## Managerial and Commercial Applications
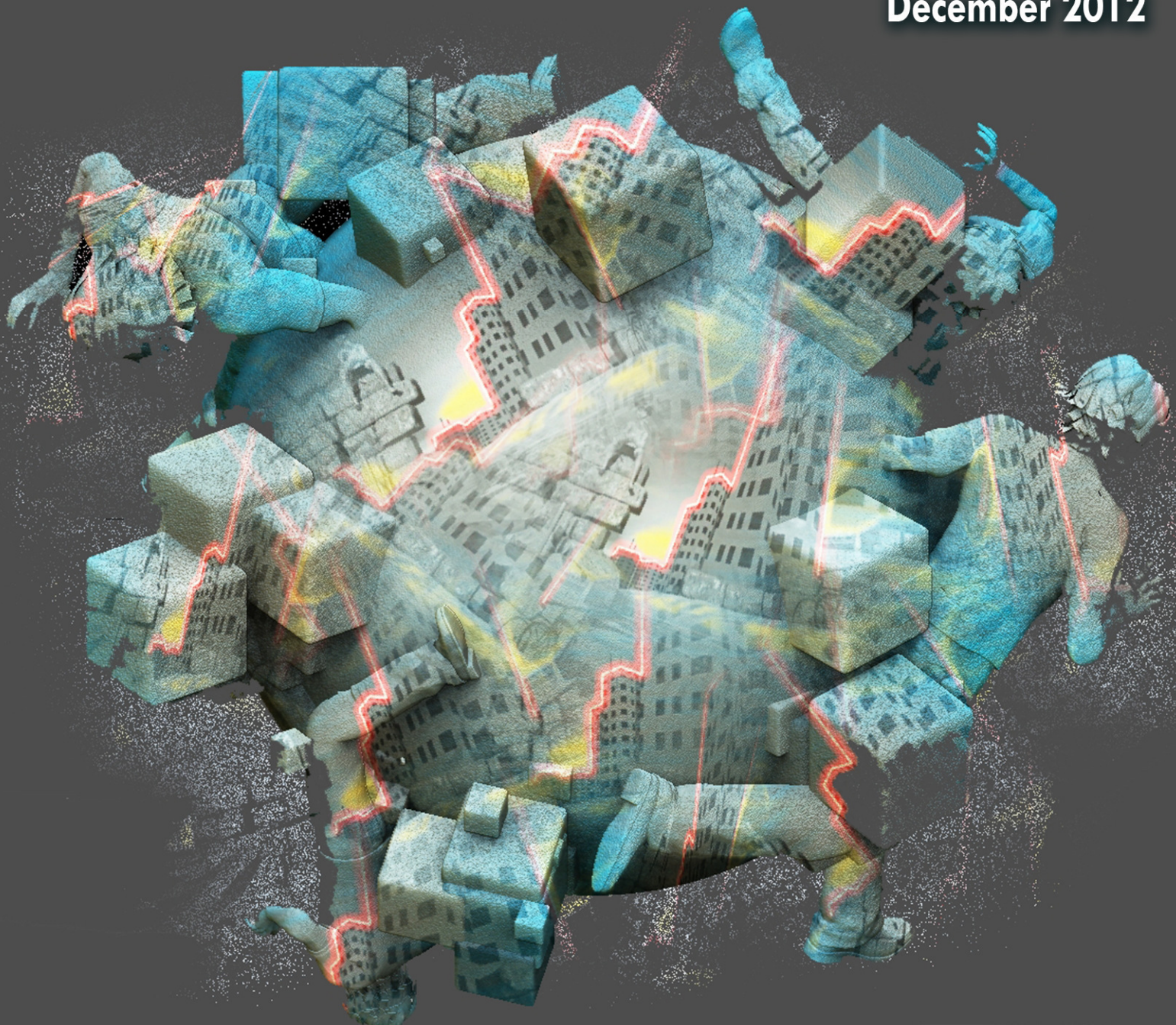
# Volume 5, Number 3
# Managerial and Commercial Applications
# December 2012

**Managing Editor**

Yesha Sivan,
Tel Aviv-Yaffo Academic College, Israel

**Guest Editors**

Shu Schiller,
Wright State University, USA

Brian Mennecke,
Iowa State University, USA

Fiona Fui-Hoon Nah,
Missouri University of Science and
Technology, USA

**Coordinating Editor**

Tzafnat Shpak

# A Cross-Case Analysis of
# Possible Facial Emotion Extraction Methods
# that Could Be Used in Second Life

# Pre Experimental Work

**Shahnaz Kamberi**
Devry University at Crystal City Arlington, VA, USA

## Abstract

This research-in-brief compares – based on documentation and web sites information -- findings of three different facial emotion extraction methods and puts forward possibilities of implementing the methods to Second Life. The motivation for the research stemmed from a literature review which indicated that current virtual communication tools did not satisfy users. The review showed that people preferred real-life like communication in virtual environments due to higher immersion and better user experience. Research revealed three methods used to create avatar facial expressiveness using facial emotion extraction. The three methods found were:

1.  Extracting emotion through user texts to apply to avatar facial features in real-time

2.  Using Microsoft's Kinect technology to capture user facial motion to apply to the avatars' in real-time

3.  Extracting emotion through video capture of user's facial expressions via webcam in real-time.

This research analyzed the three methods in terms of implementation, integration and feasibility in Second Life.

This analysis hypothesizes that extracting user facial emotion via webcam is the easiest to implement, integrate, and is the most feasible method to use.

## 1.  Introduction

Virtual worlds are growing in popularity. "60% of [businesses surveyed] plan to increase spending for virtual environments and events, and 67% are contemplating hosting 10 or more virtual events in the next 12 months" (Gardner, 2011), this includes virtual environments, webinars, etc.

However, "virtual worlds as we know them today are not user friendly or effective as a *seriously* used communication tool" (Bouda, 2012). One of the main reasons for this is the lack of a real-life like communication format.

To support communication, avatar facial features and expressions should be well developed (Perlin, 2000). Second Life (SL), an online virtual world, was focused on for this analysis.

Although avatars in SL can text chat or voice chat with other avatars (with or without Lip Sync), they lack expressive facial features.

Facial emotion extraction refers to the method of extracting the current facial expression of a user in real-life and applying that expression on the face of the avatar in real-time. This case analysis focused on Second Life and how it can better increase communication between avatars by looking at three facial emotion extraction methods available today. This analysis will purpose the best method based on ease of implementation, integration, and use in Second Life. Research limitations and future advancement opportunities are also discussed.

### 1.1    Literature Review

The literature review helps support the need for better facial expression and features in Second Life by looking at research in two areas: the importance of expressiveness for communication and immersion in virtual worlds and studies on methods in creating good facial expressions for avatars. Second Life's current avatar expressiveness methods are discussed and the three emotion extraction methods to be reviewed in this study are introduced.

### 1.2    Importance of Expressiveness for Communication and Immersion in Virtual Worlds

According to dictionary.com (2012) immersion is defined as a "state of being deeply engaged or involved; absorption". To have immersion in a virtual world implies that users are highly absorbed in the environment, are having a deeply engaging user experience, and the communication feels continuous. Studies have found that having a real life-like form of communication is what immerses users, and therefore research has looked at ways to make virtual world communication even more like real world communication through avatar and environment design (John et. al, 2011; Andre et. al, 1999; Bates, 1994). It is found that, "in face-to-face interactions emotions are integral to the interpersonal processes that help develop mutual rapport between the communicators" (John et. al, 2011). As a result, effective virtual world communication would require the same emotional expression as that provided by face to face interaction.

The main form of communication between avatars that Second Life provides, is through text chatting or voice chatting. The research findings suggest that text chatting is not the most effective, due to the misinterpretation it might cause. Lack of non-verbal cues might lead to misreading of emotion by one user from another. Kiesler et al. (1984) found that without visual cues, users communicating online

might be more uninhibited or aggressive than when communicating in real-life (John et. al, 2011). This shows that having avatars chat via text is not the best way to provide accurate information. Through chat boxes, SL users will not get a true real-life feeling of communication.

The other form of communication SL provides is through voice chatting. Although emotion can definitely be heard through voice chatting, the audio might not match the visual. An avatar in SL can have very expressionless facial features as the user of that avatar chats away happily, angrily or with other emotion.

Users may use Lip Sync, if they enable it, to have their avatar's lips move in unison to the user's voice (Lip Sync, 2012). However, this method focuses primarily on the syncing of the movement of the lips of the avatar to the voice of the user, rather than focusing on the emotional facial/body animation of the avatar.

Studies have shown that it is important for avatars to "demonstrate intelligent life-like behavior to make them believable in social computing" (John et. al, 2011; Prendinger et al, 2003). Hayes-Roth (2003) suggests that avatars should show emotional responses in order for them to have 'life-like' behavior (John et. al, 2011).

Second Life's interface does include a HUD – Heads Up Display – which is defined as a "display where gamers can see their character's vital statistics and more" (Webopedia, 2012). The HUD in SL allows users to select a particular gesture that changes the avatar's facial expression and body movement, based on the choice. Because the user of the avatar has to choose the correct gesture while speaking in voice chat and the emotion is not automatically displayed on the avatar's face in correspondence to what is being said, the user's immersion in the virtual world is interrupted. In real-life communication, one will not be speaking and pausing to think (similar to selecting a gesture in the HUD in SL) about what to do with their face and body; facial expressions and body movements will automatically coincide with what one is saying. This suggests that a better method is needed in SL to allow for an immersive communication between avatars.

According to Bouda, gestures and motions in virtual worlds do influence user experience and "studies show that there are a lot of users demotivated or disappointed from the virtual world's environment and after their first visit they never come back. That has to change" (2012).

## 1.3   Methods for Creating Good Facial Expressions for Avatars

Researchers from Stanford University and the Research Center for Virtual Environments and Behavior are currently studying many topics regarding virtual world and virtual world avatars (Stanford University, 2012; ReCVEB, 2012). These studies include: how virtual traveling of avatars reduces energy use, implications of having an avatar, what exactly do people do in SL, exploring a world as another person, spatial behavior, social psychology, and more (Stanford University, 2012; ReCVEB, 2012). None of the above studies currently conducted are on methods of creating better facial expressions on avatars in SL. However, some researchers have focused on similar areas of study.

According to John et. al. (2011), Prendinger et al. (2003) and Andre et. al. (2000) have looked at a way to develop a language to script "emotionally and socially appropriate responses for animated characters." Thalmann et. al. (2000) "presented an approach to implementation of autonomous virtual actors in virtual worlds based on perception and virtual sensors" (John et. al, 2011). Cassell et.al (2000)

and Badler et. al. (1995) "[have] developed a framework for designing automated response for animated characters who participate in conversational interaction with human users" (2011). Although these researchers have looked at ways to create better emotional expressions on avatar facial features, none of them looked at methods to extract facial expressions from users to apply to avatar expressions in SL.

John et al. (2011) have looked at a way to extract expressions from users to apply to avatar facial features in virtual worlds. They proposed a method called "Emotion Analyzer". This method involves extracting emotion through users' text messages and applying that emotion to the face of the avatar during a virtual world chat (2011). According to the research, this will "enhance social interaction in 3D social worlds" (2011). Since SL provides text chatting as a form of communication between avatars, this is a plausible method SL can use to provide an 'enhanced' social interaction. In fact, in the Second Life Marketplace, 'an automatic facial animation HUD' can be purchased that reads a user's text in the chat box and portrays the gesture automatically, based on the words read.

Bouda (2012) states, "windows have developed Kinect, which can be used for controlling [the] virtual world of Second Life by body motions." Microsoft has a video game console named Xbox 360; the Kinect is a system used with the Xbox 360 which allows players to use their body as a controller when playing a game. This method uses motion capture, which is the digital recording of real world gestures (oxforddictionaries.com, 2012). In 2011, Microsoft introduced Avatar Kinect, which "takes the technology to the next level, not only expanding animation to user-specific avatars themselves, but also animating coarse-grained facial features of those avatars" (Embedded Vision Aliance, 2011). Following Microsoft's innovation, Sony has developed a facial recognition technology (also using motion capture) for its new hand-held device named Vita; this technology allows users to have immersive avatar chats (Ishaan, 2011). This method can be applied in SL as Bouda (2012) suggests.

nViso (2012), a company based in Lausanne, Switzerland has developed a technology that can "passively capture human emotions from facial expressions and eye movement by tracking over 143 points on a face using only a webcam" (2012). This is another methodology SL can use to create better avatar facial expressiveness during virtual world communications.

### 1.4 Three Cases for Cross-Case Analysis

Through research it is shown that to have the best form of user experience in a virtual world, more specifically Second Life, users communicating in such a world need to feel as if they are speaking face-to-face. Emotions are found to be crucial to face-to-face communication, hence important to virtual communication. This literature review showed that having avatars express real-time emotions is a key for better user-experience and immersion in SL. This review has also shown that although studies were conducted on avatar expressiveness in various virtual platforms, no specific research has thoroughly looked at the best method for avatar expressiveness in SL. Out of the research and technologies that have studied facial emotion extraction methods, three were identified.

1. Extracting emotion through user texts to apply to avatar facial features in real-time.

2. Using Microsoft's Kinect technology to capture user facial motion to apply to the avatars in real-time.

3. Extracting emotions through video capture of user's facial expressions via webcam in real-time.

This research will analyze the three methods in terms of implementation, integration and feasibility and suggest the method that SL should incorporate into its virtual world experience.

## 2. Cross-Case Analysis

An analysis of Implementation/Integration/Feasibility of the Methods in SL.

### 2.1 Extracting emotion through user texts to apply to avatar facial features in real-time

As discussed before, Second Life provides a HUD to its users to choose gestures their avatars can make. These gestures mimic certain emotions such as happiness, sadness, anger, etc. Users of Second Life can visit Second Life Marketplace and purchase gestures in exchange for Linden dollars.



**Figure 1: Really Useful Face Emoter for Ladies (Second Life Marketplace, 2011)**

For L$247 (Linden dollars) or for $1.36 US dollars a user can purchase the Face Emoter in Figure 1, which displays such expressions as smile, pain, sad, surprise, and plead. There are other packages one can buy through Second Life Marketplace.
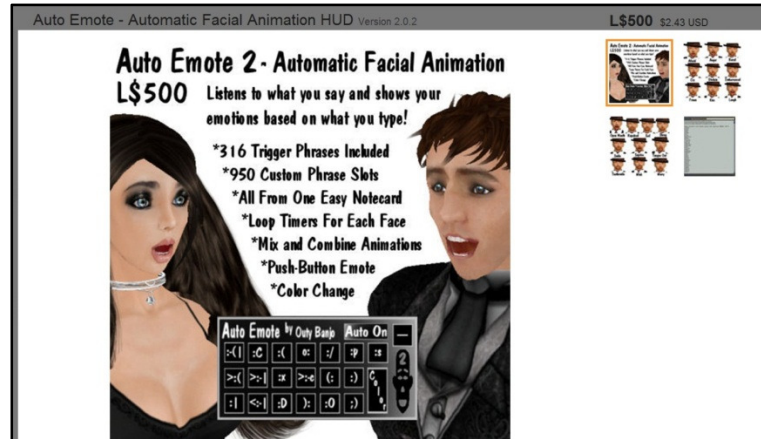
**Figure 2: Automatic Facial Animation HUD (Second Life Marketplace, 2008)**

For L\$500 or \$2.43, users can buy this HUD that will allow them to "show emotions based on what you type" (Second Life Marketplace, 2008). This shows that Second Life has already implemented the first form of facial expression extraction method, the extraction of emotion through user text, and has easily integrated it into the world of SL.

However, as discussed before, this form of implementation relies on users' use of text-based communication which, unlike face to face communication, causes time lapses between the spoken words and emotional expressions conveyed.

Since this method is already integrated into SL, it can be easily accessed by the users. However, users need to be willing to pay the L\$500+ or \$2.43+. This analysis shows that although the first method is already in use in SL, it relies on text-based communication and a purchase of specific HUDs. This can act as a deterrent to users unwilling to pay the purchase price and, in turn, limit their immersion and life-like communication experience.

## 2.2    Using Microsoft's Kinect Technology to Capture User's Facial Motion to Apply to the Avatars' in Real-Time

Microsoft released Avatar Kinect in 2011 to the Xbox LIVE marketplace. It gives users the ability, through their avatars, to socialize with their friends in a virtual world provided by Xbox LIVE (Embedded Vision Alliance, 2011). Users can have virtual meetings, talk shows, game shows, etc. Following suit, Sony released its hand-held device, Vita, in November 2011. Vita uses the same motion capture technology that allows users to have virtual chats using their avatars (Ishaan, 2011). Both technologies use motion capture for facial recognition.

Xbox, which already connects to the Internet via Wi-Fi, can connect to SL; Kinect can easily control SL avatars similar to Avatar Kinect. This implementation could mean the elimination of the keyboard and the mouse for the SL user. Since Kinect allows the user to be the controller, SL users can walk, talk, run, fly etc. using their bodies and face as controllers. This can lead to full immersion into the SL world, increasing positive user experience. Since good virtual world communication mimics real-

world communication, this method will allow that to the fullest. The initial analysis of this technology looks promising.
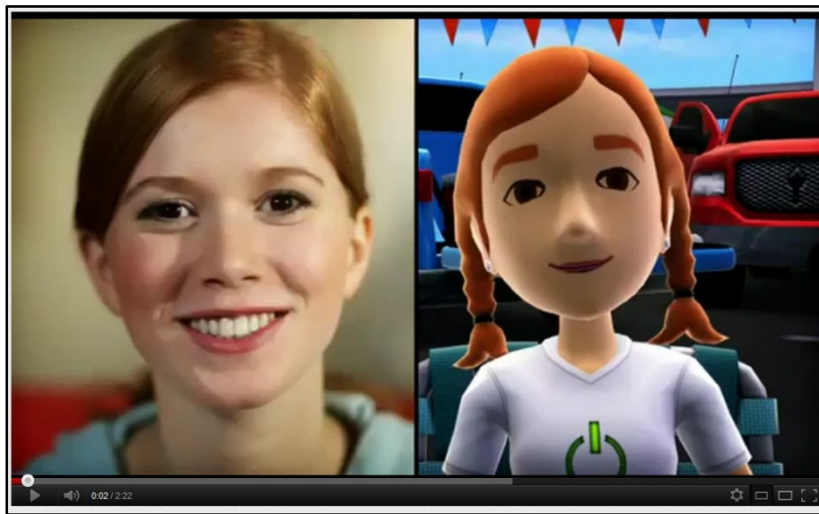


**Figure 3: Avatar Kinect Launch Trailer. (YouTube, 2011a)**

Figure 3 is a screen capture of a YouTube video of the Avatar Kinect launch trailer, viewed here: Video 1(http://youtu.be/7pXtfZ43rPU). The technology looks immersive and fun. To further evaluate Kinect technology vs. Second Life, game shows hosted in Xbox LIVE and in Second Life were compared.



**Figure 4: A Quick Look at Avatar Kinect (YouTube, 2011b)**

**Figure 5: The 1st Question – 15 January 2012 (the1stquestion.com, 2012)**

Figure 4 is a screen capture of a YouTube video (Video 2) and Figure 5 is a screen capture of a Second Life game-show called The 1st Question (Video 3). Although not very obvious in the screen capture, watching the actual videos shows that Kinect allows for a more immersive form of game show/talk show as supposed to SL in terms of avatar gestures and facial expressions.

Using this form of technology might suggest collaboration between Linden Lab and Microsoft.

Integration into SL however, poses a problem. An Xbox 360 console with Kinect costs $299 (Wallmart.com, 2012). Although current Xbox 360 users might use Second Life, chances are that not all Second Life users own the Xbox 360 console and Kinect. According to one statistic, Kinect is owned by 8 to 10 million people in the US (McEntegart, 2011), and in 2010 it was estimated that Second Life had 21.3 million accounts registered (Wikipedia, 2012). So even if Kinect technology was implemented in SL by Microsoft collaborating with Linden Lab, the integration of this technology would mean that all SL users needed to purchase the Xbox 360 console and Kinect. In terms of easy integration of Kinect to the world of SL, this is a very hard way of getting users to incorporate the technology. Chances are that not everyone using SL (which allows for their users to download the viewer and register for free) is willing to pay $299 just to experience the virtual world.

As a result overall analysis shows that although Kinect technology is immersive and mimics the face-to-face form of communication, the implementation of Kinect through Xbox LIVE to connect to SL is not very feasible, since SL users need to buy expensive hardware to experience this technology.

## 2.3   Extracting Emotion through Video Capture of User's Facial Expressions via Webcam in Real-Time

nViso utilizes a technology called 3D Facial Imaging which captures human emotions using a webcam in real-time (2012). The company explains that their technology can "measure emotions based on automated facial expression recognition and eye tracking […] free from wires...", is "available in a wide range of online and offline platforms including mobile and web apps […] across three geographic regions including North America, Europe, and Asia-Pacific", and "integrates into existing survey frameworks and platforms" (2012).

**Figure 6: nViso Technology (nViso, 2012)**

Currently, this company offers services in analyzing "emotional response levels of consumers to marketing stimuli in real time" (2012). Technically although nViso provides facial emotion extraction only for marketing purposes, this technology, in theory, works for SL.

Second Life users can use voice chat to communicate with other avatars with their webcams on and their avatars can express the same emotions as they are, whilst talking. This form of communication mimics real face to face communication, allowing for immersion and positive user experience.

Implementing this technology into SL means that Linden Lab needs to contact nViso and ask for their services. As stated on their website, nViso's technology "integrates into existing survey frameworks and platforms" (2012), which means nViso is willing to integrate their technology to any platform (albeit survey platforms for now). However since nViso's technology only extracts facial emotion data, another form of software is needed to take that extracted data and apply it to 3D avatar features, which Linden Lab needs to provide. Linden Lab can incorporate nViso technology into Second Life Viewer allowing users to access it free of cost.

Integration of this technology by the user is also plausible. Besides the possibility of it being free via Second Life Viewer, this method uses only a webcam as hardware to read user facial expressions. According to PC world, 79% of laptops now have webcams (2011); this means chances are that a Second Life user already has a webcam. Statistics from Pew Internet & American Life Project show that 72% of 18 – 20 year olds own a laptop (2011), and according to Cisco (2011) more than 50% of Generation Y owns a webcam. These statistics support the idea that using this method of extracting facial emotion data is very feasible, since many people own laptops and most laptops have built in webcams.

Overall analysis of this method shows that implementation of this technology is feasible since it only requires Linden Lab acquiring services from nViso. Integrating the method is also feasible due to nViso's willingness to work with any platform and the use of only webcams to extract facial emotion, which most laptop owners have.

## 3. Analysis Results

After comparing and contrasting the three facial emotion extraction methods in terms of feasibility, implementation and integration, the following results were found:

| Method | Implementation | Feasibility | Integration |
|---|---|---|---|
| 1. **Extracting emotion through user text** | • Already implemented in SL through Second Life Marketplace | • Uses text chat which means total immersion of communication in the virtual world to mimic real face-to-face communication is not feasible | • Users can integrate it by buying Automatic Facial Animation HUDs<br>• Not all users are willing to pay for the HUDs. |
| 2. **Extracting emotion using motion capture technology via Xbox and Kinect** | • SL can be accessed through the Xbox 360 console via Xbox LIVE through Wi-Fi connection<br>• Implies Microsoft cooperating with Linden Lab | • Not feasible to believe users are willing to buy expensive hardware just to use SL | • Users need to buy Xbox 360 and Kinect in order to integrate this technology. |
| 3. **Extracting emotion using nViso's technology via webcams** | • Linden Lab hiring nViso<br>• Finding a method to use the extracted data from nViso's technology to apply to 3D avatar facial features. | • Most users own laptops<br>• Most laptops have webcams<br>• nViso is a start-up company willing to work with others | • Users do not need to do anything except for using their webcams in SL<br>• Can be integrated free via Second Life Viewer |

As a result, extracting facial emotion using nViso's technique via webcam is the best method out of the three cases considered.

### 3.1   Limitations

This study is a cross-case analysis of the three facial emotion extraction methods identified through literature review. The results were reached strictly through comparing and contrasting the possibilities of using the methods for Second Life. The methods were not actually implemented within a virtual world environment to conduct the research. Furthermore, this study looks at only three facial emotion extraction methods used for conveying better avatar expressiveness; further research is needed

to identify more methods. nViso's facial emotion extraction method only reads the data on a user's face via webcam; it does not have the means to apply that data to 3D avatars.

### 3.2    Future Research

Further research is necessary in order to justify the hypothesis formed in this study. Applying the methods identified to an actual virtual world environment and collecting qualitative and/or quantitative data can help further this research.

## 4.  Conclusion

Virtual worlds are growing in popularity; they are being used by businesses, educational institutions and to socialize. Some of the reasons for this popularity are cost efficiency for businesses in terms of travel for meetings, providing a fun environment for education, and also as a form of a therapeutic environment. Mimicking real-life communication in virtual worlds is crucial for users' immersive experience. Better communication leads to better utilization of the virtual world. However, today's virtual world avatar communication could be significantly improved.

Through literature review, three technologies where identified that can help with avatar communication in virtual worlds. The three methods were: extracting emotion through user texts to apply to avatar facial features in real-time, using Microsoft's Kinect technology to capture user facial motion to apply to the avatars' in real-time, and extracting emotion through video capture of user's facial expressions via webcam in real-time. A specific virtual world, Second Life, was focused on for possible implementations of these methods.

This research evaluated the three technologies available to better user experience in Second Life through comparing and contrasting the implementation, integration and feasibility of the methods. After conducting comparisons of the likelihoods of using these technologies in Second Life, it was concluded that extracting emotion via webcam was the best method out of the three cases studied.

## References

Andre, E., Klesen, M., Gebhard, P., Allen, S. and Rist, T., (1999) Integrating Models of Personality and Rmotions into Lifelike Characters. In A. Paiva, and C. Martinho (Eds.), *Proceedings of the Workshop on Affect in Interactions - Towards a new Generation of Interfaces*, (pp. 136-149). Siena, Italy.

Andre, Rist, T., Van Mulken, S., Klesen, M., and Baldes, S. (2000), The Automated Design of Believable Dialogue for Animated Presentation Teams. In J. Cassell, J. Sullivan, S. Prevost, and E. Churchill (Eds.), *Embodied Conversational Agents*, (pp. 220-255). Cambridge, MA: The MIT Press.

Badler, N. I., Metaxas, D., Webber, B., and Steedman, M., (1995). The Center for Human Modeling and Simulation, *Presence (Camb)*, vol. 4, no.1, 81-96.

Bartneck, C. (2001) How Convincing is Mr. Data's Smile: Affective Expressions of Machines, *User Model User-adapt. Interact.*, Vol. 11, 279-295.

Bates, J., (1994). The Role of Emotion in Believable Agents, *Commun. ACM*, vol. 37, no. 7, 122-125.

Bianchi-Berthouze, C., Lisetti, L. (2002). Modelling Multimodal Expression of User's Affective Subjective Experience, *User Model User-adapt. Interact.*, vol. 12, no. 1, 49-84.

Bouda, T., (2012). User-Centered Design and Evaluation of Virtual Worlds. Retrieved March 9, 2012 from: http://www.inter-disciplinary.net/wp-content/uploads/2012/02/boudaepaper.pdf.

Cabiria, J,. (2008) Benefits of Virtual World Engagement: Implications for Marginalized Gay and Lesbian People. *Media Psychology Review.* Vol. 1(1). Retrieved March 10, 2012 from: http://mprcenter.org/mpr/index.php?option=com_content&view=article&id=167&Itemid=126.

Calongne, C. M.(2008). Educational Frontiers: Learning in a Virtual World. *EDUCAUSE Review*, v. 43, no. 5. Retrieved March 10, 2012 from: http://www.educause.edu/EDUCAUSE+Review/EDUCAUSEReviewMagazineVolume43/EducationalFrontiersLearningin/163163.

Cassell, J., (2000). More than just another pretty face: embodied conversational interface agents, *Commun. ACM*, Vol. 43, No. 4, 70-78.

Cassell, J., Bickmore, T., Campbell, L., Vilhjlmsson H., and Yan, H., (2000), Human Conversation as a System Framework Designing Embodied Conversational Agents. In J. Cassell, J. Sullivan, S. Prevost, and E. Churchill, (Eds.), *Embodied Conversational Agents*, (pp. 29-63). Cambridge, MA: The MIT Press.

Cisco. (2011). *www.cisco.com.*

Definition of Avatar (2012). TechTerms. Retrieved online March 10, 2012 from: http://www.techterms.com/definition/avatar.

Definition of HUD (2012). Webopedia. Retrieved online March 10, 2012 from: http://www.webopedia.com/TERM/H/HUD.html.

Definition of Immersion (2012). www.dictionary.com. Retrieved March 14, 2012 from:
    http://dictionary.reference.com/browse/immersion?s=t.

Definition of MMOG (2012). Oxforddictionaries.com. Retrieved October 18, 2012 from:
    http://oxforddictionaries.com/definition/english/MMOG.

Definition of Motion Capture (2012). Oxforddictionaries.com. Retrieved October 18, 2012 from:
    http://oxforddictionaries.com/definition/english/motion%2Bcapture?q=motion+capture

Embedded Vision Alliance. (2011). Avatar Kinect Hits the Xbox LIVE Marketplace: Facial Recognition
    Becomes Commonplace. Retrieved February 22, 2012 from: http://www.embedded-
    vision.com/news/2011/07/26/avatar-kinect-hits-xbox-live-marketplace-facial-recognition-
    becomes-commonplace.

Gardner, David (2011). 60% of Marketers to Increase Spend on Virtual Conferences. *CMO.com
    Exclusive*. Retrieved March 10, 2012 from: http://www.cmo.com/virtual-worlds/60-marketers-
    increase-spend-virtual-conferences.

Hayes-Roth. (2003). What Makes Characters Seem Life-like. In Prendinger, H. and Ishizuka, M. (Eds.),
    *Lifelike Charactes: Tools, Affective Functions and Applications*, (pp. 447- 462). Berlin, Germany.

Ishaan. (2011). PlayStation Vita Facial Recognition Tech Demo Shows Video Chat with Avatars.
    Retrieved March 1 2012 from: http://www.siliconera.com/2011/06/30/playstation-vita-facial-
    recognition-tech-demo-shows-video-chat-with-avatars/.

Issues of Human Computer Interaction. (2004). (An Interview with Anabelo Sarmento*). Information
    Technology Newsletter,* vol.15, no. 2, 15- 23.

John, D., Gatzidis, C., Boucouvalas, A.,  Liarokapis, F., and Brujic-Okretic, V., (2011). Prototyping
    Expressive 3D Social Worlds. The Open Virtual Reality Journal, 3, 1 – 15. Retrieved March 1,
    2012 from: http://www.benthamscience.com/open/tovrj/articles/V003/1TOVRJ.pdf.

Kiesler, S., Siegel J., and McGuire, T.W., (1984). Social Psychological Aspects of Computer-Mediated
    Communication, *Am. Psychol.*, Vol. 39, 1123-1134.

Koda, and Maes, P., (1996). Agents with Faces: The Effects of Personification of Agents, *Proceedings
    of HCI'96, (*pp. 98-103). London.

Linden Lab., (2011). The Second Life Economy in Q2 2011. Retrieved March 10, 2012 from:
    http://community.secondlife.com/t5/Featured-News/The-Second-Life-Economy-in-Q2-2011/ba-
    p/1035321.

Lip Sync. (2012). Second Life Wiki. Retrieved November 26th, 2012 from:
    http://wiki.secondlife.com/wiki/Lip_sync.

McEntegart, Jane (2011). Kinect Breaks Consumer Electronics Sales Record. Retrieved online March
    10, 2012 from: http://www.tomsguide.com/us/Kinect-Sales-10-million-Guinness-World-Records-
    Gaming-Edition,news-10409.html.

Moore Robert J., Ducheneaut N., and Nickell, E., (2006). Doing Virtually Nothing: Awareness and
    Accountability in Massively Multiplayer Online World. *Computer Supported Cooperative Work*.
    Retrieved March 18, 2012 from:

https://docs.google.com/viewer?a=v&q=cache:i2oHNcvDsFAJ:citeseerx.ist.psu.edu/viewdoc/dow
nload%3Fdoi%3D10.1.1.90.2228%26rep%3Drep1%26type%3Dpdf+&hl=en&gl=us&pid=bl&srci
d=ADGEEShliYhm07YqnSiAHj8eryKoor6ytiS2cdkH4VolTqKKqCdDGsz4iRE9yr6jYwChKzNd
oYOadTWV48Gh57JaFQUK_EQ_intLQ_0UAdiH_R1lhTnt9QdGOLDI7TPjdY_kT1P2jDwJ&si
g=AHIEtbTAXgCOfTRr0znYdKAmtI5d8F8wkQ.

Neurofuturist. (2012). Emotional Avatars in Virtual Reality Environments. Retrieved March 2, 2012
from: http://futuretechnologytrends.com/2012/02/emotional-avatars-in-virtual-reality-
environments/.

nViso (2012). Company Web Site. Retrieved March 2 2012 from: http://www.nviso.ch/index.html

Parkinson. (2008). Emotions in direct and remote social interaction: Getting through the spaces between
us, *Comput. Hum. Behav*.,Vol. 24, No. 4, 1510-1529.

PC World. (2011). *http://www.pcworld.com.*

Perlin, K., (2000). Creating Emotive Responsive Characters within Virtual Worlds. Virtual worlds:
second international conference; proceedings/VW 2000, Paris, France, July 5 – 7, 2000. Retrieved
February 18, 2012 from:
http://books.google.com/books?id=AK7kRV2wgMC&pg=PA115&lpg=PA115&dq=s

oftware+to+better+understand+virtual+world+facial+expressions&source=bl&ots=
Erdx3YCgjE&sig=Y0hhIaKumo72Qz7FUEltgaTQnDk&hl=en&sa=X&ei=n2xATirAom
W2QXX8fWiCA&ved=0CDAQ6AEwAg#v=onepage&q=software%20to%20better%2
0understand%20virtual%20world%20facial%20expressions&f=false.

Pew Research Center's Internet & American Life Project. (2011). *www.pewinternet.org.*

Prendinger, H., Descamps, S., and Ishizuka, M., (2002). Scripting Affective Communication with Life-
Like Characters in Web-based Interaction Systems, *Appl. Artif. Intell.*, Vol. 16, Nos. 7-8, 519–553.

Prendinger H., and Ishizuka, M. (2003). Introducing the Cast for Social Computing: Life-Like
Characters. In H. Prendinger, and M. Ishizuka, (Eds.). *Life-Like Characters. Tools, Affective
Functions and Applications*, (pp. 3-16) Berlin.

Prendinger, H., Saeyor, S., and Ishizuka, M. (2003). MPML and SCREAM: Scripting the Bodies and
Minds of Life-Like Characters. In H. Prendinger, and M. Ishizuka, (Eds.), *Life-Like Characters.
Tools, Affective Functions and Applications*, (pp. 213-242). Berlin.

ReCVEB (2012). Research Center for Virtual Environments and Behavior. Retrieved March 10, 2012
from: http://www.recveb.ucsb.edu/research.html.

Second Life. (2012). Wikipedia. Retrieved March 10, 2012 from:
http://en.wikipedia.org/wiki/Second_Life.

Second Life Marketplace (2008). Auto Emote – Automatic Facial Animation HUD Version 2.0.2.
Retrieved March 10, 2012 from: https://marketplace.secondlife.com/p/Auto-Emote-Automatic-
Facial-Animation-HUD/122757.

Second Life Marketplace. (2011). Really Useful Face Emoter for Ladies. Retrieved March 10, 2012 from: https://marketplace.secondlife.com/p/Really-Useful-Face-Emoter-for-Ladies-facial-expressions-HUD/756590?id=756590&slug=Really-Useful-Face-Emoter-for-Ladies-facial-expressions-HUD.

Stellmack, David (2010) Could Microsoft Buy Second Life? Retrieved online March 10, 2012 from: http://www.fudzilla.com/home/item/20366-could-microsoft-buy-second-life.

The 1st Question. (2012). The 1st Question – 15 January 2012. Retrieved February, 2012 from: http://www.the1stquestion.com/2012/01/1st-question-15-january-2012.html.

Virtual Human Interaction Lab Projects (2012). Stanford University. Retrieved March 10, 2012 from: http://vhil.stanford.edu/projects/.

Vitay J., Hamker, FH., (2011). A Neuroscientific View on the Role of Emotions in Behaving Cognitive Agents. *Kunstliche Intelligenz,* Vol .25, No.3, 235 – 244.

Walmart, (2012). Xbox 360 console with Kinect cost. Retrieved March 10, 2012 from: http://www.walmart.com/ip/Xbox-360-4GB-Console-w-Kinect/15196666?findingMethod=rr.

YouTube. (2011a). Avatar Kinect Launch Trailer. Retrieved March 10, 2012 from: http://www.youtube.com/watch?v=7pXtfZ43rPU.

YouTube. (2011b). A Quick Look at Avatar Kinect. Retrieved March 10, 2012 from: http://www.youtube.com/watch?v=N7lQ5XSb0do&feature=related.

## Appendices

**1.      Abbreviations**

SL = Second Life

ReCVEB = Research Center for Virtual Environments and Behavior

MMOG = Massively Multiplayer Online Game

HUD = Heads Up Display

HCI = Human Computer Interaction

AI = Artificial Intelligent

**2.      Definitions**

- Immersion: state of being deeply engaged or involved; absorption (dictionary.com, 2012)

- HUD: display where gamers can see their character's vital statistics and more (Webopedia, 2012).

- Avatar: avatar is the virtual representation of the online user (TechTerms.com, 2012).

- Information Accountability: Information accountability means the use of information should be transparent so it is possible to determine whether a particular use is appropriate under a given set of rules and that the system enables individuals and institutions to be held accountable for misuse (Weitzner et. al., 2007).

- Lip Sync (in Second Life): Whenever someone uses voice chat and you see the green waves above the avatar's head, you should also see the avatars lips move (Lip Sync, 2012).

- MMOG: an online video game which can be played by a very large number of people simultaneously (oxforddictionaries.com, 2012).

- Motion Capture: the process or technique of recording patterns of movement digitally, especially the recording of an actor's movements for the purpose of animating a digital character in a film or computer game (oxforddictionaries.com, 2012).