

Applying Virtual Reality to Cooperative Learning Grouping

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Abstract

Virtual Reality Modeling Language (VRML) is used to describe 3D virtual interactive world, it also constructs an impressive scene or object in a virtual world. The client user may get contact with others in the virtual world and make them a good impression by using programming languages such as JAVA.

In this thesis, we used VRML to construct an online Collaborative Virtual Environment. With Virtual Reality's immersive ability, students may interact with others just like in the real world. We have an observation on students with the same human relationship and get them together in the virtual world as in the real world. So we can observe the friendship or interaction between teammates quickly and correctly.

Background

Internet is now in widespread use, and it changes the way people acquire information and knowledge. We can now begin learning at any place in any time through internet.

VR in Education

Burdea [1] explains that immersion, interaction, and imagination define VR in Virtual Reality Technology.

- **Immersion**

People were immersed in the virtual world.

- **Interaction**

People can greet friends at the door, or pick up the stone on the ground, or open the room door in the virtual world just the same as in the true world.

- **Imagination**

With people's rich imagination and creativity, people can combine the true world with the virtual world. For example, we can construct a space scene or an inner earth scene that is not easier for people to travel.

There are a lot of researches using VR's immersion to help people learning. VR is regarded as a new technology to show the teaching materials. Learners tour in the virtual scene and discuss with the other learners. Here are some examples:

- **Virtual Planetarium [14]**

Virtual planetarium was developed by National Hsin-Che Teachers College. People can tour in the virtual planetarium and learn information about the solar system.



Figure 1 Virtual Planetarium

- **VR School [15]**

VR school was developed by Department of Information and Computer Engineering, Chung Yuan Christian University. It contains a lot of learning materials and virtual experiments that people can learn and operate experiments online.

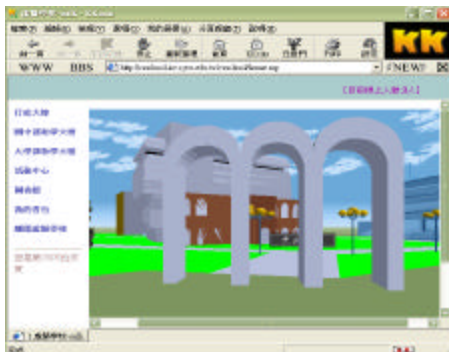


Figure 2 VR School

VR can help student more willing to accept challenging material and work out of curiosity and interest.

Cooperative learning

The top three categories of the learning activity for teacher adopting are:

- **Individualized learning**

Learner can choose some particular parts of the course which interests him. He can control the learning progress by himself, and other learners will not interfere.

But learner failed without teammates to

discuss with on some abstruse parts of course may make him lose his learning motive .

- **Competed learning**

Competed learning encourage learner's learning motive and ambition. But they may become shortsighted because of their aspiration after outcome without paying attention to the progress.

- **Cooperative learning**

Learners work together on a project focusing on different parts. Cooperative learning increases learners' learning motive, achievement, and creativity[3].

Cooperative learning is the most efficient among the three learning categories. It is group not individual in cooperative learning activities. Learners use communicative skills to ensure their learning goals. To group learners and make them work together on learning goals are the characteristics of cooperative learning. The grouping elements of learners are learning capability, achievement, motive, behavior, gender, race...etc. There are a lot of researches on grouping focus on learner's achievements and capabilities. Some researches[10,13] declared that heterogeneous learning is better and some[9] declared there is no difference between heterogeneous and homogeneous learning.

To make cooperative learning activities successful and efficient, grouping methods usually consider heterogeneous grouping by achievement. They promise to make a complementary group in achievement, but does it promise to make a complementary group in friendship? Friendship will affect the group members' interaction frequency. For example, people would rather to get along with good friends than unknown persons.

Interpersonal Relationship and Education

The teammates' interaction will determine the group's learning progress which leads to the success or failures of the learning goal. The bases of interaction are [8]:

- **Interpersonal perception**

Interpersonal perception is people's first impression on others. If people have a high degree of interpersonal perception with each other, then interacting and communicating would be easier.

- **Interpersonal attraction**

The difference of vigor, gender, age, and race could affect people's communicative ability. This is because human learn by classing and chaining. We will identify people with the same background and characteristic. That is, we are able to predict everyone's behavior. People will get nervous and afraid if he can't predict others' behavior.

- **Interpersonal conversance**

When people have interpersonal attraction and well communication with each other, they will get closer and become more intimate.

Edward T. Hall [2] developed his theory of proxemics in 1966. He differentiated four types of human perceptions of space, and they are:

- **Intimate space**

From next to the skin to 1.5', entry into this space is acceptable only for the closest friends and intimates.

- **Social space**

From 1.5' to 4', the space where people feel comfortable conducting social interaction with acquaintances.

- **Consultative space**

From 4' to 12', the space where people feel comfortable conducting social interaction with

strangers.

- **Public space**

12' and upward, the space where people will perceive interactions as impersonal strangers.

Hall thought that proxemics are molded and patterned by culture, that is, the social distance in many parts of Asia may be different from that in the United States. Surely the shorter the social distance is the more intimate people are regardless of the different cultures. For example, if the social distance between two people is very short, then they may be intimate friends or confidants. The social interactions and communication activities between them will be persistent and superior

Basically, it's hard to observe friendships between teammates on a modern online learning environment. In this thesis, we used VRML to construct an online Collaborative Virtual Environment. With Virtual Reality's immersive ability, students may interact with others just like in the real world.

By analyzing the people's mutual distance in the virtual world, we have an observation on students with the same human relationship and get them together in the virtual world as in the real world. So we can observe the friendship or interaction between teammates quickly and correctly.

As shown in figure 3 in a virtual world avatar mirror the user and digital data mirrors the action in the real world.

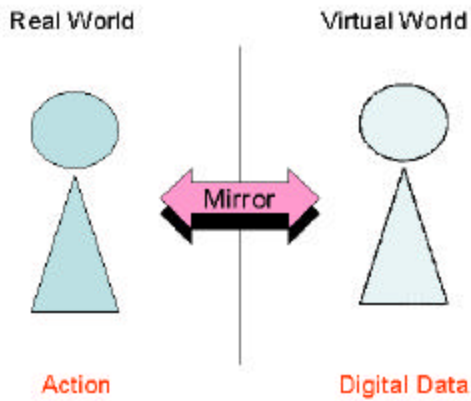


Figure 3 Virtual world mirrors the Real world

System design

We used VRML2.0 and JAVA to construct our virtual environment. VRML2.0 provides an interface EAI[11] to make a virtual world constructed by VRML communicate with all users possible. The EAI provides JAVA class libraries which define the way to get VRML browser functions. So we can use a JAVA applet to control virtual object or update other people's coordinate and information(e.g. chat text).

There are two major parts in our system. One is the JAVA client-server framework and the other is the virtual scene.

1. Virtual scene

We used the Parallel Graphics Limited's production? ISA and ISB[7] to construct our virtual scenes. Every login user will be assigned his own avatar to travel and be recognized in the virtual world.

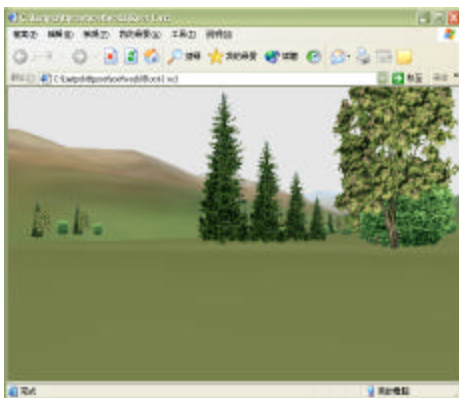


Figure 4 one view of virtual scene

2. client-server

Client programs provide four functions to control and update the virtual scenes. They are:

- **add/remove virtual objects**

This function adds a virtual object (avatar) while a user login to the system and remove the virtual object after the user logout.

- **update the coordinate**

This function update the virtual object(avatar)'s coordinate while user travels in the virtual world. So the others can see where the user is going.

- **control virtual worlds ' status**

This function controls the worlds' status like switching day/night to make the virtual world almost real.

- **Chatroom**

This function makes the user in the system be able to exchange idea, information, and text while traveling in the virtual world. But it has a special restriction that everyone has an invisible circle around him as shown in figure 6. People who want to exchange information should get into the range of circle. Otherwise, information exchanging won't be allowed. Just like in the real world, you can't hear someone's voice if he is far away from you. This function can make users congregate naturally.

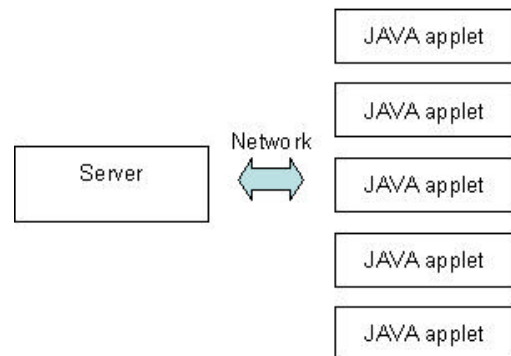


Figure 5 client/server framework

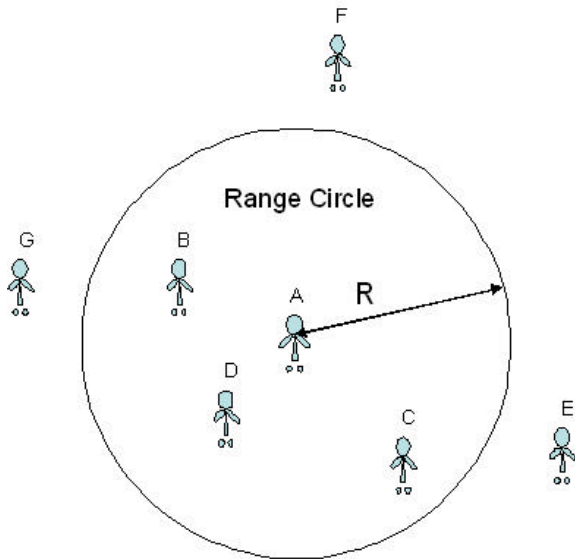


Figure 6 User A's range circle---Only user B, C, and D may receive user A's chat data or Information because they are within user A's range circle.

The server program's function is to receive information like coordinate and chatroom text data from one client program and broadcast it to other client programs. This can synchronize every client program's status. The structure view of system is shown in the figure 7.

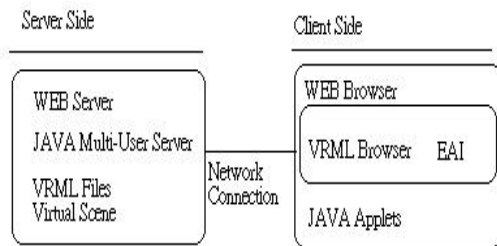


Figure 7 structure view of system

It is very easy for people to learn how to operate in the virtual world. Just like playing a pgame, people can use the computer mouse to go forward, go backward, turn left, turn right, and turn around.

System will add an avatar to the virtual scene while a

user login. That avatar represents the user. Other users can see the avatar acting or moving in their own display. So people can approach that avatar to see what is what is he (avatar) doing or enable the chat function. People can interact with virtual object, too. For example, the virtual birds will fly away after the user touched it by mouse cursor. It interests people.

Classification

We can get the coordinate while users travel in the virtual world and have to make a classification. We use two computational geometry algorithms? voronoi diagram and delaunay triangulation[5] to do some preliminary analyses about two and three people friendship examination.

- **Voronoi diagram**

After implementing the algorithm, we executed the program and got a graphic like figure 8. Each point represents a user.

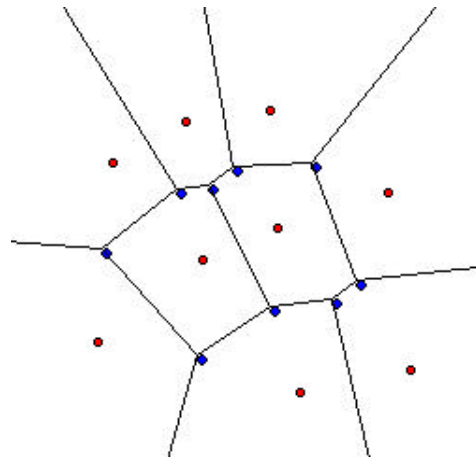


Figure 8 voronoi diagram

Then we calculate the distance between each point to its neighbor points. We choose the neighbor point with the shortest distance. And then it is referred as the best friend. In Figure 9 we choose A and B as best couple.

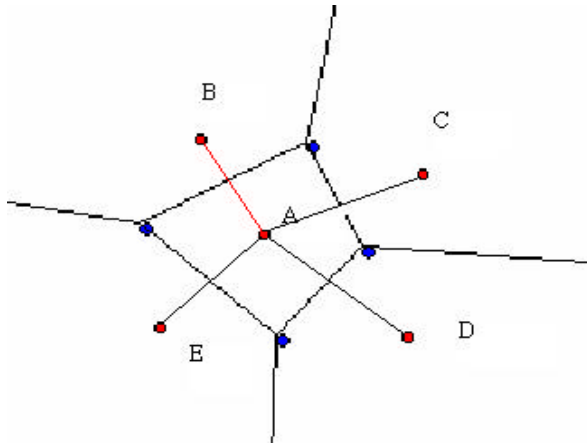


Figure 9 The best couple

● **Delaunay triangulation**

The Delaunay triangulation is the extension of Voronoi diagram. We also implemented the algorithm and after executing the program, we get figure 10.

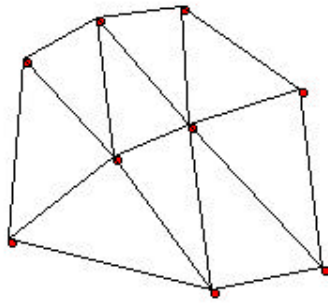


Figure 10 Delaunay triangulation

Each point can form a lot of triangles with neighbor points. The next step is to do a circle to find all circumscribed circles of each point. We choose the triangle that circumscribed circle radius is the shortest as the best choice. The other two point are the refer point's best friends. As shown in figure 11.

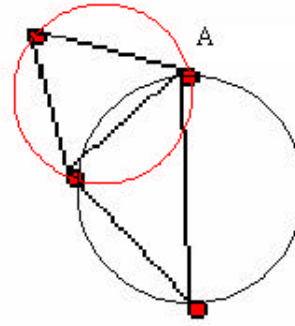


Figure 11 shortest radius of circumscribed circle

Experiment

We chose 78 fifth grade students to examine the system. We constructed a virtual forest scene and put a lot of wild animal objects in the scene. They had four periods to use the system per week, and persisted for two weeks. After one period ended, we got their coordinate and ran the classification to form a questionnaire. We got an outcome with the questionnaire through statistical inference. Using Kolmogorov-Smirnov one sample test, 73 valid samples and $\alpha=0.05$:

Score->	Acceptable				Unacceptable
	4	3	2	1	0
f	3	40	12	15	3
F(O)	1/5	2/5	3/5	4/5	1
S(O)	3/73	43/73	55/73	70/73	73/73
F(O)-S(O)	0.159	0.189	0.153	0.159	0

Table 1 Best Couples

Score->	Acceptable				Unacceptable
	4	3	2	1	0
f	2	42	10	13	6
F(O)	1/5	2/5	3/5	4/5	1
S(O)	2/73	44/73	54/73	67/73	73/73
F(O)-S(O)	0.173	0.203	0.14	0.118	0

Table 2 Best Trinity

The results imply that students tend to agree with the questionnaire. We successfully used virtual reality technology to mirror the friendship and relationship between people in the real world.

Conclusion and Future works

We had constructed an immersive collaborative virtual environment, including a virtual forest with a lot of wild animals. In order to make it as real as possible, we made a restriction to chatroom function that people should get close enough to exchange information, idea, and chat text data. And we applied Voronoi diagram and Delaunay triangulation theories in classifications. Finally, we successfully used VR technology to mirror the interrelationship between people that ordinary learning environment can't observe.

We can now get people's interrelationship efficiently and faithfully by using VR technology. What we have to do in the next step is to study how to combine traditional cooperative learning heterogeneous grouping strategies with people's interrelationship. To group learning teams with strong interaction and communication abilities that can help increase cooperative learning efficiency and achievement.

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