NUMBERED MUSICAL NOTATION COMPOSER

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ABSTRACT

Computer and it's technology has been given so many advantages in any side, also in music. Computer's technology allows people to build application to compose music in any musical notation. Besides, computer's technology in music also allows to edit and save the composed notation easily, compare to use paper and handwriting (manually). Some applications of musical notation have been built but generally they were built in standard notation system and it causes the use of the applications are limited to people who know well about standard musical notation. The goal of this thesis is to build the application of musical notation in numbered system that can be used by anyone, also provides the simply of editing and safely storage. Numbered Musical Notation Composer (NMNC) is an application to compose musical notation in numbered system. It is developed based on algorithm and using Borland Delphi 6.0. By the use of this application user can not only compose music in numbered notation easily, but also listen the sound, and do not need so much time in editing.

Keywords: *Computer's technology in music, standard musical notation, numbered musical notation.*

1. INTRODUCTION

Until a decade ago all music notation, specially standard musical notation was copied by hand. Musicians—in the manner of medieval scribe—were trained to copy music using India Ink and a dip pen, editing with the aid of a razor blade. Many composers trained themselves as calligraphers or had to pay professional copyists to transcribe their works [SD06].

Today, numbered musical notation is more familiar rather than standard notation. It is because numbered musical notation is simple and easy to be understood. Besides that, the implementation of computer technology in music allows people whether inexpert or experienced in music, to increase their sense of music to become more imaginative than before.

The important area of composition with computer is algorithmic composition, that is, composing music using algorithms. This can be realized by running a special type of software program on a computer. Generally, the application of musical notation are built in standard notation, it causes, not all people can use the application. There are also some applications that use numbered system, but the applications have some weakness such as can not print the document, can generate sound but only have one type of voice, or with four type of voices software that is built to combine the functions of the previous applications. The application also records the input of numbered notations in digital format. Therefore, the data can be easily edited and manipulated. Further, this software freed hours of recopying and editing that absolutely liberate people's musical imagination.

2. MUSIC THEORY

Music theory is a field of study that describes the elements of music application of methods for analyzing and composing music, and the interrelationship between the notation of music and performance practice. Broadly, theory may include any statement belief, or conception of music [BB95]. Music is an art, involves organized and audible sound, though definitions may vary, to make them express a message, an impression, a state of heart, an atmosphere, an emotion, feelings and so on. It is a communication which emanates from the composer or performer and goes to the auditor.

Music is primarily transmitted by sound. All sound characteristics can thus be exploited to enrich musical communication.

The elements of music often have an implicit concept of time, pitch, and energy. The presence or lack of these elements can be used to classify music . They can be organized into units with interrelated rhythm, harmony, and melody. Organizing musical sound is part of composition and improvisation. Music can invoke or convey a sense of motion in time.

Music theory describes how sounds, which travel in waves, are notated, and how what is sounded, or played, is perceived by listeners.

In music, sound waves are usually measured not by length (or wavelength) or period, but by frequency. A note is generally perceived as a sound on a single pitch Notes have a regular wave perhaps other animals as well) find pleasing. This may be in part due to the fact that from the moment the hearing function becomes available to an unborn child, there is the regular rhythm of the mother's heartbeat.

Often the fundamental aspects of sound and music are described as pitch, duration, intensity, and timbre.

Pitch

Sounds can be classified into pitches, according to their frequencies or their relative distance from a reference pitch. Tuning is the process of assigning pitches to notes. The difference in pitch between two notes is called an interval.

Numbered Musical Notation Described

Numbered Musical Notation is a musical notation system invented by The French philosopher Jean Jacques Rousseau (1712~1778). It has never been popular probably because composers had no computers in the past. But it's just like a computer language for music composition. You can do sight-singing and transposition so easily with this notation system. Moreover, using numbers (thus the than using the mouse. It is a very good tool for music copyists. And it is easy to understand and once mastered, can save you a lot of time.

Musical Note

Numbers 1 to 7 represents the They always correspond to the diatonic major scale.
For example, in the key of C major, their relationship with the notes and the solfege is shown below:

Note: C D E F G A B
Solfege: do re mi fa sol la ti
Notation: 1 2 3 4 5 6 7

Major and Minor Scales

A number is assigned to each note of the diatonic scale. All other notes are sharpened or flattened.

Do(1) is movable depending on the key. Major scales begin on ***Do(1)*** and minor scales begin on ***La(6)***.

Octave Change

Dots above or below a musical note raise or lower it to other octaves. The number of dots equals the number of octaves. For example, a number with a dot below ( ) is at an octave lower than ( ) A number with two dot below ( ) is two octaves lower than the one without a dot below ( ). Musical scales can thus be written like this:

major scale: 1 2 3 4 5 6 7 1
natural minor scale: 6 7 1 2 3 4 5 6

Duration

A number without underscore is a quarter note. A number with an underscore is an eighth note. A number with two underscores is a sixteenth note. A number with three underscores is a thirty-second note. A number with four underscores is a sixty-fourth note. A number followed by a dash is a half note, as long as two quarter notes. A number followed by two dashes is a note as long as three quarter notes. A number followed by three dashes is a full note. As long as four quarter notes. A number followed by a dot (.) is a dotted note.

Musical Rest

The number "0" represents the musical rest. The rules for length is customary to repeat "0" instead of adding dashes for rests longer than a quarter rest. Unlike the bar rest. The bar rest of 3/4 time is "| 0 0 0 |" and the bar rest of 4/4 time is "| 0 0 0 0 |".

Bar Line

The end of a measure is marked with a vertical line. Two vertical lines represents the double bar line, and usually also the end bar line, though the thin and thick line variation resembling the standard notation is also used. Repeat signs also resemble the standard notation.

Time Signature

The time signature is written as a fraction: 2/4, 3/4, 4/4, 6/8, usually placed after the key signature. Change of time signature within the piece of music may be marked in-line or above the line of music.

Time signatures can be "simple" or "compound". In simple time signatures, the upper number indicates how many beats there are in a bar, and the lower number indicates the length of that beat.

Accidentals and Key Signature

The notation uses a movable Do(1) system. The key signature defines the pitch of "1". So "1=C" means "C major". Minor keys are based on the natural minor or the Aeolian mode, and the key signature defines the pitch of "6".

So "6=C" means "C minor". Naturally, the Dorian mode of D should be marked as "2=D".

Some people prefer to write "Key: C" or "Key: Cm" instead.

The same accidentals in the standard notation are used, and as in common practice, an accidental is placed before the notes "1 2 3 4 5 6 7" to raise or lower the pitch and placed after the note names "C D E F G A B", which are used for key signature and chord markings in the numbered system.

Beaming

When notes with underscores lie together in groups they are often linked with one another. This is called beaming.

Tie

Groups of notes can be linked by one or more ties. Tied notes are treated as a single unbroken note whose duration is given by the duration of the notes under the tie taken successively. Rests are never tied.

Variations

In some versions of the numbered musical notation, underlines indicating note length are written above the note instead. Ties and slurs may be written below the music line. In some versions, octave change is represented in a different way.

Instead of dots above or below the numbers, a horizontal line is drawn and the number is written on, above, or below the line.

Dotted Note

Dotted note is a note with a small dot written after it. The dot adds a half as much again to the basic note's duration. The corresponding dotted note lasts 3 beats.

Fermata

A fermata (or *hold*) is an element of musical notation indicating that the note value would indicate. Exactly discretion of performer, but twice as above, but occasionally below (upside down), the note that is to be held longer. Occasionally holds are also printed above rests or bar lines, indicating pause of indefinite duration.

Types of Voices:

a. Soprano

Soprano (in Italian = above) is female voice of highest pitch. The three basic types of solo soprano are coloratura, lyric, and dramatic. The coloratura has a great range and impressive vocal agility; the lyric soprano has a light, pretty voice; and the dramatic soprano has a sustained power suitable for operatic roles.

b. Alto

Alto is a musical part or section higher than tenor and lower than soprano. Originally called contratenor altus, high countertenor, the part that performed a countermelody above the tenor or main melody. Alto singing voice the range of which is lower than the soprano by the interval of fifth.

c. Tenor

Tenor is highest natural male voice. In certain families of instruments the member whose register corresponds to that of the tenor voice is called tenor, e.g., tenor horn and tenor trombone.

d. Bass

Bass is a low spectrum of sound tones. It is a section of musical group that produces low-itched sound, lower than tenor and sung by male singer. The clef sign that indicates that the pitch of the notes is below middle C.

3. ANALYSIS AND DESIGN

Software General Description

Numbered Musical Notation Composer (NMNC) is an application to compose a musical notation in number as sounds. The application lies many advantages in composing music. It is so easy to use in editing and manipulating, it also save a lot of time in working.

Requirement Analysis

Numbered Musical Notation Composer can be used by people who ant to create numbered musical notation. With the application user can create, edit, manipulate, save, print, and listen the sound of composed musical notation.

Table 1. Problem identification and analysis

Problem	***Solution***
Standard musical notation difficult to be understood by inexperienced people	Numbered Musical notation is easy to be understood by people
Standard musical notation is difficult to create.	Use Numbered musical notation
Creating musical notation whether standard notation or numbered notation on paper, increase the risk of losing data.	Create the numbered musical notation application that can store data safely.
Editing manually are time consuming	Use application to edit is easily and save a lot of time.

System Specification

NMN Composer Functions and Features

Table 2. NMN Composer functions and Features

Feature Group	***Description***
Compose	Application composes numbered musical notation based on music theory and user requirement.
Composing page	Displays some features, the input and the output.
Edit	Application supports editing the composed notation based on user requirement.
Save	Application can store data safely
Play	Application generates sound. The sound automatically sounded when user input the notation and click play button
Print	The composed notation can be printed out.

4. IMPLEMENTATION AND TESTING

4.1 Algorithm

4.1.1 Lines of Note's Duration

```
set line[0,1] := '42110';
set line[0,2] := '42020';
set line[0,4] := '40040';
set line[0,8] := '00080';
set line[1,1] := '00010';
set line[1,2] := '000110';
set line[1,4] := '0001210';
set line[1,8] := '00012410';
set line[2,1] := '01110';
set line[2,2] := '00020';
set line[2,4] := '000220';
set line[2,8] := '0002420';
set line[4,1] := '00010';
set line[4,2] := '000110';
set line[4,4] := '0001210';
set line[4,8] := '00014210';
set line[4,1] := '22110';
set line[4,2] := '22020';
set line[4,4] := '00040';
set line[4,8] := '000440';
set line[5,1] := '00010';
set line[5,2] := '000110';
set line[5,4] := '0001210';
set line[5,8] := '00012410';
set line[6,1] := '11110';
set line[6,2] := '00020';
set line[6,4] := '000220';
set line[6,8] := '0002420';
set line[7,1] := '00010';
set line[7,2] := '000110';
set line[7,4] := '0001210';
set line[7,8] := '00014210';
```

The rules above are used to draw the line. The line presents the length of note between one note to another. The drawing is managed based on the numbers in []. The number on the left side is the sum of notation and the number on the right side is note's duration. The numbers after equal symbol present the distance between the notation and also determine the next position for the new input.

4.1.2 Drawing Note Algorithm

```
set left = 100;
set top = 100;
clear the canvas;
for v = 1 to 4
set l = 0;
set sum8 = 0;
set xx = left;
set yy = top + (v-1) * 4;
       for i = 1 to note_countv
              set j = notev,i.duration;
              set h = linesum8,j;
              set k = 4;
              set j = hk;
              set h2 = h;
              while (true)
              set x4 = h2[1];
              set x2 = h2[2];
              set x1 = h2[4];
draw_note(xx,yy,notev,i.note,notev,i.
octave2);
       set xx2 = xx
       set yy2 = yy
       if (x4 != 0) {
       draw_line(xx,yy,xx+x4,yy); }
       if (x2 != 0) {
       draw_line(xx,yy+1,xx+x2,yy+1) }
       if (x1 != 0) {
       draw_line(xx,yy+2,xx+x1,yy+2) }
       sum8 =sum8+ j
       if (sum8 > 8) { sum8 -= 8; }
              xx = xx+j
              l = l +j
       if (l >= 42)
              yy =yy+5
              set l = 0;
              set xx = left;
       draw_bar_line(xx+42
       ,yy,xx+42,yy+4);
       set j2 = j;
       inc kk
       j = hk
       if (j != 0)
       set h2 = linesum8,j
       draw_arc(xx2,yy2,xx,yy)
```

4.1.3 Playing Sound Algorithm

```
for j =1 to 4
       ij = 0
       dj = 0
       set bj = ij < note_countj
       set stop = false
       while (!stop) {
       for j =1 to 4 {
              if (dj = 0 and bj) {
              inc ij
              dj= notej,ij.duration
              play_sound(notej,ij.note)
              }
              Dec dj
              }
delay(tempo);
for j = 1 to 4 { set bj = ij <
note_countj; }
stop = true;
for j = 1 to 4 { set stop = stop and (ij
== note_countj) }
}
```

4.2 Implementation

4.2.1 General Specification

1. The application implemented using Borland Delphi 6.0
2. The application works on windows platform
3. The application made on computer with specification as follow:
   Processor: IntelPentium®4 2.66 GHz
   Memory: 256 MB of RAM
   Hard Drive : 30 GB
   Audio and MIDI sounds are installed on the computer.

4.2.2 Troubleshooting

There are some troubles can be occurred during the implementation.

1. If the application can not run on the computer, please check the computer specification.
2. If there is no sound when implementing the application, please do the following steps to check does MIDI exist in your computer.
   - . Open 'Run' then type "dxdiag", then it will show 'DirectX diagnostic tool'
   - . Go to Music tab. At combo box of directX features choose Microsoft synthesizer, then click 'Test Direct Music' button.
3. If the previous step is success but still no sound, please check your device volume.

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5. CONCLUSION & FURTHER DIRECTION

5.1 Conclusion

1. Numbered Musical Composer (NMNC) has been built based on the relevant theory and it can composed numbered musical notation.
2. Numbered Musical Composer (NMNC) can play the sound of composed numbered musical notation in four types of voices.
3. Editing and manipulating with Numbered Musical Notation Composer (NMNC) reduce timeconsuming problem

5.2 Further Direction

1. The application should be improved by adding the number of music instruments. So the sound can play in different music instrument as user's choice.
2. The application should be added with more of composing pages.
3. The application should be developed with double dotted note, triple dotted note and triplet

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