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Bitmap Fonts

Bitmap Font
ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
0123456789

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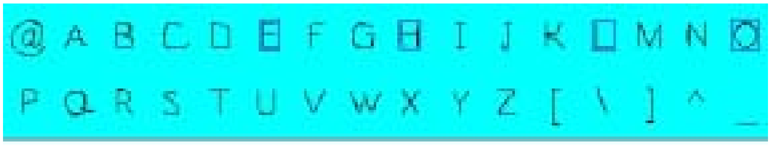
Good fonting programs can be expensive, and sometimes font APIs (like SDL_ttf) are simply not flexible enough. While time consuming, making your own bitmap font engine can be useful. This tutorial will teach you to make a common style bitmap font.

A bitmap font is simply a sprite sheet.

If we wanted to make "HELLO" show on the screen we would do this:


@ A B C D E F G H I J K L M N O
P Q R S T U V W X Y Z [\ ] ^ _

We would take the "H" sprite, the "E" sprite, two of the "L" sprite, and finally the "O" sprite and then show them on the screen one after the other.

Now that you know the basic concept, it's time to make a bitmap fonting engine.

```
//Our bitmap font
class BitmapFont
{
    private:
    //The font surface
    SDL_Surface *bitmap;

    //The individual characters in the surface
    SDL_Rect chars[ 256 ];

    public:
    //The default constructor
    BitmapFont();

    //Generates the font when the object is made
    BitmapFont( SDL_Surface *surface );

    //Generates the font
    void build_font( SDL_Surface *surface );

    //Shows the text
    void show_text( int x, int y, std::string text, SDL_Surface *surface );
};
```

Here is our bitmap font class.

First thing we have is the surface of the bitmap font. Then we have to have an array of rectangles to clip the letters from the bitmap font. We have 256 of them, one for each of the extended ASCII characters.

Then we have our constructors. We also have a build_font() to initialize the font. Finally, we have show_text() to show text on the screen.

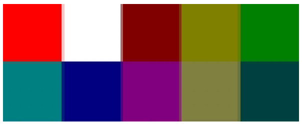
```
Uint32 get_pixel32( int x, int y, SDL_Surface *surface )
{
    //Convert the pixels to 32 bit
    Uint32 *pixels = (Uint32 *)surface->pixels;

    //Get the pixel requested
    return pixels[ ( y * surface->w ) + x ];
}
```

First off we need to make a function that get an individual pixel from a surface. Why the SDL API doesn't have one built in I'll never know.

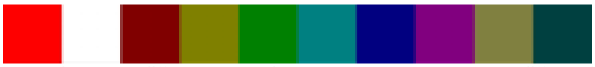
First thing we do is convert the pixel pointer from type void to 32bit integer so we can properly access them. After all, a surface's pixels are nothing more than an array of 32bit integers. Then we get or set the requested pixel.

You maybe be wondering why I don't just go "return pixels[x][y]".

The thing is the pixels aren't stored like this:



They're stored like this:



in a single dimensional array. Its because different operating systems store 2D arrays differently (At least I think that's why).

So to retrieve the red pixel from the array we multiply the y offset by the width and add the x offset.

These functions only work for 32-bit surfaces. You'll have to make one of your own if you're using a different format.

```
BitmapFont::BitmapFont()
{
    //Set the bitmap to NULL
    bitmap = NULL;
}

BitmapFont::BitmapFont( SDL_Surface *surface )
{
    //Build the font
    build_font( surface );
}
```

Here are our contructors.

The first one simply initializes the pointer to the bitmap to NULL. The second one create the object and builds the font with the given variables.

```
void BitmapFont::build_font( SDL_Surface *surface )
{
    //If surface is NULL
    if( surface == NULL )
    {
        return;
    }

    //Get the bitmap
    bitmap = surface;

    //Set the background color
    Uint32 bgColor = SDL_MapRGB( bitmap->format, 0, 0xFF, 0xFF );
```

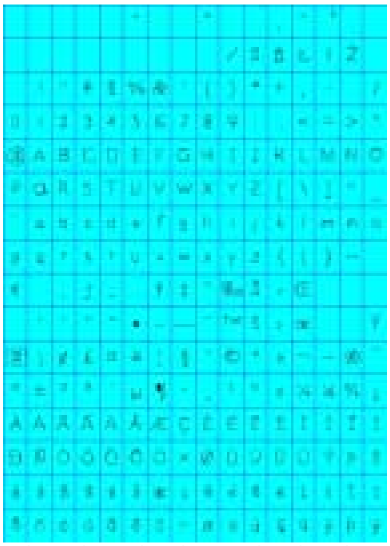
Now it's time to build our font. We have to first check that a valid surface was given to us.

Then we get the actual bitmap font surface from the given argument. Then we set the background color.

```
    //Set the cell dimensions
    int cellW = bitmap->w / 16;
    int cellH = bitmap->h / 16;
```

Here we calculate the cell width and height. What are cells? Cells are used to arrange the letters on our bitmap to make it easy to get the individual characters.

A typical bitmap font has the 256 characters in ASCII order. Each of the letters are in a uniformly sized cell and are laid out in 16 columns and 16 rows. It looks like this:



The lines lining the cell don't have to be there, they're just there to show how the cells look. To calculate cell width, divide the image width by 16 since there are 16 equal sides. The same thing is done with the height.

Now that we've got our bitmap and set the cells, it's time to clip the individual letters.

```
//The current character we're setting
int currentChar = 0;

//Go through the cell rows
for( int rows = 0; rows < 16; rows++ )
{
    //Go through the cell columns
    for( int cols = 0; cols < 16; cols++ )
    {
```

First off, we make an integer to keep track of which character we're setting. Then we go through the rows of the cells, then through each individual column.

```
        //Set the character offset
        chars[ currentChar ].x = cellW * cols;
        chars[ currentChar ].y = cellH * rows;

        //Set the dimentions of the character
        chars[ currentChar ].w = cellW;
        chars[ currentChar ].h = cellH;
```

Then we set the default offsets and dimensions of the current character which are the offsets and dimensions of the cell. Certain ASCII values have no character assigned to them so the default values will never change.

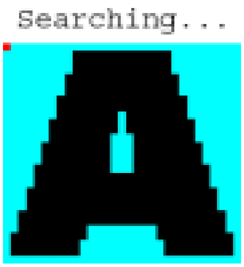
However, most characters will not all have the same x offsets and widths. So we go through the each of the cells to set the unique clip rectangles of each character.

```
        //Go through pixel columns
        for( int pCol = 0; pCol < cellW; pCol++ )
        {
            //Go through pixel rows
            for( int pRow = 0; pRow < cellH; pRow++ )
            {
                //Get the pixel offsets
                int pX = ( cellW * cols ) + pCol;
                int pY = ( cellH * rows ) + pRow;
```

Now we go through the pixels in the cell. We calculate the offset by adding the relative pixel offset to the cell's offset.

```
                //If a non colorkey pixel is found
                if( get_pixel32( pX, pY, bitmap ) != bgColor )
                {
                    //Set the x offset
                    chars[ currentChar ].x = pX;

                    //Break the loops
                    pCol = cellW;
                    pRow = cellH;
                }
            }
        }
```

As we're going through the pixels in the cell, we scan for a pixel that is not of the background color like so:



When a non background pixel is found that means we found the x offset of the character. So we set the x offset of the sprite then crudely break the loop.

```
            //Go through pixel colums
            for( int pCol_w = cellW - 1; pCol_w >= 0; pCol_w-- )
            {
                //Go through pixel rows
                for( int pRow_w = 0; pRow_w < cellH; pRow_w++ )
                {
                    //Get the pixel offsets
                    int pX = ( cellW * cols ) + pCol_w;
                    int pY = ( cellH * rows ) + pRow_w;

                    //If a non colorkey pixel is found
                    if( get_pixel32( pX, pY, bitmap ) != bgColor )
                    {
                        //Set the width
                        chars[ currentChar ].w = ( pX - chars[ currentChar ].x ) + 1;

                        //Break the loops
                        pCol_w = -1;
                        pRow_w = cellH;
                    }
                }
            }

            //Go to the next character
            currentChar++;
        }
    }
}
```

Then we do pretty much the same thing for the width. However this time we start from the right and move backward. When we find a pixel of the character, the width is calculated by subtracting the x offset from the offset of the pixel we found and adding one.

Once we're done setting the current character, we increment the counter to move onto the next character.

Remember, in order for this function to work properly the bitmap font has to have the 256 characters in ASCII order and laid out in 16 columns and 16 rows. Any other way would require you to create your own building function.

You may be wondering why we didn't alter the y offset and the height. The thing is because of newlines, we need to keep that uniform for all the characters.

```
void BitmapFont::show_text( int x, int y, std::string text, SDL_Surface *surface )
{
    //Temp offsets
    int X = x, Y = y;
```

Now here's the function that actually shows the text.

First thing we do is get the given offsets and store them in the temp offsets. The offsets given in the arguments serve as base offsets, the temp offsets are where the next sprite will be blitted.

```
    //If the font has been built
    if( bitmap != NULL )
    {
        //Go through the text
        for( int show = 0; text[ show ] != '\0'; show++ )
        {
```

Then we check if a bitmap was given for us to use. If there is one, we go through the characters in the string.

```
            //If the current character is a space
            if( text[ show ] == ' ' )
            {
                //Move over
                X += bitmap->w / 32;
            }
            //If the current character is a newline
            else if( text[ show ] == '\n' )
            {
                //Move down
                Y += bitmap->h / 16;

                //Move back
                X = x;
            }
```

First thing we do here is check if the current character is a space or a newline.

If the character is a space, we move the temp offset over to the right half of the cell width. You don't have to do it this way but it's how I like to do it.

If the character is a newline the temp offset goes down the cell height, and then moves back to the base x offset.

```
            else
            {
                //Get the ASCII value of the character
                int ascii = (unsigned char)text[ show ];

                //Show the character
                apply_surface( X, Y, bitmap, surface, &chars[ ascii ] );

                //Move over the width of the character with one pixel of padding
                X += chars[ ascii ].w + 1;
            }
        }
    }
}
```

If the current character is not one of our special characters we apply the character's sprite on the screen.

To show the character first we have to get the ASCII value by type casting the character to an integer. Then we apply the sprite onto the screen. This is easily done since the sprites are in ASCII order.

Then the temp offset is moved over the width of the sprite plus one. That way the next sprite will be applied next to the previous sprite with one pixel of padding.

We keep looping through this until all the characters are shown.

```
    //Create our font
    BitmapFont font( bitmapFont );

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

    //Show the text
    font.show_text( 100, 100, "Bitmap Font:\nABDCEFGHIJKLMNOPQRSTUVWXYZ\nabcdefghijklmnopqrstuvwxyz\n0123456789", scre

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

Here's a basic demonstration of our bitmap class that we do in the main() function.

All we do is create a font object, fill screen white, apply some text, and update the screen.

Download the media and source code for this tutorial here.

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