

## Research Article

# Detection and Application of Mobile Target Image Based on Artificial Intelligence

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In the 21st century, with the rapid development of high technology, artificial intelligence technology is becoming more and more mature, and its application in various aspects is becoming more and more extensive. Image recognition is an important feature of artificial intelligence. For mobile target image detection and application, the reasonable application of artificial intelligence technology and related research analyzes the changes brought by mobile target image detection and application and adopts its optimal scheme which can improve the innovation of mobile target image detection and application. Moving object image detection and tracking are the algorithm process of intelligent dynamic analysis. It also provides a lot of help for the development of many research aspects. This paper analyzes and studies the detection and application of mobile target images from the perspective of artificial intelligence and improves the algorithm of the current target image detection. The improved artificial intelligence algorithm will be applied to future mobile target image detection and application. The results show that in the nonoptimized detection and reconnaissance system of moving targets, the program can run in parallel after the system is optimized, and the running time of each image is kept between 5 and 8 seconds, thus improving the system's performance. Through the continuous trend of linear graphics, the number of actual test frames increases, the line graph tends to be stable, and the performance is improved by about 20–30 times, which shows the feasibility of the algorithm.

## 1. Introduction

With the rapid development of artificial intelligence technology, the simulation of human vision is based on image recognition features, which can be used for identity authentication, security monitoring, model comparison, and other aspects, and has a wide range of application prospects in many fields [1]. This paper presents an algorithm for the detection of background-moving target images. Each pair of saved images underwent differential surgery, and then the three differential images were multiplied by the pixels to obtain very clear correlation peaks on the moving target. This is yet another stage [2].

The video mobile target recognition and tracking system combine a variety of advanced computer technologies, including shape recognition, artificial intelligence, and image processing. This is one of the main research directions in the field of computer vision. Currently, in practice, targets

become blurred due to background changes, shadow interference, and other factors. Therefore, when discussing and improving target detection and tracking algorithms, people often focus on improving the accuracy of moving target image detection in video systems. In this paper, the target detection and tracking algorithm is based on the bold idea of how to solve the puzzle. Firstly, the knowledge related to the basic image segmentation technology is introduced, and the advantages and disadvantages of three commonly used algorithms in target detection are reviewed and analyzed. The background difference method and the three-image difference method are proposed, and the hybrid difference method is studied and tested. The paper reveals an AI-based online rapid detection method of optical remote sensing image objects to create a network model for rapid object discovery. We use the target dataset of optical remote sensing images to train and evaluate a target fast detection network model. An invented optical remote sensing mobile

object image detection method can cope with complex external interference with the advantages of high detection accuracy, fast detection speed, low memory allocation, low cost, and low energy consumption for embedded mobile platforms, etc. Real-time detection speed and high detection accuracy can be realized on the embedded platform, which can be used for remote sensing detection of targets from mobile devices such as the platform [3].

With the rapid development of artificial intelligence in the Internet of Things, the establishment of the Internet of Things can make breakthroughs in the field of artificial intelligence. Traditional image recognition methods use a wave power algorithm to subdivide the background noise and the edge noise. This causes some problems, such as poor resolution, low image recognition accuracy, slow detection speed, and insufficient image depth analysis. The design of the AI image recognition system based on object Internet has the advantages of high image recognition rate, high recognition accuracy, stable operation, and high processing efficiency. It provides a new design idea for the research and development of image recognition system and has a good application value of [4]. At present, face recognition technology has been effectively used in the security control system and mobile payment system, greatly improving people's quality of life and ensuring the safety of people and property. Traditional image recognition systems use a waveform energy algorithm that is very susceptible to background types, reflecting the problems of slow capture speed, low resolution, and low accuracy. It cannot meet the current image recognition requirements. The artificial intelligence image recognition system is based on the development of the Internet of Things technology. In order to ensure the design quality, it is necessary to strengthen the research of AI mutual recognition system to improve the timeliness and accuracy of image recognition. This paper starts with the idea of designing an artificial intelligence image recognition system based on the Internet of Things and analyzes how to design an artificial intelligence image recognition system based on the Internet of Things in order to make full use of the advantages of the Internet of Things technology [5]. Traditional wavelet image recognition algorithms can no longer meet the development needs of modern object recognition on the Internet. Then, the wavelet image recognition algorithm has accuracy and speed defects. Based on the abovementioned phenomenon, this paper adopts artificial intelligence capture technology to extract the basic features of images and then combines the powerful computing power of the object Internet and its massive data information to analyze and deconstruct the collected image features. According to the feedback feature signal, the object Internet artificial intelligence image recognition system is constructed through the comprehensive object Internet artificial intelligence image mobile target image detection [6].

The algorithms used in traditional image recognition systems are mainly wave energy algorithms. The mobile target image detection method based on the wavelet energy algorithm is susceptible to the image edge noise and background type and has some defects. Slow image

recognition speed, low image recognition accuracy, and low image recognition ability cannot meet the current human needs for image recognition. Driven by the rapid development of the Internet of Things technology and artificial intelligence technology, the artificial intelligence image recognition system based on the Internet of Things has been developed, which effectively improves the accuracy and timeliness of the image recognition system and makes up for the deficiency of the traditional image recognition system. Based on the basis of previous research results, this paper discusses in detail the design of an object Internet AI image recognition system and the realization of an image recognition function, which provides a reliable reference for the extensive use of object Internet AI image recognition systems [7].

Visual images and computer systems are systems that enable the computer to perceive, process, and understand efficiency. The working environment of moving target image detection is very complex [8]. The experimental comparison of the target segmentation detection results of crops and fruits under different light conditions shows that this method can maintain a good detection effect compared with other commonly used detection methods under different light conditions [9]. Traditional passive tracking methods are vulnerable to complex environments and produce a large number of false sites, resulting in low positioning accuracy and long positioning time. Thus, a passive positioning method based on multisensor and multitarget artificial intelligence is proposed to optimize the correlation of cluster-based elastic neural networks, and accurate target angle information can be obtained in different periods. As long as all the sensor targets can be observed and the detection radius is large enough, the target dynamics model, the target metric model, and the moving sensor motion state models are created. According to the localization principle of model analysis, the results of cross-localization experiments using data to achieve goals show that this method can perform accurate and rapid passive localization of multiple sensors and multiple targets, which has important theoretical and practical applications [10]. Mobile target image detection technology is an information technology developed in the information age, which mainly uses artificial intelligence to replace human beings and process a large amount of information. This paper summarizes the principles and shape recognition of image recognition technology and analyzes the recognition process, focusing on the reduction of neuronal network and nonlinear dimensions. It should be a reference for researchers and users related to image recognition [11].

Image recognition technology is an important technology in the information age, designed to enable computers rather than humans to process large amounts of physical information. With the progress of computer technology, people's understanding of image recognition technology has improved as the image recognition process is divided into information acquisition, preprocessing, function, extraction and selection, decision classification, and classification. Articles are very easy to analyze with pictures. Subsequently, image recognition techniques for neural networks and

nonlinear dimensions are introduced. There are many application fields of image editing technology that can be summarized. Human life cannot be separated from image recognition technology, and the importance of image editing technology is discussed [12]. Artificial intelligence is a pet in today's technology era, which is conducive to the rapid development of the country and society and facilitates people's lives. Image recognition is a widely used field in artificial intelligence, fingerprint, face recognition information, fast image search, environmental monitoring, and so on [13]. Since the 21st century, artificial intelligence has developed so rapidly that it has gradually expanded to various fields and affected various fields. Mobile target image detection is an important feature of artificial intelligence. Mobile target image detection technology has therefore become a high priority. This paper analyzes the AI-related mobile target image detection technology and further improves the application of mobile target image detection technology [14]. In the related research process, the abovementioned research literature has high recognition efficiency and accuracy for fixed targets, but there are multitarget problems, noise, and interference problems in moving target recognition, which lead to poor recognition effects. In this paper, a moving target image detection method based on artificial intelligence is proposed, which has a good recognition effect and accuracy.

In the face of the doubt of traditional methods for moving target image detection and application, the interpretability of artificial intelligence technology is studied. Based on domain knowledge, an interpretable design trial method has been established to promote the development of cross-research between artificial intelligence and moving object image detection and application. For the moving target image detection and application of the full and reasonable use of artificial intelligence technology and related research, for its moving target image detection and application of the changes brought about by the analysis, to take its optimal solution can improve the innovation of moving target detection and application.

## 2. AI Detection-Related Algorithms

**2.1. Frame Difference Method.** The frame difference method is a time-based difference method. It is thought that the background does not change significantly in a short time when the target moves between frames. Two adjacent frames can be distinguished to obtain absolute values of the image difference. The threshold is then set to binarize the image, extract the moving regions, and determine the target. When handling frame differences, the key is to set the threshold value. A high threshold causes incomplete target extraction and missing useful information. The choice of threshold usually depends on certain external environmental conditions. The algorithm steps are as follows:

$$\begin{aligned} D_{(k-1,k)} &= |I_k - I_{k-1}|, \\ D_{(k,k-1)} &= |I_{k+1} - I_k|. \end{aligned} \quad (1)$$

A threshold is set to binarize the difference image.

$$\begin{aligned} B_{(k-1,k)}(x, y) &= \begin{cases} 0, D_{(k-1,k)}(x, y) < T, \\ 1, D_{(k-1,k)}(x, y) \geq T, \end{cases} \\ B_{(k,k+1)}(x, y) &= \begin{cases} 0, D_{(k,k+1)}(x, y) < T, \\ 1, D_{(k,k+1)}(x, y) \geq T. \end{cases} \end{aligned} \quad (2)$$

Formulas (3) and (4) obtain the final formula (4):

$$G_k(x, y) = \begin{cases} 0, R_{(k-1,k)}(x, y) \cap R_{(k,k+1)}(x, y) = 0, \\ 1, R_{(k-1,k)}(x, y) \cap R_{(k,k+1)}(x, y) = 1. \end{cases} \quad (3)$$

**2.2. Mean Background Modeling.** The average background method is a relatively simple background modeling algorithm [15]. The principle is to obtain a continuous sequence image from the video and represent the background model according to the average of each pixel plus a certain threshold range [16]. The algorithmic steps are as follows

- (1) The cumulative background general algorithm is as follows:

$$\begin{aligned} G_M &= \sum_{k=2}^M I_k, \\ F_M(x, y) &= \sum_{k=2}^M F_k(x, y) = \sum_{k=2}^M |I_k(x, y) - I_{k-1}(x, y)|. \end{aligned} \quad (4)$$

- (2) Creating a statistics-based background model:

$$\begin{aligned} u(x, y) &= \frac{1}{M} G_M, \\ u_d(x, y) &= \frac{1}{M} F_M, \end{aligned} \quad (5)$$

$$d_s(x, y) = \sqrt{\frac{1}{M} \sum_{k=2}^M \sum (F_k(x, y) - u_d(x, y))^2}.$$

- (3) Splitting the background model to segment the background:

$$\begin{aligned} d(x, y) &= I(x, y) - u(x, y), \\ \text{output}(x, y) &= \begin{cases} 1, |d(x, y)| > T, \\ 0, \text{otherwise.} \end{cases} \end{aligned} \quad (6)$$

- (4) The background update formula is as follows:

$$\begin{aligned} u'(x, y) &= (1 - \alpha) \times u(x, y) + \alpha \times I(x, y), \\ u'_d(x, y) &= (1 - \alpha) \times u_d(x, y) + \alpha \times F(x, y), \\ d'_s(x, y) &= (1 - \alpha) \times d_s(x, y) + \alpha \times |F(x, y) - u'_d(x, y)|. \end{aligned} \quad (7)$$

Here is the learning rate, the value ranges from 0 to 1; the larger the value, the faster the fitness for background change.

### 3. Related Algorithms for Image Detection

#### 3.1. Convolutional Neural Network

**3.1.1. Convolutional Layer.** Convolutional layer is the most important part of convolutional neural network and is calculated as follows:

$$x_j^l = f\left(\sum_{i \in N_j} W_{ij}^l * x_i^{l-1} + b_j^l\right). \quad (8)$$

**3.1.2. Pooling Layer.** The pooling layer is used to reduce the dimension of the feature graph matrix, reduce the amount of operation, and enable the model to identify a part of the image that has been moved or processed. The calculation formula is as follows:

$$x_j^l = f(\beta_j^l \text{down}(x_j^{l-1}) + b_j^l). \quad (9)$$

#### 3.2. Improved Algorithm for the Detection of Sequence Fragment Images

**3.2.1. Improved Detection Algorithm.** The NMS algorithm is developed to improve the accuracy of detection. The improved reset function is

$$S_i = \begin{cases} s_i, & IOU(M, b_i) < N_i, \\ 0, & IOU(M, b_i) \geq N_i. \end{cases} \quad (10)$$

A modular transformation-based model is designed in the NMS algorithm to improve the score reset function of the algorithm. The score reset function of the modified NMS algorithm is

$$S_i \longrightarrow f(IOU(M, b_i)), \\ f(IOU(M, b_i)) = \begin{cases} s_i, & IOU(M, b_i) < N_i, \\ s_i(1 - IOU(M, b_i)), & IOU(M, b_i) \geq N_i. \end{cases} \quad (11)$$

**3.2.2. Network Training of the Improved Algorithm.** To ensure that the parameters of the convolutional layer remain unified, the fully connected layer is fine-tuned using the RPN to form a unified network [17]. However, during training, the loss function for each fragment candidate region is

$$L(p_i, t_i) = \frac{1}{N_{cls}} \sum_i L_{cls}(p_i, p_i^*) + \lambda \frac{1}{N_{reg}} \sum_i p_i^* L_{reg}(t_i, t_i^*). \quad (12)$$

Because there is a gap in the actual training process, we introduce a method to reduce the gap, thus ensuring that the calculation of the network loss function can consider two loss functions [18].

$$L_{cls}(p_i, p_i^*) = -\lg[p_i p_i^* + (1 - p_i^*)(1 - p_i)], \\ L_{reg}(t_i, t_i^*) = \sum_{t \in \{x, y, w, h\}} \text{smooth}_{L1}(t_i, t_i^*), \quad (13)$$

$$\text{smooth}_{L_j}(x) = \begin{cases} 0.5x^2, & \text{if } |x| < 1, \\ |x| - 0.5, & \text{otherwise.} \end{cases}$$

In the model, the weight decay is set to 0.0005 and the power to 0.9, which can reduce the probability of training error for progress, after the updated rule is

$$v_{i+1} = 0.9v_i - 0.0005\epsilon w_i - \epsilon \left( \frac{\partial L}{\partial w} \Big|_{D_i} w_i \right), \quad (14)$$

$$w_{i+1} = w_i + v_{i+1}.$$

### 4. Development Status of Mobile Target Image Detection

**4.1. Overview of the Detection Technology.** Today, with the development of technology, much work has been replaced by artificial intelligence, thus entering the era of artificial intelligence. Computer vision analysis is the entire process of converting information in recorded video images into digital signals and analyzing and processing received signal information [19].

Mobile target image detection plays a very important role in artificial intelligence. From a technical perspective, mobile target image detection is an algorithmic process of intelligent dynamic image analysis. From the analysis of application, he has completed various intelligent tasks for our company. From the perspective of discipline, with the continuous development of technology, it has become common to use intelligent devices instead of boring physical labor. Camera motion includes 360-degree rotation of the field camera, fixed shaft motion of the camera, or loading of the mobile device. Camera motion analysis is more complex and can move the background of the video image. There are many failures in the traditional background analysis algorithm, so a new algorithm is needed to solve this problem, and the difficulty has also increased [20].

**4.2. Summary of Target Detection Technology.** Without prior knowledge, target detection is the first step in target tracking technology. The principle is to use a detection algorithm to separate moving targets from the background without knowing which one is present in the scene. Currently, the mainstream recognition algorithms include the interframe difference algorithm, background modeling algorithm, and image segmentation algorithm [21]. It is assumed that the background system does not change significantly in a short time, and the motion information can be obtained based on the image difference results of two or three consecutive images. The algorithm has low time complexity and is easy to use, but has limited application schemes and poor detection of slow or fast moving targets. Furthermore, if the brightness

of the scene changes suddenly, it is easy to create the wrong targets.

In general, today's target recognition algorithms can work well in simple contexts or changing situations, but for complex systems, they often encounter various problems, and their real-time performance, accuracy, and reliability are all affected.

*4.3. Difficulties and Development Direction of Mobile Target Image Detection.* A good visual image tracking system should have the advantages of good real-time performance, high tracking accuracy, and a powerful tracking process. However, these features are difficult to simultaneously observe due to various disturbances in the monitoring process [22]. The challenges of monitoring objectives are mainly reflected in the following aspects:

- (1) Target deformation, such as deformation caused by zooming, rotating, or changing the viewing angle.
- (2) Context changes are uneven. Currently, there are some applicable modeling methods with conventional background changes, but background modeling with conventional changes is difficult and easy to obtain error detection.
- (3) If there are multiple goals close to each other, it is easy to join, thus reducing the number of targets.
- (4) From the camera point of view, the small target is completely locked by the large target, and the tracking algorithm cannot track when the locked target appears again.

Of course, different systems require different axes of tracking algorithms, but these difficulties are common problems that need to be solved by tracking systems. Based on the comprehensive analysis, the future development direction of the target tracking algorithm mainly lies in the following [23]:

- (1) Study combining data from multiple sources, such as wireless sensor networks combined with target tracking and multiangle tracking, to address blocking and background changes.
- (2) Reviewing the universal evaluation criteria. Monitoring objectives are an ongoing process, and assessing the relevance of the data is also a major area of research.
- (3) Reviewing the human visual characteristics, imitating the process of storage, comparison, and extraction of information, and making the target tracking process more intelligent [24].

## 5. Examples of Research

*5.1. Experimental Environment.* To study mobile object image detection and application, image object detection is tested.

Tables 1 and 2 show the external environment of the mobile target test and it is comprehensively developed and tested in the C++ 14 language version.

*5.2. Source of Experimental Data.* The experimental data mainly include the videos collected on the website about the UAV moving in the relevant dynamic background and the basic information collected on the UAV. Sample label information is described by the appropriate UAV image number and position information so that the video information and label information can be directly trained when forming an appropriate classification model. There is no reverse sampling in the dataset, but if you drive the model accordingly, you can label the nonadvanced sampling in the video as reverse sampling.

The data focus on both internal and external scenes, lighting effects, and background complexity. The data collected by the Computer Vision Laboratory of the Swiss Federal Institute of Technology mainly include outdoor scenes, and the data collected by the website mainly include indoor scenes. Thus, the sum of the datasets can be used as experimental data for moving target detection in a dynamic background.

### 5.3. Experiment Results and Analysis

*5.3.1. Target Identification Accuracy Test.* For the mobile object detection and recognition system in the dynamic background, the accuracy of the mobile object detection and recognition is an important standard to measure the image detection system. Experimental accuracy was mainly verified by the selected target location and subsequent manual work and calculated for correct detection and error detection.

Similar algorithms are available to detect moving targets. Table 3 was compiled from the precision statistics of this set of experimental data. Through the experimental data, it can be determined that traditional algorithms such as DPM, random forest, and ACF have poor background detection effect, dynamic background, and cannot be accurately detected. Only the transaction compensation algorithm and the new algorithm proposed in this paper perform quite well.

However, the slow operation speed of the motion compensation algorithm is the main bottleneck of the dynamic background, so it is still unsuitable for practical use. Then, we experimentally compare the original motion compensation algorithm and the execution speed of the proposed algorithm.

*5.3.2. System Processing Speed Test.* To verify the accuracy of the algorithm, multiple measurements were analyzed. A total of 5 measurements are calculated and recorded in Table 4. Then, Table 4 is used to make a line chart for easy observation, which is shown in Figure 1.

It is clear from the line in Figure 1 that in the unoptimized detection and reconnaissance system of moving targets, it takes about 10 seconds to process each image on average, mainly due to the large computational effort and the time required for the reconnaissance part of the target. After optimizing the system, the program can run in parallel, keeping the running time of each image

TABLE 1: Experiment hardware environment.

Hardware	Model
CPU	AMD FX-6100 six-core
Internal storage	Kingston, DDR3 1333 MHz
Lay in	West Number WDC WD20EZRZ-00Z5HB0

TABLE 2: Experimental software version.

Software	Edition
MATLAB	R2017a
Visual studio	2013
OpenCV	2.4.9

TABLE 3: Comparison of the accuracy of the algorithms in similar studies.

Algorithm	DPM (%)	Random forest (%)	ACF (%)	Motion compensation (%)	Text method (%)
Accuracy	57.3	61.8	65.2	78	81

TABLE 4: Average image processing time per frame.

Video (frame)	50	100	150	200	250	300	350	400	450	500
The original system	9.8	8.9	10.2	9.6	11.12	10.4	10.5	10.2	10.22	11.12
Optimized code	7.8	4.8	5.6	5	6.2	7.4	5.8	6.6	6.80	6.21
Improve the algorithm	0.13	0.11	0.26	0.4	0.56	0.32	0.33	0.41	0.53	0.42

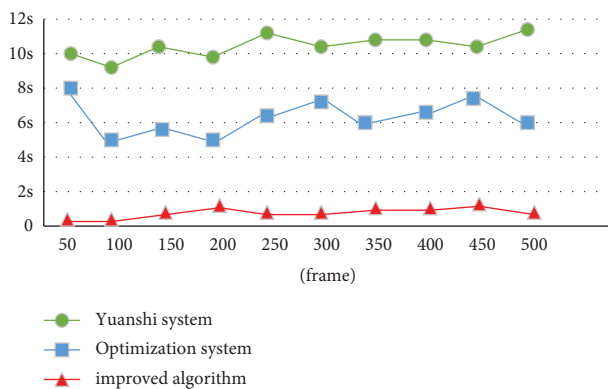


FIGURE 1: The processing time of each frame before and after the improvement.

between 5 and 8 seconds, thus improving the system performance. Finally, the improved algorithm is introduced. Each image runs for about 400 to 500 ms and can be greatly increased in run time. When testing between 50 and 150 video frames, the average running time per frame was less than 0.3 seconds. It can be seen from the experimental video that the experiment is good because the image background is relatively stable. With increasing test data, the average running time per frame was also stable between 400 and 500 ms.

*5.4. Analysis of the Experimental Results.* The results are analyzed from both the mobile target detection accuracy and the running speed of the system.

First, there are many difficulties that affect the accuracy of target detection, such as the detected diversity of target shapes, small target size, and background dynamic changes, which will correspondingly affect the accuracy of target detection. In this experiment, the accuracy of detecting the moving target will be 83%, and the original method will reach 80%. The main reason for the improved detection accuracy is that a large number of background profiles and noise are filtered out when shielding the target, so that the threshold of detecting the target can be lowered accordingly when the target is finally determined. With few interference conditions, the results of detecting moving targets will naturally improve.

Furthermore, the experimental results of the system running must record the current time at the beginning and end of the system and create statistics based on two-time differences. To compare the improved execution effects, the improvement time of the original detection and detection algorithms will be computed after adding the optimized link or the improved algorithm, as shown in Table 5.

By analyzing the experimental results in Table 5 and line in Figure 2, the operating performance of the system was roughly doubled after optimizing the code, as shown in the blue line in Figure 2. The red line indicates the overall effect of the system enhancement after adding the enhancement function. If the test images are less, the performance of the test results will increase by 75 times, mainly due to the special experimental scene data. Through the continuous trend of linear graphs, it can be determined that the increase of the actual test frame number stabilizes and the

TABLE 5: Time performance multiples.

Video (frame)	50	100	150	200	250	300	350	400	450	500
Code optimization	1.2	2.2	1.8	1.9	1.7	1.41	1.8	1.5	1.50	1.7
Algorithm improvement	75.3	21.7	39.2	24	19.8	32.5	31.8	24.8	19.28	26.4

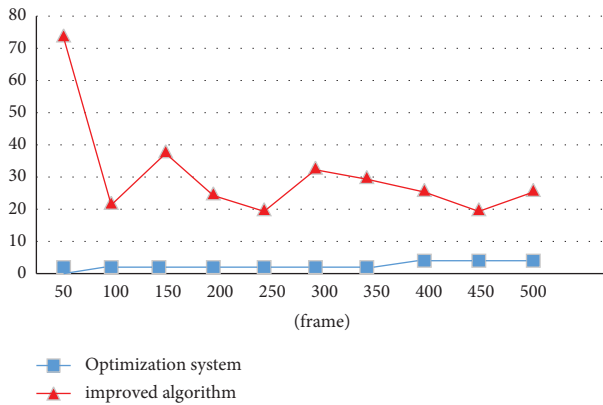


FIGURE 2: Time performance improvement multiple.

performance improves by about 20–30 times, which proves the feasibility of the algorithm.

## 6. Conclusion

In view of the problems existing in mobile target image detection and application in the current era of science and technology, various artificial intelligence algorithms are preliminarily studied and need to be further explored. In the era of new technology, especially in artificial intelligence, the mobile target image detection and application have just started facing many uncertainties and challenges, but the application prospect is broad.

- (1) Aiming at the development frontier of mobile target image detection and application, and constantly introducing the latest computing intelligence algorithms to provide methods for mobile target image detection and application research. The image detection and application of mobile targets are taken as the focus of research, and the characteristics of different mobile target images are compared and analyzed through simulation experiments, so as to further improve the detection and application ability of mobile target images under the background of artificial intelligence.
- (2) Facing the doubts of traditional methods on the detection and application of mobile target images, we conduct research on the interpretability of artificial intelligence technology. Based on domain knowledge, we will establish an interpretable design trial method to promote the development of cross-sectional research in artificial intelligence and mobile target image detection and application.
- (3) For mobile target image detection and application of mobile target images, the rational application of

artificial intelligence technology and related research, analyzing the changes brought by mobile target image detection and application and adopting its optimal scheme can improve the innovation of mobile target image detection and application [25].

## Data Availability

The experimental data used to support the findings of this study are available from the corresponding author upon request.

## Conflicts of Interest

The authors declared that they have no conflicts of interest regarding this work.

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