Having fun with the blitter

author

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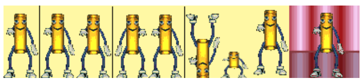

What is it?

If you like messing with graphics the blitter could be your best friend. Back in the early days graphics used to be written to and from a memory location by the processor itself. The PC used a videosync timer to poll the memory and paint the graphics to the screen. You had to code carefully to be sure your drawing was finished before the videosync kicked in.

Blitting hardware was developed to allow large areas of graphics to be copied and pasted in memory without requiring processor cycles. This vastly improved animation and drawing that could be achieved between videosync events.

Graphics have evolved still more and now its all "surfaces" and openGL rendering or DirectX rendering, but you can still have a lot of fun with the blitter.

Display Timing

How fast can we show blitted graphics? Notice I said "show". A moden PC's graphics card renders screen images at 60hz, or a frame every 16.6ms. Now the blitter is much much faster than this but there is little point in blitting for blittings sake if the graphic image is only shown once every 16.6ms.

So its best to use the Liberty BASIC TIMER statement to control a drawing loop to slow things down and not waste time drawing graphics that are never seen.

While the TIMER uses millisecond values you will find that 16.6ms is the smallest value it can discern. Run the code below and see how the TIMER value jumps in 16.6ms increments. This is because Windows updates it's clock at 60hz.

So, don't try and run your TIMER loop faster than 17ms, the TIMER statement won't run any faster.

In actual fact animation will run perfectly well at lower speed. The speed of your processor and graphics card will determine what is achievable but stay in tune with your PC, anything between 50ms and 100ms provide watchable animation.

```
for delay=1 to 60
    timenow=time$("ms")
    timer 1,[done]
    wait

    [done]
    print "Delay should be 1ms Delay is ";timenow-time$("ms")
next delay
```

Blitter Functionality

Blitting swaps one area of graphic for another. The blitter can merge, overwrite or transparently combine the graphics. It can flip, mirror, stretch or shrink the image as it does so. Animation is achieved by moving one image relative to the other.

Blitting is usually associated with animation though it is equally happy stretching, blending, flipping or compressing static images.

Blitter code

You will need to cut and paste these blitter functions to the foot of each of the following code examples. We will run an example then explain what the functions do.

```
'==============================Window and DC functions=================
================
Function GetDC(hWnd)
    CallDLL #user32, "GetDC",_
    hWnd As ulong,_  'window or control handle
    GetDC As ulong   'returns device context
    End Function

Sub ReleaseDC hWnd, hDC
   CallDLL#user32,"ReleaseDC",_
    hWnd As ulong,_  'window or control handle
    hDC As ulong,_   'handle of DC to delete
    result As Long
    End Sub

Function CreateCompatibleDC(hDC)
    CallDLL #gdi32,"CreateCompatibleDC",_
    hDC As ulong,_              'window DC
    CreateCompatibleDC As ulong  'memory DC
    End Function

Sub DeleteDC hDC
    CallDLL #gdi32, "DeleteDC",_
    hDC As ulong,_   'memory DC to delete
    r As long
    End Sub

Sub StretchBlt hDCdest,x,y,w,h,hDCsrc,x2,y2,w2,h2
    CallDLL #gdi32, "SetStretchBltMode",_
        hDCdest As ulong,_       'device context
        _COLORONCOLOR As Long,_ 'color reduction mode
        RESULT As Long
    CallDLL #gdi32, "StretchBlt",_
        hDCdest As ulong,_   'destination
        x As Long,_         'destination x pos
        y As Long,_         'destination y pos
        w As Long,_         'destination width desired
        h As Long,_         'destination height desired
        hDCsrc As ulong,_    'source
        x2 As Long,_        'x location to start from source
        y2 As Long,_        'y location to start from source
        w2 As Long,_        'width desired from source
        h2 As Long,_        'height desired from source
        _SRCCOPY As long,_ 'dwRasterOperation
        RESULT As long
    End Sub

Sub TransparentBlt hDCdest,x,y,w,h,hDCsrc,x2,y2,w2,h2,crTransparent
    calldll #m, "TransparentBlt",_
        hDCdest As uLong,_   'destination
        x As Long,_         'destination x pos
        y As Long,_         'destination y pos
        w As Long,_         'destination width desired
        h As Long,_         'destination height desired
        hDCsrc As uLong,_    'source
        x2 As Long,_        'x location to start from source
        y2 As Long,_        'y location to start from source
        w2 As Long,_        'width desired from source
        h2 As Long,_        'height desired from source
        crTransparent as ulong,_ 'color to make transparent
        result as long
    end sub

Function SelectObject(hDC,hObject)
    CallDLL #gdi32,"SelectObject",_
        hDC As ulong,_        'memory device context
        hObject As long,_    'handle of object
        SelectObject As long 'returns previously selected object
    End Function

Function SetPixel(hDc,x,y,rgbColor)
    CallDll #gdi32, "SetPixel",_
        hDc as Ulong,_
'the handle of the Device context from GetDC
        x as long,_         'the x coordinate to draw the pixel
        y as long,_         'the y coordinate to draw the pixel
        rgbColor as long,_
        SetPixel as long
    End Function


Sub SetBkMode hDC, flag
```

```
    '1=transparent
    '2=opaque
    CallDLL #gdi32, "SetBkMode",hDC As ulong,_
    flag As long, RESULT As long
    End Sub

Sub TextOutA hDc,X,Y,text$
    lengthtext=len(text$)
    calldll #gdi32, "TextOutA", _
    hDc as ulong,_      'device context of window or graphicbox
    X as long,_         'x origin of text
    Y as long,_         'y origin of text
    text$ as ptr,_      'text string to display
    lengthtext as long,_'length of text string
    result as long      'nonzero if successful
    End Sub

sub SetTextColor hDc,crColor
    calldll #gdi32, "SetTextColor", _
    hDc as ulong,_      'device context of window or control
    crColor as long,_   'long integer color value
    result as long      'returns previous text color, if successful
    End Sub
```

How fast is the Blitter?

Lets run some unrestricted code on your machine to see what blitting performance you get. The code will create a copy of your screen, select an image into it and then blit it back to the screen repeatedly. It is important to remember that we are not blitting directly to the screen in front of you but to the memory that defines that screen, lets call it the screen buffer. The blitting will be very fast, run it now.

Fantastic result? unbelievably fast? you bet. On my machine which is a middle of the road laptop I rendered the half megabyte of graphics in 420 milliseconds, that's over 2300 frames per second, wow!

Now of course you didn't see anything. First because it was a black image blitted over a black image but more importantly the screen buffer was rendered to the LCD or Glass display much more slowly at 60 frames per second, very much slower indeed. So even if the image was changing you would only see 38 of those 2300 frames we rendered to memory.

That's great news, it means that if we need to, we can blit in massive amounts of graphics between video display updates.

```
        nomainwin
        WindowWidth  = 600
        WindowHeight = 600
        UpperLeftX   = (DisplayWidth-WindowWidth)/2
        UpperLeftY   = (DisplayHeight-WindowHeight)/2
        graphicbox #1.g, 50,80,500,300
        textbox #1.t, 50,390, 500,25
        open "Blitter" for graphics_nf_nsb as #1
        print #1,   "trapclose [quit]"


' set up our bitmaps, open device contexts and store our bitmaps in th
em

        ' bDC is our screen buffer, (DC handle to the graphicsbox)

        print #1.g, "down; fill black"
        print #1.g, "getbmp bmp 0 0 500 300"
        bDC=GetDC(hwnd(#1.g))

        ' mDC is a copy of the screen in memory

        mDC=CreateCompatibleDC(bDC)
        hBitmap=hbmp("bmp")
        oldBmp=SelectObject(mDC,hBitmap)

        [timeloop]
        now=time$("ms")
        for n= 1 to 1000
        scan
        ' flip the memory image to the screen
        call StretchBlt,bDC,0,0,500,300,mDC,0,0,500,300
        next n
        t=time$("ms")-now
        print #1.t,
"Rendered 439Mb of graphics in ";t;" Milliseconds, ";int(1000/t*
1000);" FPS"
        wait

        [quit]
        unloadbmp "bmp"
        call ReleaseDC hwnd(#1), gDC
        call DeleteDC mDC
        close #1
        end
```

Device Contexts

The blitter is made available to us via API calls from Liberty BASIC. Obviously before we can blit anything we need somewhere to blit from and somewhere to blit to. Typically we would blit to the screen buffer. So how do we access this buffer?

We need to find it's address and would use an API call to do so.

```
gDC=GetDC(hwnd(#1.g))

Function GetDC(hWnd)
    CallDLL #user32, "GetDC",_
        hWnd As ulong,_  'window or control handle
        GetDC As ulong   'returns device context
    End Function
```

This obtains a ulong number which is the pointer to the Device Context (DC) that Windows created for our graphicbox. So the screen buffer is in fact the DC that Windows has created behind the scenes.

Now we create a copy of that DC.

```
mDC=CreateCompatibleDC(gDC)

Function CreateCompatibleDC(hDC)
    CallDLL #gdi32,"CreateCompatibleDC",_
        hDC As ulong,_              'window DC
        CreateCompatibleDC As ulong  'memory DC
    End Function
```

Then we fill it with some graphics by getting a handle to our "bmp" image and selecting it into the new DC.

```
hBitmap=hbmp("bmp")
oldBmp=SelectObject(mDC,hBitmap)

Function SelectObject(hDC,hObject)
    CallDLL #gdi32,"SelectObject",_
        hDC As ulong,_       'memory device context
        hObject As long,_    'handle of object
        SelectObject As long 'returns previously selected object
    End Function
```

And that's all we need to start blitting! DCs are amorphous things, if you select in a large bmp you can have lots of graphics in one location to blit from.

Once you have finished with a DC you must release and delete it.

```
call ReleaseDC hwnd(#1), gDC
call DeleteDC mDC

Sub ReleaseDC hWnd, hDC
    CallDLL#user32,"ReleaseDC",_
        hWnd As ulong,_  'window or control handle
        hDC As ulong,_   'handle of DC to delete
        result As Long
    End Sub

Sub DeleteDC hDC
    CallDLL #gdi32, "DeleteDC",_
    hDC As ulong,_   'memory DC to delete
    r As Long
    End Sub
```

That's a whistle stop tour of DCs, check the following link for help on API and DCs under the GDI banner.

http://lbpe.wikispaces.com/GDI

Basic Blitting

Lets draw ourselves some graphics to blit from. We use the left 225 pixels of the screen to draw some stars and then replicate that in the next 225 pixels giving us a 450 pixel image that will scroll without an obvious end. Confused? Don't worry the tutorial is about blitting not game graphics (That might be next).

Then I draw a little circle in the remaining 50 pixels. Use the debugger to step through and see what's happening. Now when I start blitting I take the first 225 pixels from the memory DC and blit them to the buffer DC but stretch them width ways up to 500 pixels. In this way you cut out little parts of the memory DC and fill the buffer DC. Next iteration I move the source 5 pixels to the right in the graphics DC and so repetitively move the star background to the left.

Then I cut out the little circle and blit it a couple of times same size into the buffer. Net result a scrolling background with two sprites moving about. Well they would be sprites if I had used TransparentBlt, notice that the circle backgrounds overwrite when they cross over. If I had used TransparentBlt you would just see the white circles.

```
        nomainwin
        WindowWidth  = 600
        WindowHeight = 600
        UpperLeftX   = (DisplayWidth-WindowWidth)/2
        UpperLeftY   = (DisplayHeight-WindowHeight)/2
        graphicbox #1.g, 50,80,500,300
        textbox #1.t, 50,390, 500,25
        open "Blitter" for graphics_nf_nsb as #1
        print #1,   "trapclose [quit]"


' set up our bitmaps, open device contexts and store our bitmaps in th
em

        ' bDC is our screen buffer, (DC handle to the graphicsbox)

        print #1.g, "down; fill black ; color white"
        for x = 1 to 50
        print #1.g, "place ";int(rnd(0)*250);" ";int(rnd(0)*300)
        print #1.g, "size ";int(rnd(0)*4)
        print #1.g, "circle ";int(rnd(0)*3)
        next x
        print #1.g, "getbmp bmp 0 0 225 300"
        print #1.g, "drawbmp bmp 225 0"
        print #1.g, "place 475 40 ; size 1 ;circle 20"
        unloadbmp "bmp"
        print #1.g, "getbmp bmp 0 0 500 300"
        bDC=GetDC(hwnd(#1.g))

        ' mDC is a copy of the screen in memory

        mDC=CreateCompatibleDC(bDC)
        hBitmap=hbmp("bmp")
        oldBmp=SelectObject(mDC,hBitmap)

        ' set up a repeating loop to draw our graphics
        x=-1
        y=-1
        timer 17, [timedloop]
        wait

        ' draw from the memory to the buffer
```

```
[timedloop]
x=x+1
if x=225 then x=0
y=y+1
if y=300 then y=0
call StretchBlt,bDC,0,0,500,300,mDC,x,0,225,300
call StretchBlt,bDC,250,y,40,40,mDC,455,20,40,40
call StretchBlt,bDC,250,300-y,40,40,mDC,455,20,40,40
wait

[quit]
unloadbmp "bmp"
call ReleaseDC hwnd(#1), gDC
call DeleteDC mDC
close #1
end
```

So there are several call you can make BitBlt, StretchBlt PrlBlt and TransparentBlt each has it's own strength some can flip and mirror some can't, one can do it transparently, basically pick your blitter call by the functionality you wish.

Double Buffering

Double buffering is something you will eventually come to. When you render large or complex images or start to render text you will find that the image starts to flicker. The solution is to double buffer. Very simply we draw all the complex graphics to an intermediate DC and then on a regular basis blit its contents to the screen buffer DC and leave it alone. This ensures there is a stable copy of what we want displayed and provides rock solid graphics.

The flicker is rooted in how Windows updates it's screen, the videosync is not made available to us as many windows may wish redrawn or updated. So the screen refresh happens randomly as far as we are concerned. Right in the middle of drawing a line or rendering some text. But because we can blit a single screen image so quickly with the blitter it rarely, if ever, is half drawn when the refresh occurs.

One of the other great things about blitting is that you do not use up graphics memory, each DC consumes a finite amount of memory but after that you are just blitting between them and no other graphics memory is consumed.

```
nomainwin
WindowWidth  = 600
WindowHeight = 600
UpperLeftX   = (DisplayWidth-WindowWidth)/2
```

```
        UpperLeftY   = (DisplayHeight-WindowHeight)/2
        graphicbox #1.g, 50,80,500,300
        textbox #1.t, 50,390, 500,25
        open "Blitter" for graphics_nf_nsb as #1
        print #1,   "trapclose [quit]"


' set up our bitmaps, open device contexts and store our bitmaps in th
em

        print #1.g, "down; fill black ; color white"
        for x = 1 to 50
        print #1.g, "place ";int(rnd(0)*250);" ";int(rnd(0)*300)
        print #1.g, "size ";int(rnd(0)*4)
        print #1.g, "circle ";int(rnd(0)*3)
        next x
        print #1.g, "getbmp bmp 0 0 225 300"
        print #1.g, "drawbmp bmp 225 0"
        print #1.g, "place 475 40 ; size 1 ;circle 20"
        unloadbmp "bmp"
        print #1.g, "getbmp bmp 0 0 500 300"
        print #1.g, "getbmp bkg 0 0 500 300"

        ' bDC is our screen buffer, (DC handle to the graphicsbox)

        bDC=GetDC(hwnd(#1.g))

        ' mDC is a copy of the screen in memory (double buffer)

        mDC=CreateCompatibleDC(bDC)
        hBitmap=hbmp("bmp")
        oldBmp=SelectObject(mDC,hBitmap)



' gDC is a copy of the screen in memory to store reusable graphics in
        ' our graphics pallete if you like.

        gDC=CreateCompatibleDC(bDC)

        ' we copy the screen but fill it with graphics of our choice
        ' and low and behold this amorphous data object assumes the
        ' size of the bmp we select into it

        hBitmap=hbmp("bkg")
        oldBmp=SelectObject(gDC,hBitmap)
        ' set up a repeating loop to draw our graphics
        x=-1
        y=-1
        timer 17, [timedloop]
        wait

        [timedloop]
        scan
        ' first thng we do now is draw from the memory to the buffer
        call StretchBlt,bDC,0,0,500,300,mDC,0,0,500,300

        ' now draw from the graphics resource to the memory

        x=x+1
        if x=225 then x=0
        y=y+1
        if y=300 then y=0
        call StretchBlt,mDC,0,0,500,300,gDC,x,0,225,300
        call StretchBlt,mDC,250,y,40,40,gDC,455,20,40,40
        call StretchBlt,mDC,250,300-y,40,40,gDC,455,20,40,40
        wait

        [quit]
        unloadbmp "bmp"
        call ReleaseDC hwnd(#1), gDC
        call DeleteDC mDC
        close #1
        end
```

Adding Text

We use another API call to render text to our DC. This action in itself triggers the need for the double buffer. Here we create the same moving background but ignore the circle sprite and instead render two sets of text. The text API calls firstly set the text background color to be transparent. Then they set the text color and render the text.

```
    nomainwin
    'open a window and graphicbox
    WindowWidth = 500
    WindowHeight = 300
    graphicbox #1.g, 0, 0, 500, 300
    open "Blitting" for graphics_nf_nsb as #1
    print #1,   "trapclose [quit]"

    ' set up our device contexts (DCs, copys of the screen) and
    ' store our various bitmaps in them
    ' once we know the "handles" of our DC's we can operate
    ' on them.

    print #1.g, "down; fill black ; color white"
    for x = 1 to 50
        print #1.g, "place ";int(rnd(0)*250);" ";int(rnd(0)*300)
        print #1.g, "size ";int(rnd(0)*4)
        print #1.g, "circle ";int(rnd(0)*3)
    next x
    print #1.g, "getbmp bmp 0 0 225 300"
    print #1.g, "drawbmp bmp 225 0"
    print #1.g, "place 475 40 ; size 1 ;circle 20"
    unloadbmp "bmp"
    print #1.g, "getbmp bmp 0 0 500 300"
    print #1.g, "getbmp bkg 0 0 500 300"

    ' bDC is our screen buffer

    bDC=GetDC(hwnd(#1.g))


' mDC is a copy of the screen buffer in memory used as a double buffer
    ' to collate our drawing operations prior to displaying.

    mDC=CreateCompatibleDC(bDC)

    ' once you have the DC you can fill it with graphics

    hBitmap=hbmp("bmp")
    oldBmp=SelectObject(mDC,hBitmap)


' as this is the main drawing screen we set transparent text drawing
    ' on. Any Text drawing will have a transparent background.

    call SetBkMode,mDC,1



' gDC is a copy of the screen in memory to store reusable graphics in
    ' our graphics pallete if you like.
    gDC=CreateCompatibleDC(bDC)

    ' we copy the screen but fill it with the bkg graphics

    hBitmap=hbmp("bkg")
    oldBmp=SelectObject(gDC,hBitmap)

    ' variables
    x=-1
    t1=100
    t2=150
    y=15

    ' start timed drawing loop
    timer 17, [draw]
    wait

    [draw]

    ' check for mouse or keyboard events
    scan


' blit the double buffer to the buffer so that it is visible and stabl
e for as long as possible

' StretchBlt takes data from the resource DC gDC and stretches it to f
ill the target DC, mDC.

' There is also TransparentBlt if you wish to draw transparent data. Y
ou can flip, mirror

' and squish the graphics if you choose the correct Blit operation.

    call StretchBlt,bDC,0,0,500,300,mDC,0,0,500,300

    ' now start to redraw everything on the buffer

    ' first slip the background xy a little to the left
    x=x+1
    if x=225 then x=0

    ' now draw the backgrond from gDC stretching it to fill mDC

' the source, gDC can be flipped, reversed as it is drawn if you choos
```

```
e negative
    ' values.
    call StretchBlt,mDC,0,0,500,300,gDC,x,0,225,300

    ' slip the text1 xy to the left
    t1=t1+1
    if t1>500 then t1=-100

    ' set the txt color and draw it
    call SetTextColor,mDC,(255*256*256)+(0*256)+(0)'blue
    text$ = "Text string to display."
    call TextOutA,mDC,t1,150,text$

    ' slip the text2 xy up
    y=y-1
    if y<-20 then y=320

    ' set thesecond  txt color and draw it
    call SetTextColor,mDC,(0*256*256)+(255*256)+(0)'green
    text$ = "Yet more text."
    call TextOutA,mDC,t2,y,text$
    wait


    [quit]
    timer 0
    call ReleaseDC hwnd(#1.g), bDC
    call ReleaseDC hwnd(#1.g), mDC
    call ReleaseDC hwnd(#1.g), gDC
    call DeleteDC bDC
    call DeleteDC mDC
    call DeleteDC gDC
    unloadbmp "bkg"
    unloadbmp "bmp"
    close #1
    end
```

Seasick?

Ok scrolling stars and text gets a bit boring. Do you get seasick? Check out this rolling ocean. Use the mouse or arrow keys to turn and speed up or slow down. It kinda gives the impression of being on a rolling ocean swell. The ocean.bmp has four strips for the horizon which I blit into the top of the picture depending on what the heading is. Then I blit four copies of the sea section. I roll these up and down using a sine curve and I also roll them forward to create more movement. The further away section rolls least and they double up their movement the nearer the bottom of the screen they are.

Its just like having multiple backgrounds in the sprite engine. There is lots of time to draw sprites on top of this moving background. Doing so creates a pretty cool game environment.

Copy this bmp to your own PC

```
nomainwin
timervalue=42
true=1
false=0
heading=0
turn=0
speed=0
```

```
        midx=400
        midy=300
        posx=40
        posy=40


' now open our window as a full screen popup window and set its event
labels

        WindowWidth  = 800
        WindowHeight = 600
        UpperLeftX   = (DisplayWidth-WindowWidth)/2
        UpperLeftY   = (DisplayHeight-WindowHeight)/2
        graphicbox #1.g, 0,0,800,600
        open "Ocean" for window_popup as #1
        print #1,   "trapclose [quit]"
        print #1.g, "when mouseMove [movemouse]"


        ' open the dll file used for TransparentBlt

        open "msimg32.dll" for dll as #m


' set up our bitmaps, open device contexts and store our bitmaps in th
em
        print #1.g, "down ; fill black"
        print #1.g, "getbmp bmp 0 0 800 600"
        loadbmp "ocean","ocean.bmp"

        ' bDC is our screen buffer, (DC handle to the graphicsbox)

        bDC=GetDC(hwnd(#1.g))

        ' mDC is a copy of the screen in memory (double buffer)

        mDC=CreateCompatibleDC(bDC)
        hBitmap=hbmp("bmp")
        oldBmp=SelectObject(mDC,hBitmap)



' gDC is a copy of the screen in memory to store reusable graphics in
        ' our graphics pallete if you like.

        gDC=CreateCompatibleDC(bDC)
        ' we copy the screen but fill it with graphics of our choice
        ' and low and behold this amorphous data object assumes the
        ' size of the bmp we select into it

        hBitmap=hbmp("ocean")
        oldBmp=SelectObject(gDC,hBitmap)

        ' start the game timer

        timer timervalue , [drawloop]
        wait

        ' the main drawing loop

        [drawloop]

        ' read keyboard and mouse events

        scan


' flip the mDC to the bDC so that it is visible and stable for as long
 as possible

        call StretchBlt,bDC,0,0,800,600,mDC,0,0,800,600

        ' now start to redraw everything to mDC from gDC


        ' draw the horizon
        heading=heading+turn
        if heading<0 then heading=heading+3200
        if heading>3199 then heading=heading-3200
        horizonX=heading-(int(heading/800))*800
        horizonY=int(heading/800)*100
        horizonZ=horizonY+100
        if horizonZ=400 then horizonZ=0
        call StretchBlt,mDC,0,0,800-horizonX,200,gDC,horizonX,
horizonY,800-horizonX,100
        call StretchBlt,mDC,800-horizonX,0,horizonX,200,gDC,0,
horizonZ,horizonX,100

        ' draw the sea
        wave1=int(sin(roll/57.29577951)*(40-speed))
        wave2=int(wave1/2)
        wave3=int(wave1/4)
        wave4=int(wave1/8)
        roll=roll+8+speed
        if roll>=360 then roll=0

        sea1=sea1-(speed/2)
        sea2=sea2-(speed/4)
        sea3=sea3-(speed/8)
        sea4=sea4-(speed/16)
        if sea1<400 then sea1=500
        if sea2<400 then sea2=500
        if sea3<400 then sea3=500
        if sea4<400 then sea4=500

        turn4=turn4+(turn/2)
        turn3=turn3+(turn/4)
        turn2=turn2+(turn/8)
        turn1=turn1+(turn/16)
        if turn4<0 then turn4=turn4+800
        if turn4>799 then turn4=turn4-800
        if turn3<0 then turn3=turn3+800
        if turn3>799 then turn3=turn3-800
        if turn2<0 then turn2=turn2+800
        if turn2>799 then turn2=turn2-800
        if turn1<0 then turn1=turn1+800
        if turn1>799 then turn1=turn1-800

        call StretchBlt,mDC,0,200,800-int(turn4),100,gDC,int(
turn4),int(sea4),800-int(turn4),100
        call StretchBlt,mDC,800-int(turn4),200,int(turn4),100,gDC,0,
int(sea4),int(turn4),100
        call StretchBlt,mDC,0,280+wave3,800-int(turn3),120,gDC,int(
turn3),int(sea3),800-int(turn3),100
        call StretchBlt,mDC,800-int(turn3),280+wave3,int(turn3),120,
gDC,0,int(sea3),int(turn3),100
        call StretchBlt,mDC,0,380+wave2,800-int(turn2),150,gDC,int(
turn2),int(sea2),800-int(turn2),100
        call StretchBlt,mDC,800-int(turn2),380+wave2,int(turn2),150,
gDC,0,int(sea2),int(turn2),100
        call StretchBlt,mDC,0,480+wave1,800-int(turn1),150,gDC,int(
turn1),int(sea1),800-int(turn1),100
        call StretchBlt,mDC,800-int(turn1),480+wave1,int(turn1),150,
gDC,0,int(sea1),int(turn1),100


        ' read the keyboard
        'escape/quit
        CallDLL #user32, "GetAsyncKeyState",_VK_ESCAPE AS long,k1 AS
long
        if k1<0  then [quit]

        'left
        CallDLL #user32, "GetAsyncKeyState",_VK_LEFT AS long,k1 AS
long
        if k1<0  then [left]

        'right
        CallDLL #user32, "GetAsyncKeyState",_VK_RIGHT AS long,k1 AS
long
        if k1<0  then [right]

        'up
        CallDLL #user32, "GetAsyncKeyState",_VK_UP AS long,k1 AS long
        if k1<0  then [accelerate]

        'down
        CallDLL #user32, "GetAsyncKeyState",_VK_DOWN AS long,k1 AS
long
        if k1<0  then [brake]
        wait

        [movemouse]
        if MouseX<oldx then [left]
        if MouseX>oldx then [right]
        if MouseY<oldy then [accelerate]
        if MouseY>oldy then [brake]
        wait

        [left]
        select case turn
            case -4
                turn=-8
            case -2
                turn=-4
            case -1
                turn=-2
            case 0
                turn=-1
            case 1
                turn=0
            case 2
                turn=1
```

```
    case 4
        turn=2
    case 8
        turn=4
end select
oldx=MouseX
wait

[right]
 select case turn
    case -8
        turn=-4
    case -4
        turn=-2
    case -2
        turn=-1
    case -1
        turn=0
    case 0
        turn=1
    case 1
        turn=2
    case 2
        turn=4
    case 4
        turn=8
end select
oldx=MouseX
wait

[accelerate]
speed=min(32,speed+1)
oldy=MouseY
wait

[brake]
speed=max(1,speed-1)
oldy=MouseY
wait


[quit]
unloadbmp "ocean"
unloadbmp "bmp"
call ReleaseDC hwnd(#1), bDC
call DeleteDC mDC
```

```
        call DeleteDC gDC
        close #1
        close #m
        end
```

Where Now?

Actually the only barrier is your imagination.

Happy coding

rodbird@hotmail.com

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