Mobile Networks and Applications
https://doi.org/10.1007/s11036-024-02292-1

A Brief Introduction to Vision Based Mobile Information System

Wenxiang Zhang[1,2] · Zhenyuan Tian[1,2] · Shuai Wang[3] · Ting Yang[4]

1 Editorial

Mobile information is one of the most widely-used information forms in real world, which includes more content than any other information forms. However, Mobile information also has more complex architecture than other information processing systems. Today, the developed collection equipment and communication system make mobile information increase in a huge amount. Therefore, it becomes important to research in related domains for mobile information systems, providing robust transmission, optimal allocation and safe services for information, constructing as well as expanding more applications for mobile information systems (MIS) [1].

Many scholars have provided varies models and applications in this domain, especially for mobile visual information systems. Image based methods in mobile/edge computing can expand application scenarios for vision based MIS [2, 3]; Feature extraction and mining can improve computing cability for low-power MIS [4, 5]; Data clustering and allocation can provide stability and reliability for heterogeneous MIS [6, 7].

In this way, the special issue "Mobile Vision based Theory, Analysis and Applications" is held for scholars and engineers for their more effective theories and applications for mobile vision based theories, models and applications in this area. The issue provides an opportunity for researchers to publish their gifted theoretical and technological studies of emerging theory on vision based MIS, and their novel engineering applications within this domain. Excellent review /survey articles are also welcome.

This issue received 36 submissions and accepted 13 out of them with at least 2 rounds of strict reviews, with acceptance ratio 36.11%. This editorial is divided into two sections, which aims to the "Vision based MIS with Applications" in the first section, the "Multimodal MIS with Applications" in the second section.

2 Vision Based MIS with Applications

The first section of this issue includes seven articles, which focuses on the image processing and visual computing in MIS, including image matching, recognition, watermarking, feature diagnosis, motion and trajectory detection.

In the mobile network environment, the accuracy of related image matching algorithms is affected by factors such as bandwidth uncertainty and channel interference, resulting in significant limitations in image feature matching. Therefore, The first article "High-precision Matching Algorithm for Multi-image Segmentation of Micro Animation Videos in Mobile Network Environment", authored by Youcef Djenouri from University of South-Eastern Norway, Norway, designs a high-precision matching algorithm for multi-image segmentation of micro animation videos in mobile network environments. It smoothly fuses 2D HD-DWT, Harris algorithm, K-means, SIFT, and RANCAS to match noisy image. Experimental results show that the proposed method can effectively reduce image noise, improve image quality, and generate a large number of matching pairs, and the production effect of micro animated videos in mobile networks can be significantly improved with the proposed method [8].

Sensitive information in images is leaked during attacks, resulting in the malicious acquisition of personal privacy. To improve the robustness of attacking defence for video

✉ Shuai Wang
wangshuai123@whu.edu.cn

✉ Ting Yang
yangting@imau.edu.cn

1 Institute of Interdisciplinary Studies, Hunan Normal University, Changsha 410081, China

2 College of Information Science and Engineering, Hunan Normal University, Changsha 410081, China

3 School of Computer Science, Wuhan University, Wuhan 430072, China

4 College of Computer and Information Engineering, Inner Mongolia Agricultural University, Hohhot 010012, China

Published online: 20 January 2024

images, a digital watermarking algorithm based on locality-sensitive hashing (LSH) is designed in the second paper "Digital Watermarks for Videos based on a Locality-sensitive Hashing Algorithm", authored by Gautam Srivastava from Department of Math and Computer Science, Brandon University, Canada. The Y-M algorithm is used to identify image tampering. The data string of hash function values and the identification watermark W2 are used to identify and counter the pseudo-authentication attacks. The SVD was used to adaptively adjust the embedding strength of the watermark. Experimental results show that the proposed algorithm has good invisibility and anti-attack capacity for embedding digital watermarks into images, with an average accuracy 97%, PSNR 49DB, correlation coefficient greater than 0.85 under different attack modes [9].

Due to the substantial increase in medical data and patient diagnostic needs, conventional diagnostic methods are gradually unable to meet the current diagnostic requirements. Therefore, a network medical image information feature diagnosis method based on big data is designed to improve the effect of disease diagnosis in the third paper "Design of Network Medical Image Information Feature Diagnosis Method based on Big Data", authored by Hui Liu from Institute of Medical Information, Chinese Academy of Medical Sciences & Peking Union Medical College, China. The convolutional deep belief network and the t-SNE algorithm are used to select the most valuable features. The fusion of AdaBoost, Bagging and ABC algorithms are used to improve the accuracy of disease diagnosis. At different spatial resolutions of network medical images, the Kappa values of disease diagnosis of this method are high, and the lowest Kappa value is about 0.875, which means that this method has high disease diagnosis performance [10].

In order to obtain high precision image identification results of transmission line ice thickness, an image identification method of transmission line ice thickness based on visual sensing is proposed in the fourth paper "Image Identification Method of Ice Thickness on Transmission Line based on Visual Sensing", authored by Maazen Alsabaan from College of Computer and Information Sciences, King Saud University, Saudi Arabia. The non-local self-similarity information of the ice-covered images are regularized prior constraint term combined with K-SVD algorithm to remove the noise. The ice-covered regions of transmission lines are segmented and then ice thickness is calculated. Experimental results show that the SNR is higher than SOTA methods, and the deviation between the calculated icing thickness and the actual value is less than 0.05 mm, which has a strong engineering application value [11].

Human joint motion exhibits a high degree of freedom, with different joints capable of moving and rotating in various directions. Consequently, accurately capturing the features of posture motion becomes challenging, resulting in lower prediction accuracy. To address this issue, the fifth paper "Enhancing Human Motion Prediction through Joint-based Analysis and AVI Video Conversion", authored by Syed Atif Moqurrab from School of Computing, Gachon University, South Korea, proposes a novel method for predicting human motion based on joints using AVI video conversion. The AVI video is converted into a 3D video by fusing the foreground and background images. Motion feature vectorization is employed to reduce edge detection errors. The PF algorithm is utilized to establish the human joint motion model, and joint-based motion prediction is conducted. Experimental results shows that the prediction results of human movement based on joints is more accurate than comparisons [12].

In sports movements, relevant actions occur at a fast pace. Recognizing such action features poses significant challenges, thereby affecting the accuracy of motion training correction. Therefore, the sixth paper "Sports Training Correction based on 3D Virtual Image Model", authored by Wei Wei from School of Computer Science and Engineering, Xi'an University of Technology, China, proposes a correction method for sports training based on a support vector machine classification model. The method involves constructing a skeletal model of the athlete's body, and creating a 3D virtual image model for the motion training using spherical linear interpolation and spatiotemporal deformation methods. Experimental results show that the structural similarity is over 0.923, the image information entropy is over 0.917, the recognition rate of dribbling training actions is 97.4%, and the PSNR of action images is 7.2dB. After correcting the shooting actions using the proposed method, the shooting accuracy reaches 94% [13].

The ball moves in a basketball game is dynamic, and it is hard to track. In the seventh paper "Basketball Flight Trajectory Tracking using Video Signal Filtering", authored by Ryan Alturki from College of Computers and Information Systems, Umm Al-Qura University, Saudi Arabia, an accurate image tracking of a basketball flight path is provided for the basketball training and other applications. The adaptive median filtering algorithm is used to filter the basketball flight video signal by selecting the image difference to enhance the trajectory flight with Harris algorithm. Then, the SURF is used to extract features of basketball targets and the PSO algorithm optimizes the basketball flight trajectory tracking results. Experimental results show that the proposed method can accurately track the flight path of basketball with accuracy 97%, and the maximum difference to ground truth is 1 frame. Both the position error and end position error are less than 5 cm [14].

3 Multimodal MIS with Applications

The second section of this issue includes six articles, which focuses on allocation, clustering, mining and such researches and applications in MIS.

Different devices and applications in wireless networks share spectrum resources reasonably. However, there are still issues such as channel overlap and adjacent interference in spectrum allocation and utilization, making the process of data dynamic resource allocation more complex. Therefore, a new data dynamic resource allocation technique for wireless networks is proposed in the eighth paper "Dynamic Resource Allocation Techniques for Wireless Network Data in Elastic Optical Network Applications", authored by Farhan Ullah from School of Software, Northwestern Polytechnical University, China. A global constrained resource allocation optimization model is established based on the threshold of the maximum frequency gap number occupied on the fiber core at the end of allocation. Experimental results show that the spectrum utilization obtained by the proposed method is higher when the number of cores is 12, and the spectrum utilization is significantly improved [15].

For target searching with robot in large search area, path planning spends long time and is affected by the surrounding environment, which makes the efficiency of the whole searching is not high. In this way, a shortest path control method for target searching using robot in a large range of complex tasks is proposed in the ninth paper "Shortest Path Control for Target Searching using Robot in Complex Task with Large Range", authored by Li Zhao from Software Department, Hunan College of Information, China. This method establishes an environmental map for searching by laser sensors, and uses SMO algorithm to find the shortest path and avoids collision with obstacles. To ensure the movement is optimal, a path controller is applied during the robot's target searching. Experimental results show that the proposed method effectively avoids obstacles in the path, the planned path distance is kept within 5 m, and the path planning time is less than 50s, which indicates that the proposed method has high path planning efficiency [16].

Wireless smart bracelet can transmit data including motion, sleep time, heart rate, blood pressure and position, etc., which have diversity and high complexity. Also, there are interconnections or interactions between the data, which have high clustering difficulty. To this end, a new data clustering algorithm is studied for wireless smart bracelets in the tenth paper "Research on Hybrid Data Clustering Algorithm for Wireless Communication Intelligent Bracelets", authored by Marcin Woźniak from Faculty of Applied Mathematics, Silesian university of Technology, Poland. The K-medoids algorithm is used to calculate the intra-cluster, inter-cluster, and overall similarity for the initial clustering of the bracelet data. Then the clustering evaluation index is set to determine the optimal clusters' number. Experimental results show that the proposed algorithm cluster the heart rate monitoring, temperature monitoring, energy consumption, and sleep monitoring are all higher than 97%, better than SOTA methods [17].

In order to relieve the pressure of medical resources and meet the demand of human health real-time detection, a remote health detection algorithm based on sensor signal purification was designed in the eleventh paper "A Remote Health Detection System with Sensor Signal Purification", authored by Thippa Reddy Gadekallu from School of Information Technology and Engineering, Vellore Institute of Technology, India. In the wearable health device, health parameter sensors such as integrated temperature sensors were set up, and human health sensing signals were collected by wireless communication technology and transmitted to a remote data processing center. The Baum-Welch algorithm is used to update the parameters of a HMM and the human health detection results were output. Experimental results show that the acquisition error is less than 0.5%, and the abnormal health state of testers such as falling, high body temperature and high blood pressure is accurately detected [18].

To improve the accuracy and robustness of data feature mining, a highly reliable and robust feature mining method for university education data based on dynamic semantic memory network is proposed in the twelfth paper "Highly Reliable Robust Mining of Educational Data Features in Universities Based on Dynamic Semantic Memory Networks", authored by Mohamed Baza from Department of Computer Science, College of Charleston, USA. The range transformation method is used to transform and process scattered data, achieving reasonable classification of data feature attributes. Then the KNN and floating search are used to reduce the search range in equivalent classification and feature dimensionality. Finally, Levy function optimizes the feature mining function of dynamic semantic memory network to achieve highly reliable and robust mining. Experimental results show that the proposed method maintains high mining accuracy and robustness under overload and attack intensity states [19].

The rapid growth of online education provides massive behavioral data for classroom behavior research. To analyse the empirical research of classroom behavior, the last article "Empirical Research of Classroom Behavior Based on Online Education: A Systematic Review", authored by Shuai Liu from School of Educational Science as well as Institute of Interdisciplinary Studies, Hunan Normal University, China, studied 124 empirical researches of classroom behavior. With statistical analysis, the results show the empirical research on classroom behavior has increased

rapidly with the topics focusing on influencing factors and behavior characteristics. Also, most of the researches center on primary and secondary school subjects with incomplete overviews of school divisions and disciplines and the related studies provide reference for mining the law and improving teaching, and more sophisticated approach to empirical research combining online education and complex classroom behaviors are required [20].

Many scholars have provided varies models and applications in this domain, especially for mobile visual information systems. Image based methods in mobile/edge computing can expand application scenarios for vision based MIS [2, 3]; Feature extraction and mining can improve computing cability for low-power MIS [4, 5]; Data clustering and allocation can provide stability and reliability for heterogeneous MIS [6, 7].

Acknowledgements The guest editors are thankful to our reviewers for their effort in reviewing the manuscripts. We also thank the Edit-in-Chief, Dr. Imrich Chlamtac for his supportive guidance during the entire process. This work was supported by the This work was supported in part by the Natural Science Foundation of China under Grant 62207012, in part by the Key Scientific Research Projects of Department of Education of Hunan Province under Grant 22A0049, 2023 Key Supported Project of the 14th Five Year Plan for Education and Science in Hunan Province with No.ND230795, and in part by the National Social Science Foundation of China under Grant AEA200013.

References

1. Fu W, Chen Z, Liu S (2023) Key Problem on Mobile Intelligent Multimedia System. Wireless Netw 29:2891–2895
2. Liu S, Huang S, Xu X, Lloret J, Muhammad K (2023) Efficient visual Tracking based on fuzzy inference for Intelligent Transportation systems. IEEE Trans Intell Transp Syst 24(12):15795–15806
3. Liu S, Wang S, Liu X, Dai J, Muhammad K, Gandomi AH, Ding W, Hijji M, Albuquerque VHC (2023) Human Inertial thinking strategy: a novel fuzzy reasoning mechanism for IoT-Assisted visual monitoring. IEEE Internet of Things Journal 10(5):3735–3748
4. Liu S, Xu X, Zhang Y, Muhammad K, Fu WA (2023) Reliable Sample Selection Strategy for weakly-supervised Visual Tracking. IEEE Trans Reliab 72(1):15–26
5. Liu S, Chen P, Zhang YA, Multiscale Feature (2023) Pyramid SAR Ship Detection Network with robust background interference. IEEE J Sel Top Appl Earth Observations Remote Sens 16:9904–9915
6. Tu Y, Lin Y, Wang J, Lim J (2018) Semi-supervised learning with generative adversarial networks on Digital Signal Modulation classification. CMC-Computers Mater Continua 55(2):243–254
7. Lin Y, Zhao H, Ma X, Tu Y, Wang M (2021) Adversarial attacks in Modulation Recognition with Convolutional neural networks. IEEE Trans Reliab 70(1):389–401
8. Su Y, Djenouri Y (2023) High-Precision Matching Algorithm for Multi-Image Segmentation of Micro Animation Videos in Mobile Network Environment. Mobile Networks and Applications Online first, https://doi.org/10.1007/s11036-023-02278-5
9. Sun Y, Srivastava G (2023) Digital watermarks for videos based on a locality-sensitive hashing algorithm. Mob Networks Appl. https://doi.org/10.1007/s11036-023-02240-5. Online first
10. Li W, Liu H, Design of Network Medical Image Information Feature Diagnosis Method Based on Big Data (2023) Online first. Mob Networks Appl. https://doi.org/10.1007/s11036-023-02237-0
11. Hu M, He J, Alsabaan M (2023) Image Identification Method of Ice Thickness on Transmission Line Based on Visual Sensing. Mobile Networks and Applications Online first, https://doi.org/10.1007/s11036-023-02244-1
12. Xiong Y, Moqurrab SA, Ahmad A (2023) Enhancing Human Motion Prediction through Joint-based Analysis and AVI Video Conversion. Mobile Networks and Applications Online first, https://doi.org/10.1007/s11036-023-02261-0
13. Zhang Y, Wei W (2023) Sports Training Correction based on 3D Virtual Image Model. Mobile Networks and Applications Online first, https://doi.org/10.1007/s11036-023-02252-1
14. Zhang B, Zhang Y, Alshawi B et al (2023) Basketball Flight Trajectory Tracking using Video Signal Filtering. Mobile Networks and Applications Online first, https://doi.org/10.1007/s11036-023-02253-0
15. Ge J, Wu K, Jamal N et al (2023) Dynamic Resource Allocation Techniques for Wireless Network Data in Elastic Optical Network Applications. Mobile Networks and Applications Online first, https://doi.org/10.1007/s11036-023-02243-2
16. Peng J, Zhao L (2023) Shortest Path Control for Target Searching Using Robot in Complex Task with Large Range. Mobile Networks and Applications Online first, https://doi.org/10.1007/s11036-023-02247-y
17. Sun J, Yang K, Woźniak M (2023) Research on Hybrid Data Clustering Algorithm for Wireless Communication Intelligent Bracelets. Mobile Networks and Applications Online first, https://doi.org/10.1007/s11036-023-02249-w
18. Zhang J, Gadekallu TR (2023) A Remote Health Detection System with Sensor Signal Purification. Mobile Networks and Applications Online first, https://doi.org/10.1007/s11036-023-02266-9
19. Zhou D, Baza M, Rasheed A (2023) Highly Reliable Robust Mining of Educational Data Features in Universities Based on Dynamic Semantic Memory Networks. Mobile Networks and Applications Online first, https://doi.org/10.1007/s11036-023-02250-3
20. Huang Y, Peng C, Liu S (2023) Empirical Research of Classroom Behavior Based on Online Education: A Systematic Review. Mobile Networks and Applications Online first, https://doi.org/10.1007/s11036-023-02251-2