Lecture 12:
3D LIVE HUMANS IN MIXED REALITY ENTERTAINMENT Prince et al

COMP 30025J

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First up essay feedback

- I was happy with the content but you all need more detail in conclusions to give your opinions

- Reference need quotes !!!!!!!!!!!

- Copy text from papers without referencing will get you zero marks, this includes the exam.

-   Using this paper as example , lets look at how we should reference.

Grading example

- "shape-from-silhouette algorithm reconstructs a 3-d model of the live subject from the user's perspective and re-samples the original images to generate the novel view" (Prince et al 2003)   which demonstrates how live 3D models can be created . (100%)

- A shape-from-silhouette algorithm reconstructs a 3-d model of the live subject from the user's perspective and re-samples the original images to generate the novel view)   which demonstrates how live 3D models can be created(Prince et al 2003)   (40%)

- The shape-from-silhouette algorithm reconstructs a 3-d model of the live subject from the user's perspective and re-samples the original images to generate the novel view,)   which demonstrates how live 3D models can be created (0%, you did not write this)

Other points

- Remember to use "I " for the exam and not "We", sometimes if it's a solo author , you can write in "This author opinion based on " / " This author compares" etc

- Give your essay structure, list what you are going to discuss in each section.

- Tell them what you are going to do and then do it , then tell them what you did.

Tele-Presence

- Before we get into the paper , we need to set the scene of what research question the paper is addressing

- The concept of Tele-presence , over projecting yourself into another space has been a human fantasy for millennia.

- The concept became more of a reality with the invention of telephone which could project your voice anywhere in the world

- This was further built upon with television., we were could see into world .

- But you were not presence there.

Tele-Presence continued

- Sci-Fi authors soon realised that with TV signals , you could remotely control a machine . The short story "Waldo" by Robert A. Heinlein told a story about an inventor who creates a remote control hand so that he can at first interact with the world due to his illness and then eventually to becoming a very rich man.

- As with much of the field of VR and AR, ideas from Science fiction eventually become reality.

Tele-Presence continued

- The first connection of Tele-Presence and VR came from MARVIN MINSKY in his paper Tele-Presence

- http://web.media.mit.edu/~minsky/papers/Telepresence.html

- He outlined the idea of what you could do with Tele-Presence in terms of remote control.

  - *Safe and efficient nuclear power generation, waste processing, and land and sea mining.*

  - *Advances in fabrication, assembly, inspection, and maintenance systems.*

  - *The elimination of many chemical and physical health hazards and creation of new medical and surgical techniques.*

  - *Reducing time and energy costs.*

  - *The construction and operation of low-cost space stations.*

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Research question that 3D live addresses

- This paper was written by the world of foremost leading in Augmented Reality at the time

- It attempted without inventing new hardware to solve the problem of in real time scanning and projecting a person into a different place.

- It shows how research can be conducted even without major hardware resource, it uses 15 camera which were expensive but they did not have to create new hardware like the Kinect

VR examples

- Early examples used tracking of devices like power gloves to put the user in the VR world.

- This tracking proved difficult.

- Eventually this problem was solved using time of flight sensors such as the ones used in Hololens or Kinect.

- This is the best example I have seen about how software can in a brute force way , simulate technologies that will not be possible for many years in the future

Abstract

- Introduces the 3D live capturing system

- Novel concept of taking a convex hull by using multiple cameras

- 3-d model of the live subject from the user's perspective

- Novel mixed reality entertainment application in which users apply tangible computing techniques to interact with a collaborator in a virtual space

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5 Conclusions

- Presents a system that can run in real time (25 frames does have its issues)

- 100 ms latency is still to much but given the technology this is amazing achievement at this time.

- Demonstrates that real time visualisation collaborations

1 Introduction

- Addressing the issues of inability to visualise users
- Non-Verbal behavioural cues are needed in a VR collaborative environment
- Combining this with AR compounds this issue as your interacting in the real world where you expect this cues.
- Earlier editions just simple put webcam 2D images on textures
- This was not a bad solution but a better one was needed.

2 Algorithm Overview

- Uses ARToolkit markers to calculate the view "Virtual Camera" for the observer into the VR world

- In general this was a solved problem so the paper brushes by it and moves on to discuss the main algorithm which is to create the virtual viewpoint in a real time fashion.

2.1 Virtual Viewpoint Generation

- Shape-from-silhouette principle - an approximation to the shape of a 3D object can be calculated based on its silhouette

- Requires finding multiple corresponding points on each image

- If no intersections are found the pixel is assumed to be background.
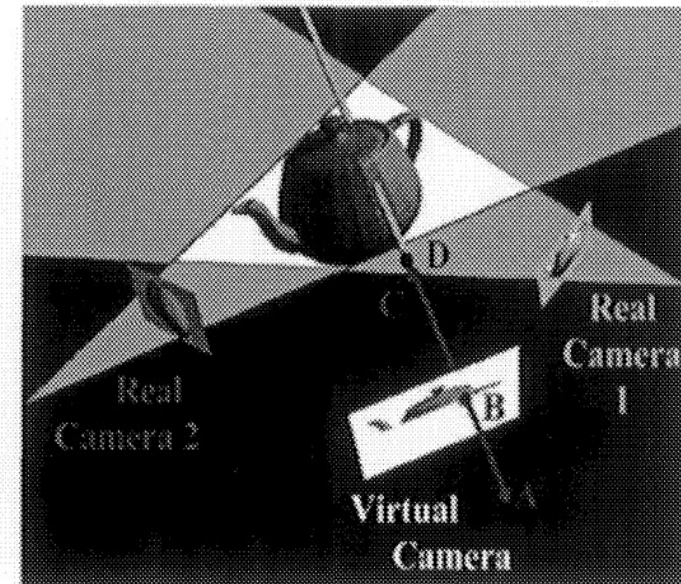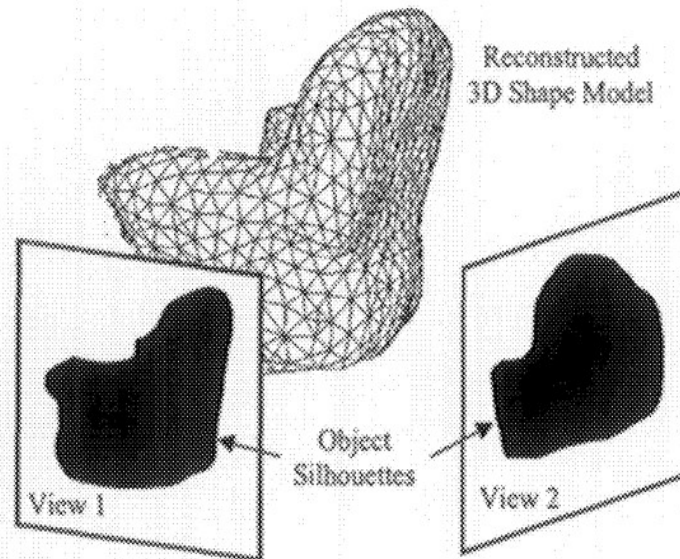
2.1 Virtual Viewpoint Generation (Cont.)

- Algorithm

for each pixel p in desired image do
    distanceAlongRay = 0;
    while (isOutsideVisualHull)
    distanceAlongRay++;
    if (intersectionFound)
    for each realCamera
    if (notOccluded && nearToVirtualImage)
    sampleColour();
    pixelColour = weightedMean(samples);
    else
   pixel=background

2.2 System Details

- Sony Glasstron HMD (640 x 480)
- 14 x Sony DCX-390
- 5 x Dual 1ghz machine (medium end for 2003) processing 3 camera each.
- 1.7 GHz Dual Pentium IV Xeon rendering machine
- Pre-processs step
    - classification of the pixel as foreground or background,
    - application of morphological operators
    - compensation for geometrical lens distortion
    - lossless compression

2.2 System details
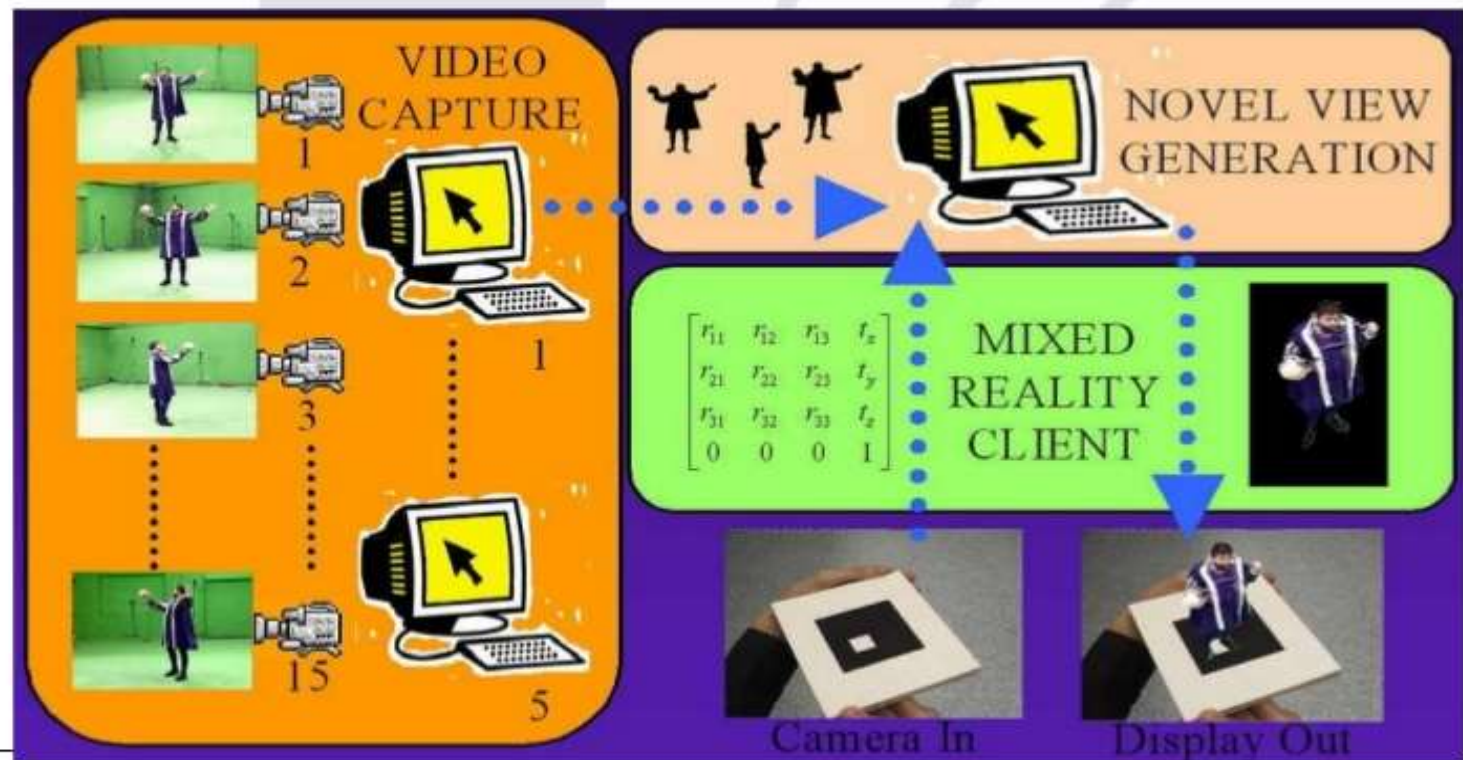
2.3 System Performance

- Linear performance in terms of pixel count

- 384 x 288 at 25 hz performance, which is the best the HMD at the time could read in.

- Capture space 2.5m high and 3.3m in diameter (similar to VIVE space) and CAVE environment

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3 Comparison with previous work

- no current system of this type has positioned cameras 360 degrees around the subject

- Approach has been tried before but it was the entire visual hull , so not as useful as they do not process it correctly to allow the visual hull to be reconstructed exactly

- Another approach was Lok et al , but that approach was not linear in terms of resoutlion and grew N^3

4 Entertainment Applications

- Non real time : model generation and recording

- Real time telepresence applications

- Tangible interface

References

- Good overview of the area
- Two self references but they are relevant
- References Azuma to give an overview
- Links to the tools used for the paper

Virtual Reality Questions

- "How can you create and use a Tele-presence environment   ?"
  - Creating a real time Tele-presence system **, Prince et al** gives one example
  - **Cruiz-Neira et al** and **Campbell et al** for CAVE designs that allow telepresence
  - Alternative ways to view a Tele-presence environment **Olson et al** and **Surale and Shinde**
  - Use of game engines to create a environment **Lewis and Jacobson**