Overview

- **Research topic:** Sketch-based 3D model retrieval
  - An intuitive user interface scheme
  - Promising in: game design, 3D animation and human computer interaction, etc.

- **Motivation:** Big semantic gap exists between traditional human-drawn 2D sketches and 3D models
  - 2D sketch: an iconic representation of an object
  - 3D model: accurate representation of the geometry information
  - Constraining a sketch to two dimensions limits the 3D information that can be communicated:
    - Creates a huge semantic gap between 2D sketch and 3D model
    - Makes 2D sketch-based 3D model retrieval very challenging

- **Proposed:** 3D sketch-based 3D model retrieval
  - 3D sketch
    - Encodes 3D information, depth and features of more facets of the object
    - Includes the salient 3D feature lines of its counterpart of 3D models
  - An initial study on 3D sketching
  - Proposes a novel 3D sketch-based 3D model retrieval system

- **Research results:**
  - Promising retrieval performance has been achieved in experiments based on
    - 300 collected 3D sketches (Kinect300)
    - A recent large scale sketch-based 3D shape retrieval benchmark (SHREC13STB)

- **Contributions:**
  - A novel 3D sketching virtual drawing "board" (software) is proposed and implemented
  - Allows users to freely draw 3D sketches in the air (a real 3D space)
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  - Contains both online and offline processes
  - Consists of three major components: data processing, feature extraction, and matching
  - A novel 3D sketch-based 3D model retrieval system is introduced for the first time to solve the matching problem between 3D sketches and models

3D Sketching

- **Considerations:**
  - Target: a smart, user-friendly, and inexpensive 3D sketching virtual drawing "board"
  - Using Microsoft Kinect
    - A popular and low cost motion sensing input device
    - Offers a built-in color VGA video camera, depth sensor, and multi-array microphone
    - Supporting a voice-activated Kinect-based 3D sketching Graphical User Interface (GUI)
    - Enables sketching and retrieval
  - Functionality:
    - Not only tracks the movement of a user's hand, but also supports voice commands
      - e.g. start, left/ right (hand), pause, resume, front/side view, search, and reset
    - A Kalman filter is applied to combat the noise due to shaking of hand

3D Sketching (Cont.)

- **Overview:**
  - An efficient 3D sketch-based 3D model retrieval system
    - Contains both online and offline processes
    - Consists of three major components: data processing, feature extraction, and matching

Experiments

- **Kinect300 3D sketch dataset collection**
  - Based on the drawing "board", we have collected a 3D sketch dataset named Kinect300:
    - 300 sketches in 3 object categories, each with 10 sketches
    - Collected from 31 users (4 females and 13 males) with an average age of 21 years

- **3D sketch-based 3D model retrieval**
  - Evaluation metrics:
    - Nearest Neighbor (NN), First Tier (FT), Second Tier (ST), E-Measure (E), Discounted Cumulative Gain (DCG) and Precision-Rank (PR)
  - Query set: a hand-drawn 3D sketch from Kinect300
  - Target dataset: SHREC13STB benchmark [2] (target dataset only):
    - 1,258 target 3D models of 90 classes

- **Performance:**
  - Efficiency: only 1.22 sec to perform a 3D model retrieval given a hand-drawn 3D sketch
  - Accuracy:

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  (a) Simple
  (b) Complicated

  - Sketch-model retrieval is a challenging task
  - Still much room left for further improvement in this task
  - More descriptive shape descriptors are desired for further exploration

References


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