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Combining Augmented Reality and Multi-User Remote Collaboration to Improve Sustainable Agriculture and Economy

Bo-Yiang Jiang
Dept. of Digital Media Design
National Yunlin University of Science and Technology, Yunlin, Taiwan
m11035004@yuntech.edu.tw

Chao-Ming Wang
Dept. of Digital Media Design,
National Yunlin University of Science and Technology, Yunlin, Taiwan
wangcm@yuntech.edu.tw

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***Abstract*— Agri-food education activity becomes more and more important as modern agriculture has caused damage to biological ecology. However, the activity is faced with a lack of expert human resources and motivation to participate. It results in ineffective cognition of healthy consumption. In this study, a novel model of multi-user remote collaboration using wearable augmented reality (AR) that aims to improve participants' motivation is proposed. At present, the system only proposes concepts and prototype designs, expert interviews and participant interviews will be used to improve the system in the future. The expected results of this study are as follows. Using the proposed model, which could increase participants' motivation and reduce over-reliance on experts in the activity, to solve the lack in the above. Finally, through prototyping and interview comments, five key points about how the techniques improve problems in the activity are concluded at the end of this paper, providing relevant studies and departments as references.**

Keywords—augmented reality, multi-user interaction, remote collaboration, agri-food, human-computer interaction

I. Introduction

There are almost 10% of the crop in the whole world that relies on insect pollination. Bee, one of the insects, can bring more valuable products such as honey and beeswax, which are reduced in number and yield by human over-used pesticides[1]. This situation also influences human health[2]. In addition to redesigning new approaches to production, increasing people's cognition of healthy consumption would be a better way to prompt the production system to be more sustainable[3]. However, the way often presents inefficient in traditional exhibitions and schooling. Increasing motivation to participate would solve this problem[4]. Some studies show that multi-user network communication[5] and role-playing games[6] can increase the ability to cooperate and motivation to interact. And the effectiveness, of using wearable AR devices to promote cognition of sustainable agriculture, has been confirmed[4]. Therefore, this research proposes a model of multi-user remote collaboration using wearable AR. Taking beekeeping and planting crops as an interactive situation, participants must discuss and make decisions together to balance the ecological and economic systems in the game. Replacing traditional education with immersive interaction to enhance participants' cognition of sustainable agriculture and economy.

II. System Design

We choose AR, which allows groups to solve complex tasks[7], to be the interactive environment. Using mobile as a display, and put into a Merge Headset that supports AR. Because most users tend to use gesture and speech to interact[8], the system contains an interactive glove and a game server that can process speech commands. In Fig. 1, the interactive glove wirelessly transmits data from inertial sensors and flex sensors to the mobile via a micro-controller. And convert data to the movement of arm, palm, and fingers in virtual space. In Fig. 2, syncing local position and showing as an avatar to other remote users via ARCore API and game server. Moreover, the game server translates users' speech to abstract commands[8], such as to get information, create objects or delete objects, via Google Speech API. This system is introduced into the interactive situation in the next paragraph To conduct the experiments of this study.

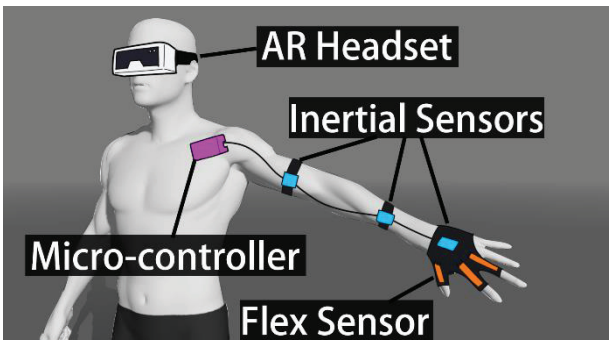

Fig. 1. Device schematic

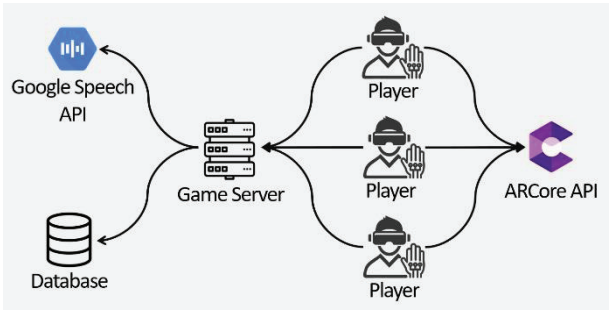

Fig. 2. System structure

III. Interactive Situation

This game allows three participants to remote collaborate at the same time. In Fig. 3, participants enter the game by identifying specific pictures through mobile. And play as a beekeeper, a farmer, and a consumer. In Fig. 4. , the beekeeper produces honey for the consumer which can increase happiness; the farmer produces vegetables for the consumer which can increase health. However, happiness and health diminish over time, and game over when running out of health.

While the game wins if getting enough happiness. At the end of the game, The data of the process of participants' interaction change into a visualization chart which provides participants to reconsider and discuss, how to improve the situation.

(1) Consumer uses speech commands to provide production resources (bees, hives, seeds, and pesticides), which controls production efficiency.

(2) Beekeeper uses gloves to trigger hive to release bees to gather nectar or collect honey from it. And uses speech to send requests, that about ask for more bees or hives, to the consumer.

(3) Farmer uses gloves to Sow, harvest, and crop-dusting. And uses speech to send requests, that about ask for more seeds or pesticides, to the consumer.

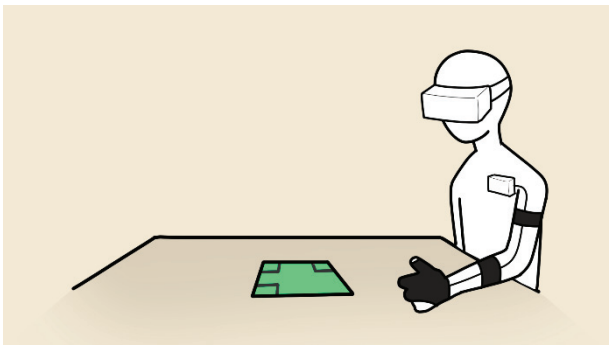

Fig. 3. Participant using the device

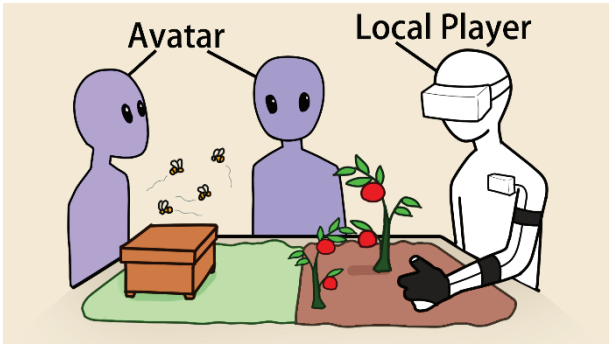

Fig. 4. Virtual interaction

IV. Results And Discussion

Obstacles to agri-food education activities are often due to experts' lack of willingness to participate, participants learning too passively, and difficulty in arranging agricultural experiences. Through using the immersion of AR and the immersive experience of interactive gloves to enhance the learning motivation. On the other hand, participants play different roles, that make decisions with full consideration of interests, needs, and ecological environment, in the game without any expert guidance. This situation allows participants to significantly improve their self-learning ability[6]. In addition, how to reduce the cost of agri-food education activities is an important item, it also prompts the production system to be more sustainable due to participants building healthy consumption. In the future, the system and the interactive situation will be improved by usability, validity, and entertainment through the interview of experts and participants.

V. Conclusion

In this research, using AR and multi-user remote collaboration to build an interactive system are proposed, which enhances the quality of agri-food education activities. Overall, effective agri-food education activities revolve around reducing reliance on expert teaching and improving participants' motivation to learn. Therefore, five key points are concluded to improve the quality of activities and lead to more effective promotion of cognition of sustainable agriculture and economy as follows.

(1) The use of AR technology can make the farming situation present in a real and immersive way, and enhance the motivation to participate.

(2) Provide a virtual space to reduce the difficulty in arranging agricultural experiences.

(3) The multi-user remote collaboration creates opportunities for participants to interact and reduces the dependence of activities on expert teaching.

(4) Participants who play role-playing games tend to be more learning motivation compared to traditional education.

(5) Providing a anonymous environment, such as an avatar, can significantly increase the willingness to interact.

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