J. COMBIN. MATH. COMBIN. COMPUT. 127a (2025) 8579--8591

Journal of Combinatorial Mathematics and Combinatorial Computing
www.combinatorialpress.com/jcmcc

Exploration of Detection and Management Mechanism of Public Health Emergencies in Smart Communities Based on Computer Vision

Juan Wang[1,2,✉], Qiang Li[3], Yanyan Wang[4]

[1] *School of Management Science and Engineering, Shandong Technology and Business University, Yantai, Shandong, 264003, China*
[2] *School of Business, Qingdao University, Qingdao, Shandong, 266071, China*
[3] *Safety and Emergency Department, Yantai Engineering and Technology College, Yantai, Shandong, 264006, China*
[4] *Yantai Vocational College of Culture and Tourism, Department of Tourism management, Yantai, Shandong, 264005, China*

ABSTRACT
In order to be able to study in-depth image recognition technology for the detection of emergencies, this paper firstly adopts the image processing technology image processing, removes the noise in the image, improves the clarity of the image, and reduces the distortion of the image. Secondly, the signal in the image is extracted, and the network transmission algorithm is used to detect the signal in the image and calculate the corresponding transmission energy value. Finally, a standard threshold is set according to the calculation results, and once the transmission energy exceeds the threshold, it is an abnormal event. The analysis of the emergency event detection model based on image recognition technology shows that the image contrast effect is good, around 8.5 points, indicating that the image quality obtained based on image recognition technology is good. For the third emergency detection, the value based on image recognition technology is 93.3%, the detection results are more accurate, the response speed is faster, the fastest can reach about 1.1s, can real-time feedback on the results of the detection of the emergency situation in a timely manner to deal with the emergency situation, to reduce the loss of personnel, and to improve the efficiency of the management of the smart community emergencies of public health events.

Keywords: image recognition technology, emergencies, image distortion, image contrast, public health events

1. Introduction

In today's era, technology is developing rapidly, and smart community technology is gradually

✉ Corresponding author.
E-mail address: 202013809@sdtbu.edu.cn (J. Wang).
Received 15 January 2024; Revised 10 February 2024; Accepted 30 November 2024; Published Online 15 April 2025.
DOI: 10.61091/jcmcc127a-474

maturing and becoming the main direction of mature quality. Smart community is mainly a technology that combines information technology such as Internet of Things, computers and artificial intelligence as a way to improve the efficiency and quality of community management [1]. However, due to the traditional detection and response mechanism is difficult to face the large-scale data processing and detection, the efficiency of management is low, so it is necessary to introduce the image recognition technology, so as to be more clear and convenient to the community's emergencies processing and detection. Image recognition technology mainly recognizes and processes images, analyzes the scenes and features in the images, and manages the people in the community [2-3]. Therefore, using image recognition technology to detect and manage emergencies in the community not only improves the efficiency of management, but also provides timely feedback on emergencies, enables real-time monitoring and management of the situation in the community, reduces the pressure on the staff, and provides support and promotion of smart communities [4-5].

In this paper, firstly, the image processing technology is utilized to process the image captured by the camera and other devices, remove the noise in the image, make the image clearer, and carry out feature extraction on the processed image, so as to facilitate the subsequent detection of the image. Second, the network transmission algorithm is utilized to detect the signals in the image, evaluate the transmission energy in the image, and set the evaluation threshold according to the transmission capacity signal. Finally, according to the set threshold, determine the abnormal transmission energy in the image signal, so as to detect emergencies in public places, and timely treatment of emergencies to avoid the loss of personnel and property. Faster detection results can improve the management efficiency of the community, reduce the workload of the staff and improve the accuracy of detection. It can carry out real-time management of the situation in the community, reduce the occurrence of emergencies, and promote the intelligence of community management. Combining image recognition technology and management technology promotes the development and progress of the image recognition field and community management.

2. Related Works

In detecting and identifying emergencies in public places, Peixoto, J. et al. analyze and activate critical response-related infrastructure settings after detecting emergencies, and utilize the facilities and response mechanisms to deal with and defend against emergencies in order to minimize people's losses. Locating and deploying the area according to the localization algorithm to mitigate the emergency situation. The results show that this approach can quickly detect emergencies and activate the response mechanism in time to avoid casualties and property losses [6]. Peixoto, J. et al. calculated risk zones for cities with sudden emergencies and launched a search in a map to obtain the location and modeling of the site, activating the response mechanism of the city in the emergency situation to deal with the emergency. The response mechanism of the city is activated to handle the emergency. Assistance is provided according to the needs of the city to minimize the loss of the city. The testing of this method shows that the detection of emergencies is more rapid, the feedback results are faster, the response mechanism can be activated quickly, the reliability is stronger, the response speed is faster, and the accuracy of the detection is higher [7]. El Khatib, R. et al. proposed a model for detecting anomalous changes in monitoring variables based on crowd perception and heterogeneous data, where anomalous changes represent emergent situations. The problem was formulated in terms of sequential change point detection and Shiryaev's test was utilized to construct two variants of the solution as a way to detect emergent situations in public places. Tests have shown that the method is more accurate and faster in detecting, and can sense abnormal events in public places and solve them in time, with strong validity and reliability [8]. Park, J. et al. designed an on-device, real-time urban sound monitoring system, which is utilized to categorize various urban sounds and accurately detect emergencies in the city. The system mainly consists of edge AI nodes and FIWARE based server. In order to achieve real-time inference on the resource-constrained edge

AI nodes, the input and model configurations need to be adapted, and a lightweight convolutional neural network is utilized to achieve high-accuracy sound classification and detection. According to the experiments, the model has a high accuracy rate, which can reach 94.7%, and is able to detect abnormal behaviors in public places in a timely manner and handle the corresponding events according to the response mechanism [9]. Xu, Z. et al. proposed the 5W model with which to detect emergencies. First, social media users were set as the target of crowdsourcing in order to detect unexpected events more accurately. Second, spatial and temporal information is extracted from social media to detect real-time events, which are monitored and analyzed in real time. Finally, an annotated GIS-based urban outbreak detection is demonstrated to monitor and analyze outbreaks. The testing and evaluation of the approach concluded that the method is faster and more accurate for the detection of emergencies, has high real-time and reliability, and is able to provide timely feedback on the results of the detection and reduce the corresponding losses [10]. Liu, J. et al. based on the research framework of emergency cooperation integration - emergency cooperation modularization, analyzed and studied the structural characteristics of urban cross-regional emergency cooperation and the cooperation network of different emergency function modules to get the impacts and cooperation of different emergency mechanisms. Improvements are made to the construction and coordination of emergency response mechanisms based on the above investigations to detect emergencies in time and reduce losses. According to the test, it is concluded that the response mechanism developed in this way is more perfect and can deal with emergencies in a timely manner to avoid the loss of property and people [11]. Wang, M. et al. constructed a model for detecting emergencies in public places based on the crisis life cycle theory and the four phases and task contents of urban emergency management to detect abnormal behaviors in public places. According to the tests and experiments, it can be concluded that the model can accurately detect the abnormal behavior in public places, the detection speed is faster, and the emergencies can be detected in time to deal with them and set up a more reasonable and perfect response mechanism [12]. To sum up, in today's era, intelligent community management gradually replaces manual management and improves the quality and efficiency of management, but the traditional community management is less efficient and cannot process and analyze large-scale events, so it is necessary to introduce image recognition technology to scan and detect the environment of the community in real time.

3. Image pre-processing

The real-time observation and capture of public places are obtained by utilizing devices such as cameras. In order to make the obtained images clearer, they need to be processed for subsequent detection and recognition [13-14].

The following equation is used to describe the image captured using a device such as a camera as follows:

$$f(x,y,k)=f_{\mathrm{T}}(x,y,k)+f_{\mathrm{B}}(x,y,k)+N(x,y,k) \tag{1}$$

where, $f(x,y,k)$ is used to represent the gray value of point (x,y) in the image at frame k, $f_{\mathrm{T}}(x,y,k)$ is used to represent the gray value of the target passing through the point, $N(x,y,k)$ represents the sum of noise and $f_{\mathrm{B}}(x,y,k)$ represents the gray value of the background.

The noise in the image is removed using noise suppression in adaptive neighborhood to enhance the contrast of the image and make the subsequent recognition clearer and more accurate. Let the pixel neighborhood range of the image be 7×7 and mark the pixels as follows:

$$I(k,l)=\begin{cases}1, & |I(k,l)-I(i,j)|<T\\ 0, & other\end{cases} \tag{2}$$

where $I(i,j)$ represents the pixel value of the pixel, $I(k,l)$ represents the pixels within the 7×7 neighborhood, and T represents the similarity threshold between pixels.

With $S=\{0,1,2,\cdots,N\}$ representing the set of grays in the image, P_i representing the probability of occurrence of grays i in the set, and with $C_0=\{1,2,\cdots,k\}$ and $C_1=\{k+1,k+2,\cdots,N\}$ representing the set of grays between the background and the target image, the interclass variance is derived as follows:

$$\sigma^2=\omega_0\cdot\omega_1\cdot(\mu_1-\mu_0)^2 \tag{3}$$

Eqs. $\omega_0=\sum_{i=0}^{k}P_i$, $\omega_1=\sum_{i=\mathrm{k}+1}^{N}P_i$, $\mu_0=\sum_{i=0}^{k}\frac{i\cdot P_i}{\omega_0}$, and $\mu_1=\sum_{i=k+1}^{N}\frac{i\cdot P_i}{\omega_1}$.

According to the maximum variance criterion, the segmentation threshold T was varied between 0 and N and the computation of inter-class variance was carried out until the segmentation threshold was optimal when the maximum threshold was obtained.

The adaptive neighborhood of a pixel in an image is connected with pixels marked with 1, while the background region is marked with 0 and connected with at least one pixel marked with 1. Based on this form of marking it can be concluded that the adaptive neighborhood of a pixel in the image is the object corresponding to the pixel, and if the pixel is a single noise the adaptive neighborhood is itself. If the pixel is an edge in the image then the adaptive neighborhood is also an edge of the image, and in this way the corresponding adaptive neighborhood is derived so that the noise of the pixel can be suppressed, as shown in the following equation:

$$I(i,j)=\begin{cases}\frac{1}{9}\sum_{m=-1}^{1}\sum_{n=-1}^{1}I(i+m,j+n), N_{\mathrm{c}}=1\\ \frac{1}{N_{\mathrm{c}}}\sum_{(k,l)\in D_{\mathrm{c}}}I(k,l), N_{\mathrm{c}}>1\end{cases} \tag{4}$$

where, $I(i,j)$ represents the pixel value, D_{c} represents the adaptive neighborhood range, N_c represents the number of pixels in the adaptive neighborhood, and 1 is noise.

After suppressing the image noise, the contrast of the image is calculated as follows:

$$C(i,j)=\frac{|M_{\mathrm{c}}(i,j)-M_{\mathrm{b}}(i,j)|}{M_{\mathrm{c}}(i,j)+M_{\mathrm{b}}(i,j)} \tag{5}$$

where, $M_{\mathrm{b}}(i,j)$ represents the average gray value of the pixels in the background region, $M_{\mathrm{c}}(i,j)$ represents the average gray value of the pixels in the adaptive neighborhood, and $C(i,j)$ represents the contrast, the larger its value the larger the contrast.

In enhancing the contrast of the image, a small contrast is quantization noise and no enhancement is required, a large contrast is medium enhancement, and a large enough contrast portion, no contrast enhancement is performed. Based on this approach, the following enhancement equation for contrast is derived:

$$c'_{ij} = \begin{cases} \dfrac{c_{ij} - c_1}{1.2} + c_{ij}, & c_{ij} \in \left[c_1, \dfrac{c_1 + c_2}{2} \right] \\ c_{ij}, & other \\ \dfrac{c_2 - c_{ij}}{1.2} + c_{ij}, & c_{ij} \in \left[\dfrac{c_1 + c_2}{2}, c_2 \right] \end{cases} \tag{6}$$

The pixel gray values obtained by contrast enhancement are as follows:

$$I(i,j) = \left| \begin{array}{l} \dfrac{M_b \left[1 + c'(i,j) \right]}{1 - c'(i,j)}, M_c \geq M_b \\ \dfrac{M_b \left[1 - c'(i,j) \right]}{1 + c'(i,j)}, M_c < M_b \end{array} \right. \tag{7}$$

Denoising and contrast enhancement of the image is accomplished according to the above equation to make the image clearer, and the key features and information in the image are extracted using feature extraction to facilitate subsequent recognition and detection.

4. Detection of emergencies in public places

4.1. Modeling for detecting emergencies in public places

The denoising of the image is completed according to the above steps, which improves the quality of the image and makes it clearer. In order to be able to detect the emergencies in public places in time, it is necessary to carry out their detection [15-16].

From the knowledge related to probability theory, it is concluded that any kind of probability can be expressed by the combination of multiplication and addition operations, and according to the model of probability theory, a complete event expression can be obtained once:

$$p(x_n) = p(x_n | x_{n-1}) \ldots p(x_2 | x_1) p(x_1) \tag{8}$$

Based on the above event probability equation, Figure 1 shows the probabilistic events. The network transmission algorithm is used to detect the emergencies in public places so that the appropriate mechanism can be activated in time to avoid damages. The network transmission algorithm is used to analyze and study the signal information and location in the image in order to detect the emergencies.

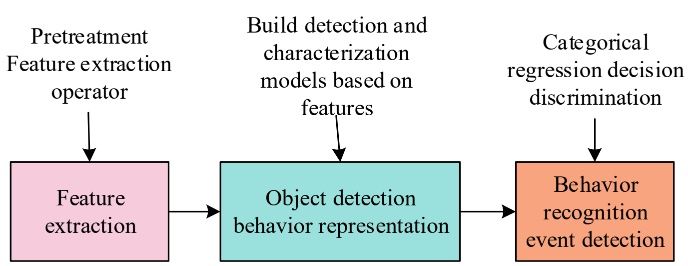

Fig. 1. Probabilistic events

Since signals consume energy when they are transmitted in the network, there is no upper bound if the path appears as a loop, and an upper bound exists for energy consumption if no loop appears. Let the energy consumed to transmit the signal from node i when the image signal is transmitted through the network without the presence of closed loops be the upper bound, with $E_{\max}(i)$ representing the maximum energy consumption, and the energy consumed to transmit from node i

to node j be the lower bound, with $E_{\min}(i,j)$ representing the minimum energy consumption in the transmission, from which the following equation can be derived:

$$E_{\max}(i) = \max_{j\in G}\left(E_{\min}(i,j)\right) \tag{9}$$

Let the sequence of transmission paths for signal transmission from node i_1 to node $i_2 \cdots i_{k-1}$ to target node i_k be shown below:

$$P(i_1,i_k) = \text{ vector } :\{i_1,\ldots i_{k-1},i_k\} \tag{10}$$

The nodes that will pass through are denoted by $N\left(P(i_1,i_k)\right)$ and the node tree is generated as $T\left(P(i_1,i_k)\right)$ based on this set.

Denote by $E_B(T)$ the energy required to transmit the signal from node tree T to leaf nodes, and denote by $P(i,j)$ the sequence of transmission paths, and if path $P(i,j)$ consumes energy up to $E_{\min}(i,j)$, it is a standard transmission path, denoted by $P_{std}(i,j)$.

Let the upper bound of the transmission path sequence $P(i,j)$ be the maximum value of the minimum transmission energy consumption of all nodes, denoted by $E_{\max}\left(P(i,j)\right)$, as follows in Eq:

$$E_{\max}\left(P(i,j)\right) = \max\left(\underset{T\in T(P(i,j))}{E_B}(T)\right) \tag{11}$$

The construction of nodes and parameters in the network transmission algorithm is completed according to the above steps, which facilitates the subsequent detection of emergencies and the activation of emergency mechanisms.

4.2. Modeling Process for Detecting Emergencies in Public Places

4.2.1. Detection process. The modeling process for detecting unexpected events on images captured by devices such as cameras is shown in Fig. 2 as follows:

1) The captured image is processed to make the image clearer, and the image is chunked, and a network model is established based on the chunks, and the behavioral correlations in the chunks are established as the weights of the network edges.

2) According to the established network model, the behavior of pedestrians is transmitted and the degree of abnormality is calculated.

3) Based on the network transmission model, evaluate the normal behavioral energy of pedestrians.

4) Judge the abnormal behavior based on the normal behavior energy to detect the abnormality [17-18].

5) Activate the emergency response mechanism.

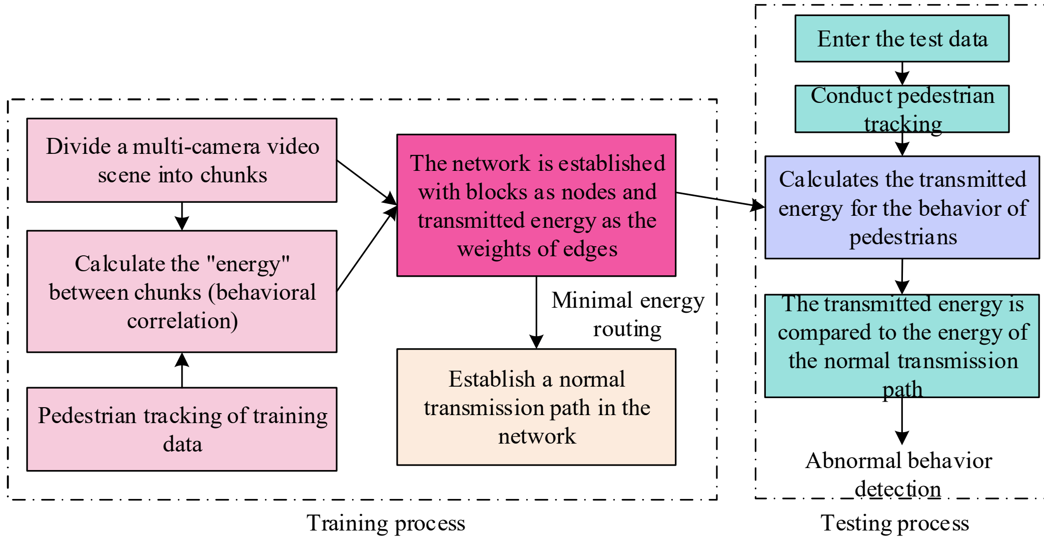

Fig. 2. Model flow

4.2.2. Detection process. The chunking of the captured image can be divided into three parts as follows:

1) The area size of the image chunks should be moderate, and the size size of the chunks should be consistent with the target size, and if the size of the segmentation appears to be inconsistent, it needs to be changed manually.

2) The automatically segmented image chunks are divided in different chunks, and the non-automatically segmented chunks need to be manually divided in different chunks.

3) If the image captured by the camera is duplicated, the duplicates need to be aligned in chunks.

After completing the chunking of the image according to the above steps, it is necessary to model the chunks in the image, set the chunks as nodes, and the behaviors between the chunks as weight edges, in order to generate a network model, and achieve the purpose of detecting abnormalities by training the network model [19-20].

The weight edges in the network model are determined by the behaviors between the chunks, and the correlation of the behaviors can be obtained based on the direct transmission energy during model training. The direct transmission energy mainly refers to the energy required for image signal s to be transmitted from chunk i to chunk j, which can directly reflect the behavioral correlation between image chunks. If the behavior of pedestrians in the image traverses from one chunk to another, it is the number of traversals, and a relatively low transmission energy exists between chunk nodes blow.

Let $e(i,j)$ be the direct transmission energy between node i and node j in the network transmission model, the value of which is related to the number of traversals, from which the relationship between $e(i,j)$ and the number of traversals $CT(i,j)$ can be derived as follows:

$$e(i,j)=\begin{cases}0 & \text{if } i \text{ and } j \text{ are overlapping}\\ f(CT) & \text{if } i \text{ and } j \text{ are adjacent}\\ f(0)+L & \text{if } i \text{ and } j \text{ are not adjacent}\end{cases} \tag{12}$$

where L represents a non-negative real number and $f(\cdot)$ represents a monotonically decreasing function in the range of non-negative real numbers, which can be used to realize the energy transfer between arbitrary chunks by converting the number of traversals into transmission energy.

The behavioral anomaly index in the image is the consumption of the transmission energy of the behavioral signal, and the anomaly index S_A of the transmission path $P(i_1,i_k)$ is:

$$S_A\left[P\left(i_1,i_k\right)\right]=\sum_{k=2}^{n}e\left(i_{k-1},i_k\right) \tag{13}$$

According to the above equation the transmitted energy consumption in the image signal can be analyzed to realize the detection of unexpected events, but due to the high similarity between normal and abnormal behaviors, it cannot be identified only based on the transmitted energy, so it is necessary to set the energy index of normal behavior.

For the network transmission model, $P_{STD}\left(i,j\right)$ is used to denote the standard path for signal transmission between node i and node j as follows in Eq:

$$S_A\left[P_{STD}\left(i,j\right)\right]=E_{\min}\left(i,j\right) \tag{14}$$

The combination of normal transmitted energy and abnormal transmitted energy unfolds the identification of the behavior in the image and detects the unexpected events. For abnormal index detection, a threshold is set in the energy transmission, and if the value transmitted is greater than the set threshold, the behavior can be judged as an abnormal behavior. For deviation index detection, if the detected behavior deviates more than the normal transmission energy, it can be judged as abnormal behavior and needs to pay further attention to it [21].

According to the above process, the detection of emergencies in public places can be completed, so as to activate the response mechanism to deal with emergencies, solve the problem in time, avoid losses, reduce casualties, and is suitable for wide dissemination.

5. Automatic detection and response result analysis

5.1. Image processing quality analysis

Image processing quality analysis is mainly used to measure the processing energy of the model for the captured image and to assess the emotional point and reproduction of the image. If the image quality is higher, it means that the model has better processing energy for the image, and can get a clearer and more realistic image to show the content of the image comprehensively. Therefore, the image processing quality of the model needs to be tested, and Table 1 shows the comparison of image processing quality. It can be concluded that the image quality based on image recognition technology is better, the clarity of the image is higher at about 8 points. And the image clarity of the other two kinds is low, which is around 7.1 points and 7.5 points respectively. And due to the denoising of the image, there is less noise in the image which can be around 8.3 points. While the other two ways are around 6.1 and 7.2 points, the contrast effect of the image is better and is around 8.5 points and the other two ways are 7 and 6.9 points respectively. It can be concluded that the image processing effect based on image recognition technology is clearer than the other two, and there is less noise, so that the content in the image can be clearly derived, and the image can be comprehensively analyzed and processed to reduce the error rate of subsequent detection.

Table 1. Comparison of image processing quality

Image Quality Description	Image Recognition	Big Data Technology	Artificial Intelligence
Image Clarity	8ingredient	7.1ingredient	7.5ingredient
Image noise condition	8.3ingredient	6.1ingredient	7.2ingredient
Image Contrast	8.5ingredient	7ingredient	6.9ingredient
Image Detail	8.1ingredient	7.1ingredient	7.5ingredient
Image Color Accuracy	7.8ingredient	7.1ingredient	7.3ingredient
Image Readability	8.3ingredient	7.7ingredient	6.5ingredient
Image Error	8ingredient	7.2ingredient	7.5ingredient
Image Color Depth	8.1ingredient	7.5ingredient	6.2ingredient
Image Structure	8.5ingredient	7ingredient	6.9ingredient

5.2. Recognition accuracy test

The recognition accuracy test is mainly used to measure the degree of the model's detection of emergencies, whether it can accurately detect abnormal events in public places, deal with the events that occur in a timely manner, and avoid the loss of property. If the recognition accuracy is high, it means that the model can accurately recognize all the emergencies in public places and can guarantee people's safety. Therefore, the recognition accuracy of the model needs to be tested, and the results of the recognition accuracy test are shown in Table 2. The first time to detect the emergencies, the value based on image recognition technology is 95%, the value of big data technology is 85%, and the value of artificial intelligence detection is 75%. For the second time of detecting the emergencies, the value of the image recognition based technique is 93%, the value of the big data technique is 83% and the value of the artificial intelligence detection is 77%. For the third detection of emergencies, the value of image based recognition technique is 93.3%, the value of big data technique is 86.1% and the value of artificial intelligence detection is 78.1%. This can show that image recognition based technology can accurately detect abnormal events in public places, and can handle emergencies in a timely manner to reduce the loss of property. While the accuracy of big data technology and artificial intelligence technology is low, it is difficult to accurately detect the emergencies, and can't handle the emergencies in time, which increases the loss of the society.

Table 2. Recognition accuracy test results

Ordinal number	Image Recognition	Big Data Technology	Artificial Intelligence
1	95%	85%	75%
2	93%	83%	77%
3	93.3%	86.1%	78.1%
4	95.3%	82%	77.2%
5	94.1%	84%	74%
6	93%	85.5%	75%
7	94%	82.1%	76.5%
8	94.2%	86.7%	76.3%
9	95%	82%	81%

5.3. Image Recognition Test

The image recognition test is mainly used to measure whether the model can accurately recognize the content in the image, and whether the recognition result is consistent with the actual content of the image. If the results of the model recognition and the actual agreement, it means that the model recognition effect is better, can accurately recognize the content of the image, and facilitate the subsequent detection and processing. Therefore, it is necessary to test the image recognition ability of the model, and Table 3 shows the image recognition test.

It can be seen that the image recognition based technology image recognition ability is stronger, in the image of the actual content of pedestrians, bicycles, lawns, based on the image recognition technology can accurately identify the content of the image, the results and the actual content of the same. The other two ways to recognize the content of the missing, in the image of the actual content of the lawn, cars, pedestrians. Image recognition based technology can comprehensively identify the content of the image, big data technology can only identify the lawn, artificial intelligence technology can only identify the car. This can show that the recognition ability of the image recognition based technology is better, can completely identify all the contents in the image, reduce the error rate in detection, and can detect all the abnormal behaviors in public places in time.

Table 3. Image recognition test

The actual content of the image	Image Recognition	Big Data Technology	Artificial Intelligence
Pedestrian, Bicycle, Lawn	Pedestrian, Lawn, Bicycle	Pedestrian, Lawn	Bicycle
Multiple Pedestrians, Cars	Multiple Pedestrians, Cars	Car	Multiple pedestrians, cars
Normal Pedestrian, Multiple Cars	Normal Pedestrian, Multiple Vehicles	Normal Pedestrian	Normal Pedestrian
Multiple pedestrians, morning runners, bicyclists	Multiple Pedestrians, Morning Jogger, Bicycle	Multiple pedestrians, morning runners	Morning runners, bicycles
Lawn, Children	Lawn, Children	Lawn, Children	Children
Children, Pedestrian	Children, Pedestrian	Pedestrian	Children, Pedestrian
Lawn, Dog Pedestrian, Bicycle	Lawn, Dog Pedestrian, Bicycle	Lawn, Dog Walking Pedestrian	Lawn, Bicycle
Pedestrian, Morning Walker	Pedestrian, Morning Walker	Morning Walking	Morning walk
Lawn, Car, Pedestrian	Lawn, Car, Pedestrian	Lawn	Car

5.4. Response Speed Test

Response speed test is mainly to measure the feedback speed of the model to detect emergencies in public places, the faster the speed of the model's response, indicating that the model can provide timely feedback on the results of the detection, to avoid users waiting for a long time. Abnormal behavior in public places can be captured in a timely manner to reduce the occurrence of damage and avoid casualties, so it is necessary to test the response speed of the model, and the response speed test is shown in Table 4. It can be seen that in the first test, the response speed based on image recognition is 2s, big data technology is 3s, and artificial intelligence technology is 6s.In the second test, the response speed based on image recognition is 1.5, big data technology is 3.2s, and artificial intelligence technology is 5s. In the third test, the response speed of image-based recognition is 2.1s, big data technology is 4.5s, and artificial intelligence technology is 6.1s.From this, we can conclude that the response speed of image-based recognition technology is much faster than the other two kinds, which reduces the waiting time, and can deal with the emergencies in time to reduce the loss of property and people, so it can be popularized and used.

Table 4. Response Speed Test

Ordinal number	Image Recognition	Big Data Technology	Artificial Intelligence
1	2s	3s	6s
2	1.5s	3.2s	5s
3	2.1s	4.5s	6.1s
4	2s	3.1s	5.3s
5	1.1s	4.1s	5.2s
6	2s	5s	5s
7	2.1s	4.3s	6s
8	2s	3.5s	5.1s
9	2.3s	3.7s	6.2s

6. Conclusion

In this paper, firstly, image processing technology is utilized to de-noise the obtained image to make the image clearer, and feature extraction is performed on the processed image. Secondly, the network transmission algorithm is used to detect the signals in the image and set the corresponding thresholds for judging abnormal behaviors and events. Finally, the abnormal behaviors and events are evaluated according to the set thresholds and standard behavioral routes to complete the detection of emergencies in public places, and the response mechanism is activated to deal with the emergencies. The conclusions are as follows:

1) The detection of emergencies in public places based on image recognition technology is analyzed and it is concluded that the detection ability based on image recognition technology is better and the quasi-detection rate based on image recognition technology can reach 95%, which indicates that the accuracy rate of image recognition technology is higher.

2) The response speed of the image recognition technology is analyzed, in the first test, the response speed based on image recognition is 2s, and in the second test, the response speed based on image recognition is 1.5, which indicates that the feedback speed of the image recognition technology is faster.

3) And the image quality of the image recognition based technology is better, the clarity of the image is higher at about 8 points, and the noise content in the image is less, which can be about 8.3 points. This can show that based on image recognition technology can accurately identify the situation in the image, the accuracy of detection is higher, reducing the occurrence of losses, and promoting the progress and development of intelligent communities.

Funding

This work was supported by Humanities and Social Science Research Youth Foundation of Ministry of Education (No. 22YJCZH170).

References

[1] Huang, Y., Lou, X., Wang, C., & Chen, Z. (2022). Incentive mechanism design in collaborative management of public health emergencies. *Sustainability*, *14*(12), 7155.

[2] Geng, S., Hou, H., & Geng, J. (2021). The mechanism of operation effectiveness of emergency shelter rescue systems. *Sustainability*, *13*(10), 5540.

[3] Karolius, K. B., Cichowicz, J., & Vassalos, D. (2021). Risk-based, sensor-fused detection of flooding casualties for emergency response. *Ships and Offshore Structures*, *16*(5), 449-478.

[4] Xiang, H. (2021). Urban Road Network Emergency: An Integrative Vulnerability Identification Method. *Complexity*, *2021*(1), 6325578.

[5] Zhou, L., & Ouyang, F. (2023). Innovate emergency governance mechanism of urban communities in response to major public health events: a qualitative study from multiple principals in Guangzhou, China. *Frontiers in Public Health*, *11*, 1008378.

[6] Peixoto, J. P. J., Costa, D. G., da Franca Rocha, W. D. J., Portugal, P., & Vasques, F. (2023). On the positioning of emergencies detection units based on geospatial data of urban response centres. *Sustainable Cities and Society*, *97*, 104713.

[7] Peixoto, J. P. J., Bittencourt, J. C. N., Jesus, T. C., Costa, D. G., Portugal, P., & Vasques, F. (2024). Exploiting geospatial data of connectivity and urban infrastructure for efficient positioning of emergency detection units in smart cities. *Computers, Environment and Urban Systems*, *107*, 102054.

[8] El Khatib, R. F., Zorba, N., & Hassanein, H. S. (2020). Rapid sensing-based emergency detection: A sequential approach. *Computer Communications*, *159*, 222-230.

[9] Park, J., Yoo, T., Lee, S., & Kim, T. (2023). Urban Noise Analysis and Emergency Detection System using Lightweight End-to-End Convolutional Neural Network. *INTERNATIONAL JOURNAL OF COMPUTERS COMMUNICATIONS & CONTROL*, *18*(5).

[10] Xu, Z., Liu, Y., Yen, N. Y., Mei, L., Luo, X., Wei, X., & Hu, C. (2016). Crowdsourcing based description of urban emergency events using social media big data. *IEEE Transactions on Cloud Computing*, *8*(2), 387-397.

[11] Liu, J., Dong, C., & An, S. (2022). Integration and modularization: Research on urban cross-regional emergency cooperation based on the network approach. *International Journal of Disaster Risk Reduction*, *82*, 103375.

[12] Wang, M., & Wang, J. (2023). Performance Evaluation of Urban Emergency Governance: Conceptual Connotations and Empirical Research Based on the Crisis Life Cycle Theory. *Evaluation Review*, 0193841X231215208.

[13] Jebur, R. S., Zabil, M. H. B. M., Hammood, D. A., & Cheng, L. K. (2024). A comprehensive review of image denoising in deep learning. *Multimedia Tools and Applications*, *83*(20), 58181-58199.

[14] Du, H. (2019). Image denoising algorithm based on nonlocal regularization sparse representation. *IEEE Sensors Journal*, *20*(20), 11943-11950.

[15] Chen, Y., & Tang, Z. (2021). Research on the construction of intelligent community emergency service platform based on convolutional neural network. *Scientific programming*, *2021*(1), 5089236.

[16] Li, Z., She, J., Guo, Z., Du, J., & Zhou, Y. (2024). An evaluation of factors influencing the community emergency management under compounding risks perspective. *International Journal of Disaster Risk Reduction*, *100*, 104179.

[17] Sun, Y. (2023). Establishment of the emergency material reserve mechanism for public health emergencies and optimization of the management of various functional departments. *Frontiers in public health*, *10*, 1092375.

[18] Yin, X., Xu, X., & Chen, X. (2020). Risk mechanisms of large group emergency decision-making based on multi-agent simulation. *Natural Hazards*, *103*(1), 1009-1034.

[19] Carter, H., Drury, J., & Amlôt, R. (2020). Social identity and intergroup relationships in the management of crowds during mass emergencies and disasters: recommendations for emergency planners and responders. *Policing: A Journal of Policy and Practice*, *14*(4), 931-944.

[20] Wang, Y., Li, H., Shi, Y., & Yao, Q. (2022). A study on spatial accessibility of the urban stadium emergency

response under the flood disaster scenario. *Sustainability*, *14*(24), 17041.

[21] Wang, K., Feng, Y., Yang, H., Deng, J., & Li, Q. (2023). Evaluation of Community Emergency Management Capability Based on SWOT Analysis—A Case Study. *Sustainability*, *15*(17), 12770.