

Using SDL_bgi

Although `SDL_bgi` is almost perfectly compatible with the original BGI library, a few minor differences were introduced to take advantage of modern SDL graphics. You don't want a slow library!

Compiling programs

To compile a C or C++ program on GNU/Linux or macOS you can use the `gcc` or `clang` compiler:

```
$ gcc -o program program.c -lSDL_bgi -lSDL2
```

To compile a program in MSYS2 + mingw-w64:

```
$ gcc -o program.exe program.c -lmingw32 -L/mingw64/bin \
    -lSDL_bgi -lSDL2main -lSDL2 # -mwindows
```

The `-mwindows` switch creates a window-only program, i.e. a terminal is not started. **Beware:** functions provided by `stdio.h` will not work if you don't start a terminal. Your program will have to rely on mouse input only!

Code::Blocks users should read the file `howto_CodeBlocks.md`.

Dev-C++ users should read the file `howto_Dev-Cpp.md`.

Windows users **must** declare the `main()` function as:

```
int main (int argc, char *argv[])
```

even if `argc` and `argv` are not used. Your program will not compile if you use a different `main()` definition (i.e. `int main (void)`), because of conflict with the `WinMain()` definition. It's an SDL2 issue; please consult <https://wiki.libsdl.org/FAQWindows> for details.

Most old programs that use the original BGI library should compile unmodified. For instance,

```
int gd = DETECT, gm;  
initgraph (&gd, &gm, "");
```

opens an 800x600 window, mimicking SVGA graphics. If the environment variable `SDL_BGI_RES` is `VGA`, window resolution will be 640x480.

Minimal `dos.h` and `conio.h` are provided in the `test/` directory; they're good enough to compile the original `bgidemo.c` unmodified, on Unix-like platforms.

Please note that non-BGI functions are *not* implemented. If you need `conio.h` for GNU/Linux, please see the ncurses-based implementation <https://github.com/nowres/conio-for-linux>.

To specify the window size, you can use the new SDL driver:

```
gd = SDL;
gm = <mode>;
```

where <mode> can be one of the following:

CGA	320x200
SDL_320x200	320x200
EGA	640x350
SDL_640x480	640x350
VGA	640x480
SDL_640x480	640x480
SVGA	800x600
SDL_800x600	800x600
SDL_1024x768	1024x768
SDL_1152x900	1152x900
SDL_1280x1024	1280x1024
SDL_1366x768	1366x768
SDL_FULLSCREEN	fullscreen

You may want to use `initwindow(int width, int height)` instead.

`SDL_bgi.h` defines the `_SDL_BGI_H` constant. You can check for its presence and write programs that employ `SDL_bgi` extensions; please have a look at the test program `fern.c`.

Screen Refresh

The only real difference between the original BGI and `SDL_bgi` is the way the screen is refreshed. In BGI, every graphics element drawn on screen was immediately displayed. This was a terribly inefficient way of drawing stuff: the screen should be refreshed only when the drawing is done. For example, in SDL2 this action is performed by `SDL_RenderPresent()`.

You can choose whether to open the graphics system using `initgraph()`, which toggles BGI compatibility on and forces a screen refresh after every graphics command, or using `initwindow()` that leaves you in charge of refreshing the screen when needed, using the new function `refresh()`.

The first method is fully compatible with the original BGI, but it also painfully slow. An experimental feature is ‘auto mode’: if the environment variable `SDL_BGI_RATE` is set to `auto`, screen refresh is automatically performed; this is **much** faster than the default. This variable may also contain a refresh rate; e.g. 60. Unfortunately, auto mode may not work on some NVIDIA graphic cards.

As a tradeoff between performance and speed, a screen refresh is also performed by `getch()`, `kbhit()`, and `delay()`. Functions `sdlbgifast(void)`, `sdlbgislow(void)`, and `sdlbgiauto(void)` are also available. They trigger fast, slow, and auto mode, respectively.

Documentation and sample BGI programs are available at this address:

<http://www.cs.colorado.edu/~main/cs1300/doc/bgi/>

Nearly all programs can be compiled with `SDL_bgi`.

The original Borland Turbo C 2.0 manual is also available at:

https://archive.org/details/bitsavers__borlandturReferenceGuide1988_19310204.

Avoid Slow Programs

This is possibly the slowest `SDL_bgi` code one could write:

```
while (! event ()) {
    putpixel (random(x), random(y), random(col));
    refresh ();
}
```

This code, which plots pixels until an event occurs (mouse click or key press), is extremely inefficient. First of all, calling `event()` is relatively expensive; secondly, refreshing the screen after plotting a single pixel is insane. You should write something like this:

```
counter = 0;
stop = 0;
while (! stop) {
    putpixel (random(x), random(y), random(col));
    if (1000 == ++counter) {
        if (event())
            stop = 1;
        refresh ();
        counter = 0;
    }
}
```

In general, you should use `kbhit()`, `mouseclick()` and `event()` sparingly, because they're slow.

Differences

- The following functions may be called but do nothing:

<code>_graphfreemem</code>	- unneeded
<code>_graphgetmem</code>	- unneeded
<code>installuserdriver</code>	- it makes no sense in SDL
<code>registerbgidriver</code>	- it makes no sense in SDL
<code>registerbgifont</code>	- it makes no sense in <code>SDL_bgi</code>
<code>setgraphbufsize</code>	- unneeded

- `setpalette()` only affects future drawing. That is, you can't get a "rotating palette animation" as in Turbo C.
- `putimage()` bitwise operations (`XOR_PUT`, `OR_PUT` etc.) are applied to RGB colour components. This is apparently not the same behaviour as old Turbo C.
- `setusercharsize()` also works with `DEFAULT_FONT`.

Colours

The default BGI palette includes 16 named colours (`BLACK..WHITE`); standard BGI functions use this palette. The colours don't have the same RGB values as the original BGI colours (the palette is brighter); the original RGB values will be used if the environment variable `SDL_BGI_PALETTE` is set to `BGI`.

An extended ARGB palette of `PALETTE_SIZE` additional colours can be created and accessed using functions described below. Please see the example programs in the `test/` directory.

Fonts

By default, the original proprietary `.CHR` fonts are implemented using free Hershey fonts. Turbo C 2.01 only had the first four, while Turbo C++ added six more fonts:

```
TRIP.CHR (TRIPLEX_FONT)    --> timesrb
LITT.CHR (SMALL_FONT)     --> small
SANS.CHR (SANS_SERIF_FONT) --> futuram
GOTH.CHR (GOTHIC_FONT)    --> gothgbt
SCRI.CHR (SCRIPT_FONT)   --> cursive
SIMP.CHR (SIMPLEX_FONT)   --> futural
TSCR.CHR (TRIPLEX_SCR_FONT) --> rowmant
LCOM.CHR (COMPLEX_FONT)   --> timesr
BOLD.CHR (BOLD_FONT)      --> (timesrb)
EURO.CHR (EUROPEAN_FONT) --> (timesrb)
```

Please note that `EURO` and `BOLD` have no Hershey equivalent; they are replaced by Hershey `timesrb`.

Hershey fonts only support characters in the ASCII range 32-127, as in Turbo C 2.01. Font metrics are the same as the original `.CHR` fonts.

Preliminary `.CHR` font support is available. If a `.CHR` font exists in the same directory as the running program, it will be used instead of its Hershey equivalent. However, font metrics are not pixel-perfect yet.

`.CHR` fonts support was added by Marco Diego Aurélio Mesquita.

Additions

Some functions and macros have been added to add functionality and provide compatibility with other BGI implementations (namely, Xbgi and WinBGI).

Further, the following variables (declared in `SDL_bgi.h`) are accessible to the programmer:

```
SDL_Window   *bgi_window;
SDL_Renderer *bgi_renderer;
SDL_Texture  *bgi_texture;
```

and can be used by native SDL2 functions; see example in `test/sdlbgidemo.c`.

Screen and Windows Functions

- `void initwindow(int width, int height)` lets you open a window specifying its size.
- `void detectgraph(int *gd, int *gm)` returns `SDL`, `SDL_FULLSCREEN`.
- `void setwindowoptions(char *title, int x, int y, Uint32 flags)` lets you specify the window title (default is `SDL_bgi`), window position, and some SDL2 window flags OR'ed together. In particular, you can get non-native fullscreen resolution with:

```
setwindowoptions("", -1, -1, SDL_WINDOW_FULLSCREEN);
initwindow(800, 600);
```

- `void sdlbgifast(void)` triggers “fast mode” even if the graphics system was opened with `initgraph()`. Calling `refresh()` is needed to display graphics.
- `void sdlbgislow(void)` triggers “slow mode” even if the graphics system was opened with `initwindow()`. Calling `refresh()` is not needed.
- `void sdlbgiauto(void)` triggers automatic screen refresh. **Note:** it may not work on some graphics cards.

Multiple Windows Functions

Subsequent calls to `initgraph()` or `initwindow()` make it possible to open several windows; only one of them is active (= being drawn on) at any given time, regardless of mouse focus.

Functions `setvisualpage()` and `setactivepage()` only work properly in single window mode.

- `int getcurrentwindow()` returns the active window identifier.
- `void setcurrentwindow(int id)` sets the current active window. `id` is an integer identifier, as returned by `getcurrentwindow()`.

- `void closewindow(int id)` closes a window of given id.

Colour Functions

- `void setrgbpalette(int color, int r, int g, int b)` sets an additional palette containing RGB colours (up to `MAXRGBCOLORS + 1`). See example in `test/mandelbrot.c`.
- `void setrgbcolor(int col)` and `void setbkrbcolor(int col)` are the RGB equivalent of `setcolor(int col)` and `setbkcolor(int col)`. `col` is an allocated colour entry in the RGB palette.
- `COLOR(int r, int g, int b)` can be used as an argument whenever a colour value is expected (e.g. `setcolor()` and other functions). It's an alternative to `setrgbcolor(int col)` and `setbkrbcolor(int col)`. Allocating colours with `setrgbpalette()` and using `setrgbcolor()` is much faster, though.
- `COLOR32(Uint32 color)` works like `COLOR()`, but accepts a colour argument as an ARGB integer.
- `colorRGB(int r, int g, int b)` can be used to compose a 32 bit colour. This macro is typically used to set values in memory buffers.
- `IS_BGI_COLOR(int c)` and `IS_RGB_COLOR(int c)` return 1 if the current colour is standard BGI or RGB, respectively. The argument is actually redundant.
- `ALPHA_VALUE(int c)`, `RED_VALUE(int c)`, `GREEN_VALUE(int c)`, and `BLUE_VALUE(int c)` return the A, R, G, B component of an RGB colour in the extended palette.
- `setalpha(int col, Uint8 alpha)` sets the alpha component of colour 'col'.
- `setblendmode(int blendmode)` sets the blending mode for screen refresh (`SDL_BLENDMODE_NONE` or `SDL_BLENDMODE_BLEND`).

Buffer Functions

- `getbuffer (Uint32 *buffer)` and `putbuffer (Uint32 *buffer)` copy the current window contents to a buffer, and the reverse. Using `getbuffer()` and `putbuffer()` is faster than direct pixel manipulation, as shown by `test/psychedelia.c`
- `getlinebuffer (int y, Uint32 *linebuffer)` and `putlinebuffer (int y, Uint32 *linebuffer)` work like `getbuffer()` and `putbuffer()`, but on a single line of pixels.

Mouse Functions

- `int mouseclick(void)` returns the code of the mouse button that was clicked, or 0 if none was clicked. Mouse buttons and movement constants are defined in `SDL_bgi.h`:

```
WM_LBUTTONDOWN  
WM_MBUTTONDOWN  
WM_RBUTTONDOWN  
WM_WHEEL  
WM_WHEELUP  
WM_WHEELDOWN  
WM_MOUSEMOVE
```

- `int mousex(void)` and `int mousey(void)` return the mouse coordinates of the last click.
- `int ismouseclick(int btn)` returns 1 if the `btn` mouse button was clicked.
- `void getmouseclick(int kind, int *x, int *y)` sets the `x`, `y` coordinates of the last button click expected by `ismouseclick()`.
- `void getleftclick(void)`, `void getmiddleclick(void)`, and `void getrightclick(void)` wait for the left, middle, and right mouse button to be clicked and released.

Miscellaneous Functions

- `showerrorbox(const char *message)` and `showinfobox(const char *message)` open a window message box with the specified message.
- `void _putpixel(int x, int y)` is equivalent to `putpixel(int x, int y, int col)`, but uses the current drawing colour and the pixel is not refreshed in slow mode.
- `random(range)` is defined as macro: `rand()%range`
- `int getch()` waits for a key and returns its ASCII code. Special keys and the `SDL_QUIT` event are also reported; please see `SDL_bgi.h`.
- `void delay(msec)` waits for `msec` milliseconds.
- `int getevent(void)` waits for a keypress or mouse click, and returns the code of the key or mouse button. It also catches and returns `SDL_QUIT` events.
- `int event(void)` is a non-blocking version of `getevent()`.
- `int eventtype(void)` returns the type of the last event.

- `void readimagefile(char *filename, int x1, int y1, int x2, int y2)` reads a `.bmp` file and displays it immediately (i.e. no refresh needed).
- `void writeimagefile(char *filename, int left, int top, int right, int bottom)` writes a `.bmp` file from the screen rectangle defined by `(left,top-right,bottom)`.
- `void xkbhit(void)` returns 1 when any key is pressed, including Shift, Alt, etc.

The Real Thing

You may want to try the online Borland Turbo C 2.01 emulator at the Internet Archive:

https://archive.org/details/msdos_borland_turbo_c_2.01.

The `bgidemo.c` program demonstrates the capabilities of the BGI library. You can download it and compile it using `SDL_bgi`; in Windows, you will have to change its `main()` definition.

A version of Turbo C++ that is apparently released as Public Domain is available at:

https://archive.org/details/TurboC_201510

Bugs & Issues

In GNU/Linux, there may be visualisation problems on NVIDIA GK208BM (GeForce 920M) with `nvidia-driver-440`. As far as I can say, this is an NVIDIA driver problem.

Console routines such as `getch()` may hang or not work properly in MSYS2. This is a problem in Mingw/MSYS2 console handling.

Probably, this documentation is not 100% accurate. Your feedback is more than welcome.