Gesture-based Learning: Learning Environments of the Future

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Abstract

•Research studies have shown that gestures enhance learning
•Potential of gesture-based interaction for providing a novel form of interaction, expression, and activity
•Current technologies have limitations (accuracy, comfort, cost)
•Solution: Kinect sensor + Unity +SDKs
•Results: Proof of concept

Introduction

•Gestures enhance learning
•Currenr technologies have limitations
  •accuracy in detection gestures
  •providing comfortable environment
•Potential of TOF cameras
  •providing depth information
  •easy figure-ground segmentation
  •robust to environmental noise (lighting, reflection, shadow)

Literature Review

•Comprehension and consequently memory is enhanced by gestures
•Gestures facilitate deep and long-lasting learning
•Gestures help externalization of thoughts
•More cognitive resources become available for learning from the limited resources of the mind
•Current gesture-based interaction technologies use expensive sensors with wires or optic cameras
•Problems:
  •Expensive equipment
  •Uncomfortable environments
  •Low accuracy in detecting gestures

Results

4 different activities were performed.
1. Vector addition education software
2. Mirror education simulations
3. Character learning with painting
4. Gesture recognition using kNN classfier

Vector Addition:

- A software that detects gestures, and
- Plots 3D vectors on the screen,
- Draws the addition of vectors

Figure-1 Vector addition

Mirror Puzzle:

- A puzzle game to teach mirror concept
- Goal: reflect the light to target position
- Using gestures to position the mirrors and to change their orientations.

Figure 2- Mirror Puzzle

Gesture Recognition:

- Goal: To classify 5 gestures (right, left, up, down and push).
- k-nearest neighbors algorithm used.
- The algorithm stores all available cases and classifies new cases based on a similarity measure.
- K=1, Measure =Euclidean distance
- Data: 6 Ss X 5 gestures X 10 times
- Results: In the first test, first 5 gestures of each movement of every subject were used for training, and the remaining ones were used as testing. The success rate in this case is 99.32%.
- In the second case, the gestures of the 3 subjects were used as training data and the gestures of other 3 subjects were used as testing data. In this experiment, the success rate is 98.65%.

Character Learning with Painting:

•Using gestures to learn writing characters
• This software may be used in primary schools for teaching how to write the characters, or it may be used to teach foreign languages such as Chinese to adults as well.

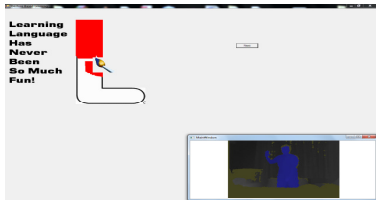

Figure 3- Character Painting

Discussion

•Potential of TOF technology to create gesture-based learning environments
•Problems in detecting gestures accurately
•Opportunities to classify gestures by intelligent algorithms

Project Outputs

•An article published in British Journal of Educational Technology (indexed in SSCI)
•An application to an European Union FP7 project as a partner
•An application to a TUBITAK fund (2209) for undergraduate students

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