omega_i = \frac{f_i(x)}{\sum_j^M f_j(x)} \tag{17}$$

Solutions that perform well in most goals are more likely to get lower ones. Since each goal of a solution corresponds to its own weight vector, for extreme points, there will be a smaller probability and be selected in the subsequent environment selection. Subsequent experiments have also proved that the improvement is compared with the traditional the cumulative sum of, its performance is better.

$$f_{div}(x) = \sqrt{\sum_{y \in P, y \neq x} sh(x, y)} \tag{18}$$

Used to measure the similarity or distance between solutions, The traditional sharing function is calculated using Eq. (19).

$$sh(x, y) = \begin{cases} 1 - \frac{d(x,y)}{\sigma_{share}} \\ 0 \end{cases} \tag{19}$$

Only one solution can dominate other solutions, thus maintaining the diversification of the non-dominated solution set. Selecting a set of solutions with the highest degree of convergence in the same niche ensures the reliability and convergence of the non-dominated solution set. Assuming that the two solutions are not in the same niche, if the degree of convergence is much worse, there is still the possibility that the solution dominates the solution. The convergence of the non-dominated solution set can still be guaranteed. Figure 2 shows Schematic diagram of diversity indicators.

On the sports field, the athlete's behavior and position can be regarded as a high-dimensional target space, and the traditional Euclidean distance cannot accurately measure the distribution of the solution in this high-dimensional space. Therefore, in order to better measure the similarity between the two solutions, the optical motion capture device can use the cosine interaction similarity to measure. Cosine interaction similarity measures the similarity between two solutions by calculating the cosine equation of two vectors. When

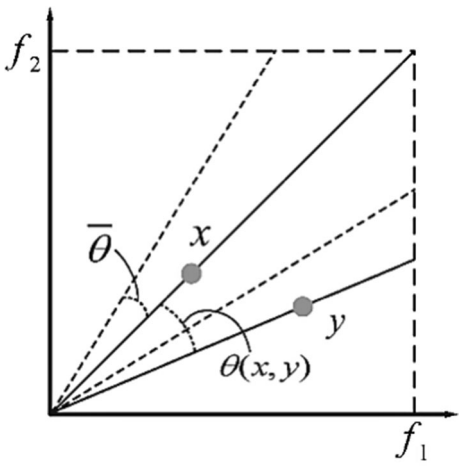

Fig. 2 Schematic diagram of diversity indicators

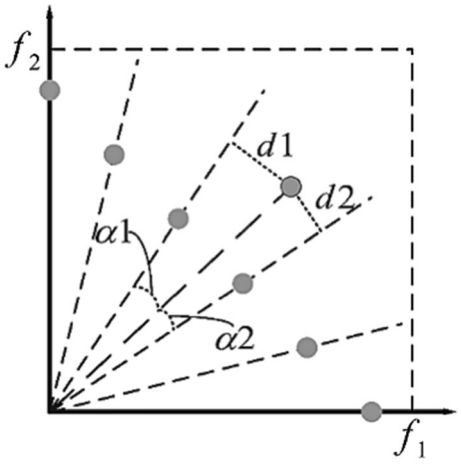

Fig. 3 Schematic diagram of angular distance

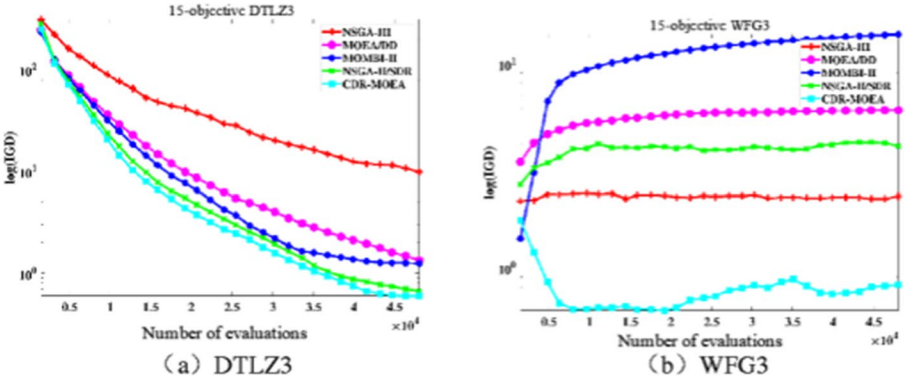

Fig. 4 The average convergence curve of the algorithm on 15 targets and 15 targets

two new target vector Spaces have the same vector target, their similarity is defined as 1; When two new target vectors are mutual or perpendicular in different Spaces, the cosine similarity is defined as 0. Therefore, the cosine similarity ranges from 0 to 1. Angular distance and cosine distance are similar, both of which can reflect the similarity between the two solutions. Figure 3 provides the main idea of angular distance.

Figure 4 plots the convergence curves of the values obtained by each algorithm on 15 targets and 15 targets. Obviously, compared with the other four algorithms, this algorithm can converge to the frontier faster. At the same time, it can only converge when solving 15 goals. In order to further observe the performance of the algorithm, two test questions with 15 goals are selected.

In order to solve the above problems, since cosine similarity can purely estimate the diversity of individuals, the cosine similarity is adopted as a shared function:

$$sh(x,y) = \begin{cases} \frac{f_{con}(x)}{f_{con(y)}}\left(1 - \frac{angle(x,y)}{\theta_{share}}\right) \\ 0 \end{cases} \tag{20}$$

Among them, θ_{share} represents the angle between the solution sum, which is calculated using Eq. (21):

$$\theta_{\text{share}} = 0.3 \tag{21}$$

User-defined parameters used to control the size of the niche. For the population under consideration, the minimum angle between each solution is:

$$\lambda = 0.5 \tag{22}$$

In order to empirically evaluate the performance, two well-known multi-objective optimization test problem sets are used in the experiment, namely, the test function set and the test function set.

$$D = M + K - 1 \tag{23}$$

The maximum number of evaluations is selected as the termination condition of all algorithms, and the population size and the maximum number of evaluations are the parameters used to divide the inner layer and the outer layer.

$$D = K + L \tag{24}$$

The parameters ensure that the value range on each target is different, and that the test problems other than those are non-degenerate problems. It is worth noting that the domain of all $x \in \boldsymbol{x}$ is also the mathematical expression of the test function:

$$t^3_{i=1;N} = bpoly\left(y_i, 0.02\right) \tag{25}$$

4 Auxiliary recognition system for sports arena

4.1 Relevant concepts and methods of risk identification for large-scale sports venues

In order to solve the problem of security risk identification in large-scale sports events and stadium operation, the light motion capture device based on Android intelligent platform is introduced into the sports field auxiliary identification system. This device can capture and recognize the various movements and tracks of athletes on the sports field in real time. Through the use of light motion capture devices, the system can accurately and quickly identify potential safety risk factors. By capturing and recording the athletes' movement data, the optical motion capture device can help the system analyze and identify the athletes' behavior and position, and further find out the possible sources of safety risks. Combined with the system's data analysis technology, the light motion capture device is able to comprehensively search and retrieve data related to safety risks on the sports field, helping the system to accurately identify and analyze risk factors. For large-scale sports events and venue operations, the identification of security risks is very important. Due to the large number of people involved in various competitions, security risks include the risk of security management of the sporting event itself, as well as the normal protection of the venue. Through the application of light motion capture devices, the system can more comprehensively identify and manage safety risks on the sports field. This will provide more

comprehensive and accurate data support for the safety management of large-scale sports events and venues, thereby improving the overall level of safety management.

At the same time, risk identification is not only a task of various risk management agencies, but also requires close communication and communication among various departments such as the Competition Department, the Logistics Department, the Engineering Department, the Information Technology Department, the Volunteer Work Department, and the Medical and Health Department. Risk identification for the operation of sports venues is a connected and uninterrupted process. From the preparation and holding of a sports event to the final end, the conditions and components of the event are subject to change at any time. If volunteers are only a kind of voluntary reception and service for activities, and do not receive wages and salaries on time, the limit for accepting the rules and regulations of the organizing committee is relatively small, and it is prone to unreasonable absences or resignations; athletes are personally personal Or due to organizational reasons, the competition cannot be carried out on time; or because the award-giving guests temporarily change their itinerary, they are not allowed to enter the award-giving scene. When formulating the risk prediction plan for the operation of large-scale competitive sports venues, it is necessary to comprehensively and systematically identify and screen out potential risk factors that may directly affect the normal progress of the event. And it is not possible to miss a part of the risk due to some subjective reasons of the risk manager, especially the major risk. Each sporting event needs to have a detailed event arrangement before and before it is held. It can be based on the environment, activity content, various participants and activities involved in the three stages before, during and after the game. Financial, material and other aspects have a comprehensive grasp of the risks, so that they can provide decision-makers with more detailed and complete decision-making information in a timely and clear manner.

4.2 The basic principles of risk identification for large-scale sports venues

The principle of systematization guarantees the effect of risk identification, while the principle of importance guarantees the efficiency of risk identification. The importance principle means that large-scale sports events need to focus on the identification of risks in the normal operation of venues. The person in charge or general manager of the venue should ensure the smooth development of various sports events and maintain the safe operation environment of the venues as much as possible. Use the lowest capital and economic income to help them obtain the best benefits and reduce the losses caused by risks. Therefore, under the constraints of resources and environmental conditions, risk managers must reasonably choose the best and omissible identification methods based on actual situation requirements; the data are sorted and selected on the basis of comprehensive identification of risk influencing factors. The relatively important risks are obtained and analyzed, which is beneficial to reduce costs and ensure the efficiency of identification. The operation of large-scale comprehensive sports venues needs to involve a wide range, which itself is a complex sports system with multiple structures, multiple factors, and multiple levels. The formation of one kind of risk is often caused by a variety of factors, and a single source of risk may also produce multiple results at the same time, which can easily lead to problems such as overlap, overlap, and omission of risk impact factors.

In this case, the application of light motion capture devices can provide a comprehensive and accurate identification method to help managers better analyze and identify various safety risks on the sports field. Light motion capture devices can capture and record

athletes' movement data in real time, and by analyzing and identifying these data, potential safety risk factors can be accurately identified. Compared with other recognition methods, the optical motion capture device can capture and record various movements and tracks of athletes in real time and accurately through high-precision optical sensors. This high-precision data acquisition capability can help managers identify and analyze potential security risks in more detail. The light motion capture device can capture the data of all athletes on the sports field, and carry out comprehensive monitoring and identification throughout the field. This helps to avoid overlap and omission of risk influencing factors and improve the accuracy and comprehensiveness of identification. The light motion capture device can transmit the captured data to the system for analysis and identification in real time by combining with the Android intelligent platform. This real-time data transmission and analysis capability can help managers identify and address potential security risks in a timely manner.

According to the domino theory and Hatton's energy release theory, risk identification mainly revolves around the goal of running in large-scale competitive sports venues. The goal is to find a factor that is harmful to these goals. Analyzing these factors that are harmful to the target and looking for these risk factors can more comprehensively identify these harmful factors and solve the above problems. Therefore, the goal is to identify the operational risk of large-scale competitive sports venues as its starting point and fundamental. The expert survey method refers to two types of experts (one type is mainly technical personnel and business management personnel who specialize in sports event risk management, and the other type is mainly experts or experts who specialize in sports event risk management work. Scholars) conduct repeated consultations and analyze and summarize the opinions of these experts to determine various risk factors that may affect the construction and operation of sports venues. Finally, an evaluation scale of risk influencing factors was compiled, and relevant experts and their practical staff were invited to make a qualitative estimate of the possibility and severity of various risks. Among them are Delphi method and brainstorming method. The organizer first drafted a risk investigation plan and determined the content of the risk investigation. Invite a number of academic experts who are engaged in the field of risk management knowledge and practice and theoretical research of sports events to answer their questions in the form of distribution of research reports. This market research report is mainly open-ended and does not require any theoretical framework. It only puts forward the various issues that need to be predicted in detail. Experts are invited to work together around the topics to be predicted to study and put forward all the needs to be predicted. Various events. The organizer analyzed and collected all the completed field survey report data of the survey experts according to their needs, and provided them with a list of data that can predict the survey events with accurate language and scientific terms, and collected them as the report of the second round of on-site investigation was distributed to the investigating experts.

4.3 Comparison of risk identification methods for large-scale sports event venues

Different types of risk identification have different application scopes, application stages, qualitative or quantitative means. Different identification technologies have their own characteristics, advantages and disadvantages. Now we compare and summarize common risk identification methods with traditional identification technologies. From this we can clearly see that the structural decomposition method is a combination of qualitative and quantitative. It can be applied to the entire life cycle of decision-making events. It can not

only accurately grasp the overall situation of a complex system, but also integrate it more deeply. Here come the operation details of the event. The operation of large-scale comprehensive sports venues needs to involve a wide range, which itself is a complex system with multiple structures, multiple factors, and multiple levels. The formation of risks is often considered to be caused by or caused by multiple factors, and a single source of risk may also produce multiple results at the same time, which can easily lead to the overlap, overlap or omission of risk impact factors. In order to effectively solve this technical difficulty, this article adopts a target damage-oriented approach to find the factors that damage the target, and then decomposes the factors that are damaged by the target to backtrack the structure, so that we can more comprehensively Identify the risk factors; and make full use of the feature mapping theory to establish the feature set of risk targets, the feature set of target damage, and the feature set of risk influencing factors in the operation of large-scale competitive sports venues. Since the mapping set algebra theory again requires that every element in a set range must not be repeated again, and the mapping set theory again requires a range of values for every element in the set, in other the elements in the definition domain can only be all and only one of them corresponds to each other. By using research methods such as set linear theory, feature theory, and mapping set theory, it is possible to effectively avoid the crossover, overlap and mutual loss of different risk impact factors. Finally, the main factors and characteristics of various factors affecting safety risks were accurately diagnosed, screened, or analyzed and supplemented in time. The preliminary research formed a theoretical framework for the identification of operating risks of large-scale professional sports event venues. Risk identification First, we need to collect basic data and information through search, and on this basis, analyze the risks and uncertainties of various sports venues from different stages, different goals, and the environment in which different events are held. Then it summarized and classified the degree and magnitude of the risk caused by the influencing factors of uncertainty, and finally compiled a risk identification report, which formed the research results of risk identification. Of course, the work of risk identification is a complicated project, and the path of risk identification using different methods will result in different final identification results. There are mainly many types of risk identification methods, which can start from the analysis of the characteristics and nature of risks, predict the source of risk and the necessary conditions for risk conversion; also from the perspective of the process of sports events, takerisks for different stages of the event. Recognition. In order to improve the scientificity of risk identification and the effectiveness of information, combined with the actual situation of Chinese sports competitions, this paper chooses a multi-objective demand-oriented method in the research to establish a set of normative and operable Risk identification path.

4.4 Analysis of other risk sources

The huge hazards of natural disasters are difficult to accurately predict and people cannot effectively resist the characteristics of capabilities, which provide many uncertain factors for the normal operation and safety of large-scale sports events in China and their venues, and affect the normal operation of the venues. For safety, the risk management of venues is shown in Fig. 5. Generally speaking, natural disasters often have a certain destructive ability, causing activities to be temporarily postponed or cancelled, and may even induce major riots and conflicts, which may cause serious casualties. According to preliminary statistics, so far, the two incidents with the largest number of casualties among visitors in the two direct major risk disaster incidents

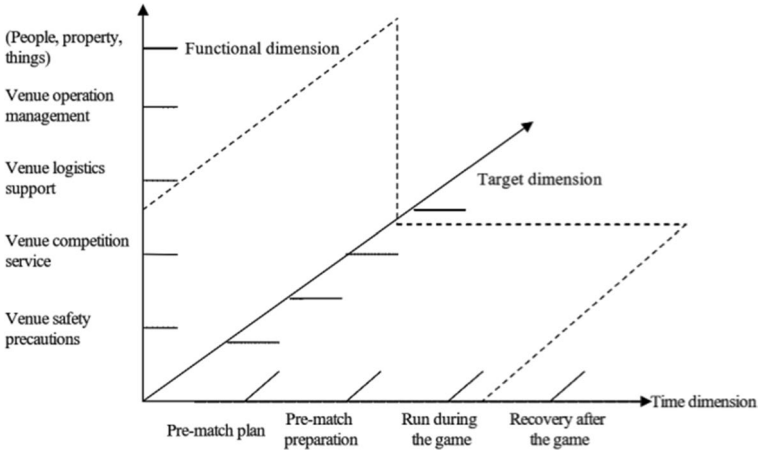

Fig. 5 Three-dimensional structure diagram of risk management for large-scale sports venues

in stadiums caused by various reasons of natural disasters are the two outbreaks in the stadiums in Kathmandu, Nepal in 1988 The riotous mass riots, crowding and violent trampling directly triggered by the second violent winds, heavy rains and hail caused nearly 100 casualties and deaths in total. And so far, the most serious football incident in China occurred at the Dongfeng International Stadium in Kunming, Yunnan, China. At about 2 pm on February 7, 1985, 25,000 Chinese spectators entered the stadium to participate in the Dolton, Hungary. An international football match between the national football team and China's Yunnan team. The game was about to be over. The sudden heavy rain in the sky caused the touchpad to fall on the ground and caused a strong trampling. A total of 8 people were killed and 167 people were injured by pedaling, 33 of whom suffered minor head injuries.

In this case, the application of light motion capture devices can help predict and identify the potential impact of natural disasters on sports venues and events to a certain extent, thus providing better risk management and safety measures. The light motion capture device can capture and record athletes' movement data in real time and accurately, which can not only be used to analyze and identify safety risks, but also to predict and warn natural disasters through relevant algorithms and models. The large amount of motion data obtained through the light motion capture device can be applied to machine learning and data analysis and other technologies, through the integration and analysis of historical data and real-time data, predictive models can be established to predict the potential impact of natural disasters on venues and events in advance. For example, through the data analysis of different natural disasters and related influencing factors, a model can be established to predict the specific impacts that may occur in a certain venue under a specific natural disaster, such as the bearing capacity of the venue structure and the efficiency of audience evacuation. Light motion capture devices can also be used in conjunction with other sensors to further improve the accuracy and reliability of natural disaster prediction. For example, through joint applications with weather sensors, more accurate weather data can be obtained to better predict weather conditions that may trigger natural disasters.

5 Conclusion

This paper proposes and develops a novel dual-file multi-objective evolutionary algorithm specifically designed for multi-objective optimization problems. The algorithm integrates genetic algorithm for global search and incorporates two distinct archives for local search. By leveraging genetic algorithm in the global detection phase, the algorithm effectively enhances the convergence rate. In the local search phase, reverse learning technology is employed to augment the algorithm's capability to capture local optima when escaping them. Empirical results demonstrate that the proposed algorithm outperforms classic multi-objective algorithms in terms of both convergence and diversity, thereby showcasing significant performance improvements. This paper takes the specific operational risk response of large-scale competitive sports events and stadiums as the main objects of its risk research. Through the analysis and identification of stadium operation management risks, it has clarified the possible operational risks, and further researched and constructed stadium operation management risks. The basic index system of the assessment and the detailed rules for the implementation of the operational risk assessment system; then through the operational risk assessment, the results of the analysis are followed to obtain the maximum probability and potential economic losses that these major risk factors may occur; in a comprehensive analysis of these major risk factors. As a new auxiliary recognition system, light motion capture device can help managers better analyze and identify the safety risks on the sports field by capturing and recording the movement data of athletes in real time. The application based on Android intelligent platform further improves the practicability and convenience of light motion capture device. In conjunction with other sensors, light motion capture devices can also predict and identify the potential impact of natural disasters on stadiums and events, further enhancing the effectiveness of safety management. The application of light motion capture device in the sports field auxiliary identification system is of great significance, which can provide strong support and guarantee for the safety management of large-scale sports venues and events.

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Declarations

Conflict of interest The authors declare that they have no competing interests.

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