MA Digital Culture and Technology

Digital Practice

The computer has existed in different forms since the early Greek and Roman periods of History in the form of the abacus, however in comparison to modern standards the abacus is comparable to a data storage facility. The abacus stores values of numbers in varying positions along its frame but it still requires the logic of a human to operate it and help perform the calculations.

The last millennium saw the invention of the computer as it is now thought of, but not before several versions of these machines existed. In the 1600's Pascal and Leibniz created machines that performed calculations and used special algorithms to do so. The machines operated using a gearing system to store values, data was inputted mechanically. The algorithms could not be adapted once the machine was built, so compared to modern standards the machine could be called a semi automatic, data storage facility to use a rough term, but this would be analogous to a primitive calculator.

The 1800's saw the specification of a computing device by Charles Babbage. The specification theoretically would allow the machine to perform calculations of relative complexity. The importance of the machine that Babbage designed is that it was programmable, it would read programs through punched cards, and it would print readouts on paper to prevent transcription error. His assistant Ada Byron Lovelace speculated that the machine would facilitate composition of complex music, be capable of producing graphics, and would be used for practical and scientific applications. She also specified a method for calculating Bernoulli numbers using the Babbage device. The fact that the machine specified by Babbage was programmable, means that it is regarded in some accounts as the worlds very first computer, Ada Lovelace is seen as the very first computer programmer and her specification for the calculation of Bernoulli numbers the very first computer program respectively.

The modern computing age began in the 1940's with the creation of several computers that compete for the title of the very first modern computer. Two machines of significant importance are the Z3 created by Konrad Zuse in Germany, 1941, and Colossus created by Alan Turing and other colleagues in Great Britain in 1943. The Z3 was based on electromechanical relays, however Colossus was the first digital electronic machine.

Both machines have factors that make them equally viable for being the first modern computer. However the irony lies in a theory developed by Turing himself:

> A Turing machine consists of an infinite amount of memory, a finite set of symbols and an instruction set. Re-arranging these symbols in memory and utilising an instruction set on these symbols allows mathematical functions to be calculated. A mathematical function exists if and only if it can be computed using a Turing machine. The Universal Turing machine is one that can imitate any other Turing machine. Any machine with the computational power the same as a Universal Turing machine is described as Turing-complete.

Colossus created by Turing was an electronic machine it was also programmable, however it was incapable of certain mathematical tasks and therefore was not Turing-complete. The Z3 was completely programmable, if it was possible to give the Z3 an infinite amount of memory it could imitate any other Turing machine. Therefore it is described as Turing-Complete, and by this standard can be called the first modern computer.

In 1950's and 1960's America, a new revolution began in terms of computers…

Although the development of computers continued throughout the 40's and early 50's it was within laboratories belonging to governments and large corporations beginning to specialise in this area that the development occurred. The ideologies within these laboratories were not always necessarily far-seeing. IBM for example, saw the computer as a bulk-processing machine, continuously operating but with very little interactivity. If this trend had continued it could be quite feasible that the computer as we now know it would not exist. However as the development continued and new machines were created old machines were not discarded but given to certain universities and other academic institutions such as the Massachusetts Institute of Technology (MIT) in America, for study and teaching purposes.

Within the laboratories of this institution the world of hacking was born and from that epicentre the world of computing has never been the same since. The MIT hackers, and other institutions given the ability to access machines such as the TX-0, the PDP-1 and the PDP-6 began to interact with the machines producing new software, where compilers and programming languages and other software were not comprehensive enough these hackers designed new compilers, new programming languages and new software for ever increasing new purposes. These hackers started everything from scratch in terms of software creating mathematical routines, graphical routines, basic calculators, rudimentary games, and as there visions grew so did their projects including venturing into the realms of artificial intelligence and musical composition. The predictions made by Ada Lovelace were beginning to be realised. Hardware was not untouched either and where these hackers had the ability to improve on the circuits and components of machines they were given the opportunity to experiment and install their new components if it would prove to be advantageous to development.

The culture grew and although it began to leave the institutions, the programmers that left the institutions began to form companies or spread the word in other colleges, and those who began to discover computers outside of academic life became part of the culture themselves. The late 60's and 70's saw the development of hardware, and saw the advent of the first personal computer. The desire to create a machine that could be used in the home for programming, and the friendly competition and cooperation that came about in pursuit of this goal saw the creation of many computers of varying capabilities that could be assembled at home and then used for various programming tasks. However the unprecedented arrival of the Apple Macintosh, created by Steve Wozniack one of the many hardware hackers in this age, signalled the arrival of the personal desktop computer.

The 80's saw the creation of the gaming culture, along with the development of home and business software applications. Hardware also improved and began to spread through to regular homes and businesses and started to become part of everyday lives. This trend has continued and is still growing in the 21st century.

Computing has become part of everyday culture, and it is a large part of our heritage and the worlds identity, but in the same way that it has become part of our culture, culture itself is beginning to take advantage of digital processes in a way that may never have been imagined before.

When the very first computer game was created on the machines in the MIT laboratories in the 50's we saw an example of modelling and simulation, an artificially intelligent opponent gave the application a method of automated movement around the board, however this could be hard coded. The very first applications taking advantage of the data storage capabilities of computers created a whole new world of data representation, and the first applications allowing users to type words and save the created document, created a new method for the storage and retrieval of the printed form. The first database, the first use of the Internet, the list goes on but each advent in terms of the computer revolution did not just create a solution for a specific problem, rather solutions could be taken and re-used if appropriate, or re-programmed into more practical forms. This has lead to the application of computers over many cultural areas new and old, each taking advantage of old methods, and spearheading development and the innovation of new computing technologies.

- Art History
- History
- Music
- Information Management
- Libraries
- Museums
- Records and Archives
- Architecture
- Archaeology

So out of two seemingly disparate areas, technology, and culture, there now exists a synergy between the two that hopefully will prove to be advantageous to each other as this relationship continues to evolve. As we move through this course we shall learn more about the technology and begin to see applications of computers within these varying subject areas, and how they can help one another in terms of further development, and exactly how this synergy between the two exists.

References

www.ams.org/new-in-math/cover/turing.html - accessed 28th January 2005

www.gchq.gov.uk - accessed 28th January 2005

www.maxmon.com/1943ad.htm - accessed 28th January 2005

www.oed.com - accessed 28th January 2005

www.webopaedia.com - accessed 28th January 2005

www.wikipedia.com - accessed 28th January 2005

www.yourdictionary.com - accessed 28th January 2005

Bibliography

Brookshear, J. G. (2000). Computer Science, An Overview. Addison-Wesley

Levy, S. (1984). Hackers, Heroes of the Computer Revolution. Dell Publishing

Wordsworth Dictionary of Science and Technology. (1995). Cambridge University Press

Analogue vs. Digital

This lecture covered a number of aspects of analogue and digital technology. Looking at the various types of signals and the corresponding data types that can be transmitted using the various signal types:

	Analogue Data	Digital Data
Analogue Signal	Radio, TV	Fax Machines
Digital Signal	Mobile Phones	Computers

Table 1.

The difference between the two types of signal and the different data types transmitted using each signal was shown.

An analogue signal is naturally varying over a certain range, within that specific range there are an infinite number of values that the analogue signal will represent at any one point. A classic example that is used to distinguish between analogue and digital is a dimmer switch that is used to turn on a light. The dimmer switch can be moved to any point around its circumference, and at any one point between the 360 degrees that the switch may turn the light will be varied at that level. This is in contrast to a regular light switch that can only be turned on or off.

This is fundamental to the understanding of a digital signal. A digital signal is represented electronically as either a '1' or a '0', an electrical pulse or no electrical pulse, a pulse of light, or no pulse of light, 'on' or 'off' in the light analogy respectively.

Analogue signals can transmit analogue data, this is experienced in our every day lives as television, radio, everything we hear and see is also in analogue and can be considered as analogue data. An analogue signal can transmit digital data such as used in a fax machine.

Broadband technology such as ADSL (Asymmetric DSL) is an example of an analogue signal being used to transmit digital data, as is the case with communications using a normal modem. A regular modem will simply convert a digital signal to an analogue signal and vice versa most modems offer data transfer rates of 56kbps. ADSL has the capability of offering 8mbps downstream data transfer and 1mbps upstream data transfer compared to 56kpbs. The only difference however is to use ADSL the user requires a specific ADSL modem, a splitter which removes voice from data, and an Ethernet card which creates a short two node network between the computer and the ADSL modem, but providing high speed communication between the two.

In terms of signals and data transmission, for effective communication there are very specific requirements, and environmental constraints; providing these are satisfied analogue can be an effective method for data transmission. However it can be prone to errors, digital provides an alternative.

Digital signals can transmit digital data, and analogue data. Digital data refers to the way data moves around circuits within computers and other such devices such as the internal workings of a video recorder, mobile phone, or even microwaves. The binary values of zero or one are converted to pulses of electricity and pass along circuits this way. At the other side of the circuit it is converted back into its binary representation.

Analogue data can also be sent using a digital signal. The mobile phone provides us with an example. Within a mobile phone the analogue voice signal is converted into binary, binary is then converted to an undulating current and sent as pulses along analogue circuits. These pulses are sent over 823 microwave frequency channels divided into four dedicated categories for control, paging, access and data. When the signal arrives at its destination is converted back into binary, and then back into its corresponding analogue signal. The mobile phone used to use analogue signals to represent the voice signal, but applying digital technology now allows for the transmission of digital voice data, and digital voice and data, represented as third generation technology (3G).

The advantage of converting the analogue voice signal to digital is that any distortion introduced into the signal during transmission can be located and removed at any point, usually at the destination mobile, this allows the user on the other end of the mobile to receive a full quality communications

transmission. This is called error correction and is one of the many advantages of using digital signals to transmit analogue signals. It is not possible to achieve this within the analogue signals used to transmit analogue data.

The lecture also looked at the spectrum of signals and the concept of bandwidth of a particular type of wave. Hand-shaking protocols were also covered, which allow analogue communications methods to achieve the highest communications rate possible.

Digital signals, for analogue and digital data transmission does have its advantages. But it also has its disadvantages, such as the frequencies that are removed using the mp3 encoding process to reduce the size of a sound recording, this would not be possible with an analogue recording, and it is be debatable which would provide the better quality playback. Also the ability to receive an analogue signal is relatively easy as was shown with an old record and needle, and a basic crystal radio, not even accurate documentation of digital circuitry, and architecture could allow for a layman to pick up the blue print for a digital radio box and recreate one, technological expertise would be needed to create the circuits, and to even understand the plans. Therefore the question must be asked how much should one rely on digital wizardry? Unfortunately the answer may not be provided until one day we are forced to find out.

References

www.ieee-virtual-museum.org - accessed 28th January 2005

www.webopaedia.org - accessed 28th January 2005

www.marconicalling.com - accessed 28th January 2005

Bibliography

Brookshear, J. G. (2000). Computer Science, An Overview. Addison-Wesley

Tanenbaum, A, S. (1996). Computer Networks. Prentice-Hall

Information

Information is defined as facts or knowledge that are provided or learned. Communication of information has occurred since the very first human settlements ever existed. It is an important ability that humans possess and it is a phenomenon that is studied by scientists, philosophers and psychologists alike. Digital communication has developed worldwide since the understanding of the Laws of Electrodynamics, a theory created by James Clerk Maxwell based on work by Rudolf Heinz Hertz. The use of these four laws thus lead to the creation and use of radio waves, and a short step away was the creation of the very first wireless transmitted created by Marconi in 1894 using a spark gap transmitter and a coherer for the reception of signals. Wireless communication continued to evolve through the 20th Century and has developed into television, and digital transmission and the mobile phone culture that we have now, and modern communications methods take advantage of a mixture wireless technologies, satellite technologies, radio and the hard-wired telephone network infrastructure.

An important concept of information is that it is communicated effectively. If it took a large number of seconds to communicate sentences such as yes or no, or watch out, then difficulties could arise for everyone. In terms of the speeds of communication nowadays it seems rather insignificant, but in terms of technologies such as the Internet, effective coding techniques are paramount.

Information theory developed by Claude Shannon in 1948 helps to outline the idea of working out the amount of information in a message and the most effective way to communicate that information. It is possible to analyse the amount of bits of data that is required to be sent against a single bit of information, this is called the measured entropy of a message, it is the measure of information content in bits.

Effective use of this theory helps us to achieve optimal communications techniques for the technology that we have available. Morse code developed in 1835 is considered as a entropy encoded communications technique as although it was developed in the early half of the 19th Century it uses a variable length coding technique using short codes for frequent letters such as ‘a’ and ‘e’ and longer codes for less frequent letters such as ‘z’ and ‘q’.

Modern coding and compression techniques of digital data allow for effective digital communication techniques in similar ways to the entropy coding of Morse code but also incorporating new techniques that have been developed to aid in the effective and efficient communication of information.

Two categories of coding exist, lossy coding and lossless coding. Lossy coding formats involve removing redundant information within messages. Such a technique is MP3 encoding. The MP3 coding process removes frequencies of sounds that are inaudible to the human ear. The sounds appear in the frequency domain between 2.5KHz and 5Khz. As the name suggests once this information is removed it is lost, and the data can never be represented in the same way again.

This is in contrast to the lossless coding such as those employed in PNG images, and ZIP archives. Lossless coding techniques use special algorithms that optimise the data within a message. LZW is an example of a lossless coding technique, it is a dictionary-based method of compression that looks for pairs of strings within the data and stores them together within the dictionary. The only data then sent over the communications link is the dictionary. An effective decompression algorithm is what allows this dictionary to be analysed and used to construct the data in its original form. No information is lost within lossless coding as data can be compressed and decompressed without removing any data.

As looked at within an earlier section of this portfolio mobile phones convert analogue voice signals ultimately into digital pulses and then back again to allow voice communications. Mobile phone communication can be improved by adding compression techniques into this conversion process. Before converting the analogue signal into a binary representation extraneous frequencies that represent white noise are removed from the voice signal to clean it up. This reduces the amount of information that needs to be communicated but it also aids in the effective use of error correction when the data is received at the other end.

The Internet is making more use of compression techniques as communications using it are expensive, even creators of HTML files need to observe good programming practices to remove white space and

redundant information from the file as bandwidth is limited and it is necessary to communicate as much information possible with the least number of bits. Compression techniques are therefore used to achieve this in areas where simple good programming practices cannot be applied such as the creation and transmission of image files such as JPEG, which depending on the particular JPEG file type used can either be a form of lossy or lossless coding.

References

www.oed.com - accessed 28th January 2005

www.webopaedia.com - accessed 28th January 2005

www.wikipedia.org - accessed 28th January 2005

Bibliography

Spainhour, S. Eckstein, R. (2003). Webmaster, In a Nutshell. O'Reilly

Wordsworth Dictionary of Science and Technology. (1995). Cambridge University Press

Computer Hardware

A brief history of the computer was covered in the introduction to the digital practice section of this portfolio. It was concluded within this introduction that any machine that imitated a universal Turing machine could be considered a computer.

The modern desktop computer has developed out of the use of logic gates that can be used to manipulate data. All modern computational devices are a combination of just three basic logic gates, and, or, not.

And		
0	0	0
0	1	0
1	0	0
1	1	1

Or		
0	0	0
0	1	1
1	0	1
1	1	1

Not	
0	1
1	0

Figure 1.

The realisation of these gates using transistors and then integrated circuits has lead to the size of the computer being reduced and the performance of such devices improve greatly.

A basic computer is made up of the following devices:

CPU – The brains of the PC is its CPU. It is here that the most basic instructions for the movement of manipulation of data within the memory exist. This instruction set is called machine code and in many ways is the heart of any programming language. This shall be looked at in more detail later.

PCI cards – PCI cards allow a user to add functionality to a computer without replacing the entire hard disk. PCI cards exist to help improve graphics, allow for network communications or to allow for processing and output of sound. These cards are the Graphics, Network and Sound cards respectively.

RAM – Random Access Memory is volatile memory that exists only while a power source is available to the chip. Turing represented memory as paper sheets. Memory is designed to act like this. If you write something on a piece of paper it is recorded, if you use an eraser to remove this information it is lost and can be written over once again. RAM allows for quick access to any data it contains. Such data includes the operating system which is a loaded into memory on start up. Other applications programs are loaded into memory as required.

ROM – Read Only Memory is stable memory that constantly exists and cannot, unless in very specific cases be overwritten. A ROM chip is used within a PC to store the BIOS. BIOS stands for basic input output system. The BIOS determines what a computer is capable of without accessing any data stored on disk.

Chipset – The chipset is a collection of integrated circuits that are designed to perform one or more related functions. Modern chipsets can perform many different functions that in the past would have required multiple chips. Such functions include communicating with peripherals and disk drives taking in data, and passing it to where it is needed within the machine, and also sending data to such devices where necessary.

Disk Drives – There are various different disk drives available. A hard disk drive is a magnetic storage facility that is capable of storing large amounts of data and accessing such data at high speeds. A floppy disk drive is a magnetic storage facility but with limited capacity and storage and retrieval speeds. More disk drives exist in the form of DVD and CD-ROM drives.

Peripherals – Peripherals include the keyboard, mouse and printers. Peripherals allow the user to interact with the computer and also allow the user to print data from the computer into some physical form such as paper.

USB / Parallel Port – Peripheral devices can be connected to a PC through different ports. Two types are Parallel and USB. Parallel ports allow the communication of parallel pieces of information, i.e. more than one bit of information at a time. USB stands for universal serial bus and uses standardised connections; handshaking procedures and data transfer rates to allow for plug and play connection to peripherals and other devices.

These devices all sit on top of a motherboard. The motherboard is a central circuit board that contains the connectors required to connect these devices and to facilitate communication between them. The devices are all controlled, store and transmit data using various bus types.

Address Bus – The address bus stores information about where data can be found.

Control Bus – Synchronises events within devices and carries back signals

Data Bus – Transports data to and from the CPU, RAM or input / output devices.

Computers exist all around us in various forms. A microcontroller for example exists within programmable washing machines, digital television boxes etc. They have existed within devices such as toasters since the early 80's. Microcontrollers are dedicated specifically to a single task; this means they have limited capability, and may or may not be true computers. However as hardware is increasingly improved and reduced in size new developments are coming into existence which could in theory put an entire computer into the palm of our hand.

The most recent development in MP3 players for example consist of a hard disk drive, memory, CPU, sound card capabilities, an operating system analogous to those found on mobile phones allowing users to perform a single task at a time. The processing technology does vary among players, so whether these machines can be called computers is debatable, however if devices such as the I-POD or the SONY net Walkman can be proven to be Turing-complete as described within digital practice, then these machines can be considered to be computers.

References

www.webopaedia.com - accessed 28th January 2005

www.wikipedia.org - accessed 28th January 2005

Bibliography

Brookshear, J. G. (2000). Computer Science, An Overview. Addison-Wesley

Computer Networks

Networks have formed an infrastructure for communication since the formation of telegraph networks. Networks allow for the distribution and sharing of information between numerous users. In terms of computing networks allow for the distribution and sharing of resources, plus the ability to share and manipulate data over distances, and have allowed for the introduction of other communications methods such as email, and more recent developments such as voice over IP.

Networks consist of a transmission medium that forms its basic infrastructure. Local area networks that extend no further than an office block or a school for example could use shielded twisted pair or coaxial cable to form its basic infrastructure. Data is sent down these wires in a similar way that data is communicated using the Internet. Another transmission for such a network may also be wireless that adopts radio frequencies to transmit data to machines with wireless receivers. Wide area networks, which is the best term used to describe the internet and, networks within corporate companies that extend internationally use a mixture of transmission mediums, possibly including such technologies as satellite, fibre optics and radio.

Protocols are adopted within networks to allow computers to communicate. As the name suggests protocols are standard methods for achieving a specific behaviour. The protocols operate in a layered network model or protocol stacks. The layers are as follows:

- Application
- Transport
- Internet
- Network

The concept of the specification of such a model is that each layer can easily be upgraded or replaced if necessary, it helps to promote the durability of the network model. This applies to certain protocols as well, the TCP (Transmission Control Protocol) was designed specifically to work across dissimilar networks and unreliable connections, so in the event of an attack, or war nothing would disrupt the communications system between computers.

TCP and UDP are two important protocols that exist within the transport layer. Transmission control protocol is a connection-oriented protocol that ensures the delivery of data along a packet switched or virtual circuit network. UDP is a connectionless protocol that has no inbuilt reliability features. UDP is especially important in modern computing, as it is capable of handling time-based media. That is information that changes meaningfully with respect to time; this encompasses video and audio streaming and other similar technologies.

The Internet protocol specifies the format of packets within networks and the addressing scheme. TCP or UDP are usually combined with IP to form TCP/IP and UDP/IP connections respectively. Regardless of the network being packet switched or a virtual circuit, data is still required to be sent in packets to allow routers to be able to handle them. The difference is the connection, while the packet switched network will reassemble packets back in the correct order each packet can travel many different routes to reach its destination. A virtual circuit creates a single route for the packets to travel. A virtual circuit promotes reliability, speed and increased packet sizes.

The network layer describes the type of network. For example wireless, bluetooth or Ethernet. Each type of network has its own particular behaviour, for example bluetooth is an ad hoc network that can be created by simply being in proximity to another bluetooth device. Ethernet is a physical network. The Ethernet protocol describes how to handle the physical aspect, and data transfer within this network.

References

www.ciscopress.com - accessed 28th January 2005

www.ieee-virtual-museum.org - accessed 28th January 2005

www.webopaedia.org - accessed 28th January 2005

www.marconicalling.com - accessed 28th January 2005

Bibliography

Bates, C. (2003). Web Programming, Building Internet Applications. John Wiley & Sons

Tanenbaum, A, S. (1996). Computer Networks. Prentice-Hall

Human Computer Interaction

Human computer interaction can be described in terms of software. Operating systems software and applications software respectively.

The operating system forms an abstraction layer between the user and the rudimentary software of the bios and the hardware resources. The operating system wraps necessary functions of a computer within an easy to use interface that can either be graphical, or some sort of text interface. Microsoft DOS for example is an early operating system that was available on IBM desktop machines, and still available through various iterations of windows up until Windows ME. It stands for disk operating system and used commands allowing the user to interact with the hardware, it offered the ability to program basic programs using QBASIC but also allowed users to install pre-made programs such as basic word processors, computer games, databases etc.

Microsoft DOS evolved into its more graphical counter partner Microsoft Windows. Windows was a realisation of a graphical interface similar to that, which had already been created by competitors Apple Macintosh.

The operating system is required to manage the processor, as the processor alone is only capable of a single operation at a time. The operating system schedules tasks and maintains resource, making sure a task has the available memory and disk space to be completed. The operating system facilitates multi-tasking; it provides memory management, and device management.

With the differences that exist in hardware because of the differences in companies that create CPU's, PCI cards etc. The operating system has to be able to provide an interface between dissimilar hardware types. This allows applications software to interface with the operating system specifically and not the hardware underneath, making the task of programming applications much easier.

Operating systems can now be found on PDA's Mobile Phones, and within specialised equipment such as control machinery. The size of operating systems such as pebble Linux also makes certain operating systems portable. Pebble Linux can fit on a single flash card and can be used on any machine that can read the card.

Discussed above is the use of applications software. This applications software is created using programming languages.

The most basic programming language, and the most complex of all is Machine Code. This is difficult to use as it uses numbers to represent functions and actions within the CPU instruction set. Therefore assembler language was created. It uses words to represent specific functions, and forms a slight abstraction layer between the machine code and the user. Each instruction in the machine code instruction set is represented in another form within assembly language; a compiler converts assembler into back into machine code by translating the assembler instructions.

From this point first generation programming languages were created. These programming languages have been labelled unrestricted programming languages; they include Basic, Fortran, and Cobol. They are the very first programming languages; some created by the very first hackers in MIT in the 50's and 60's others slightly later. They were unrestricted as you type instructions in basic line by line, to refer to a line later in the program you would refer to the line number, (IF < 10 GOTO 12), the program would then execute sequentially from line 12 but this is as far as structure went.

Later programming languages attempted to address this by allowing the use of functions and procedures. By separating functions and procedures from other parts of code, they can be reused whenever needed, thus cutting down the size of a program, but also promoting the reuse of code in other programs and component based software engineering.

Programming languages require strict adherence to the syntax of the language. Failing to comply to the syntax will result in a program that wont compile. And a program that wont compile can be attributable to a single semi colon being left out at the end of a line. Therefore programming languages can be fragile, and complex. However the higher level the language the less complex the language becomes as

creators attempt to put another abstraction layer between the user and the machine. The reason different programming languages exist is first to try and solve a problem that might not have been addressed, or addressed correctly in another language, for example although Java was created to be open source and platform independent, it suffers from difficulties over different platforms, but it has less difficulties than a language that was not created to be platform independent. Also different languages exist depending on suitability for purpose. A complex programming language such as J2SE has an over complicated instruction set for mobile phones, therefore a mobile version was created called J2ME. J2ME is used to program applications for mobile phones, and is also small enough to fit on specialised integrated circuits that can be used for other hand held devices.

References

www.webopaedia.com - accessed 28th January 2005

Bibliography

Brookshear, J. G. (2000). Computer Science, An Overview. Addison-Wesley

Horstmann, C. (2002). Big Java. John Wiley & Sons

Tanenbaum, A, S. (1996). Computer Networks. Prentice-Hall

Mobile Phone Culture

Developed through the wireless communications techniques created by Marconi in the late 1800's and early 1900's and a combination of the complicated electronics that have streamlined and enhanced such technologies, the mobile phone is a modern communications device that has evolved more in the past decade than the entire past century alone, and is shaping our everyday lives and social interactions.

The mobile phone has evolved from providing users with simple analogue voice communication in the late 80's and early 90's to providing digital voice communications in the late 90's to now provide us with Digital voice and data communications in the form of third-generation mobile phone technology. Mobile phones are now more powerful than personal computers that existed just 7 years ago (The O2 XDA-II which resembles a palmtop computer has a 400mhz processor and 128MB RAM). Providing digital communications on the spot allowing access to the Internet, access to files such as PDF, and text documents, and even the ability to play movies and MP3 files. Mobile phones now operate operating systems such as a mobile version of windows and Symbian OS, and run Java virtual machines that mean that they can be controlled and manipulated by programmers using high level programming languages such as Java.

Mobile phones have helped to shape cultural phenomenons. One particular phenomenon is that of the text message, or 'txt' message. The text message is an example of how individuals have adapted to get better and more efficient use out of a service provided by the phone. The common text message abbreviates words and sayings creating a range of new words and acronyms to elicit more information using less space and time. This idea closely follows those of Claude Shannon and information theory. Shannon attempted to determine the capacity of a communication channel in terms of a common currency of bits. On the mobile phone the communication channel could be considered the text message, and the currency of the channel would be 160 characters. Those who used text messages strove to convey as much information in a message as possible incurring as little cost as possible.

Mobile phones are always evolving. They form a rich and controversial subject relating to health; ethical considerations need to be considered with the development of cameras being built into phones, also with the ability to triangulate the location of a mobile phone receiver. Txt messages are linguistically and culturally interesting. The way people communicate and why people communicate has changed, in theory people are constantly in touch with one another. For better or worse an individual is only a button away from a member of their address book. The mobile phone also opens the world to an individual, because they can continually move around with it, continually communicating with others and allowing individuals to explore the realms of the Internet should they have a phone capable of this, it also allows them to take the time to contact individuals they might not otherwise contact.

In terms of the development of the mobile phone they look like becoming more analogous to personal computers. Their portability is paramount to their popularity so we could see a change in size or convenience. The work of Kevin Warwick may play a part in mobile phone culture. The integration of a mobile communications device within a human being and attempt to use the nervous system to operate the device is a likely progression of his research. The mobile phone may benefit from other research into virtual reality such as augmented reality, providing users with a constant database of information about their current surrounding area, landmarks, sights and images they may come across. The ability to recognise music is available using mobile phones, the technology 'Shazam' will recognise any music track played through the microphone and communicate this information back to the user through text message. More complicated augmented reality projects could be developed from ones such as this, but certainly they don't seem too far away.

References

http://www.shazam.com/uk/do/home

http://en.wikipedia.org/wiki/Information_theory

Global Memory

In 1945 Vannevar Bush developed the idea that one day all human knowledge would be available through a desk like mechanism – A Memex. This idea from 1945 is a close estimation of today's reality of the Internet. Bush's concept was one of the leading factors in the development of the Internet; key scientists such as J.C.R. Licklider sketched the structure for a vast network of information to form the basis of the library of the future.

If every computer in the world were connected to the Internet at the same time then we would have something that resembles global memory. Access to every computer without restriction would allow access to a mass of information that would be impossible to disseminate within our own lifetime. We would have access to individual thoughts and opinions, journals, scientific research, and a mass of media files including midis, wav's, mp3's, movies and all sorts of images, we would also have access to organised and searchable archives of information that provide a stricter representation of what global memory could be considered as.

Developed with a goal of improved access and enhanced preservation, archives of digital formats exist that could be considered as global memory. These archives of digital formats range from text documents to images, to movies and sound files. The information could be of great academic importance and interest. Making such information available to everyone with access to the Internet fosters creative growth among others and not just those fortunate to have access to it in institutions. Such archives include the Corpus Vitrearum Medii Aevi, a project focusing on the publication of stained glass; they could include art resources such as SCRAN, or collections of newspapers such as the daily archiving of papers at the guardian website. Not all archives hold academic value.

A feature of memory is that it can constantly be accessed and queried, should archives that are digital but cannot be accessed online be considered part of global memory? Even though these archives contribute to global memory, they do not function in the same way as the archives previously mentioned.

Non-academic contributions to global memory that represent cultural artefacts include web forums, web blogs, and web sites. Web blogs represent individual's personal beliefs but can also form part of a literary project or record important information and views on world topics. Personal websites can feature such blogs but can also feature access to files, works created by the author, even the website programming could be considered an intelligent work that warrants preservation.

The list of digital cultural artefacts that some consider to warrant preservation is extensive. While the creator of a web site may not give a second thought about deleting it and replacing it with another, others believe they need saving – projects such as the wayback machine have been archiving websites since 1996. On the same note, the cultural artefacts some consider aren't worth saving can be discarded without a second thought by anyone – for example, what would warrant the saving of the Times newspaper over the Sun newspaper, or the Daily Star. Both offer a cultural snapshot of a particular moment in history, and for that both warrant saving, along with other such tabloids and broadsheets.

The idea of all human knowledge being available through a single desktop mechanism is clearly a possibility. A percentage of human knowledge exists on the Internet either in its entirety, partially or as a reference to another resource. However there is a lot of other information that could equally be described as irrelevant at any one point as it is useful at another. Some information available is also misleading or incorrect Broers (2005) states the importance of teaching individuals to be intelligent critics so that they can use information correctly. Currently there exists the dissemination of disinformation and misinformation which whether such information was created on purpose or accidentally could be considered a misuse of the Internet.

Vaughn (2005) looks at the problems involved with the book. He describes the book as inflexible, once printed it cannot be changed, only refuted. The importance for archiving is clear, scientific facts that have been discovered are important because they provide the basis for many of today's technologies and future discoveries, history and culture is important because it describes who we are as a group; individually, and how we have arrived at this current point in time. Revision however is paramount; the Internet provides a method to allow flexibility and revision.

The collection and storage of digital resources such as websites goes back to the idea of keeping knowledge within books. He describes the book as an agent of inflexible ideologies that have caused such misery in mankind. The storage of everything on the web in projects such as the wayback machine means the disinformation and misinformation described by Broers is stored with it, in the same way it is stored in the book.

If the websites featuring disinformation and misinformation are eventually removed then it is no loss to global memory or culture. Should they be revised and kept updated however with the correct information and facts then the use of the Internet for the world's knowledge and used by everyone without the fear of being misled becomes a more viable possibility.

References

http://www.archive.org/web/web.php - accessed June 12th 2005

http://www.bbc.co.uk/radio4/reith2005/lectures.shtml#lecture1 - accessed June 12th 2005

Jacobs, J. A. Humphrey, C. Preserving Research Data. Communications of the ACM, 47(9), September 2004, pp27-29

http://oldeee.see.ed.ac.uk/online/internaut/internaut-01/comm.html - accessed June 12th 2005

Rosenbloom, A. The Blogosphere: Introduction. Communications of the ACM, 47(12), December 2004, pp30-33

Vaughn, W. History of Art in the Digital Age. Problems and Possibilities, 2005

Nardi, B. A. Schiano, D. J. Gumbrecht, M. Swartz, L. Why We Blog. Communications of the ACM, 47(12), December 2004, pp41-46

Locating and Exploiting Virtual Reality in the Humanities

The humanities are described as those branches of knowledge, such as philosophy, literature, and art, that are concerned with human thought and culture; the liberal arts. Art, a rather broad area of the humanities relates to creative activities such as painting, music and drama. Literature relates to written works that have artistic merit. As we will see, virtual reality can play a part in enhancing both of these branches, creatively and academically.

Three-Dimensional vision techniques created for use in virtual reality systems such as Quick Time VR, stereoscopic vision techniques, volumetric displays and immersive environments can all be of use within the humanities[1]. These technologies can be used to represent any visual art form, environment or situation realistically and interactively.

Simple techniques exist that allow the user of a system to interact with a light source and move it so that the effects of the light on a painting can be seen from many angles around the painting. It is a basic idea but it allows the user to gain an insight about the texture of the painting and brush strokes used to create it, this technology is similar to Quick Time VR. Quick Time VR is a 360-degree video made out of stitching images made from every angle around a single point. This technology can be used for example to display a photographic representation of the inside of a theatre that could be used to look at the architectural nature of such a structure.

The work completed by the 3D Visualisation Centre at Warwick University covers a large area of virtual reality in the humanities, some of their projects are:

Appia Project – Relating very closely to the research into performance and the dramatic arts, the Appia project was named after Adolphe Appia. Appia was a visionary who developed the experimental theatre Hellerau near Dresden in Germany that made use of innovative designs for performance space, scenography and stage lighting. After the First World War the theatre was used as a recreational facility for Hitler's SS, and during the second world was as a barracks for Russian soldiers. The theatre requires restoration and work is currently being completed to do this in reality.

The 3D Visualisation Centre in the meantime to aid in the restoration process and to experiment with the concepts designed by Appia, recreated the theatre using virtual reality techniques. The visualisation is designed to help understand the architectural concepts and also allows for experimentation with the techniques developed by Appia by simulating the effects of various components created by him. Much of modern theatre is accredited to have been developed within the theatre. Appia's techniques involved varying the light within the theatre to accord with changes in music and mood, other techniques involved reflecting light sources towards the external wall back through cloth curtains to create a diffused glow. Geometric blocks were used in the theatre as scenery.

The virtual version of Hellerau allowed for the creation of VR sets that could be varied depending on their purpose. For example settings that were never built at Hellerau can be simulated and stored to show what they look like and how they could be used. A complicated lighting technique called the lighting organ was created after extensive research into the possible methods of creating such a device. This virtual version can be used as a teaching aid allowing us to play the lighting organ to affect the mood within the theatre, to change sets and view the theatre from multiple, often impossible angles. This can be used to help us understand the concept of theatre being a total work of art, something Appia wanted to create with this project.

[1] These techniques will be discussed in further detail within the section devoted to virtual reality

Pompey Project – Another virtual reconstruction of the 3DVC was the Pompey Project. The Pompey theatre was large theatre that could hold a 35,000 strong audience. It was Rome's earliest stone theatre and was constructed in 55B.C. The theatre no longer exists in its entirety with large parts having been built over by housing and other such structures. The virtual recreation has been constructed purely from architectural information based on studies by other scholars, noticeably Luigi Canina from the 19th Century. It is hoped that archaeological studies can be completed gradually to help verify the accuracy of the model and its position within the landscape. The 3DVC also hope to make the resource available online featuring hypertext links from each element of the model to an extensive database of scholarly articles, primary sources, photos and designs of relevant artefacts, and critical discussion and debate relating to the theatre and its location.

Pompeian Fresco Research – The 3DVC undertook a groundbreaking project to investigate scenes depicted on a number of Pompeian frescos. Using 3D modelling technology, the 3DVC created a series of reconstructions to allow scholars interactively to explore and analyse the structures shown in the frescos[2]. Through this research and exploration of the frescos various discoveries were made about the illusions used in the scenery used in theatrical performance dating back to 79A.D. It was discovered that vanishing point and perspective was used to create an illusion of a three-dimensional scene on the two-dimensional background.

A theme of the work conducted by the 3DVC is the use of virtual reality to answer real questions that are either difficult or impossible to answer otherwise. The project at Hellerau was considered impossible to synthesise from photography from before 1912, however the creation of the space virtually allowed hypotheses about it to be made and tested to gain a better understanding of the building. Much of their work can be used to allow students to understand the architectural nature of buildings, the way the stages in various theatres would be used for performance and even provide a method to understand what it is like to sit in a 50,000 seat theatre. Motion Capture development by the 3DVC looks to allow performances to be acted out in front of a blue-screen and the virtual environment projected onto the screen using the computer so students can grasp what it would actually be like performing on a stage setting from the past. Using virtual reality techniques for teaching and research is a theme we shall come across again in conflict simulation and in virtual reality.

The virtual museum, the Musée du Quai Branly in Paris is another interesting example of the use of virtual reality in the humanities. The project helps with the visualization of various design scenarios within the museum such as access for the disabled. The project can function as a tool for curators planning future exhibitions and in a similar way to the methods described above lighting, sound and positioning of artifacts can be manipulated. The museum can be experienced in an immersive environment that allows for a greater level of interaction with it, allowing users to move around objects and gain an understanding of scale and positioning within the setting.

Augmented reality (AR) is another field of virtual reality. Described in the VR section of this portfolio it overlays digital information on the real world. A display is used such as a modified pair of glasses or a mobile phone. On the glasses digital information will be reflected off the back of the glass so that the user can perceive it. The mobile phone would display information on its display screen. The concept of augmented reality is to take in information about the surrounding environment and augment the scene in some way by providing information about it, such as the location of the person in relation to their home, or maybe intended goal.

A concept described in the virtual reality section is the combination of AR with image recognition techniques such as content-based image retrieval. The augmented reality device would be connected to an optical sensor such as a camera; the device in turn would have access to a database of images through a hard wired or wireless connection. Within an art gallery it could be possible for the user to hold the camera up to a particular portrait or sculpture, the information about it would be sent to the computer where it would query the image database using the basic measurements and features of the image. The image could be matched to one in the database and the information relating to that image could be displayed on the augmented reality display to enhance the experience of seeing the picture. This could be extended outside of a gallery situation to allow users to query any visual art form they come across. Although it depends on the accuracy of the CBIR system, with such developments already in existence a technology such as this could easily be bought into existence.

[2] http://www.warwick.ac.uk/3d/pompeii.html

Augmented reality has been implemented in a project called Archeoguide. Archeoguide looks at overlapping virtual objects on archaeological sites, the purpose of the project being to provide new ways of accessing information at these sites of cultural heritage. As the user moves around a particular site wearing a special headset (Head Mounted Display (HMD)) consisting of a camera, a microphone; earphone and connected to a lightweight computer. The computer is connected through a wireless connection to a site server and devices that allow it to sense the position and orientation of the user. As the user moves around in the site the mobile units communicate with the site information server to download information relevant to the new area of the site the user has entered, this information is then displayed visually on the head mounted display and through audio description through the earphone. In theory the objects presented on the display can be entire buildings reconstructed virtually, or they can be artefacts that may have been found in the area the user is standing, again reconstructed virtually, or as the scene may have been first discovered.

Virtual reality because of its nature favours three-dimensional environments. However it could be possible to create virtual three-dimensional works of art in the same way a digital artist would create a digital image. Computer aided design and the creation of architectural works is an example of how VR representations are currently used, but these methods could easily be adapted for other purposes. Some of the research that we will come to look at in writing and narrative and conflict simulation will show how virtual reality environments can be adapted for education, but one important example relating to the humanities is the work completed by Robertson and Good (2005) researching the use of game design to aid in the development of storytelling. The game creation process helping to create literacy skills needed to be able to tell well formed and interesting stories – literary works being an important area of the humanities.

References

http://archeoguide.intranet.gr/project.htm - accessed June 12th 2005

www.felix3d.com/www/index.php?show=Applications - accessed June 12th 2005

Rosenbloom, A. Interactive Immersion in 3D Computer Graphics. Communications of the ACM, 47(8), August 2004, pp28-31

www.theatron.co.uk/hellerau.htm - accessed June 12th 2005

www.warwick.ac.uk/3d/portfolio.html - accessed June 12th 2005

www.yourdictionary.com - accessed June 12th 2005

Exploring Performance using Digital Resources

Performance is the act of performing a play or piece of music or a concert in front of an audience. Digital resources are valuable tool that can help us to explore performance from a variety of perspectives past and present.

Digital technology in its present form allows us to record performances such as dramatic works in numerous ways. We can store scripts and annotations of performances digitally. It is possible to store cast lists and critical material of performances. We can keep a record of cultural differences in performances and even store scripts and performance material from different countries and in different languages. Text based resources can be enhanced using various methods for re-presentation, putting two or more scripts side by side for analysis, and providing methods for annotation of differences between them. Run-Time translation can be completed on scripts written in different languages. Hyper linking can be used to cross reference important sections of plays with notes and annotations, or between alternate versions.

Photographic material from performances can be added to digital resources and be presented along with the text. Photographic material is important as it provides a record of sets and scenery, it provides a record of costumes and provides another record of actors and their appearance. Photographic evidence may also exist of the theatre that can help to contextualize the entire performance within its setting.

Should audio files exist of a performance then these can be used to enhance a digital resource. Improving technology allows recordings of significant length to be handled easily by the computer from the storage media that a resource may be kept on. Audio is important because it allows us to look at how an actor delivers the lines of the play, how lines were pronounced, what intonation's were put on particular words or phrases. A further step from this would be to include video footage from a performance for the same reasons, a further stage from this would be to use videos filmed from multiple angles during the performance to capture as accurately as possible each performance of a play.

Digital techniques can help us to collate a large body of evidence and information, large storage capabilities allow us to film concerts and plays from multiple views and provide interactive access to these views for an accurate representation of the performance being studied, the limitations are almost endless.

The importance of studying performance and keeping records on each production is that each production is considered as important as every other performance. No one performance is considered as 'definitive', each play has its own merits and a collection of material about every production of a single play allows this view to be put forward.

The AHDS Glasgow have developed the FESTE database which is a detailed record of all performances of the Royal Shakespeare Company and its predecessors in Stratford from 1879 to the present. The database includes full cast lists of performances, bibliographic data and contemporary review material from the time.

Historical performances are as important as future performances. While audio and video may not exist from some historical performances digital provides a tool for the storage and analysis of as much material as can be collected so that historical differences in performance can be recorded.

One of the criticisms from the 3D Visual Centre at the university of Warwick is that certain elements are missing in studying performance from text, even sound, even video. The study of performance using text alone is limited. Using digital resources it allows us to enhance the experience by providing additional texts with searchable features, and as mentioned audio and video. Using digital resources also allows us to provide simulations of theatres and space, and virtual reality re-enactment of plays.

While image, audio and video may not exist for historical performances the ability to create a virtual recreation of a theatre, a stage, or thee play itself allows it to be studied in new and challenging ways. Theatron, a project developed by the members of the 3D visualisation group at Warwick University specialises in the creation of virtual 3D environments. The project combines archaeological and architectural skills, along with computer programming, virtual reality modelling and multimedia designers to help create accurate representations of theatres past and present.

Theatron is an educational tool that uses walkthroughs of accurate 3D models of theatres, and combines such walkthroughs with texts relating to the theatres along with multimedia tools. Other features are photographs, animations, and 360-degree panoramic views such as those created in Quick time VR. The project has also managed to create audio reconstructions to allow users to hear what the audience would have heard from different sections of the theatre.

The motivation for such a project is the additional sensory experience that can be given to the users of the simulation.

Text gives no direct sensory experience of events, and nor do depictions in the form of paintings, drawings, or musical scores and choreography. Photographs provide a visual representation, and audio gives a sense of time and sound. Film can give a sense of timing, sound and visual. However simulations can provide a sense of timing, image and sound, plus can depict and give a sense of the space a performance is acted within.

VR Re-Enactment provides a combination of space, and allows the users to act within the space. The VR re-enactment techniques are still being developed but do currently allow users to step inside a scene using blue screen technology and monitor their performance within the theatre.

Other research by the 3DVC includes the creation of a virtual model of the Hellerau theatre designed by Adolphe Appia and opened in 1910. The theatre used experimental lighting, stage layouts and scenery. Light would change according to sound and mood. For a student to be able to study their own performance and the performance of others within an experimental environment such as this would allow them to gain an understanding of the effect environment had on the performance, and the effect of the environment on the perception of the performance.

Development in digital technology now allows resources combining these elements online for greater access for students and those showing general interest alike.

References

http://appserver.pads.arts.gla.ac.uk/cgi-bin/WebObjects/PadsBrowser.woa - accessed June 12th 2005

http://www.kcl.ac.uk/depsta/humanities/english/tper.html - accessed June 12th 2005

http://www.theatron.co.uk/ - accessed June 12th 2005

http://www.warwick.ac.uk/3d/theatron.html - accessed June 12th 2005

Authorship Uniqueness

The effect of digital technology on copyright law is an effect that can be measured by looking at how laws relating to the field of computing and intangible digital works have changed over the past two decades. The changes implemented however, are not necessarily representative of the changes that need to be implemented to protect people using digital technology to create works of an intangible nature. Intellectual property is defined as:

"A product of the intellect that has commercial value, including copyrighted property such as literary or artistic works, and ideational property, such as patents, appellations of origin, business methods, and industrial processes"

It can also be described as:

"A general name for property (such as patents, trademarks, and copyright material) which is the product of invention or creativity, and which does not exist in a tangible, physical form"

The oxford dictionary also describes a case stating the purpose of laws protecting intellectual property: "intellectual property, the labours of the mind, productions and interests are as much a man's own as the wheat he cultivates" and describes intellectual property as "relating to: literary, artistic and scientific works, industrial designs, trademarks etc."

The difficulty with copyright laws and digital technology is that digital in itself is inherently intangible. An idea that only exists as a series of zero's and one's electronically. The nature of digital information is also one that is yet to be completely gauged, its fragility is recognised, but its longevity is neither safeguarded nor has been properly tested. The format of a digital file causes issues with whether a file is reusable on another platform, let alone on another computer system in 20 years time.

Also one of the advantages of digital is one of the key problems in copyrighting of material. A file that is created digitally and copied digitally is not specifically a copy of the original – it is an exact recreation and representation of the original file. No flaws exist in a digital 'copy', for all intensive purposes it 'is' the original. If a digital image is used by someone other than the original creator, and does not ask permission nor provide credit for the original artist then they are in breach of copyright laws, however, if there is no way to prove who created the original file then there is nothing that can be done for the original artist.

If we are going to use digital methods to create art, music, books, articles, databases etc. as we have mentioned in other sections of this portfolio then we need the correct protection methods to be able to do so. There exists a range of tools that can be employed such as simple password protection and watermarking, or digital steganography to help prove the ownership of digital material, and to prevent others from using digital material. On top of this there are laws for patents and trademarks that will protect owners from theft of innovations (scientific, software, chemical, mechanical) or trademarks (brand names, apple, Nike) respectively.

Deegan and Tanner however show that the hacker is never far behind cracking such digital markers, and as such the works created digitally that sit broadly under copyright law are extremely difficult to protect against theft and unauthorised usage. The problem described by them, is one of proving authenticity, and the laws that are created to help the creator of archives and materials need to better understand the functional requirements for authenticity on the part of creators and users of digital resources.

Overall how do the laws allow the author to use the work? And what protection does it provide? The senior advisor of the Labour Party business manifesto for 2005 describes the following: "Copyright was originally conceived as a means for delivering a balance between the rights of the inventor and the rights of subsequent others to build on the development and use it as a trigger for innovation, over the years that balance tipped further in favour of the original inventor rather than others being free to use it in further developments."

This is interesting in terms of what we have looked at in digtial art. Some of the work produced by Thomson and Craighead such as Decorative News Feeds and Driving Through Las Vegas. These works are considered art, but ecause they have become art what effect does this have on people wanting to use and develop the technological ideas, and not the artistic expression. These two works although atistically could be considred important, resemble 'tricks' or routines that the average programmer or web designer may use to liven up a website or to provide entertainment for others in a program or again, a website or presentation. In some cases such routines might not be considered revolutionary in the computing world, combining and manipulating two easy to control technologies, in others the combination might be considered an intelligent work that can be used if given credit for, if necessary i.e. someone expresses interest, or a notice explaining the work is someone elses, or granting a license to another user, but even then, this wont be considered as art. A debate exists, but it cannot be discussed here.

This example does however point out a mismatch between how intellectual property laws are seen by professionals. In one respect they don't provide enough protection for the author, but in others they are seen to favour the creator of works, stifling development and innovation. The rest of the statement showing the changes necessary is as follows: "We will modernise copyright and intellectual property regimes so that in a digital age creators, entrepreneurs and creative industries can invest in ideas and talent knowing they will get a proper reward for their investment.". The mismatch however is also shown with companies such as Microsoft trying to show the issues involved by offering a prize of £2,000 for the best film that helps to raise awareness of intellectual property theft[3]. The mismatch appears in at least two of the three areas of intellectual property law, Copyright and Patents. Microsoft currently in a lawsuit themselves for alleged patent infringement on technology created by Alacritech, a networking company.

While protection of our intellectual property rights is important regardless of working in analogue or digital there are other issues raised when methods go too far. For example, the UK has no specific protection for databases. The database is a collection of information and materials, but it is not seen as original work therefore there is no protection. The EU on the other hand has protection for databases of substantial investment. In America gaps exist in similar laws because of emerging technologies such as the Internet and other improving technologies. To combat these gaps however proposals have been made to strengthen the laws.

Databases contain individual pieces of information and details, and more importantly they can contain facts and ideas. As well as protecting the databases, they propose that facts and ideas are held under copyright laws. These facts could range from the electrodynamic theory of light in science to the theories of modularity and best programming practices in software engineering and computer science. These laws would affect publishers of these facts such as the British Computing Society, or the IEEE, or even researchers in such a way that they could be made to pay for each individual fact used in the course of research. Vaughn (2005) discusses the difficulty of gaining adequate access to copyrighted material such as pictures for teaching purposes in the UK without having to pay a substantial amount to owners, who are generally large institutions and require membership, the difficulty is such that using copyrighted material without permission becomes an understandable temptation. Should scientific facts and knowledge be protected in such a way under intellectual property law then it could be damaging to education, it would restrict creativity and technological development. Grove (2004) points out that in this case overprotection far exceeds the cost of under protection.

Currently the law relating to digital works is created through comparison by analogy to existing laws relating to literary works, film and other media, and other cultural works, inventions in the field of science, engineering, software etc. Questions arise to the suitability of such methods of creating the law. While some digital material is similar to analogue material, digital often affords us the chance to enhance the analogue counterpart. In the field of databases for example many years could be taken to create a paper database. A digital database with the equivalent number of man years of material could be created within weeks with new methods of collecting and collating data, yet the law relating to a more valuable database are exactly the same – although data collection using the computer is quicker, the complete database could be copied in a fraction of that time still. Used without permission and advantages gained from would be unfair to the author.

[3] http://www.computing.co.uk/news/1162915

Computers do not change the intentions of intellectual property laws, but they do change the way we have to protect and think about protecting intellectual property. In the same way technology is evolving to help us create new material, the laws should change to reflect this, but it is necessary that it be done in such a way that it respects the idea that "the open exchange of such data and information is fundamental to the advancement of knowledge, technology and culture"[4]. And to ensure that the intangible costs of overprotection do not outweigh those of under protection.

[4] Grove (2004)

References

www.computing.co.uk/news/1162977 - accessed June 12th 2005

www.computing.co.uk/news/1162915 - accessed June 12th 2005

www.computing.co.uk/vnunet/news/2127143/legal-action-threatens-microsoft-longhorn - accessed June 12th 2005

Deegan, M. Tanner, S. (2002). Digital Futures: Strategies for the Information Age. Library Association Publishing, London

Grove, J. Wanted: Public Policies that Foster the Creation of Knowledge. Communications of the ACM, 47(5), May 2004, pp23-25

www.oed.com - accessed June 12th 2005

Samuelson, P. Why Reform the U.S. Patent System? Communications of the ACM, 47(6), June 2004, pp19-23

Vaughn, W. History of Art in the Digital Age. Problems and Possibilities. 2005

Wang, H. Shuozhong, W. Cyber Warfare: Steganography vs. Steganalysis. Communications of the ACM, 47(10), October 2004, pp76-82

www.yourdictionary.com - accessed June 12th 2005

Writing and Narrative

Digital resources can be used as an aid in the production of professional looking documents. Tools such as adobe PageMaker provide desktop publishing methods that are comparable to those used by professional publishers, facilities such as typesetting and guidance to page layout can be used by non-professionals to create such documents. They could publish magazines, newspapers; even books can be set and printed from within the home. Distribution of such material is another question.

The Internet can be used to help promote the work of unknown artists and writers. Hoffman et al. (2004) state that in 2003 the Internet had 126 million users. Should a proportion of these users discover an article or document designed by an unknown artist and even be slightly moved by the document, then it is possible for unknown writers to reach thousands of individuals without professional interference.

Writing does not have to be in the form of a book or a journalistic article. Digital resources and the Internet facilitate the use of other technologies, but a fundamental tool is the innovative use of web design techniques. The distribution of a hyperlink is also much easier than the distribution of a physical document. Unknown artists can gain support from using web-forums related to writing. Competitions are run online such as the BBC's last laugh comedy competition. A writer enters a competition such as this by submitting a unique and innovative piece of writing around the topic of the competition; in this case it was comedy. However the competition is only a fraction of what is provided by a competition set up like this – a message board system is provided for users of like mind to socialise with one another and discuss concepts and ideas. Users provide support for one another. Other non competition message boards exist for writers from all walks of life where support for story writing can be found, these message boards are also often in the field one specialises in such as science fiction.

The Blog in its current form is a recent development in Internet culture. The Weblog has existed for a number of years as a method of sharing links among users of weblogs. The weblog has evolved into a different entity providing a method for documenting the events in an individual's everyday life; provide a method for providing commentary and opinions. Nardi et al. describe the blog as a new grass routes form of journalism that can provide a way to shape democracy. They describe the blog as providing scope for an enormous variety of expression within a restricted format. Topics can be politics and world events. One blog was used to keep viewers up to date on the health of the individual's wife who was critically ill with cancer – in this case it provided an outlet for thoughts, feelings and emotion. Some blogs are also kept as works of complete fictions. Two blogs discovered during the course of my own research describe the daily events of two famous film characters between each of their six film appearances. Fictional blogs provide an interesting example to look at from history.

Charles Dickens first released his books in the form of a serialisation. He was rarely ahead of his readers in terms of the story he was creating, one famous example being cited as the character little Nell in the serialisation of the Old Curiosity Shop receiving support from readers so dickens wouldn't kill her character off. The interest was created because they knew dickens didn't right in advance, and as such it was possible to attempt to interact in the story writing process. He did kill little Nell off. The sales of stories provided a form of interaction for the serialisation, as dickens would take the poor sales of an edition to be a sign that the story one week wasn't a success. He would change the next months story accordingly. Blogs can be similar to the serialisation of dickens's novels in the same way because they are written periodically by bloggers, and input can often be provided on blogs in the form of user comments.

The serialisation of a novel has been shown to create a different reader perception and attachment to the characters involved in stories. The steadied distribution of a story using the internet is an interesting method of publishing a story.

An example making use of innovative web design and interactive design is the story of Oldton told by Tim Wright. The story of Oldton takes place over the course of 52 playing cards that map out the town where the character used to live. The reader can determine his or her own route around the 52-card map by clicking on hyperlinks within the frame created for the story. The story also asks external writers to aid in the story telling. External hyperlinks have been created directing readers to other people works where they can learn more about the story of Oldton.

A website such as this can be accessed by the 126 million users of the Internet. The author can determine the success by how well they advertise the site over the web. Even if it only managed to attract friends, and friends of friends then it reaches more readers than a completely unpublished work.

An example of the importance of being able to release unknown artists works can also be taken from history. The story of the Bodley press is a story created by a man who had an appreciation for fine art, but also wanted to make money on the books he released. John Lane of the Bodley press discovered ways to save money releasing books, including changing print techniques. Two areas he found savings was by releasing the works of unknown artists. The work of unknown artists came cheap, and chosen carefully for the quality of their work by John Lane they slowly gained popularity, which in turn resulted in more people purchasing John Lanes books of poetry. One artist involved in his work was William Butler Yeats.

The unknown artist taking the initiative and releasing works themselves over the Internet cuts out the middleman in a situation similar to that of the Bodley press. Publication costs however are free, and so is word and mouth around the web. Should an unknown artist want to get their work noticed using digital resources then it is completely possible.

References

http://www.adobe.com/products/pagemaker/main.html

http://www.bbc.co.uk/scotland/tv/lastlaugh/

The Bodley Head Press – Some Bibliographical Extrapolations. R.D. Brown.

Hoffman, D.L. Novak, T. P. Venkatesh, A. Has the Internet become Indispensable? Communications of the ACM, 47(7) July 2004, pp37-42

Nardi, B. A. Schiano, D. J. Gumbrecht, M. Swartz, L. Why We Blog. Communications of the ACM, 47(12), December 2004, pp41-46

www.oldton.com/ - accessed June 12th 2005

Robertson, J. Good, J. Story Creation in Virtual Game Worlds. Communications of the ACM, 48(1), January 2005, pp61-65

Rosenbloom, A. The Blogosphere: Introduction. Communications of the ACM, 47(12), December 2004, pp30-33

Electronic Music

Electronics have helped facilitate musical expression since 1876.

Musical innovation has been aided by the addition of electronic methods to the field of music. Instruments have evolved out of developments in the field of electronics such as the musical telegraph created in 1876. Other important instruments in the field include the Thelharmonium created in 1897, and the Theremin created in 1917. Many musical instruments have been created by the manipulation and conversion of electronic signals into sound.

The gramophone represents an important concept of mechanical representation. The ability to represent analogue signals mechanically is a theme that runs throughout the field of computing, such as the modulation and demodulation of analogue phone signals in modems. The gramophone provides us with a particularly relevant example – an electronic pulse can represent the raised points within the grooves. No pulse can represent the trough. This forms the basis for the representation of music digitally.

Once it was possible to recreate sound digitally we could begin to record actual music. Today this presents a dilemma where music recorded through digital methods without owning the copyright is illegal. This has always been the state of affairs, however digital techniques facilitate the distribution and sharing of such music. The distribution and sharing of music makes it more likely that those with the digital recordings do not own the copyright for the original track.

Apple I-Tunes provides a legal way to download electronic tracks. Apple sells single tracks, with a license to re-create the same file four times. Once this number of times has been exceeded the user can no longer copy the music. Apple I-Tunes does not have effective methods of stopping these files from being shared by the person purchasing the tune and sharing it with other individuals. Some would see I-Tunes as facilitating the distribution of better quality, higher quality recordings of copied music. A legal dilemma has occurred here, and needs to be solved.

Everyone who owns an apple computer with its most recent operating system Mac OS is capable of being their own music producer. Similarly using simple methods of combining portable CD players, MP3 players, and other tools anyone can be their own personal DJ.

Digital Art

The topic of digital art looks at how the computer has affected artistic expression since its emergence form research institutions in the early 50's. Although Ada Byron Lovelace in the 1800's speculated that the computer would facilitate composition of complex music and be capable of producing graphics it has only been since the widening levels of access to the computer that it has been used for more creative purposes.

The computer can be used in several creative ways, from allowing the user to create a digital art form such as a digital image or allowing users to control a piece of art by providing levels of interaction with viewers or simply controlling the output of a sculpture or installation. The various ways in which the computer can be used shall be looked at in more detail below using actual pieces to highlight its uses. There are questions raised about what constitutes art on the computer and what constitutes a simple computer program, graphical routine, or a various other number of processes on the computer. This debate shall be looked at briefly after I have discussed what can be creatively achieved using the computer:

Static Digital Images

Images can be represented digitally. Images can be scanned and the corresponding bitmap displayed on screen, they can be photographed digitally, uploaded and the bitmap displayed. Alternatively digital static images can be created using digital paint tools, and by using a combination of paint tools and actual photography or graphics. There is a wide range of tools to support creating static digital images from the software to the hardware, and the peripherals.

Software is an important core component of creating a digital image; two packages of interest are Paint Shop Pro by Corel, and Adobe Photoshop. Both packages allow users to access a wide range of drawing tools, textures, effects, pallets and many other facilities that allow users to create images on screen. Other packages that exist to allow users to create digital images include Computer Aided Design (CAD) and vector drawing packages such as CorelDraw.

Input devices exist to allow artists to use the computer like a drawing pad. The mouse is a useful tool, but for those that do not find it flexible enough, drawing pens and graphics tablets exist so that the user can make use of the screen in the same way they would use pencil and paper. Monitors and graphics card are of importance in terms of size, resolution and colours that can be accessed and used by an artist to create images. An image can exist of photographic components as well. Digital cameras and scanners facilitate this combination and the improving memory capabilities and visual capabilities of both scanners and cameras, plus the connectivity provided by USB and Fire wire mean that images the same quality as actual photographs can be immediately accessed and manipulated on screen.

Digital imaging itself is being used more and more on the web. Image resources are available for teachers at places like SCRAN.ac.uk, galleries such as the national gallery London and Tate gallery are making more images available of artwork for everyone with access over the web. Actual Digital artwork is becoming more and more prevalent. One notable resource is the Ars Electronica, a gallery situated in Austria, with access to work online. The gallery focuses on digital art of all kinds from digital sculptures and installations, to mixed digital media to the static image.

Digital images can be found in our every day lives on our computer desktops, in advertising campaigns on billboards, or even on the front cover of books we may read. One example of where digital techniques are applied to real life situation is the pseudo colouring techniques applied to photographs of star systems taken from powerful telescopes, see figure 1.

While not necessarily considered artwork in the traditional sense that it conveys some element of meaning, or will necessarily be discovered in an art gallery, imaging such as that in figure 1 is only possible because of digital techniques and allows scientists to learn much more about what they are seeing through telescopes because of the detail revealed through additional colour detail.

Fig 1. An example of pseudo colouring applied to space photography, creating a unique and

Figure 1. Can also be looked at as a picture that is aesthetically pleasing and therefore it is likely that it could be found displayed in a home, or a local bar, for interest, or simply because it looks good.

Artwork created from scratch, digitally, can be discovered on websites such at Corbis.com, which provides web resource images of all types. Corbis allows users to access illustrations, digital captures of artwork, digital graphics and a wide resource of other types of image. These images include digital images such as those in figure 2.

Fig 2. An example of two pictures available from Corbis. These pictures have been created digitally, and could be considered as being

With many people being able to access the computer and with more and more people becoming interested in using the computer for more than just word processing, it means more people are willing to experiment with what tools are available. Children are able to pick up Microsoft paint from a young age; their first picture of the family pet using paint could be considered digital art. Access to these tools is reflected online with a wide number of resources and galleries available for users to exhibit their work with limited discrimination to what is shown. From the simple, to the complicated, and from the mundane to the exotic, if people can find a suitable place for exhibit online then it is possible for them to do so. It is also possible for artists to host their own work themselves making their entire portfolio known to the public.

Sculpt Materials in Three Dimensions

Computer Aided Design (CAD), mentioned briefly above, allows users to create 3D visualisations of objects on screen. CAD can be used to model anything from a cube to a building; architects have used it for the latter purpose for a number of decades. Engineers also make use of CAD, and combining it with tools such as Computer Aided Manufacturing (CAM) it allows them to gain complete control over the machine they are operating. CAM will convert the drawings and measurements created using CAD into a series of instructions that are translated into a machines movements when drilling a hole, cutting metal, or even carving a piece of wood. Wood can be embossed and engraved or moulds can be created for shaping plastic and metal.

More creatively the tools of CAD and CAM can be used to sculpt objects that have been designed by artists. These tools together can be used to create jewellery, statues, and other artificial objects such as units of a larger sculpture, or detailed objects in their own right.

Create a Linear Animation

A definition of Animation is to make, design, or produce a cartoon so as to create the illusion of motion.

An animation can be made by the juxtaposition of two or more images. The images should be almost identical, bar a subtle change in either of the two that depicts an object or person within the image as being in motion, such as a subtle gesture of the arm, or the image in Figure 3. which depicts a droplet of water falling into a larger body of water.

There are only two images in figure three but they can be animated using a device called a thaumatrope. A thaumatrope is a cardboard disk with two strings attached to it. The circling of the disk using the strings to rotate it back and forth creates the illusion of the droplet falling into the body of water.

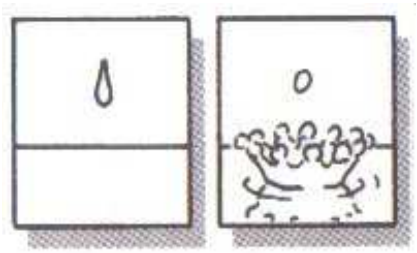

Fig 3. Running these two images side by side, or in a device for basic animation would create the illusion of motion

Other manual animation devices that can be used are the flipbook, the phenakistoscope or the zoetrope.

The combination of film and manual animation techniques lead to greater automation in the field of animation. Animation by the likes of Disney and Warner Brothers, were of extreme importance for their popularity among the public, but also their combination of animation and film pushing the boundaries between live-action cinema and cartoons.

The history of the computer and animation began in 1967. Tony Pritchet in 1967 is credited with the creation of the first computer-animated film. The animation was drawn by hand and animated using a university of London Atlas computer. The animation also made use of profound sound that was combined with the animation using the computer.

Since 1967 there have been many advances in the field of computing and animation. Sylvester Squirrel created by Alan Kitching, and work in films completed by companies such as System Simulation are of particular importance to the British role in the history of digital animation. The computer on the space mining ship featured in the film alien is one example of the animation work being done (fig 4.):

The advances in this area have resulted in the first full-length computer generated feature film – Toy Story being released in 1995. The creation of Toy Story required 800,000 hours to be generated on computers, consisting of 87 2-CPU Sun Microsystems SparcStation 20's, 30 4-CPU Sun SparcStation 20's and a single Sun SparcServer 1000. The film runs 81 Minutes in length and in complete colour and Dolby Digital surround sound.

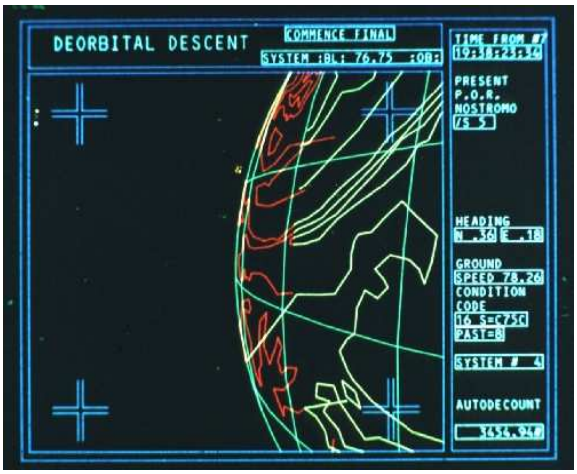

Fig 4. System Simulation based in London helped to produce the animated graphics for the film Alien (1979) Directed by Ridley Scott

There are now a large number of movies being created using just computer animation; titles include Monsters Inc. (2001), and Madagascar (2005). Each new film pushing the boundaries between the content you would expect in live-action cinema and what would fundamentally be considered a cartoon; creating almost a new art form in itself. However, a feature of modern computer animation is how close they can make an animated character look like a real human being, from skin texture to the movement of the hair on the head to the number of individually animated hair strands that can be seen

in a movie. The furry character Sully in monsters inc. noted as an achievement for the animation of over 2,320,413 hairs, taking around 11 to 12 hours to animate a single frame that included this character. The movie Final Fantasy: The Spirits Within (2001), created by Squaresoft/Square Pictures a computer games company/film studio noted as an achievement for featuring only computer generated 'photo-realistic' actors and locations.

The techniques used have been taken to such a level where the computer generated 'photo-realistic' actors featured in a computer generated movie can now star alongside real actors in live-action movies, the three 'prequel-trilogy' Star Wars films, most notably Attack of the Clones (2002), and Revenge of the Sith (2005), featuring a mix of computer animated characters and real actors alongside each other. At one point in the former of these two a number of live actors can be seen alongside a computer generated army five thousand and more in strength. This is only possible thanks to the combination of animation and computers.

Create Interactive Artwork

The computer can respond to artist during production and the viewer after production or even act as a creative agent in its own right if programmed to do so.

The work of Thomson and Craighead is an example of where the computer acting as a creative agent is put to good use. The idea of their work is to explore the ways in which new technologies and electronics global communications networks are changing the way we perceive the world around us.

Two works by Thompson and Craighead – Driving through Las Vegas and Decorative News Feeds show the idea of using the computer as a creative agent if programmed to. In driving through Vegas the computer is used to source live music radio feeds from online stations located at live365.com. The sourced radio show is then played over the top of a video feed displaying in first person view the drive along the Las Vegas strip. This work looks at the different cultures represented along the Las Vegas strip and how perception changes with a different audio feed in the background of the journey down it.

According to Thompson and Craighead, Decorative News Feeds: "presents up to the minute headline news from around the world as a series of pleasant animations, allowing gallery visitors to keep informed while contemplating a kind of readymade sculpture or perhaps an automatic drawing."

Edward Ihnatowicz also provides us with an example of where the computer has been used to create an interactive artwork. Ihnatowicz's artwork explored the interaction between robotic works and the audience. The Senster project is one of the larger and more well known projects he completed. Figure 5 shows Senster:

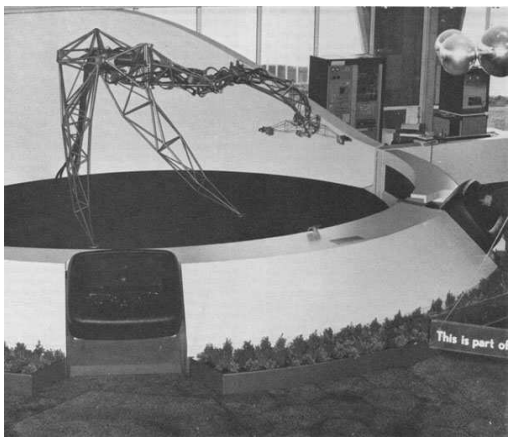

Fig 5. The Senster

The Senster was a 15foot long hydraulic robotic. It could respond to people's voices and it could respond to movement by the use of radar. One of the first computer controlled robotic structures it would home in on predominant sounds and move towards it, the structure itself following in stages behind the head. Any large noises or sudden movements and Senster would shy away. The emergent behaviour of the Senster made the Senster seem more complicated than it actually was, but the reason for its behaviour was discovered to be complicated acoustics of the exhibition hall and the unpredictable public.

In the same way the sculpture was discovered to have unique emergent behaviour the emergent behaviour of the crowd as a whole and as individuals was also of interest, and the main focus of the Senster artwork.

A Controller in a Larger Installation

Another example provided by Thomson and Craighead shows a good example of where a computer can be used as a controller in a larger installation. Unprepared piano is a piano that is controlled by the output of a computer. The piano is connected to the PC in such a way that the computer controls each key; the output to the piano can be to any key, which will accordingly be played. Midi files are collected from the Internet in this installation and played at random. The interesting thing is the midi file contains multiple notations for many instruments and could be playing a composition for violin or for electric guitar. The purpose of this installation is to experiment with the sounds and the music that can be created with the piano using these different notations that have been appropriated and manipulated through the communications network of the World Wide Web.

The Computer as an artistic element in its own right

One interesting idea is the computer as an artistic element in its own right, the idea that the computers that we use every day will one day be viewed in a different light. New values could be added to the computer because of what a particular artist is attempting to express. Two computers that could be considered as artistic elements in their own right are:

Fig 6. Diab DS-101 (Left), Apple IMAC (right)

Diab DS-101 Computer: Designed by Richard Hamilton in 1983 the concept of this computer is that it is a ready-made artistic object. However what sets this apart from other 'ready-made' artistic objects is that its functionality is both visible and paramount to what the object is – A computer.

Apple IMAC – Created in 1998 by Johnathan Ive the IMAC was created with strong design and artistic sensibilities. It has become an icon since its release, and it has set a standard for the design of apple products such as the IPod (designed once again by Ive's). Whether it can be considered as art is arguable, but the IMAC, and incidentally its multi-million dollar release campaign can be considered of paramount importance to contemporary design culture.

The computer can be used in many ways in digital art; one area not discussed here is the use of the computer as a minor element in another artistic work. I have only managed to skim two very large areas, and provide a summary of the other areas where the computer can be used to create art or as art itself. Using graphics packages to create works of architectural value, or specialist input tools to create unique digital pieces, to the use of digital image in live action film and the computer itself providing a method for discovering human reaction to art, or the computer itself as an art piece; the area of digital art is vast.

On the outskirts of the artwork itself is the what the computer can do to make the viewing of existing art more pleasurable, or even possible: from the distribution of art and providing digital tools for teaching art, and providing access the millions of individuals around the globe, to the restoration of art, through the use of imaging techniques and simulation. There are also a number of advantages the computer can bring to existing art.

One of the key areas since the conception of what would be possible using Babbage's device as described by Ada Byron Lovelace in the 1800's[5] is expression. As we looked at in the previous section the computer can be used to create music, we have seen that it can be used to aid in the recreation of dramatic performances and in this one section on digital art it is hoped that the ability to express concepts, ideas and feelings using the computer has been shown to not just be possible, but it is being explored by new generations of artists every day.

[5] See section entitled digital practice

As the computer becomes more powerful its applications become more and more. It could be seen that work such as that of Thompson and Craighead, or Edward Ihnatowicz or even Tony Pritchet is a function of this increasing capability. As the computer becomes more capable, the ways in which people discover to manipulate it become even more. This manipulation equates to how these artists are finding ways of expressing themselves.

References

www.adobe.com/products/photoshop/main.html - accessed 11th June 2005

www.aec.at/en/index.asp - accessed 11th June 2005

www.apple.com - accessed 11th June 2005

http://artworks.avalonweb.net/ - accessed 11th June 2005

http://artworks.avalonweb.net/ - accessed 11th June 2005

www.computing.co.uk/news/54668 - accessed 11th June 2005

www.corbis.com - accessed 11th June 2005

www.corel.com/servlet/Satellite?pagename=Corel3/Products/Display&pid=1047023911984 - accessed 11th June 2005

http://dam.org/franke/ - accessed 11th June 2005

www.designmuseum.org/design/index.php?id=63 - accessed 11th June 2005

www.imdb.com/title/tt0173840/ - accessed 11th June 2005

www.imdb.com/title/tt0114709/ - accessed 11th June 2005

www.imdb.com/title/tt0198781/ - accessed 11th June 2005

www.senster.com - accessed 11th June 2005

www.tate.org.uk/servlet/ViewWork?workid=21670&searchid=37448 - accessed 11th June 2005

www.nasa.gov - accessed 11th June 2005

www.prototech.no/tekstsider.cfm?artid=6049 - accessed 11th June 2005

www.thomson-craighead.net/ - accessed 11th June 2005

www.webopaedia.com - accessed 11th June 2005

Digital Culture Identity

The lecture conducted by Charlie Gere looked at what it means to call a culture digital. Looking at the development of technology from the early 1800's, computing and digital culture has evolved through a continual trail of events looking at improving the quality of human life and making everyday tasks easier and more automated.

Beginning with the Jacquard Loom created in 1801, the device used punch cards to control the weaving of patterns in fabric, each punch card corresponding to a single row in the fabric. The jacquard loom exhibits a form of semi-automation. The reduction of human error could be achieved by the patterns being pre-determined rather than human configuration at run-time. The punch card mechanism presented a solution that would later be used in early modern computers for storing programs, although it was adapted first and foremost by Charles Babbage for the Analytical Engine:

Charles Babbage sought to reduce the human error rate in the calculation of mathematical tables. To solve this problem he looked at how it could be achieved mechanically. His specification for the Analytical Engine, considered as the first mechanical computer could successfully achieve this, in theory. His assistant Ada Lovelace specifying a method for calculation of Bernoulli numbers using the machine, and predicting that it would be capable of facilitating the composition of complex music. Again the machine sought to achieve some form of automation, self-regulation, and to reduce human error.

Other discoveries and inventions between the 1800's and now such as the idea that a logical mathematics could be used to express much more than a purely numerical mathematics and the creation of Boolean algebra, the use of Morse code for communication (a digital form of communication using just dots and dashes (ones and zero's)), even the parallel evolution of travel networks has aided in the creation of the digital culture we now live in. The invention of the typewriter, the use of punch cards and tabulation machines in calculating census results. Even the gramophone has helped us to understand the principles of mechanical reproduction of analogue signals.

Events that led to the creation of the Electrodynamic Theories of Light eventually lead to the creation of wireless communication techniques. The advent of the Second World War required techniques to decode signals sent by the German army, this resulted in the creation of machines that would be capable of decoding them – these would be known as the first computers, however they were dedicated to a single task, the first modern computer came out of research conducted over this period and is considered to be the Manchester MK1, developed by Alan Turing.

In more recent years research into durable communications techniques and global memory, integrated circuits, visual display routines and concepts, and the accessibility of computers and electronics to amateurs such as the hackers mentioned in the section digital practice has led us respectively to the creation of the internet, modern processors, modern user interfaces such as Mac OS and Windows, and the creation of the computer as we know it today with the creation of Apple Macintosh in the early 80's.

The history is vast, and one of many threads that have bled into this point. However the overall theme of what we are discovering is that our current culture has been created through a series of events that people have pushed for or discovered through the course of other events and research. Everything relating to digital culture is a product of the ideas and concepts discovered in the past 200 years. As mentioned above through the quest for the improvement of human quality of life, the quest to gain control of the environment around us, and a general 'hands-on' prerogative, a term coined to describe the ideals of the hackers of the MIT labs in the 1950's, to discover how things work, and how to improve and manipulate them.

Currently we embrace digital technologies that have arrived through these 200 years of development. Using such technologies for education, creating art, music and other cultural works. We now use digital technology to help develop research such as the modelling of information and data and the simulation of events and practices. We also use make use of digital technologies in our everyday lives, using the technology to run our bank accounts, conduct our everyday shopping and even socialise, health issues are explored first on the internet, travel bookings made, and games, email, and instant messaging still make up a good proportion of how individuals use this one technology. Hoffman et al. (2004) for example in a research project to discover whether the Internet was now indispensable discovered that to a large proportion of individuals it was.

Digital Identity however moves beyond the identity of the individual as defined by the digital technologies they use. Digital Identity in this case looks at society and culture as a whole, and how it has been shaped by the development of technology. We have shown a small proportion of the events and developments that have led us to this point now. Digital has shaped our current identity, but how is this identity likely to evolve?

With development leading into this 'one' point it is difficult to see where we are likely to go. The key though is that 'developments' have bought us to this one point where we can define our culture as digital. It could be seen that we may be heading for a period of technological inertia, where the technology we now have will simply be modified and improved as human life has being doing with the aid of technology over the past 200 years. But the key could lie in a pattern that Babbage first noticed with the analytical engine. A key breakthrough in the creation of the analytical engine was when he re-directed the machine's output to the input for further equations; he described this as the machine "eating its own tail".

This concept of the machine eating its own tail could be a key point in where culture is likely to go. As technology and processes improve we put it back into developing new technology. For example as processor technology improves in computing we can put this technology into new machines that can run simulations faster and more accurately. The results of a more accurate faster simulations is that new developments could be made in new products, or advances in the old, which can then be put into a new product, which may eventually go back into improving processor technology, such as the successful development of nanotechnology processors through advanced modelling techniques developed through the faster processing technologies before. Technology will breed new technology along with providing solutions for society to use in the meantime.

References

http://en.wikipedia.org/wiki/Charles_Babbage - accessed 12th June 2005

http://en.wikipedia.org/wiki/Jacquard_loom - accessed 12th June 2005

Hoffman, D.L. Novak, T. P. Venkatesh, A. Has the Internet become Indispensable? Communications of the ACM, 47(7) July 2004, pp37-42

Kraut, R. Patterson, M. Lundmark, V. Kiesler, S. Mukopadhyay, T. Scherlis, W. Internet Paradox: A Social Technology that Reduces Social Involvement and Psychological Well-Being? American Psychologist 53 (1998), pp1017–1032.

Conflict Simulation

"In the whole range of human activities, war most closely resembles a game of cards" - Carl von Clausewitz (1827)

Wargames are a method of understanding and exploring warfare without actual combat. They have been adopted by the military as a means of exploring strategy and tactics and their effects for centuries. Chess is an example of a game that could be considered a wargame. The first war games to take advantage of the computer were Space War (1962) created by Steve (Slug) Russell in the MIT computing labs, and ATLAS an American military war game created at the same time. Commercially the wargame influenced the popular game dungeons and dragons. The game Dungeons and Dragons replaced real settings and weapons of war with fantasy elements such as swords and sorcerers. The computer game version of dungeons and dragons first appeared in 1987 and is an important advance in the technology used to represent the wargame digitally because of its ability to accurately represent the vast rulebook of the paper version of the game.

The wargame does not necessarily have to be a complex piece of software. To play the paper version of a wargame the requirements are simply a board that represents a map, or the terrain that the game is to be played over; counters that represent the military units and dice. Along with a set of rules each person adopts a side and the game can begin. This can be represented on a computer using simple bitmaps and a method of storing the positions of the bitmap counters at any one point in the game so that should it be necessary a game can be closed down and players can come back to it. Communication using email adds the ability to play the game over a distributed area.

The importance of a wargame in an academic context is not how well the game plays but how well it can be used to teach both simple, and complicated theories of conflict, to allow one to gain a sense of dilemmas involved in warfare. A simple game can be as effective as a more complex one.

Other wargames that exist include flight simulators that can be used to help give students tactical experience of air fighting. While students may not be training to be pilots the flight simulator can be used to help provide an understanding of the pilots thinking. The student could have access to memoirs, battle footage, films and documentaries, but this visual representation is limited due to it not being from the pilots' point of view in the cockpit and providing the ability to look at the multiple views available. Even footage from war can be limited due to bias of the cameraman, or just the ability to take in multiple views.

The computer game can provide part of a solution to allowing students to gain a pilots perspective. Taking a computer game of the shelf that allows the open source modification of its programming allows the tailoring of the software to our particular needs. The game can be changed to model accurate hardware conflicts between enemy aircraft, it can be changed to model accurate handling and it can be modified to model accurate behaviour from the computer controlled enemy craft. The computer game is still limited in many ways, for example no physical feedback is given to the user about handling, and monitor resolution is limited so the full depth of vision cannot be accurately represented, also the physics of plane targeting cannot be completely modelled.

Although the computer game is limited, technology in simulations used to train pilots is improving. A number of technologies and approaches are employed in the field of Flight Simulators for example, the use of a real cockpit and flight controls; haptic feedback is used to recreate the feeling of flying a real aircraft, computer generated sky, runway, and background is presented to the user on the view screens, and augmented reality is employed to provide additional controls in the same way that would be used in real aircraft such as the Eurofighter on the cockpit window. This technology will be explored in more detail when we come to look at virtual reality. The importance of this technology in conflict simulation beyond university is that we can teach pilots in as real an environment as possible, without endangering their lives, the fundamental skills involved in warfare. This however points out a major failing in such representations of warfare.

In the board wargames and the flight simulators there is no simulation for loss of life. It is an advantage that the learner can be taken away from the reality of war to learn the technical details and tactics of flying, or battle strategy, but human behaviour is a major factor in war. How does one react to loss,

how does one react in a dangerous and hectic environment. How would one make a decision about another life in the spare of the moment? These are all important questions and factors that cannot be modelled in simulations. A person's behaviour on a simulation can only be modelled to a certain extent.

Academically the focus of the wargame is to teach students an understanding of war and the dilemmas involved. Conflict Simulation academically goes beyond playing wargames, but also asks students to model an actual conflict. The modelling and simulation of conflicts allows questions to be asked, and answered that might not be so simple to do writing an essay about the subject:

"This requires students to go back to historical battles and research the history, geography and orders of battle in the engagement concerned, studying existing simulations of the same or related engagements, and choosing simulation mechanisms which come together to create a realistic but playable representation of the actual events. Students must develop a deep analytical understanding of the dynamics underlying the real battle or campaign. They must address issues such as logistics, force-to-space ratios and intelligence, and must make judgements as to how close-run the actual battle was, how different tactical or strategic choices might have affected the actual outcome, and what pressures led the actual commanders to make the decisions that they did"[6]. The concept of studying conflict in such a way is to understand history by gaining a proper grasp of the alternative involved.

Scharver et al. (2004) describes how gaming and simulation techniques such as those described above could be bought together in real life to provide a mechanism for improving surgical methods. Using a mixture of the simulative environment and haptic feedback, techniques that previously made use of CAD (computer aided design) and CAM (computer aided modelling) can be replaced using virtual representations.

The modelling of cranial implants requires great accuracy, labour, material and money. Using CAD and CAM reduced costs previously, but the improvement of VR and haptic techniques allows a representation of the patients unique implant design to be projected onto the modelling material and using special control devices the sculptor can model the material around the virtual template. This allows a greater level of accuracy to be bought into the modelling process.

Currently the technique to mould cranial implants is still in development due to the difficulty of merging the 3D representation and actual objects. Also the virtual reality controls are not conducive to traditional sculpting techniques. In the future however such combination of techniques could become more common. An example more analogous to the simulation and gaming techniques used to teach conflict simulation is also in the medial field:

Delingette and Ayache (2005), provide an example of medical simulation where highly realistic simulation techniques are used to help surgeons train in innovative procedures to help reduce their learning curve before attempting such methods on real patients. The procedures discussed are performed using special instruments inserted through small incisions along with a camera that transmits the image within the abdomen to a high-resolution monitor. Special skills and keen hand-eye coordination are required by the surgeon before attempting such a procedure, but because of the nature of the set up it can be represented in a computer simulation to allow the surgeon to practice the appropriate skills before performing the procedure on a patient.

The use of simulation and gaming in education has attracted the attention of others. Robertson and Good (2005) describe the use of gaming to help improve the literacy of adolescents between the ages 12-15 and show that learning can occur in a game-play environment. The result of their study showed that allowing young people to create computer games they will ultimately want to play not only offers key educational benefits but also builds self-esteem and teamwork skills.

[6] http://www.kcl.ac.uk/depsta/wsg/consim.html

The project was created to help literacy development through a non-textual medium. Robertson and Good ran a game maker workshop that promised to teach the participants the necessary skills to design and build their own computer game using a ready existing game editor for the game Neverwinter Nights. The study showed that through creating computer games children can develop basic storytelling skills such as creating coherent plots, motivated characters and convincing dialogue. On top of this they could learn skills specific to computer games such as creating emotional context through sounds, music and lighting techniques.

Although it was the first study of its kind Robertson and Good found it to be a success finding in the students an overall motivational effect of completing the task this way, students being engrossed in creating their interactive storylines and characters, and a bolstering of self-esteem and enthusiasm. A student that found they didn't like writing stories at school showed noticeable signs of enthusiasm and was encouraged to continue designing games and possibly take it further in education terms.

Simulation and Gaming techniques beyond those of wargames can be of great academic importance and if used correctly can be used to teach a large range of topics and ideas in an interactive and interesting fashion. Also should the line between the virtual and the real in environments such as the new Eurofighter plane or even surgical environments continue to be blurred, the skills discovered in the safety of simulations could be found as transferable to the real world, which would be advantageous to the learner, and everyone else involved.

References

Delingette, H. Ayache, N. Hepatic Surgery Simulation. Communications of the ACM, 48(2), February 2004, pp31-36

http://www.hyw.com/Books/WargamesHandbook/6-3-gene.htm - accessed June 12th 2005

http://www.kcl.ac.uk/depsta/wsg/consim.html - accessed June 12th 2005

http://www.marxists.org/reference/archive/clausewitz/works/on-war/ - accessed June 12th 2005

http://pc.gamespy.com/articles/538/538865p1.html?fromint=1 - accessed June 12th 2005

Robertson, J. Good, J. Story Creation in Virtual Game Worlds. Communications of the ACM, 48(1), January 2005, pp61-65

Rosenbloom, A. Interactive Immersion in 3D Computer Graphics. Communications of the ACM, 47(8), August 2004, pp28-31

Scharver, C. Evenhouse, R. Johnson, A. Leigh, J. Designing Cranial Implants in a Haptic Augmented Reality Environment. Communications of the ACM, 47(8), September 2004, pp32-38

Virtual Reality

Virtual Reality: “A system in which images that look like real objects are created by computer and can be interacted with by using special electronic equipment.”

The oxford dictionary definition of virtual reality is true from a certain perspective. However the boundaries of virtual reality are constantly being pushed with the advances that are constantly being made in computing, virtual reality and related research areas.

The work of Kevin Warwick is one example of how virtual reality is a continually developing area. Kevin Warwick is a professor of cybernetics researching into the concept of the human ‘Cyborg’. In two experiments Warwick had electronic implants put into him. The first of these implants was a radio frequency identification chip (RFID). This chip was monitored through a wireless link by a computer in his office, the computer was able to monitor his movements and knowing where he was allowed the computer to open doors and switch on lights for him accordingly. The second implant was a 100-electrode array that was connected directly to Warwick’s nervous system, through his left arm. The implant was connected through hardwire or wireless link to another computer. The implant allowed Warwick to control the movement of a robotic arm and neural control of an intelligent home environment. The data communicated with the computer in this second experiment it is hoped can be transmitted back down the connection to the arm and then translated as an emotional response in the participant. This is one example of where the lines between the real and the virtual become blurred. Should it be possible to send signals back to through the connection to the nervous system the computer could be used to create artificial emotional signals that could elicit a desired response within Warwick. In theory any number of emotional responses could be re-created, should enough information be available to do so.

Another example challenging the definition in the oxford dictionary is the development of the seeing tongue. Developed by scientist Paul Bach-y-Rita the seeing tongue allows the wearer whether blind or simply blindfolded to see the general shape of objects through their tongue. Transmitting images from a camera to a control box through a cable and then back onto a 12-by-12 gold plated electrode array, roughly the size of a desert fork, the wearer places it the device onto their tongue like a lollipop. The stimulation from the electrodes produces sensations that subjects can then interpret as visual signals. The device has clear implications for scientific research notably in the fields of neuroscience and psychology.

Both of these devices could be adapted and integrated into virtual reality systems to provide a new definition of virtual reality that takes it beyond the concept of interacting with images, but rather interacting with ‘real’ virtual objects – objects that exist virtually and could be given virtual mass, texture, and feeling, and perceived directly by the users. Special equipment would still be used, but perception would not occur ‘through’ the equipment it would seem like direct interaction with the object.

These technologies are still being developed, but other technologies that challenge the definition provided by the oxford dictionary, but fit in with more relevant ideas of virtual reality will be looked at in more detail below.

Some Virtual Reality research areas are as follows:

- Vision, 3D Graphics
- Around Sound
- Smell/Taste
- Immersive Reality
- Touch, Haptic Feedback
- Augmented Reality

Vision, 3D Graphics

Vanishing points are used to create the illusion of a 3D view. Constantly changing the vanishing point to reflect the movement of the person viewing a picture can create the illusion of navigating a 3D space. Vanishing points create perspective within a picture, creating the illusion of depth within a two-dimensional image.

The creation of this illusion using a computer is aided by the ability for the computer to be able to redraw the vanishing points and the scene as quickly and as accurately as possible as the user navigates the environment. The process allowing the computer to re-calculate and re-draw these vanishing points is called rendering. Rendering involves the re-calculation and redrawing of the vanishing points and the entire scene as mentioned, but it also involves the re-calculation of light sources, and how it would be reflected and absorbed by various objects so that the image can be given other three-dimensional qualities such as variations in shade, colour intensity, and shadows.

In terms of virtual reality the projection of the 3D image on a screen is not necessarily enough to create the illusion of a virtual environment due to issues with perception, including spatial awareness and depth perception[7]. Stereoscopic vision however looks to resolve these issues. Stereoscopic vision allows for look-around, walk-around and fly-through capabilities in virtual environments, although some users are still unable to pick up this perception, according to 3D photographer Boris Starosta 10% of the population are 'stereo-blind' and must rely on non-stereoscopic depth cues within the 2D pictures.

Software that allows us to create 3D representations of images include QuickTime VR, and Holomatix Blaze 3D. The Tate gallery insight project has adopted blaze 3D as part of its exploration into methods of representing art digitally. Blaze 3D is a similar package to Quick Time VR and can create a view which can be rotated 360 degrees around, under and above an object, the view can also be zoomed into and explored in more detail.

Also making use of 3D vision beyond gaming technologies are art museums such as the Musée du Quai Branly in Paris and the Museo Virtual de Artes el Pais in Uruguay. Both museums exist purely virtually. They use virtual architecture that can be explored using tools to interact with the environment. The Musée du Quai Branly in Paris has the additional quality of being modeled using stereoscopic techniques and can be viewed within an immersive environment and interacted with using specially designed controls. 3D virtual representations such as those found in games such as Quake are being used in many areas. One such area is to help gain an understanding of patient hallucinations in Australia. Descriptions of real psychotic events can be depicted using software as a 3D representation – An abyss could appear where the floor should be, distorted mirror images of the patient can be provided, and abusive voices can be presented simultaneously with the images on screen. Such technology is employed for cognitive behavioral therapy to teach patients how to ignore hallucinations. It is another example in many of the increasing uses of three-dimensional representations.

Around Sound – As discussed within the field of electronic music the ability to create sound using electronic means has been around for over a century. The ability to do so with a computer has been theoretically possible since its conception, and physically possible since experts began experimenting with systems back in the 50's. Sounds can be synthesised and created using a computer, or simply re-presented through the computer speakers. Creating realistic sounds requires our ears to receive the sound at slightly different times. Technologies such as Dolby Stereo surround sound allow us to create realistic sound using multiple audio channels, speakers and a decoder.

[7] http://interactivity.ucsd.edu/projects/augMedia/perceptionVE.html

Smell/Taste – As mentioned above sight can be recreated through the stimulation of electrodes on a human tongue. Also the idea that emotions can be recorded and then manipulated using controls connected directly to the human nervous system is explored in the experiments conducted by Kevin Warwick. These experiments are only a step away from the creation of virtual smell and taste. Should emotion be re-created by sending virtual signals through the nervous system, it is a logical step that should the correct signals be discovered the same techniques could be used to create the sensation of smell and taste within the wearer of a special device. Although still a theoretical idea, the ability to record emotion and reactions to particular situations may lie in the same realm as re-creating these emotions and sensations, including possibly smell and taste.

Immersive Reality: Immersive environments create an experience for the user that makes them seem actually within a 'virtual' environment. Immersive reality allows the user a complete field of view in a 360-degree area around them. A head mounted display could be used to help achieve this effect or the user could experience the display within a small room dedicated to the projection of the environment. Stereoscopic vision allows some form of interaction with objects within the 3D environment by creating an interactive space that can be explored in a different way from a simple 3D projection on a display screen. Immersive reality is closest to the oxford dictionary definition: "A system in which images that look like real objects are created by computer and can be interacted with by using special electronic equipment". The combination of advanced display techniques and realistic sound and interaction allow the user to feel completely immersed within a 'virtual-reality'.

Haptics is described the science of applying tactile sensation to human interaction with computers. A haptic device is one that involves physical contact between the computer and the user, usually through an input/output device, such as a joystick or data gloves. Haptic feedback is the term used for the sensation created by this physical contact. A user can pick up a virtual tennis ball using a data glove. The computer senses the movement and moves the virtual ball on the display. However, because of the nature of a haptic interface, the user will feel the tennis ball in his hand through tactile sensations that the computer sends through the data glove, mimicking the feel of the tennis ball in the user's hand[8].

Augmented reality is the combination of virtual information within a real-life space. Information or images can be projected onto a screen of some form that is actually being used within a real environment that augments the environment with addition information about it. A heads-up display within an aircraft is an example of augmented reality. Additional information that the pilot requires can be projected onto the cockpit, or onto the pilots visor unobtrusively and without affecting the normal view of the pilot. The information is used to enhance the experience of flying the plane by providing information that the pilot may need such as location, or targeting information within a battle in a practical and useable way. The underlying objective is to enhance the users performance in and perception of the world. The idea is to create a system that the user cannot tell the difference between the real world and the virtual augmentation of it – the user would perceive it as a single real scene[9].

Augmented reality can be used in everyday life such as a heads up display in our own cars depicting speed information and location provided by a global positioning system. An augmented reality display might eventually be developed on a display device that is similar to a pair of glasses. The user would wear the glasses and as they move the display on the glasses display would change to provide additional information about the environment. An enticing idea is the combination of an augmented reality display and technology such as content-based image retrieval for identifying objects, which is then used within an art gallery setting. A user could look at a picture or sculpture within the gallery; its likeness will be discovered through its basic shape and parameters using CBIR and information displayed about the picture on the display. It would provide a method of enhancing the experience of going around an art gallery in the same way audio tours might nowadays. However the augmented reality display or headset provides scope for more personalised and relevant information.

[8] www.webopaedia.com
[9] www.se.rit.edu

Hybrid environments combine a number of the technologies mentioned here. A hybrid environment is a combination of the virtual and the real and can be used within a real or virtual situation. In the field of conflict simulation we looked at the hybrid environment of a flight simulator. The flight simulator discussed merges a number of technologies. The flight simulator merges an immersive environment with the use of a real cockpit and flight controls; haptic feedback is used to recreate the feeling of flying a real aircraft, such as the feeling of landing, or turbulence; computer generated sky, runway, and background is presented to the user on the view screens, and augmented reality is employed to provide additional controls and display in the same way that would be used in real aircraft such as the Eurofighter on the cockpit window. This can be described as a 'hybrid environment' and merges the real with the virtual along with 'rich' user interaction. Along with the other example mentioned – the modelling of cranial implants using a hybrid-environment it is clear the boundaries of the definition of virtual reality discussed above are being pushed. The uses of such revolutionary technology are still being discovered, but it is clear that there are uses for this technology in our everyday lives in the form of entertainment; education can be enriched by providing students with 3D interactive views of anatomy and architecture; NASA have even adopted virtual environments and hybrid environments for assembly training, hardware layout, and design evaluation of payload design. The Internet could be enhanced by such methods adding another level of reality to what some could consider a form of 'reality' in itself, certainly part of their everyday routine and lifestyles. The internet used for managing bank accounts, booking holidays and even socialising already could be represented in a three-dimensional immersive environment with hybrid elements to provide users or 'participants' with a virtual shopping mall featuring a virtual bank and desk clerk, a virtual travel agent and even the socialising element could be represented with enhanced three-dimensional interactive avatars for users in web-forums and obviously gaming situations.

References

ACM News Track: Virtual Visions. Communications of the ACM, 47(9), September 2004, pp9-10

http://cave.ncsa.uiuc.edu/about.html - accessed June 12th 2005

http://www.elpais.com.uy/muva2/ - accessed June 12th 2005

Hoffman, D.L. Novak, T. P. Venkatesh, A. Has the Internet become Indispensable? Communications of the ACM, 47(7) July 2004, pp37-42

www.holomatix.com - accessed June 12th 205

http://interactivity.ucsd.edu/projects/augMedia/perceptionVE.html - accessed June 12th 2005

Imielinska, C. Molholt, P. Incorporating 3D Virtual Anatomy into the Medical Curriculum. Communications of the ACM, 48(2), February 2005, pp49-54

www.kevinwarwick.com/ - accessed June 12th 2005

Lok, B. C. Toward the Merging of Real and Virtual Spaces. Communications of the ACM, 47(8), August 2004, pp48-53

http://news.bbc.co.uk/1/hi/england/kent/4557881.stm - accessed June 12th 2005

www.readymade.fr/ - accessed June 12th 2005

Rosenbloom, A. Interactive Immersion in 3D Computer Graphics. Communications of the ACM, 47(8), August 2004, pp28-31

www.se.rit.edu - accessed June 12th 2005

www.starosta.com/3dshowcase/istereo.html - accessed June 12th 2005

www.tate.org.uk/collections/insight - accessed June 12th 2005

UKRI Newsletter, Tom Hammons, October 2003

www.webopedia.com/TERM/R/rendering.html - accessed June 12th 2005

www.webopedia.com/TERM/R/ray_tracing.html - accessed June 12th 2005