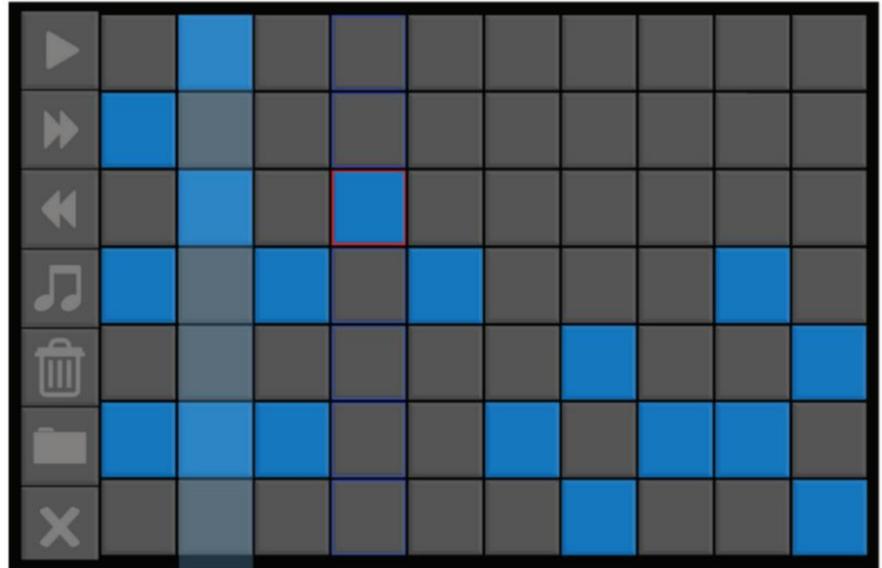


# JAMMASTER GRACE

Designed specifically with Grace in mind, JamMaster Grace is an Android application that allows people with cerebral palsy to easily compose music using a simple grid-based interface tailored to their needs. JamMaster aims to provide a tool people with cerebral palsy can use to have fun and expand their creative freedom.

## PROJECT GOAL

Team Tyzatone set out to give Grace a way to create art through music. There are already tools that allow Grace to communicate verbally, but none that are designed for creative expression. We wanted to create a simple, fun app that preserved the dynamic nature of music composition, while being usable for people with severe motor impairments.



### MIXCOLUMN

- ▼ PIANO
  - PIANO\_G.WAV
  - PIANO\_F.WAV
  - PIANO\_E.WAV
  - PIANO\_D.WAV
  - PIANO\_C.WAV → TRACK6.WAV
  - PIANO\_B.WAV
  - PIANO\_A.WAV
- > TRUMPET
- > DRUMS

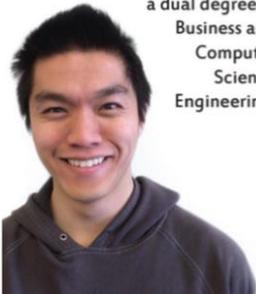
## DESIGN

JamMaster Grace is a music sequencer, modified for people with motor control disabilities. The grid interface makes music composition easy and intuitive. Each row in the grid corresponds to a note, and each column corresponds to a point in time. A collection of instruments are available to the user, allowing her or him to compose with a piano, trumpet, and even a drum kit, among other instruments. JamMaster's save and load functionality makes it possible for the user to save compositions and view them later. To make the app accessible for Grace, we have used the ASK Scanning Library as our input system.

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To: Dr. David Chesney, Professor  
CC: Mr. Chris McMeeking, Instructor  
Mr. David Sabourin, Instructor  
Mr. Cory Gordinier, Instructor  
From: Rachael Miller, Student  
Subject: Music Composition Application Proposal  
Date: January 18, 2014

## 1 Foreword

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As Software Engineering students, we have been asked to apply our computer science knowledge to improve the life of Grace Simon, a young girl with cerebral palsy who is severely impaired in physical movement and communication. In the following memo, I propose the *Jam Master Grace* digital sequencer as a tool for creative expression and play for Grace and other individuals with cerebral palsy.

## 2 Summary

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For a thirteen year old girl, play and creative expression are critical to a positive youth experience. Because of her cerebral palsy, Grace Simon is limited in her ability to participate in creative activities, even though she has demonstrated a love for music and has no impairment in her mental ability to compose it. Because Grace indicated that she would like to be able to play music, and because music has numerous positive effects on child development and well-being, I propose a simple, disability-adapted music sequencing application as a creative outlet for Grace. This application will be modeled after current grid-based systems, modified to suit Grace's ability level and take advantage of her strengths.

## 3 Proposal

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### 3.1 Giving music to Grace

Grace is a cognitively normal, energetic young girl, but is extremely handicapped in her ability to express herself. Because there are already highly effective textual communication systems designed for Grace currently in development, I have elected to focus on building a more right-brained tool to allow her and other disabled individuals to explore music through composition. As discussed in class, Grace could be a phenomenal artist, musician, or have other talents that are invisible to the outside world because there are no adaptive expression media that suit her needs. By building an accessible digital sequencer, we can give her the opportunity to develop these abilities like any other thirteen year old. Of course, musical composition is not limited to any age group; such an application will be enjoyable for all ages.

### 3.2 General Design

The sequencer will be a tablet-based grid, in order to take advantage of Grace's ability and familiarity with her letter board. To create music, Grace will toggle the on/off state of squares in the grid (Fig. 1), selecting row to indicate pitch and column to indicate time. As a vertical time marker line moving at constant speed passes over each column, the tablet will play a simple tone for any of the notes in that column that are marked "on." In this way, Grace will be able compose melodies note-by-note. Upon reaching the last column, the time marker will return to the first column, and the notes will play again. This process will repeat until Grace stops the playback by pressing a physical play/stop button. Grace will be able to control the tempo by pushing a joystick up or down.

C				
B				
A				
G				
F				
E				
D				
C				

Fig. 1: An example layout. The configuration shown would currently be playing an F and a C simultaneously. From start to finish, the sequencer would play: B and E, D and G, C and F, C and A, and C and G.

### 3.3 Adaptations

To enable Grace to select squares with confidence, the interface will highlight squares as they are touched, but will toggle their on/off state. When Grace has highlighted the square that she wants to select, she will press a large physical button to confirm her choice. To change the tempo, she will push a joystick forward to increase the tempo and backward to decrease it. Input from the joystick will be scaled by the software to cause the tempo to change slowly, so that Grace will have fine control over the tempo without having to make precise movements. Finally, the play/stop button will be large, like the confirmation button, to ensure that it is easy for Grace to use.

### 3.4 Alternative Ideas

While a grid-based application lends itself well to a scanning input system, I have elected not to use one because of its time-sensitive nature. The movement of the time marker and the beat of the music will not necessarily be slow enough to synchronize with the scanning speed of the input system, and this issue could make selection very confusing. However, scanning input remains a viable option if, after testing, Grace finds the touch-and-confirm system challenging or tiresome. Additionally, a second input alternative may be to instead use external MaKey MaKey buttons for the grid that can be spaced further apart than the size of the tablet allows.

### 3.5 Stretch Goals

If development is quick and successful, I hope to add extra features. The first, in consideration of Grace's interest in the drums, is a setting that maps rows to different drum and cymbal sounds, instead of pitches. This idea could be expanded to other instruments as well. The second stretch goal will be to allow Grace to push to the right on the joystick to scroll the grid sideways and create more columns, enabling her to compose longer melodies. Once she has created more columns than can be displayed on the screen at one time, pushing the joystick left and right will allow her to scroll back and forth through her composition. Finally, the third stretch goal will be a "record" feature that will allow her to save her work.

## 4 Technical Design Plan

### 4.1 Technology

The *Jam Master Grace* sequencer will be developed as a Windows 8 application, in order to take advantage of the size of the Microsoft Surface as compared to the available Nexus 7 devices, and the availability of even larger touch surfaces on Windows 8 notebooks, should the project continue. iOS was not chosen because of the limitations placed on developers by Apple, and the inability to scale up to any device larger than an iPad. Additionally, many Windows 8 tablets have the option for USB input,

allowing the use of peripherals like the MaKey MaKey if desired. Further investigation will be required to determine the suitability of a Windows 8 store versus desktop application.

Development will be in C++ and XAML, one of the standard pairs for Windows 8 app development, due to the widespread knowledge of C++ among Michigan engineers. XAML makes UI and multimedia development simple, and C++ will be used for non-UI work.

The application will interpret touch input as pre-selection highlighting. When a square is highlighted, it will remain so, even if Grace removes her hand from the screen, until she presses the “confirm” button. This button will be physical, either a simple switch similar to the “Easy button” or a MaKey MaKey button, depending on whether MaKey MaKey proves to be compatible with Windows 8 store applications. Joystick input will be read only as up/down/left/right, disregarding any force vectors so that Grace does not have to control pressure on the joystick, only direction.

## 4.2 Work Coordination

The team will use Git for source control, per course requirements. All team members will follow standard revision control practice, and will minimize branching for simplicity. The development process will be broken into small tasks, such as building a button grid, writing logic for highlighting and confirmation, and playing sounds. The steps will be as follows, with team members working simultaneously:

1. Create button grid; play sounds; draw moving tempo line and build “play tone X at time Y” logic
2. Play multiple sounds at once; loop tones; combine parts into non-accessible app version
3. Interpret touch input as “highlight”; read “confirm” and play/stop buttons
4. Change tempo with arrow keys; begin reading joystick input
5. Change tempo with joystick; consider stretch goals

If there are enough team members, we will create mini-teams and practice pair programming.

## 5 Conclusion

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*Jam Master Grace* will provide Grace and other individuals with cerebral palsy with a way to begin playing music. By adding accessibility features to a simple, grid-based sequencer, the application will allow its user to play with a flexible, fun instrument and give Grace a way to express herself in a creative context.