

<b>WANG,Xiao</b>	MSc(IT)HKUST Hong Kong	<b>Supervisor: Prof. Rossiter</b>
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# **Physical Modeling System for Generating Fireworks**

## **Project Report**

**Supervisor: Prof. Rossiter**

**Prepared by: WANG Xiao, MSc(IT) Student**

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# 1. Introduction

## 1.1 Overview

In recent years, with rapid development of Internet, computers and computer-generated images touch many aspects of daily life. Computer imagery is found on television, in newspapers, for example in weather reports, or for example in all kinds of medical investigation and surgical procedures. And Fireworks are a class of explosive pyrotechnic devices used for aesthetic and entertainment purposes. Because of the development of the computer graphics, modeling and generating fireworks on computer will be more safe and will economize not only in making fireworks but also in protecting environment.

The project we plan to develop will create a physical modeling for the whole process of fireworks which can accurately display the generation, launch and exploding of fireworks. The program is based on an open source programming language and environment for people who want to create images, animations and interactions. From this point of view, the small app will help the user generate a fireworks show with their own background and music.

## 1.2 Objectives

The project need different scope skills not only about the programming, math model, but also the user interface and user experience.

- The project based on a new environment requires me extra time for programming.
- The math model of displaying also should be build for accurately showing fireworks shooting up into the sky and exploding.
- The user interface and user experience of the program which help users create their fireworks and video are also important.

## 2. Background

### 2.1 Processing

Processing is an open source programming language and environment for people who want to create images, animations, and interactions. Initially developed to serve as a software sketchbook and to teach fundamentals of computer programming within a visual context, Processing also has evolved into a tool for generating finished professional work. Today, there are tens of thousands of students, artists, designers, researchers, and hobbyists who use Processing for learning, prototyping, and production.

### 2.2 UI and UX

The user interface, in the industrial design field of human-machine interaction, is the space where interaction between humans and machines occurs. The goal of interaction between a human and a machine at the user interface is effective operation and control of the machine, and feedback from the machine which aids the operator in making operational decisions.

User experience (UX) is the way a person feels about using a product, system or service. User experience highlights the experiential, affective, meaningful and valuable aspects of human-machine interaction and product ownership, but it also includes a person's perceptions of the practical aspects such as utility, ease of use and efficiency of the system. User experience is subjective in nature, because it is about an individual's feelings and thoughts about the system. User experience is dynamic, because it changes over time as the circumstances change.

## 3. Physical Modeling

### 3.1 Introduction

The project we plan to develop will create a physical modeling for the whole process of fireworks which can accurately display the generation, launch and exploding of fireworks. As show in the real world, fireworks are made of particles, the project also need to use particles for generate the whole process of the fireworks.

### 3.2 Design

The whole process of fireworks have three basic steps:

#### 3.2.1.Generation

Generating particles at a random point in original plane.

#### 3.2.2.Launch

The particles launch from the original plane to a random height.

#### 3.2.3.Exploding

The particles exploding from height point and burst based on the height.

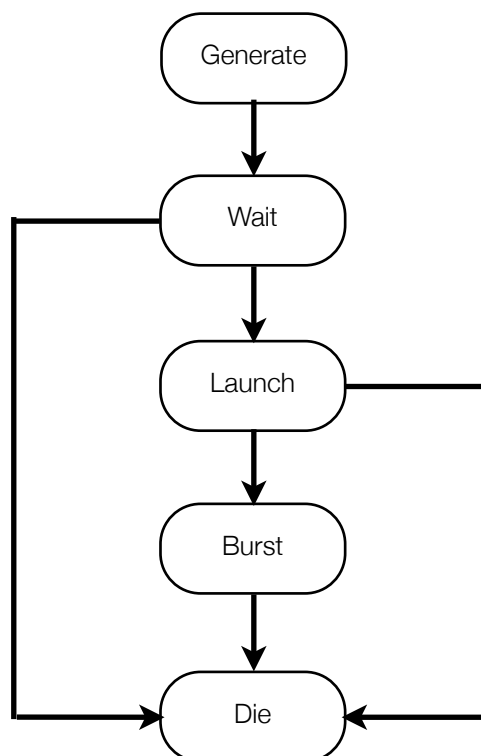


Figure 1 A flow diagram of fireworks particles

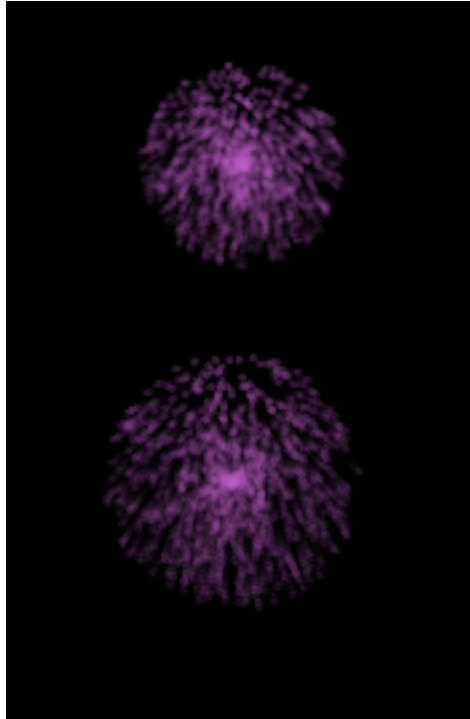


Figure 2 Exploding of fireworks particles in 2D

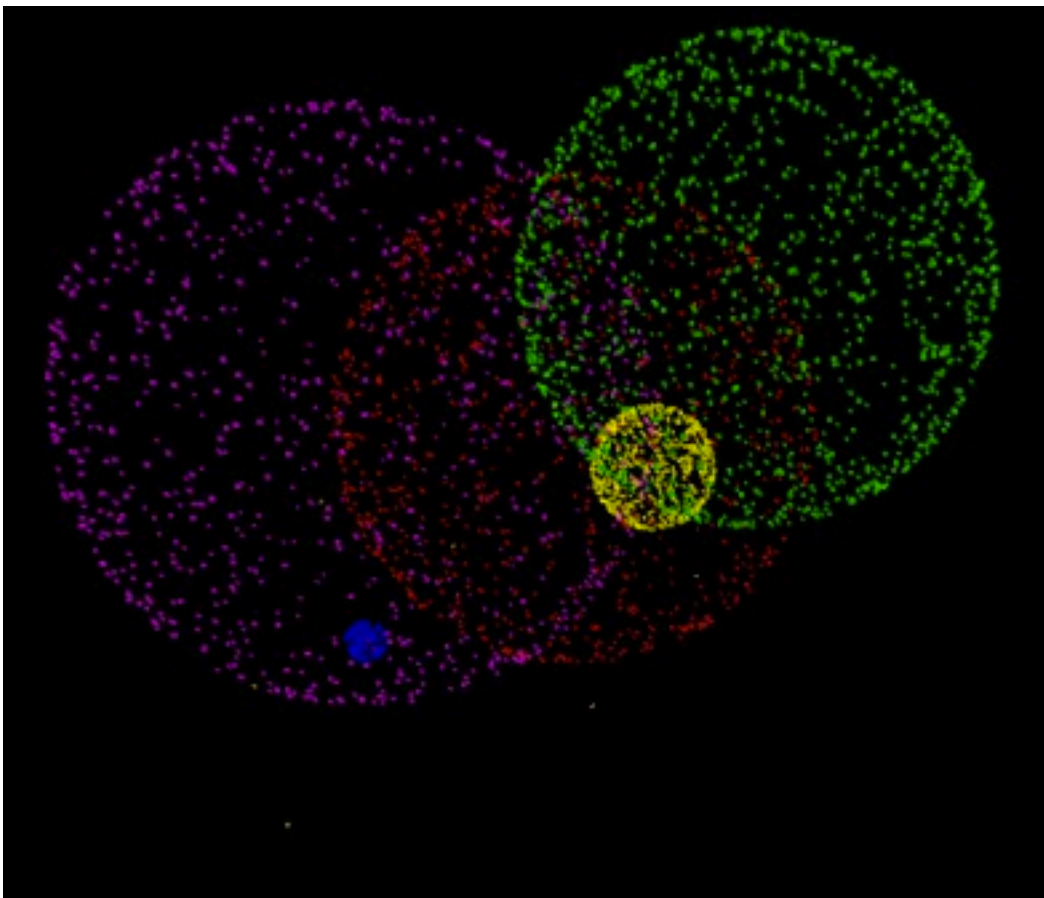


Figure 3 Exploding of fireworks particles in 3D

## 3.3 Implementation

Three fundamental activity classes are involved:

### 3.3.1.Setup:

To initialize the particles.

### 3.3.2.Draw:

Be called automatically and draw the particles on the screen.

### 3.3.3.Shell:

To generate the particles, judge the steps of the particles and display the particles' transformation in every steps.



## 4. UI Designing

### 4.1 Introduction

The user interface and user experience of the program which help users create their fireworks. The user interface in the project we plan to develop will include the frame, window, button and color picker. With the help of using lots of different application, the user experience of the project we design will as simple as possible.

### 4.2 Design

The whole user interface of fireworks have four parts:

#### 4.2.1.Frame

Because the application mainly display the whole process of fireworks, the window need focus on the display. The show part should as big as possible and the contrast should as clear as possible.

#### 4.2.2.Button

The less button we have, the better the user will feel. One button for control the fireworks start/pause is necessary.

#### 4.2.3.Color picker

##### RGB color picker

As show in the figure4, the RGB color picker is powerful and easy to get the color for user who understand the RGB theory.

But for user who can not easy to get the color in a RGB color picker, it is very hard to use.



Figure 4 RGB color picker for fireworks application

##### HSV color picker

As show in the figure5, the HSV color picker is much easier to control and much more distinct to get the color.

User experience includes a person's perceptions of the practical aspects such as utility, ease of use and efficiency of the system, so the HSV color picker makes the user feel better.



Figure 5 HSV color picker for fireworks application

So the project chooses HSV color picker to help the user get custom color.

### Color showing and initializing

As show in the figure6, user need know which color they have already chose, so a clear and convenience signal should be in the right place.

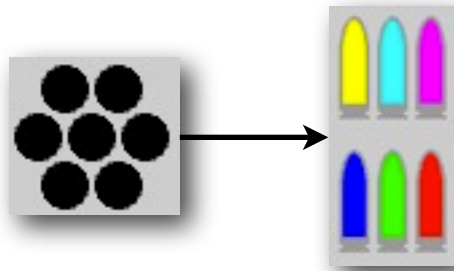


Figure 6 The evolvement of color showing

In the first version( left ), color signals arrange like a five-shooter and the initial color is black. So every time the user have to choose 7 colors to watch the fireworks show.

In the second version( right ), color signals look like bullets and it is easy for users understanding the meaning of the signals. Also, the initial color is given and it is easier for users to just press the Start button.

#### 4.2.4.Sound

The fireworks particles have two steps user can see, so the project need two sound for launching and bursting.

## 4.3 Implementation

Three fundamental activity classes are involved:

### 4.3.1.ControlP5.\*:

The project need respond buttons, so it imports the library of controlP5 to make the button works and for further developing.

**4.3.2.Hint(DISABLE\_DEPTH\_TEST):**

Disable the zbuffer, allowing you to draw on top of everything at will. When depth testing is disabled, items will be drawn to the screen sequentially, like a painting. This hint is most often used to draw in 3D, then draw in 2D on top of it (for instance, to draw GUI controls in 2D on top of a 3D interface).

Because we generate the fireworks in a 3D space, so we use the Hint to draw the GUI controls in 2D.

**4.3.3.DrawColorSelectorAndGuides:**

To draw the color picker in 2D on top of the 3D interface, to get the color of your mouse's choice and to draw the an indicator of current selection.

**4.3.4.Ddf.minim.\*:**

To generate two sound for launching and bursting, the project imports the library of ddf.minim to control the sound importing, playing and stopping.

## 5. Project Demonstration

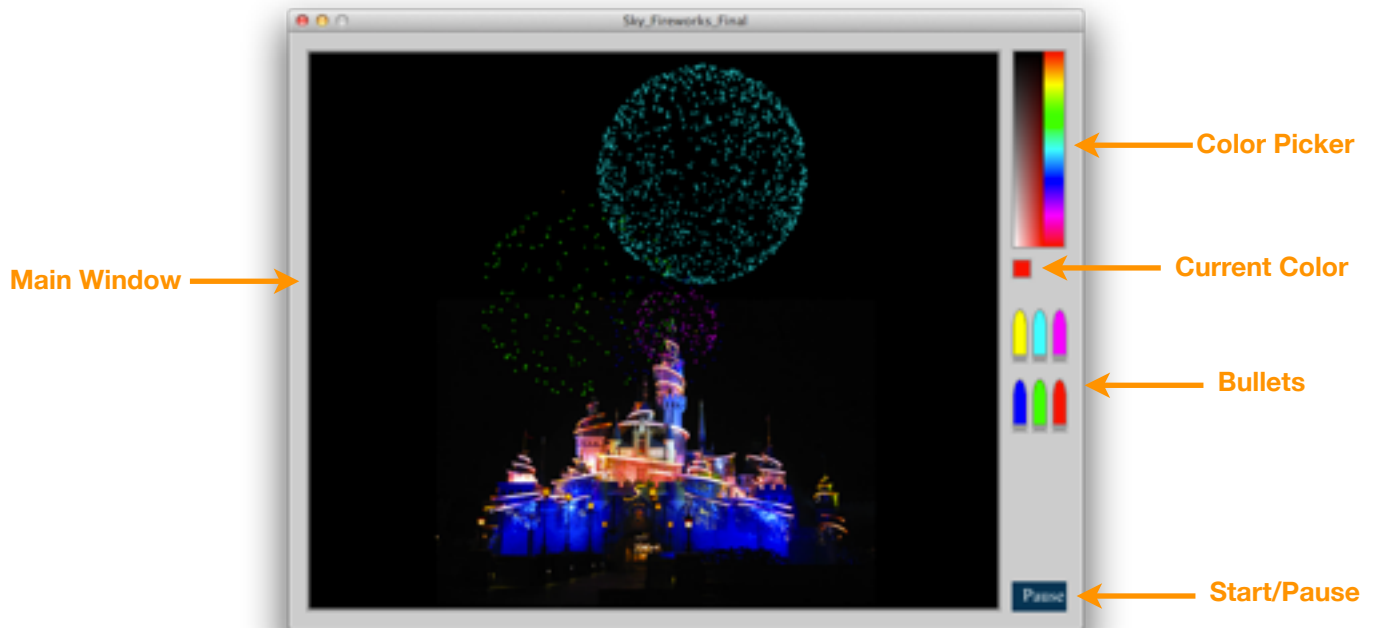


Figure 7 The instruction of fireworks application

### 5.1 Choose the color

At beginning, the main window as figure 7, bullets on the right have already have 6 different color. If user want to custom their favorite color, they just need press the color picker above the bullets and can get a color in the little square. At this time, press keyboard 1~6, user can refill the bullets with their color.

### 5.2 Start/Pause

Press Start to simple start or pause the fireworks display.

## 6. Further development

Since limited time, the basic structure of the fireworks display is done and there are many possibilities for further development and improvement, such as:

### 6.1 More functions

- 1.The fireworks can have different shapes.
- 2.User can custom their background to make it better.
- 3.Making Video of the fireworks include the background and sound.

### 6.2 Better UI/UX

- 1.The interface of the application can be improved to make it become more friendly.
- 2.The user experience of the application can have more instruction and can use the nature language for a person's perceptions of the practical aspects.

## 7. Conclusion

The successful deployment of fireworks display marks the creative goal of the project has been accomplished. With the aid of the open source Processing, I managed to develop an application that display the fireworks in 3D space. The users can enjoy the display with their favorite color.

During the progress of the development, as a multimedia student, I tackled some challenges, such as modeling the fireworks in Processing and drawing the HSV color picker, etc. Although the application is simple and the effect is not attractive enough, with the successful deployment of the application, it means I have already implemented the idea and the project reflects an efficient method to achieve my multimedia knowledge.

## 8. Appendix

### Minutes of the 1st Project Meeting

**Date:** 30th September 2011 (Friday)

**Time:** 11:00 AM

**Place:** Rm. 3512

**Attending:** Prof. Rossiter, WANG Xiao

**Absent:** None

**Recorder:** WANG Xiao

#### 1. Approval of minutes

This is first formal group meeting, so there were no minutes to approve.

#### 2. Report on Progress

Since this is the first meeting, there is no progress to be reported.

#### 3. Discussion Items Things to do

- Scope of the project
- Simple demo of fireworks for the project
- Build the user interface

#### 4. Meeting adjournment and next meeting

The meeting was adjourned at 11:20 AM. The next meeting will be held in 7th October 2011 (Friday).

## **Minutes of the 2nd Project Meeting**

**Date:** 7th October 2011 (Friday)

**Time:** 11:05 AM

**Place:** Rm. 3512

**Attending:** Prof. Rossiter, WANG Xiao

**Absent:** None

**Recorder:** WANG Xiao

### **1. Approval of minutes**

The minutes of the last meeting were approved without amendment.

### **2. Report on Progress**

WANG Xiao have finished a simple demo of fireworks for the project and have built a first version of the user interface.

### **3. Discussion Items Things to do**

- Build the construction of the project
- Finish the physical modeling about the whole processing of fireworks
- Add different colors and shapes of the fireworks

### **4. Meeting adjournment and next meeting**

The meeting was adjourned at 11:25 AM. The next meeting will be held in 21st October 2011 (Friday).



## **Minutes of the 3rd Project Meeting**

**Date:** 21st October 2011 (Friday)

**Time:** 11:25 AM

**Place:** Rm. 3512

**Attending:** Prof. Rossiter, WANG Xiao

**Absent:** None

**Recorder:** WANG Xiao

### **1. Approval of minutes**

The minutes of the last meeting were approved without amendment.

### **2. Report on Progress**

WANG Xiao have finished the physical modeling about the whole processing of fireworks, have added different colors of the fireworks for the projects and have added a background in 3D view of the project.

### **3. Discussion Items Things to do**

- Finish programming the frame and functions using the physical modeling in Processing
- Designing the user interface for choosing different fireworks styles, amount, color
- Add sound effect of the project

### **4. Meeting adjournment and next meeting**

The meeting was adjourned at 11:45 AM. The next meeting will be held in 2nd December 2011 (Friday).

## **Minutes of the 4th Project Meeting**

**Date:** 2nd December 2011 (Friday)

**Time:** 11:25 AM

**Place:** Rm. 3512

**Attending:** Prof. Rossiter, WANG Xiao

**Absent:** None

**Recorder:** WANG Xiao

### **1. Approval of minutes**

The minutes of the last meeting were approved without amendment.

### **2. Report on Progress**

WANG Xiao have finished

### **3. Discussion Items Things to do**

- Finish the final program
- Finish the final project report
- Make a instruction video

### **4. Meeting adjournment and next meeting**

The meeting was adjourned at 11:45 AM.