

## Initial Project Proposal

**Year: 2014 Semester: Spring**

**Project Name: BeatSquare**

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### 1.0 Description of Problem

There are a myriad of electronic means of creating music, but few of these easily allow users to manipulate, visualize, and listen to a repeating melody. Even fewer of these devices, particularly those designed for young users, feature a method of saving the generated music to a file or remotely manipulating the device. Those that do are often complex, sophisticated, and intimidating. A simple, yet portable solution would be desirable for those learning to make simple musical melodies without the steep learning curve of more complex devices.

### 2.0 Proposed Solution

The proposed solution is a device that repeatedly outputs a series of tones based upon a pattern input on an 8x8 grid interface. This grid will contain a total of sixty-four pushbuttons; each column will represent a beat, and each row will represent a pitch. As each column is polled, a sound that comprises of all the selected tones in that column will be played. The columns of the grid will be polled at a steady pace, producing a constantly repeating melody.

Other ways to interface with BeatSquare will include the ability to save and load matrix configurations to memory, manipulate a stored configuration from a web application, and write a stored configuration as a MIDI file to an electronic storage device. This would make the device very accessible while remaining simple and easy to use for the average user. Concept drawings of BeatSquare are included in Appendix 1.

### 3.0 ECE477 Course Requirements Satisfaction

#### 3.1 Expected Microcontroller Responsibilities

The microcontroller is expected to interface to several peripherals. First, it will store basic audio information needed to produce tones, perform some basic sound manipulation, and output the sound to a speaker. Second, it will drive a four-line LCD and read from several buttons and dials to save and load configuration data, change settings, reset the device, and turn it on or off. Third, the controller will poll an 8x8 matrix of buttons for presses. Fourth, the controller will drive LEDs under the buttons and will illuminate them to indicated whether a tone is “activated” on

the matrix, and which tones are playing at the current time. Finally, it will communicate to a Raspberry Pi in order to save configuration data to an SD card in MIDI format, and read configuration data from a web application.

### **3.2 Expected Printed Circuit Responsibilities**

The printed circuit board will essentially provide the “glue” between the microcontroller, the aforementioned peripherals, and the Raspberry Pi; in particular, the pushbutton matrix will be mounted on a set of boards prepopulated with contacts and LEDs, each of which in turn will connect to the PCB. The PCB will also connect the LCD and associated interactive controls to the micro. It will also provide power to all the electrical components as well as voltage regulation to protect against power surges. The PCB will interface with a power cord that will plug into a standard wall outlet.

### **4.0 Market Analysis**

The target audience for our product is a vast range from toddlers to elders who are interested creating simple melodies without the complexity of more sophisticated devices and software. The point of the product is to have dedicated hardware for easily interfacing with and visualization of output audio. Sales of products such as Guitar Hero that have a huge base of young users has exceeded two billion dollars according to gamespot.com [1]. An android app called MusicGrid in the Google Play store has 500,000 downloads with an average of four and half star rating [2]. Some tools, such as Novation's Launchpad Mini, also require much more interconnectivity to program and enjoy [3], making it less portable and more complex to set up.

### **5.0 Competitive Analysis**

#### **5.1 Preliminary Patent Analysis**

##### **5.1.1 Patent #1:**

Patent Application: US8330033 B2  
Patent Title: Graphical User Interface for Music Sequence Programming  
Patent Holder: Apple Inc.  
Patent Filing Date: September 13th, 2010

This patent, belonging to Apple Inc., describes a grid matrix interface to create and manipulate audio and music. [4] While this interface is similar to the one defined in this project, this patent pertains to the ability of the device to output a sound or tone based upon an object icon placed in a cell of the grid. The axes of the grid represent "intensity" and "complexity", rather than time and scale. This design also calls for the ability to output stored MIDI patterns and program a MIDI-based drum kit implemented on a computer system.

##### **5.1.2 Patent #2:**

Patent Application: EP 1748418A1

Patent Title: Performance Apparatus and Tone Generation Method Therefor

Patent Holder: Yamaha Corporation

Patent Filing Date: July 27th, 2006

This patent pertaining to a device invented by Yamaha Corp., which details a music board of sorts where each button contained in a grid emits a tone upon operation by the user. [5] There are additional functionalities and adjustments located around the perimeter of the grid, permitting users to change the sounds output by the button grid. This interface is also similar to the project described in this document, but does not have the capability to automatically play a preset music sequence as is outlined by this project.

## 5.2 Commercial Product Analysis

### 5.2.1 Commercial Product #1: Novation Launchpad Mini

The Novation Launchpad is a device used to “let you play loops, sounds, effects and more to produce and perform music immediately with your iPad - and your Windows or Mac” [3]. The device includes an 8 by 8 grid along with 16 control buttons. The device utilizes a MIDI protocol and connects to the host device (iPad or PC) via USB. The Launchpad itself contains no sound reproduction devices but relies on the host device for audio playback. A specific program or app is needed on the host (iPad or PC) side in order to utilize the device. Compared to the proposed device the Launchpad Mini contains a more complex in feature set, including more diverse options for sound type selection and sequencing. The trade-off is ease of use - the Launchpad Mini has a much larger learning curve.



### 5.2.2 Commercial Product #2: Monome

The Monome, like the Launchpad, utilizes an 8 by 8 grid of illuminated buttons. Unlike the other designs, the illumination is only in white. This device also utilizes the MIDI protocol just as the

Launchpad Mini does. The Monome also does not contain any audio reproduction and relies on the host machine to produce sound. [6] The Monome seems to be much more “DIY” compared to other products and the producing company does not distribute its own music generation software. Just as with all three of the detailed products the Monome device communicates via USB.



### 5.2.3 Commercial Product #3: Ableton Push

The Ableton Push is similar to the Launchpad Mini. The Push has an 8 by 8 grid of tri-color LED buttons, but has many more control buttons than the Launchpad Mini, including arrow keys and dedicated adjustment dials. [7] Similar to the proposed device, the Ableton Push includes an LCD. The Push also includes a tone bending feature via a touch strip. Just as with the Launchpad Mini, the average Push user will spend a significant amount of time learning how to use the device.



## 5.3 Open Source Project Analysis

### 5.3.1 Open Source Project #1:

### 5.3.2 Open Source Project #2:

<https://engineering.purdue.edu/ece477>

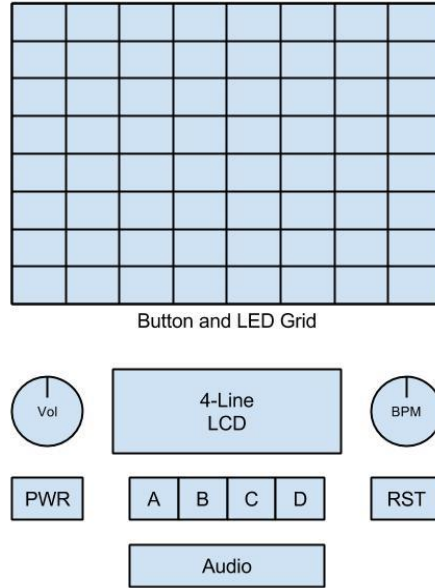
### 5.3.3 Open Source Project #3:

## 6.0 Sources Cited

- [1] Tor Thorsen. “Guitar Hero tops \$2 billion, Activision Blizzard earns \$981 million in Q1,” (gamespot.com), [online] 2009. Available: <http://www.gamespot.com/articles/guitar-hero-tops-2-billion-activision-blizzard-earns-981-million-in-q1/1100-6209327/>. Accessed 29 January 2014.
- [2] Andrew Brampton. “MusicGrid,” (Google play), [online] 2010. Available: <https://play.google.com/store/apps/details?id=net.bramp.musicgrid&hl=en>. Accessed 29 January 2014.
- [3] Launchpad Mini, Novation.com, [online] 2014 <http://global.novationmusic.com/midi-controllers-dj/launchpad-mini> (Accessed: 29 January 2014)
- [4] Gerhard Lengeling, Jan-Hinnerk Helms. “Graphical user interface for music sequence programming,” U.S. Patent US8330033 B2, December 11, 2012.
- [5] Yu Nishibori, Toshio Iwai. “Performance apparatus and tone generation method therefor,” U.S. Patent EP1748418 A1, January 31, 2007.
- [6] devices | monome, Monome.org, [online] 2014 <http://monome.org/devices/> (Accessed: 29 January 2014)
- [7] Ableton Push, ableton.com [online] 2014 <https://www.ableton.com/en/push/> (Accessed: 29 January 2014)

### A1. BeatSquare Concept Overview

BeatSquare: Overview



BeatSquare: Functional Sketch

