



Crossing the Lines of Disciplines

The 6th Research Forum between
Changzhou University and Satakunta University of Applied Sciences



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Changzhou University and Satakunta University of Applied Sciences

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Satakunta University of Applied Sciences

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Foreword

This publication is a compilation of articles covering topics dealt with in the 6th annual Research Forum between Satakunta University of Applied Sciences, Finland, and Changzhou University, China, as well as Maynooth University, Ireland. The Research Forum is organised alternate years in China and Finland, and this time the hosting city was Pori, Finland.

The articles indicate that the core of university research is to serve the surrounding society in all possible fields. They also reflect studies not being conducted inside one narrow field only, but crossing the lines between different disciplines, and thus reaching most impressive results.

Researchers from all three universities tackle issues present in the modern society. Technology and AI is used to discover innovative solutions to support health care and ageing society. Even safety can be monitored as well as career opportunities followed by means of technical innovations.

The publication familiarises the reader with practical uses of research, and how it can be applied to various needs in life. Reading the articles reveals how resourceful research can be, and in how many ways the society can benefit from it.

May 2019 in Pori

Marina Wikman, Editor

Satakunta University of Applied Sciences: Innovation Led Higher Education and Research

Jari Multisilta, Managing Director and Rector of Satakunta University of Applied Sciences

Satakunta University of Applied Sciences (SAMK) had a great pleasure to organize the sixth Research Forum with Changzhou University in SAMK Pori Campus in May 2019. The Research Forum included a full day of presentations from Changzhou University and Satakunta University of Applied Sciences. In addition, also Maynooth University from Ireland sent their representative to participate and present in the forum. The presentation topics ranged from the effectiveness of EEG feedback on attention in 3D environments to discussion of AI in various contexts. In addition, various topics on health care were presented.

The discussions between researchers and teachers were very fruitful. It is through sharing our knowledge that we can learn and develop our own work. I am convinced that the connections made during the forum will continue and that the presentations and discussions provided important feedback to the work of the participants.

I believe that this type of international collaboration is also a valuable way to build our capacity to serve the society surrounding us. SAMK profiles itself as an industrial higher education institution, and it is our mission to renew the industries in our region by providing skillful professionals and research data to the companies and the industry.

According to the Ministry of Education and Culture in Finland “Universities of applied sciences enjoy freedom of research, science, art and tuition. They are responsible for the content and quality of the education they provide.” The role of universities of applied sciences (UAS) in Finland is to give higher education that meets the requirements of working life and is based on research.

What does “innovation led higher education and research” actually mean in practice, how can we accomplish it and what is its impact?

First, innovation led higher education and research means that the UAS have a close and continuing discussion with the industry, companies and organizations in their region, as it is impossible to serve the region without knowing the needs.

Obviously, there is not only a single way to accomplish the task of innovation led higher education and research. Many UAS in Finland have advisory boards with members from surrounding industry and organizations for the degree programs. The advisory boards are typically consulted when the UAS is updating curriculums or is planning to launch a new program.

In addition to advisory boards, also more frequent and informal discussion is needed. It is the personal contacts of our teachers and researchers that provide us day-to-day information of the requirements of the industry. This information can be utilized for example for planning new research projects in which we would like to have industry and companies as partners. The collaboration in research projects between companies and the UAS is an effective way of sharing knowledge. SAMK has developed a so-called academy model, where students complete most of their studies in industry projects. To be able to solve the problem in the project the student must consult the learning material and receive tutoring and help from the supervising teachers. The projects are real-life problem-solving tasks that the industry is providing to us. In the academy model there are less lectures and more actual engineering work.

The best innovation is not born by doing research by ourselves. In order to complete SAMK mission, we need to find the best international partners, and be active in international research and training networks. This is the way to bring the best innovations from international research to the region, but it is also the way to deliver our own research knowledge to other countries. I strongly believe in the power of international collaboration, both in research and training. It is clear, that the Research Forum with Changzhou University serves this purpose well.

Finally, the aim of the innovation led higher education and research is to impact and improve the industry and companies so that they are competitive and add value to the whole region where they operate. We can see that cities with higher education institutions have more innovation led business and that they also attract young people to live and work there. To conclude, I hope we will continue the Research Forum series in the future and keep learning from each other.

Changzhou University: Responsibility and Excellence

Huang Haiyan, Professor and Vice President of Changzhou University

It is a great honor to participate in the sixth Research Forum held in Pori, and a great pleasure to meet professors and scholars from Satakunta University of Applied Sciences and Maynooth University in Ireland. Focusing on the scientific and technological frontier and future of health care and information technology, this forum pays attention to people's livelihood and seeks common development. The Research Forum was held for the first time in Changzhou in 2010, which expanded at the Seventh Session in 2017 when Maynooth University joined. The Forum has become a fine tradition and an effective link between the three universities, and this year, I believe, has witnessed closer cooperation and exchanges among the three sides.

Research, education and links with the industries are closely interacted in Changzhou University, which contribute to the continuous improvement of the university and its education quality. According to the 2019 Wu Shulian Chinese University Ranking, Changzhou University is placed at 156 among over 2000 Chinese universities. The academic level of its faculty members is ranked 69 among Chinese universities. The University boasts a number of outstanding disciplines in chemistry, chemical engineering, materials science and engineering, power engineering and engineering thermophysics, computer science and technology, petroleum and gas engineering, environmental science and engineering, safety science and engineering and business administration. Three disciplines of Chemistry, Material Sciences and Engineering are ranked among top 1% in the world by the ESI. Some technology has been commercialized with the support of CZU National Technology Transfer Center, Provincial Collaborative Innovation Center, and the University Science and Technology Park.

Changzhou University aims to make students responsible, innovative and cooperative through continuous reforms of undergraduate programs and the integration of education and industry. In recent years, eight bachelor's degree programs have been accredited by China Engineering Education Accreditation Association, a member of the Washington Accord. Its students have won many top awards in National College Students Innovation and Entrepreneurship Competition, National Science Project Competition, and National Math Contest in Modeling. The University tops among Chinese universities in the rate of graduation, employment and employer satisfaction.

Changzhou University offers a wide range of short-term cultural programs and four-year Chinese taught degree programs to international students. Four English taught degree programs are offered to international students in Petroleum Engineering, Chemical Engineering and Technology, Computer Science and Technology and International Business. With its good location, lower living costs and strong teaching, the university accommodates over 500 international students from 32 countries, including Uzbekistan, Kazakhstan, the Laos, Thailand, Vietnam, Pakistan, Yemen, Turkey, Ethiopia, Zambia, the UK, Canada, Finland, Japan, etc. Nearly 300 Chinese students study abroad for long-term and short-term programs each year, and a dozen of them choose SAMK.

The Effectiveness of EEG-Feedback on Attention in 3D Virtual Environment via Brain-Computer Interface

Ling Zou, Changzhou University

Introduction

The degree of attention, to a certain extent, is related to the brain's ability to process signals and encode information, resulting in influencing people's performance (Smithson E F, 2013, 3029-3040). Nowadays, the studies on attention involving electroencephalography (EEG) biofeedback are mainly divided into two types: "Attention Training" and "Attention Monitoring" (Sun C Y & Yeh P C, 2017, 73-82). The former monitors and measures people's attention state during the task, and further improves the attention through the feedback provided by their performance (Chen C M, 2014, 959-980).

During the research, Electroencephalogram (EEG) devices are used to monitor and measure attention states and provide learners with different attention feedback signals (Lin C S, 2014, 164-171). The visual system is one of the factors influencing EEG activity and attention (Gola M, 2013, 334-341). The brain can be communicated with external devices through brain-computer interfaces (BCIs), and BCIs are quite widely applied in many areas (Zhengrui Qin & Qun Li, 2018, 115-128). EEG is deemed as one of the most common neuroimaging methods to design BCI systems (Rami Alazrai, 2019, 113-120). Because of high time-resolution characteristics of EEG (Kai W, 2018, 59) portable and non-invasive EEG devices are often used to acquire EEG combined with BCI (Jesús González, 2019, 407-418), by which messages can be sent without using nerves and muscles (Zou Ling, 2011, 43-56). The fusion of BCI and virtual reality (VR) allows a wide range of experiences where participants can control various aspects of their environment, either in an explicit or implicit manner, by using mental effort alone.

In order to reach full advantage of the neurobiological mechanisms underlying recovery, such as attention deficit hyperactivity disorder (ADHD), this paper integrates the whole front-end hardware circuits into the same chip, and makes the self-made 16-channel brain electric amplifier as the core. At the same time, it adopts the HTC's VIVE head-mounted virtual reality helmet, and an "Underwater World" is designed, which is a virtual reality scene of the model, to present attentional feature information and, thus, forming an EEG-attention feedback system.

Methods

System overview

The system design scheme is shown in Figure 1.

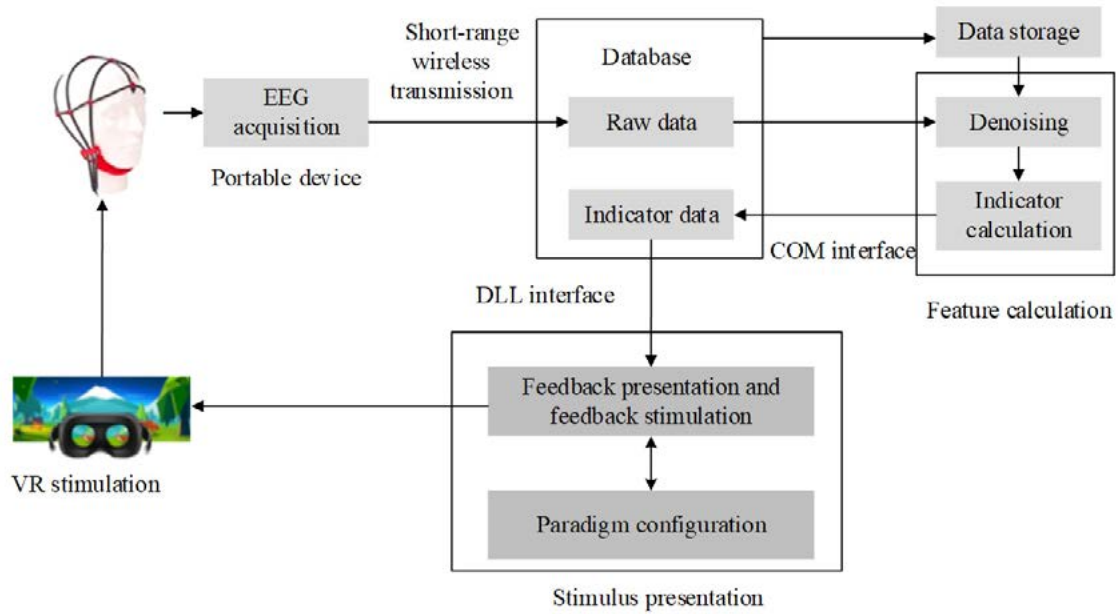


Figure 1. System overall plan

The self-made 16-channel portable EEG acquisition device sends multi-channel-EEG data to the data acquisition server by Bluetooth on time. The server stores data into working database and backup storage. Then, the COM (Component Object Model) interface is used to call some user defined plugin module to denoise and carry out indicator calculation, the returned result also stores into working database.

The high-performance data acquisition and rich-presentation module are matched with the Dynamic Link Library (DLL) technology, which could get the online indicator from working database when the stimulus presentation module needs to be updated. According to the attention-parameters, virtual reality is created by UNITY3D, which has complex architecture for VR while the data acquisition function is simple. All present logic programs are stored in Unity3D or the presentation module. Finally, the 3D scene is presented to the subject using the HTC's VR headset called VIVE.

Self-made 16-channel brain electrical amplifier design

The overall design of the system mainly consists of two parts—acquisition and transmission module and host computer (Figure 2). The former is in charge of acquisition, amplification, digital conversion, EEG signal transmission and the entire system power supply. The latter can store data, process signals and configure the relevant parameters of the acquisition transmission module (Ye Z, 2017, 282-290).

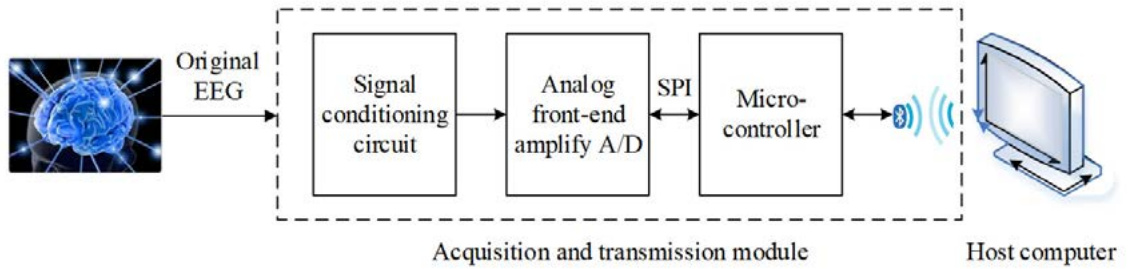


Figure 2. Schematic diagram of the 16-channel EEG acquisition system

Attention feature parameter estimation

This project adopts the power ratio of sensorimotor rhythm (SMR) and θ wave in a time window as the characteristic of current attention. When the SMR component is higher, the subject is more nervous and more concentrated.

The SMR band has a frequency range of 12 to 15 Hz; the theta band has a frequency range of 4 to 8 Hz. Therefore, the power ratio (R) expression of the two is as shown in equation 1:

$$R = \frac{\sum_{i=12}^{15} P_{smr}(i)}{\sum_{i=4}^{8} P_{theta}(i)}, i \in N^*$$

Formula 1.

$P_{smr}(i)$ and $P_{theta}(i)$ respectively represent the power of the SMR wave and the θ wave when the frequency is i . After the power ratio is obtained, the ratio is normalized to an integer value between 0 and 100 for use in the attention feedback paradigm:

$$atn = MIN + \frac{(MAX - MIN)(R - \min)}{\max - \min}$$

Formula 2.

Where $MAX=100$ and $MIN=0$, the two are regularizing the upper and lower limits respectively; R is the power ratio calculated by equation 1; \max and \min are empirical constants respectively, representing the normal interval of the power ratio, The value is determined by the doctor. Through formula 2 the attention is converted into a linear value between MAX and MIN to obtain the final attention index (atn).

Result analysis

Steady-state visual evoked potential observation

Five participants were tested using the Greentek 16-channel detachable electrode cap with self-made 16-channel brain electrical amplifier. The sampling rate was set to 500 Hz. The output was set to text, and the electrode installation position is set to P3, P4, Pz, O1, O2 position according to the international 10-20 standard, and the reference electrodes were placed at the left and right mastoid positions. The test system (Figure 3) presents alternately flipped black and white boxes on the screen at different frequencies. The test is executed for 2 minutes, and the data obtained by the acquisition platform is imported into Matlab for further processing.

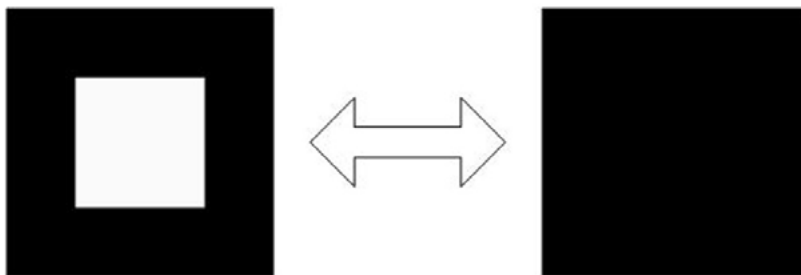


Figure 3. SSVEP image reversal stimulation

Figure 4 shows the spectrum of the occipital electrode at different frequencies of stimulation. For example, at the 10 Hz stimulation frequency, a peak at 10.01 Hz and 20.02 Hz at the fundamental frequency is observed, indicating that steady-state visual evoked potential (SSVEP) can be effectively induced, and the frequency response of SSVEP appears at the fundamental and first harmonics of the stimulation frequency. The amplitude at the frequency is significantly higher than the amplitude at the first harmonic. Figure 5 shows the EEG spectra of the five participants at different stimulation frequencies, indicating that all five participants can elicit a steady-state EEG response at the corresponding stimulation frequency. The experimental results are consistent with the characteristics of the SSVEP response, and the system can accurately collect the induced EEG.

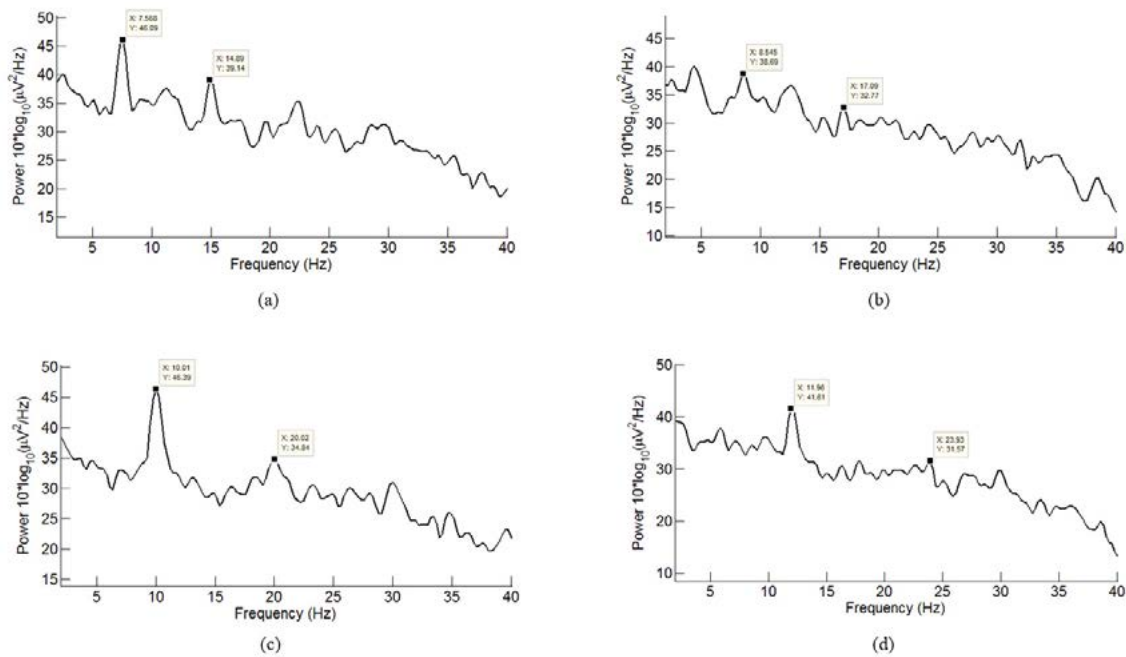


Figure 4. The EEG frequency spectrum of a subject at different stimulation frequency

(a) 7.5Hz ; (b) 8.57Hz ; (c) 10Hz ; (d) 12Hz

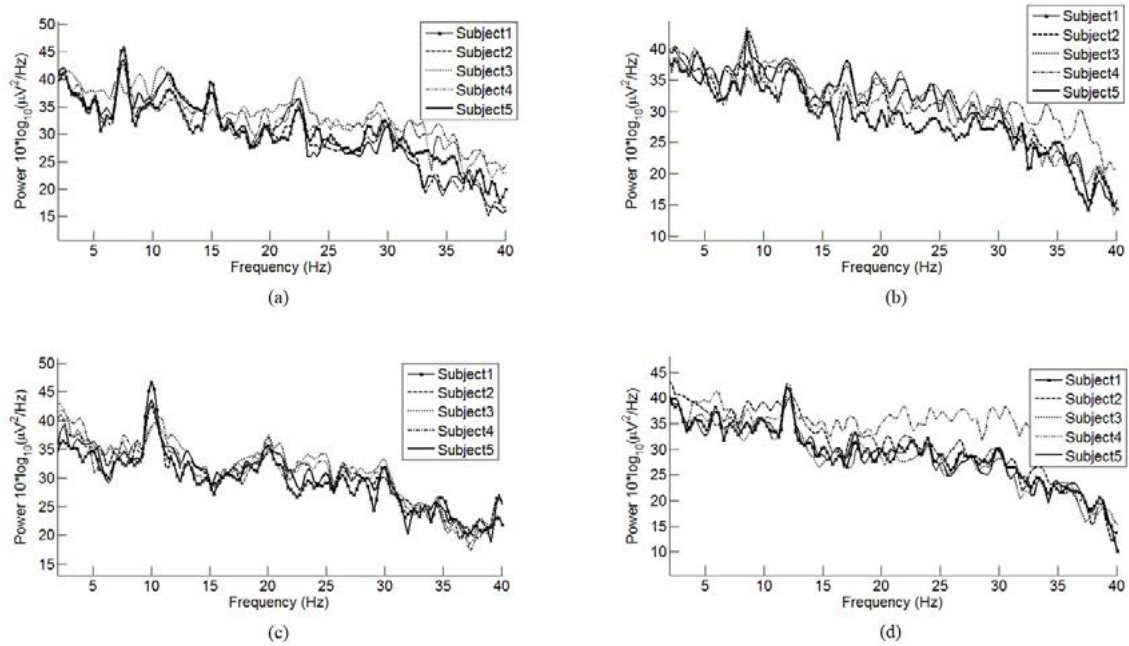


Figure 5. The EEG frequency spectrum of five subjects at different stimulation frequency (a) 7.5Hz ; (b) 8.57Hz ; (c) 10Hz ; (d) 12Hz

VR integration test

One participant, first wearing the Greentech 16-lead brain cap, then wearing HTC's VIVE virtual reality helmet, was collecting subjects in a calm and awake state EEG. As shown in figure 6, the input of the multimode acquisition software is set to 16-lead EEG. The output is selected as the attention indicator, and the attention value is transmitted to the feedback end VR underwater world in the VR environment, showing changes in attention in the VR environment.

Figure 6 and figure 7 show the interface of the acquisition and VR feedback sections in the integration test respectively.

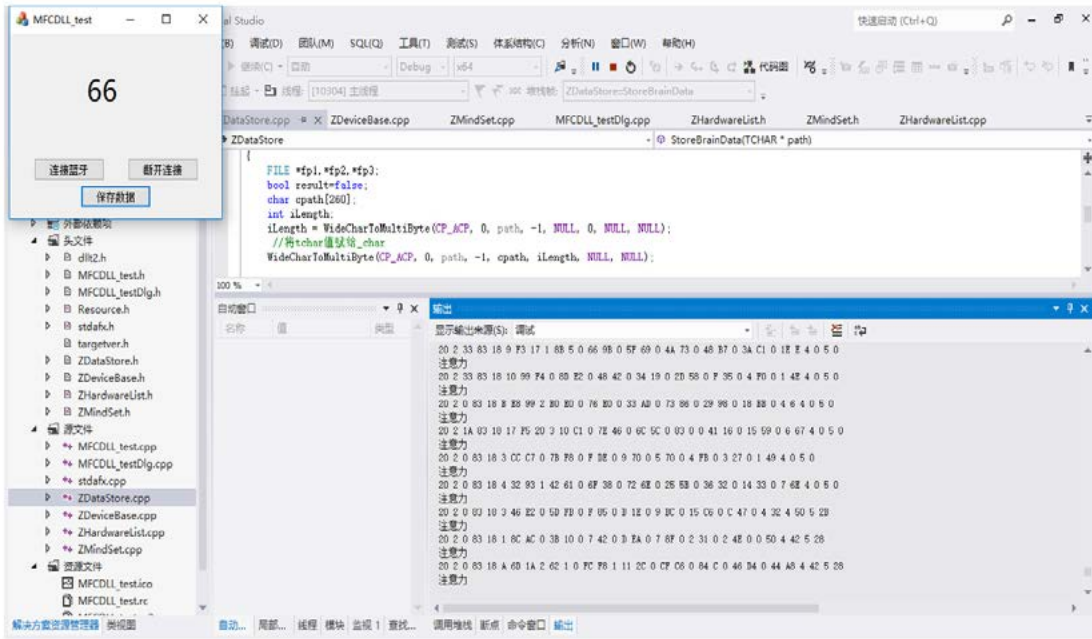


Figure 6. Acquisition part of the integration test

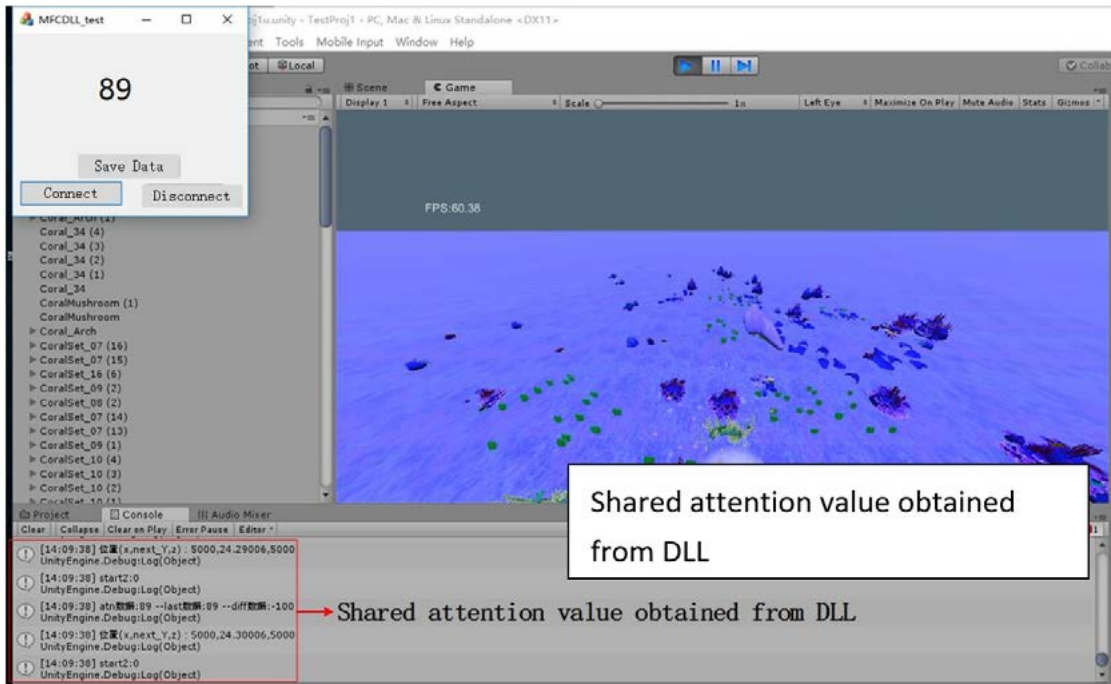


Figure 7. VR feedback part of the integration test

The test shows that the whole system integrates the EEG acquisition and VR technology, and uses the real-time algorithm to calculate the attention feature value. The feedback is sent to the participants tested, and this constitutes the virtual realistic EEG biofeedback system. When the level of attention of the subjects is low, the deep sea close-up mode is presented, and when the level of attention is high, the shallow sea vision mode is presented, so the virtual reality scene of the system can effectively reflect the current level of attention of the subjects. The entire system can work together and operate normally.

Discussion

The system can effectively collect the EEG information of the subject, calculate the attention feature value through the real-time algorithm, and stimulate the subject to realize the biofeedback through the virtual reality rendering system.

The system has the characteristics of stable operation, good reliability, simple operation, friendly interface, strong usability, good interface and strong openness. Its function basically realizes the requirements of multi-modal biofeedback therapy and the expected work objectives. Due to the tight time, this research and development focuses on the system architecture. In terms of miniaturization and portability, each acquisition amplifier is in a laboratory form and requires further packaging and inspection. There are many places in the application that have good ideas but have not been realized. The research on the disease has yet to be carried out, such as increasing the application of virtual reality biofeedback, developing the operational imagination paradigm, and applying it to the limb rehabilitation and swallowing rehabilitation of stroke patients.

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Safety Helmet Wearing Detection Based on Improved Region Convolutional Neural Network

Lin Shi, Changzhou University

Introduction

Petrochemical industry is very important in China and work safety is being paid more and more attention by the Chinese government. Safety helmet wearing detection, as an important technology of video security supervision, has been widely a concern of researchers at home and abroad.

Early research on safety helmet wearing detection is mainly based on traditional machine learning methods. For example, Rubaiya et al^[1]. extract Hough transform features of head region and input them into SVM (support-vector machine) for detection. This kind of method requires that specific features with good adaptability should be studied and designed for different detection tasks. In recent years, deep learning methods are widely used in various fields, such as image classification^[2], target detection^[3], and semantics segmentation^[4]. Vishnu et al^[5]. applied CNN(convolutional neural network) on upper one fourth part for further recognition of motorcyclists driving without a helmet.

At present, the main target detection algorithms based on deep learning are mainly divided into two categories. The first are region-based target detection algorithms, such as Fast RCNN(Fast Region-based CNN)^[6], Faster RCNN(Faster Region-based CNN)^[7] and R-FCN(Region- based Fully Convolution Network)^[8]. The detection accuracy of this kind of algorithm is higher, but the detection speed is slower. Another kind of main target detection algorithm is to transform detection into regression problem solving, such as YOLO^[9] and SSD^[10], which have low detection accuracy. Faster RCNN uses RPN(Region Proposal Network) to generate candidate regions, which fully implement end-to-end detection. Therefore, this paper chooses Faster RCNN as the basic network of safety helmet wearing detection. However, there are many problems when Faster RCNN is directly applied to safety helmet wearing detection, such as the imbalance of positive and negative samples and the poor detection effect of small targets and occluded targets in the process of network training. Therefore, this paper introduces online hard example mining and multi-scale convolution feature fusion technology, this algorithm solves the problem of too large negative sample space in the process of network training, and improves the sensitivity of network to small target and occlusion target features.

Safety helmet wearing detection

The framework of the safety helmet wearing detection system designed in this paper is shown in Figure 1. Firstly, information labeling is carried out for the persons wearing safety helmets in the collected pictures, which is converted into VOC2007 format. Secondly, the data samples are input into CNN for feature extraction. Thirdly, the features of convolution layer are fused and input into RPN network to extract candidate regions. Finally, the candidate region feature map is input into ROI (Regions of Interest) network embedded in OHEM mechanism to select difficult samples and perform target classification and regression operations.

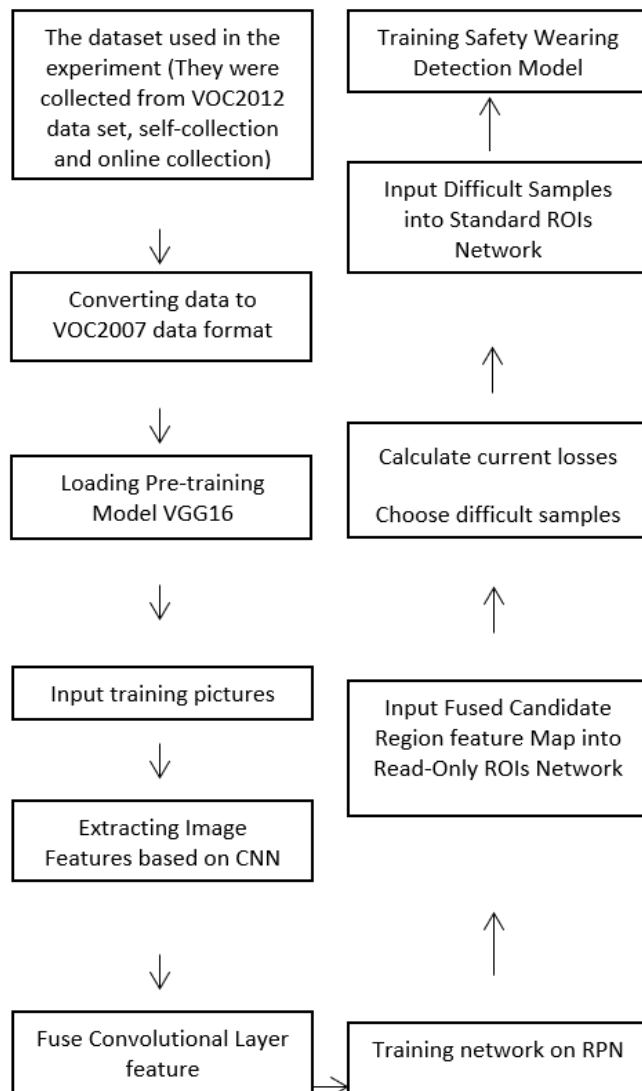


Figure 1. The framework of the safety helmet wearing detection system

Introduction to Faster RCNN

Faster RCNN is a general target detection network framework based on regional convolution neural network proposed by Rens et al. in 2016. The mean Average Precision (mAP) [13] on VOC2007 datasets has reached 73%. Faster RCNN network mainly includes region Proposal Network (RPN) for generating candidate regions and Fast RCNN network for classification and regression.

RPN takes the convolution feature map extracted from the original image as input, and outputs a series of target candidate boxes. RPN uses sliding windows, and each sliding window generates a short eigenvector to input to the full connection layer for location and category judgment. At the same time, it predicts multiple candidate regions. Each sliding window maps to a low-dimensional short vector, which is input to two parallel full connection layers. One network layer outputs the category and probability of its own, and another network layer outputs coordinate regression values of candidate box positions.

When training RPN networks, a binary label is assigned to each candidate box for network training. We will assign positive labels to the largest candidate box of an IoU (Intersection-over-Union) for a real target area box and to the candidate box with an IoU greater than 0.7 for any real target area box, and assign negative labels to candidate boxes with IoU less than 0.3 for all real target boxes and then train the network. The loss function of image is shown in Formula (1) [7].

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

Formula 1.

Where i represents the index of the first candidate box in small batch processing, p_i is probability of target for candidate box i . If i is a candidate, then p_i is 1, otherwise 0, $t_i = \{t_x, t_y, t_w, t_h\}$ is a vector, which represents coordinates of candidate box, t_i^* is the coordinate vector corresponding to the real target box.

The classification loss function L_{cls} is shown in Formula (2).

$$L_{cls}(p_i, p_i^*) = -\log[p_i^* p_i + (1 - p_i^*)(1 - p_i)]$$

Formula 2.

The Loss function of regression L_{reg} is shown in Formula (3).

$$L_{reg}(t_i, t_i^*) = R(t_i - t_i^*)$$

Formula 3.

Where R is a function $smooth_{L1}$, which is shown in Formula (4).

$$smooth_{L1}(x) = \begin{cases} 0.5x^2, & |x| < 1 \\ |x| - 0.5, & |x| \geq 1 \end{cases}$$

Formula 4.

Faster RCNN uses original images and the corresponding target candidate region box generated by RPN as input to Fast RCNN to detect people wearing safety helmets. When Faster RCNN network is training, the feature vectors of regions of interest are obtained by convolution pooling, using the data set marked with relevant information such as the person wearing a helmet as input, and then input to Softmax and target box regression to generate the category probability and regional coordinates.

Improved Faster RCNN

During Faster RCNN Network training, the proportion of people wearing safety helmet in the whole picture area may be small in training dataset, which results in imbalance of prospects and backgrounds of candidate regions generated by RPN and there are many invalid candidate regions. It is not conducive to updating network parameters. In the detection stage, the target size of the wearer will affect the detection result, which is not good for small targets and occluded targets. Therefore, based on Faster RCNN algorithm, this paper introduces multi-scale convolution feature fusion technology and online difficult sample mining strategy. The improved Faster RCNN network framework is shown in Figure 2.

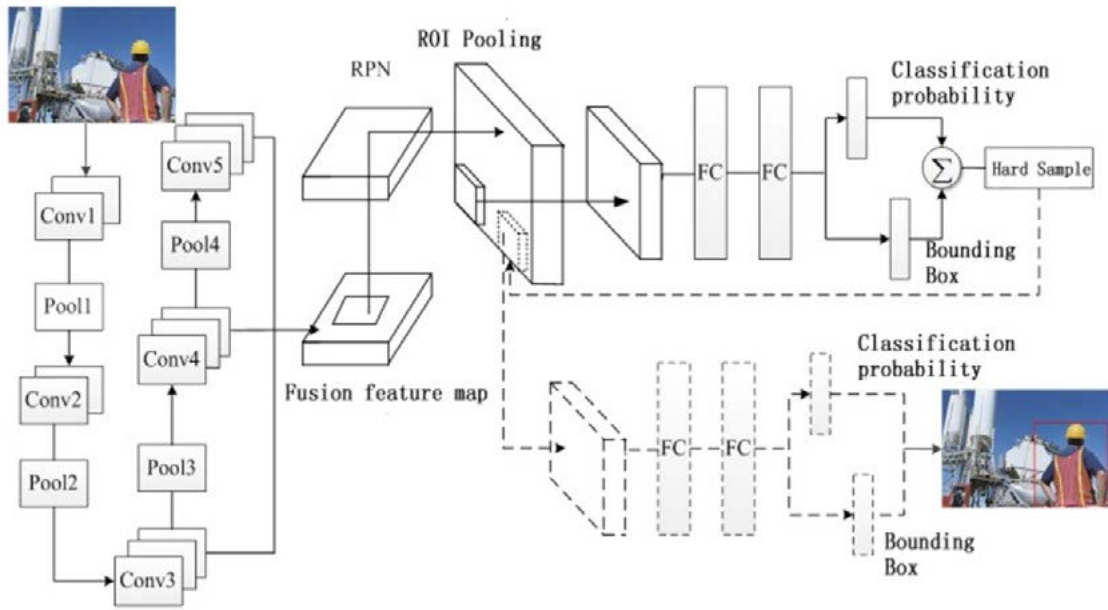


Figure 2. Improved Faster RCNN Framework

Experiment

The dataset used in the experiment was collected from VOC2012 data set ^[14], self-collection and online collection, totaling 7,000 pieces, as shown in figure 3. According to experimental requirements, these images are converted to VOC2007 dataset format and trained in network. The experimental environment is GPU GeForce GTX 1080Ti, CUDA 8.0, Ubuntu 16.04, memory 12GB. Depth learning framework Caffe was chosen as experimental platform.

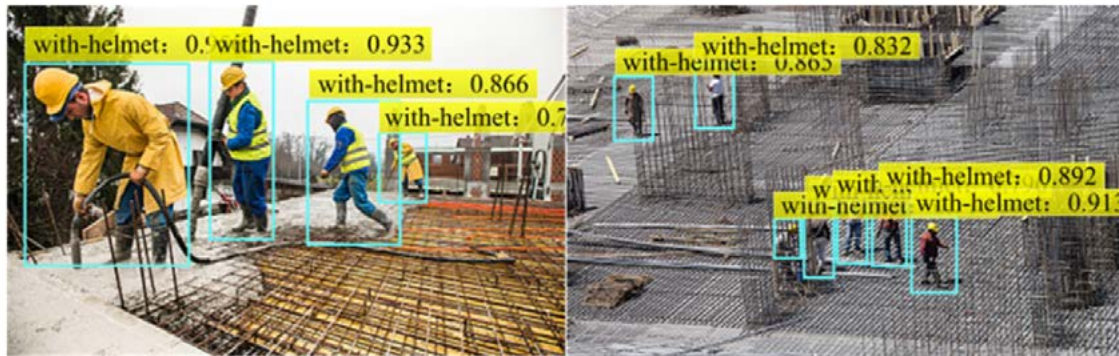


Figure 3. Sample Data

This experiment evaluates the method on the collected dataset to verify the validity of the proposed safety helmet wearing detection method. The results of the detection are shown in figure 4 and figure 5.

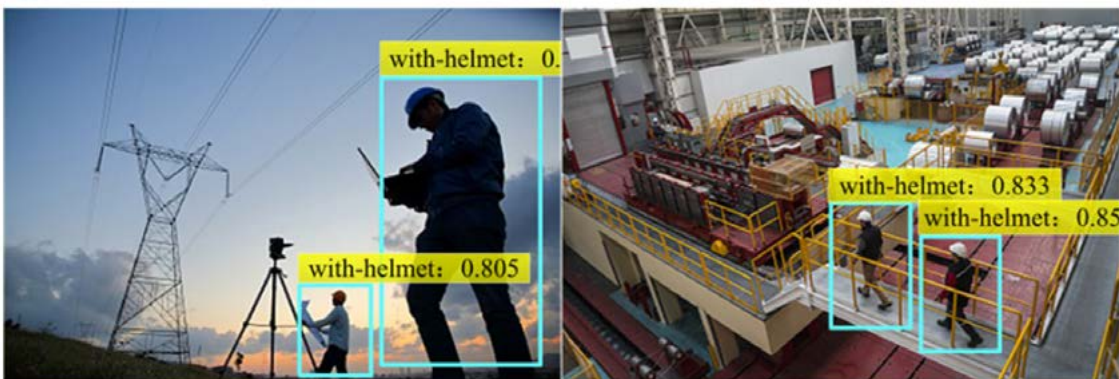


(a) Detection effect of original Faster RCNN



(b) Detection effect of improved Faster RCNN

Figure 4. Comparisons of Detection Effect of Two Algorithms



(a) Poor light

(b) Small targets



(c) Large gap in target size (d) Target ambiguity



(e) Partial occlusion (f) Multi-scale detection

Figure 5. Testing effect of safety helmet wearing based on improved Faster RCNN

Conclusions

The improved Faster RCNN helmet wearing detection algorithm proposed in this paper can effectively detect small targets and partly occluded targets, and improve detection accuracy. Based on the original Faster RCNN algorithm, the multi-scale convolution feature fusion technology is introduced, which combines the high-level semantic features and low-level pixel features to solve the target scale problem. In the stage of target detection, the on-line difficult sample mining method is used to select effective examples for training detection model. The experimental results show that the detection accuracy of this method is better than that of the original Faster RCNN, and the robustness of small target and occlusion target detection under different environmental conditions is enhanced. Network Optimization, detection speed and model size will be the focus of our work in future.

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Beneficial Effects of Auricular Acupressure on Preventing Constipation in Breast Cancer Patients Undergoing Chemotherapy: Evidence from Systematic Review and Meta-Analysis

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Introduction

Breast cancer (BC) is ranked as the second most common malignancy in women worldwide.¹ Recently, in population-based studies, the prevalence of BC in Asian regions is reported to be almost 10% and the increase from 1999 to 2013 at a 5.7 % average annual rate was significantly rapid.²

To date, most BC patients may receive chemotherapy after they have undergone mastectomy. Chemotherapy, as an aggressive treatment, may make a great contribution to extending life for BC patients. However, it is often accompanied by chemotherapy-induced constipation. BC patients who suffered from the chemotherapy-induced constipation may have impaired quality of life which can result in severe psychological symptoms such as anxiety and stress.³ Moreover, untreated constipation may progress to fecal impaction, intestinal obstruction and even sepsis.⁴ So far, oral and/or rectal laxatives may be the first-line choices to manage the chemotherapy-induced constipation. Unfortunately, these laxatives are often associated with some risk of serious adverse events (AEs) involving the electrolyte and mineral imbalances, severe dehydration and laxative dependence.⁵

As a major integral part of Traditional Chinese Medicine (TCM), Auricular acupressure (AA) is described as a technique that involves *Semen vaccariae* (*wang bu liu xing*) seeds, *Semen raphani* (*lai fu*) seeds, *Semen sinapis Albae* (*bai jie*) seeds or magnetic pellets with an adhesive tape on certain acupuncture points of ears.⁶ Based on meridian theory in China, the ear is associated with 12 meridians, and continuously stimulating the ear can improve vital energy (Qi) and remove the blood stasis.⁷

Nowadays, numerous systematic reviews have investigated the effects of AA on insomnia⁸, postoperative pain⁹, and vitro fertilization¹⁰. Nevertheless, there was no systematic review specifically focusing on the efficacy of AA for preventing constipation in BC patients undergoing chemotherapy. Therefore, the aim of this study was to update and critically evaluate the evidence from randomized controlled trials (RCTs) that have tested the efficacy and safety of AA in preventing constipation in BC patients undergoing chemotherapy.

Methods

The detailed reporting items for this study were based on the (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) PRISMA for systematic review (PRISMA-Chart ; <http://www.prismastatement.org>).

Types of studies

Only the RCTs related to the effects of AA for preventing constipation in BC patients undergoing chemotherapy were included in this study. Trials published in the form of dissertations were also selected as eligible studies. No language restrictions were imposed.

Types of participants

BC Patients aged >18 years who experienced constipation after chemotherapy were included. BC patients who suffered from degenerative neurological condition, lesions on both ears, and had had abdominal operation in the past 6 months were excluded from this study.

Types of interventions

Control Interventions

A sham AA/placebo or routine care as control was included. The routine care involved appropriate physical and psychological interventions as well as dietary modification.¹¹ If BC patients undergoing chemotherapy experienced constipation, laxative therapies would be administered. Studies were excluded if the control group treatments were not relevant to routine care or other TCM therapies were used as an adjunct treatment in conjunction with the routine care.

Experimental Interventions

Studies were included if AA was used as an adjunct therapy in conjunction with routine care for preventing constipation among BC patients undergoing chemotherapy. In addition, we excluded studies in which other TCM therapies were utilized as an adjunct treatment in conjunction with the routine care.

Outcomes

Primary outcomes

- ① Response rate: Bristol Stool Form (BSF) is an internationally used validated questionnaire to determine the form of feces. A higher BSF score indicated soft feces. Response rate, also known as improved effectiveness according to the Guiding Principles of Clinical Research on New Drugs criteria (GPCRND-constipation), was defined as the number of patients who achieved BSF Scale score over 3 after intervention in our study.
- ② Constipation Assessment Scale (CAS): CAS score was used to assess patients with constipation in the clinical settings.¹² This questionnaire included 8 items. For each item, we had three possible response options: no constipation, some problem, and severe problem. The equivalent scores were 0, 1 and 2, respectively. The total CAS score ranged from 0 to 16. Higher scores can indicate higher degrees of constipation.

Secondary outcomes

- ① Patient Assessment of Constipation–Quality of Life (PAC-QOL): It was a valid and reliable measurement containing 28 items in four dimensions (physical discomfort 4 items; worries and concerns 11 items; psychosocial discomfort 8 items; and satisfaction 5 items). Each item was rated using a five-point Likert scale from 0 (not at all) to 4 (extremely). A higher score indicated a more severe effect of constipation.¹³
- ② AEs: The incidence and the severity of AEs from AA, the proportion of patients requiring discontinuation of AA.

Data sources and search methods

The following electronic databases were searched from their inception to the current date: OvidMedline, Embase, the Cochrane Central Register of Controlled Trials (CENTRAL), and AMED. We also searched four Chinese databases: Chinese BioMedical Database (CBM), China National Knowledge Infrastructure (CNKI), Wan-Fang Data, and Chinese VIP Database. Experienced researchers helped the research team to develop a search strategy to identify the relevant articles. The Ovid Medline search strategy can be seen in *Online Supplementary A*.

Study Selection

The results of the searches were exported to the Endnote referencing software, and duplicates were removed. Studies were selected by two independent reviewers (Zheng and

Yan). In most cases, disagreements were resolved by discussion between the two reviewers. If disagreement remained after discussion, a third reviewer (Xu) was consulted before taking the final decision on the disagreements. A flowchart depicting the trial selection process was shown in the PRISMA flow diagram

Data extraction and quality assessment

The complete text of each included article was read by two independent reviewers (Zheng and Yan) who extracted relevant data and conducted quality assessment of the RCTs based on a data extraction form (Excel). The following data were extracted from the original articles: (1) author, year and country; (2) sample size; (3) experimental interventions (duration of treatment, auricular acupuncture points choosing); (4) control Interventions (routine care interventions, types of laxatives, dose, methods of administration, and the duration of treatment); (5) follow-up (6) main outcomes (7) AEs. In addition, when reported data were insufficient, we would try our best to retrieve the missing information from the corresponding authors. The risk of bias would be assessed with the “Risk of bias” tool from the Cochrane Handbook V.5.1.0, which includes random sequence generation, allocation concealment, blinding of the participants and personnel, blinding of the outcome assessments, incomplete outcome data, selective reporting, and other sources of bias.¹⁴ For the results assessment, the study bias was classified as either “unclear,” “low-risk,” or “high-risk”. Disagreements were resolved by discussion between the two reviewers. If consensus was not reached, the third reviewer was consulted for a final decision.

Data collection and synthesis

In our study, meta-analysis was performed using software RevMan 5.3 (Review Manager [RevMan; Computer program]. Version 5.3. Copenhagen: The Nordic Cochrane Centre, the Cochrane Collaboration, 2014.). For dichotomous data, we presented results as risk ratio (RR) with 95% confidence intervals (CIs). For continuous data, mean difference (MD) was included in the meta-analysis. If outcome variables were measured on different scales, standard mean differences (SMD) analysis with 95% CIs was included in the meta-analysis. In each meta-analysis, the c^2 and I^2 tests were used to evaluate statistical heterogeneity.¹⁵ Given $I^2 < 50\%$ and $P > 0.1$, the studies were considered to be homogeneous, and a fixed-effects model was applied. On the other hand, if $I^2 \geq 50\%$ and $P < 0.1$, the trials were considered to be heterogeneous, and a random effects model based on Mantel-Haenszel (MH) or inverse variance (IV) statistical approach was selected.¹⁵

Sensitivity analysis

If the test for heterogeneity *P*- value was < 0.1 after performing the subgroup analysis, the sensitivity analysis would be conducted to evaluate the robustness of our results. The meta-analysis was repeated after omitting the low-quality studies. Moreover, we also assessed whether the statistical model (random-effects vs fixed-effects model) will affect the current results.

Assessment of reporting biases

If a sufficient number of studies were available (at least 10 studies), we attempted to assess publication bias using a funnel plot.¹⁶

Results

Trial flow and study characteristics

The literature search of databases generated 180 citations. After excluding the duplicate manuscripts, titles and abstracts, we analyzed 30 full-text articles. Of these 30 articles, 26 were excluded as they did not satisfy the inclusion criteria, leaving four eligible RCTs¹⁷⁻²⁰ involving 322 participants for the systematic review (Figure 1). Four included RCTs all originated in China and had a relatively small sample size. All included trials compared a co-intervention of AA and routine care with a control of routine care alone. Moreover, the duration and frequency of the interventions was mostly 25 minutes and three times/day, respectively. The acupuncture points of AA varied according to TCM theory and the view of Nogier's theory for all included RCTs. Details regarding the 4 eligible RCTs¹⁷⁻²⁰ included in our meta-analysis are summarized in Table 1.

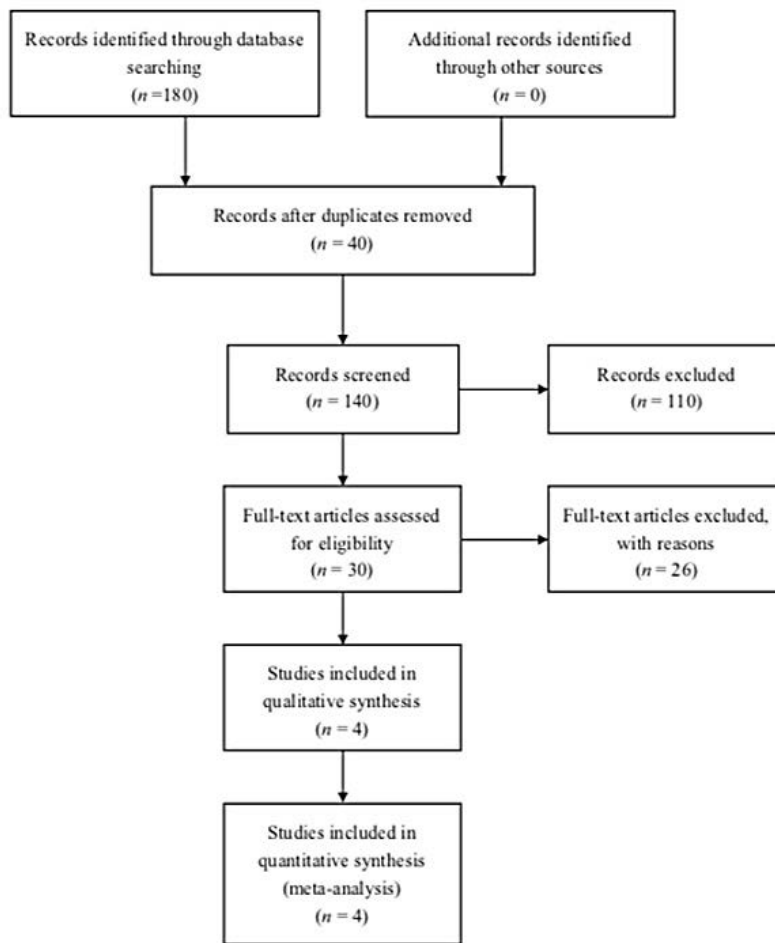


Figure 1. Flowchart of the trial selection process.

Table 1. Summary of the RCTs of AA for treating constipation in BC patients undergoing chemotherapy.

Study	Sample size	Intervention group (regimen)	Control group (regimen)	Main outcomes	Acupuncture points	AEs
Shin and Park ¹⁷	52	(A) AA (one session = 20 minutes, three times/day, total 20 days, <i>n</i> = 26), plus (B)	(B) Routine care, <i>n</i> = 26	CAS PAC-QOL	Rectum, large intestine, lung, and San Jiao	Mild pain, mild discomfort
Wang et al ¹⁸	60	(A) AA (one session = 25 minutes, three times/day, total 18 days, <i>n</i> = 30), plus (B)	(B) Routine care, <i>n</i> = 30	Response rate	Rectum, large intestine, lung, San Jiao, and subcortex	n.r.
Xu et al ¹⁹	90	(A) AA (one session = 30 minutes, three times/day, total 18 days, <i>n</i> = 45), plus (B)	(B) Routine care, <i>n</i> = 45	Response rate	Rectum, large intestine, lung, San Jiao, and subcortex	n.r.
Feng et al ²⁰	120	(A) AA (one session = 30 minutes, three times/day, total 20 days, <i>n</i> = 60), plus (B)	(B) Routine care, <i>n</i> = 60	Response rate	Rectum, large intestine, lung, San Jiao, and subcortex	n.r.

Note: AA, auricular acupressure; AEs, adverse events; BC, breast cancer; CAS, Constipation Assessment Scale; n.r., not reported; PAC-QOL, Patient Assessment of Constipation-Quality of Life; RCT, randomized controlled trial.

Risk of bias

The Cochrane risk of bias is shown in figures 2 and 3. One of the included trials¹⁷ reported appropriate sequence-generation methods for the randomization, whereas the remaining trials¹⁸⁻²⁰ did not describe the methods of sequence generation. One of the included trials¹⁷ conducted concealment of allocation by sealed envelopes, while one RCT²⁰ used inappropriate methods and the remaining trials^{18, 19} did not describe the methods of sequence generation. Moreover, the authors reported that in addition to one RCT¹⁷, none of the included trials employed patient-blinding methods, whereas the assessor blinding was unclear in 3 RCTs¹⁸⁻²⁰. Of all included RCTs, only one RCT¹⁷ stated the risk of bias for participant dropout or withdrawal. Considering other biases, the sources of funding were shown in all included trials. The sources of direct funding were a medical university or Ministry of Health research foundations; these trials were considered to be free from the risk of bias posed by a financial conflict of interest.

Meta-analysis outcomes

Response rate.

Three RCTs¹⁸⁻²⁰ (involving 270 patients) were identified with the outcome measurement of response rate. The pooled results displayed favorable significant effects of routine care plus AA on response rate when compared with the AA alone (RR=1.27, 95%CI [1.14, 1.42], $p < 0.01$) with low heterogeneity ($C^2=2.31$, $P = 0.31$, $I^2=14\%$; Figure 4).

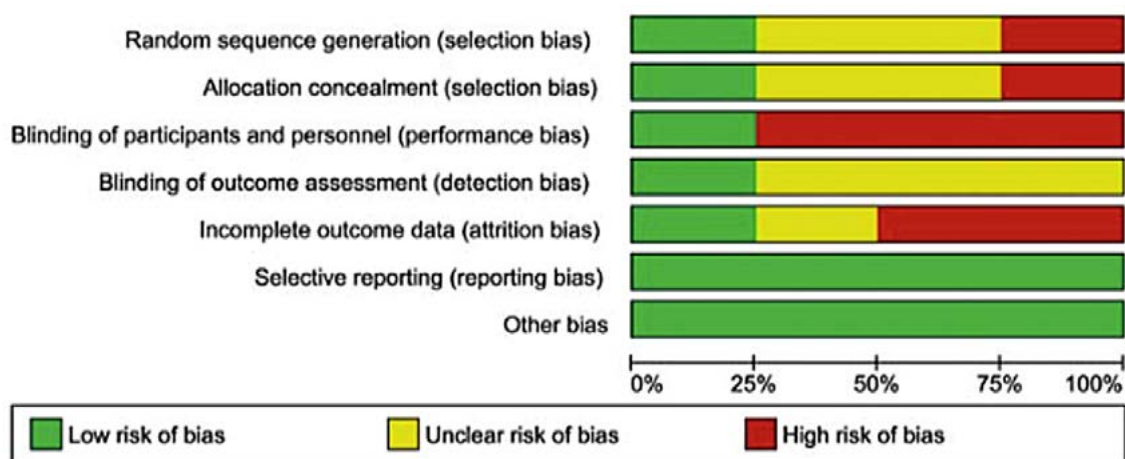


Figure 2. Risk of bias summary: reviewers' judgements about each risk of bias item for each included study

	Random sequence generation (selection bias)	Allocation concealment (selection bias)	Blinding of participants and personnel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data (attrition bias)	Selective reporting (reporting bias)	Other bias
Feng 2015	⊖	⊖	⊖	?	?	+	+
Shin 2016	+	+	+	+	+	+	+
Wang 2013	?	?	⊖	?	⊖	+	+
Xu 2016	?	?	⊖	?	⊖	+	+

Figure 3. Ris of bias graph: reviewers' judgements about each risk of bias item presented as percentages across all included studies

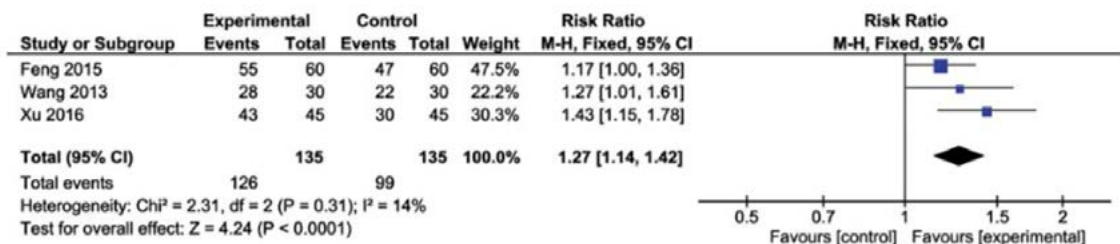


Figure 4. Routine care vs routine care plus AA on response rate.

CAS

Only one RCT¹⁷ used CAS as the outcome measure. The result of this RCT showed superior effects of routine care plus AA on CAS when compared with the routine care alone (MD = -5.07, 95%CI [-6.86, -3.28], *p* < 0.01).

PAC-QOL

There was only one RCT¹⁷ which used PAC-QOL as an outcome measure for the improvement in chemotherapy-induced constipation. The result of this trial showed superior effects of routine care plus AA on PAC-QOL when compared with the AA alone (MD = -1.26, 95%CI [-1.59, -0.93], $p < 0.01$).

AEs

In all included trials, only one RCT¹⁷ assessed AEs, while the other RCTs did not.¹⁸⁻²⁰ Several common adverse outcomes (mild discomfort or pain) from the routine care plus AA therapy group were reported in this trial.

Discussion

Overall, our meta-analysis showed that the combined use of routine care and AA was found to be superior to routine care therapy alone in terms of BSF, CAS, and PAC-QOL.

Previously, Luo, et al.²¹ summarized the current evidence to examine the effect of AA on constipation. Unfortunately, in that systematic review, the author included RCTs only to test the effect of AA for preventing opioids-induced constipation in cancer patients. Their findings are somewhat consistent with our study. Nevertheless, chemotherapy-induced constipation was not included in the previous systematic review.²¹ Moreover, the previous systematic review²¹ included some RCTs that compared different Complementary and Alternative Medicine(CAM) therapies. We excluded these trials according to our inclusion criteria. To our knowledge, our inclusion criteria gave us a more concrete picture on the role of AA than before. Moreover, compared to Luo, et al.'s study²¹, one new RCT from Korea¹⁷ was also included and analyzed in our study. Therefore, it is important to consider that a systematic review and meta-analysis should be updated periodically as new RCTs are published.

The results of our study showed that AA may have a beneficial effect on treating constipation in BC patients undergoing chemotherapy. The mechanism of action of AA is interesting for the study, and various theories have been proposed. (1) From the TCM perspective, the constipation falls under the heading of *Bian Jie*, which is attributed to “dysfunction of spleen in transportation” and “stomach disharmony”. According to the theory of TCM, AA stimulates acupuncture points on ears, which could reinforce *qi* circulation and affect nourishment of the spleen, leading to an improved *Bian Jie* state.²² (2) The primary modern

speculation about AA is somatotopic arrangement theory. Oleson et al.²³ recruited 40 patients with specific musculoskeletal pain condition in a double-blind study to examine whether somatotopic arrangement theory corresponded to parts of the body and they obtained a 75.2% accuracy rating.²³ Therefore, the ears are the closest organs to the brain, and the application of AA in the auricular reflex points associated with gastrointestinal function may have a beneficial effective on alleviating constipation symptoms.²⁴ (3) There are various neurophysiological connections between auricular reflex points and the autonomic and central nervous system. Thus, groups of pluripotent cells contain information from the whole autonomic and central nervous system attempt to create regional organization centers representing different parts of the body.²⁵

As in all systematic reviews, this study is susceptible to bias. For adequate random sequence generation, high risk of bias was given to 75% of the included studies. For the allocation concealment, the group assignment was adequately concealed in only 25% of included trials and the remaining trials were given high risk of bias or unclear risk of bias. RCTs with inadequate random sequence generation and inadequate allocation concealment may be subject to selection bias and are more likely to overestimate the results of the outcome measures.^{26, 27} For the attrition bias, only 25% of included trials adequately reported the incomplete outcome data, which may lead to attrition bias²⁸. Finally, although subject blinding is difficult to achieve for AA, assessor blinding is possible. Unfortunately, only one RCT included in the systematic review adopted assessor blinding, which may result in the detection biases²⁶. Overall, caution must be taken when attempting to generalize the results of our study owing to the low quality of the included RCT.

This study may have several important limitations. First, based on the assessment of the Cochrane risk of bias, this study had a high risk of bias, which seemed to result in the positive results found. In the future, to improve the quality of RCT, authors should refer to the Consolidated Standards of Reporting Trials (CONSORT) statement for trials of AA interventions.²⁹ Second, the sample size of included studies was very small. Thus, the power of our study based on small sample size effects was more likely to be overestimated.³⁰ Third, compared with other placebos, CAM therapies may include larger placebo effect.³¹ AA, as an important integral part of CAM, may enlarge the treatment effect size. Moreover, AA conducted by CAM practitioners may increase doctor-patient face-to face time, and thus a strong placebo effect was often found when CAM practitioners performed AA for their patients. Fourth, due to the limited number of pooled studies, it was not appropriate for us to formally test the asymmetry in the funnel plot. Last but not least, most of the included RCTs originated in China, limiting the results specifically to this subset of Asian

populations. In the future, more large-scale, rigorously designed, randomized, placebo-controlled, double-blind trials are still warranted.

Conclusion

Overall, as a potential safety therapy, AA can effectively prevent constipation in BC patients undergoing chemotherapy. In the future, more rigorous RCTs must be conducted to overcome the limitations of our existing data and confirm the effect and safety of AA for managing constipation in BC patients undergoing chemotherapy.

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Mobile Memory Game Services for Finnish and Chinese Elderly Care

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MotoTiles Intervention as a Tool for Fall Prevention in the Elderly Population

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Introduction

Older adults form a large and increasing proportion of the world's population, with falls representing one of the major causes of mortality and morbidity in older adults ("Summary of the updated American Geriatrics Society", 2011). With increasing age, the associated risk of falling or sustaining an injury as the result of a fall increases. When considering the aging population, falls and fall-related injuries pose a major challenge, with approximately 30% of individuals over the age of 65 falling every year ("What are the main risk factors for falls", 2004). Considering 20-30% of falls result in injuries that reduce independence and impair mobility, this issue poses significant direct and indirect costs to the healthcare system ("What are the main risk factors for falls", 2004).

Prevention should be a priority when considering fall risk reduction in older adults. When considering rehabilitation and intervention strategies, physical exercise should be included as part of a multicomponent intervention to prevent falls in older persons ("Summary of the updated American Geriatrics Society", 2011). Various strategies may be employed when considering exercise-orientated interventions, and may include strength, balance, transfer, gait, or coordination training. For example, volitional and reactive step interventions have shown as much as 50% fall risk reduction in older adults (Okubo, Schoene & Lord, 2017).

This paper presents the findings associated with a fall prevention program applying an IMT exergame technology (MotoTiles). The IMT technology was utilised as it employs volitional and reactive step-orientated strategies within gameplay. Stepping interventions have shown significantly improved simple and choice stepping reaction time, single leg stance, and timed up and go performance in elderly patients (Okubo, Schoene & Lord, 2017). The intervention discussed in this paper was conducted in cooperation with two elderly care facilities. Participants (N=19) consisted of older adults living within these facilities. The average age of participants within the study was 83.6 years (oldest 90, youngest 77). A combination of female (N=15) and male (N=4) participants was involved in the study. The intervention involved bi-weekly training, for a period of 5-weeks. The exergame-orientated MotoTiles intervention was developed and guided by physiotherapists, with a particular focus on fall prevention.

IMT Intervention

The IMTs are a distributed system consisting of 10 slave tiles and a master tablet (Figure1). The tiles are self-contained modules, containing pressure sensors and the ability to communicate with adjacent modules and the master tablet (via ANT protocol). The tiles also house eight LEDs of varying colours, which light up during gameplay or in response to pressure (i.e. when a player presses or steps on the tile).

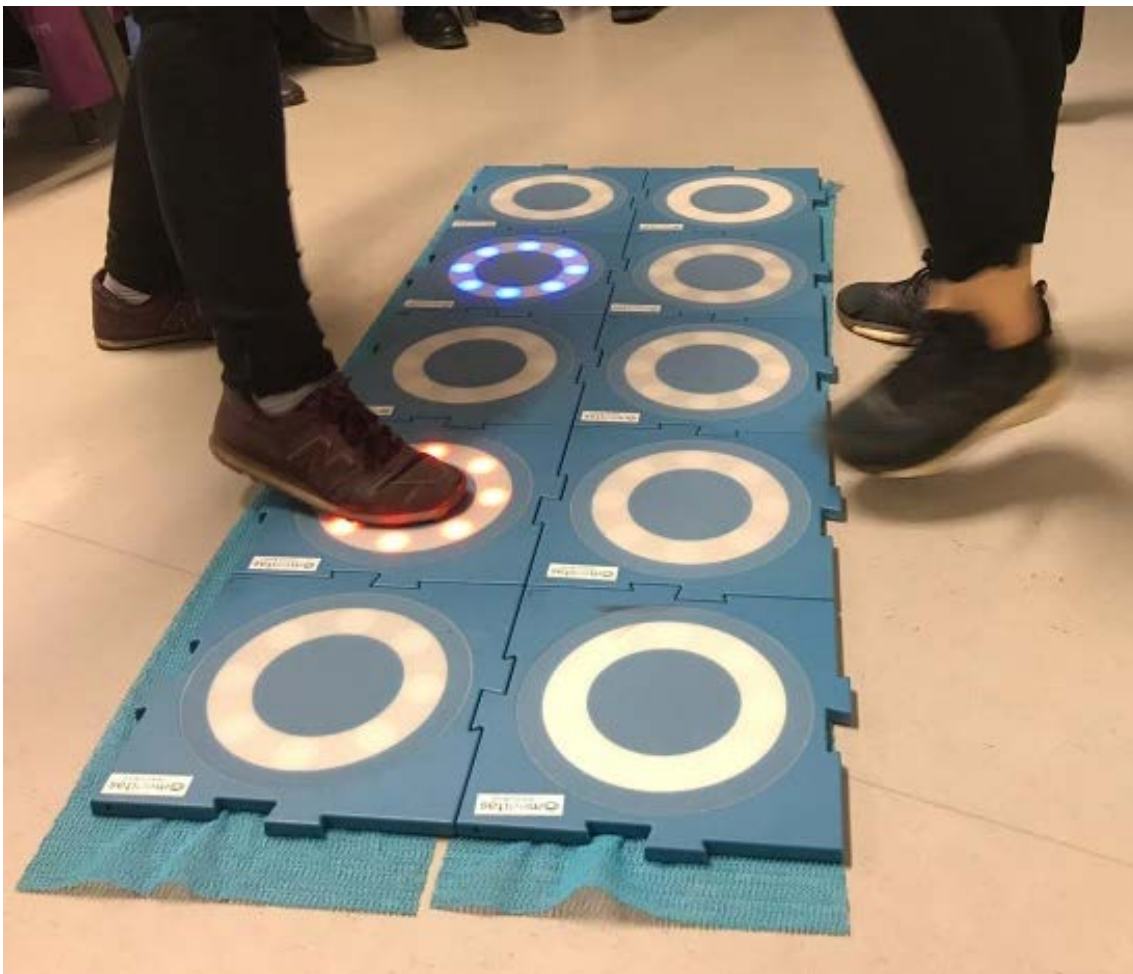


Figure 1. IMT exergame technology (MotoTiles)

The intervention program consisted of a chair-based 10-minute warm-up (performed in sitting), followed by the IMT-based exergame program, and finishing with a 10-minute cool-down and stretching period (in sitting). The IMT-based program consisted of 6 exergames specifically selected to challenge both physical and cognitive capabilities within the test group. A mixture of single, pair and group-based games were utilised, supporting competitive and collaborative gameplay, in addition to facilitating recovery periods within the intervention (while maintaining engagement within the group). During gameplay all participants had the possibility to stand independently or use an assistive aid (parallel bars or walking aid), however, were encouraged to take as little support as possible.

A combination of objective and subjective measures were utilised within the study, performed prior to commencement of the exergame intervention protocol and following the test period. The Short Physical Performance Battery (SPPB), Falls Efficacy Scale International (FES-I) and Falls Risk for Older People in the Community (FROP-Com) protocols were used within the study to assess objective and subjective function in relation to fall risk. A participant survey was also utilised following the test period to gather authentic and intuitive reactions and comments regarding the IMT intervention and associated exergames.

Results and Discussion

From the participants (N=19), four dropped-out of the intervention and did not participate in final testing. Accordingly, their data is not discussed in the below test results. The most significant results were observed in the SPPB (Figure 2). The SPPB provides objective test measures for motion and non-ambulatory based movements, offering an overall score and associated fall risk. Following the IMT exergame intervention, from the remaining participants (N=15), eight demonstrated improved overall SPPB score, three participants experienced no change, and four participants had a lower overall score. Deeper analysis of the ambulation and five time sit-to-stand components of the SPPB provides some additional insight. Of those participants with the same or reduced overall SPPB score, five out of seven participants improved test scores associated with balance during dynamically orientated movements (i.e. ambulation and sit-to-stand tests). From these seven participants, reduced test scores associated with non-ambulatory balance was associated with a reduction in overall SPPB test score. In particular, the most significant change was observed in tandem stance, with reduced capacity to maintain independent balance demonstrated in six of the seven cases.

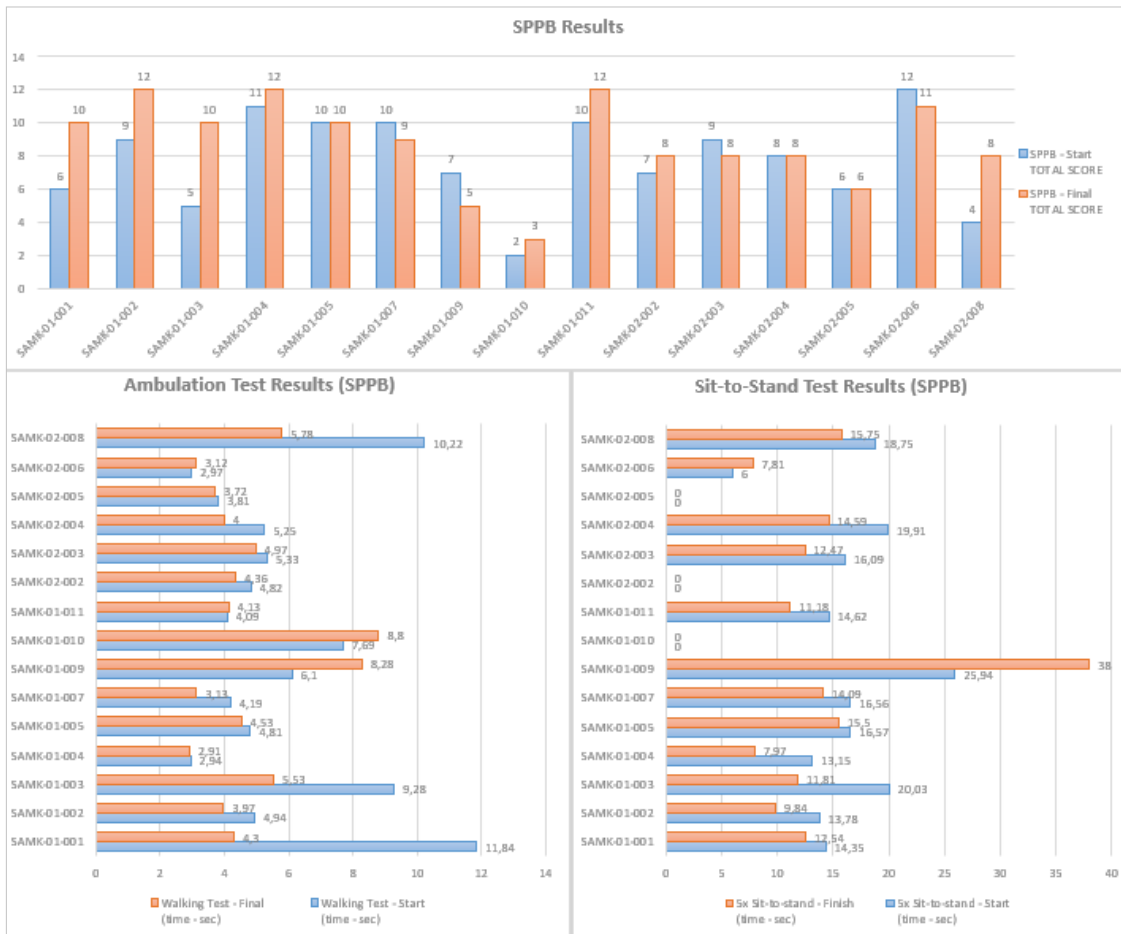


Figure 2. SPPB Intervention Results

The FES-I provides a measure of self-perceived fear of falling during various ADLs (Figure 3). Following the intervention period, 10 participants experienced positive change in self-perceived fall concern, two participants experienced no overall change, and one participant identified increased concern of falling. Two participants had invalid scores recorded during initial testing (therefore we are unable to compare results). Overall, the average change in self-perceived concern of falling decreased by 2.48 points across the exergame intervention group.



Figure 3. FES Results

The FROP-Com is a short-form assessment tool to assess overall fall risk, based on patient history and visual observation of standing, walking, turning and sitting. For the participant group, all except two participants experienced positive change, or no change in their overall test score following the IMT intervention. Although the FROP-Com provides useful information on a participant's status prior to intervention, due to the relatively short nature and format of the questionnaire, there is limited scope for improvement in total score over the course of the intervention period.

A survey was also employed to ascertain participant opinion on the IMT intervention, associated exergames and perceived effect on balance. A simple scoring system was utilized for each question, with an open-form section at the end of the participant survey. Overall, participants enjoyed the IMT intervention, wishing to continue with the program as it increased overall activity levels. Notably, several participants expressed positive change in mental health (improved mood, refreshed mind) as a result of the exergame intervention. Many also highlighted the social element of the group-based intervention as advantageous.

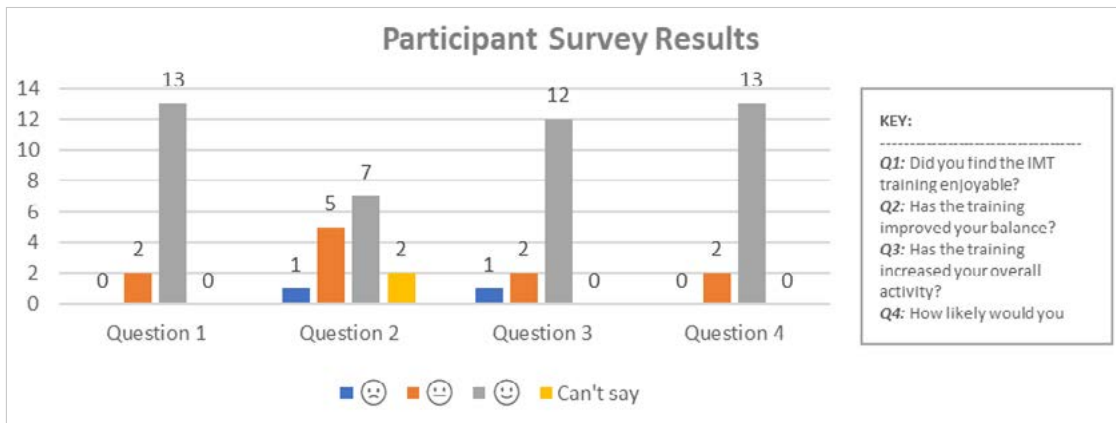


Figure 4. Participant Survey Results (following intervention period)

Conclusions

Reduced overall fall risk was observed for the majority of participants following the IMT-based exergame intervention. In particular, positive change was identified in dynamic, movement-orientated activities (i.e. ambulation and sit-to-stand), however, improvements in stance-based balance was less predictable. Ancillary benefits were also identified by participants, involving improved mental well-being and social interaction.

Overall, IMT-based exergames are seen as a suitable supporting tool for fall prevention interventions aimed at older adults. Future interventions, however, could target a combination of ambulatory and non-ambulatory balance activities, to investigate short- and long-term effect on balance and fall risk.

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Focus Prediction in Digital Holographic Microscopy Using Deep Convolutional Neural Networks

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Predictive Professional Development Platform

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Headai is developing a predictive professional development platform. We apply cognitive AI, data analytics, Digital_Twins and Digital_Self in running simulations between an individual's current skills, work expectations and continuous professional development. Our AI is in use e.g. in private companies, job offices, vocational schools, higher education institutes, NGOs, libraries and governmental offices via rest-API.

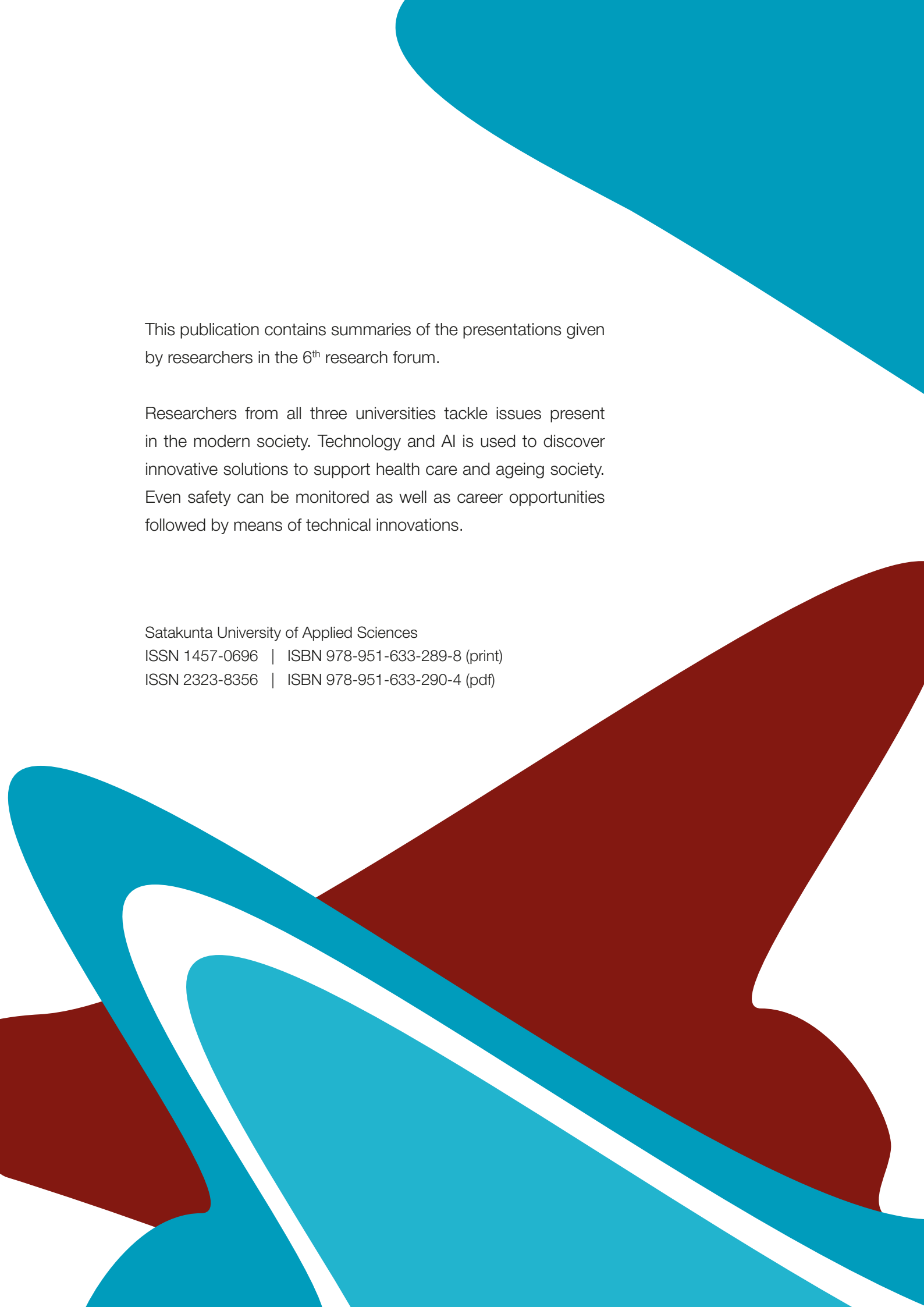
Headai Digital_Twin on labour markets is an extremely granular and detailed cognitive model on global labour market dynamics. It keeps itself up-to-date by reading through 10,000,000 job openings, 1,000,000 economic news and +100,000 investment announcements all over the world. It knows what skills are needed, in what location, in what domain. Now and in the near future.

Headai Digital_Twin on education is a similar cognitive model on educational offering. It keeps itself up-to-date by reading 100,000 course curriculums from formal, non-formal, private training and online studies. It knows what skills are on offer and if supply and demand meet.

Headai Digital_Self keeps an individual's skills, competencies, knowledge and motivations up-to-date. Headai Digital_Self is designed to optimize an individual's labour market value by suggesting new skills that help him/her to take the next steps in her/his career. Digital_Self evolves throughout an individual's life.

Our algorithms are language independent, because they are based on the combination of conceptual learning theory and chaos theory (not linguistics). AI builds its own understanding of words and their relations in different contexts based on pre-training: It applies semantic neural networks and reinforcement learning and so emulates the human way to learn.

Organisations can use Headai learning-on-demand services, Digital_Twin on labour markets and Digital_Twin on education analyses, as well as Digital-Self services via Headai developer network (API, SDK, plug-in components).

The background features abstract, organic shapes in teal and maroon colors. A large teal shape is in the top right corner, and a large maroon shape is in the bottom right corner. There are also overlapping teal and maroon shapes at the bottom left.

This publication contains summaries of the presentations given by researchers in the 6th research forum.

Researchers from all three universities tackle issues present in the modern society. Technology and AI is used to discover innovative solutions to support health care and ageing society. Even safety can be monitored as well as career opportunities followed by means of technical innovations.

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