Influence of Olfactory and Auditory Senses on Fairness Between Players in Networked Virtual 3D Object Identification Game with Haptics

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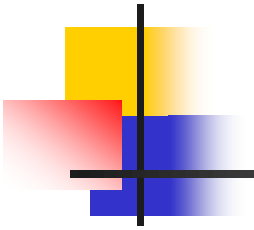


Outline

- Background
- Purpose
- Networked Virtual 3D Object Identification Game
- Assessment System
- Assessment Results
- Conclusions and Future Work

Background

By using multisensory communication, we can realize various applications such as networked games with high sense of presence.

In the games, fairness between players is important to reflect the game ability of each player to win-loss records.

We sometimes cannot use some senses by sickness, injury, surroundings, and so on.

We need to assess the fairness in various networked games.

Purpose (1/2)

*1 Y. Ishibashi *et al.*, Springer's Multimedia Systems Journal, vol. 20, issue 5, pp. 621-631, Oct. 2014.
*2 M. Sithu *et al.*, IEICE Technical Report, CQ2015-144, Mar. 2016.

Previous work

- The influence of the difference in time until smells
- H
  wit
  virt
  3D

The system is standalone, and we also need to assess the influence of olfactory and auditory senses on the fairness in networked games.

What kinds of factors largely affect the fairness is not necessarily clear enough, and we need to investigate other factors on the fairness.

Purpose (2/2)

*2 M. Sithu *et al.*, IEICE Technical Report, CQ2015-144, Mar. 2016.

This work

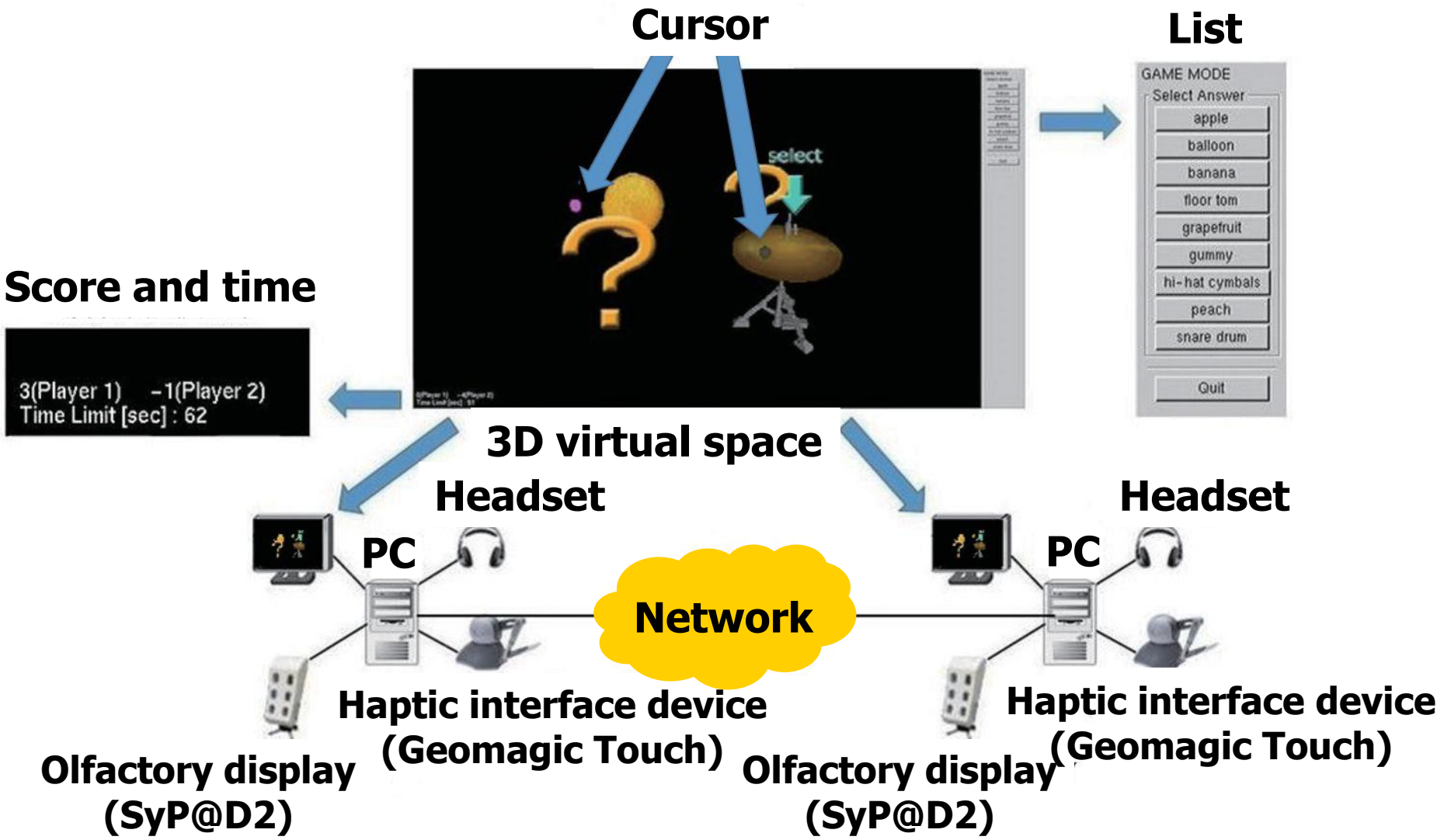
Virtual 3D Object Identification System *2

Extension

Networked Virtual 3D Object Identification Game

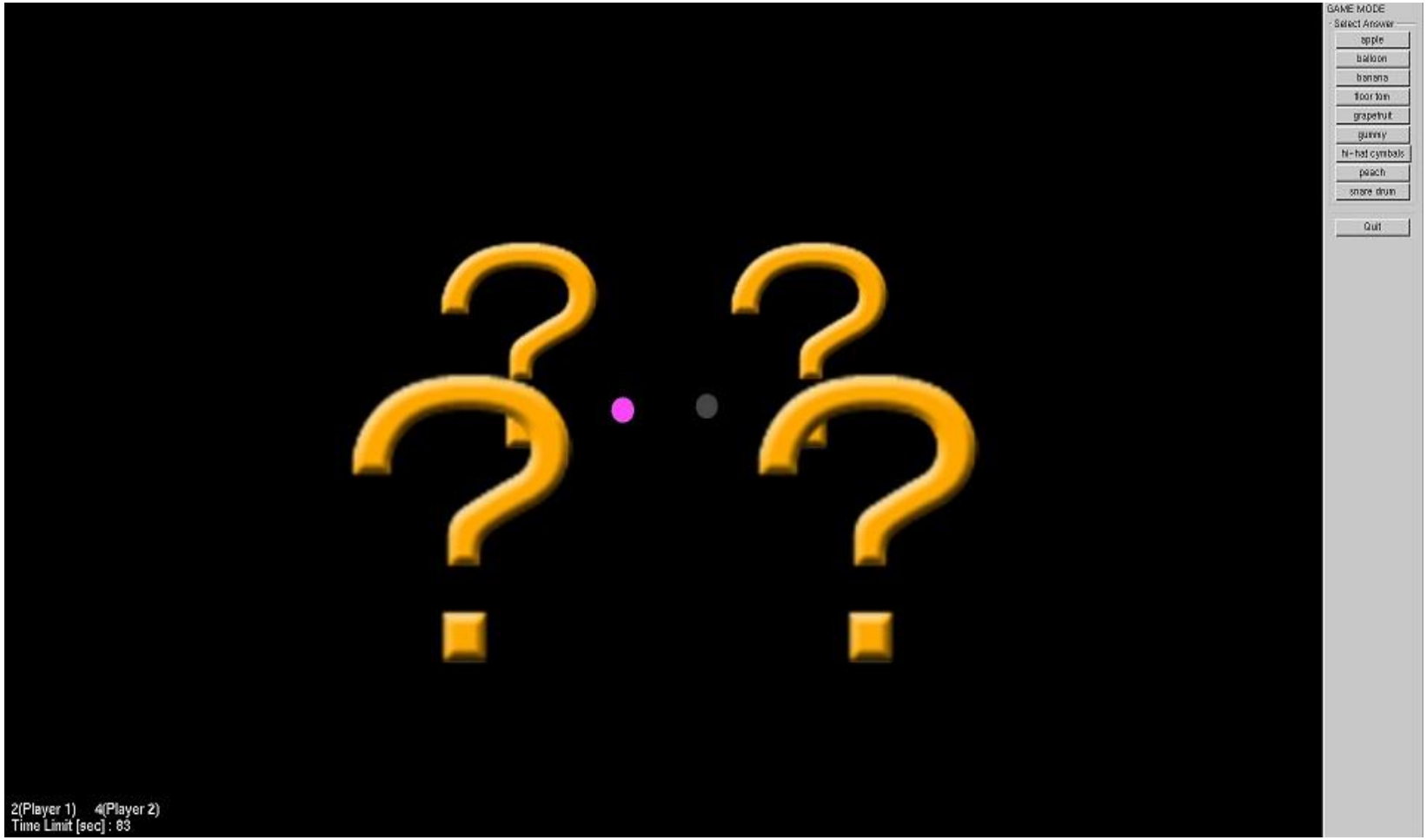
We investigate the influence of olfactory and auditory senses on the fairness by QoE assessment for the networked virtual 3D object identification game with haptics by switching whether olfactory and auditory senses are employed or not.

Networked Virtual 3D Object Identification Game



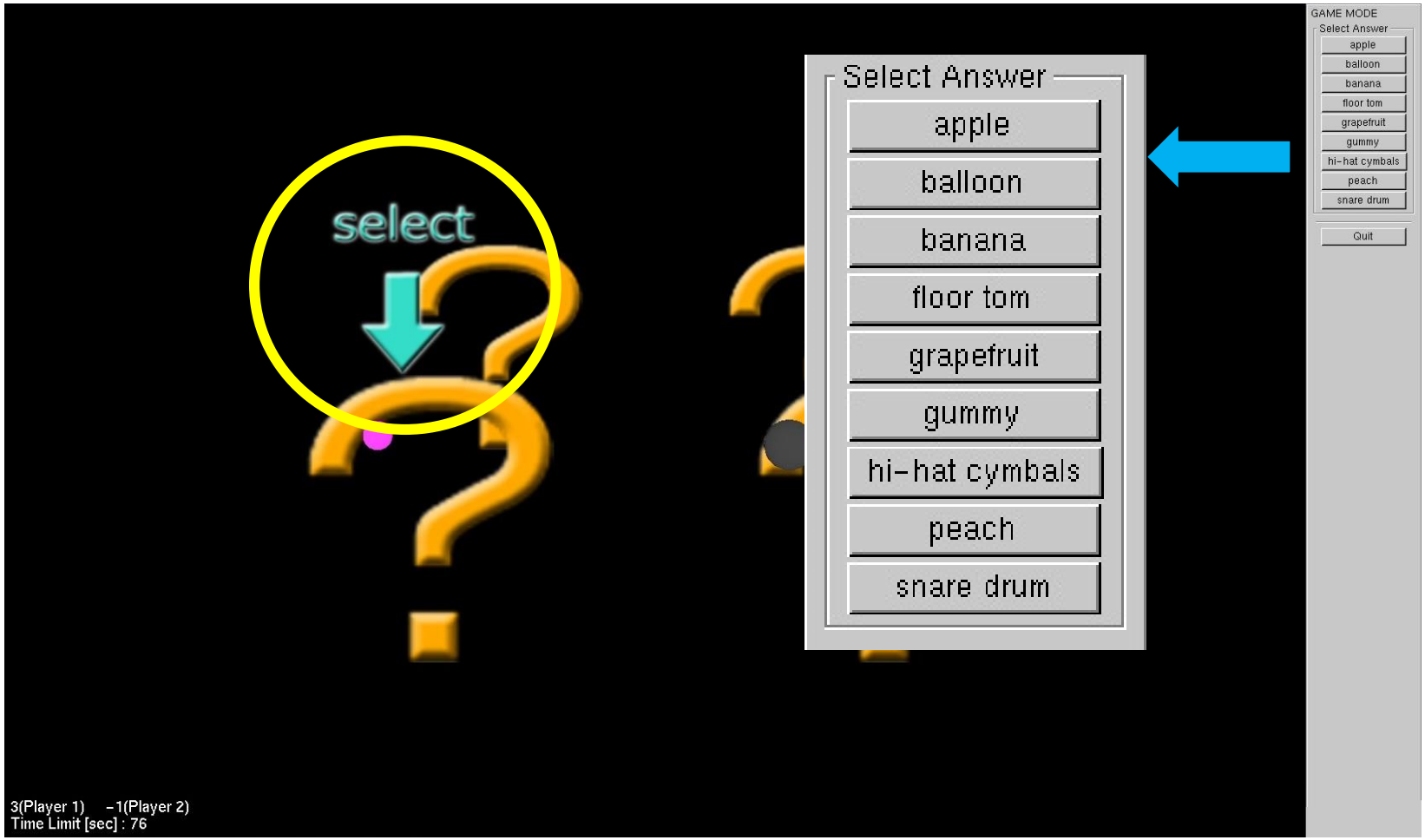
Displayed Image of Game (1/3)

Start of game



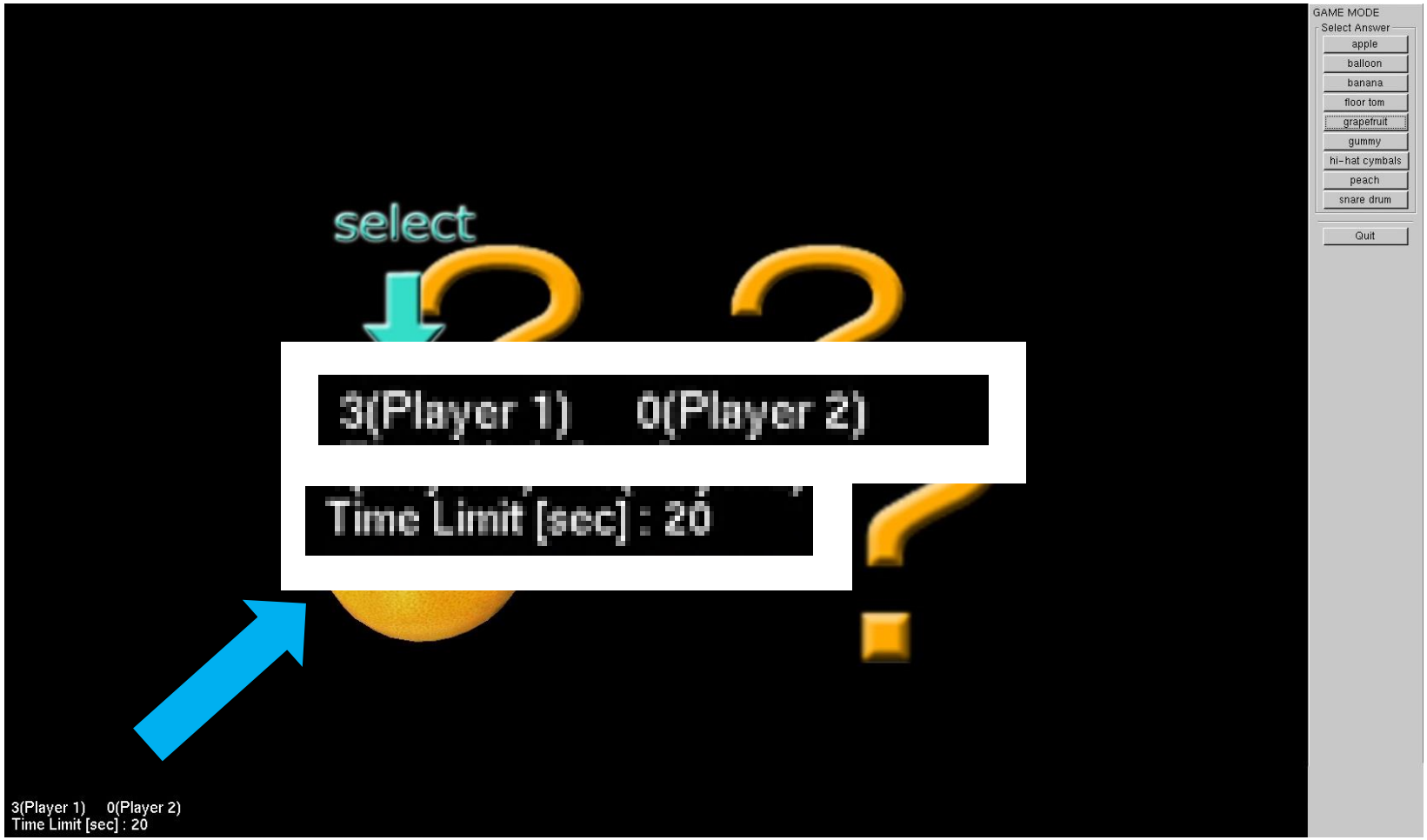
Displayed Image of Game (2/3)

Object selection



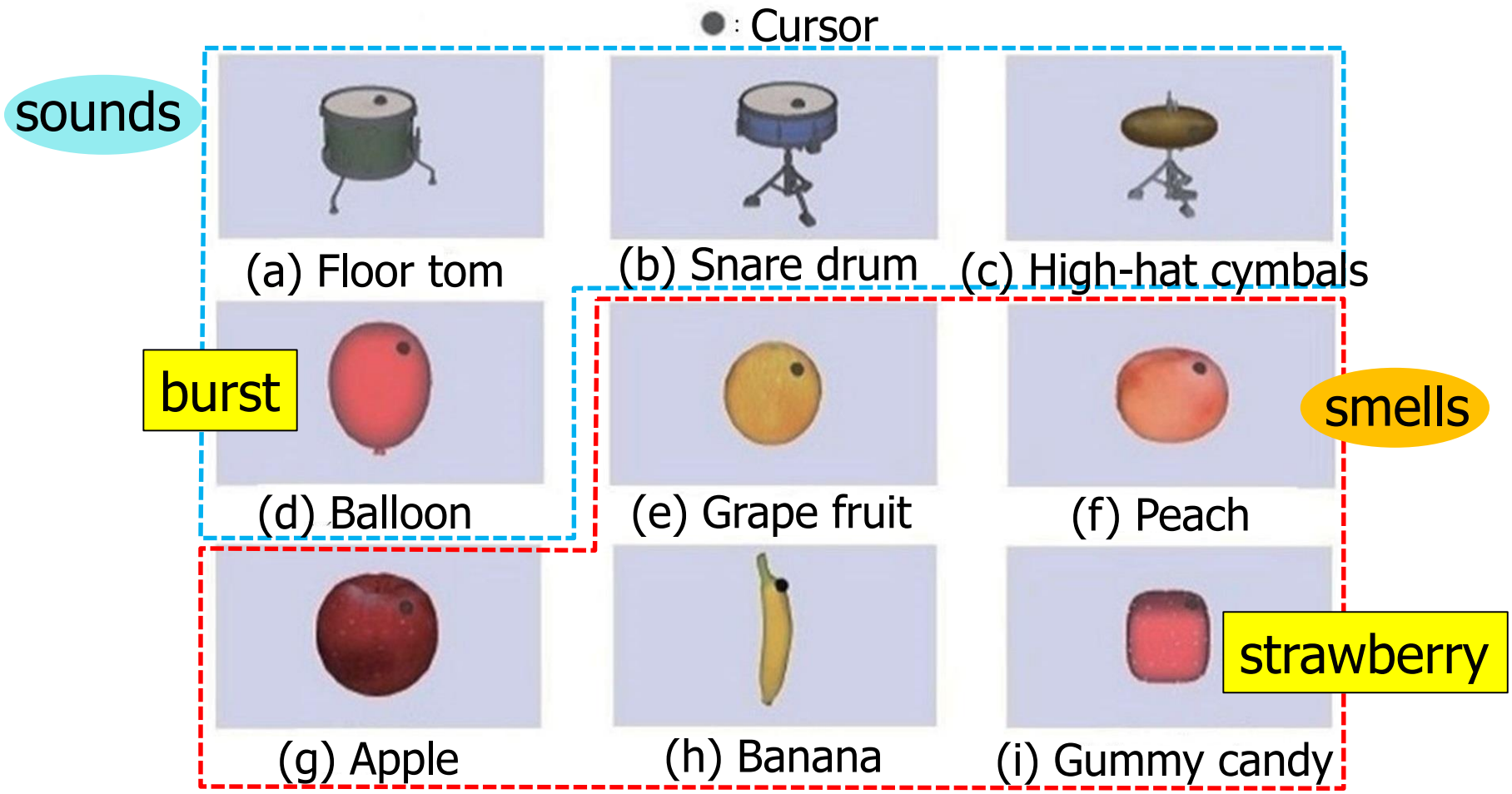
Displayed Image of Game (3/3)

Correct answer



Objects

We use nine objects which have different smells or sounds and different features such as the shape, softness, and smoothness.



Demo video

Assessment System (1/5)

- The two PCs are connected to each other directly by an Ethernet cable (100BASE-TX).
- Subjects assess the fairness of the game in three cases.
  - Case 1: Smells and sounds are presented to a pair of subjects.
  - Case 2: Smells and sounds are presented to only one subject of the pair.
    (We also switch the condition between the subjects.)
  - Case 3: Smells and sounds are not presented to any subject of the pair.

  The order of the cases provided to each pair is random.
- When the conditions of a pair of subjects are the same as each other, we regard the game as fair.

  ➡ Cases 1 and 3 are fair.

Assessment System (2/5)

- Four objects randomly-selected from among the nine are placed in the 3D virtual space.
- When the pair answer all the four objects correctly or the time in the game exceeds 90 seconds, new four objects are placed again until the end of game.
- Twelve objects are used totally in the assessment.

Assessment System (3/5)

- Before the assessment, each pair of subjects practice the game in case 3, where the game is fair.
- We regard a score in this case as the *standard score*.
- Whenever the game finishes, each subject is asked to give a value of 1 to 5 for each stimulus based on the five-grade quality scale.

Five-grade quality scale

Score	Description
5	Fair
4	Rather fair
3	Neither fair nor unfair
2	Rather unfair
1	unfair

Assessment System (4/5)

- We calculate MOS (Mean Opinion Score) by averaging the values of all the subjects.
- We use the absolute difference between the difference in standard score and that in assessment score as an objective assessment measure in order to take account of the difference in game ability between subjects.

For example

Standard score	Assessment score
1 to 4	3 to 2

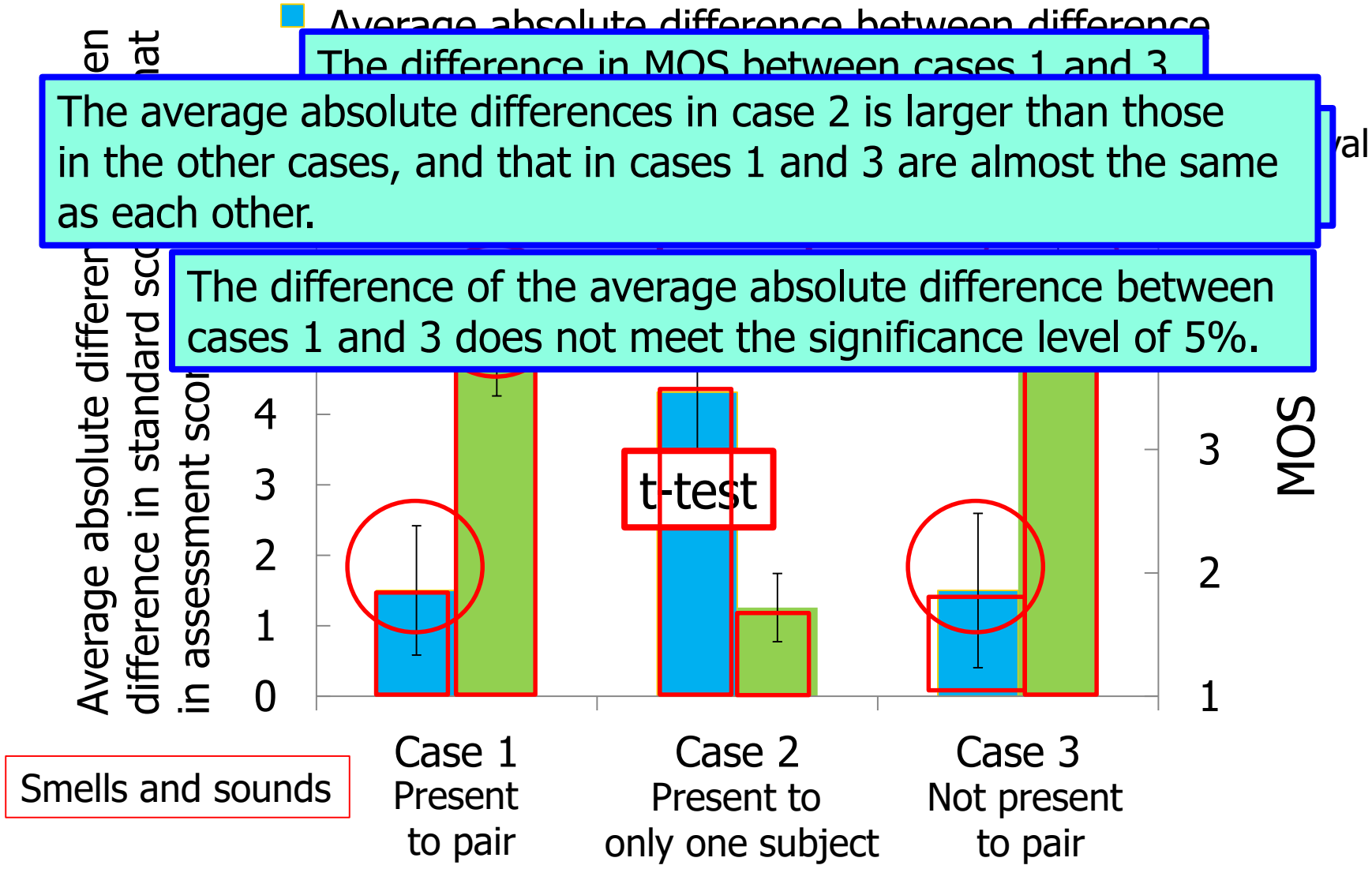
We obtain 4 because $|(1 - 4) - (3 - 2)| = 4$.

Assessment System (5/5)

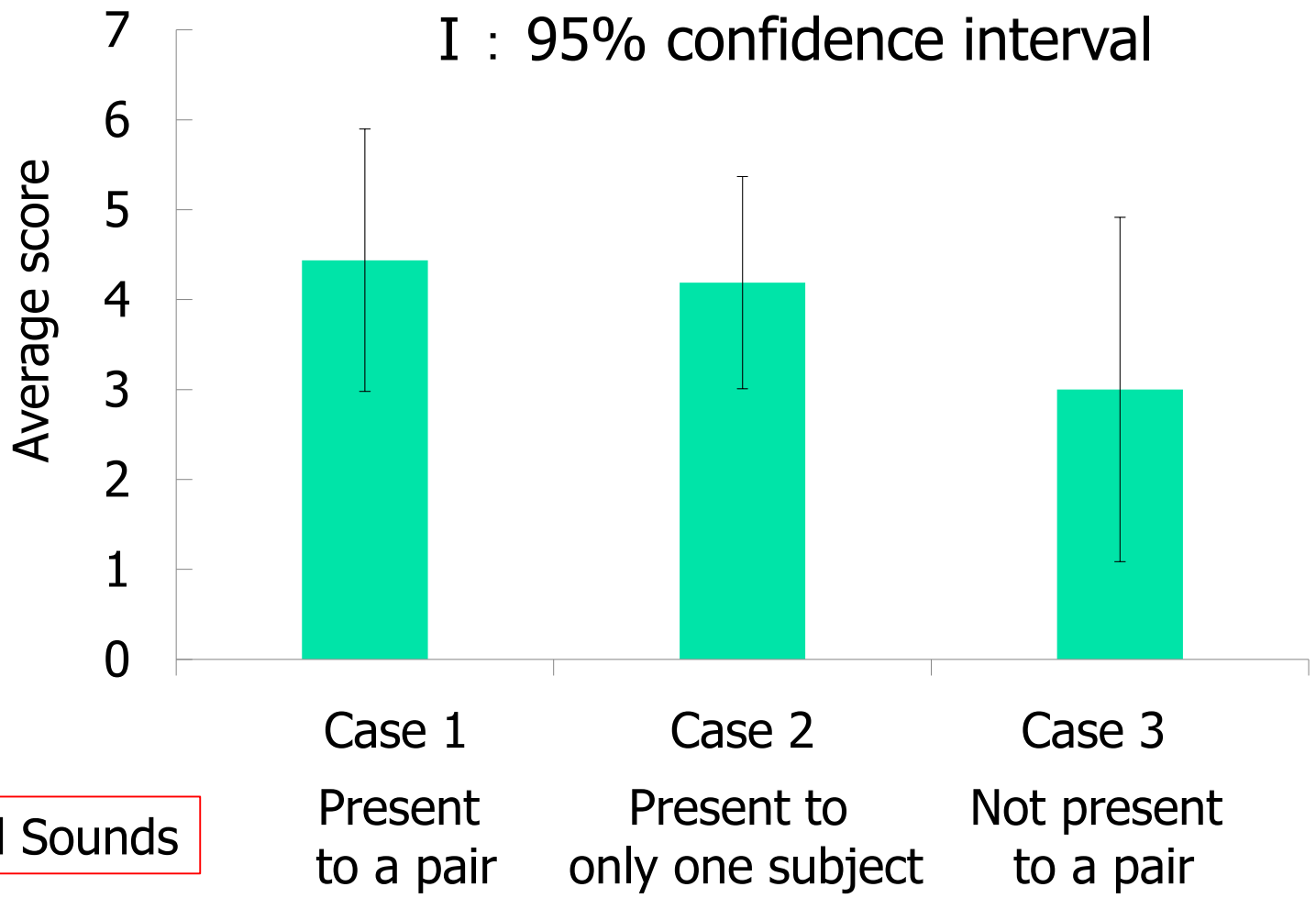
*1 Y. Ishibashi *et al.*, Springer's Multimedia Systems Journal, vol. 20, issue 5, pp. 621-631, Oct. 2014.

- We set the distance between the olfactory display and each subject's nose to 0.3 m. *1
- The room temperature was set to 26 ℃. *1
- We carried out the assessment with 16 subjects (males and females) whose ages were between 22 and 24.

Assessment Results (1/3)

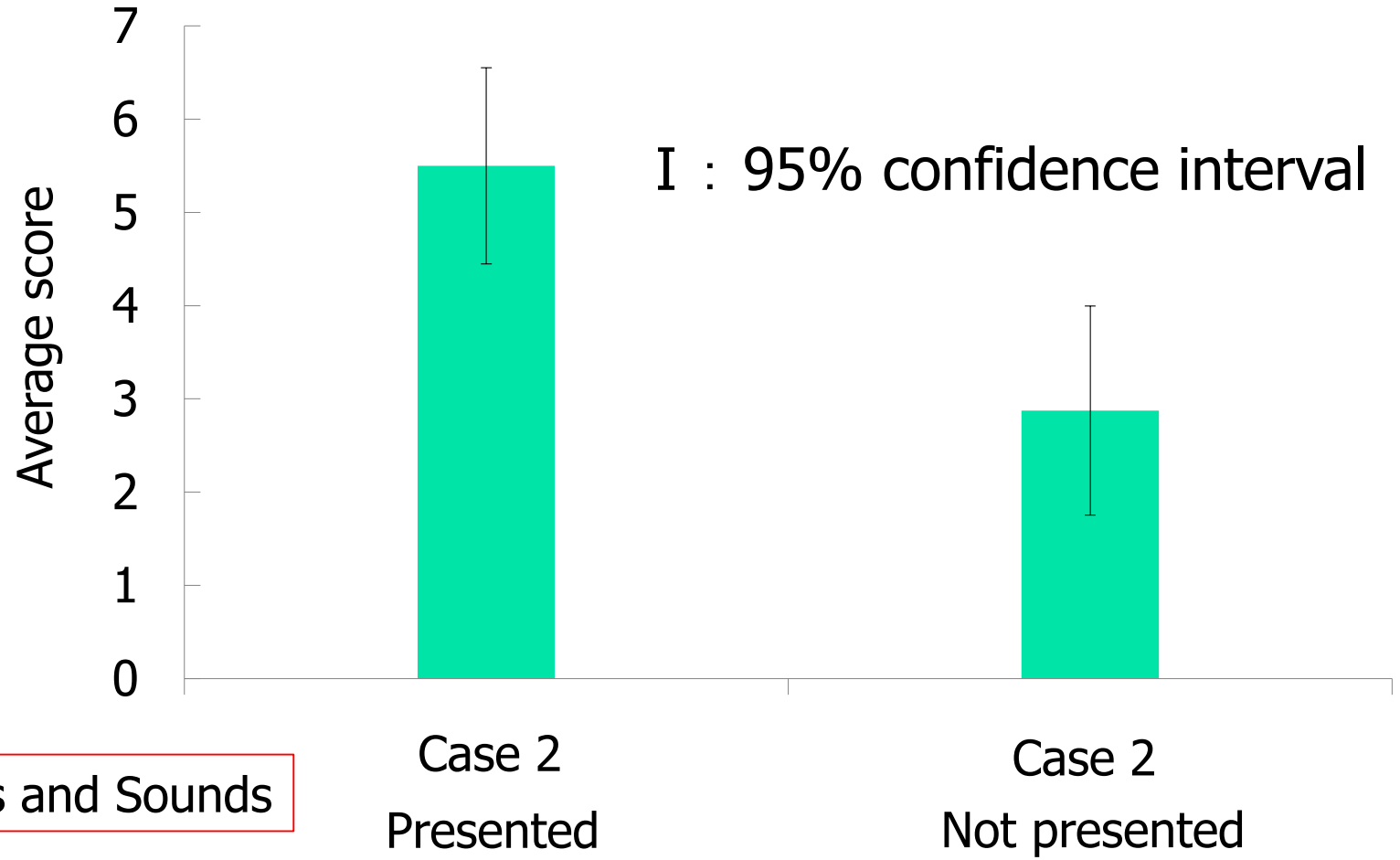


Assessment Results (2/3)



Smells and Sounds

Assessment Results (3/3)



Smells and Sounds

Conclusions

We investigated the influence of whether olfactory and auditory senses are used or not on the fairness between players in a networked virtual 3D object identification game with haptics.

We saw that the fairness of the game is seriously damaged when the senses are employed only at one player.

Future Work

- We will assess the fairness in the case where we present only smells or only sounds for the game.
- We will increase the number of objects in the game.