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
  – 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

Optical Diagnostics and Applications Laboratory ODALab @ UCF

MMVR 2003
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.
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

Measurement Number

Delay (in seconds)
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).

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