Circular Collision Detection

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Besides rectangles, the most common shape you'll have to deal with is a circle. In the last tutorial we had to use 11 collision boxes for a circle. This tutorial will teach you a more efficient way to handle circles and collision detection.

```
#include "SDL/SDL.h"
#include "SDL/SDL_image.h"
#include <string>
#include <vector>
#include <cmath>
```

This tutorial is going to require the distance formula so we include a header for math.

```
//A circle stucture
struct Circle
{
    int x, y;
    int r;
};
```

We have to create our own circle structure for this program. "x" and "y" are the offsets of the center of the circle. "r" is the radius.

```
//The dot
class Dot
{
    private:
    //The area of the dot
    Circle c;

    //The velocity of the dot
    int xVel, yVel;

    public:
    //Initializes the variables
    Dot();

    //Takes key presses and adjusts the dot's velocity
    void handle_input();

    //Moves the dot
    void move( std::vector<SDL_Rect> &rects, Circle &circle );
```

```
    //Shows the dot on the screen
    void show();
};
```

Here's yet another revision of the Dot class.

Everything is pretty much the same except for two differences. This time we have a Circle structure instead of a vector of SDL_Rects. Also, in the move() function we check collision with a vector of SDL_Rects and a Circle.

```
double distance( int x1, int y1, int x2, int y2 )
{
    //Return the distance between the two points
    return sqrt( pow( x2 - x1, 2 ) + pow( y2 - y1, 2 ) );
}
```

This function we made gives us the distance between given 2 points. This is pretty much the only real math used in this program.

For those of you using visual studio you may need to type cast those integers to doubles.

```
bool check_collision( Circle &A, Circle &B )
{
    //If the distance between the centers of the circles is less than the sum of their radii
    if( distance( A.x, A.y, B.x, B.y ) < ( A.r + B.r ) )
    {
        //The circles have collided
        return true;
    }

    //If not
    return false;
}
```

Checking collision between two circles is pretty easy. All you have to do is check whether or not the distance between the centers of the circles is less than the sum of their radii.

If it is less, a collision has happened, otherwise there's no collision.

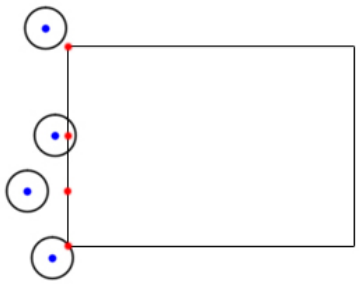
```
bool check_collision( Circle &A, std::vector<SDL_Rect> &B )
{
    //Closest point on collision box
    int cX, cY;

    //Go through the B boxes
    for( int Bbox = 0; Bbox < B.size(); Bbox++ )
    {
```

This function checks collision between a circle and a vector of rectangles. Checking for collision between a circle and a rectangle gets a bit tricky. To check if there's a collision between a circle and a collision box, you must find the point on the collision box closest to the center of the circle.

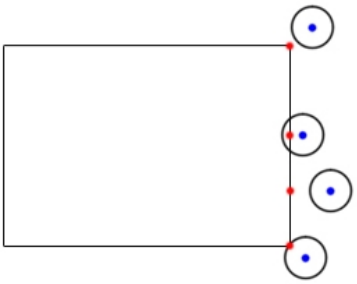
```
        //Find closest x offset
        if( A.x < B[ Bbox ].x )
        {
            cX = B[ Bbox ].x;
        }
```

If the center of the circle is to the left of the box, then the x offset of the closest point is equal to the x offset of the collision box.



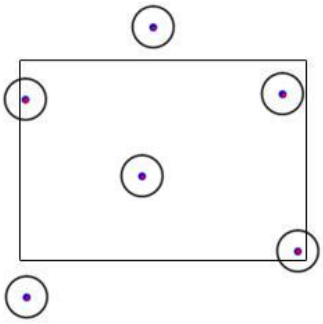
```
        else if( A.x > B[ Bbox ].x + B[ Bbox ].w )
        {
            cX = B[ Bbox ].x + B[ Bbox ].w;
        }
```

If the center of the circle is to the right of the box, then the x offset of the closest point is equal to the x offset of the right side of the collision box.



```
        else
        {
            cX = A.x;
        }
```

If the x offset of the center of the circle is not to the left or the right of the collision box, then the x offset is inside the collision box.



```
        //Find closest y offset
        if( A.y < B[ Bbox ].y )
        {
            cY = B[ Bbox ].y;
        }
        else if( A.y > B[ Bbox ].y + B[ Bbox ].h )
        {
            cY = B[ Bbox ].y + B[ Bbox ].h;
        }
        else
        {
            cY = A.y;
        }
```

Then we do the same as above to find the closest y offset.

```
        //If the closest point is inside the circle
        if( distance( A.x, A.y, cX, cY ) < A.r )
        {
            //This box and the circle have collided
            return true;
        }
    }

    //If the shapes have not collided
    return false;
}
```

If the point on the collision box closest to the circle is inside the circle, then the circle and the collision box are overlapped. Here we keep going through all the collision boxes until we find a collision or all of the boxes have been checked and there is no collision.

```
    //Make the shapes
    std::vector<SDL_Rect> box( 1 );
    Circle otherDot;

    //Set the shapes' attributes
    box[ 0 ].x = 60;
    box[ 0 ].y = 60;
    box[ 0 ].w = 40;
    box[ 0 ].h = 40;

    otherDot.x = 30;
    otherDot.y = 30;
    otherDot.r = DOT_WIDTH / 2;
```

In the main() function we create the 2 shapes the Dot is going to interact with.

```
    //While the user hasn't quit
    while( quit == false )
    {
        //Start the frame timer
        fps.start();

        //While there's events to handle
        while( SDL_PollEvent( &event ) )
        {
            //Handle events for the dot
            myDot.handle_input();

            //If the user has Xed out the window
            if( event.type == SDL_QUIT )
            {
                //Quit the program
                quit = true;
            }
        }

        //Move the dot
        myDot.move( box, otherDot );

        //Fill the screen white
        SDL_FillRect( screen, &screen->clip_rect, SDL_MapRGB( screen->format, 0xFF, 0xFF, 0xFF )

        //Show the box
        SDL_FillRect( screen, &box[ 0 ], SDL_MapRGB( screen->format, 0x00, 0x00, 0x00 ) );

        //Show the other dot
        apply_surface( otherDot.x - otherDot.r, otherDot.y - otherDot.r, dot, screen );

        //Show our dot
        myDot.show();

        //Update the screen
        if( SDL_Flip( screen ) == -1 )
        {
            return 1;
        }

        //Cap the frame rate
        if( fps.get_ticks() < 1000 / FRAMES_PER_SECOND )
```

```
        {
            SDL_Delay( ( 1000 / FRAMES_PER_SECOND ) - fps.get_ticks() );
        }
    }
```

Here's the main loop, pretty much everything is the same story as before. I would like to point one thing out.

When we show the other dot, we don't blit the image at its offset. The offset is the center of the circle, so we have to blit the dot image at the upper-left corner. We do this by subtracting the radius from the offset.

Download the media and source code for this tutorial here.

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