1 Introduction

Recent developments in commercial technologies present opportunities for education that are yet to be fully utilized. Smartphones and smartwatches are becoming more available and better developed for a consistently lowering price. The idea for our project is to use these technologies in a way to grant access to music education for all school-aged children. Our plan is to develop software to use smartphones and/or smartwatches as virtual instruments: using these instruments we can provide performance feedback (as a form of active practice) and beat memorization (as a form of passive practice) to help novices learn.

2 Overview

As technology grows, so do the number of available opportunities. Smartphones are a rapidly expanding technology, that still have many unexplored applications. Soon they will become a ubiquitous part of our lives; from May 2011 to May 2013 the percentage of all U.S. adults who own a smartphone when from 35% to 56% [4]. Smartphones are also becoming increasingly cheaper; with Google’s recent release of a sub-$200 smartphone [5], it would be reasonable to expect smartphone adoption rates to go up, especially among third-world countries and the lower class in first world countries. Smartwatches have only recently entered the market, but given the attention paid to them already by hardware developers and the media [3] it would be surprising not to see adoption rates similar to that which smartphones have achieved. Considering all these factors, we believe that right now is the perfect time to develop and release a technology which will make learning music more accessible by using the accelerometers in smartphones and smartwatches.

Our project will focus on two main software goals: a performance feedback system using virtual instruments, and a persistent beat memorization tool. The feedback system will be designed to allow for interaction with virtual instruments using the same movements used to play their analog counterparts. The focus of this system will be transparency of interaction (to foster proper muscle memory) and constructive feedback (for self improvement). This software will be meant for novices so they can begin learning an instrument before being required to purchase or somehow gain access to one, thereby lowering the entry threshold. The second half of the system, a beat memorization tool, is intended
for users who have constant access to their own smartwatch. This tool will produce a specific pattern of vibrations at intervals throughout the day to help the user memorize difficult musical patterns.

3 Justification

3.1 Intellectual Merritt

This software will produce a platform from which data, previously unobtainable, can be collected in giant amounts. Virtual reproductions of instruments controlled by mobile devices have thus far been restricted to video games [6] and unrealistic novelties [2]. Because our software will focus on learning and feedback we will be able to collect an analyzable database of users’ performance and learning curves that should reflect real world instrument learning.

3.2 Broader Impact

Our hope is that once the hardware becomes more ubiquitous our software will be used in also middle and lower class communities to allow for access to instruments and feedback where they may otherwise have access. Simply learning music can be seen as a culturally beneficial; music produces increased social interaction and fosters new talent. Not only is music good for the sake of itself, but students who enroll in music lessons have been shown to achieve increased grades, and cognitive performance compared to students who do not take such lessons [7]. This technology can also be used by adult novices as a means of exploring new creative endeavors. The ultimate aim of this technology is to help close the educational divide between economic and social classes.

4 Research Plan

4.1 Method

Integration and Availability

To test our project we will begin by distributing our platform to privileged areas likely to already have these technologies (but don’t necessarily have a good music program). As the accessibility of smart mobile devices grows our software will become easily available to a wider audience. As smart devices become commonplace our software will become more available than actual physical instruments.

Instrument Development

Our plan is to first develop for instruments played by pure physical movement, such as drums. If the tests show positive cognitive impact, we will go on to develop more instruments such as guitar, violin, and other string instruments. Development will depend on the quality of available sensors as well as our own available resources. Along with developing these instruments we intend on creating cheap cardboard or plastic housing to provide a more robust experience while performing. Depending on the rate of adaptation we will design and test new instruments appropriate and desired for those with access to the hardware.
Beat Memorization

The second half of our training regimen is a passive smartwatch haptic feedback system. This software can be used throughout the day to encourage beat memorization. This part of the system not only helps with difficult patterns but also gives the user a sense of participation in their music study even when they are not actively practicing. We believe this regular, noninvasive interaction will help promote student retention.

4.2 Resources

The resources we will need for research include prototype platforms and software development but because of our dependence on technologies already existing and adopted we will be able to minimize costs on hardware besides simply our experimental apparatuses. In the future if cheaper smartwatch technologies do not become available we may have to develop our own budget versions; we are hoping to avoid this though because it would limit availability to our software.

4.3 Evaluation

Our system can be evaluated in many ways. The most obvious and easy to obtain metric will be to analyze if users are responding to feedback given by the device and changing their behavior. We also want to see if increased performance with our system directly corresponds with increased performance with the physical instruments. GPA and instrument playing retention are also metrics which our technology aims to benefit.

References


