

# 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

# Roadmap

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

# 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

# Freescal 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
- Actimage 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

# Actimage 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 "l"s
- Can't solve within recognition software, so create list of pairs of similar characters
- If matching "block", allow " bIock", or even " blo1k"
  - 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 "l"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 on-screen 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)

# Roadmap

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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](mailto:support@noa.com)