Nintendo DS™ Tools Overview

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Roadmap

- Nintendo DS Hardware Tools
- Software Tools & Libraries
- Summary



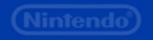




Nintendo DS Hardware Tools

- IS-NITRO-EMULATOR
 - For developers
- IS-NITRO-CAPTURE
 - For taking stills and movies
- IS-NITRO-VIDEO
 - For trade shows
- IS-NITRO-WRITER
 - For testers and publishers





IS-NITRO-EMULATOR

- 4 MB more memory than production DS
- USB 2.0 connection to Windows PC
 - Runs game images stored on PC
- Works with IS-NITRO-DEBUGGER
- Works with CodeWarrior debugger
- Programs one NITRO Flash Card at a time
- Can read backup memory in Flash Card
- Cannot read contents of Flash Card





IS-NITRO-EMULATOR Options

- Wireless Upgrade
 - Allows communication with retail DS units
 - Otherwise use IS-NITRO Network Hub
- Video Output Upgrade
 - NTSC Non-interlaced video & audio output to two TV monitors
 - PAL is not supported





IS-NITRO-CAPTURE

- Captures still images and AVIs
 - Does not capture audio
- USB 2.0 connection to Windows PC
 - Only to save images and AVIs
- Runs games store on NITRO Flash Cards
- NTSC Non-interlaced video & audio output
 - To one or two TV monitors; No PAL
- Same memory as production DS





IS-NITRO-CAPTURE Options

- Wireless Upgrade
 - Allows communication with retail DS units
 - Otherwise use IS-NITRO Network Hub





IS-NITRO-VIDEO

- NTSC Non-interlaced video & audio output
 - Always to two TV monitors
 - PAL is not supported
- Runs games store on NITRO Flash Cards
- Same memory as production DS
- Not available with DS Lite controller
- Not available to EU countries





IS-NITRO-VIDEO Options

- Wireless Upgrade
 - Allows communication with retail DS units
 - Otherwise use IS-NITRO Network Hub
 - Not available to EU Countries





IS-NITRO-WRITER

- Writes up to 8 NITRO Flash Cards at once
- USB 2.0 connection to Windows PC
- Can connect multiple units to one PC





NITRO Flash Card

- Re-writeable Flash Card
 - 512 Mbit and 1 Gbit sizes
- Backup Memory sold separately
 - EEPROM: 4 Kbit, 64 Kbit, 512 Kbit
 - Flash: 2 Mbit, 4 Mbit
- Use with retail DS, IS-NITRO-VIDEO, IS-NITRO-CAPTURE
- Program using IS-NITRO-WRITER
 - Or IS-NITRO-EMULATOR





IS-NITRO-HUB

- Connects up to 16 devices:
 - IS-NITRO-EMULATOR
 - IS-NITRO-CAPTURE
 - IS-NITRO-VIDEO
- Use CAT 5 crossover cables to connect
- Not available to EU Countries





IS-NITRO-UIC (MIDI)

- View / verify data on DS. Use with
 - NITRO-Viewer software
 - NITRO-Composer software
 - NITRO-Player software
- Requires retail DS + NITRO Flash Card
 - Or use an IS-NITRO-EMULATOR
- USB 2.0 connection to Windows PC
- Includes MIDI (IN) DIN Connector

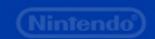




ensata

- Nintendo DS Software Emulation
- Use with Freescale CodeWarrior debugger
- Displays top and bottom screens
- Touch screen using PC mouse
- Supports backup memory
- No audio support
- Requires Win XP/2000





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Software Tools & Libraries

- Essential Tools & Libraries
- Nintendo Wi-Fi Connection (later today)
- High-Level Libraries (later today)
- Free Middleware





Essential Tools & Libraries

- Nitro SDK 4.0 + Patch 1 (earlier today)
- Freescale CodeWarrior for Nintendo DS
- IS-NITRO-DEBUGGER
- Cygwin bash, make 3.80-1





Freescale CodeWarrior

- IDE for Nintendo DS development
- C/C++ Compiler
- Source Code Debugger
 - IS-NITRO-EMULATOR hardware
 - ensata
- Command-line compiler





IS-NITRO-DEBUGGER

- Source Code Debugger
- Debug ARM 9 main processor & ARM7 subprocessor
- Works with IS-NITRO-EMULATOR only
- Also use to
 - Write NITRO Flash Cards
 - Update IS-NITRO-EMULATOR firmware





Cygwin

- Essential for Nintendo DS development
- Required to build Nitro SDK samples
- Unix-inspired shell running under Win XP
- Get older make 3.80-1 from WarioWorld





Nintendo Wi-Fi Connection

- Nitro DWC (later today)
- Nitro DWC-DL (later today)
- Nitro Wi-Fi (later today)
- Nitro Crypto
- Nitro Voice Chat Library





Nitro Crypto

- RC4 Encryption library
 - Public key encryption
 - Stream encryption
 - High-speed encryption/decryption
- Digital signature library
 - Verify authenticity of data through insecure channel
 - Uses private key, public key, sent data, and digital signature





Nitro Voice Chat Library

- Voice communication over UDP & TCP/IP
- Three communication styles
 - One-to-one (Telephone Mode)
 - Only between 2 parties
 - One-to-many (Transceiver Mode)
 - Supports up to 8 parties
 - Many-to-many (Conference Mode)
 - Supports up to 4 parties





High-Level Libraries

- NITRO-System
 - Foundation Library (Fnd)
 - Graphics Foundation (Gfd)
 - Graphics 2D Library (G2d)
 - Graphics 3D Library (G3d)
 - NITRO-Composer (Snd)
 - Multiple Channel Stream (Mcs)
- All to be discussed later today





Free Middleware

- Sharp LC Fonts
- Software Keyboard
- Actimagine VX Video Codec
- Access Co. Ltd NetFront Browser
- Zi Corporation Decuma handwriting recognition library
- Matsushita Voice Recognition Engine





Sharp LC Fonts

- Developed by Sharp for use with a liquid crystal display
- Supports various data sizes up to 16 dots by 16 dots
- LC Font supports ASCII, Katakana, Hiragana, nearly 7,000 types of Kanji (JIS level 1 and 2, NEC JIS 13), characters/ symbols other than Kanji, all in single-byte and double-byte formats





Software Keyboard

- Nitro Sample SoftKeyboard package
- Displays keyboard on-screen, allows keypresses using stylus
- Uses Sharp LC Fonts or user-supplied font
- Supports ASCII, Katakana and Hiragana





Actimagine VX Video Codec

- Codec to compress video & audio on PC
- Playback top screen, bottom, or both
- Playback from memory or file system
- Dual screen, 15fps, 32kHz stereo possible
- Used in many DS Download Station movies, including Diddy Kong Racing, Hotel Dusk, Pokémon Battle Revolution, Starfox Command





Actimagine VX Hints

- Use the best video source you can get
- Video source should be at least 640x480
- Use uncompress video source
- Downsize resolution as late as possible
- Only decimate when lowering frame rates
- Try to maintain original aspect ratios
- Use "Precise bicubic" or better downsize
- Adjust video / audio quality to meet targets





Access Co., Ltd NetFront Browser

- NetFront Browser Component (NFB lib)
 - Displays Limited HTML files
 - Uses Nintendo Wi-Fi library; defaults to DWC
- HTTP/HTTPS protocol (NFC API)
 - Supports HTTP GET, HEAD & POST methods
 - NFC can be used alone

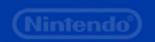




Recognition Libraries Overview

- Character and voice recognition libraries
- No dedicated recognition hardware
 - All done in software
- Design for the limitations of the libraries
 - Easier to match a small set of possible commands
 - Context sensitive
- Help the recognition software seem smarter





Zi Corporation Decuma handwriting recognition

- Single Character Recognition (SCRLIB)
 - Determines best character match from a set of handwritten strokes
 - Can also return a ranked array of best matches
- Multiple Character Recognition (MCRLIB)
 - Builds on top of SCRLIB
 - Additional problem: is stroke part of existing symbol, or start of a new symbol?





Personalization

- UDMLIB: User Database Modifier Library
 - Allows user to add new symbols or new ways to write existing symbols
- DCLIB: Decuma Categories Library
 - Creates a personal category table, e.g., hexadecimal
 - Rarely used





Case Study: Brain Age

- Had trouble distinguishing between capital "I"s and lowercase "1"s
- Can't solve within recognition software, so create list of pairs of similar characters
- If matching "block", allow "block", or even "blolk"
 - Better user experience if letter correction appears right away (instead of at end)
- Allow stroke order variations



Case Study: English Training

- Title available in Japan
- Used different character recognition engine from Matsushita
- Also auto-corrected from capital "I"s or lowercase "1"s to correct letter
- However, added a criteria: recognition score has to exceed a threshold
 - Otherwise the user would always be correct



Adjusting the Threshold Values

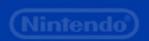
- Test conducted with Mario Club members
- 40 people on three occasions
- Wrote program that displayed the recognition result and evaluation value
- Set threshold to the lowest evaluation value among all the patterns of all participants
 - Allow for really messy handwriting



Matsushita Voice Recognition Engine

- What is possible
 - Recognize words specified in advance
 - Recognize speech from unspecified speakers
 - Recognize in real time
 - Use recognition scores
- What is not possible
 - Recognize unregistered words
 - Achieve 100% recognition





Recognition Lexicon

- Text-based
 - ASCII (English) or 2-byte Shift-JIS (Japanese)
- Up to 100 words
- Can specify variations for each
- Function returns highest scoring words





Language Models

- US English or Japanese large model
 - Higher recognition accuracy, especially in noisy environments (US: 190 KB, JP: 140 KB)
- US English or Japanese small model
 - Faster recognition processing time, but lower recognition accuracy than large models (US: 140 KB, JP: 68 KB)





Improving Recognition Performance

- Choose distinct words
 - Avoid including both "Mario" and "Maria"
 - Longer words usually perform better
 - Smaller lexicons work better
- Register multiple word for a given entry
 - Use different phonetic spellings





Improving Recognition Performance

- Design the UI to assist recognition
 - Display acceptable words
 - Mute music during speech recognition
 - Limit number of valid responses
 - Tell users not to speak too loudly
 - Let users know accuracy is not 100%





Case Study: Brain Age

- Limit to four possible answers
- Assume there is always a right answer
 - It is either Red, Blue, Yellow or Black
- Problem then becomes, "did it sound more like Red, Blue, Yellow, or Black?"
- Add variants for difficult words
 - Yellow in Japanese, Blue in English
- Allow top two scores to match
 - "Game errs in your favor"





Case Study: Brain Age

- Supplied English recognition engine works with West Coast accents
 - Apparently US has regional accents
 - blue. Blue. BLUE! BLOO!! BLEW!!!
 - Use phonetic spellings to capture nuances
- Use IS-NITRO-UIC to tune recognition dictionary
 - Shorten the feedback loop





Case Study: English Training

- Speech recognition is not used as the main aspect of the game
- User is asked to read text displayed onscreen to practice pronunciation
- Matsushita's engine not used for this
- Captured sound is compared with the rhythm of stressed and unstressed parts of the sound

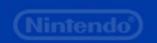




Detecting Start of Speech

- Even when game is waiting for input, sometimes there is a delay before the player starts speaking
- Performing frequency analysis
- Sounds with increased human voice frequencies values are considered to be the start of speech
- (Matsushita engine does this for you)





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Summary

- Differences between IS-NITRO-EMULATOR, IS-NITRO-CAPTURE, and IS-NITRO-VIDEO
- Essential DS software: CodeWarrior, SDK, IS-NITRO-DEBUGGER, make
- Fonts, Video Codec, Browser libraries
- Character & voice recognition libraries





Questions?

Ask me during the breaks
Or e-mail support@noa.com



