



## Conference Paper

# Relevé: An at-home ballet self-learning interactive system

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## Abstract

Benefits from the recent technology advancement, such as physical computing and social media, it has become a global industry trend to provide intelligent exercise and self-learning support in an 'at-home' environment. However, it is still a design challenge to ensure the safety of users while enhancing their experiences when developing specific 'at-home' self-training programs which require high-level techniques, such as ballet dancing. This paper introduces Relevé - an interactive self-learning system for ballet with emphasis on various safety issues. Based on the professional knowledge of ballet dancing posture and kinematic movement research, Relevé intends to answer the needs of ballet dancing home-based self-teaching activities through online courses. The design has been based mainly on the methodologies of tangible interaction design.

**Keywords:** ballet dance, self-learning, interaction system

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## 1 Introduction

Following the recent boom of various online courses in the past few years, more people tend to conduct physical activities/exercises at home. Online courses provide more affordable and convenient solutions to people. However, the safety issue has become a significant drawback when doing at-home practices or online courses; ballet as a traditional type of dance form is hard to learn by the user at home.

In the early years, standard ballet training is almost entirely teacher-led and gives the student little opportunity for communication and discussion [1]. Training dominates the program of most famous ballet schools, with a little time and attention given to the dance performance requirement of choreographers. Instead, instruction only focuses on the accuracy of correct technical exercises. Authoritarian teaching methods were standard in a variety of western concert dance techniques [2]. The majority of ballet injuries were classified as overuse, and most injuries happened in the lower extremity followed by spine [3].

On the other hand, home-based physical activities allow people to exercise or practice freely. The use of home-based physical activity research, in particular with the female, may have positive effects over group-oriented, highly structured programs that

require a lot of time, transportation, staff involvement, and money. The interventions of home-based physical activities appear to be a productive and cost effective means of increasing physical activity in different age groups [4].

Recently, more activities have been transferred online. Using online courses to acquire new abilities is efficient and convenient today. There are three main parties in the online learning system: students, instructors, and administrators [5]. A useful online-learning system should consider systems factors as well as human factors. Learners need to understand their learning styles and feel comfortable about the level of interaction that they need to sustain their interest in a course (Devi, 2001). Assistance in online course raises the likelihood of successful future task experiences. According to the ballet's specific learning process, the greatest number of injuries occur in the foot/ankle (53.4%) [3]; hence any online-learning ballet system should be designed based on a sufficient and professional research in this specific field.

## 2 Design Rationale

The possibility of using an online learning system to provide ballet learners with opportunities for a time-saving and cost-effective way of practicing at home has been emphasized in this study. To enable our design to provide a sound solution to the right target user group, we have studied the design background and relevant user needs. However, it has been realized that the research done specifically on this field of study is rather limited. Therefore, this project is a pioneer research, aiming to reduce the risks of at-home self-learning systems, while improving the social ability involved in the process.

The starting age for learning professional ballet dancing is comparatively strict in this area; usually, adolescents start practicing technical ballet posture around 10, often becoming skillful at the age of 15–18 [8]. For kids, pre-ballet classes are often offered to dancers between the ages of 4 and 8 [9]. Besides the constraint of age, users' gender, figure, even religion also have been considered based on the relatively strict regulations at different dancing studios [8].

There are two primary periods of learning ballet, which require different types of ballet practicing shoes: soft-console ballet shoes and ballet pointe shoes [3]. Dancing "en pointe," or on dancers' toes, is a major goal in a ballerina's dance life. Dancing en pointe requires tremendous strength from the legs and feet. After at least two years of practicing, many ballet teachers still have strict requirements for starting pointe work [9].

At the beginning stage of learning ballet dancing without professional guidance, the learners are usually wondering what it takes to become a ballet dancer. Whether their goal is actually to dance ballet or it is just out of interest, ballet amateur needs a place or a learning opportunity to get proper courses, which are lacking right now [10]. The

query we are asking in this paper is: how can we provide this opportunity to all ballet amateurs or beginners in a useful and efficient way.

There are also significant social needs of this design. In Australia, there are many dancing studios around the cities, but the education level is uneven. People can easily open a dancing studio in Australia without a certification or degree in the professional dancing area. Students of different ages or skill level sometimes practice in the same classroom and under the same instructions [11], which have already caused many social issues. Even the Australian dance industry once under scrutiny for the unprofessional behavior during the class. If let it untreated, the lack of teaching criterion in the dancing learning industry might cause serious safety issue in the future.

Besides lacking practicing places, the high speed of daily life can cause time constraints for people to pursue their interests. Also, some might not be able to afford the fees for practicing in the professional dancing studio all the time. Others may have different phobias standing in front of other people doing the practice, for example, individuals who have crowd phobia or just not confident about their figure.

### 3 Design

To answer the potential needs of various types of users, the goal of our design is to provide safe and fun experiences based on the integration of personalized expectations with professional ballet training prerequisites. In this section, we anticipate an interactive system which facilitates interaction behavior of 20–50-year-old people, and most importantly, develops the overall ballet dance online self-learning platform at home.

Rather than initially focusing on online courses, we aim at establishing an interactive system which arouses learners' interest and provides the more convenient way to get into the world of ballet. Moreover, it is important to ensure that ballet learners do not hurt themselves during the home-based practice, and can adjust their postures and performance in time without a real dance coach.

Regarding the technology for building the prototype, we have used a soft-sole ballet shoe and sensor kit containing six pressure sensors and two flex sensors (Fig.1). Software based on the ActionScript program runs the whole real-time detecting system and transfers data collected from sensors (Fig.2). Adobe Flash is used to present graphic results from dancers on the screen, and to compare these with the guidance support that is an existing reference library embedded in the script. This project also supports information collection and storage which help learners quickly pick up from the previous session by themselves when logging into the application next time.

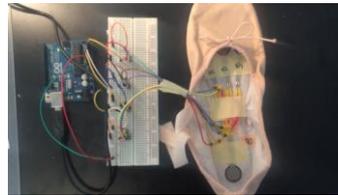


Figure 1: Prototype of Relevé.

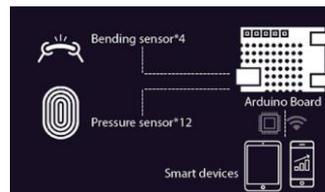


Figure 2: Technology Diagram.

## 4 Tangible Interaction Features

Relevé is not meant to be merely a pair of smart ballet shoes. The primary objective is to create an online self-teaching environment. During the learning activity, learners will receive instructions from the in-system virtual ballet teacher and then the shoes send back the learner's practice performance results. Eventually, learners receive feedback from the system after the calculation and comparison of learner's performance results with the standard performance database. To construct a supportive online self-teaching environment, we have emphasized on the following features:

1. Personalized information support
2. Real-time feedback through enhanced-understandability GUI
3. Unique virtual community

Firstly, this system has been designed for providing the feature of personalization by storing learner's personal information into the database. At the very start of the training activity, by doing groups of basic ballet technical movement, learners should initialize their personal data and body condition data after putting on the smart ballet shoes (Fig.3). Initialization and information collecting are essential for the system to detect the body condition to decrease the probability rate of injury.

Secondly, we have also focused on providing the user with real-time feedback. During every piece of a video tutorial, a real-time performance input will show on the screen; the color rings will represent the detail of each point performance on learner's feet. Based on the kinematics research and professional ballet dance technique learning, timely warnings and suggestions will pop up according to the real-time performance compared to the correct force point and bend force (Fig.4). After receiving the feedback from the screen, learners can react in time which provides a safe and efficient learning environment.



Figure 3: Calibration before training.



Figure 4: Real-time feedback.



Figure 5: Community of Relevé.

Thirdly, another feature of this system is providing users with a unique virtual community. Since immersing into a self-learning system, we also provide an excellent way to let learners interact with other learners through the Relevé community. The design lets learners share their self-learning experience and process with other learners which provides an opportunity to build an interactive way to help and share each other's performance. Also, the community involves professional dancers, who will provide dancing technique and experience.

## 5 Discussion

A significant number of products make use of newly developed technology for home-based self-teaching activity. To better illustrate our research potential and significance, during our market study, we have classified the aim of current home-based self-learning activity into the purposes of entertainment and physical fitness. Then, after figuring out the typical categories of learner's product in the market, we selectively surveyed another product which has a similar purpose and characteristics of our design. For instance, SmartMat is an intelligent Yoga mat that helps learners take their

Yoga practice to the next level by detecting when the learner is out of alignment. It then gives them real-time feedback on how to correct their pose. SmartMat is similar to a personal Yoga teacher. During the first use, SmartMat will take learners through a series of movements to calibrate their body shape, size and personal limitations which have the same initialization pattern as Relevé. Combining information as a baseline for recommendations during the learner's practice session also shares the same data analysis model as Relevé. However, the SmartMat stops short of providing an injury prevention system. Without a real teacher or coach for the lessons, home-based educational platforms such as Yoga and self-learning dance lessons, which have a comparatively higher risk during practice, may not be safe enough for self-learners.

Another good example is [onlineballetclass.com](http://onlineballetclass.com) which provides professional ballet dance courses online. Classes are separated into different levels so that learners can quickly start from different educational levels [12]. Also, they've included extra documentation to easily support ballet students studying at home. Yet according to our argument, efficient data feedback will not be sent from the learning system. Thus, learners will not easily get involved and improve their performance in time.

We want to focus on developing a professional platform for ballet learners which combines the purposes of entertainment, healthy and safe physical fitness. Rather than a website or a smart product, Relevé provides an interactive way to track the learner's performance during the learning process. Also, a game-based lesson structure provides an interesting way to get learners fully immersed in the whole system which brings a lot of fun during the learning behavior.

## 6 Future Work

This paper has suggested a potential home-based use for Relevé. We plan to continue this research by exploring further its long-term educational influence on ballet learners and even professional ballet dancers who use this system to train themselves at home.

A potential limitation of the current research is that, without empirical evaluation, the long-term influence of the system is still vague. For a system that targets many users, the effect of Relevé is still unpredictable, because users differ significantly in behaviors, preferences and learning abilities. Also, we would like to gather more data about the different sizes of feet or body shape, both of which influence the data transferred from the sensors.

In the next step, we are also aiming at providing better Behavioral support. When individuals face the same learning system, they will display vastly different behaviors, so that in some cases users may not follow the class process we designed. We would like to do further research about how individuals will behave in the different parts of our learning system, to improve it.

The development of current technology does enrich people's at-home activities. However, we are trying to achieve meaningful interaction among dance learners, so that they can develop the potential of communicating. And instead of encouraging on-line self-learning behavior, we prefer a better way for communication between ballet teacher and learner and among ballet learners themselves. We believe current technologies like virtual reality or augmented reality provide more possibilities to engage learners, and in our future research, we will continue to use new technologies to create an immersive and intuitive self-learning environment, at the same time taking into consideration the development in social communication spectrum. Investigating which technology provides the best performance is beyond the scope of this paper and will be tackled in our future work.

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