

# Untouchable Instrument “Peller-Min”

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## ABSTRACT

This paper is a report on the development of a new musical instrument in which the main concept is "Untouchable". The key concept of this instrument is "sound generation by body gesture (both hands)" and "sound generation by kneading with hands". The new composition project had completed as the premiere of a new work “controllable untouchableness” with this new instrument in December 2009.

## Keywords

Theremin, untouchable, distance sensor, Propeller processor

## 1.INTRODUCTION

This paper is a report on the development of a new musical instrument in which the main concept is "Untouchable". In attending NIME09 concerts, I was inspired with performances by hand-gesture, and the idea "multi-channel Theremin" hit me. The key concept of this instrument is "sound generation by body gesture (both hands)" and "sound generation by kneading with hands". Because I had been researching the system using the parallel processor "Propeller", this new musical instrument was achieved by using "Propeller" [1]. The reason that the name of this new musical instrument (32 channels Theremin) is "Peller-Min" is that "Peller-Min" uses "Propeller" processor. The new composition project had completed as the premiere of a new work “controllable untouchableness” with this new instrument in December 2009 at the InterCollege Computer Music Concert in Kunitachi College of Music (Tokyo)

## 2.SYSTEM DESIGN

In my composition, it is contained not only to write the score and the program but also to make the musical instrument newly and to research about computer music ([2]-[19]). I have developed many interfaces and instruments, and I have used many types of microcontrollers ([20]-[25]). AKI-H8 (Akihabara's board using Hitachi H8 CPU) is very powerful. Gainer and Arduino are very easy for sketching new systems with simple functions. However, I found that Propeller is useful to design complicated and high performance systems[1], so I designed this new instrument with Propeller. I developed my original MIDI interface circuits and MIDI library, so I selected MIDI as the interface. In the following sections, I will introduce the system.

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## 3.SENSORS

### 3.1 Infrared rays distance sensor

It shows the new instrument “Peller-Min”(Figure 1). It has double big rings, and there are eight infrared ray's distance sensors on each of them. The infrared ray distance sensor is very popular, SHARP 2Y0A21. The 16 channels output voltages are captured by two ADC0809 8-bits A/D converters. The master controller Propeller processor accesses each A/D converter, detects the distance information, and finally transfers them to MIDI output. One advantage of the design with the double ring is the performer becomes an beautiful appearance like the conductor. The other advantage of the design with the double ring is the possibility to perform to two sensors or more at the same time by one arm/hand. For instance, the pitch of the sound source of three channels can be controlled at the same time by the performance technique of squarely putting up the elbow, and bringing the forearm close to the ring. Because the range of the recognition angle of the sensor is narrow, the performer can change the number of sound channels dramatically by the little movement of the arm.

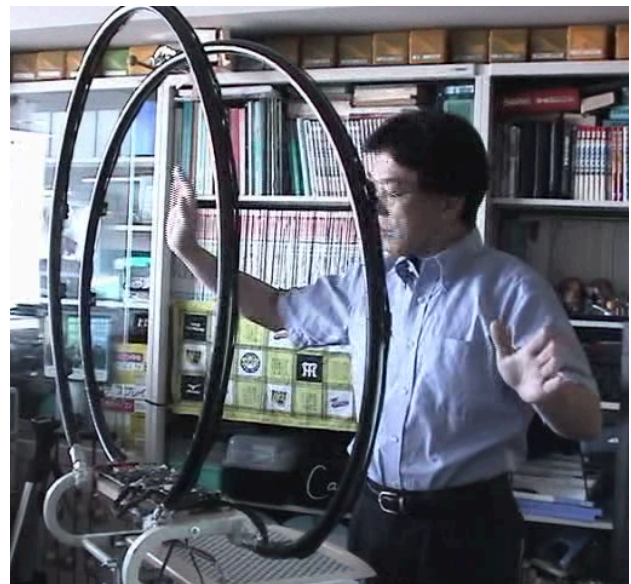


Figure 1. The new instrument “Peller-Min”.

### 3.2 LED distance sensor

It shows the close-up of “Peller-Min” (Figure 2). In the “table” part of this instrument, there are two blocks of eight LED distance sensors for the right/left hands. This LED distance sensor is my original, with a pair of a blue LED and a special sensor. NJL7502L is a very small photo-transistor to replace CdS. The optical characteristic of this device is similar to human optical characteristics. There are 16 pairs of high

luminance blue LED and NJL7502L, and the “kneading” performance can be detected with the reflection by hand/fingers. The 16 channels output voltages are also captured by two ADC0809. Propeller processor also detects the reflection information, and finally transfers them to MIDI output.

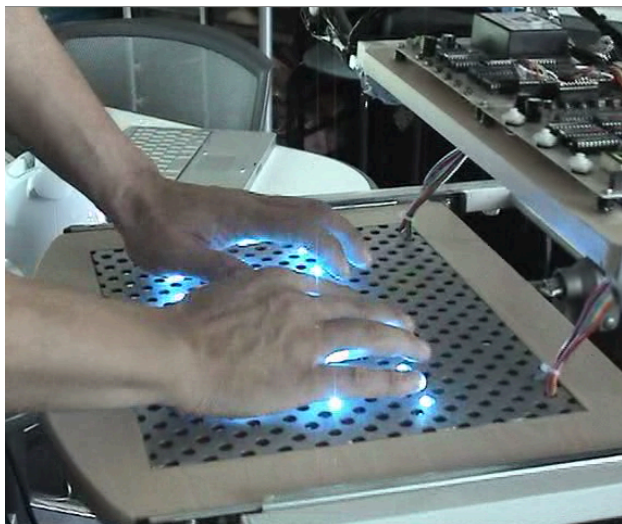


Figure 2. Close-up of “Peller-Min”.

Scenic effects of the music performance are intended to the interface in this table block. When this musical instrument is put on the center of a dark stage, very strong light that 16 high luminance LED project goes to the upper side. First of all, if the hand is held up in the sky of the table, the lower side of the hand and the arm is shone on in blue, and it becomes a very beautiful scene. Then, the sound changes corresponding to “kneading” and the movement, and the concept “kneading sound in the air” can be achieved by moving the palm and the fingers.

#### 4.HOST INTERFACE

The Propeller processor has eight parallel CPUs inside, and one of them is used as MIDI FIFO interface as a transmitter. There is no special hardware like USART inside Propeller, but each CPU is high-speed enough to manage 31.25Kbps serial signal by only software, and MIDI interface runs very well. It shows the original MIDI Tx/Rx circuits for Propeller (Figure 3) [1] [25]. There is a sample MIDI-in object in the Parallax web page [26], but I arranged and developed the universal MIDI-in/MIDI-out module [25]. This module deal MIDI information with deep Rx/Tx FIFO buffers in common memory in the chip, so it is easy to make intercommunication of each CPU.

#### 5.REMOVABLE RINGS

This musical instrument is very large. For convenience of the performance travel, it is designed (1) resolve it to carry, and (2) assemble it in the concert hall. It shows the mechanism (Figure 4). I obtained the material of this double ring in do-it-yourself store. The urethane pipe for protection against the cold was cut out, and I used the spiral stick made of hard plastic used for the wick. There are eight LED distance sensors on the ring, and the cable with a thin two wick shield has been wired for along the ring. In both ends of the ring, there are joint devices using the relay plug of the air valve.

#### 6.SOUND GENERATION

Almost my composition is the programming in Max/MSP/jitter environment. It shows the main Max/MSP patch of the “controllable untouchableness” (Figure 5). It was January 2010

that I upgraded the environment to new Max5. Therefore, the performance of this work was produced by Max/MSP/jitter4.6. Please forgive that the sample patch of Max introduced by the screen shot looks antiquity.

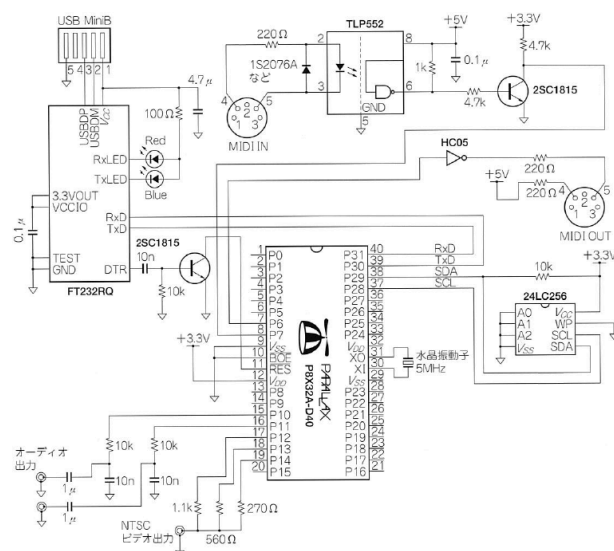


Figure 3. MIDI circuit for Propeller.

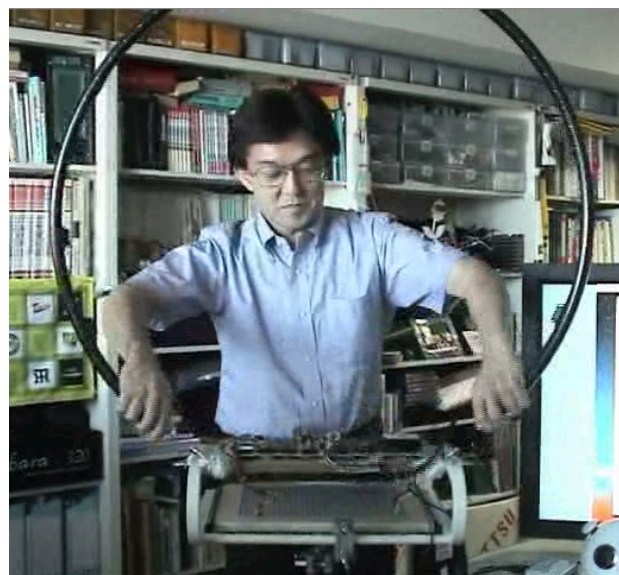


Figure 4. Removable Rings.

#### 6.1Sensor information

The output range of sensors is 7bits (0-127) and the data correction is completed in the Propeller system. The sampling rate of the distance sensors is 10-20 msec each. “Peller-Min” has a special ON/OFF switch to turn on or turn off the 16 blue LED. So the performer can get better resolution only with double rings, and get a visual effect (dark or bright) on stage.

#### 6.2“Noise+Filter” part

There are 2 different types of a sound generation algorithm in the composition - “noise+filter” and “FM bank”. It shows the “Noise+Filter” sub-patch (Figure 6). As the music goes, the cut-off frequencies and the combinations of white-noise generators are metamorphosing. Simple sounds were intentionally used. The purpose of this was for the audience to understand the relation to the generated sound well as a result the performance by the bodily movement.



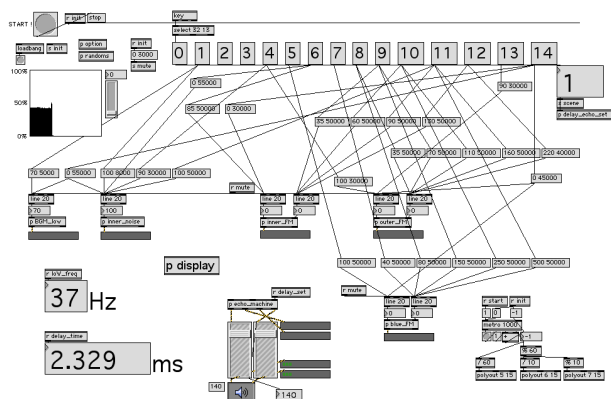


Figure 5. Main Max/MSP patch.

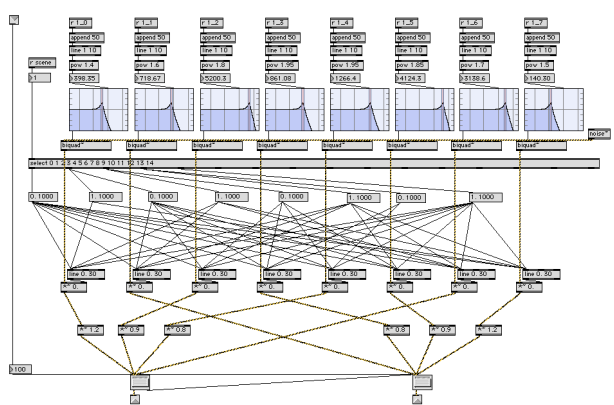


Figure 6. "Noise+Filter" part.

### 6.3 "FM bank" part

In the "FM bank" part of the Max/MSP patch, there are simple, flexible and interesting FM generator modules. The "Inner Ring", "Outer Ring" and "16 LED" sensor blocks have different control algorithms. Of course, if the FM modulation (depth) parameter is set to zero, the result output is "sinusoids". So this part can generate "16+16 sine-wave oscillators" sound at one part of the music. Time passes, and to increase little by little, this depth parameter can produce the change in the sound with the musical tension.

### 6.4 Effect part

My policy of this composition is "simple and clear". It shows the Effect patch of the work (Figure 7). I do not adopt any complicated processing algorithms like reverb, echo, chorus, etc., I only use the simple "delay" effect. At the beginning of this work, the delay time is starting from zero to very small value, so the "comb-filter" effect is obtained with "noise+filter" sounds. Then music grows wider, the delay time also grows longer, the sound-field can be listened to wider and wider.

### 6.5 LFO part

This work also used simple sine wave in the very low frequency (30Hz-45Hz). This low frequency is a kind of rumbling of the earth. It is important that the concert hall has enough amplifier and speakers for such very low frequencies. However, I can adjust the lowest frequency to avoid both the sound distortion or cabinet vibration. The Max/MSP environment is flexible for this tune up in the rehearsal. It shows the stage in the rehearsal (Figure 8/9).

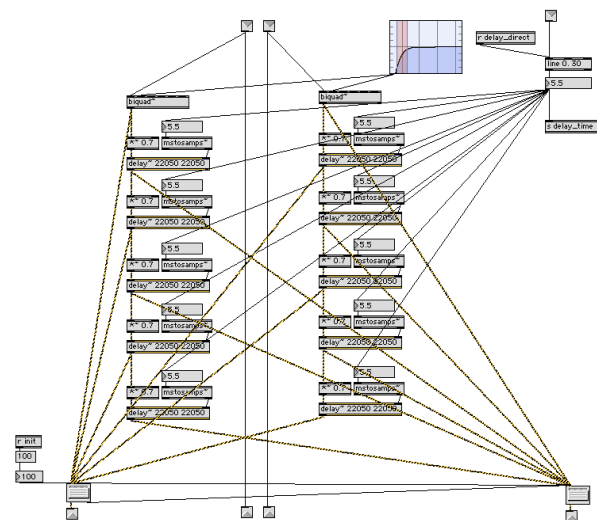


Figure 7. Effect part.



Figure 8. Rehearsal.



Figure 9. Rehearsal.

## 7. PERFORMANCE

Live Computer Music "controllable untouchableness" was composed and premiered in December 2009 at the InterCollege Computer Music Concert in Kunitachi College of Music (Tokyo). The duration of the work is about 7 minutes. It shows the performance in concert (Figure 10/11). I will show you the video recording at the poster session of NIME2010. The

audience in this concert had famous composers - Joji Yuasa, Takayuki Rai, and Masahiro Miwa. In addition, the audience had a lot of composers, musician, specialist, and students. As a lot of impressions of the audience, sticking to the concept "do not touch" was popular as the impression to this work and musical instrument.



Figure 10. Performance.



Figure 11. Performance.

## 8. NEXT STEP

At the next chance, I want to compose the work that uses the sound of the variety by using this musical instrument. I want to mount the network interface on Propeller, and to examine the possibility of communicating with other systems via OSC.

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