Immersive Multi-User 3d Video Communication

Prof. Abhinav V. Deshpande, Prof. Ram Meghe
Assistant Professor, Department of Electronics & Telecommunication Engineering,
Institute of Technology & Research, Badnera, Amravati-444701

***Abstract*- The interest in immersive video conference system exists now for many years from both the sides and the commercialization point of view as well as from a research perspective. The technological advances in the field like display and camera technology as well as the processing hardware lead a way to a new generation of immersive tele-conference systems. On one hand, large scale and high definition displays which significantly enhance the feeling of virtual presence. On the other hand, new fast graphics board solutions allow a high algorithmic parallelization in a consumer PC environment. The goal of this research paper is to discuss general issues and problems of future generation immersive multi-user 3D video conference systems. Further on, it provides a challenging first result and proposes solutions for critical questions.**

***Index Terms*- 3D Communication System, Tele-Conference System, Gesture Awareness, Multi-View Auto Stereoscopic 3D Display**

I. INTRODUCTION

The research and development in the area of video communication from a local to one or multiple remote sides has a long tradition. Especially, in the past few years the interest in generating a so called tele- presence increased rapidly. The work in this area includes the topics like naturalness, feeling of physical presence, gesture awareness and eye contact etc. Size video. Still, these systems do not present the remote participants in life-sized 3D, limiting the naturalness and thereby the sense of tele-presence. In addition, a fundamental problem is that the eye contact is unnatural and that directional gaze awareness is missing. An example which is based on a commercial system is given in the Figure 1. On the left of the figure, the viewing directions of the remote participant towards the most right local participant appear correct. But as seen in Figure 1 right, from the position of the most right local participant, the eye contact and the viewing directions is completely misleading, although the remote participant is looking directly to the local participant on its display. By keeping eye contact is indeed one of the most relevant and challenging requirements in a tele-presence system from a non-verbal communication point of view and while many attempts have been made, it has not yet been satisfactorily solved today.

Figure 1 An Example of Correct Tele Presence

1.1. What is 3D:

The technological advances in the field like display and camera technology as well as the processing hardware lead the way to a new generation of immersive tele-conference systems. On one hand, large scale and high definition displays significantly enhance the feeling of virtual presence includes topics like naturalness, feeling of physical presence, gesture awareness and eye contact etc.

Figure 2 Showing a 3D Image

1.2. Eye Contact:

The eye contact problem is to virtually correct the captured view of the conference user. Figure 3 which is to the left illustrates this approach. The right-hand local participant is being captured by the top camera (see the red arrow). In this way, when the conferees look at each other on the screen then no eye contact can be created. In order to solve this problem, the capturing camera will be virtually shifted to the eye position of the remote conferee on the screen. In this way, both the participants can look at each other into their eyes while being captured from the top of the displays. This approach requires a 3D acquisition chain.

1.3.Gesture Awareness:

In order to keep the user's impression as natural as possible, pointing the gestures between the conferees should maintain their original direction. Immersive video conference systems usually are based on the idea of a shared virtual table environment. Nevertheless, the correct reproduction of gesture direction requires a geometrically correct virtual environment. Especially for the multi-user and multi-party systems this is often more difficult to realize for all the conferees simultaneously.

II. SOME BASIC FUNDAMENTAL CONCEPTS

2.1. The 3D presence Tele-Conferencing Concept:

The major challenge of the 3D presence project is to maintain the eye contact, gesture awareness, 3D life-sized representations of the remote participants and the feeling of physical presence in a multi-party, multi-user terminal conference system. In order to achieve these objectives, the concept of a shared virtual table is applied. All remote conferees will be rendered based on a predefined shared virtual environment. The eye contact and gesture awareness can be created by adapting virtually to the 3D perspective and 3D position of all remote conferees on each of the terminal displays. Furthermore, on order to maximize the feeling of physical presence, the sophisticated multi-user 3D display technologies will be developed and applied within the 3D presence project. The concept will be proved by developing a real time demonstrator prototype system consisting of four 3D video conferencing stations in Barcelona (Spain), Tel Aviv (Israel), Eindhoven (Netherlands) and Berlin (Germany).

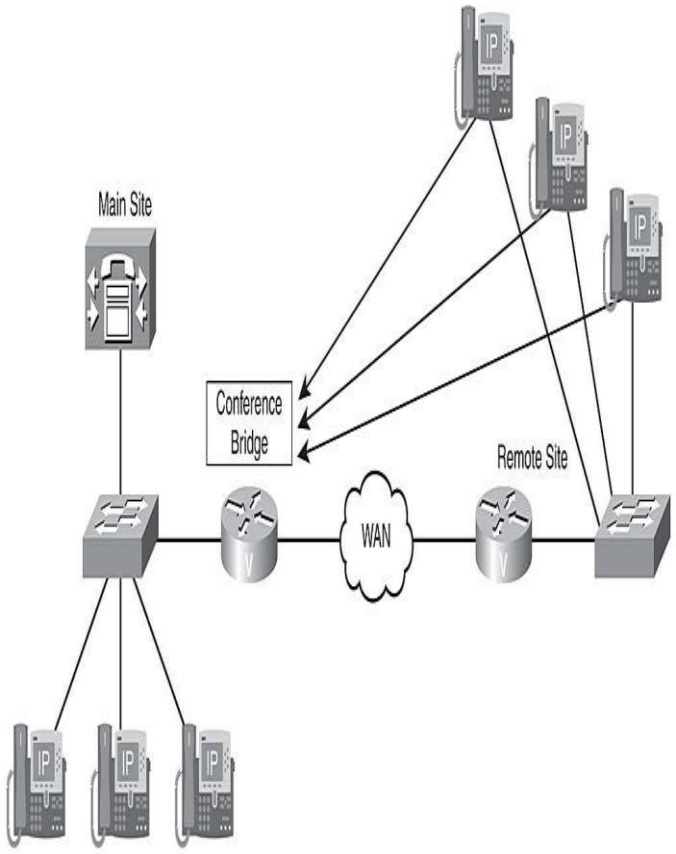

Figure 3 Tele-conference set up for three parties

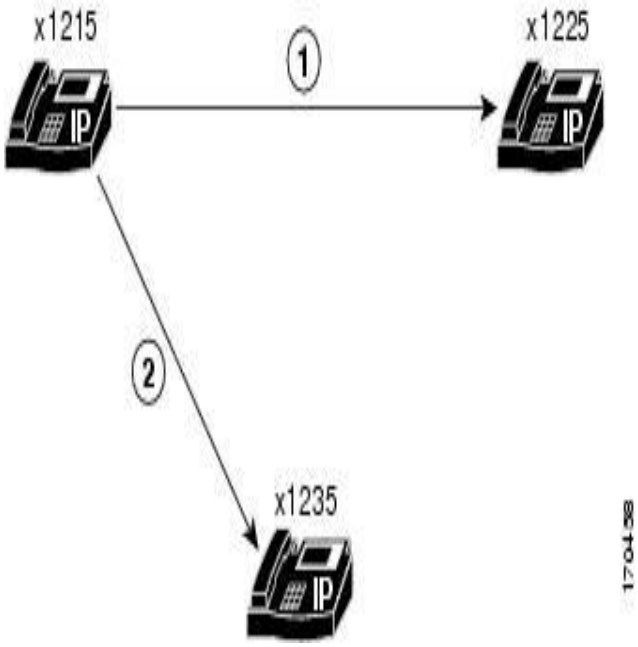

Figure 4 Tele-conference set up for six participants

2.2. Geometrical System Design:

The geometrical design of the proposed tele-conference system is based on the idea of a shared virtual table. This virtual table is supposed to simulate a real conference situation for Figure 3 parties and Table 6 participants as illustrated in Figure 4 left. Each party has two participants. Figure 4 which is to the right illustrates a possible replacement of the remote conferees by displays. The eye contact and the gesture awareness will be created by virtually adapting to the perspective of the view of all remote conferees to the given shared virtual environment. The geometrical design of such virtual environments faces several problems. On one hand, the final position and the orientation of the monitors depends on additional constraints. So, in order to create a realistic impression, the remote participants need to appear in life size. As the overall display size is limited a scaling of the remote virtual conference can be applied which are illustrated in the top.

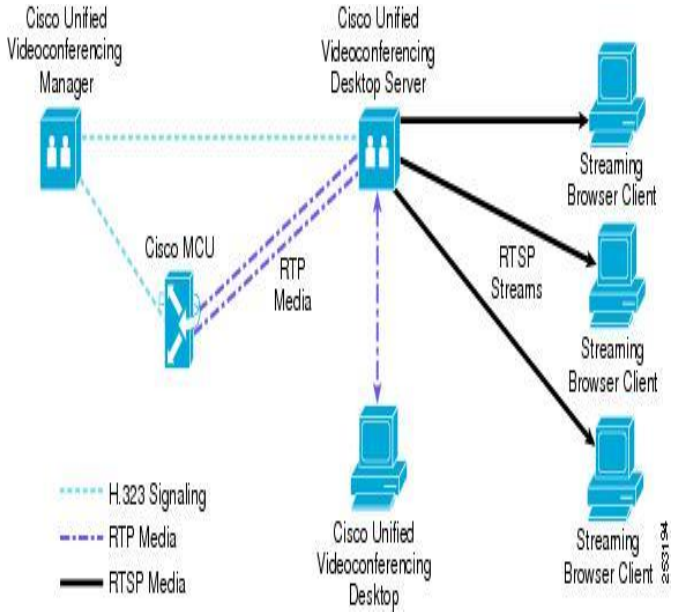

Figure 5 Block Diagram of a Tele Conference System

2.3. Multi-View Auto Stereoscopic 3D Display:

The current 3D displays are capable to provide multiple stereoscopic views in order to support the head motion parallax. Hence, the user is able to perceive a scene in 3D and recognize the different perspectives according to his head position. In contrast, the challenge in 3D presence is to provide a stereoscopic viewing for two users and head motion parallax with significantly different perspectives onto the scene. Such display type having multiple perspectives is new. It was recently developed by Philips by building further on previously developed design principles of 3D auto-stereoscopic displays which are based on slanted lenticualte lenses. There are many ways in order to make a display that doesn't require glasses. All it needs to do is to display a different picture to each eye, and there are a range of optical devices that can be used to achieve this objective which are the most common method and the method which we used in the 1990's (Fourier Plane Shuttering). This is the 1999 display that helped to build. It used the Fourier Plane Shuttering. It produced a bright, clear image with a 50 degrees diagonal. This is a recently announced New Sight Display which is based on parallax barrier technology. It has a 70 degrees diagonal. So we can build these displays and you can even buy these displays but there are fundamental limitations that mean it will be difficult for the auto stereoscopic technology in order to find its way into the home.

Figure 6 3D Stereoscopic Display

Figure 7 Pair of LC Shutter Glasses used as 3D Stereoscopic Display

Figure 8 Use of IEC Measurements in 3D Stereoscopic Displays

III. WORKING OF THE PROPOSED SYSTEM

The current state-of-the-art systems address it by monitoring the camera behind a semi-transparent viewing display, but this common approach is often limited to the special case of having one single conferee at each side of the conference. Further, this approach requires a bulky optical and mechanical mounting that is only acceptable for niche market applications. A two way video conferencing system for three participants per site has been presented in which it provides a nearly eye contact which is supported by cameras which are mounted on the top of the displays.

IV. ADVANTAGES AND DISADVANTAGES

4.1. Advantages:

1) Save money and time.
2) Build relationships.
3) Communicate "face to face" where it would be otherwise be impossible.

4.2. Disadvantages:

1) Required high speed internet server.
2) Difficult to have a proper eye contact.
3) Cannot perform any kind of physical contact during the process of communication.

V. APPLICATIONS

5.1 In Military:

In order to make the process of communication faster and this leads to faster actions and commands.

5.2. In Movies:

This technology is recently used in the bollywood movie "Kick" and in "G.I. Joe".

5.3. In Conferences:

Through this technology one can communicate with many others from longer distances which is less time consuming and free of cost.

ACKNOWLEDGMENTS

This research work was undertaken as a part of technical education quality improvement program (TEQIP-2) which was sponsored by MHRD, India in order to improve the current quality of technical education which is imparted to the students in different parts of the country. I would like to thank the Head of Department, Department of Electronics & Telecommunication Engineering, Prof. Ram Meghe Institute of Technology & Research, Badnera, Amravati-444701.

REFERENCES

[1] D. Nguyen, J. Canny,"Multi-view spatially faithful group video conferencing", Proceedings of SIGCHI Conference on Human Factors in Computing Systems", pp. 799-808,Portland, Pregon, USA, April 2005.

[2] O. Schreer, P. Kauff, "An Immersive 3D Video Conferencing System Using Shared Virtual Team User Enbironments", Proceedings of ACM Collaborative Virtual Environments (CVE 2002), PP. 105-112, Bonn, Germany, October 2002.

[3] Atzpadin N., Kauff P. And Schreer O., "Stereo Analysis by Hybrid Recursive Matching for Real Time Immersive Video Conferencing", IEEE Transactions on Circuits and Systems for Video Technology, Special Issue on Immersive Telecommunications, Volume 14, No. 3, pp. 321-334, January 2004.

[4] C. Van Berkel, "Image Preparation for 3D LCD, Proceedings of SPIE 1999, Volume 3639.

[5] C. Van Berkel, J.A. Clarke, "Characterization and Optimization of 3D LCD Module Design", Proceedings of SPIE 1997, Volume 3012, pp. 179.

[6] B. Barenbrug, "3D Throughout the Video Chain", in Proceedings of International Congress of Imaging Sciences, pp. 366-369, 2006.
[7] W.H.A. Bruls, C. Varekamp, R. Klein Gunnewiek, B. Barenbrug, A. Bourge, "Enabling introduction of Stereoscopic 3D Video: Compression Standards, Displays and Content Generation", in Proceedings of International Conference on Image Processing, pp. 89-92, 2007.
[8] J. Mulligan, V. Isler, K. Daniilidis, "Trinocular Stereo: A Real Time Algorithm and its Evaluation", International Journal of Computer Vision, 47, pp. 51-61, April 2002.

AUTHOR'S PROFILE:

My name is Prof. Abhinav V. Deshpande. I have done S.S.C. in the branch of Science from Somalwar Nikalas High School, Nagpur in the year 2000 with an aggregate of 73%. I have done H.S.S.C. in the branch of Electronics from Jupiter Science Junior College, Nagpur in the year 2002 with an aggregate of 54%. I have done B.E. in the branch of Electronics & Telecommunication Engineering from G.H. Raisoni College of Engineering, Nagpur in the year 2010 with an aggregate of 63%. I have done M.Tech. in the branch of Electronics Engineering from the same institute in the year 2012 with a CGPA of 7.90 on a scale of 10.00. I have passed the Ph.D. Entrance Test (PET) which was conducted by RTM Nagpur University in the year 2013 with a valid score of 55 marks out of 100 and in the year 2015 with a valid score of 55.75 marks out of 100. I have also passed the Ph.D. Entrance Test (PET) of Gondwana University in the year 2015 with a valid score of 51 marks out of 100. My areas of research include Digital Signal Processing, Digital Image Processing, VLSI, Soft Computing and Applications, Embedded Systems, Intelligent Transportation Systems etc. I have published 19 research papers in different and reputed International Journals and 1 research paper in International Conference. I have also published 1 book in Saarbrucken, Germany. I am having the memberships of different professional organizations like ISTE, IE (I), IEEE, IETE, UACEE, IET etc. I want to do Ph.D. in the branch of Electronics Engineering and also I want to do D.Sc. in the branch of Electronics Engineering as a future career option. I am working as an Assistant Professor on Contract Basis in the Department of Electronics & Telecommunication Engineering at Prof. Ram Meghe Institute of Technology & Research, Badnera, Amravati-444701 at present and I want to do a career in the field of Research & Development in the domain of Electronics Engineering.