B.O.M.B. – Beat Of Magic Box – : Stand-Alone Synthesizer Using Wireless Synchronization System For Musical Session and Performance

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ABSTRACT

In this paper, the authors introduce a stand-alone synthesizer, "B.O.M.B. – Beat Of Magic Box –" for electronic music sessions and live performances. "B.O.M.B." has a wireless communication system that synchronizes musical scale and tempo (BPM) between multiple devices. In addition, performers can change master/slave role between performers immediately.

Our primary motivation is to provide both musicians and non-musicians with opportunities to experience a collaborative electronic music performance. Here, the hardware and the interaction design of the device are presented.

Keywords

Stand-alone Synthesizer, Wireless Synchronization System, NIME, Musical Session, Electronic Music

1. INTRODUCTION

To date, numerous collaborative musical instruments have been developed in electronic music field [1][2][3]. The authors are interested in formations of musical sessions using stand-alone devices and leader/follower relationship in musical sessions [4]. The authors specify three important requirements of instrument design for musical session. They are as follows:

(1) **Simple Interface**: Interface that enables performers to control three sound elements (pitch, timbre, and amplitude) with simple interaction.

(2) **Portable Stand-alone System**: System that runs stand-alone (with sound generators, speakers, and batteries). Because musical sessions can be happened in anywhere and anytime, the authors consider that the portability is essential in designing musical instruments for sessions.

(3) **Wireless Synchronization**: System that supports ensembles by automatically synchronizing tempo (BPM) and tonality between multiple devices by air because of portability. In addition, performers can switch master/slave roles smoothly during a musical session.

In this research, the authors introduce "B.O.M.B. - Beat Of Magic Box -" for electronic music sessions.

2. HARDWARE DESIGN

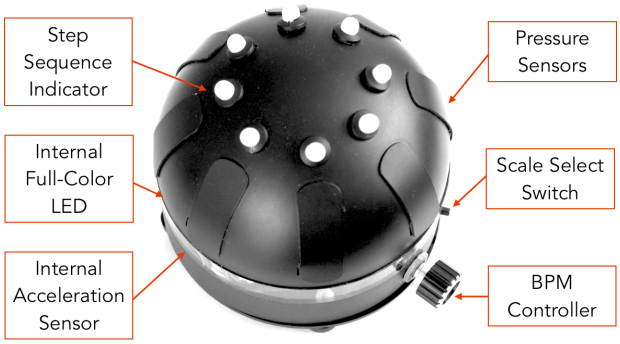

Figure 1: Hardware

2.1 Sensors

Previously, several musical interfaces were developed to achieve intuitive musical operation by use of the two-handed gesture interaction [5][6].

The "B.O.M.B." allows performers to control the pitch, timbre, and volume by single-handed interaction (Figure 2). This is achieved by assigning eight position and pressure sensors (MicroNav STRIP, Interlink Electronics) values to pitch control and acceleration sensor (Triple Axis Accelerometer Breakout - MMA7361, SparkFun Electronics) value to timbre and volume control (satisfying requirement (1)).

2.2 Microcontroller and Sound Synthesis

The Arduino based sound generator (Arduino Pro Mini, microcontroller board based on the ATmega328, operating at 5V and 16 MHz) was included in the proposed device because of its portability. "B.O.M.B." requires no external power supply, but is powered by a battery (fulfilling requirement (2)).

This device assigns sensor values to MIDI note numbers according to scale settings, and generates sound using simple oscillators (sine and saw wave oscillator) from a built-in speaker or a Φ3.5mm stereo jack. The authors use "Mozzi", the sound synthesis library for Arduino. This library is possible to generate various synthesis sounds without the need of additional shields [7].

Performers can select one of eight musical scales by use of the scale select switch (Figure 1). This switching function changes the scale setting in the following order: minor pentatonic, major pentatonic, minor, major, lydian, ryukyu, octave, chromatic, continuously.

2.3 Wireless Synchronization

"B.O.M.B." has a wireless communication function that synchronizes musical scale and BPM (Tempo) between multiple devices. This system provides smooth switching between master/slave roles (fulfilling requirement (3)). If a performer desires to alter the BPM controller (Potentiometer), the device sends the controller values to other wireless devices. Simultaneously, the transmitting device is automatically set to master mode while the receiving devices are set to slave mode. This function is achieved by XBee wireless Module (Digi International Series1).

3. INTERACTION DESIGN

3.1 Interaction

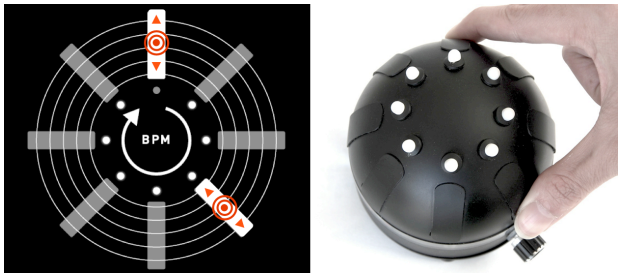

Figure 2: Interaction

As mentioned above, "B.O.M.B." allows performers to control pitches by a "grasping" interaction. Additionally, performers can change the timbre and volume by "tilting" this device (Figure 2).

3.2 Musical Instrument Modes

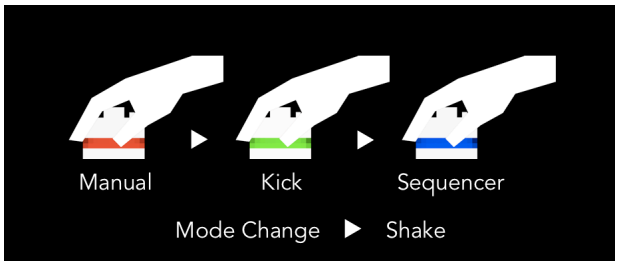

Figure 3: Mode Change Control

"B.O.M.B." has three musical instrument modes, which performers can manipulate by a "shaking" interaction. Performers can select from one of three performance modes (Manual, Kick and Sequencer Mode) providing the experience of a band performance. Modes are distinguished by the colors of an internal Full-color LED, visible through a slit in the device body (Figure 3).

3.2.1 Manual Mode (LED color: Red)

Manual Mode generates melodic and harmonic phrase using eights sine wave oscillators. In this mode, eight pressure sensor values are assigned to pitch in real-time. The maximum number of notes that can be played simultaneously is eight.

3.2.2 Kick Mode (LED color: Green)

Kick Mode is the 8-step drum like sound sequencer using a single sine wave oscillator. If performers apply pressures to sensors, this mode generates drum like sounds in time with BPM.

3.2.3 Sequencer Mode (LED color: Blue)

Sequencer Mode is the 8-step pitch sequencer using a single saw wave oscillator. In this mode, this device assigns pressure sensor values to pitches and generates sounds in time with BPM.

3.2.4 Looper Function

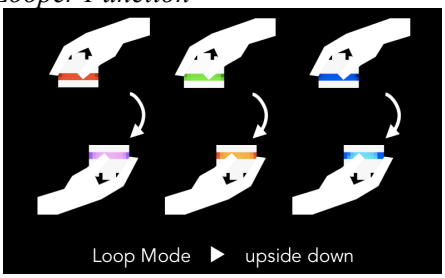

Figure 4: Loop Mode

This device can record the pitch sequence pattern by the act of turn the device upside down. Also, performers can clear a memory buffer in the same way. The recording duration of one sequence pattern is eight steps. These modes are distinguished by the LED's color (Figure 4, Manual Loop: Purple, Kick Loop: Orange, Sequencer Loop: Sky Blue).

4. USED IN PERFORMANCES

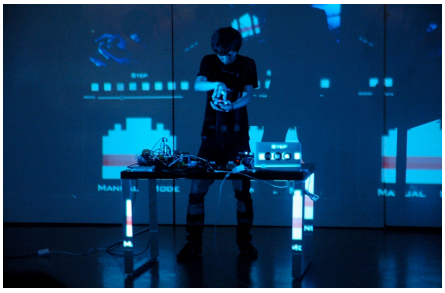

Figure 5: Performance

The authors gave ten live performances using this "B.O.M.B." at domestic and international events. In these events, the authors confirmed that our proposed wireless synchronization system worked in stable condition. It is suggested that our system demonstrate the practicality of wireless synchronization. In future, the authors will evaluate the device in terms of its stability in multi-performer musical sessions.

5. CONCLUSION

The "B.O.M.B." is the stand-alone device for electronic music session, which has wireless synchronization system. The purpose of the proposed device is to enable musicians and non-musicians to participate in electronic music sessions.

6. REFERENCES

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