RULES FEST

JBoss by Red Hat

FICO

VisionArts communications
strategic thinking • creative action

Deploying Knowledge Based Technologies in Embedded Systems

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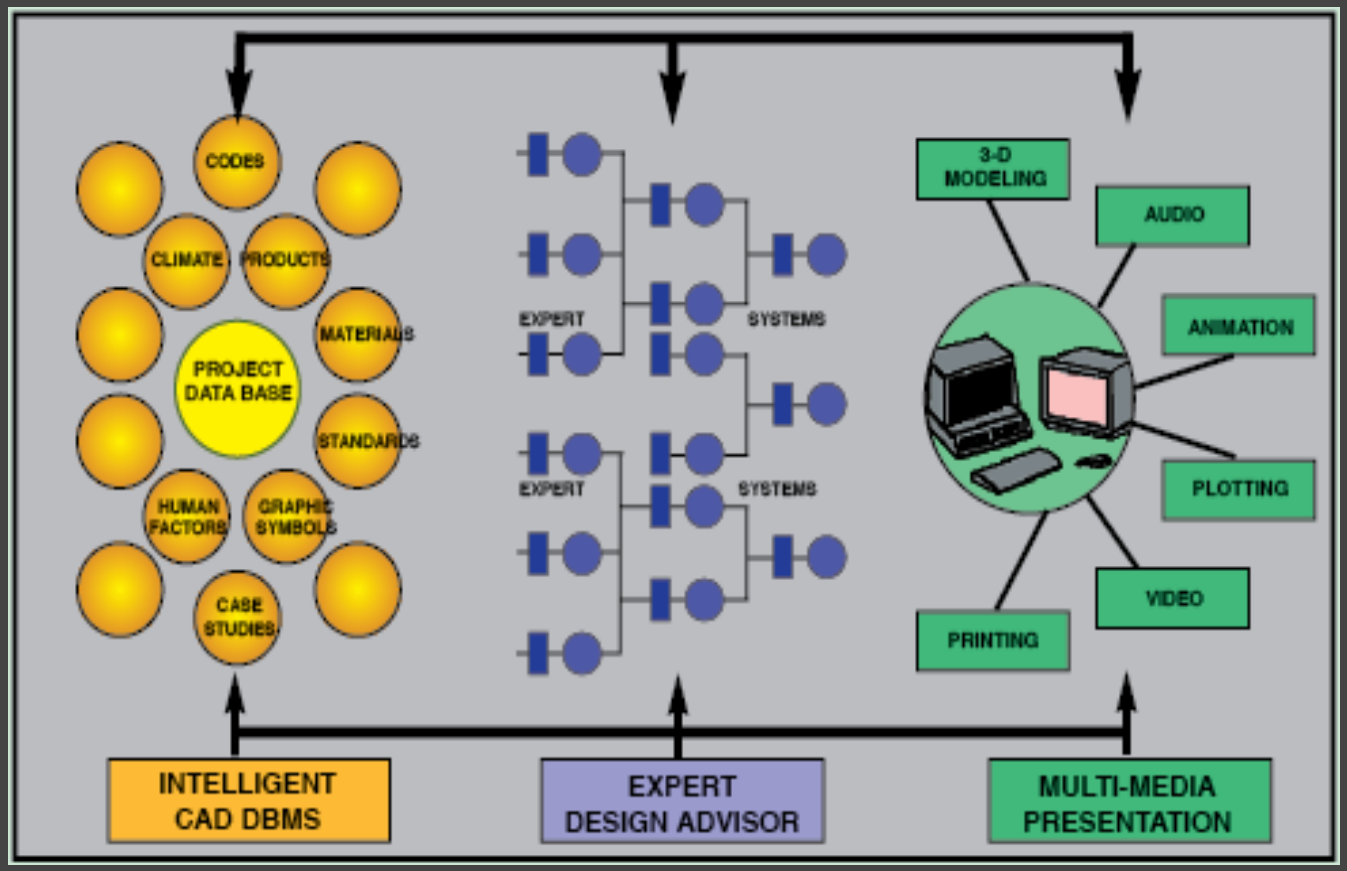
AJA Video Systems, Inc.

The ICAD System - Cal Poly SLO

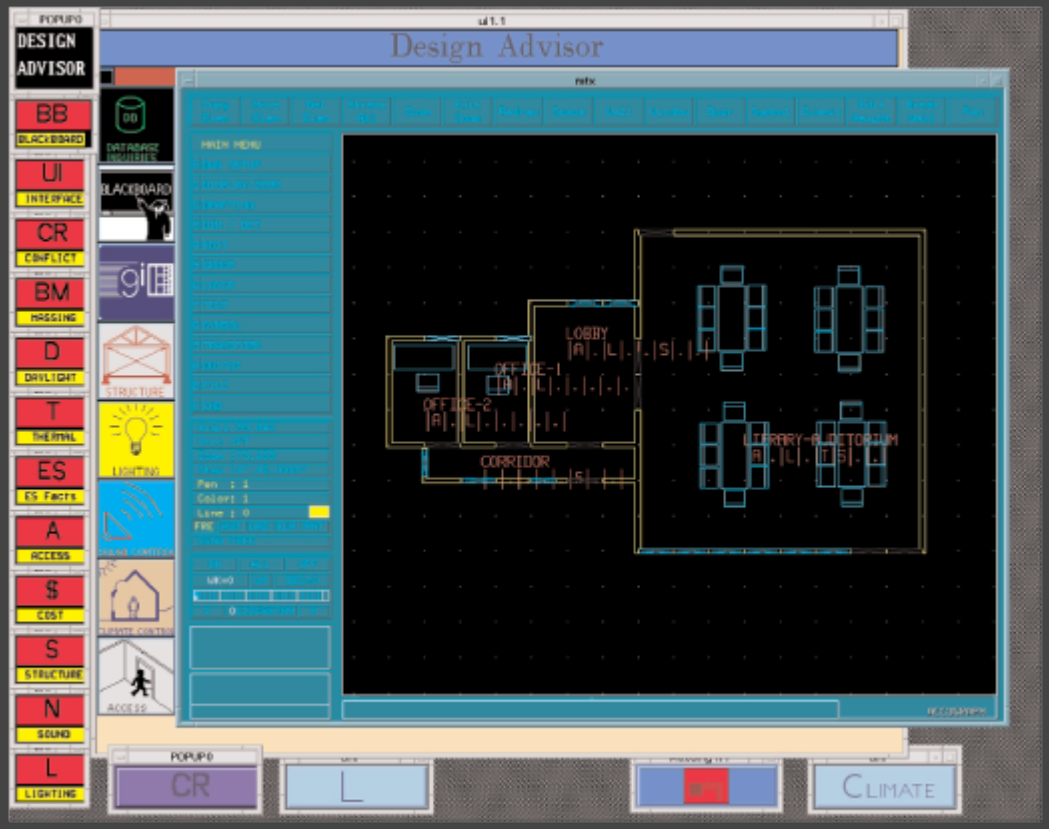
Problem Domain

- Architecture, Computer Aided 2D/3D Design
- Joint Research, CS and Architecture Departments
- Goal: Reduce design cycle time, catch errors early in design
- Commercial CAD system with multiple monitors (using X)
- Distributed "design experts" provide near real-time feedback within the drawing context

ICAD System - Cal Poly SLO



ICAD System - Cal Poly SLO



The ICAD System - Cal Poly SLO

Implementation Details

- Distributed Blackboard (bbassert (fact))
- Each expert proposed changes/violations to current drawing state
- Conflict resolver arbitrated conflicting proposals
- Asynchronous assertions into CLIPS working memory
- Frames modeled drawing elements (walls/windows/rooms) and goals/constraints defined by the architecture "Program"
- Experts register interest in specific frame types

ICAD System - Cal Poly SLO

Lessons Learned

- Conflict resolver remained a hard problem to solve
- Attempted to automatically learn resolver rules based on user decisions (generalize)
- Uniform CLIPS environment allowed us to focus on logic rather than integration issues
- Powerful model applicable to other domains

Intel Smart-TV

Problem Domain

- Set-top box and Home Theater controller
- On screen TV-Guide augmented by media assets (trailers)
- Intelligent Device Control
- Campaign Management/Targeting
- Track user behaviors, preferences, profiles

Intel Smart-TV

Intel Smart-TV

US Patents:

M & A == Method and apparatus

7,313,806 - M & A for channel surfing through multiple sources based on user-definable preferences
7,240,356 - M & A for displaying differences in the characteristics of multiple versions of an entertainment program
7,093,272 - M & A for selecting from among multiple upgraded media features for transmitted entertainment programs
7,058,635 - M & A for searching through an electronic programming guide
6,671,880 - M & A for customized rendering of commercials
6,594,825 - M & A for selecting a version of an entertainment program based on user preferences
6,317,881 - M & A for collecting and providing viewer feedback to a broadcast
6,157,411 - M & A for compiling a repository of entertainment system data from multiple sources
6,157,377 - M & A for purchasing upgraded media features for programming transmissions
6,008,802 - M & A for automatically performing a function based on the reception of information corresponding to broadcast data
5,977,964 - M & A for automatically configuring a system based on a user's monitored system interaction and preferred system access times
5,945,988 - M & A for automatically determining and dynamically updating user preferences in an entertainment system

Intel Smart-TV

Implementation Details

- Used Microsoft IE Scripting Engine Interfaces
- <script language=”clips">(defrule xyz ...)</script>
- CLIPS scripts sink DOM and custom events
- TV Guide datastore & remote servers
- Evaluated Autonomy algorithms

Intel Smart-TV

Lessons Learned

- Lack of experience modeling user behavior
- High degree of flexibility/complexity in campaign targeting not effectively utilized, difficult to communicate
- Duplicated data - C++ DB, CLIPS working memory
- Performance issues, under-powered system

Ten Square

Problem Domain

- Advertising and coupon network
- Deployed in gasoline pumps, ATMs, PIN Pads and other POS devices
- Web-based Design
- Identify, track and predict user behavior
- Use case: predict next POS stop, print coupon for active promotion(s)
- Constraint: must not hold up transaction, hard stop
- Optimize "Elapsed Time Management", ie. "lane time"

Ten Square

Implementation Details

- Java server-side (in-store) logic via servlets/jsp
- Client devices treated as if they were browsers
- Back-channel - force page transitions (transaction-end)
- Data mining done at NOC, analyzed large # transactions
- Very little client-side (device) logic
- Evaluated Jess (early version) for Campaign Management, Elapsed Time Management.

Ten Square

Lessons Learned

- Client device limitations - gas pumps are dumb
- Lack of coordination between teams (GDC, client)
- Not enough runway $
- Take the money and run...

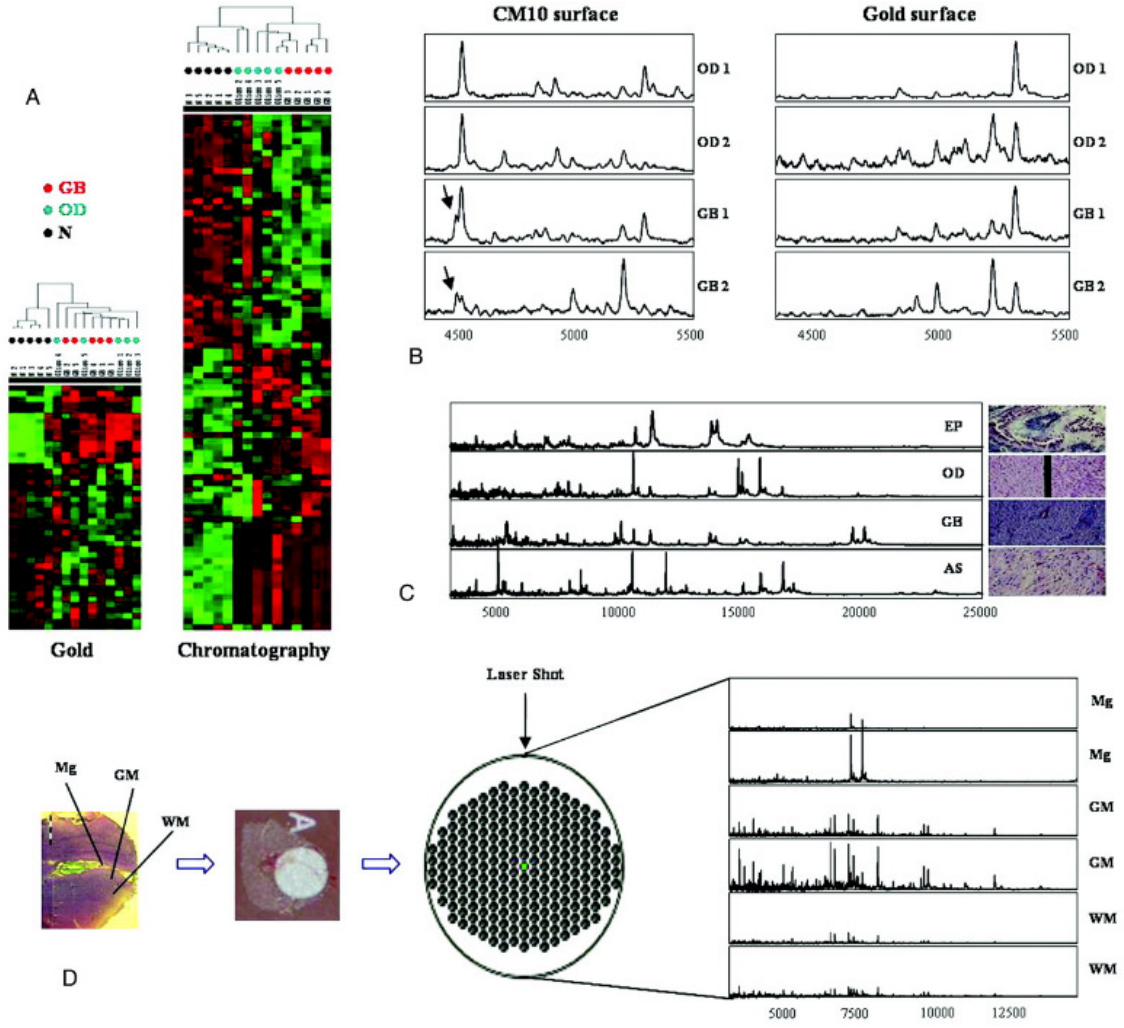
Ciphergen Biosystems

Problem Domain

- TOF Mass Spectrometer for Proteomics Research and Diagnostics
- Laser energized ions accelerated towards detector
- Instrument output is a mass spectrograph
- Headless network appliance, embedded Linux
- Advanced "Spot protocols" - optimize sample utilization
- Advanced device calibration algorithms
- Data mining and pattern detection (off-instrument)


ProteinChip System, Series 4000

Validation and clinical application of direct-tissue SELDI-TOF MS proteomics



Bouamrani, A. et al. Clin Chem 2006;52:2103-2106

Clinical Chemistry

Ciphergen Biosystems

Implementation Details

- Instrument controller implemented using Jess rule engine
- Extensive use of Asynchronous Completion Tokens
- Multi-threaded design, Concurrent library (Doug Lea), ACE
- Primary design pattern: State Machine
- State fact represents current state
- State transitions implemented using Jess rules
- Device state and events represented as facts/objects
- Designed Jess Proxy class to wrap Jess deffunctions as instance methods
- UML State Chart - microformat-DSL
- Strategy: deploy Jess for simpler tasks w/ follow-ons

Ciphergen Biosystems

Lessons Learned

- Lack of debugger problematic for C++/Java programmers
- Intermittent problem caused events to be missed/dropped
- FutureResult pattern very powerful - provided excellent decoupling for asynchronous events between threads, components
- States/Transitions easily modeled in UML, translated and implemented as rules/facts/objects - code generation
- Good match for technical users (Phd/scientists)
- Missed opportunity for advanced "spot protocols" and device calibration

AJA Video Systems

Problem Domain

- Professional Video Equipment Manufacturer (TV/Film)
- FS2 - Video Frame Synchronizer
- Ki Pro - Professional Digital Video Recorder (DVR)
- Alarm Detection
- Power Management - control temperature, battery drain, fan noise
- Ki Pro Feature Manager
- FS2 Feature Manager
- Ki Pro Gang Controller
- Decisions at frame rate (appox. 15 - 30 ms on a slow CPU)

ACQUIRE

KiPRO

Production and Post – Unified

KiPRO

KiPRO mini

Because it matters.

AJA®
VIDEO SYSTEMS

CONVERT

FS2

Dual Channel Universal HD/SD Audio/Video Frame Synchronizer and Format Converter

Because it matters.

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AJA Video Systems

Implementation Opportunities

- FS2 Feature Manager - C++ switch/if-then logic
- Ki Pro Feature Manager - table generation/lookups
- Alarm Manager - detect and report alarms
- FPGA Verilog Generator - embed rules/tables into firmware
- Need flexibility, ability of small team to make a large number of derivative products efficiently - clean feature variations
- DSL for Audio/Video processing

AJA Video Systems

Future Directions

- DSL for video processor product families
- Transparency critical for debugging with C++ code
- Micro-formats (expressions, poor man's LHS)