



# INTERSENSE

*Sensing Every Move*

## Hardening AR for Real-World Use

Eric Foxlin

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# Intro

- Not here to discuss the core technology of the Vision-Inertial Self-Tracker (VIS-Tracker) – you saw it in past ISMARs
- Talk will focus on the “devils in the details” to harden an AR product for real world applications
- Using development of the new IS-1200 VisTracker system as an example



# Long road to a real-world solution

- Technology demonstrations in 2001-2002
- Developed and fielded prototype systems for evaluation in the research, industrial, and military communities 2003-2005
- Collection of feedback and formulation of product strategy / requirements 2005
- Intensive product development 2005-2006



# Focus applications

- AR research (ISMAR community)
- AR for maintenance/repair
- AR for manufacturing
- AR sim/training
- Mobile robot navigation
- UAV navigation
- Vehicle simulators
- Enhanced/synthetic vision in real vehicles



# Collecting requirements

- First version of IS-1200 system was developed and fielded in diverse applications including:
  - AR research labs
  - Wearable AR simulation/training programs
  - High-vibration motion-platform helicopter simulator
  - Ground vehicle head-tracking
  - Robot guidance in factory settings
  - Industrial tool tracking
  - Virtual sets (film, video, TV)
- User suggestions, needs and wants were systematically captured and prioritized for each sector in a Market Requirements Document
- Much in common, but priorities varied by sector:



# AR research labs

- Lower CPU load
- Run off 5V USB power directly
- Smaller and fewer fiducials to install
- Support for very large galaxies
- Lower price
- Tools to align whole AR system



# Wearable simulation & training

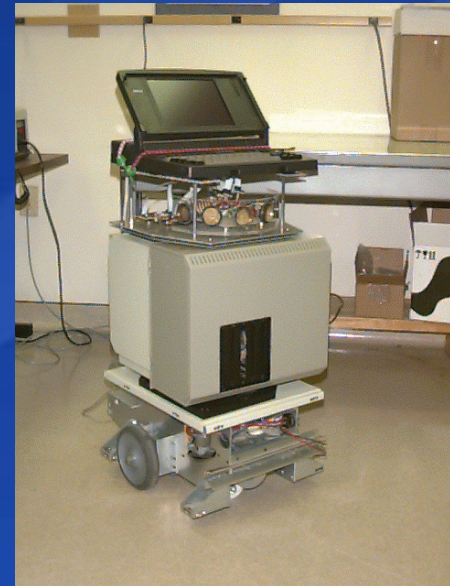
- Withstand extreme physical abuse
- Reliable crash-free software
- Less boxes, cables, batteries & connectors
- Tools for auto-mapping fiducials and aligning AR system
- Eventual reduction or elimination of fiducials
- Ability to operate outdoors too
  - GPS integration
  - Milspec temperature range





# Factory robot navigation

- Lower density of fiducials
- Longer read range
- Eventually reduce or eliminate fiducials
- Auto-mapping
- Low price in volume
- Single box
- Operate in poor lighting







# Flight simulator, ground vehicle and aircraft

- Tiny head mounted weight (<20 g)
- Operate under vibration, shock, motion
- Milspec ruggedness & temperature range
- 1 mrad angular accuracy
- Line-replaceable cameras, no re-calibration
- Day/night operation, no IR emissions



# Answers to requirements

Requirement	Response
Less boxes, cables, connectors	One-piece integrated IMU/imager/DSP with single ultra-miniature MILSPEC connector
Low power (long battery life)	Reduced to 1.5W
USB bus-powered	Wide input voltage range 3-9 VDC
Accuracy	Improved optical design and calibration
Lower CPU load	sfServer optimized and scheduled in background – consumes 1-2% of my PC
Smaller fiducials / greater range	Doubled imager resolution to 1280x1024
Lower fiducial density	New algorithm acquires and tracks with just 2
Ruggedness & reliability	Designed to meet MILSTD-810 for vibration, shock, temperature, etc.
Markerless tracking	Upgraded to Blackfin DSP (5-10x processing power of the old one leaves room to grow)
Lower price	Introduced new multi-tiered pricing options starting from ½ the original price

# UV version for aircraft





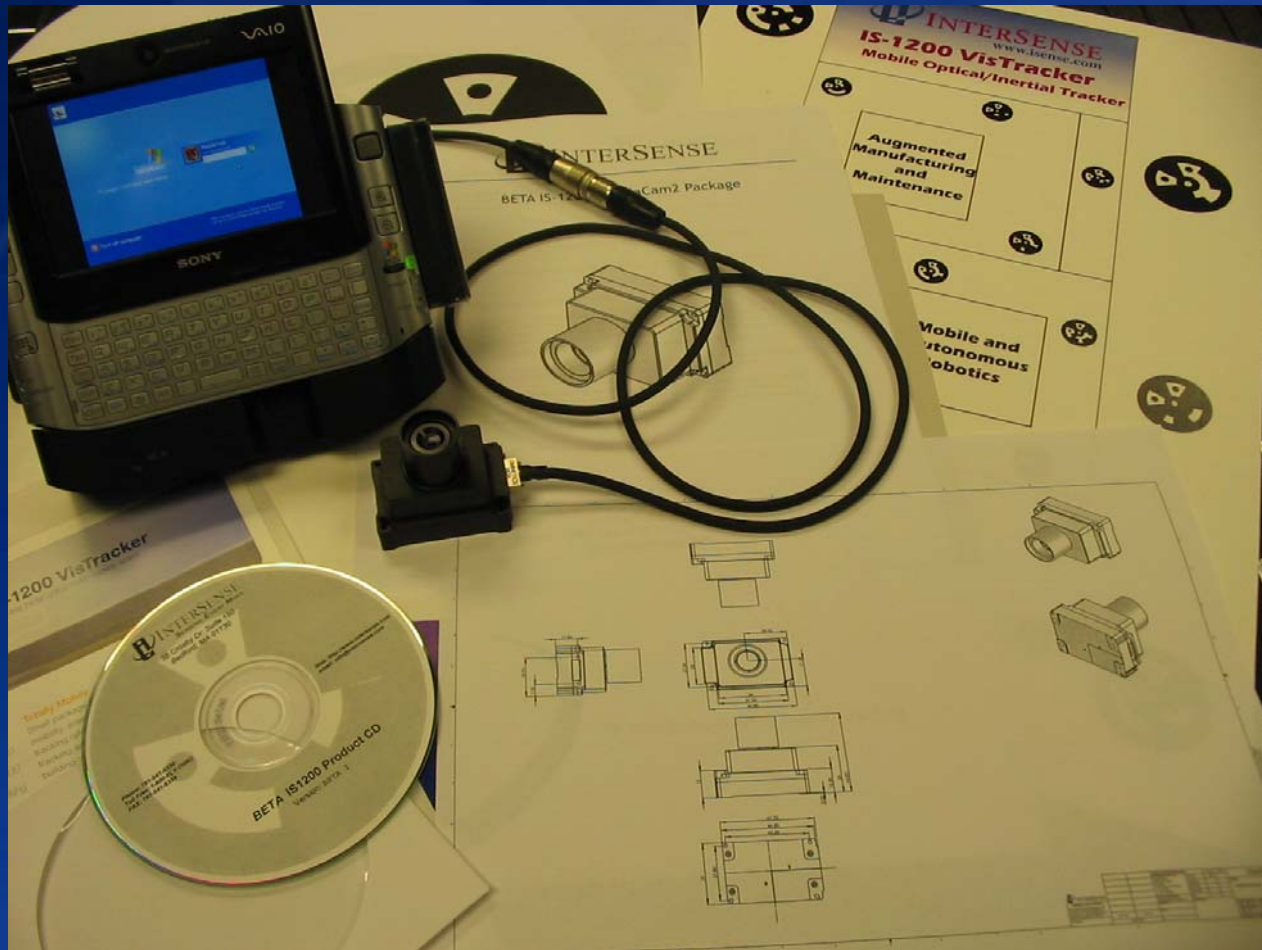
# Qualification plan (for FCS)

- HALT/HASS testing
- Four corners thermal/voltage testing
- Vibration and shock testing
- EMI testing
- MILSTD-810 Testing





# Shipped Beta on Friday





# Summary

- The process of converting a working R&D prototype into a manufacturable product for real-world use is not for the faint of heart!
- Many times greater expense and effort than the original development



# Thank you, and two last thoughts:

- We are looking to hire computer vision / AR researchers, and other positions – please come see us if you know anyone who may be interested
- Come see our wide area maze in the demos session Tuesday