Online Game Systems

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Introduction

This course covers the concepts underlying networked games (NGs) and networked virtual environments (NVEs), from their definition, to distributed systems, to networking fundamentals, quality of experience and game design needs.

Topics

- the challenges of networked games
- the origins of networked games technology
- communications architectures
- managing dynamic shared state
- systems design: client server vs peer to peer
- real-time collision detection and response
- resource management for scalability and performance
- Managing online games

Reference Texts and Readings

- Grenville Armitage, Mark Claypool, Philip Branch, Networking and Online Games - Understanding and Engineering Multiplayer Internet Games, Publ. by Wiley
- Sandeep Singhal and Michael Zyda, Networked Games: Design and Implementation, Publ. by Addison Wesley
- Anthony Steed and Manuel Fradinho Oliveira, Networked Graphics: Building Networked Games and Virtual Environments, Publ. by Morgan Kaufman
- Readings from recent papers in the networked game area

Outline of Course

Week 1 – Introduction
Week 2 - The Challenges of Networked Games
Week 3 – The Origins of Networked Game Technology and Massive Multiplayer Online Games (MMOGs)
Week 4 - Networking - An Overview
Week 5 - Networking Challenges
Week 6 - Networking Compensation Techniques
Week 7 - Playability - End User Experience
Week 8 - Traffic Measurements and Patterns
Week 9 - System Design
Week 10 - Resource Management
Week 11- Managing Online Environments
Week 12 - Future Directions
Week 13 -14 Discussions and Presentations

The Challenges of Net Games

- Components of an Online Game
  - Graphics Engines and Displays
  - Control and Communication Devices
  - Processing Systems
  - Data Network
- Design Challenges
  - Heterogeneity
  - Distributed Interaction
  - Real-Time System Design and Resource Management
  - Failure Management
  - Scalability

History of Multiplayer Online Games

- Early Multiplayer Games
- Multiplayer Networked Games
- Evolution of Online Games
- Evolution of Online Game Platforms

Communication Architecture

- Definition of an Architecture
- The Internet Model
- IP/TCP/UDP
- Routing
- Addressing

Network Challenges

- Definition of Latency, Jitter, Loss
- Sources
- Control
- Measurement
- Quality of Service
- Quality of Experience

Latency Compensation Techniques

- Dynamic Shared Space
- Prediction
- Time Manipulation
- Visual Tricks

Playability vs Network Conditions and Cheating

- Quality of Experience
- Measuring Player Tolerance
- Creating artificial network conditions
- Cheats

Traffic Measurements and Patterns

- Measurements
- Packets sizes
- Inter packet arrival times
- Estimating Traffic
- Simulating Traffic

System Design

- Multiplayer Client-Server Systems
- Multiplayer Client-Server, with Multiple-Server Architectures
- Peer-to-Peer Architectures
- Event-Based Systems
- Computational Resource Management
- Real-Time Rendering

Management of Scalability and Performance

- Optimizing the Communications Protocol
- Packet Compression
- Packet Aggregation
- Controlling the Visibility of Data
- Area-of-Interest Filtering Subscriptions
- Multicasting
- Hybrid Multicast Aggregation
- Taking Advantage of Perceptual Limitations
- Exploiting Level-of-Detail Perception
- Exploiting Temporal Perception
- Enhancing the System Architecture

Managing Online Multiplayer Games

- The Discovery Problem
- LAN-Based Discovery
- Game Broadcast
- Internet-Based Discovery
- Lobby Servers, Directories, and Registration Rooms
- Distributed Game and Node Discovery

Future Directions

- Next Generation Systems
- Augmented Reality
- Server Browsers