

# Compressing loads of content into only 20mb

*A case study through Swords & Soldiers for WiiWare™*

Joost van Dongen



# What's to come

- Introduction
- Texture compression
- Text compression
- Audio
- Executable size
- Sprite animation
- Level format



# Introduction



# Who am I?

- Joost van Dongen
- Ronimo Games
- Lead programmer / co-founder



# What is Ronimo?

- Independent game developer
- Utrecht, Netherlands
- De Blob (PC), Swords & Soldiers (WiiWare)



# Why compression?



# Download size

- Size often irrelevant for console games: DVD / Blu-ray
- Fast internet
- Large hard-discs (including 360 / PS3)



# Not so on Wii™!

- Small internal Wii system memory
- Low max size per WiiWare game
- Wii busy during download





# Stop buying?

- Gamers reluctant to remove games from Wii system memory
- Some stop buying when disc full
- 20mb target for Swords & Soldiers



# SD card update

- But...
- SD card as extra harddisc
- Works nicely
- Update released just before Swords & Soldiers
- Hardly any reason to not do some more MBs
- Still ain't much!



# Mobile platforms

- Size also important for mobile platforms
  - iPhone
  - PSN on Playstation Portable



# Swords & Soldiers

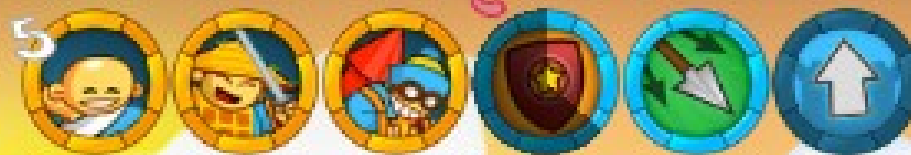


# Swords & Soldiers

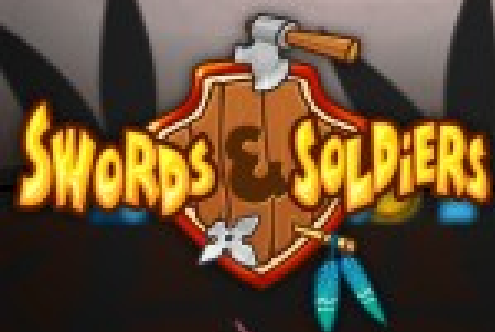
- WiiWare
- Side-scrolling real-time strategy
- Lots of features and assets *for a WiiWare game*



# Swords & Soldiers



4462  
4022



# Swords & Sizes

- Total size: 17.4mb
- Executable: 2.6mb
- Textures: 8.2mb
- Music: 2.6mb
- Sound: 1.8mb
- Text files (XML, dialogue): 0.5mb
- *Becomes 21.2mb with shared files*



# Total team

- 1 programmer + 1 intern
- 4 artists + 1 intern
- 2 designers + 1 intern
- 11 months





# Coding team

- 1 programmer + 1 intern
- 11 months
- Only quickly implementable techniques



# Wii || !Wii

- Most techniques not Wii-specific
- Some extra work might be needed elsewhere



# Texture palettes



# Textures

- 2D game
- Lots of animations
- Textures are about half the download



# Textures

- 587 textures
- 141mb without compression
- Went to 8.2mb with no visible loss

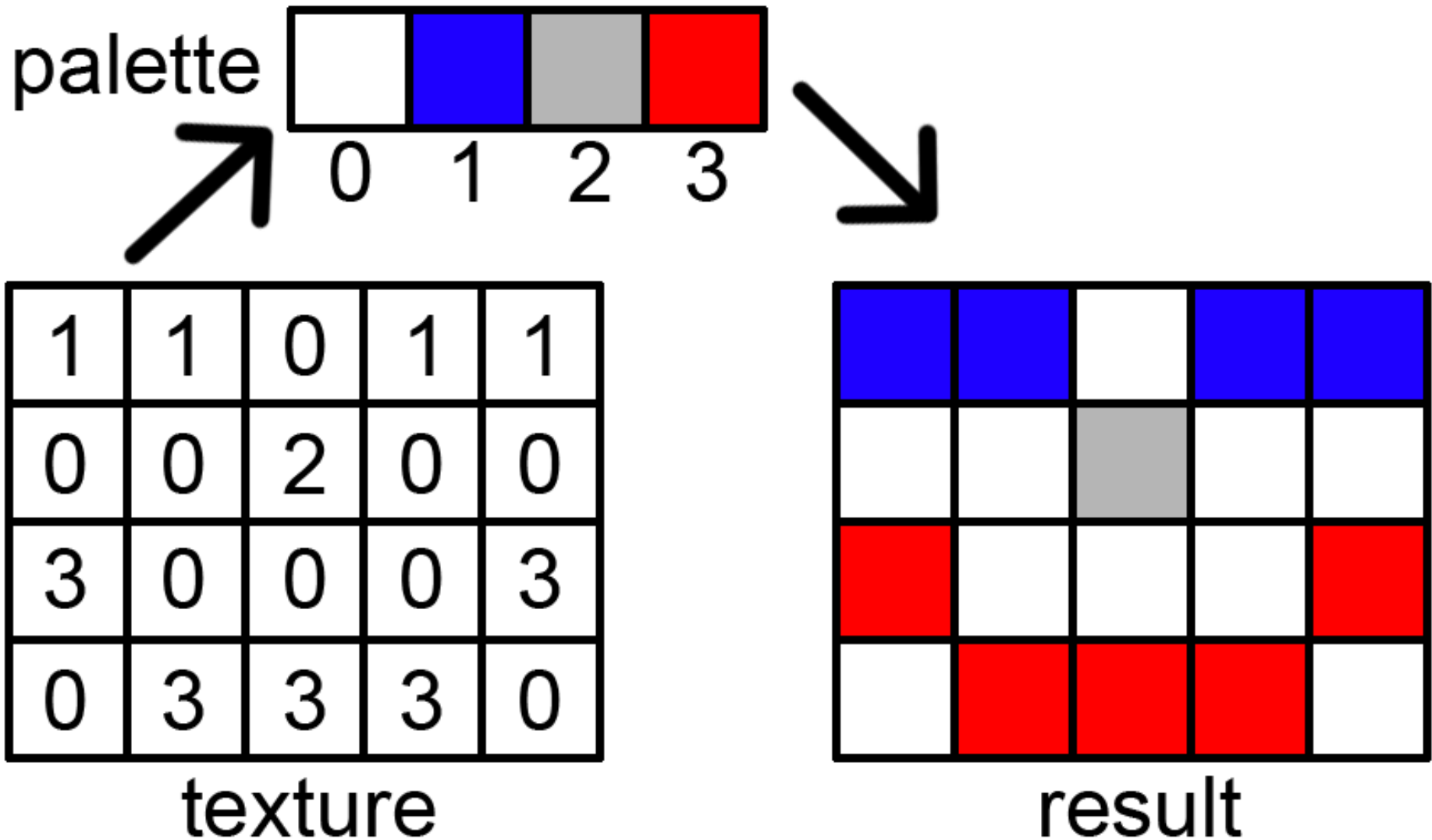


# Palette textures

- Store colour palette
- Only indices in texture
- Max 256 colours per texture
- Each colour is 16 bit



# Palette textures



# Cartoony style

- Large colour areas
- Perfect for palette textures







# Not for everything

- Coloured gradients problematic
- Fix banding when it occurs
- Swords & Soldiers:
  - 400 palette textures (8 bit)
  - 100 greyscale textures (4 bit)
  - 100 uncompressed textures (16-32 bit)



# Realistic styles

- Palette not always good option
- Causes banding
- Can probably still be used in many textures



# Results

- Uncompressed textures: 141mb
- Hardware formats: 36.8mb
- For both download and in memory



# DXT



uncompressed  
32 bit



palette  
8 bit



DXT1  
4 bit



DXT5  
8 bit

# Wii

- Individual palette per texture (re-use optional)
- 16 or 256 colours
- Colours can have alpha
- Full shading, only palette in storage
- Supported in hardware
- Nice!



# OpenGL palettes

- Same palette for everything
- Only 256 colours overall
- Shading impossible
- Useless



# Shaders

- Can emulate palette in pixel shader
- Read greyscale index from texture
- Use greyscale to look-up colour in 1D texture
- Filtering problematic without hardware support





# Shader performance

- Slower than direct texture read
- Lots of cache misses in palette?
- Or not: palette is very small
- Reduces cache misses in texture itself
- Not actually tested...
- ...but seems quite feasible



# Texture compression



# Texture size

- 36.8mb: still too much for WiiWare
- Need to drop further



# lz77

- Compression algorithm
- Uses dictionary
- Store recurring pieces once and reference them



# Runlength

- Replace repeating value
- Set how often the value occurs
- Example: 1111111 becomes 71



# Texture compression

- Hardware formats: 36.8mb
- Runlength: 13.8mb
- lz77: 8.19mb
- lz77: 5 seconds to decompress on Wii



# Why so strong?

- 78% compression
- Palettes!
- Few values repeated often
- Both lz77 and runtime love that!



# I want strong?

- Does this work for more realistic styles?
- Not easily: too many colours and noise





# I like strong!

- Reduce colour variation
- Often not noticeable!
- Also works without explicit palettes
- Can then do arbitrary colour count



Might work in things like this  
(Gears of War)



# Text compression



# Text compression

- XML common these days
- Often binary to save space





# Swords & Soldiers

- 221 text files
- Mostly XML
- No compression: 3.65mb
- LZ77: 0.30mb



# Slow?

- Often heard:
- “XML too slow to parse on load”
- “Should save memory image instead”
- So people say



# “Mwa”

- S&S skirmish AI
- One 227kb XML
- Decompressed with lx77
- Parsed with TinyXML
- Takes Wii less than 1 second
- Okay by me



Audio





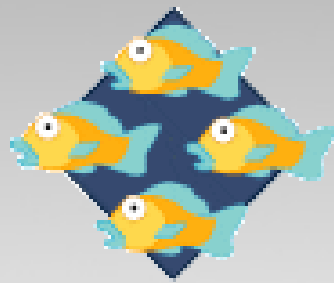
# Ogg/Vorbis

- Open source audio format
- Free to use
- BSD-like license
- Okay for closed source commercial software
- *Consult platformholder about this!*



# Ogg versus MP3

- S&S: 10 minutes of stereo music



vorbis.com

*mp3*

# Ogg versus MP3

- S&S: 10 minutes of stereo music

MP3	128kbps	9.0mb
MP3	64kbps	4.4mb
Ogg	45kbps	2.6mb



# Ogg versus MP3

- S&S: 10 minutes of stereo music

MP3	128kbps	9.0mb	sounds good
MP3	64kbps	4.4mb	sounds terrible
Ogg	45kbps	2.6mb	sounds nearly like MP3 128kbps



# Swords & Soldiers

- All audio in S&S on 45kbps Ogg
- Music, voices and audio effects



# Good enough

- Is quality good enough?
- Reviews very positive about audio in S&S
- Reviews never mention “bad audio quality”
- Apparently good enough



# Executable



# Executable

- Why would you want to compress that?!





# Executable

- Wii executable: 3.40mb
- Quite relevant on a whole of 21mb



# Executable

- S&S Windows exe: 1.15mb
- Wii executable: 3.40mb



# Executable

- S&S Windows exe: 1.15mb
- Wii executable: 3.40mb
- Cause: Wii executable contains its own OS



# Executable

- WiiWare loads compressed executables
- Uncompressed: 3.40mb
- Compressed: 2.64mb
- Nice little bonus



# Logging size

- Certain function calls grow very big
- Size without logging: 3.40mb
- Size with logging: 4.13mb
- Difference: 119 calls to template function



# Logging size

- Certain function calls grow very big
- Size without logging: 3.40mb
- Size with logging: 4.13mb
- Difference: 119 calls to template function
- *Odd: only from 1.15 to 1.17mb on Windows*



# Template function

```
template <typename T1, typename T2>
void Logger::log(const T1& part1, const T2& part2)
{
    std::stringstream output;
    output << part1 << "    " << part2;
    get()->logString(output.str());
}
```



# Instruction size

- “Wii development tips”
- Presentation on warioworld.com
- Some more tips
- Authorized Wii developers only



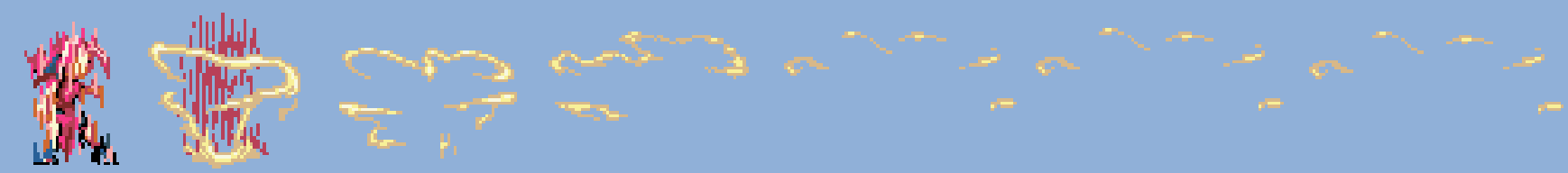
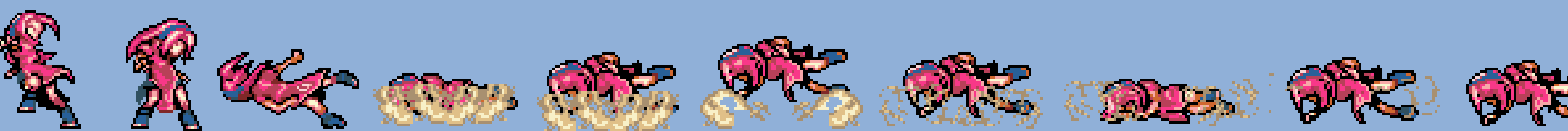
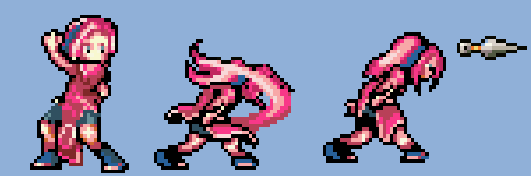


# Sprite animation





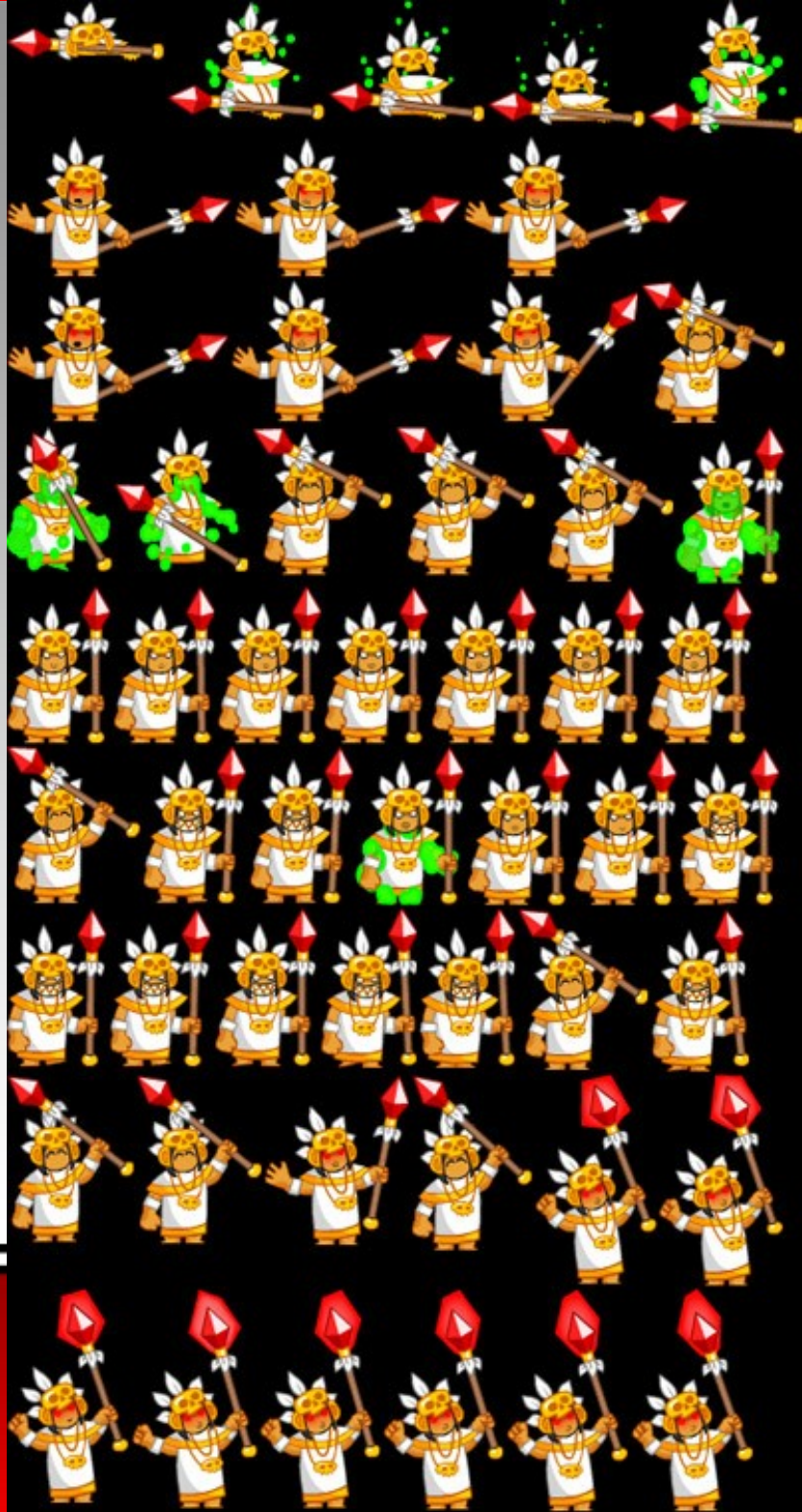
Spacing is problematic



# Simple solution

- Store center and size of each frame
- Use space optimally
- Ignore ordering





RONIMO





Building too big to store texture for each state





# Re-used animation system for buildings



# Building as animation

- Each layer in Photoshop is an animation frame
- Wrote custom exporter for this
- Frames are layered in-game
- Saved texture space on buildings this way



# Level design





# Small team

- No time to create a custom editor
- Ended up doing level design in Notepad
- I don't understand: why don't artists like Notepad?
- *(Not compression: this is about small-team development)*



# 1D

- Swords & Soldiers is really 1D



# Example level file

889986666533333333333333333333333357778

d-----d-j---j---jjdddjJ-----J-----j-  
-----j-j-----

```
rrrrrrrrrrrrdddddrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr
```

Y O Y O H  
U I G  
HH H A



# Notepad

- Not as bad as it looks
- 1D is quite clear
- Quickly editable
- Still, not WYSIWYG, so not cool
- Very fast solution if you have only one coder!



# Conclusion



# Conclusion

- Texture palette: good quality for cartoony
- The less colours, the better lz77 works
- Ogg beats MP3
- Executable size is relevant on WiiWare
- Cutting up buildings saves space





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