

# LMNKui: Overlaying computer controls on a piano controller keyboard

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## ABSTRACT

We introduce the *Look Ma No Keyboard user interface*, an ergonomic and intuitive method for controlling music sequencing software from a piano controller by adding a momentary foot switch. After describing the current practices and the design of our system, we discuss the results of early user testing, comparing the conventional input device with ours.

## Keywords

Musical Instrument Digital Interface (MIDI), sequencing, octaves, foot switch, controller, composer

## INTRODUCTION

Existing user interfaces for sequencing electronic music are cumbersome, as they require the use of three input devices; a piano controller, a computer keyboard and a mouse. Synthesizer software such as CSOUND features the ability to map a limited number of MIDI events to keys on a piano controller. Standard electronic piano controllers have additional sliders, knobs and dials that can be programmed to trigger MIDI events. One disadvantage of these conventional methods is the excessive space they occupy. More importantly, the musician's creative work is constantly interrupted by the time spent switching between multiple input devices. *LMNKui* provides a mapping of these control functions in an octave structure with a key based segmentation. This mapping provides the musician with a familiar configuration of space and sound, allowing him or her to focus on the creative aspects of music composition.

## LMNKui SYSTEM

For many computer composition functions, *LMNKui* eliminates the need for the computer keyboard and mouse by relocating their functions to the piano controller. An example of a macro that can be relocated to the controller is

the copy function, or [Control]-[C], which copies a selected sequence to the clipboard. To distinguish between keystrokes that represent notes and macros, a momentary foot switch is used as a mode switch, thereby reducing mode errors. [1] Though a secondary body channel such as the foot has a lower information processing bandwidth, it sets the framework and the reference for the primary body channel and the task in this system, as shown in Figure 1.

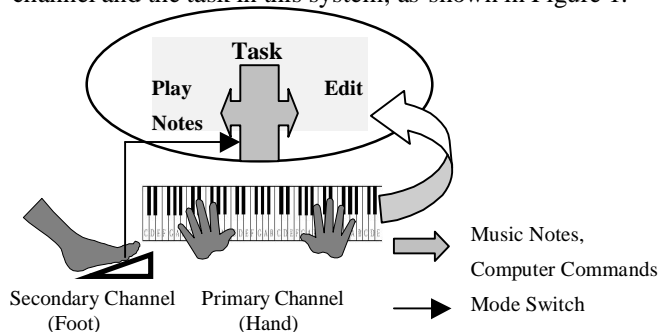


Figure 1: LMKui System setup

In addition, the system state is reinforced by the foot proprioceptive feedback, and the relocation of the functions to a single input device minimizes the device acquisition time. [2]

## DESIGN

We chose to use the Cubase sequencing program by Steinberg on Microsoft Windows, which is a popular setup among composers. Macros from the different Cubase windows were mapped to specific octaves on the controller keyboard for separation.

## Keyboard Layout Design

The design of the layout incorporates the four windows most commonly used by the composer. The functions associated with each window map to a specific octave on the piano controller keyboard.

The piano keyboard has been laid out as follows:

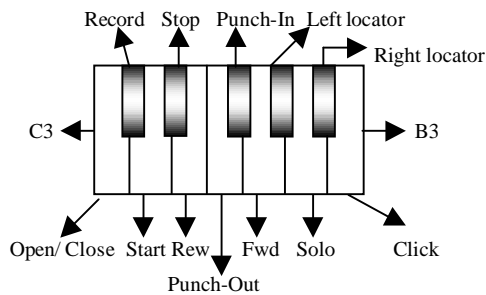
- The octaves used are the central ones found on every standard music keyboard and the layout is shown in Table 1.

WINDOW	OCTAVE USED
Transport bar	C3 to B3
Arrange Window	C4 to B4
Key Edit Window	C5 to B5
File Handling	C6 to B6

**Table 1: Window-Octave Layout**

- The middle four keys (E, F, F# and G) are used either for going up or down the tracks or parts, or punching in or out as shown in Figure 2. They correspond to the computer commands ←, ↓, ↑, →. The first note, 'C' of the different octaves is designed to 'open' windows.
- The remaining mappings are designed in accordance with the timbre associated with the notes.
- The highest note (C7) is used as an 'Enter' key for all confirmation functions. We anticipate that musicians can conveniently hit this key as it is at the extreme end and hence doesn't need to be looked for.

For example, the transport octave is used to play, stop, record, mute and solo a sequence or a specific MIDI channel.



**Figure 2: Transport Octave**

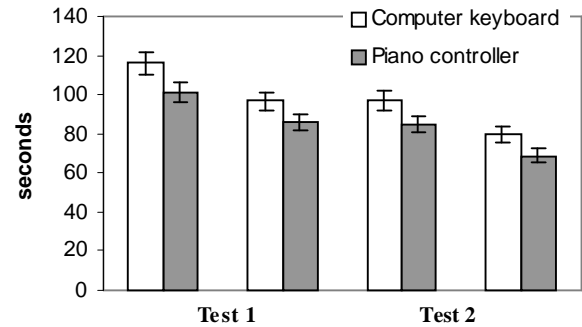
## EXPERIMENT DESIGN

Two interaction methods were tested in the experiment: the Computer keyboard and the Piano controller. A total of 6 subjects with sequencing experience performed the tests with the two methods in a pre-assigned order. Subjects were given a practice run to explore different modes and strategies. Two tasks involving repetitive sequencing and editing were performed twice, to test for the mean completion time, thereby requiring the subjects to switch back and forth between the modes on their own. We chose to turn the sound on while the piano controller was in the control mode in order to observe the effectiveness of the associated earcons. After the tests, the subjects were asked to rate the input devices on a 0 (terrible) to 6 (great) scale, based on their experiences. During testing, we explicitly checked for any mode errors while using the Piano controller.

## EVALUATION

With an average learning time of about 5 minutes, subjects performed both the tasks significantly better with the piano controller in Test1 ( $p < 0.05$ , t-Test) and Test2 ( $p < 0.06$ , t-

Test), and Test2 was done faster than Test1 as shown in Figure 3.



**Figure 3: Mean Time with 95% Confidence Error Bars**

Subjects gave the computer keyboard a significantly lower rating than the piano controller ( $p < 0.021$ , t-Test). They found the piano interaction intuitive and an effective link between playing and editing. Though the no-sound condition was not tested in our study, from the questionnaires we learnt that the earcons were effective for performing the tasks because subjects' had already acquired auditory familiarity with the piano. Interestingly, no mode errors were detected during testing using the Piano controller. We suspect that this is due to the subjects' familiarity with damper and sustain pedals, which are momentary pedals as well, and are commonly used in their industry.

## CONCLUSION AND FUTURE DIRECTIONS

The *LMNKui* system illustrates how an appropriate mapping of layout, feedback, and context is important in the design of interfaces. The system leverages on the musicians' spatial and auditory memory of the piano keyboard. Our future research includes applying the principles to other music instruments, leveraging on the principles of musical structures and investigating different key boundaries.

## ACKNOWLEDGMENTS

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## REFERENCES

1. Sellen, A., Kurtenbach, G. and Buxton, W. The Prevention of Mode Errors Through Sensory Feedback. *Human-Computer Interaction*, 1992 v.7 n.2, 141-164.
2. Sellen, A., Kurtenbach, G. and Buxton, W. The Role of Visual and Kinesthetic Feedback in the Prevention of Mode Errors Interactive Technologies and Techniques *Proceedings of Human-Computer Interaction*, 1990, 667-673.
3. Zhai, S., Smith, B., and Selker, T. Dual Stream Input for Pointing and Scrolling. *Proceedings of ACM Conference on Human Factors in Computing Systems*, 1997 v.2, 305-306.