Fall 2023

Virtual Reality

071011-1
Fall 2023
9/6/2023

Kyoung Shin Park
Computer Engineering
Dankook University

Course Information

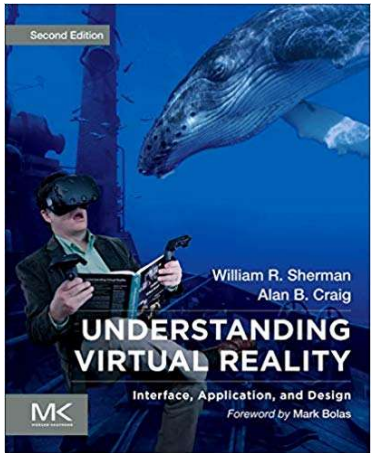
- Course
  - Virtual Reality (071011-1)
  - Fall 2023, 3 credits, 3 hours
  - Course hour: Wed 1:30-4:30 (3rd Engineering 519)
- Instructor
  - Kyoung Shin Park
  - kpark@dankook.ac.kr
  - 031-8005-3161 (office) 010-8636-1960 (mobile)
  - 2nd Engineering Building, Room 512
  - Office hour: by appointment
- Prerequisites
  - C/C++ Programming & Computer Graphics
  - Previous experience in OpenGL or Unity3D will be beneficial

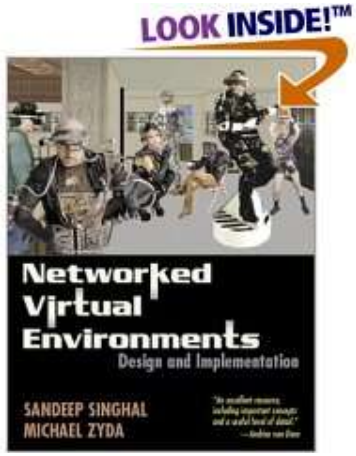
Purpose

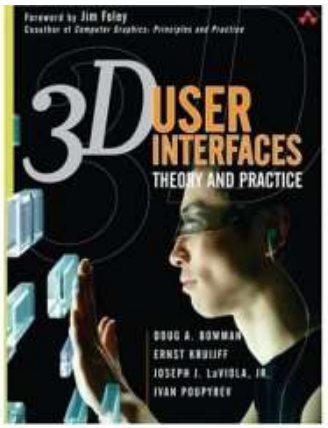
- This course is designed to cover principles of virtual reality and 3D user interfaces.
- Topics include hardware, software and design issues in presenting images and sounds in immersive environments, input and control devices, computer graphics and animation, human-computer interaction, applications and quantitative assessment of virtual reality systems.
- Students will read and present research papers on specific areas, study various research topics. The course consists of lectures, guest lectures, screenings of videos, web-sites, and installations, group term projects, and field trips.

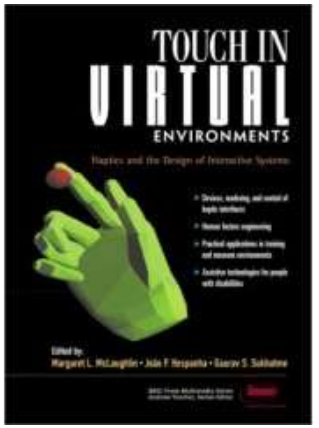
Text Book

- Text Book & Reference Book
  - Understanding Virtual Reality: Interface, Application, and Design (by W. Sherman and A. Criag), Morgan Kaufmann
  - Networked Virtual Environments: Design and Implementation (by S. Singhal and M. Zyda)
  - 3D User Interfaces: Theory and Practice (by D. Bowman, E. Kruijff, JJ. LaViola, I. Poupyrev)
  - Touch in Virtual Environments: Haptics and the Design of Interactive Systems (by Margaret L. McLaughlin, Joao P. Hespanha, Gaurav S. Sukhatme)









Topics

- VR Overview & History
- Input devices and tracking system
- Vision and Visuals
- Displays and Rendering
- Interface
- Applications
- VR Software
- Networked Virtual Environment
- Augmented Reality/Mixed Reality
- 3D User Interface Techniques
- Haptics
- 3D Display
- Presence

Schedule

- 1week : Course Overview
- 2week : Introduction to Virtual Reality
- 3week : VR System Input & Tracking
  Term Project Group Formation
- 4week : Vision & Visuals
  Term Project Proposal Presentation
- 5week : VR Displays & Rendering
- 6week : VR Interaction
- 7week : VR Applications
  Term Project Midterm Presentation
- 8week : Midterm Presentation

Schedule

- 9week : VR Application Development
- 10week : Networked Virtual Environments
- 11week : Augmented Reality/Mixed Reality

  Term Project Progress Report Presentation
- 12week : 3D User Interface
- 13week : Haptics
- 14week : Presence
- 15week : Term Project Final Presentation

  Final Exam

Evaluation

- Attendance: 20%
  - A maximum of 2 absences are permitted. After that, 2% deduction is applied to the total score.
  - Missing more than 1/3 of a course will result in F.
- Final exam: 20%
  - Take-home exam covering the material presented in class
- Paper reading, presentation, discussion: 30 %
  - 10% for paper presentation
  - 10% for paper reading & summary report
  - 10% for discussion
- Term Project: 30%
  - 5% for term project proposal
  - 10% for progress report
  - 5% for project implementation
  - 10% for final demonstration & presentation

Paper Presentation

- Paper presentation: 10 %
  - The paper presentations will be done individually
  - 20 minutes for presentation & 10 minutes for questions at the end
  - Depending on the classroom size, students will present 2~5 papers
  - You can find a paper of your interest from the reading list or online resources
- Paper reading: 10 %
  - Every student is expected to read the paper before coming to class – *Submit the 1-page long paper summary report at the beginning of class*
- Discussion & participation: 10%
  - Every student bring at least one question so that we can have a good discussion on the material

Paper Presentation

- Preference will be given to more recent papers from:
  - Presence: Teleoperators and Virtual Environments
  - IEEE Computer Graphics and Applications
  - IEEE Virtual Reality conference
  - IEEE International Symposium on Mixed and Augmented Reality
  - ACM SIGGRAPH conference
  - ACM Symposium on Virtual Reality Software and Technology
  - International Journal of Virtual Reality
  - Computers & Graphics
  - Virtual Reality
  - …

Paper Presentation

- Topics of interest for readings:
  - 3D Display: holographic, autostereoscopic, parallax polarixer barrier
  - 3D Interface: multimodal input recognition, 3D touch interface, etc
  - VR applications: rehabilitation, education, tutor, etc
  - Augmented reality: AR outdoor applications, magic book, etc
  - VR hardware: next-generation VR systems, etc
  - Haptic: Air-jet force feedback, haptics for nanorobotics, etc
  - Input: bare-hand 3D gesture, 3D input device design issues, etc
  - Interaction: locomotion, multimodal menu,
  - Networked VR: DIS, HLA, tele-surgery, telesensation, etc
  - Presence & Evaluation
  - Vision: stereo-vision intelligent robot, VR object composition using stereo-vision
  - Education: ecosystem dynamics education

Tentative Paper Presentation Schedule (Week2)

- 3week –
- 4week –
- 5week –
- 6week –
- 9week –
- 10week –
- 11week –
- 12week –
- 13week –
- 14week –

Term Project

- Topics: **AR/VR for Human Action Recognition**
- Students are encouraged to work on a project related to your own area of interest.
- Projects can be done as groups of 2~3 students (group formation by 3rd week).
- Project proposal (10-min ppt) (4th week)
- Project midterm presentation (15-min ppt) (7th week)
- Project progress report presentation (15-min ppt) (11th week)
- Final term project report & presentation (30-min ppt) (15th week)

Term Project

- Project proposal
  - Project groups will form (2~3 students in each group)
  - Once a group is form, notify me by email
  - 10-minute presentation
- Project midterm & progress report
  - 15-minute presentation
  - 4-page long progress report for the project & 15-minute presentation
- Project implementation
  - Groups will develop the interactive VR application, necessary on your chosen topic.
- Project final report
  - 30-minute in-class presentation & demo
  - 10-page long final report for the project will be in the style of a technical conference paper

https://ai4robot.github.io/etri-activity3d-en/#

ETRI-Activity3D

A Large-Scale RGB-D Dataset for Robots to Recognize Daily Activities of The Elderly

Background

As part of the solutions to an aging society, research on elder care robots has been actively carried out around the world. In order for robots to understand the elderly and provide context-sensitive services, robotic intelligence technologies that can identify various human attributes is essential. Among them, action recognition is a fundamental technology to understand the intentions of human behavior and grasp the daily life patterns of human users.

The massive success of the deep learning approach has enabled rapid improvement in many computer vision tasks. Efforts to create large scale datasets to accelerate deep learning studies have been underway in extensive research areas, including human action understanding. However, despite the large number of publicly available datasets, there is a great lack of adequate data for robots to recognize daily activities of human users. Most datasets have no consideration for the robotic environment in which humans and robots live together. Furthermore, there is no large-scale visual dataset at all that deals with the everyday behavior of the elderly. The absence of datasets centered on robots and humans has been a serious impediment to robot intelligence researches, especially for elder care robots.

Introduction

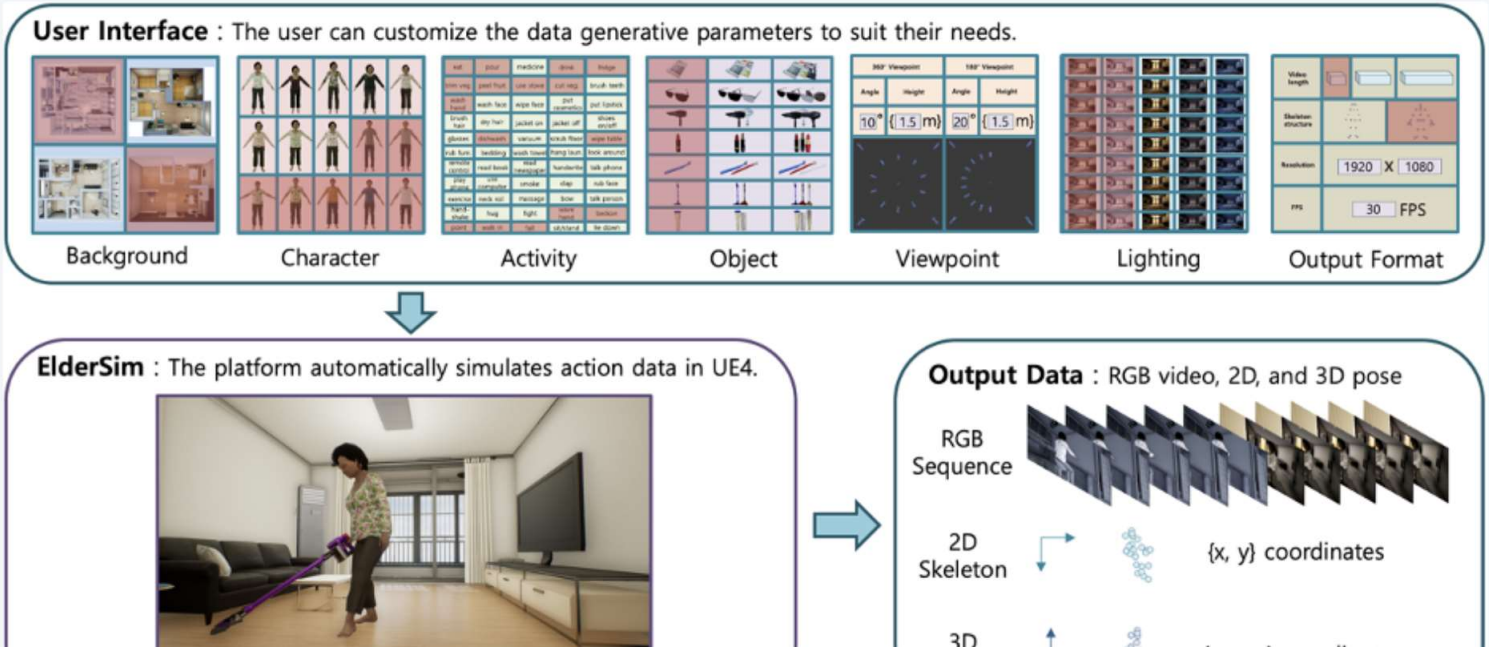
https://ai4robot.github.io/ElderSim/

ElderSim / KIST SynADL

Synthetic Action Simulation Platform for Elderly Action Data Generation

The world's elderly population growth emphasizes the necessity of eldercare technologies and underlines the role of action recognition tasks to comprehend elders' activities of daily living. However, most public datasets used in human action recognition either differ from or have limited coverage of elders' activities in many aspects. Moreover, data acquisition of elders' ADL is challenging due to the privacy and physical limitations of the elderly.

We introduce **ElderSim**, a synthetic action simulation platform that can generate synthetic data on elders' daily activities. For 55 kinds of frequent daily activities of the elders, ElderSim generates realistic motions of synthetic characters with several customizable data-generating options and provides several output modalities. We also provide **KIST SynADL dataset** which is generated from our simulation platform.



Announcement

- HW0: Post 2~3 (your presentation) papers to e-learning due by week3
- HW1: Investigate 2~3 Skeleton-based Human Action Recognition dataset and summarize the characteristics of each. Submit HW1 to e-learning due by week3
- Paper presentation schedule on week2
- Paper presentation start on week3
- Term project proposal(10-min ppt) on week4
- Class blog: http://dis.dankook.ac.kr/lectures/vr23/