

A Training Tool for Endotracheal Intubation: Distributed Augmented Reality

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Outline

- ETI and the need for training tools
- The Ultimate Intubation Head (UIH)
- Methods and Results
- Distributed AR Environment (DARE)
- The Near Future

Endotracheal Intubation (ETI) in Airway Management

- Facts:
 - Emergency airway management is classified as a cause of pre-hospital death trauma by the American Heart Association
 - Aug.1997-Oct 1998: 2392 ETIs, 309 complications, 132 because of the intubation procedures
 - Failed intubation – the leading cause of anesthesia-related mortality
- A Solution: train paramedics in pre-hospital emergency situations

Ultimate Intubation Head (UIH)

- HPS, upper airway
- See-Through Head-Mounted Projective Display
- Tracking system



Human Patient Simulator

- HPS from Medical Education Technologies



Head Mounted Projective Display

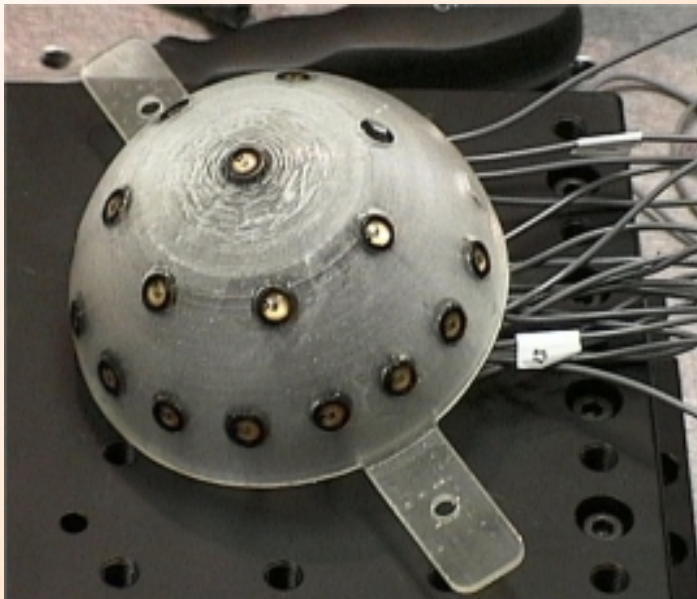
[Hua et al., AO 2000; Ha & Rolland, AO 2002]

- Optical see-through HMD
- Diagonal field of view of 52 degrees
- Current resolution 640x480 – 3.5arcmin
- Weight 700 g
- Light optics: 8 g /eye
- New system “eyeglass type” in fabrication

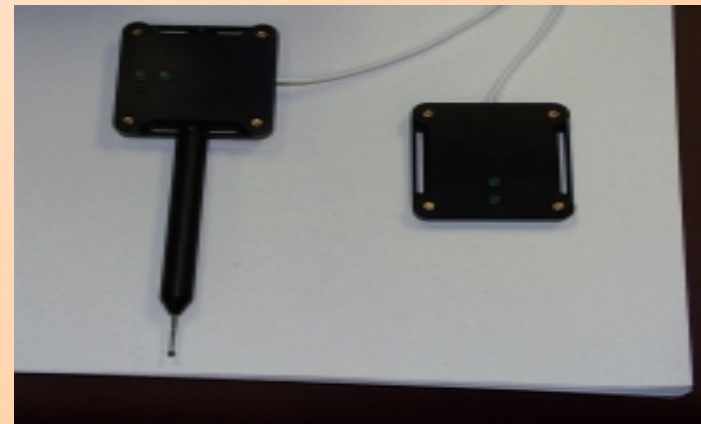


Tracking System *[Hamza-Lup et al., ISCIS 2002]*

Custom built head
tracking probe
0.3 mm position,
0.6 deg. orient.



Polaris optical
tracking devices



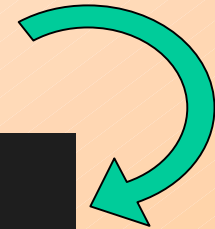
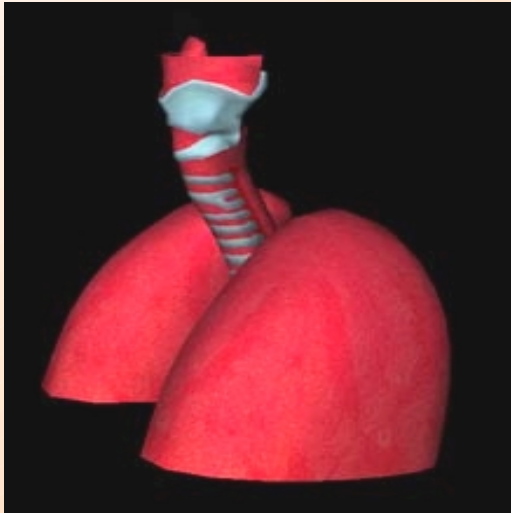
System Components

- Software
 - 3D models (the challenge)
 - Software framework
 - Dynamic registration module
 - Visualization module
 - Data distribution module

3D Models *[Imielinska et al., VH Conf, 2002]*

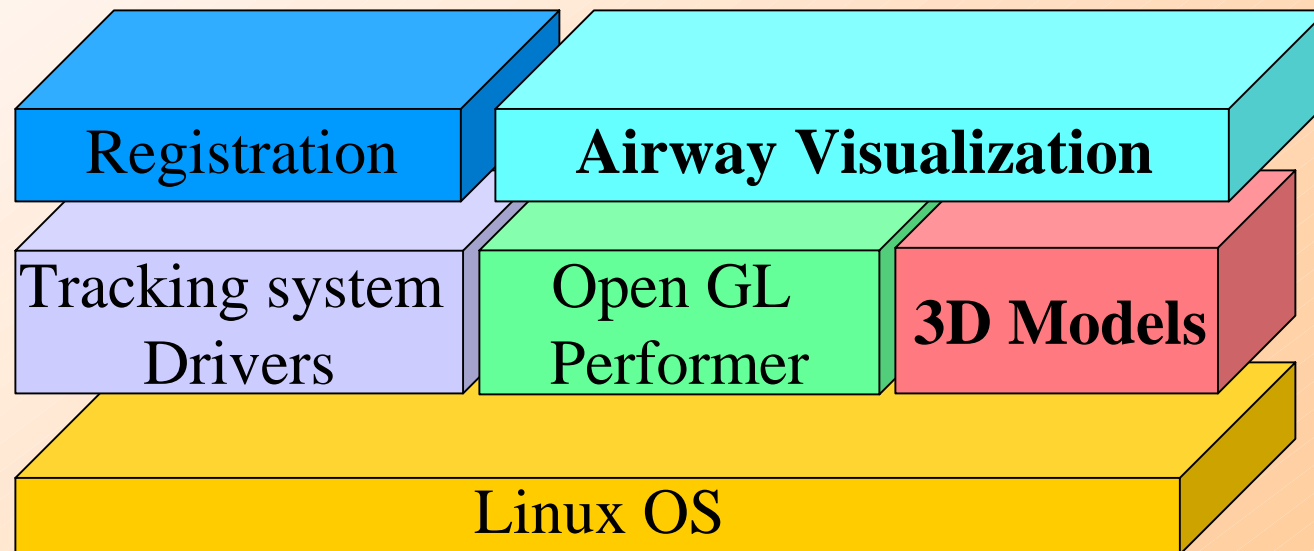
- (a) First, approximated 3D model of trachea and lungs
- (b) Anatomically Correct Models Segmented from the Male Visible Human data sets of mandible and bronchial tree

Need to scale models to HPS – in progress



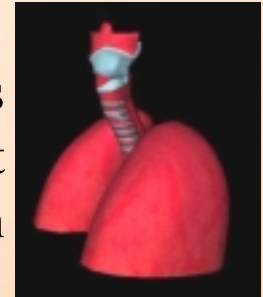
Software Framework

- Dynamic registration
- Visualization
- Data distribution

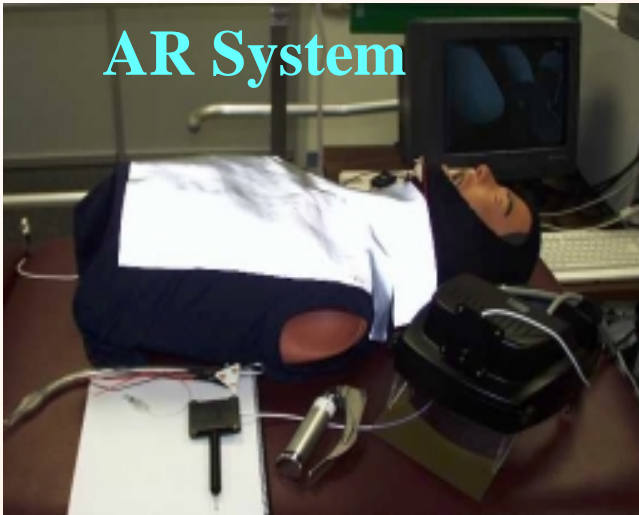


3D Visualization Results

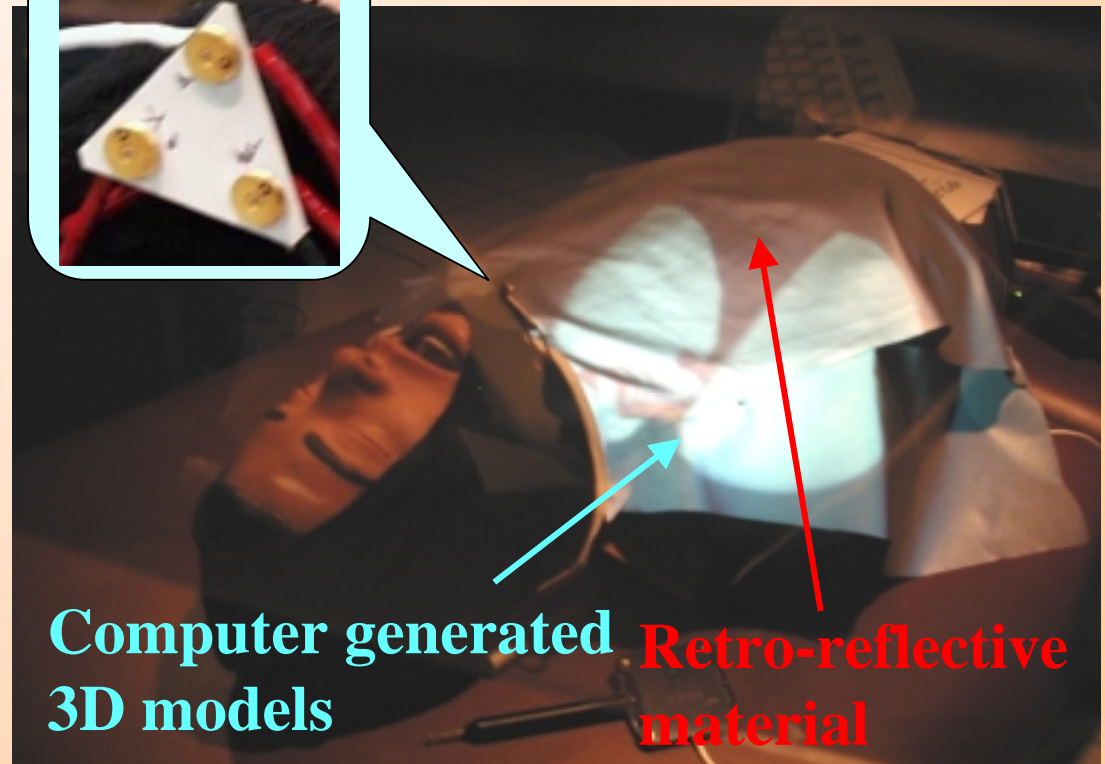
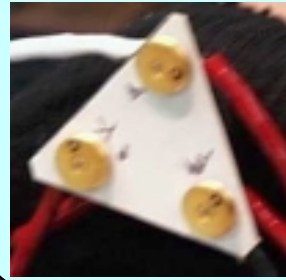
Approximated models
were used in the first
implementation



AR System



Tracking probe



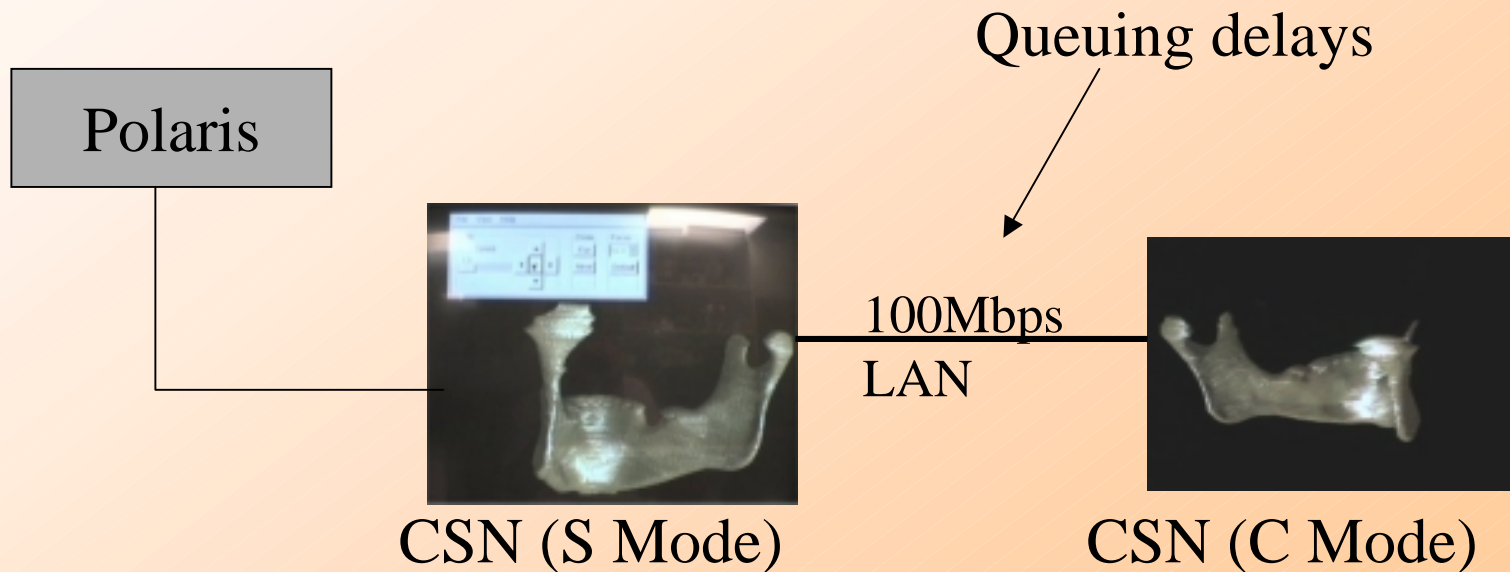
Computer generated
3D models

Retro-reflective
material

Distributed Visualization

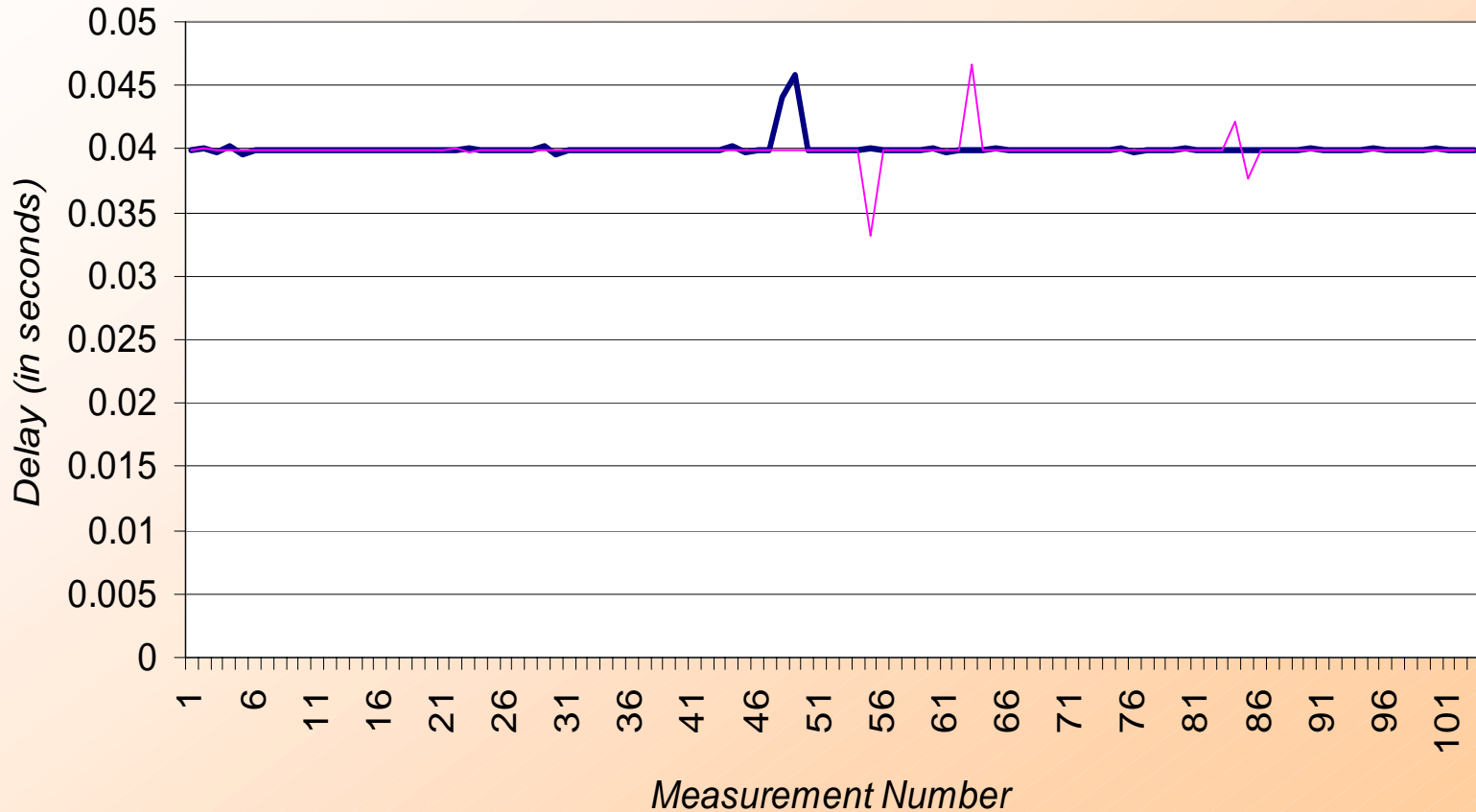
[Hamza-Lup et al. ACM Crossroads 2002]

- 100Mbps LAN
- Linux RedHat 7.2
- Tracking system 60 Hz/ max. refresh rate



Latency Assessment

Remote vs Local Delays using TCP



Future Work

1. Complete study of scalability of visible human datasets to HPS (*Spring 03*) . Working on mandible.
2. Establish the relative position of the trachea w.r.t. the mandible for head in extension during intubation
3. Update head tracking probe with ~ 0.1 deg. in orientation (*Summer 03*)
4. Apply previously developed methods of registration [*Argotti et al., 2002*] to UIH
5. Develop training scenario (*Summer 03*)
6. Assess registration and training (*Fall 03*)

Anticipate new integration phase by August 2003

Acknowledgements

- Army Stricom - UIH component
- NSF/ITR - Distributed collaboration
- METI Corporation for stimulating discussion on 3D models and for providing the HPS