Interpersonal Haptic Communication in Second Life

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***Abstract*—Potential of nonverbal communication as the communication medium between multiuser 3D virtual worlds and real environment are attracting the interest of many researchers around the world. Driven by the motivation, we explored the possibilities of integrating haptic interactions with Linden Lab's multiuser online virtual world, Second Life. We developed an add-on to the Second Life communication channel in order to facilitate emotional feedbacks such as human touch, encouraging pat and comforting hug to the participating users through real-world haptic simulation. These social touch that are fundamental to physical and emotional development in turn can enhance the users interactive and immersive experiences with the virtual social communities in the Second Life. In this paper, we describe the development of a prototype that realizes the aforementioned virtual-real communication through a haptic-jacket system. Some of the potential applications of the proposed approach include remote child caring, stress recovery, distant lover's communication etc.**

***Index Terms*—Interaction design; haptics; interpersonal communication; virtual world; Second Life;**

I. Introduction

Social emotional touches in the form of handshake, encouraging pat, hug, tickle etc. physical contacts are fundamental to mental and psychological development and hence their applications in interpersonal communication systems have attracted much attention of many researchers around the world [7]. To convey the emotional feedbacks haptic is given high value in live communication [3][12] and in immersive virtual environments [6][9]. The haptic based nonverbal modality can enhance social interactivity and emotional immersive experiences in a 3D multiuser virtual world that presents a 3D realistic environment, where people can enroll in an online virtual community [11]. One of the most popular and rapidly spreading examples of such systems is Linden Lab's Second Life (SL) [8]. In Second Life, similar to [1] and [10], once connected the users can view their avatars in a computer simulated 3D environment and they can participate in realtime they can participate in task-based games, play animation, communicate with other avatars through instant message and voice. The social communication aspect of Second Life is hugely popular and counts 19 million users this year (2010) [8]. Moreover, its open source viewer provides a unique opportunity to extend it further and equip it with other interaction modality such as haptic.

In this view, we investigated the possibilities of integrating haptic interactions in Second Life. We developed an add-on to the Second Life communication channel that provides physical and emotional intimacy to the remote users. In the prototype system a user can use touch, tickle, and hug type haptic commands to the participating users by using visual, audio or text based interfaces. The remote user can feel the touch and other touch based interactions on the contacted skin by rendering haptic stimulation through a haptic jacket system that is composed of an array of vibrotactile actuators. This paper illustrates a preliminary prototype exploring the aforesaid haptic interactions between virtual and real environment actors.

Similar haptic jacket based rendering of touch has been incorporated previously into a conventional teleconferencing system to provide haptic based interactions to the remote users in [4]. This approach uses marker tracking technique to specify touchable parts of the user's body. The markers are further tracked using a dedicated camera. Also in order to create 3D touchable area of the user, the system needs an expensive 3D camera. Haptic based input modes have also been investigated in Second Life in order to assist the blind people to be able to interact with the Second Life world [6]. The authors have implemented two new input modes that exploit the force feedback capabilities of haptic devices and allow the visually impaired users to navigate and explore the virtual environment. Also, in Second Life, Tsetserukou et. al. [11] have attempted to analyze the text conversations in Second Life. This system provides emotional haptic feedbacks to the users by using a specially designed wearable hardware. However, this approach does not seem to consider visual or pointer based graphical interactions in the 3D environment other than the text based conversation system. For example, there is no way to interact with specific parts of the virtual 3D avatar that can be used to generate haptic touch stimulation in that respective part of the real user. We addressed some of these challenges in this paper and attempted to incorporate a flexible GUI based haptic feedback mechanism to provide more natural, easy and accessible interactions in Second Life.

Our contribution in this paper is three-fold. First, in order to bridge the gap between virtual and real, we present a Second Life Client add-on, where we provide haptic interactions opportunity between the real users and their respective virtual avatars through a graphical user interface (GUI). Second, we introduce touch, hug and tickle haptic features for the Second Life users through chat and GUI interactions. Third, we incorporate virtual annotation mechanism for the Second Life avatar so that interpersonal haptic and animation interactions

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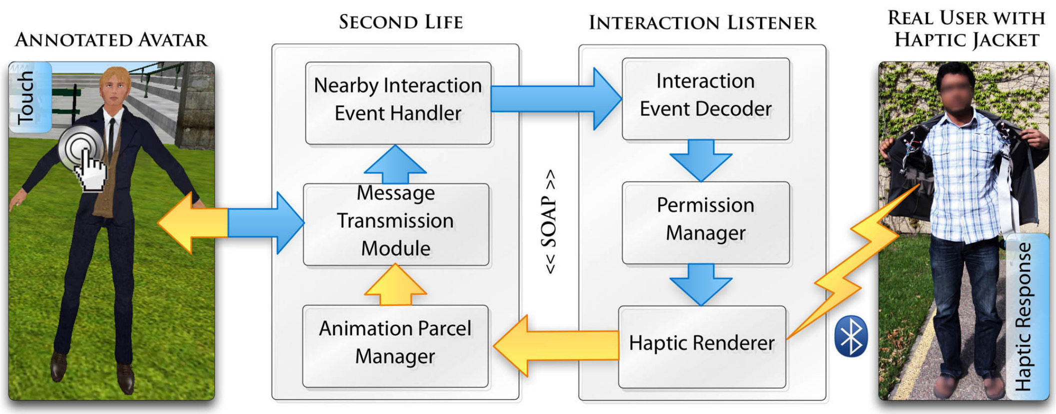

Fig. 1. Second Life and Haptic communication system block diagram.

become possible.

The remainder of this paper is organized as follows. In the beginning, in Section II we illustrate the various components of our system that facilitates the Second Life based interpersonal communication and provide a general overview of the system and its access mechanisms. Further in Section III we describe the implementation issues of the proposed work and present a usability study of the developed system. We conclude the paper in Section IV and state some possible future work directions.

II. System Description

In this section we present various components of the system and provide general description. In the beginning we illustrate the haptic jacket in Section II-A. Later in Section II-B, we present the avatar annotation and animation techniques. Furthermore, in Section II-C we describe the developed second life add-on, second life event controller and present it's different modules in details. Finally, in Section II-D, we mention the message transmission and listening process between the second life event controller and the interaction controller. The overall architecture of the system is depicted in Figure 1 as a block diagram.

A. Haptic Jacket

The haptic jacket consists of an array of vibrotactile actuators that are placed in different portions of the jacket and their patterned vibration can stimulate touch in the user's skin. Vibrotactile actuators communicate sound waves and create funneling illusion when it comes into physical contacts with skin. A series of small actuator motors are placed in a 2D plane in the jacket in a certain manner. In order to produce touch feeling the actuators are activated in a defined manner [2]. The jacket used in our prototype adhering to the aforementioned properties is shown in the Figure 2.

B. Avatar Annotation and Animation

In our system we annotate visible body parts of the avatar in Second Life and specify the corresponding physical haptic actuators to render the haptic feedback. For a specific haptic signal we also annotate the avatar animation that will be graphically rendered when that body part receives any GUI interaction from the remote user. For example, in our prototype application we annotate the 3D male avatar's left arm and specify particular haptic vibrotactile actuator stimulation. Similarly, in the annotation step, we specify the interacting animations of the participating male and female virtual avatars. Afterwards, when the user representing the female avatar issues a GUI interaction command to the male avatar arm then the annotated haptic stimulation is sent to the male user and haptic rendering takes place in the arm of the haptic jacket in real life. Moreover the participating male and female virtual avatars also plays out the defined animation sequences in the Second Life viewer.

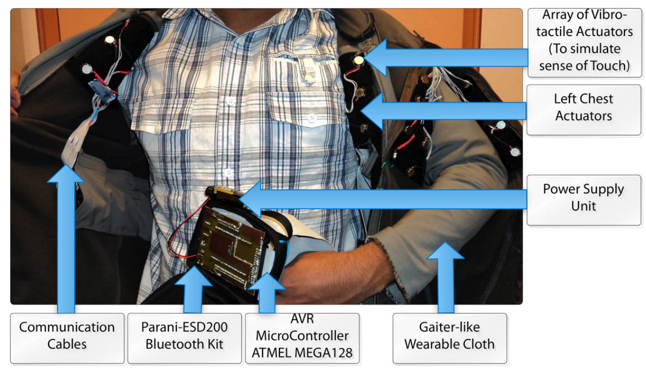

Fig. 2. The Haptic jacket.

C. Second Life Event Controller

In this section we discuss how the Second Life event controlling mechanism handles different haptic responses and avatar animation sequences. In order to communicate with the core part of the second life viewer we developed a Second Life event controller as an add-on to the viewer. This coupling architecture provides the opportunity to listen to the communication channel of the Second Life system and incorporate haptic interactions without affecting the functionality of the core system. Furthermore, the event controller interacts with other parts of the haptic system by using Simple Object Access Protocol (SOAP). In the event controller a Nearby Interaction Event Handler module capture the events that are generated from the message transmission module. The event controller performs actions by using text based messaging protocol. A message contains event trigger data, animation data or simple communication data. All the messages that are generated in the core section of the Second Life are captured by a module called Message Transmission Module. When avatar creates any event in the 3D environment, e.g., a collision event with other avatars or objects, the message transmission module captures those events and transfers the event messages to the nearby interaction event handler in order to process the events. The event handler module determines the particular event handling routine for a specific event and then packs the event handling message with the handling routine. The handler then sends the packet to the interaction event decoder. Message transmission module also receives animation data from the animation parcel manager and generates animation sequence for the avatars in the 3D virtual world.

D. Interaction Controller

In this section we discuss how a message from Second Life event controller is processed to activate some actuators in the haptic jacket. Interaction controller works as a web service and receives the SOAP message from the nearby interaction handler module. The received message is in encoded form and therefore after reception it is decoded before sending it to the permission manager. In order to achieve, authentication and control of the haptic jacket access each user is needed to send a request through his/her avatar to the jacket owner. If the jacket owner approves the request by using his/her avatar then that approved person is allowed to send haptic signals. Permission manager is responsible for monitoring these issues. When the permission manager receives a decoded message from the interaction event decoder it verifies whether the requester have the permission to issue the haptic command. If the person has this approval then s/he is allowed to send the message to the haptic renderer. Haptic renderer then processes the message and finally transmits it to the jacket actuators by using Bluetooth communication.

The interaction controller supports visual, audio and text based inputs from the requester. In the visual type interaction the controller listens for specific GUI commands from the remote users and responds to them accordingly. For example, an user representing a female avatar can point her mouse on a male avatar and produce a click event. The interaction controller detects if the annotated body parts of the male avatar has received any GUI commands and produces the annotated haptic and animation sequences after verifying the permission. Similarly, in audio based interaction the controller listens the communication channel for the voice from Second Life viewer and when specific voice command has been issued it then performs respective actions. In our prototype the hug command is issued by using the voice based interaction inputs. Moreover, while processing the text based inputs from the requester the controller analyzes the text messages sent to the jacket owner. The text message based commands have certain preamble and post-amble before and after the commands. Therefore, the interaction controller easily distinguishes the haptic commands that are issued based on the text inputs.

III. Implementation issues and Usability Study

In this section we present the details of the implementation issues of our proposed system. The system was developed using Microsoft Visual 2005 IDE and the primary language was Visual C++. In order to develop the Second Life add-on, we locally build the Second Life open source viewer by using the latest version of CMake (version 2.8.1) [5], which is a cross-platform, open-source build system. For network communication and serial port based Bluetooth communication we incorporated Microsoft Foundation Classes (MFC) library and socket programming scheme.

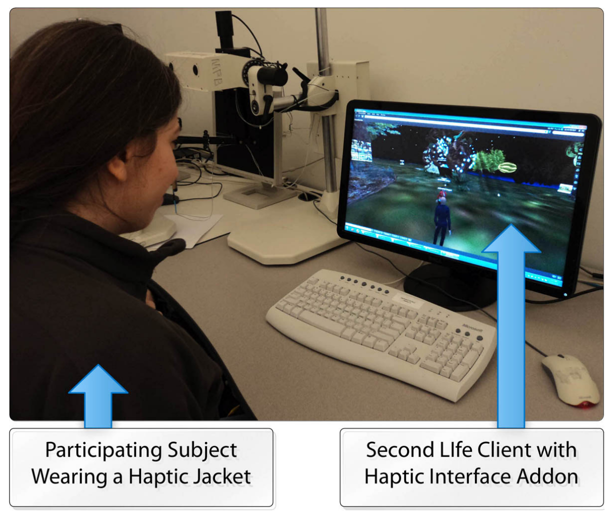

Fig. 3. A subject evaluating the Second Life HugMe system.

In order to obtain the behavior of Second Life objects and avatars we used the features of Second Life scripting language called LSL Script [8]. LSL script is a C/JAVA like event-driven language, using which we can control the objects and avatar behavior. We attached LSL scripts in each of the annotated parts of the avatar that contain the haptic commands as well as the identification number of the animation sequences. In order to receive the event trigger message from Second Life we developed a web service, which listens to the triggered messages from the Second Life controller. The interaction listener module was also developed as a web service, which listens to a Communication Serial Port (COM). A Bluetooth device was connected with the PCs USB port, which was virtually configured with the COM port so that the Bluetooth device can send signals to the haptic jacket. Our test prototype was adequately responsive in a standard Pentium dual core 32-bit machine with 2 GB systems RAM. The on board 256 MB graphics card provided on the average 26 frames per second in the visual based rendering of the Second Life client.

We conducted usability tests to evaluate the user's quality of experience with our proposed system and to justify the suitability of the proposed approach. In Figure 3 a female test subject could be seen evaluating our test prototype. The usability tests took place at the university laboratory in a controlled environment with twelve volunteers of different age groups and academic backgrounds. The users were requested to use the developed prototype and were given certain haptic interaction based tasks. Their activity is monitored throughout the experiment and noted for analysis. Afterwards, based on their interaction experience they were asked to rate four assertions in Likert Scale [13]. The ratings of the assertions were in the range of 1-5 (the higher the rating, the greater is the satisfaction). The average of the responses of the users are calculated in percentage form and recorded after the usability tests. Figure 4 shows the user's responses for each given assertions.

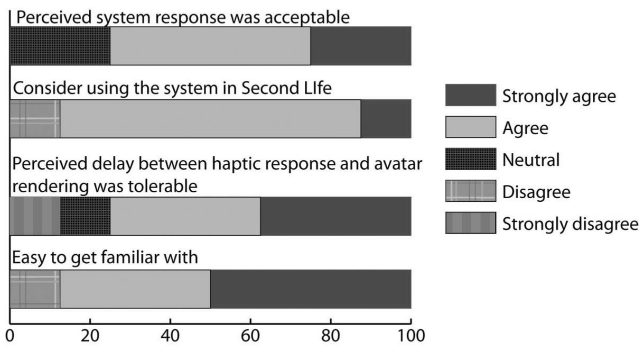

Fig. 4. Usability study of the Second Life HugMe system.

IV. Conclusion

In this paper we presented a Second Life viewer based haptic interaction prototype system that bridges the gap between the virtual the and real world events by incorporating interpersonal haptic communication system in Second Life. The developed system works as an add-on and loosely coupled to the Second Life viewer. For this nature the system uses web service based architecture to communicate messages amongst the main components of the system. The haptic and animation data are annotated in the virtual 3D avatar body parts. The 3D avatar and the annotated body parts representing a real user receive inputs when they are interacted through visual, voice or text based input modalities and produces emotional feedbacks such as touch, tickle and hug to the real user through the haptic jacket. We presented the implementation details of a preliminary prototype exploring the aforesaid haptic interactions in a real-virtual collaborative environment.

References

[1] Activeworlds. Activeworlds inc. Technical report, http://www.activeworlds.com, 2010.

[2] A. Barghout, J. Cha, A. El Saddik, J. Kammerl, and E. Steinbach. Spatial resolution of vibrotactile perception on the human forearm when exploiting funneling illusion. In *Haptic Audio visual Environments and Games, 2009. HAVE 2009. IEEE International Workshop on*, pages 19 –23, 7-8 2009.

[3] S. Brave and A. Dahley. intouch: a medium for haptic interpersonal communication. In *CHI '97: CHI '97 extended abstracts on Human factors in computing systems*, pages 363–364, New York, NY, USA, 1997. ACM.

[4] J. Cha, M. Eid, A. Barghout, A. S. M. M. Rahman, and A. El Saddik. Hugme: synchronous haptic teleconferencing. In *MM '09: Proceedings of the seventeen ACM international conference on Multimedia*, pages 1135–1136, New York, NY, USA, 2009. ACM.

[5] CMake. Cross platform build system. Technical report, http://www.cmake.org/cmake/resources/software.html, 2010.

[6] M. de Pascale, S. Mulatto, and D. Prattichizzo. Bringing haptics to second life for visually impaired people. *Haptics: Perception, Devices and Scenarios*, pages 896–905, 2008.

[7] A. Haans and W. IJsselsteijn. Mediated social touch: a review of current research and future directions. *Virtual Real.*, 9(2):149–159, 2006.

[8] L. Lab. Second life. Technical report, http://en.wikipedia.org/wiki/Second_Life, 2010.

[9] A. E. Saddik. The potential of haptics technologies. *IEEE Instrumentation and Measurement*, 10(1):10–17, February 2007.

[10] Sims. Electronic arts inc. Technical report, Sims Online, http://www.ea.com/official/thesims, 2010.

[11] D. Tsetserukou, A. Neviarouskaya, H. Prendinger, M. Ishizuka, and S. Tachi. ifeel_im: innovative real-time communication system with rich emotional and haptic channels. In *CHI EA '10: Proceedings of the 28th of the international conference extended abstracts on Human factors in computing systems*, pages 3031–3036, New York, NY, USA, 2010. ACM.

[12] R. Wang and F. Quek. Touch and talk: contextualizing remote touch for affective interaction. In *TEI '10: Proceedings of the fourth international conference on Tangible, embedded, and embodied interaction*, pages 13–20, New York, NY, USA, 2010. ACM.

[13] wikipedia. Likert scale. Technical report, http://en.wikipedia.org/wiki/Likert_scale, 2010.