12 Things You Didn’t Know You Could Do With MAME

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What is MAME?

• Never heard of it? See http://mamedev.org

• MAME = Multiple Arcade Machine Emulator

• Emulates most arcade hardware in software
  – Simulates the CPUs, sound chips, and video h/w
  – Uses original ROMs and discs
  – Developer-focused (not super user friendly)

• Really two projects in one:
  – Reverse engineering arcade hardware
  – Designing a software architecture for emulation
What Can You Do With MAME?

- Most people tend to think of MAME as a means of running games
- Developers think in terms of using it as a tool to reverse engineer games

BUT...

- There’s more to MAME than you might think
- Plus, some people are really creative!
Look at the Source Code

(Yes, even if you’re not a programmer!)

http://mamedev.org/source/mame/drivers

Key things to look for:

• Comments (in bright red at the link above)
• ADDRESS_MAP (describe memory layouts)
• ROM_LOAD (describes ROMs needed)
Look at the Source Code

```c
/* Galaxian-derived hardware
   Galaxian is the root hardware for many, many systems developed in the
   1980-1982 timeframe. The basic design, which originated with Namco(?),
   was replicated, tweaked, bootlegged, and used numerous times.

   The basic hardware design comprises three sections on a single PCB:
   a CPU section, a sound section, and a video section.

   The CPU section is based around a Z80 (though there are modified
designed that changed this to an S2650). The base galaxian hardware
is designed to allow access to up to 16k of program ROM and 2k of
working RAM.

   The sound section consists of three parts. The first part is
   a programmable 8-bit down counter that clocks a 4-bit counter which
generates a primitive waveform whose shape is hardcoded but can be
controlled by a pair of variable resistors. The second part is
a set of three 555 timers which can be individually enabled and
combined to produce square waves at fixed separated pitches. A
fourth 555 timer is configured via a 4-bit frequency parameter to
control the overall pitch of the other three. Finally, two single
bit-triggered noise circuits are available. A 17-bit noise LFSR
(which also generates stars for the video circuit) feeds into both
circuits. A "HIT" line enables a simple on/off control of one
filtered output, while a "FIRE" line triggers a fixed short duration
pulse (controlled by another 555 timer) of modulated noise.
*/
```
Look at the Source Code

    /* map derived from schematics */
    static ADDRESS_MAP_START( galaxian_map, ADDRESS_SPACE_PROGRAM, 8 )
        ADDRESS_MAP_UNMAP_HIGH
        AM_RANGE(0x0000, 0x3fff) AM_ROM
        AM_RANGE(0x4000, 0x43ff) AM_MIRROR(0x0400) AM_RAM
        AM_RANGE(0x5000, 0x53ff) AM_MIRROR(0x0400) AM_RAM_WRITE(galaxian_videoram_w) |
        AM_RANGE(0x5800, 0x58ff) AM_MIRROR(0x0700) AM_RAM_WRITE(galaxian_objram_w) AM_  
        AM_RANGE(0x6000, 0x6000) AM_MIRROR(0x07ff) AM_READ_PORT("INO")  
        AM_RANGE(0x6000, 0x6001) AM_MIRROR(0x07f8) AM_WRITE(start_lamp_w)     
        AM_RANGE(0x6002, 0x6002) AM_MIRROR(0x07f8) AM_WRITE(coin_lock_w)      
        AM_RANGE(0x6003, 0x6003) AM_MIRROR(0x07f8) AM_WRITE(coin_count_0_w)   
        AM_RANGE(0x6004, 0x6007) AM_MIRROR(0x07f8) AM_WRITE(galaxian_lfo_freq_w)  
        AM_RANGE(0x6800, 0x6800) AM_MIRROR(0x07ff) AM_READ_PORT("IN1")  
        AM_RANGE(0x6800, 0x6807) AM_MIRROR(0x07f8) AM_WRITE(galaxian_sound_w)  
        AM_RANGE(0x7000, 0x7000) AM_MIRROR(0x07ff) AM_READ_PORT("IN2")      
        AM_RANGE(0x7001, 0x7001) AM_MIRROR(0x07f8) AM_WRITE(irq_enable_w)    
        AM_RANGE(0x7004, 0x7004) AM_MIRROR(0x07f8) AM_WRITE(galaxian_stars_enable_w)  
        AM_RANGE(0x7006, 0x7006) AM_MIRROR(0x07f8) AM_WRITE(galaxian_flip_screen_x_w)  
        AM_RANGE(0x7007, 0x7007) AM_MIRROR(0x07f8) AM_WRITE(galaxian_flip_screen_y_w)  
        AM_RANGE(0x7800, 0x7800) AM_MIRROR(0x07ff) AM_WRITE(galaxian_pitch_w)  
        AM_RANGE(0x7800, 0x7800) AM_MIRROR(0x07ff) AM_READ(watchdog_reset_r)  
    ADDRESS_MAP_END
Look at the Source Code

ROM_START( galaxian )

ROM_REGION( 0x4000, "maincpu", 0 )

ROM_LOAD( "galmidw.u", 0x0000, 0x0800, CRC(745e2d61) SHA1(e6)

ROM_LOAD( "galmidw.v", 0x0800, 0x0800, CRC(9c999a40) SHA1(02)

ROM_LOAD( "galmidw.w", 0x1000, 0x0800, CRC(b5894925) SHA1(00)

ROM_LOAD( "galmidw.y", 0x1800, 0x0800, CRC(6b3ca10b) SHA1(18)

ROM_LOAD( "71", 0x2000, 0x0800, CRC(1b933207) SHA1(8b)

ROM_REGION( 0x1000, "gfx1", ROMREGION_DISPOSE )

ROM_LOAD( "1h.bin", 0x0000, 0x0800, CRC(39fb43a4) SHA1(47)

ROM_LOAD( "1k.bin", 0x0800, 0x0800, CRC(7e3f56a2) SHA1(a9)

ROM_REGION( 0x0020, "proms", 0 )

ROM_LOAD( "61.bpr", 0x0000, 0x0020, CRC(c3ac9467) SHA1(f3)

ROM_END
Identify Your PCBs

(Yes, without dumping the whole thing!)

MAME’s –romident option is your friend:

• Simply dump 1 or more ROMs
• More than 1? Place them in a directory or ZIP file
• From the command line run:
  mame -romident <file|directory|zipfile>
• This will compare your ROMs against every ROM known to MAME (and that’s a lot these days)
Identify Your PCBs

```shell
>mame -romident epr6844.ic123
  epr6844.ic123 = epr-6844.ic123
  epr6844.ic123 = epr-6844.ic123
  epr6844.ic123 = epr-6844.ic123
  epr6844.ic123 = epr-6844.ic123
  epr6844.ic123 = epr-6844.ic123
  epr6844.ic123 = (BAD) 6844.rom

Enduro Racer (YM2151, FD1089B 317-0013A)
Enduro Racer (YM2203, FD1089B 317-0013A)
Enduro Racer (bootleg set 2)
Enduro Racer (bootleg set 1)
Hang-On (Rev A)
Space Harrier (Rev A, 8751 315-5163A)
Space Harrier (8751 315-5163)
Super Hang-On (Hang-On upgrade, bootleg)

>mame -romident epr7629.ic84
  epr7629.ic84 = epr-7629.ic84

Enduro Racer (YM2203, FD1089B 317-0013A)

>mame -romident ameridart1.zip
  rom.u23 = u23.bin
  rom.u57 = u57.bin
  rom.u58 = u58.bin
  rom.u1 = u1.bin

AmeriDarts (set 2)
AmeriDarts (set 2)
AmeriDarts (set 2)
AmeriDarts (set 2)
```
Identify Your PCBs

romcmp (included with MAME) also helpful:

romcmp <directory|zipfile> [<dir2|zipfile2>]

```
>romcmp bking3
readme.txt
23 files
3rd-a24-01.e7
3rd-a24-01.e8
3rd-dm-04.c2
3rd-a24-01.e7

>romcmp crgolfhi

crgolfhi.txt
23 files
prom.s1
Copy of sub.r1a
sub.r1

>romcmp empcity
18 files
2t.bin

>-
```
Backup & Repair Your Hard Disks

(Yes, you can recover your arcade hard disks!)

MAME’s CHD format designed for hard disks
• chdman utility is included with MAME
• Easy to find USB-to-IDE adapters
• To create a hard disk image in Windows (CHD):
  chdman -createhd \\.\physicaldriveX filename.chd
• To put a CHD back onto a hard disk:
  chdman -extract filename.chd \\.\physicaldriveX
• Move to solid state (CF) via an IDE adapter
Backup & Repair Your Hard Disks

>diskpart
Microsoft DiskPart version 6.1.7266
Copyright (C) 1999-2008 Microsoft Corporation.
On computer: AARON-LAPTOP

DISKPART> list disk

<table>
<thead>
<tr>
<th>Disk</th>
<th>Status</th>
<th>Size</th>
<th>Free</th>
<th>Dyn</th>
<th>Gpt</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Online</td>
<td>111 GB</td>
<td>0 B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Online</td>
<td>976 MB</td>
<td>0 B</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

DISKPART> exit
Leaving DiskPart...

>chdman -createhd \physicaldrive1 test.chd
chdman - MAME Compressed Hunks of Data (CHD) manager 0.132u3 (Jul 9 2009)
Input file: \physicaldrive1
Output file: test.chd
Input offset: 511
Cylinders: 124
Heads: 255
Sectors: 63
Bytes/sector: 512
Sectors/hunk: 8
Logical size: 1,019,934,720
Compression complete ... final ratio = 97%

>chdman -extract test.chd \physicaldrive1
Cheat!

(Yes, you can beat the game with brute force!)

http://cheat.retrogames.com/

The MAME Cheat Engine:
• Need to be explicitly enabled (via –cheat option)
• Was recently rewritten and modernized
  – Now supports cheats in XML format
  – Now better integrated with the debugger
• Has a large group of people finding new cheats
Cheat
Cheat
Fix Bugs in Old Games

(Yes, because they’re just not hard enough!)

http://donhodges.com/

Using only MAME’s built-in debugger, reverse engineering, and logic, Don has fixed:

• Kill screens in Donkey Kong, Dig-Dug, and more
• Pac-Man split screen (level 256)
• Galaga playable demo

Even created cheats for some of them....
Fix Bugs in Old Games

- Infinite Lives: Off
- Invincibility: Off
- Enable Speed Hack: Off
- Finish this Level Now!: Set
- Select Starting Level: Off
- Select Level (for Practice): Off
- Select Ghost Changeback Speed: Off

---

Ghost Status Cheats

- Red always blue: Off
- Pink always blue: Off
- Green always blue: Off
- Orange always blue: Off
- Ghosts Always Edible (No Pts): Off

---

Fix Split Screen Bug: Off

Reset All
Return to Prior Menu
Record and Play Back Your Game

(Yes, you can show off your moves!)
http://replay.marpirc.net

MAME supports built in input recording
• To record from the command line:
  mame <game> -record <filename>.inp
• And to play it back:
  mame -playback <filename>.inp

Key to remember:
• Emulation must not have changed timings or input
• Format changed a little while back (built-in compression)
• Not sufficient for Twin Galaxies
Record and Play Back Your Game

(But wait, there’s more!)

MAME also supports recording in several formats

• To record an AVI/MNG/WAV:
  
mame <game> -aviwrite <filename>.avi
mame <game> -mngwrite <filename>.mng
mame <game> -wavwrite <filename>.wav

• To take an in-game snapshot press F12 (configurable)

You can control the size of snapshots and movies via the –snapsize and –snapview options.
• By default, it is the native screen size
Record and Play Back Your Game

(But wait, there’s more!)

Keys to remember about making movies:
• AVIs are uncompressed, huge, and slow to create
  – You will need to post-process them for compression
  – Tip: record to an INP, then make AVI from playback
• MNGs are compressed, a bit less huge, but no sound
• If your game changes resolutions, specify a snapsize
Ditch Your Front-End

(Yes, slightly more user-friendly!)

• In the old days, MAME would just error if you double-clicked it or specified no game to run
• Today, you actually get a mini front-end
  – Picks random list by default
  – As you type, recomputes list of best matches
  – When you quit, you can select a new game
Ditch Your Front-End
Ditch Your Front-End
Create a Database

(Yes, MAME is a database of arcade history!)

http://maws.mameworld.info/maws

Internally MAME has standard information about:

• ROMs and other media
• CPUs, sound chips, and clock speeds
• Controls, inputs, and DIP switches
• Video displays
• Game manufacturers and years

All accessible via the –listxml option
Drive Real Arcade Hardware

(Yes, you can make it real!)

http://www.byoac.com

MAME can be made to work in a real cabinet:
• Not an official goal of the project, however!
• Can wire up real arcade controls
• Can connect real arcade monitors
• Can put it all in a real wood box
• Several companies produce the necessary adapters
• But don’t abuse this – remember this is just for fun!
Incorporate Game Art

(Yes, the artwork was part of the allure!)

http://mrdo.mameworld.info/mame_artwork.html

MAME supports bezels, overlays, and backdrops

• All are optional, and individually selectable
• High-quality scaling to your screen resolution
• Community-wide effort to get nice, high resolution scans (see above link)
• All artwork is stored losslessly
• No cabinet or marquee art yet (3D models anyone?)
Incorporate Game Art
Incorporate Game Art
Turn Your LCD into a CRT

(Yes, you can sort of simulate old school!)

MAME’s artwork system supports overlays
• Small repeated patterns overlaid on screen areas
• Relies on high-res LCD versus low-res game
• Lowers the overall brightness a bit
• Several good ones included with MAME

Try this at home:

mame <game> -effect aperture1x2rb  (for low res displays)
mame <game> -effect aperture2x4rb  (for high res displays)
Turn Your LCD into a CRT
Turn Your LCD into a CRT
Turn Your LCD into a CRT
Play Free Games

(Yes, I know we said that wasn’t the goal…)

http://mamedev.org/roms

Some companies have done the right thing!

• Many early Exidy ROMs available
• Several developers who own the rights have given us permission to redistribute their games
• Gaelco released World Rally for free
The 12 Things You Now Know

1. Look at the source
2. Identify your PCBs
3. Repair your hard disks
4. Cheat!
5. Fix original bugs
6. Record & play back
7. Ditch your front-end
8. Create a database
9. Drive real hardware
10. Incorporate game art
11. Simulate an old CRT
12. Play free games
Some Additional Things You Can Do

• Run MAME on almost any platform (SDLMAME)
• Fast-forward through the boring parts (Ins key)
• Use nicer fonts in the MAME UI
  – http://mrdo.mameworld.info/mame_artwork_supp.html
• Choose your own crosshairs for gun games
  – Same site
• Save/restore in some games (automatically)