FireFlower

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Contents

Introduction

FireFlower is C program creating firework-like pattern.

The pattern is made of a set of particles, each trying to follow two others, and having a different color. The particle move at constant speed toward there targets with an attraction force proportional to the distance to the target. The particles leave a trace of their color, which progressively disappear. The size of the particle, length of the tail, inerty, and number of particles is either set by the user, or randomly set.

1 Makefile

```
OPTIONS_DEBUG=-ggdb -g3 -Wall
OPTIONS_RELEASE=-O3
OPTIONS=$(OPTIONS_RELEASE)
INCPATH=/home/bayashi/Coding/Include
LIBPATH=/home/bayashi/Coding/Include

all : main

main: main.o Makefile $(LIBPATH)/tgapaint.o $(LIBPATH)/gset.o $(LIBPATH)/pbmath.o $(LIBPATH)/bcurve.o
gcc $(OPTIONS) main.o $(LIBPATH)/tgapaint.o $(LIBPATH)/pbmath.o $(LIBPATH)/gset.o $(LIBPATH)/bcurve.o -o main -lm

main.o : main.c Makefile
gcc $(OPTIONS) -I$(INCPATH) -c main.c
```

```
clean :
rm -rf *.o main

test :
main out.tga -rnd

valgrind :
valgrind -v --track-origins=yes --leak-check=full --gen-suppressions=yes --show-leak-kinds=all ./main

video:
avconv -r 20 -i ./Frames/frame%03d.tga -b:v 2048k video.mp4
```

2 Usage

```
// ============ SMOKER.C ================

// ================= Include ==================

#include <stdlib.h>
#include <stdio.h>
#include <time.h>
#include <string.h>
#include "gset.h"
#include "pbmath.h"
#include "tgapaint.h"

// ================= Define ==================

#define SCREENSIZE 1000
#define rnd() (float)(rand())/(float)(RAND_MAX)

// ================= Structure ==================

struct Particle;
typedef struct Particle {
  // Position
  VecFloat *_pos;
  // Speed
  VecFloat *_speed;
  // Pencil
  TGAPencil *_pen;
  // Targets
  struct Particle **_targets;
} Particle;

// ================= Functions ==================

Particle* ParticleCreate(int nbTarget, int thickness) {
  // Allocate memory
  Particle *p = (Particle*)malloc(sizeof(Particle));
  // If we could allocate memory
  if (p != NULL) {
    // Set properties
    p->_pos = VecFloatCreate(2);
    if (p->_pos == NULL)
      return NULL;
    p->_speed = VecFloatCreate(2);
    if (p->_speed == NULL)
```

```
      return NULL;
    p->_pen = TGAGetBlackPencil();
    if (p->_pen == NULL)
      return NULL;
    TGAPencilSetAntialias(p->_pen, true);
    TGAPencilSetThickness(p->_pen, thickness);
    TGAPencilSetShapeRound(p->_pen);
    p->_targets = (Particle**)malloc(sizeof(Particle*) * nbTarget);
    if (p->_targets == NULL)
      return NULL;
  }
  // Return the particle
  return p;
}

void ParticleFree(Particle **p) {
  VecFree(&((*p)->_pos));
  VecFree(&((*p)->_speed));
  TGAFreePencil(&((*p)->_pen));
  free(*p);
  *p = NULL;
}

void FireFlower(char *fileName, int nbParticle, float fading,
  float speed, float inertia, int nbTarget, float thickness) {
  // Create the TGA
  VecShort *dim = VecShortCreate(2);
  if (dim == NULL) {
    fprintf(stderr, "VecShortCreate failed\n");
    return;
  }
  VecSet(dim, 0, SCREENSIZE);
  VecSet(dim, 1, SCREENSIZE);
  TGAPixel *pixelBg = TGAGetBlackPixel();
  if (pixelBg == NULL) {
    fprintf(stderr, "TGAGetBlackPixel failed\n");
    return;
  }
  TGA *tga = TGACreate(dim, pixelBg);
  if (tga == NULL) {
    fprintf(stderr, "TGACreate failed\n");
    return;
  }
  // Create the particles
  GSet *particles = GSetCreate();
  if (particles == NULL) {
    fprintf(stderr, "GSetCreate failed\n");
    return;
  }
  for (int iParticle = nbParticle; iParticle--;) {
    Particle *p = ParticleCreate(nbTarget, thickness);
    if (p == NULL) {
      fprintf(stderr, "ParticleCreate failed\n");
      return;
    }
    for (int dim = 2; dim--;)
      VecSet(p->_pos, dim, (0.1 + rnd() * 0.8) * (float)SCREENSIZE);
    TGAPixel *color = TGAGetWhitePixel();
    color->_rgba[4] = 125;
    for (int irgb = 3; irgb--;)
      color->_rgba[irgb] = (unsigned char)floor(rnd() * 255.0);
    TGAPencilSetColor(p->_pen, color);
```

```
  TGAFreePixel(&color);
  GSetAppend(particles, p);
}
// Set the target of the particles
GSetElem *elem = particles->_head;
int iElem = 0;
while (elem != NULL) {
  Particle *p = (Particle*)(elem->_data);
  for (int iTarget = nbTarget; iTarget--;) {
    int jElem = iElem;
    while (iElem == jElem)
      jElem = (int)floor(rnd() * (float)nbParticle);
    p->_targets[iTarget] =
      (Particle*)GSetGet(particles, jElem);
  }
  ++iElem;
  elem = elem->_next;
}
// Declare a flag to stop the simulation loop
bool flagStop = false;
// Declare a vector equal to the centre of th eimage
VecFloat *center = VecFloatCreate(2);
if (center == NULL) {
  fprintf(stderr, "VecFloatCreate failed\n");
  return;
}
VecSet(center, 0, 0.5 * (float)SCREENSIZE);
VecSet(center, 1, 0.5 * (float)SCREENSIZE);
// Simulation loop
float t = 0.0;
int iFrame = 0;
while (flagStop == false) {
  fprintf(stderr, "%.1f       \r", t);
  // Fading
  VecShort *pos = VecShortCreate(2);
  if (pos == NULL) {
    fprintf(stderr, "VecShortCreate failed\n");
    return;
  }
  for (VecSet(pos, 0, 0); VecGet(pos, 0) < SCREENSIZE;
    VecSet(pos, 0, VecGet(pos, 0) + 1)) {
    for (VecSet(pos, 1, 0); VecGet(pos, 1) < SCREENSIZE;
      VecSet(pos, 1, VecGet(pos, 1) + 1)) {
      TGAPixel *pixel = TGAGetPix(tga, pos);
      TGAPixel *blend = TGABlendPixel(pixel, pixelBg, fading);
      TGASetPix(tga, pos, blend);
      TGAFreePixel(&blend);
    }
  }
  VecShortFree(&pos);
  // For each particle
  elem = particles->_head;
  while (elem != NULL) {
    Particle *p = (Particle*)(elem->_data);
    // For each target
    for (int iTarget = nbTarget; iTarget--;) {
      Particle *pT = p->_targets[iTarget];
      // Get the attraction
      VecFloat *v = VecGetOp(pT->_pos, 1.0, p->_pos, -1.0);
      float d = VecNorm(v);
      float a = 1.0 / d;
      //if (d < 0.5)
```

```
        //flagStop = true;
      VecNormalise(v);
      // Update speed
      VecOp(p->_speed, inertia, v, a);
      VecNormalise(p->_speed);
      VecOp(p->_speed, speed, NULL, 1.0);
      // Free memory
      VecFree(&v);
    }
    // Add attraction toward the center of the image
    VecFloat *v = VecGetOp(center, 1.0, p->_pos, -1.0);
    float d = VecNorm(v);
    //float a = 1.0 / (d * (float)nbTarget);
    float a = 1.0 * pow(d / (float)SCREENSIZE, 3.0);
    VecNormalise(v);
    // Update speed
    VecOp(p->_speed, inertia, v, a);
    VecNormalise(p->_speed);
    VecOp(p->_speed, speed, NULL, 1.0);
    // Free memory
    VecFree(&v);
    // Draw
    VecFloat *to = VecGetOp(p->_pos, 1.0, p->_speed, 1.0);
    if (to == NULL) {
      fprintf(stderr, "VecGetOp failed\n");
      return;
    }
    TGADrawLine(tga, p->_pos, to, p->_pen);
    elem = elem->_next;
  }
  // Move particles
  elem = particles->_head;
  while (elem != NULL) {
    Particle *p = (Particle*)(elem->_data);
    VecOp(p->_pos, 1.0, p->_speed, 1.0);
    elem = elem->_next;
  }
  // Save the frame
  //char frame[100];
  //sprintf(frame, "./Frames/frame%03d.tga", iFrame);
  //TGASave(tga, frame);
  // End condition
  t += 1.0;
  ++iFrame;
  if (t * 2.0 > SCREENSIZE)
    flagStop = true;

}
fprintf(stderr,"\n");
// Save the TGA
int ret = TGASave(tga, fileName);
if (ret != 0) {
  fprintf(stderr, "TGASave failed\n");
  return;
}
// Free memory
elem = particles->_head;
while (elem != NULL) {
  ParticleFree((Particle**)(&(elem->_data)));
  elem = elem->_next;
}
GSetFree(&particles);
```

```
  VecFree(&dim);
  TGAFreePixel(&pixelBg);
  TGAFree(&tga);
}

// ================= Main function ==================

int main(int argc, char **argv) {
  // Initialize the random generator
  time_t seed = time(NULL);
  srandom(seed);
  // Declare variables to memorize the arguments and set default values
  if (argc < 2)
    return 1;
  char *fileName = argv[1];
  int nbParticle = 100;
  float fading = 0.05;
  float speed = 5.0;
  float inertia = 0.01;
  int nbTarget = 3;
  float thickness = 2.0;
  // Decode arguments
  for (int iArg = 2; iArg < argc; ++iArg) {
    if (strcmp(argv[iArg] , "-rnd") == 0) {
      thickness = 1.0 + rnd() * 4.0;
      inertia = rnd() * 0.03;
      fading = 0.01 + 0.09 * rnd();
      nbParticle = 25 + (int)floor(rnd() * 75.0);
      fprintf(stdout, "thickness: %.3f\n", thickness);
      fprintf(stdout, "inertia: %.3f\n", inertia);
      fprintf(stdout, "fading: %.3f\n", fading);
      fprintf(stdout, "nbParticle: %d\n", nbParticle);
    } else if (strcmp(argv[iArg] , "-thick") == 0 && iArg + 1 < argc) {
      ++iArg;
      sscanf(argv[iArg], "%f", &thickness);
    } else if (strcmp(argv[iArg] , "-inertia") == 0 && iArg + 1 < argc) {
      ++iArg;
      sscanf(argv[iArg], "%f", &inertia);
    } else if (strcmp(argv[iArg] , "-fading") == 0 && iArg + 1 < argc) {
      ++iArg;
      sscanf(argv[iArg], "%f", &fading);
    } else if (strcmp(argv[iArg] , "-nb") == 0 && iArg + 1 < argc) {
      ++iArg;
      sscanf(argv[iArg], "%d", &nbParticle);
    } else if (strcmp(argv[iArg] , "-help") == 0) {
      printf("arguments : <filename> [-help] [-rnd] ");
      printf("[-thick] [-inertia] [-fading] [-nb]\n");
      // Stop here
      return 0;
    }
  }
  // Create the image
  FireFlower(fileName, nbParticle, fading, speed, inertia, nbTarget,
    thickness);
  // Return the success code
  return 0;
}
```