HG2052: Language, Tech & The Internet
Assignment One- Medium of communication
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Holographic Technologies

Since its conception, the field of Information Communication Technology (ICT) has made monumental advancements. The interactive 3-Dimensional Hologram Technology (3DHT) has long been touted as the ideal medium of communication for its potential of revolutionizing and redefining the way ICT works. The 3DHT, once an ideal science-fiction semantic device for popular films like Avatar, Hunger Games, Star Wars and in video games such as the Final Fantasy series, no longer remains a fantasy but has finally became a possible reality due to ground-breaking developments of the ICT.

The word hologram stems from Greek terms "holos", meaning "whole view" and “gamma”, meaning "writing (of the information)" (Ghuloum, 2010). A hologram, technically known as wave front reconstruction, is a three-dimensional documentation of laser light wavelength patterns-recreating the wavelength fronts of light from the original object to form an identical image (Jeong, 2008). Such 3D holographic images are thus realistic replicas of actual or imaginary environments.

	Hologram type	**Viewing illumination**	**Image position**	**Image Depth**	**Typical Subjects**
1947-1796	Gabor	Filtered monochromatic lamp	Focused centimetres from hologram	Fraction of millimetre	Lined drawings and electron-microscope shadow grams
1967	Pulsed Laser	Laser	Behind Hologram plane	Up to a meter or so, but usually tens of millimetres	Human portraits, rapidly moving scenes
Post 1985	Computer-generated	White Light	Straddling hologram plane	A few millimetres	Decorative patterns or security

Table 1: Evolving nature of holograms (as adapted from Johnson, 2008)

The fundamentals of 3DHT were developed in 1947 by Hungarian physicist, Dennis Gabor. Gabor's concept required a two-step imaging process. Firstly, a beam of light waves consisting of a single frequency would generate the shadow of an object, resulting in interference of light diffraction around the object's edges. This interference was used to diffract light from another beam to "reconstruct" an image of the origal object. In principle,

this could generate 3D images but the images constructed then were poor (Johnston, 2008). The use of Holographs has since then underwent series of technical evolution in terms of the subjects and the type of viewing illumination used, as seen in **Table 1.** Gabor's technique was not optimized until the development of laser technology in the 1960s. 3DHT has since advanced notably due to emergence of inexpensive and accessible lasers in devices like DVD players.

Figure 1. Holographic Hatsune Miku Concert. [Primary source]

Figure 2. Holographic Kagamine Twins concert [Primary source]

A current prominent use of the 3DHT comes in the form of the immensely popular Vocaloid concerts. The Vocaloid culture presents a whole new futuristic concept with the use of 3DHT-a concept uncharacteristic of the modern music industry. Virtual Japanese pop idols like Hatsune Miku, Kagamine Rin and Kagamine Len shot to international fame after release of their music sound bank on the popular Japanese counterpart of Youtube, Nico Nico Douga. Using cutting- edge 3D projection technology, the Vocaloid idols were brought to life. With a solid fan base, the virtual idols are able to hold series of sold-out concerts and overseas 'tours' with a real human live band through their holographic projections, as shown in Figures 1 and 2. On the 3DHT platform, the idols are no longer a figment of imagination but literally a larger than life artiste of great entertainment value.

Going beyond the transmission of holographic projections for entertainment purposes, the development of 3DHT has since led to a new modality of communication- **3D video conferencing.** Various approaches have been suggested to enable real-time 3D reconstruction for immersive communication-some using silhouette, some on computer-based graphic simulation, and some on image-matching. (Zhang, Cai, Chou, Zhang & Martin-Brualla, 2012)

The **TeleHuman** is one of the latest inventions of 3D video conferencing. While 3-D holographic video conferencing is not a new technology (creation of an on-stage holographic video conference by Cisco and Musion Systems in 2007), the TeleHuman demonstrates a much simpler and cheaper use of the technology (Jablonski, 2012). Utilizing existing hardware like the Microsoft Kinect sensors, a 3D projector, a life-sized translucent acrylic cylinder and a convex mirror as shown in Figure 3, the TeleHuman 3D

Figure 3: The TeleHuman hardware- a cylindrical display surface with 6 Kinects and a 3D projector in base

video conferencing system acts as a display portal that displays a 360º motion perception of a life-sized human presence. Interlocutors are given the liberty to move around the 3D display of the other interlocutor while wearing shutter glasses for a stereoscopic view of the solidity and depth of the other party.

The main design rationale for the TeleHuman was to support comprehensive 3D nonverbal communication (NVC) via 3DHT. As shown in Figure 4, the NVC cues include important gestures like body postures and movements, eye contacts and 3D spatial visualisation of interlocutors. A review by the original team of researchers of the TeleHuman observes that relevant design attributes like the 3D visual directional cues (mainly the 3 pointing cues (gaze, hand, gaze & hand gestures) can help to facilitate and regulate conversation flow and also provide immediate feedback for the understanding of any additional linguistic context of speech (Kim, Bolton, Girouard., Cooperstock, & Vertegaal, 2012).

Figure 4: The TeleHuman

The communication modality of the TeleHuman is most similar to that of **video conferencing**. Current videoconferencing platforms enables interlocutors from different locations to interact simultaneously via real time visual videos and audios. Examples of videoconferencing medium ranges from free services like Skype and chat roulette websites like Omegle, to costly commercial business conference systems like the Cisco's Telepresence system and the Polycom RealPresence. Referring to Crystal's 7 features of communication, an analysis of both the TeleHuman and videoconferencing tools supports the further development of the TeleHuman as an optimal medium of communication. Both are similar in terms of being time-bound, spontaneous, socially interactive and prosodically rich, due to their capacity to visually contextualise the interlocutors. The spontaneity of communication of both videoconferencing and TeleHuman can be stunted by the speed of the internet, so the effectiveness of the communication is subjected to the efficiency of communication networks.

Unlike the Telehuman, the functionality of videoconferencing is much more readily available; with a plethora of digital devices like mobile phones, personal digital assistants (PDAs), laptops and even networks like the Internet protocol supporting its applications. Since only real time visual parameters are being transmitted, videoconferencing systems also requires much less bandwidth than that of TeleHuman. Furthermore, the fact that the TeleHuman is only able to transmit 3D images meant that communication was only limited to visual cues and not really reciprocal, unlike the immediacy of feedback videoconferencing can provide. Since it is only limited to visual cues, perhaps a valid alternative use of using the TeleHuman for communication is via sign languages. In this way, the TeleHuman remains a competent medium of communication when compared to videoconferencing, just that it would be limited to interlocutors who understand sign language.

Lastly, the development of 3DHT has not been able to advance to accommodate to large numbers of interlocutors simultaneously. For example, unlike videoconferencing, the

TeleHuman is limited to only one to a few interlocutors at a time. There is simply no space for the holographic projection of a crowd. It is arguable that this limitation does not count against the effectiveness of the TeleHuman as a medium of communication; for it is only human for each interlocutor to be able to concentrate in communicating with just one other interlocutor instead of a group.

	Speech	**Text**	**TeleHuman**	**Video conferencing**
Crystal's 7 features of communication	Time bound	Space-bound	Time bound	Time bound
	Spontaneous	Contrived	Spontaneous	Spontaneous
	Face-to-face	Visually decontextualized	Face-to-face	Face-to-face
	Loosely structured (Verbal)	Elaborately structured	Loosely structured (hand signs)	Loosely structured (Verbal)
	Socially interactive	Factually communicative	Socially interactive	Socially interactive
	Immediately revisable	Repeatedly revisable	Immediately revisable	Immediately revisable
	Prosodically rich	Graphically rich (written representation)	Graphically rich (gesture representation)	Prosodically rich
Nonverbal communication (NVC) cues	**Yes**	Yes, but in a **different way**	**Yes**	Yes, but with **much restrictions**

Table 2: Comparison of Speech, Text, TeleHuman and Video Conferencing (as adapted from Crystal's features of communication)

Referring to Table 2, videoconferencing may still prove to be a more effective communication tool than the TeleHuman mainly because it is able to preserve features of face-to-face speech. It is more convenient and cheap to use. The only weakness is that videoconferencing is only able to preserve partial visual cues. Subtle body language and gestures, eye contact, room acoustics, and joint interactions are often inadequate, misrepresented, or entirely absent. Its inability to relay NVC cues comprehensively thus limits its support of naturalistic human-centred communication.

The 3D video model of TeleHuman, as opposed to the direct display of the 2D videoconferencing output, seeks to bridge this gap by facilitating the preservation of eye contact, accuracy of hand pointing and bodily gestures. It helps to avoid misperceptions of social distance with the life- sized visual image and also aids to convey a significant sense of realism and presence of the interlocutors (Kim, Bolton, Girouard., Cooperstock, & Vertegaal, 2012). All these may help to reduce the chances of miscommunication. All in all, the TeleHuman is a competent medium for communication with a great scope of potential functions if it is developed and improved in the right direction.

Comparing the 3DHT communication of TeleHuman to speech, it is evident that both are also very similar to each other as seen from Table 2. The telephone is an example of

devices utilizing only speech. In analysing both mediums based on Crystal's features of communication, both are time-bound, spontaneous, socially interactive, immediately revisable and prosodically rich. Interestingly, speech comprises of nonverbal elements also known as paralanguage, which includes voicing quality, speaking style and emotion, in addition to prosodic features like rhythm, intonation and stress (Narayana & Kulkarni, 2013). Due to the spontaneous nature of both mediums of communication, the languages used are likely to be loosely structured- contractions and the use of informal vocabulary are more common. Speech makes much use of prosody that is suitable for social interactions. If we only consider speech in terms of using telephones, then the 3DHT communication would be a much more efficient medium of communication due to its ability to communicate nonverbal communication (NVC) cues. However, in terms of face to face communication, speech is evidently much more convenient and straightforward than the use of 3DHT communication.

Written texts, another standard method of communication, is vastly different from the 3DHT communication of TeleHuman. Written texts have several nonverbal elements of its own such as the style of handwriting, spatial presentation of words, or the expression of moods (Narayana & Kulkarni, 2013). The contemporary example of written text is the use of digital texting. Referring again to the adapted version of Crystal's features of communication in Table 2, unlike the TeleHuman, written texts are space-bound, contrived, graphically rich and factually communicative. As there are no longer any immediate feedback cues like the face-to-face interactions, it is visually decontextualized. Hence there is a need for it to be elaborately structured so as to clearly communicate meaning intended across to the other party. Language use is thus likely to be more formal than that of the language use in the TeleHuman.

Most importantly, as it is written down, it is considered repeatedly revisable and hence, reduces the potential for miscommunication by the reinforcement of intended meaning. With the advent of speech to text recognition software, speech made by holographic projections may even result in production and recording of real time subtitles, forming yet another modal of text-like communication. If the TeleHuman can integrate this form of technology into its own system, it would become a powerfully effective medium of communication indeed.

Though highly effective, there are still some barriers preventing the integration of 3DHT into communication environments. These come mainly in the form of the high cost of installation of the system and requirements of a high-speed Internet connection. Though the TeleHuman as a 3DHT device claims to be made as cost effective as possible, it does not seem to take into account of the costs of acquiring multiple Kinect hardware and perhaps a screening room with compatible lighting and video technology, which can add up to almost 150,000 US dollars for installation (Ghuloum, 2010). The use of 3DHT also requires a speedy Internet connection, with a minimum guaranteed constant speed for real time projection of the holographic images. People who are less technologically-savvy or are not accustomed to the new form of technology may not want to use it at all; turning to less complicated alternatives like phone calls or videoconferencing.

Prima facie, though in need of further developments and improvements, the 3DHT clearly has a dynamic and formidable future. Its impacts on human communication are likely to be far-reaching, complex and multifaceted-influencing all the critical institutions of society including social relationships, business, education and even environment.

The use of 3DHT may have a significant impact on the field of business management; especially in the areas of marketing and advertising. For one, the use of 3DHT is still a novel concept. Besides facilitating business conferences and communication, 3DHT can also be used for marketing campaigns. The use of 3DHT can help to sell a concept or product through a thorough presentation of depth and design, facilitating visualisation for audiences. The integration of 3DHT in featuring the Vocaloid diva, Hatsune Miku, with Toyota's marketing campaign has been a hit sensation since its inauguration in 2011, with its Youtube videos garnering over 3 million views. (PR Newswire, 2011). The novelty of the 3DHT marketing hence gives it a sense of a high profile credibility.

The relevance of 3DHT on the society lies critically on the interdependence of human relations (Ghuloum, 2010). The maintenance of relationships can be greater enhanced through communication facilitated by the use of 3DHT. Parents who are away from home or overseas are able to leave a sense of 'telepresence' for reassuring and comforting their young children at home. Interactive virtual holographic companions can help to reduce people's sense of loneliness. For instance, in UK, according to the Campaign to End Loneliness group, about one out of ten elderlies suffer from "intense" loneliness (Coughlan, 2011). As the use of 3DHT can help to create the illusion a telepresence and of face-to-face conversations, devices like the TeleHuman system, according to ActiveAge in their BusinessLab review in 2012, could be used to reduce the degree of loneliness among the elderly population. However, the beneficial uses may conversely be abused and exploited for adult entertainment.

The use of 3DHT can also be beneficial for the environment. Like videoconferencing, the use of TeleHuman eliminates the need for interlocutors to travel in order to meet the other party to communicate. Since less transportation fuels are needed, the method of communication is not only convenient and timesaving, it also helps to reduce tons of carbon dioxide and greenhouse gases that could have been produced from usage of travel fuels. For instance, holograms can now allow students to be taught by a 'virtual teacher' who could be in another region or even country. This innovation goes a step beyond video conferencing in the way that the hologram teacher can have a 'telepresence' in the classroom, and can even see and interact with the students like they are all in the same room. Edex, the largest Internet connections host of to the UK education market, was able to demonstrate the service of such a 'virtual teacher' at the BETT2000 educational technology show in London (BBC News, 2000).

The use of 3DHT can even be utilized in the area of education. For instance, it provides a platform for the presentation and exploration of teaching materials. There are already developments made for the Bodipod, a counterpart of the TeleHuman. It is basically a 3D 360° stereoscopic human anatomy browser that allows users to interact with the human anatomy model. As seen in Figure 4, through the use of gestures like scaling, rotating, peeling and labelling and the use of speech, it aids users in visualizing of the human body parts (Bolton, Wang, Kim & Vertegaal, 2012). Analysing data volumetrically facilitates comprehensive understanding and immediate feedback. With this, it is viable for 3DHT to enhance the effectiveness of simulators. The current flight simulators artificially re-create aircraft flight scenarios to train pilots. The 3DHT visual cues may aid in reviewing of the mechanics of planar movement and navigating environmental terrains.

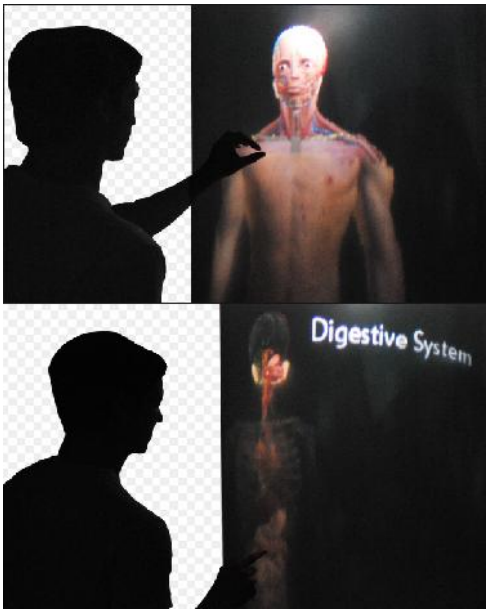

Figure 4: Peeling and Pointing interactions of the BodiPod

Figure 5: **How the Oculus Rift works**

This leads to much more possibilities in gaming genres like role-playing games. With the prospect of the 3DHT providing a realistic 360º holographic view for players, an immersive gaming experience in the form of first-person shooter scenarios is possible. Virtual Reality Massively Multiplayer (MMOW) online games envisioned by highly popular anime and manga series like Sword Art Online and Gun Gale Online will no longer be of a far-fetched fantasy. In fact, the world of virtual reality may be within our grasp with the

recent launch of the Oculus Rift (as seen in Figure 5), a virtual reality head-mounted display that provides users with a 3D view. Though not exactly an interactive platform for communication (does not support internet connection yet), the Oculus Rift has continued to receive rave reviews since its launch of developer and consumer kit. Further improvements and integration of the Oculus Rift with the 3DHT allowing players to communicate face-to-face (virtually) may then result in the use of a new online visual language to communicate a certain message or experience. Language use will be graphically rich through the players' gesture representation and also loosely structured as communication becomes immediately revisable and spontaneous.

People are turning to novel integrated communication technologies for the immediacy of an in-person meeting, while still being able to work from another location (McCallion, 2013). Though present 3DHT devices have the potential to substantially improve communication experience from that of traditional video conferencing, they are still far from being truly immersive. Developers like Microsoft are trying to develop essential hardware and software foundations for a naturalistic physical 'body proxy' in formal meetings –the ability and flexibility to gaze around and turn sideways for a real time conversation with neighbouring colleagues. In time, the same medium will allow high-definition communication for consumers over original and proven platforms like Skype, Facebook Messenger and Lync, along with new emerging platforms like Surface and Windows 8.

Communication modalities with the use of 3DHT may be as similar as possible to that of a face-to-face meeting. As discussed in this paper, 3DHT as a medium of communication is presently very similar to that of videoconferencing. However, its ability to facilitate visual and non-verbal cues will bring it much closer to face-to-face speech if further developments of it as a mode of communication are pursued. The field of 3DHT clearly has an influential and dynamic future with its potential to branch out to impact other aspects of ICT inventions. Hence its impacts on human communication are likely to be far-reaching and complex.

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