A Freehand Natural Interaction System for Mixed Reality Healthcare Demonstration

Maite Frutos-Pascual, Maadh Al-Kalbani, Alan Dolhasz, Ian Williams

Dr Maite Frutos-Pascual
maite.frutos@bcu.ac.uk
DMT Lab - Birmingham City University
Millennium Point
1 Curzon Street
Birmingham
Contents

1. DMT Lab, Birmingham City University
2. MR Interactive System for Healthcare Demonstration
3. System Architecture
4. System functionalities and demo
5. Future work and current developments
DMT Lab is active in **three key areas of research:**

1. Image Processing and Mixed Reality
2. Digital Audio Processing
3. Digital Media Distribution

**9 research staff and 13 full-time PhD students**
MR Interactive System for Healthcare Demonstration

- Real time integration of practitioners and multimodal patient data (3D models, images, text, video)
- Freehand natural interaction with virtual anatomical models and medical data
  - Grasping methods derived from previous interaction analysis \([1,2]\)
- Scalable environment, both exocentric (fig.1) or desktop

Fig.1 Freehand interaction in real time with medical data


A Freehand Natural Interaction System for Mixed Reality Healthcare Demonstration
Maite Frutos-Pascual, Maadh Al-Kalbani, Alan Dolhasz, Ian Williams
DMT Lab – [http://dmtlab.bcu.ac.uk](http://dmtlab.bcu.ac.uk)
System Architecture

- **Hardware**
  - Microsoft Kinect 2
  - Feedback monitor

- **Software**
  - Unity Game Engine[1]
  - C# Programming language
  - Microsoft Kinect SDK[2]
  - Modelling software (Blender[3]/Maya[4])

1. https://unity3d.com/
3. https://www.blender.org/
User Tracking for Interaction and Occlusion

- **25 body joints** are tracked in 3D Space \((x, y, z)\)

- **Occlusion** handling
  - Depth \((z)\) coordinates of the 25 body joints

- **Interaction** handling
  - \((x, y, z)\) coordinates of hand joints
    - Wrist, palm, thumb and finger tip
  - Single or bi-manual interaction
  - Recognition and tracking of **grasping** and **grabbing**
Real-time Occlusion

Input Layers

Layer 1
Video feed

Layer 2
Virtual object

Layer 3
Depth segmented video

Processing
Layer composition

Result
Composited output: real-time dynamic occlusion

A Freehand Natural Interaction System for Mixed Reality Healthcare Demonstration
Maite Frutos-Pascual, Maadh Al-Kalbani, Alan Dolhasz, Ian Williams
DMT Lab – http://dmtlab.bcu.ac.uk

Conference, 24th January 2017
System functionalities - Interaction

Interaction models allowing occlusion and object manipulation in real time

- The system enables real-time interaction and manipulation of virtual anatomical models
- The models can be scaled, rotated, moved and changed dynamically
- Virtual objects have a representative location in real space, thus allowing real-time occlusion
System functionalities - Customisation

- Customisation of 3D anatomical models to reflect lifestyle health choices
  - Textures can be changed to match lifestyle choices
  - The models can be altered to reflect patients’ habits
Freehand interaction with multi-modal patient data

- Freehand interaction with medical image data real-time
- Tools for interaction with medical Image data
  - Switch between different imaging modalities
  - Region of Interest (ROI) definition
  - Measurements
## System functionalities - Data

<table>
<thead>
<tr>
<th>Supported Data Files</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients’ metadata</td>
</tr>
<tr>
<td>Customised 3D models</td>
</tr>
<tr>
<td>Medical Images</td>
</tr>
</tbody>
</table>

### e.g.: Patients’ metadata
- Case data
- External information
- Statistics
- Open data

### e.g.: Customised 3D models
- Pre-generated virtual objects
- Animations

### e.g.: Medical Images
- 2D and 3D datasets
- CT
- MRI
System - Current Developments

This customisable system is being developed in the following areas:

- Interactive Educational Games for Children (e.g. Interactive Body Scanner - Anatomy learning)
- MR Interactive Remote Medical Appointments (e.g. Remote consultations)
- Self-awareness interaction tool (e.g. Lifestyle health choices)
A Freehand Natural Interaction System for Mixed Reality Healthcare Demonstration

Maite Frutos-Pascual, Maadh Al-Kalbani, Alan Dolhasz, Ian Williams

Many Thanks,

Dr Maite Frutos-Pascual
maite.frutos@bcu.ac.uk
DMT Lab - Birmingham City University
Millennium Point
1 Curzon Street
Birmingham