DAFT DATUM – AN INTERFACE FOR PRODUCING MUSIC THROUGH FOOT-BASED INTERACTION

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ABSTRACT
Daft Datum is an autonomous new media artefact that takes input from movement of the feet (i.e. tapping/stomping/stamping) on a wooden surface, underneath which is a sensor sheet. The sensors in the sheet are mapped to various sound samples and synthesized sounds. Attributes of the synthesized sound, such as pitch and octave, can be controlled using the Nintendo Wii Remote. It also facilitates switching between modes of sound and recording/playing back a segment of audio. The result is music generated by dancing on the device that is further modulated by a hand-held controller.

Keywords
Daft Datum, Wii, Dance Pad, Feet, Controller, Bluetooth, Musical Interface, Dance, Sensor Sheet

1. INTRODUCTION
In our preliminary research, we came across endeavors that linked movement to music [2][3]. Nintendo released a Power Pad in 1986 that also allowed users to play musical notes with their feet. It blended movement and music in a rudimentary way that did not allow for much musical variety. Dance Dance Revolution, the music video game, capitalizes on the aesthetic of dancing feet, but the music heard is not consequential to the movements of the user. DDR EAMIR [2] is a dance pad with prerecorded musical loops that can be triggered and synchronized in real-time by a user's feet. But long and prerecorded loops do not promote minute movements. In each case, there was either limited musical capability or restricted controllability and as a result, user expressivity was limited.

In designing Daft Datum, we sought to create a musical interface that translates highly expressive bodily gestures into equally expressive sound, effectively blending dance and music. Our design incorporates a commercially available 'dance pad' [11] and a 'Wii Remote' [6][7], which communicate with Pure Data (PD) for sound synthesis.

2. HARDWARE
Daft Datum includes a sensor sheet that has marked squares. When pressure is applied to these zones, the device sends out discrete information that can be interpreted by any software capable of reading HID information.

The Wii Remote, originally intended for use with the Wii Console, is a bluetooth device that pairs with many other bluetooth adapters. The remote is sturdy in its build and includes a set of sensors that transmit accurate sensor data. Examples include accelerometer data, button pressing/depressing and IR information.

The Beagle Board [5] is a low-power, low-cost single-board computer produced by Texas Instruments, with a 600MHz OMAP3530 processor, running Satellite CCRMA [1]. The Beagle Board runs PD and connects to the dance pad's sensor sheet and Wii Remote through USB and bluetooth respectively. The Beagle Board introduces autonomy and portability into the entire project, making it laptop/desktop machine-free.

3. PHYSICAL DESIGN
The idea was to prototype a device that would bear the weight of a dancing body. At the same time, the material covering the sensor sheet would have to be pliable enough to allow for accurate and low latency sensing of pressure from the user's feet. So, a body consisting of a wooden square enclosure was built, within which lay (in order from top to bottom) planks of thin wood, a sensor sheet and a sheet of dense foam.

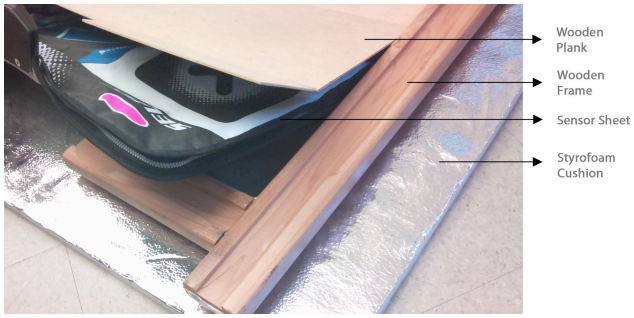

Fig. 1: Daft Datum

4. SOUND DESIGN
Given just eight sensors on the sheet, we asked ourselves how one could maximize the variety of sounds so that the user has enough range of expression for dancing out musically interesting pieces? Daft Datum incorporates multiple user modes, analogous to having a set of function keys on a computer. Each square on the pad is capable of producing two sounds, depending on the mode currently selected.

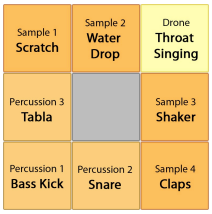

Fig. 2: Samples in Mode 1

The first mode features an assortment of recorded percussive samples (see Fig. 2) with which the user can create groovy, rhythmic base lines. In this mode, the percussion samples are assigned to the back row (from the perspective of the performer) in an arrangement that is suggestive of stomping out the beat. The two other rows feature non-percussive samples that supplement the percussive samples, adding variety to the base line. The second "synth" mode enables the user to compose melodies with notes from the D-minor scale. The sound synthesizer sums three sawtooth waves of different frequencies and post-processes them with a low-pass filter to produce a rich and crisp timbre.

5. THE WII REMOTE CONTROLLER

In order to further the sonic capabilities of the device, allow more expressivity of the dancer and enrich the interaction between the two, the notion of a handheld controller was conceived with the intention that the hands would shape the music produced by the feet. To this end, the Wii Remote was particularly appropriate, as it not only satisfied all these requirements but also communicated flawlessly with PD.

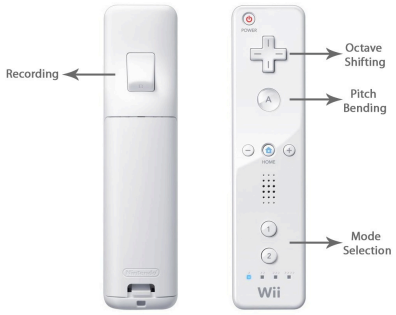

Fig. 3: Functions of the Wii Remote buttons

The buttons on the Wii Remote were intuitively mapped to switch modes, bend pitches, shift octaves and record segments of music that could then be looped (see Fig. 3).

1) The buttons 1 and 2 switch the sensor sheet mappings between the corresponding modes.
2) Pitch bending, activated when the 'A' button of the remote is held-down, is the product of accelerometer data that changes the frequency of a given note as it is being played.
3) The octave register of notes currently played by the feet are shifted by pressing the "up/down" buttons – multiplying the note's frequency with a factor of 2 or 0.5, respectively.
4) Pressing the "B" button of the controller activates the recorder functionality in the patch. Holding the button down records any sounds currently being played; releasing the button stops the recording and starts looping the segment that has just been recorded.

6. COMMUNICATION BETWEEN DEVICES

The sensor sheet is plugged to a USB port on the Beagle Board and is recognised in Pure Data using the `hid` [7] object. The Wii Remote is paired with a bluetooth dongle plugged into another USB port on the Beagle Board. The `wiimote` [4][6] object is used to read data from the dongle. The readings from both USB ports were simultaneously processed in a custom patch. This patch sends out audio through the regular system-out.

7. CONCLUSION AND FUTURE WORK

Although the current physical design of Daft Datum suffices for prototyping purposes, we envision a future version of this interface that is sturdier and portable. Ideally, instead of carrying and setting up four separate layers of material, there would be a single platform that would also enclose the Beagle Board.

Another important development that we envision Daft Datum to have is a self-contained sound synthesis module, in which all sounds being produced are synthesized using Pure Data objects and not pre-recorded samples, specifically for the Mode 1, as we hear them now.

In conlusion, Daft Datum seeks to provide a medium for musical composition via dance, an art form which is cross-cultural [6]. It was aimed at a broad range of audience and does not require previous musical experience. However, with some practice, there is room for complexity in sound design and the user can create more intricate musical statements.

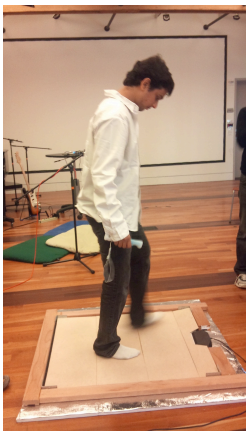

Fig 4. Performance on Daft Datum

8. ACKNOWLEDGEMENTS

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10. APPENDICES

1. Videos of performances on Daft Datum
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