Evaluation of the application of CPR Composite Error Action Recognition System Based on Artificial Intelligence Technology

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Abstract Summary

• Artificial intelligence technology has been widely used in medical field, which greatly reduces labor intensity of medical workers and improves their work efficiency. Based on AI technology, a medical teaching assistant evaluation system based on vision was constructed to complete error action recognition and skill assessment in CPR. In this study, we evaluate its effectiveness, cost, and cost-effectiveness.

Introduction

• Cardiopulmonary Resuscitation (CPR) is a critical life-saving technique for cardiac and respiratory arrest. The CPR composite error action recognition system based on artificial intelligence technology can effectively assist doctors in CPR skill assessment, which can alleviate the time-consuming and labor-intensive issues of traditional assessment methods. This study aims to explore the effectiveness of the action recognition system in real assessment.

Methods

• A vision-based system was constructed through literature research and expert consultation to define 13 single and 74 composite error actions of extracorporeal cardiac compression in CPR. From July to September 2023, we collected 500 CPR action videos in Zhongshan hospital and constructed a fine-grained composite error action set named CPR-Coach. In addition, we proposed a neural network that can predict composite errors while training single-error samples. The control group rated videos through traditional methods, others with the proposed model. T test was used for comparison among groups. This study uses incremental cost effectiveness ratio to analyze the effectiveness of the system.

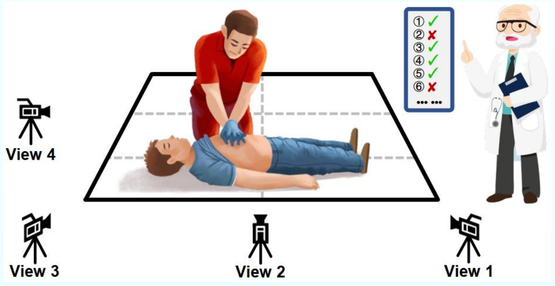


Figure 1 Camera Layout and CPR Scene

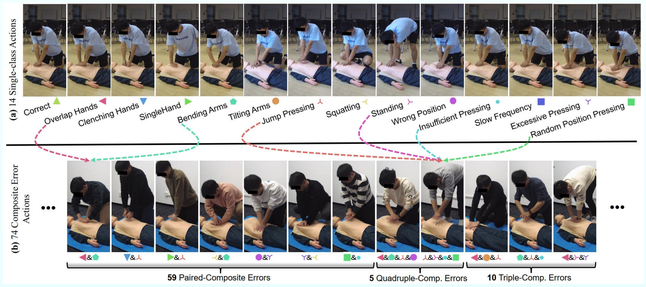


Figure 2 Construction of the multi-composite error dataset CPR-Coach

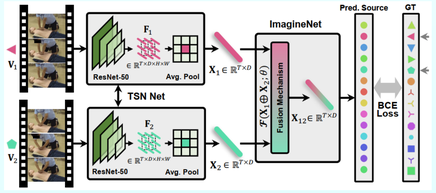


Figure 3 Schematic diagram of the ImageNet algorithm structure

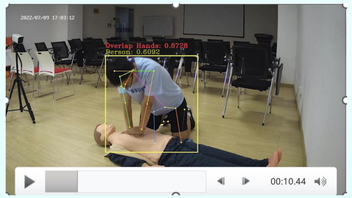


Figure 4 Detection Results of Single-Class Error Behaviors

Figure 5 Detection Results of Multiple Compound Error Behaviors

Results

• In the CPR-Coach dataset, our model achieved 88.79% Top-1 Acc and 99.40% Top-3 Acc, which suggests that it can effectively handle composite error recognition tasks. There were no differences in age, gender, educational background and clinical competence between the evaluation experts in groups. Results showed that there is no difference in accuracy between the control group (99.56 %) and the experimental group (99.72 %). But the average time consuming in experimental group (57 mins) was saved by nearly four times compared with the control group (15 mins) (P<0.05). The proposed system has preliminary capabilities to assist decision-making in CPR assessment.

Model	mAP	Δ	mmit mAP	Δ
TSN [47]	0.5598	—	0.6143	—
w/ ImagineNet-FC	**0.6259**	↑ 6.61%	**0.6893**	↑ 8.50%
TPN [53]	0.6250	—	0.7016	—
w/ ImagineNet-FC	**0.7094**	↑ 8.44%	**0.7620**	↑ 6.04%
TSM [26]	0.5662	—	0.6618	—
w/ ImagineNet-FC	**0.7053**	↑ 13.91%	**0.7566**	↑ 9.48%
ST-GCN [52]	0.5776	—	0.6692	—
w/ ImagineNet-FC	**0.6404**	↑ 6.28%	**0.7115**	↑ 4.23%

Table 1 Comparison Experiment of Algorithm Performance Improvement

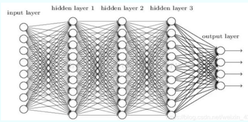
Model	Modality	Latency (ms)↓	mAP	mmit mAP
TSN [47]	RGB	–	0.5598	0.6143
ST-GCN [52]	Pose	–	0.5776	0.6692
Two-Stream [42]	RGB+Pose	**0.1426**	0.5915	0.6823
CBP [18]	RGB+Pose	0.3032	0.7066	0.7460
BLOCK [5]	RGB+Pose	1.254	0.7094	0.7597
w/ ImagineNet-CA	RGB+Pose	0.1612	**0.7133**	**0.7641**

Table 2 Comparison Test of Cross-modal Recognition Rate

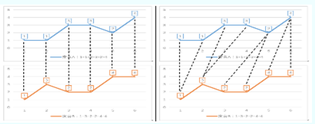
Conclusions

• The CPR composite error action recognition system based on AI, which can support fine-grained action recognition and composite error action recognition tasks under restricted supervision, can effectively assist doctors in CPR skill assessment, which can alleviate the time-consuming and labor-intensive issues of traditional assessment methods. In addition, it can effectively reduce labor costs and time costs without increasing the cost.

Construction of a Knowledge Graph for Medical Practice



Design of Fine-Grained Medical Behavior Recognition Algorithm



Design of Behavior Sequence Matching Algorithm Based on Dynamic Time Warping

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