Rubikon: A Multimodal Tutor for 3D Physical Task Learning

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Introduction

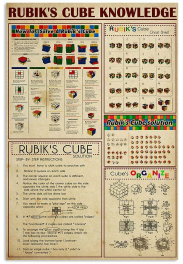
Motivations

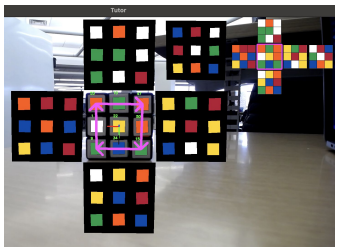
Traditionally, self-learning of **3D physical tasks** relies on 2D static instructions, e.g. manuals, which

- Lack instant feedback / dynamic task generation for knowledge enhancement
- Have high cognitive load for hidden information

The Intelligent Tutoring System (ITS) is a potential approach to them. Challenges include

- Capturing learners' behaviors in 3D space
- Preserving learning space & reality similarity





Goals

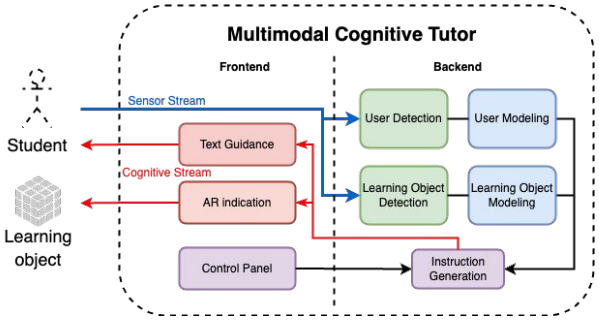
A **Multimodal Tutor** framework for ITS composed of AI and AR, aiming to augment current tutorial methods and contribute scientific understanding to the teaching and learning of physical 3D tasks.

Desired features include:

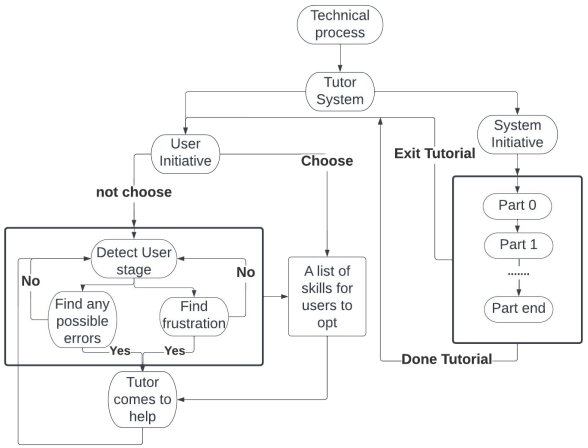
- Immediate feedback + dynamic task generation
- View Extension to expose hidden information
- Learner modeling through multimodal input
- Preserving perspectives of reality for users

Instance: Rubik's Cube

System Architecture



User Journey



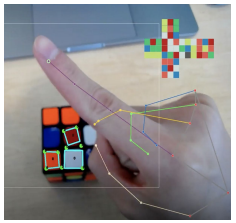
AR features

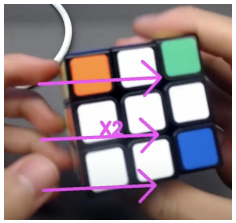
Extended View: show hidden information

Hand Tracking: detect user movement to allow interaction with system

Audio: provide guidance and system status

Arrow guidance: provide visual aid for rotation





Design Considerations and Expected Outcomes

Our new ITS:

- **Immediate or preemptive feedback:**
  Detect error via cube stage
- **Cognitive load reduction:**
  Extend views for hidden information
- **User behavior tracking**
  Process multimodal user inputs (hand tracking, user static time, user stage, etc..)
- **Immersive environment:**
  Uses AR to add guidance and extended views
  HoloLens might be applied in future
- **Freedom of choice:**
  Provide user & system initiative modes
- **Targeting practice:**
  Improve user weakness