2D graphics

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This is a live document, and is full of gaps, mistakes, typos etc.

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2d graphics. sprites. palattes

4.2 Picture Processing Unit (PPU)

4.2.1 Introduction

Dedicated hardware. Each clock output pixel.

4.3 Audio Processing Unit (APU)

4.3.1 Introduction

Dedicated hardware.

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Chapter 11

SORT 2025

11.1 Introduction

11.1.1 Introduction

have thing on various graphics there. cga, ega, vga, svga. are hardware oututs

page on flash. flasharch program to run flash files?

xdg-open (opens in desktop environment. eg run ”xdg-open file.jpg” to open in default image viewer) fonts in 2d TrueType fonts (ttf) OpenType font (otf)

linux: imagemagick

2d: alpha compositing (transparency stuff)

on graphics, page for each of prominant ppu + nes + gb/gbc + gba + snes + genesis + master system/gg + arcade: CPS Super Chip

GNU texinfo

GNU roff (groff) mobi epub

page on replacing login shell (they don’t use one? do different approach?)

graphics/audio firmware?

gnu plotutils (graphics)

Mathematical Markup Language (mathml)

gimp

11.1.2 2D

scalable vector graphics (SVG)

Computer engineering frame buffer

decompilation of stuff with images: + can open as images to find uncompresed images

big page on graphics + framebuffer

+ bitmap on 2d + vector based on 2d + image compression h3 * jpeg

+ colours * rgb model 1. #ffffff (6) 2. #fff(3) * indexed color * eg option of 7 colors and 8th for transparency. 7 colours defined in palette * allows sprites to take up less space, be easier to process, to integrate transparency

tile maps for eg nes backgrounds separate to sprites can enable scrolling in 1 direction at least? can say mirror/flip bigger than screen. can update tile map by changing when offscreen

animated tilemaps? relation between rom and ram for tilset? uncompress when bring out tiles?

2d graphics: masks. bitmaps.

11.1.3 2d hardware on consoles

on eg snes/genesis, multiple tilemaps? transparency?

11.1.4 dos (CGA, EGA, VGA)

CGA (color graphics adapter) EGA (enhanced grahics adapter) VGA (video graphics array)

11.1.5 nes

nes graphics: + tiles of 8x8. + two layers. background. sprites + 4 colour limit on tiles

11.1.6 snes

snes: + tiles of 8x8 or 16x16 + up to 4 background layer + smoother scrolling of background layers + modes 0-6 for different setups of scrolling layer, bits per pixel in layers + between 2 and 8 bits per pixel for colours (between 4 colours and 256)

11.1.7 markup and latex

latex: new line for each sentence allows picked up by diff etc easier

h3 markup language + html * pug + markdown + epub + org mode + pdf + css + latex + PostScript + djvu

Utf8 ASCII etc. More complex on post c?

11.1.8 2d physics

2d physics. + colission detection. hurtbox/hitboxs

11.1.9 desktop and window environments

+ wayland?

in graphical deskptop environment, something on polkit? allows authentication outside the non graphical terminal? or is this just an arch thing.

pages on desktop environments: + KDE + GNOME + Xfce + LXDE + Cinnamon

xorg + /usr/share/X11/xorg.conf.d/ + /etc/X11/xorg.conf.d/ + /etc/X11/xorg.conf OR /etc/xorg.conf + can generate conf template using Xorg :0 -configure

tiling window managers gtk qt

11.1.10 video and ffmpeg

+ video codec * encorder page, then page on container? * h.263 * mpeg 2 1. h.262/mpeg-2 part 2 * mpeg 4 * mpeg-4 part 2 * advanced video coding * h.264 or mpeg-4 part 10 * mpeg-h * high efficiency video coding (hevc) * h.265 * vp8 (open) * vp9 (open) * av1 (open) * concept of profiles * concept of levels * average bitrate * two-pass * 1 pass * constant quality * constrained quality * constant quality * lossess

video compression. containers. formats. bitrates. audio formats etc

11.1.11 Audio Introduction

soundcard in title? sound card audio: digital signal processing

pipewire on linux. audio server? alt to pulseaudio?

11.1.12 audio

music editing with audacity?

advanced linux sound architecture (ALSA) + alsamixer

sound card: + amixer sset Master unmute + amixer sset Speaker unmute + amxier sset Headphone unmute speaker-test -c 2 speaker-test -c 8 (for 7.1)

pulse audio + provides interfaces for interacting with alsa + pulseaudio-alsa package to manage alsa using pulseaudio

the ”audio” group

audio + cmus + pulseaudio + mpd (music player daemon)

11.1.13 3D Introduction

11.1.14 basic wireframe, including model space, world space and camera space

local space (aka ?) model space + has vertices and meshes of model world space + position, rotation and scaling of models + affine transformation from model space camera space aka view space + camera has location, view angle, origin of camera is now from camera at camera angle + then project, every vertex has matrix multiplication, field of view

heightmaps for 3d terrain

vertex: 3d point triangle: 3 vertices normal: 3d vector per vertex in triangle describing surface orientation

11.1.15 clipping space, wireframe culling and depth buffers, and perspective divide

Frustom culling . Hide things too far left right up down far back Occulision culling ..hide.things hidden by other things

perspective divide - results in image space, aka normalised device coordinates (ndc)

culling and normals and clipping and depth buffer (inc z sorting)

11.1.16 texture mapping

Perspective correction Texture map involves changing each pixel from raw texture. Proper operation is non linear, different from each pixel, Eg part of texture further away have points closer to each other But this expensive. Can do contact vales to each pixel but this causes texture warping Perspective correct texture mapping Can divide polygons to subdivision levels to reduce warping

mip mapping image scaled to be 1/2 ength. can then be used as texture at further distances without shimmering effects

pixel to texture ratio calculated. if one way do mip mapping, if other magnification

trilinear filtering is extension of mip mapping? interpolation betweeen mipmap levels

textures should be powers of 2 to support mip mapping

after done the trnasformations, want to figure out what pixels are what rasterisation/scanline interpolation go row by row see if pixel ”in” triangle

AS filtering bilinear filtering linear filtering trilinear filtering

How to draw nearest thing for given pixel? Depth buffer. Depth buffer is distance to object for every pixel. Can loop over every object and draw. Ie loop over every pixel. Only draw if depth less than depth buffer, store depth in depth buffer if is closest so can save for future comparisons How to get z buffer in advance? + Render at lower resolution with lower poly count objects. Hierarchical z buffer + Can then use z buffer to drop objects before rendering anything

3d rendering. Can use fixed bins to determine draw order. Is what PS1 did. Is faster but less accurate

11.1.17 lighting

h3 on lighting (with just value per vertex applied across?)

3d bump mapping Stencil shadow

alpha textures. height map for material

concept of baked lighting?

something called ”the rendering equation” for lighting? Bidirectional Reflectance Distribution Function

lighting types: + ambient lighting + diffuse lighting + specular lighting + above 3 combine to make ”phong reflection”. attentuation also plays role

phong lighting is per fragment lighting. gourand shading is per vertex. flat shading is also a thing

bump mapping height map (black and white) normal map spec map material maps channel map channel packing (use alpha channel for other stuff)

ray tracing?

specularity

11.1.18 animation and key frames

11.1.19 post processing

anti aliasing and types

11.1.20 scaling and rotating sprites inc mode 7 and super scalar

11.1.21 sort

3dfx voodoo nvidia 256 opengl glcore vulkan sdl glide direct3d direct 3d directx 789

nvtop. monitors gpu stuff

k-d trees after binary space partitioning on 3d.

texel

skybox

pseudo 3d: super scaler; mode 7; wolf/doom/duke

gpu drivers, what for? just have single threaded here?

rasterisation is 3d thing . convert eg vector of line to pixel

rasterisation Vs raytracing Vs earlier (wolfen/doom):