Stars 3-D#

I was looking for something to do with my shiny new Action! cartridge when I ran across the article Stars 3-D by Craig Patchett in ANALOG No. 16. To become familiar with the new language, I decided to translate this demonstration program into Action!, a job I thought would take one or two hours. The task eventually took much longer, due to a number of strange quirks associated with the Action! language. I hope this discussion of my problems will save other Action! programmers some hair pulling and nail chewing.

My first task was to find a place for the display list (DLIST) and screen memory (STRLIN). I wanted to put them in a safe location, while allowing easy access from Action!-generated code and in-line machine code. I finally decided to put them in Action! arrays whose starting addresses were defined such that the display list and screen memory started on 1K boundaries in high memory. (The Atari cannot easily deal with a display list which crosses a 1K boundary or screen memory which crosses a 4K boundary.)

Calculations to generate the display list required that the address of screen memory be divided by 256 to obtain the high byte of the address. Performing this division on addresses greater than 32767, unfortunately, gives the wrong answer, since Action! multiplications and divisions always assume they are acting on signed numbers. Try typing:

```
X PRINTCE(32768/256)
```

in the Action! monitor and see what you get. After figuring out the problem, I replaced the division by 256 with "RSH 8" (shift cardinal number right 8 bits). The use of this technique can be seen by examining the procedures STRINI() and DLSINI().

The next problem was to insert the addresses of the arrays STRTPH, STRTPL, and STRPOS into the machine language procedure SCROLL(). My initial attempt to do this involved inserting the address during the compilation phase. Using this method, the first instruction in the procedure SCROLL() would be:

```
$B0 STRTPL; LDA STRTPL,X
```

To my horror, the addresses of arrays compiled into the code by this technique frequently (but not always) differed from those observed after compilation. Apparently, the addresses of arrays change during the compile phase, and the compiler cannot modify addresses inserted into machine code. The solution was to "POKEC" the addresses into the machine language routines during run time [see the procedure MAIN90].

I believe everything else in the listing is understandable, because I kept the names of all routines and most of the comments the same as those in the original assembly language listing. A word of warning: this program is designed to work with a machine having 48K of memory. If your machine has less memory, you will have to change the starting address of the arrays DLIST and STRLIN. The place to do this is clearly marked in the listing.

Before finishing, I should mention another couple of Action! peculiarities.
1. Negative FOR loops do not work. Try:

FOR COUNTER=5 TO 0 STEP -1

in a sample test procedure. It won't work. 2. You cannot initialize a variable to a negative number.

TEMP1=[-1]

will not work. However

temp1=[[65535]

will accomplish the same thing. 3. The example on page 123 of the manual doesn't work (at least with Version 3.5 of Action!). PRINTCE(rec. idnum) prints the wrong answer. For some reason, PRINTCE(rec. idnum*1) gives the right answer. I suspect Action! will never be used to write commercial arcade-style games, because it is just not as efficient at "bit-twiddling" as machine code (try writing the procedure scroll() in Action!). It also does not produce code as compact as that produced by a good assembly language hacker, a definite consideration when trying to stuff a game in an 8K or 16K ROM cartridge. Nevertheless, I feel that the language (perhaps with the help of a few machine language routines) can be used to write games similar in quality to the machine language games found in ANALOG in a much shorter time than usually required. Games written in Action! would also be easier for novices to analyze and understand.

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**Action! Listing**

; ***********************
; *   STARS 3D DEMO   *
; * BY CRAIG PATCHETT *
; * ACTION! VERSION   *
; * BY DON GLOVER    *
; ***********************

; system equates
CARD sdmctl=$022F,
  nmien=$D40E,
  random=$D20A,
  wsync=$D40A,
  sdlstl=$0230,
  vdslst=$0200,
  colpf0=$d016,
  color4=$02C8,
  xitvbl=$E462

BYTE index ;used to index into strcol
CARD indrct=$D6 ;pointer for indirect addressing
BYTE ARRAY timer=[8 8 6 6 5 5 3 3 2 2 1 1], ; timers for scrolling
timary=[8 8 6 6 5 5 3 3 2 2 1 1], ;values to reset timers
mancol=[[22 $24 $26 $28 $2A $2C $2E $22], ; star colors
  ***careful-requires a 40k machine to work
dlist(600)=35840, ;display list
strlin(768)=36864, ;star(screen) memory
  ;**************************************************
  strtpl(16), ;addresses of beginning of
  strtph(16), ;each star line
  strpos(16), ;position of star on line
  strcol(192) ;color of each line
CARD ARRAY strtp(16) ;temp. hold addresses to be
  ;transferred into strtpl,strtph
PROC setvbv=$E45C(BYTE command,vblankhigh,vblanklow)
  ;**************************************************
PROC SCROLL(BYTE dummy,starindex) ; star scroll routine
; ACTION! is too much trouble to use here with all the bit twiddling
[
$BD$FFFF ; LDA STRTPL,X
$85$ INDRCT ; STA INDRCT
$BD$FFFF ; LDA STRTPH,X
$85$ INDRCT+1 ; STA INDRCT+1
$BC$FFFF ; LDY STRPOS,X
$B1$ INDRCT ; LDA (INDRCT),Y
$0A$ ; ASL
$0A$ ; ASL
$91$ INDRCT ; STA (INDRCT),Y
$90$ $0F$ ; BCC SCRBR1
$A9$ $01$ ; LDA #1
$88$ ; DEY
$C0$ $FF$ ; CPY =255
$D0$ $02$ ; BNE SCRBR2
$A0$ $2F$ ; LDY #47
; SCRBR2
$91$ INDRCT ; STA (INDRCT),Y
$98$ ; TYA
$9D$ $FFFF$ ; STA STRPOS,X
; SCRBR1
]
RETURN

; ************************************
PROC cntdwn() ; timer routine
    BYTE starcounter
    scroll(0,13) scroll(0,13) ; move fastest star
    scroll(0,12) scroll(0,12) ; and its twin
    ; now do rest of stars
    FOR starcounter=0 to 11
        DO
            timer(starcounter)==-1
            IF timer(starcounter)==0 THEN
                scroll(0,starcounter) ; scroll if ready
                timer(starcounter)=timary(starcounter) ; reset timer
            FI
        OD
    RETURN

; ************************************
PROC vblank() ; vblank routine
    cntdwn()
    index=0 ; back to scan line zero
    [$4C xitvbl ; jmp xitvbv
    ]
RETURN ; never gets here

; ************************************
PROC strini() ; initialize stars
    BYTE counter
    ; set up screen memory address tables
    ; first use dummy array for simplicity
    FOR counter=0 to 15 DO
        strtp(counter)=strlin+48*counter
        strpos(counter)=0 ;all stars start at pos. zero
    OD
    ; now transfer addresses to byte arrays
    FOR counter=0 to 16 DO
        strtpl(counter)=strtp(counter)&255
; cannot divide numbers>32767 and get correct results
strtp(counter)=strtp(counter) RSH 8
OD
; clear star memory
ZERO(strlin,768)
; give each line a star
FOR counter=0 to 15 DO
  strlin(48*counter)=64
OD
RETURN
; **************************************************
PROC dlisi() ; initialize display list
BYTE startype,offset,counter
CARD TEMP
; do for each scan line
dlist(0)=$70 dlist(1)=$70 dlist(2)=$F0
FOR counter=0 to 191
  DO
    dlist(3*(counter+1))=$CE ; graphics 7+
    ; now pick star type
    startype=RAND(8)
    ; set color for each line
    strcol(counter)=mancol(startype)
    ; randomize offset into memory
    offset=RAND(48) ;offset into line
    ; now put address of line into display list
    dlist(3*(counter+1)+1)=(strtp(2*startype)+offset)&255
    ; cannot divide numbers>32767 and get correct results
    dlist(3*(counter+1)+2)=(strtp(2*startype)+offset) RSH 8
  OD
; now finish up display list
dlist(579)=$41 ; jump instruction
dlist(580)=dlist&255
dlist(581)=dlist RSH 8
sdlstl=dlist ;tell antic where display list is
sdmctl=$23 ;wide screen
RETURN
; **************************************************
PROC dli() ; display list interrupt routine
; too little time to even think about using ACTION!
[ $AE INDEX ; LDX INDEX
  $BD $FFFF ; LDA STRCOL,X
  $8D WSYNC ; STA WSYNC
  $8D COLPF0 ; STA COLPF0
  $EE INDEX ; INC INDEX
  $40 ; RTI
]
RETURN
; **************************************************
PROC MAIN()
; fix up ml routines
; by poking in addresses of various arrays
POKEC(dli+4,strcol)
POKEC(scroll+7,strtph)
POKEC(scroll+12,strtp)
POKEC(scroll+17,strpos)
POKEC(scroll+40,strpos)
POKEC(DLI+1,@index)
strini() ; set up stars
dlsini() ; set up display list
color4=0 ; set background color
SETVBV(7,vblank/256,vblank&255) ; set up vblank
vdslst=dl1 nmienn=192 ; get dli's going
; now just let things run
DO
OD
RETURN

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