Programming In Forth on the Vectrex – Phillip Eaton 2018

Define Goals

- Get Forth running on Vectrex with interactive terminal
- No Vectrex hardware modification allowed (can't swap out the BIOS)
- Must provide Forth API to the BIOS
- Must be comparatively fast compared with assembler and C, not a toy
- Must be accessible to potential new developers

What is a Vectrex?

https://youtu.be/k8GiErP6Nfc

Circuit board

- CPU: Motorola 68A09 @ 1.5 MHz
- RAM: 1 KB (two 4-bit 2114 chips)
- ROM: 8 KB (one 8-bit 2363 chip)
- Cartridge ROM: 32 KB
- MOS 6522 Versatile Interface Adapter (VIA)

Sound

- Sound: General Instrument AY-3-8912
- 3-inch electrodynamic paper cone speaker

Design

European release Vectrex playing the built-in game Minestorm, without overlay

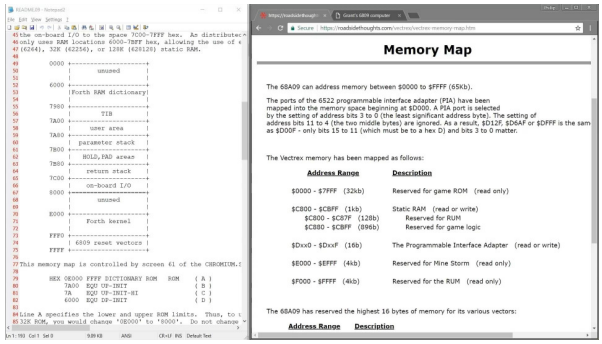
Step 1

- Configure CamelForth For Vectrex and cross compile
- No DOSBox – convert cross compiler from F83 to.... Gforth
- No block source files, need to tweak parser – took a lot of thinking about!

My Background

- Spent 90s programming Z80 SBCs with MPE Forth for SCADA applications
- Collected a lot of classic video arcade games: Space Invaders, Asteroids, Defender
- Spent 2000's in London and Zurich on financial systems
- 2 years ago, acquired a dead Vectrex and fixed it

Setting up camel forth memory map



What can I do with it?

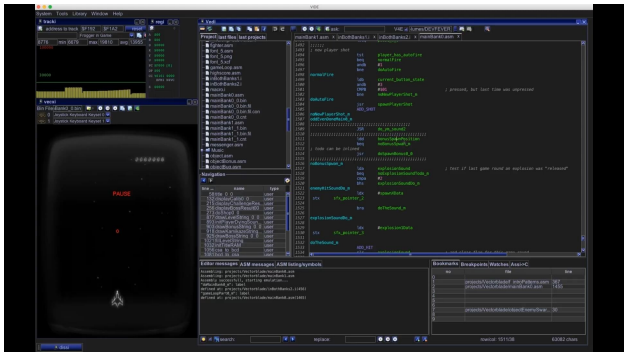
- Vibrant home brew community, some amazing programs, hardware hacking
- Memory map and cartridge port simple and open
- I could put CamelForth onto the bare metal 😀
- Challenges: no serial port, don't know 6809 assembler, don't know Vectrex BIOS, don't know low-level Forth

Step 2

- Debug in VIDE emulator
  - Create label file for debugger
  - Use Starting Forth to learn how code is compiled
  - Will it clash with BIOS?
  - Hack COLD to write to display via BIOS

https://youtu.be/t4IwoWBXPhA

Vectrex IDE



Other little videos

• City Bomber – the basics of a game
https://youtu.be/wbV4a56reNA

• Interactive test to discover what BIOS Wait_Recal function does
https://youtu.be/yWUVZyadA0w

Step 3

- No serial port. Time to get hands dirty now…enter VecFever
- Rewrote EMIT, KEY?, KEY for soft UART
- Unhack COLD
- Try it out…

https://youtu.be/FhHfR9zPqqq

```
285  : BZ \ -- ;
286  \  2 RND +! \ New seed for Random
287    INIT
288    0 BOMBY C!
289    BEGIN
290      0 9F \ FF
291      DO \ y axis
292        FF 0
293        DO \ x axis
294          CR ." Stk:" .S  ."  T2-Hi:" D009 C@ U.
295          _Wait_Recal _Intensity_5F
296          -7F -7F _Moveto_d_7F
297          7F 20 CITYVL _Draw_VL_ab
298          \
299          _ResetORef
300          I 80 - FF AND J 80 - FF AND _Moveto_d_7F
301          20 4 PLANE _Draw_VL_ab
302          \
303          BOMBY C@ 0 =
```

Game main loop – not optimized or factored!

Forth interface to Vectrex BIOS – no optimization!

```
154  CODE _Intensity_7F \ -- ;
155       8 # ( DP) PSHU,           \ -- ; Save DP
156       DO # LDX,    X DPR TFR,    \ -- ; DP to DO
157       6 # ( D) PSHS,    Intensity_7F JSR,    6 # ( D) PULS,
158       8 # ( DP) PULU,           \ -- ; Restore DP
159      NEXT ;C
160
161  CODE _Print_Str_d \ x y c-addr -- ; Print single string to screen
162      8 # ( DP) PSHU,           \ -- x y c-addr ; Save DP
163      DO # LDX,    X DPR TFR,    \ -- x y c-addr ; DP to DO
164      D U EXG,                   \ -- x y U-addr ; String addr to U, save U to D
165      S 2 , LDX,    S 2 , STD,    \                ; Stack -ROT (2 lines)
166      S 0, LDD,    S 0, STX,     \ -- U-addr x y ;
167      A B EXG,    S ,++ ADDD,    \ -- U-addr yx  ; Combine x and y
168      Print_Str_d JSR,           \ Call Vectrex BIOS subroutine
169      6 # ( D) PULS,             \ -- U-addr     ; Drop TOS
170      D U TFR,    6 # ( D) PULS, \ -- ; Restore U, drop TOS
171      8 # ( DP) PULU,            \ -- ; Restore DP
172      NEXT ;C
```