

# onNote: A Musical Interface Using Markerless Physical Scores

Yusuke Yamamoto\*  
Keio University

Hideaki Uchiyama†  
INRIA Rennes

Yasuaki Kakehi\*  
Keio University



Figure 1: *onNote*

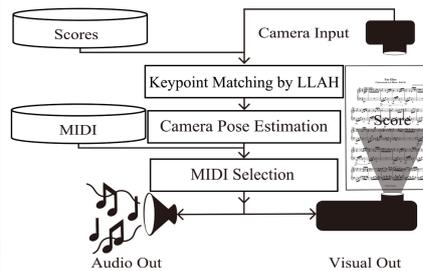


Figure 2: *Image Processing for onNote*



Figure 3: *Playing Music with a Physical Score*

## 1 Introduction

Intuitive music playing using various digital musical instruments with specific tangible interfaces has become one of the ways to enjoy the music experience [Jorda et al. 2007]. When we start studying music, we need to learn how to read musical scores to understand the different instrumental parts and also understand the melody, rhythm, fingering and so on. However, reading scores is often a difficult task for beginners and could create a barrier for playing music. To solve this problem, we propose a novel musical interface system named “onNote”. In this system, physical markerless musical scores are used as instruments to play music intuitively (see Figure 1). The notes on the score are captured by a camera and are processed by the system which retrieves the music from a score database. In addition, the system can do a real-time recognition of the paper’s position and the rotation. Thus, by physically moving and connecting the musical scores we can play music intuitively.

## 2 onNote

To develop our music instrument, we propose two technical innovations. First, we propose an image processing approach for tracking and retrieving the markerless physical musical scores placed in front of the camera. Since users move the score freely, it is not always possible for the camera to cover the whole area of the paper. Thus, in this research, we adopted a Locally Likely Arrangement Hashing (LLAH) method [Nakai et al. 2006] for retrieving the binary document images. This method relies on the geometrical relationship of keypoints as a descriptor rather than using local texture. And also, we developed another method for extracting the stable keypoints on the score and combined it with LLAH for keypoint matching, then the system identifies the score by referencing the score database. In addition, by using these methods, the system recognizes the position and rotation of the score in realtime.

Second, we have developed software architecture for classifying the user’s actions and generating the sounds. According to the various input information provided by the user such as position, rotation and page numbers, the system accesses the MIDI database and controls the sound in realtime.

\*e-mail: {usuk, ykakehi}@sf.c.keio.ac.jp

†e-mail: uchiyama@hvrl.ics.keio.ac.jp

One of the main features of this system is its strong robustness toward occlusions on the score because of the adopted keypoint based approach. Thus, the system can work effectively even with the usage of an overhead projection that shows additional information on the score. And it can work effectively even if the users put their hands and fingers on the score. Therefore, these features and methods enable the system to intuitively and interactively play music.

## 3 Applications and Future Works

OnNote is a system that provides several interactive applications. First, it can play music according to the movement of the score. By controlling the speed and direction of the score, users can manipulate music just as a DJ would. The system projects a red pointer on the music notes and generates the corresponding sound in realtime. In addition, the system can use the user’s fingers or line of sight to play the music instead of using the red pointer.

Second, the system can be used as a music effector. The user could adjust and control the outputted music by changing the score’s position and rotation. By rotating or moving the score up and down, the user could adjust sound parameters such as volume, pitch and tone.

Third, the system generates different music pieces when presented with different segments. Users can enjoy music mashups easily by connecting and changing the arrangement of the music segments. This application makes use of the system as an edutainment tool which users could play puzzle games to find and learn the correct sequence of music. In the future, we plan to develop furthermore applications related to different situations using onNote system.

## References

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- NAKAI, T., KISE, K., AND IWAMURA, M. 2006. Use of affine invariants in locally likely arrangement hashing for camera-based document image retrieval. In *Lecture Notes in Computer Science (7th International Workshop DAS2006)*, 3872, 541–552.