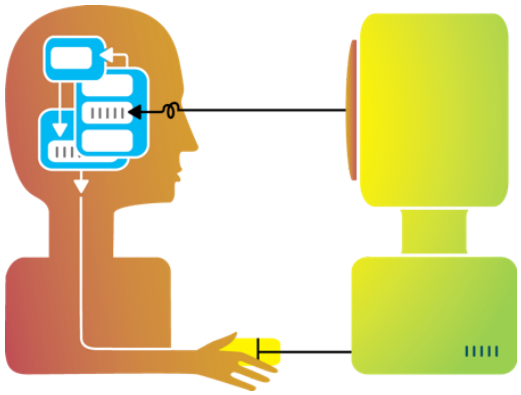
Development of Human Computer Interactions

***Image Sources are placed found at the bottom of the page as a footnote**

What is Human Computer Interaction

Human Computer Interaction is the insight of how we, Humans, interact with computers. What makes it work for us and to understand the difference of what is a Good interaction and a Bad interactions. For anyone it takes time to translate what we see on a screen to the options available to use to command the computer and the better the computer interface is, the quicker it takes to understand, the simpler the actions and the better it is for the user.



[1] Image - [Centre]

The design of an interface and development of an interface is all dependant on who would be using it, for many interfaces this would a wide range of people, such as those who are very experienced while there being many who aren't and those who would be less able, Visual and motor impairments. There is also a need to understand how HCI impacts society, Computers taking over automated job that was once done by Humans, the Education system getting more technological and the change in someone's everyday life.

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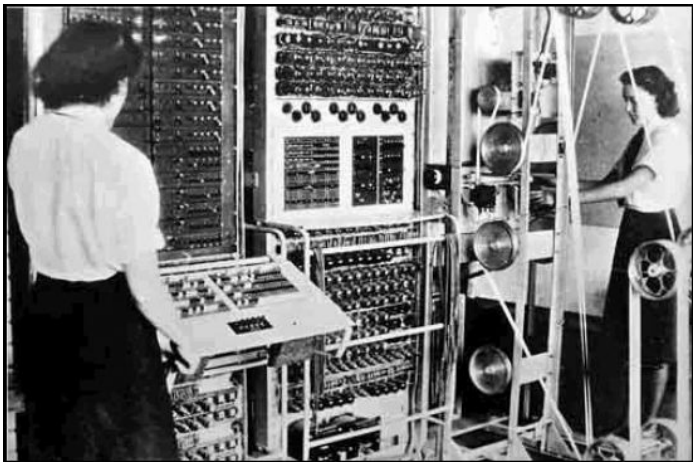
[1] http://1.bp.blogspot.com/-M7lqrRLv-g0/UQDWCUL6tmI/AAAAAAAAAQI/xelGTcuavPI/s1600/human-computer-interaction.png

History of HCI

Origins of HCI (Electronic Computing)



Starting with the first generation in 1937 the first electronic digital computer was built by Dr. John V. Atanasoff and Clifford Berry and is named the Atanasoff-Berry Computer (ABC). In 1943 an electronic computer the Colossus was built, for the US military it helped crack the German Code and shorten the war by incredible lengths
1946 the first general– purpose digital computer, the Electronic Numerical Integrator and Computer (ENIAC) was built, incredibly large in size thanks to the vacuum tubes, it puts massive strains with any power system they had at the time. This computer being only able to process one task at a time a poor rates and turning of the lights of the local area, this closed the chapter of the First Generation of Computers

[2] Image - Colossus Computer

1947 was the start of the next Generation of Computers where transistors replaced vacuum tubes, making it more reliable and then in 1951 the first computer for commercial use was introduced to the public; the Universal Automatic Computer (UNIVAC 1) followed up in 1953 with the International Business Machine (IBM) 650 & 700 series. This was the generation where there were Operating systems and more that a few dozen programming languages. With the use of Storage and Printing making it's stand in the commercial world of computers. This generation ended in 1962

1963 brought forth the world that is today, Integrated circuits started third generation of computers, allowing computers to reach higher power while bringing down the size and power consumption, making them more reliable to the commercial world. They could run multiple programs at a time, where in 1980 Microsoft Disk Operating System (MS-Dos) was born and right behind them was IBM in 1981 with the first Personal Computer (PC) for the everyday office and home use. Few years forward and Apple made the Macintosh computer with its icon driven interface and the 90s gave us Windows operating system.

Over the constant improvement and development of the Third Generation of computers have we now got the technology we have today accompanied by more gadgets than ever before.

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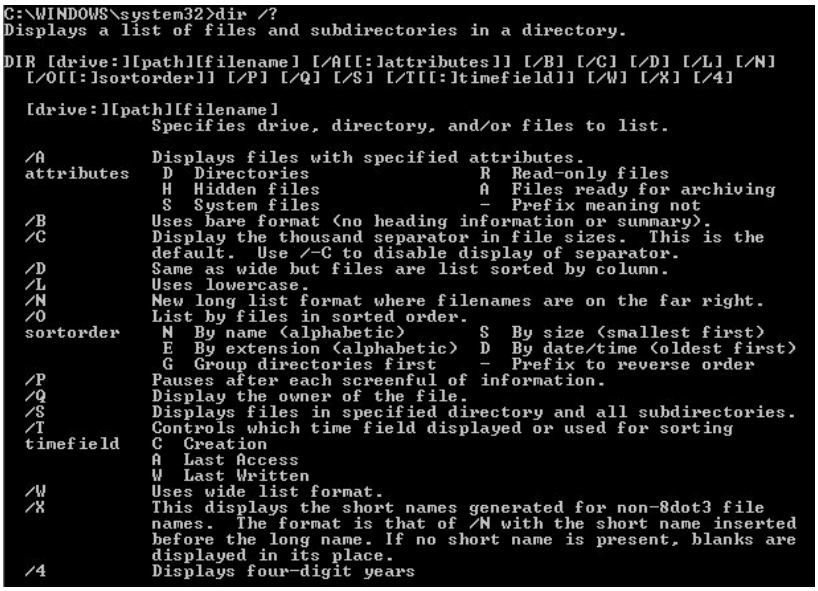
[2] https://en.wikipedia.org/wiki/Colossus_computer#/media/File:Colossus.jpg

Command line interfaces

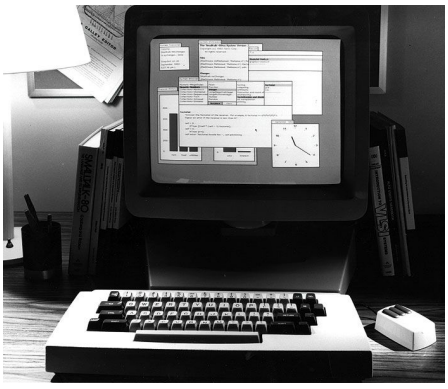


A command-line interface or command language interpreter (CLI) is how you operated the earliest of Third Generation computers, these were interfaces where you have to remember specific keywords (Recall rather than recognition), by entering these commands the computer could interpret what you would like to do and in return receive a response or have the computer complete a task.

MS DOS [3] is an example of this, being made by Microsoft it was a CLI interface. Back then the use of these computers slowly reached homes, though only people with a lot of money could afford it. Opening applications meant remembering the file directories of your programmes and the following commands to even reach that point. Within most if not all Command Line Interfaces there is a help command to see all the commands you can do and from there most people would only remember what they need. These interfaces weren't so practical for general purpose use.

Evolution of Graphical User Interfaces

As commercial use of computers increased, more or more uses in where computers could be used in everyday life, it reached a limit in who could use it, not everyone could have the capacity to remember all the commands for a CLI. A better and now a more modern way of interacting with a computer is with visuals, this is better know as a Graphical User Interface, this is the use of recognition over recall. Just noticing icons could make it quicker to know what you can do on the screen and thus more practical for everyday users or people who operate it quickly.



Starting with April 1973, the first operational Alto[4] computer is completed at Xerox PARC. The Alto is the first system to pull together all of the elements of the 'modern' Graphical User Interface at the time, with a simple bit-mapped display operated

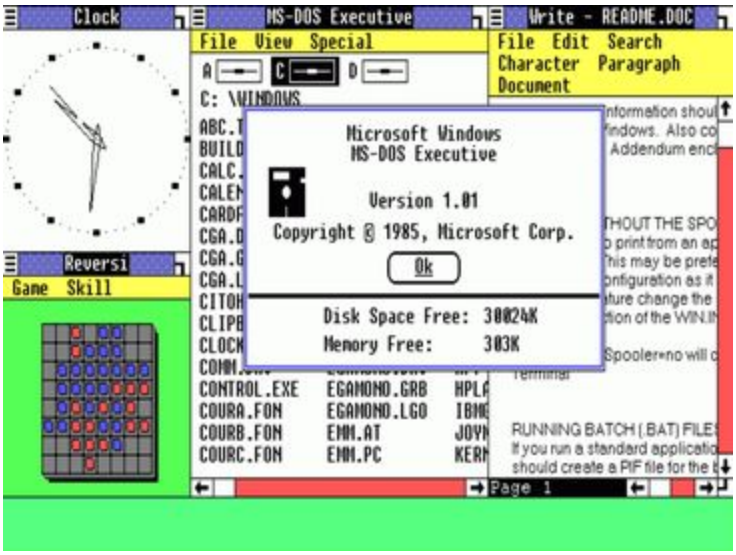
3 http://11986-presscdn-0-77.pagely.netdna-cdn.com/wp-content/uploads/2008/02/dir-ms-dos-command.png

4 http://www.digibarn.com/collections/software/alto/altost2.jpg

with a keyboard and mouse. Following WIMP (**W**indows **I**cons **M**enus **P**ointer) this started the generation of the more modern interface.
What followed the Alto in GUI and making the PC a more ‘homely’ product was the Macintosh 128k PC - 1984.

What made the Macintosh 128k PC a much more special than just a Computer with a ‘modern’ for it's time GUI was that the PC was an ‘all in one’ meaning that it had it's own, built in floppy disk drive. Rather than at the time buying one externally this PC came with it built it. This made it easier for people to buy with everything they needed, reducing the need to buy ‘modules’ for the PC

[5] Macintosh 128k PC



So far the GUIs shown came with a pre-made PC, bundled together. Though what came after is a GUI that came stand-alone. Not with a PC but instead installable via Floppy disks at the time or came with different pre-made PCs

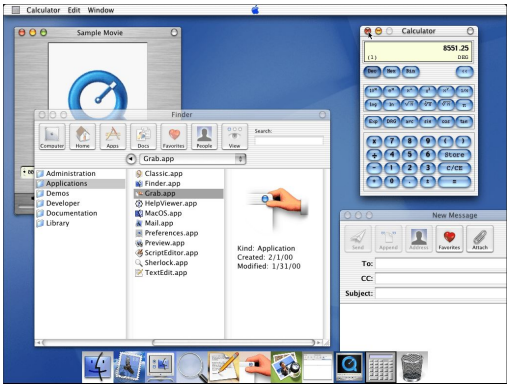
[6]Windows 1.0

One year later came 1985 and Microsoft released Windows 1.0, the first stand-alone Operating system that came with it's own GUI. Windows 1.0 was the predecessor to it's old CLI OS, MS-DOS and what Windows 1.0 allowed was multitasking of MS-DOS Applications. This GUI had the requirement that the PC had a Graphic Card at the time, and depending on the one you could either work with a MonoChrome Screen (Black and White) or a Coloured Screen working with the 8 bits colour depth. This was needed at the OS was not made for a pre-made PC.

The next major jump in GUIs came in 1987 where Apple one upped Windows and made the Apple Macintosh II the first color GUI and Macintosh, where they got a 13 inch screen with a resolution of 640 x 480 to display 16.7 million colours, this made a new height in quality and being able to see in detail when it came to GUI, this made the

[5] https://en.wikipedia.org/wiki/Macintosh#/media/File:Macintosh_128k_transparency.png
[6] https://en.wikipedia.org/wiki/Windows_1.0#/media/File:Windows1.0.png

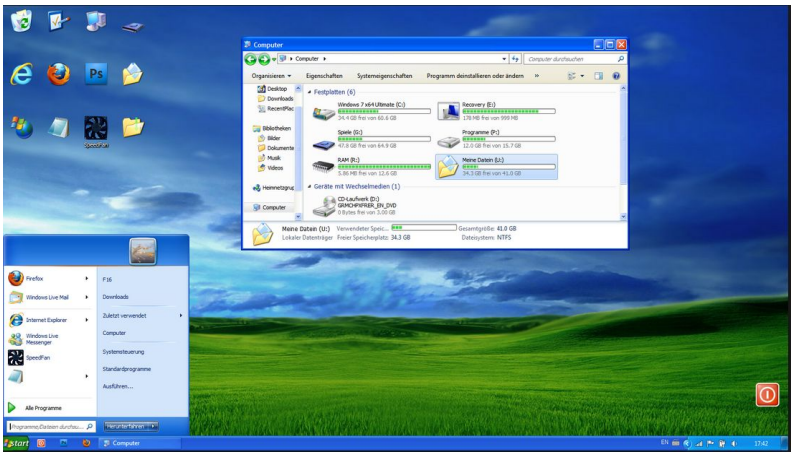
open access for designing and image creation and manipulation on a computer to make a start.
[7] Macintosh II with an image using the potential of True Colour Depth



A big jump to the year 2000 was the newest release, Aqua, the GUI design of Apple's MacOS X and simply where Apple's GUI designs originated to the modern era, Aqua was the name of the GUI before being implemented full into MacOS . This was a huge change, the design of the UI had a new style, curved edges and circular window control buttons, the whole rounded design made it more 'comfy' and struck very quickly to average users. This was where the way people interacted with the UI changed. You were able to see clearly and do more at a time. Something that windows looked at

[8]Aqua UI before Mac OS implementation

Windows came out perfectly 1 year after (2001) with Windows XP, throwing out the Windows



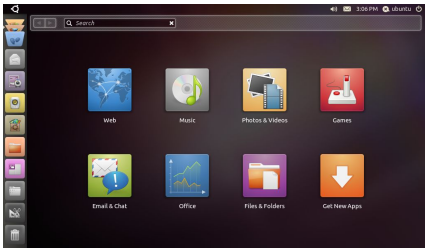
1.0 - 3.0 this came with more visual goodies than it's old UI and reaching the 'True Colour' Depth that Apple got with. This UI could handle more operations while also a general boost in performance compared to the older GUI and a much more needed - multimedia expansion (Video, Storage devices, Animation) XP was the most notorious GUI for it's time as well as an OS.

Overtime for the next 6 years were just constant small changes and improvements to the main two GUIs / OSs, Windows and MacOS X, This was where the mains of HCI came in, where small changes and fixed applied to make the GUIs Optimal for the user.

[7] http://images.macworld.com/images/article/2012/06/leopard-preview-media-1-283221.jpg
[8] https://i2.wp.com/512pixels.net/wp-content/uploads/S3/macosxdp3.png

This then lead to 6 years later in 2007 Windows Releasing Windows Vista, A new UI with a bunch of changes compared to Windows XP in terms of UI, the Windows Button was round and big, Window Controls (Minimizing, Maximizing, Exit) became shorter but wider and the Power Options were put under one button with a menu after it. Though Vista had poor performance as an OS this didn't take over XP at any point, but the UI was told to be nice, more user friends and had a 'smoother' feel, HCI and the way we design for users was fully put into effect as Vista took the streets.

Reaching closer to the Modern Era were the UIs that are still being commonly used to the modern day.
From [9]Ubuntu 11.4, with the new Unity Interface



[10]Gnome 3 with a similar design

[11]Windows 7

[9] http://distrowatch.com/images/screenshots/ubuntu-10.10-netbook.png
[10] https://gnome.org/wp-content/uploads/2010/09/activities-overview-applications-420x236.png
[11] http://www.top-windows-tutorials.com/images/2013/05/windows-7-desktop.png

[12]Windows 8(.1)

All these UI evolved over long periods of time to optimize its user interactions, trying to make it easier and simpler to access certain thing and areas while making each one of these GUIs Customizable to the user's needs and wants.

Up to the very now and most recent GUI to hit the line would be [13]Windows 10. This UI is a merge of the good features of Windows 7 and 8 put together.

Windows 10 changed how certain things were accessed, such as Notification for the PC and your most commonly used applications. This came with navigation and better search functions to find any application on your PC immediately.

12 https://www.extremetech.com/wp-content/uploads/2013/04/windows-8-start8-start-menu-crop-640x353.jpg & https://cdn.arstechnica.net/wp-content/uploads/2013/10/new-start-screen.png

13 https://upload.wikimedia.org/wikipedia/en/7/7b/Windows_10_build_14393_(Redstone).png

Development

With all the GUIs and ways we can see things there also new ways we can interact with, this is starting from physical touch inputs to using our voice and facial gestures. All down to the way we receive from a computer, that being new VR and synthetic voices. All these changes and new technologies have made it easier for us to interact with computers and hence allows users to cut out the middleman when interacting with a computer making actions be completed quicker and for the general purpose tasks on any computer, do it quicker. Computers have replaced what once would've been done by someone or even mechanically alone.

Inputs

Touch Screen

Touch Screens are a huge thing in a modern person's daily life, our Phones and Tablets, going to the Ticket Machine to Top-Up our Oysters and that time you use the new Drink Machine at Burger King. These have allowed us users to do things much quicker and also open more options.

With Phones we now have a quicker way of unlocking your phone, accessing contacts and replying to messages. Touch has given phones from the old classic keypads to the modern designs a new UI, one that could make the best use of someone being able to interact with the phone through touch, this being from being able to swipe down on the notification to make an instant reply of swiping sideways to ignore it while playing flappy birds, more complex games can be operated on a phone, one that requires precision movement depending where you move your finger to making your everyday apps quicker to operate, going to the menu of an app and then swiping sideways to hide the menu. This has also changed how we can access our phones, the most modern of touch technology allows us to use our finger to unlock our phone while if not that you can make a pattern or a tap code to unlock your phone not like the old phones where all you have was a 4 digit pin code. These massive leaps have made replying to those miss calls and the ease of checking out your notifications that much easier that it's such a leap.

[14]Iphone vs keypad phone.

[14] http://s.hswstatic.com/gif/question716-1.jpg & http://www.gizbot.com/img/400x90/img/gadget-finder/original/2014/04/nokia-220-dual-sim-price-in-india_13974670610.jpg

From Mobile devices utilizing touch screen, something before that made use of Touch Screens, used at now every train station was [15]Oyster Card Ticket Machines. These were used to replace the man at the ticket office and allowed you to just walk up, scan your card and put money in your card, no talking required. The results, a faster and more efficient way of people to get around on the trains. Now you just go with one of the given options for you and tap accordingly and what's even better than since it's turned from a Human - Human to a Human - Computer interaction the computer can display all the text in different languages following the user's need. This UI simply allows for people with no - minimal english to read the screen in a better language that they would understand better and to change the language, all you do is press the flag corresponding to the language.

Something very unusual but very valid is something such as the computerized drink machines at your popular fast-food restaurant, before all you would do is pull a cup to a lever where your drink choice would pour down below. With this you were limited to about 6 flavours and they would not have the variants such as 'Coke Cherry'. The point is that with the use of a Touch Screen the interaction to having your special unique flavour is done differently. The machine; '[16]Coca-Cola Freestyle' can provide 165 different flavours. The UI is made simply to pick your big brand and then behind that the flavour you want. This Human Computer Interaction allows for a quick selection of drink which was once limit to about 6 options now unlocks 165 with the aid of a computer. For the sake of someone who may need to manage the machine part of the UI is a 'Crew Mode' a mode for checking the levels in the machine as well as opening up the storage space. This all works with HCI and ease of access for both the customers and the staff.

For Touch Screen is very clear that it has made interactions with systems quicker for things such as the mobile phone and has replaced the role of a human (Ticket Machines) as well as a strictly mechanical system (Drink Machine) allowing for more options while also making the whole process quicker in some aspects. Touch Screen Development first started on big stationary computers such as the average ticket machine before having the more mobile, responsive and improved advances that made touch screen on phones possible.

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[15] http://i.dailymail.co.uk/i/pix/2014/09/17/article-2759440-061CB84800000514-37_634x391.jpg
[16] http://www.coca-colacompany.com/content/dam/journey/us/en/private/2010/01/freestyle1-7d9ff257.jpg

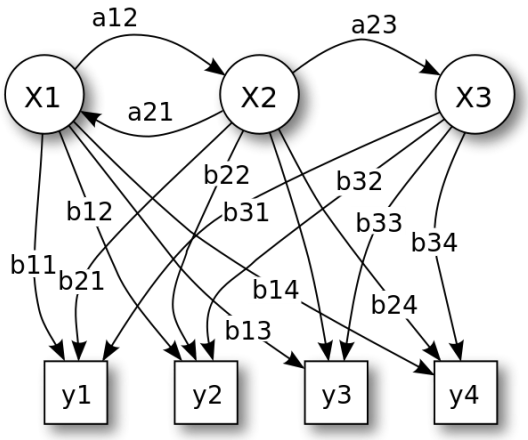
Voice Recognition

The first public occurrence of hearing about Voice Recognition being a practical thing would've been Siri, Apple's personal assistant on your Iphone.

Before any of that the first starts of voice recognition was created in the 1950s with simple technology allowed computers to understand numbers spoken from a single voice. This technology known as the Audery System was made by Bell Laboratories.

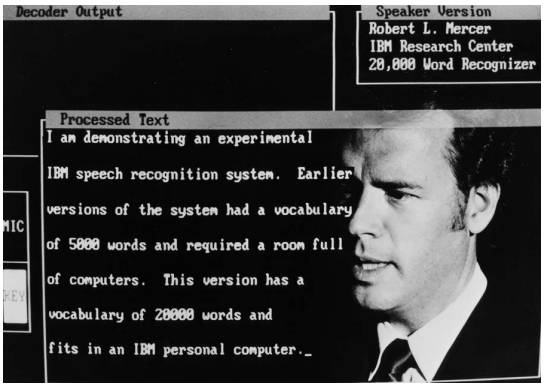
Later into the 1960s was the time IBM entered the show, they made a system able to understand 16 English Spoken words, this system was named Shoebox and was where the concept of computers reaching 'baby talk' started

Cutting a few year forward a 5 year voice recognition research project was funded, after the 5 years the aim was to make a system to understand 1,000 words, and what came out was a System named Harpy that could understand 1,011 english words. This system was able to create it's own state table that could consider grammar into its recognition though it needed human interaction to remove redundancies.



Something critical to was would be the future of computer predictions and reaching the 'predictive vs descriptive' stage of HCI was the Hidden Markov Model (HMM), the model was made to make predictions against 'hidden variables' that may not be thought of in a way of dealing with a multiple outcome situation, such as if someone says, 'Hello my name is ----' and someone else says 'Hello I'm ----' the HMM is a model that lets you deal with both inputs and treat them the same as they both mean that the person's name is '----'. It's also used in ways of output and making predictions on actions of a given event or such. Though these do not apply to voice recognition. [17]Example model of HMM

[17] https://en.wikipedia.org/wiki/Hidden_Markov_model#/media/File:HiddenMarkovModel.svg



The HMM leads to next jump in voice recognition systems with IBM creating Tangora, a system that can understand 20,000 words, the machine showed the path into making statistical approaches into voice recognition though, each user had to 'typewrite' each work into the machine with sizable pauses and loud clear speech. This wasn't the most practical system however, the required power was immense to where it was nowhere near practical home use.

Finally, our first commercially viable voice recognition software came in 1990, Dragon Dictate. Dragon Dictate was made of MacOS X Leopard only in its first release. The system was able to typewrite as if it was keyboard input based on what the user said, following the cursor in the text document. Though very basic in nature, the system could only type if the text box was selected already by the user e.g. mouse click on a text editor. Later on the Windows version was released and more versions of MacOS X. This voice recognition system was the first point where the common keyboard could be replaced by voice to a certain level. Of course with all voice recognition so far, it's not perfect, if someone isn't clear the wrong words are given and so on, these errors would still make it unappealing to switch from keyboard to voice.

After was more and more iterations of developing Voice Recognition systems. All were expand their their vocabulary while progressively getting faster, more responsive and more accurate.

The Sphinx-II in 1993 a system that had a very much expanded vocabulary that could accept continuous speech, this was simple an invention and not a commercial product of any sort but what took pointers from this was IBM in 1996 with 'Medspeak' - [18]"a radiologist would dictate the examination of a patient's X-ray, and MedSpeak/Radiology would convert the comments into a written report." This was a big jump, and this worked with high accuracy, little to no fixing was needed per report from the translation of the voice to type. This made the process of examining a patient and moving to the much more faster.

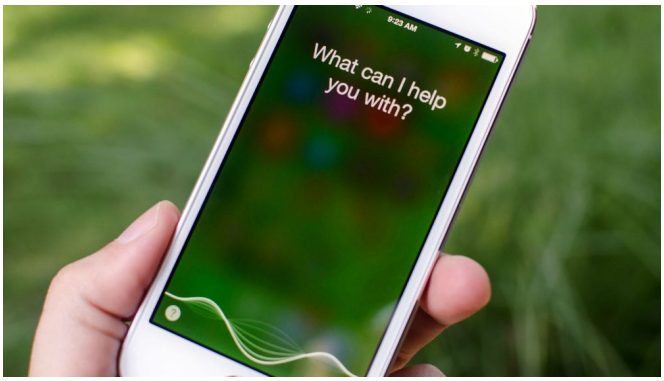
In 2002 Microsoft picked up on voice recognition and implemented voice recognition into the Office Package, you could then speak rather than type into the word processor. This allows office users within their personal quiet environment to sit back and speak rather than type, all with just a small need to fix errors as they come through, though the whole typing process was much quicker than just typing.

After a long time looking into the technology the NSA in 2006 looked into the practicality of using voice recognition to find keyword in recorded calls, the high improvements to average modern

[18] http://www-03.ibm.com/ibm/history/ibm100/us/en/icons/speechreco/breakthroughs/

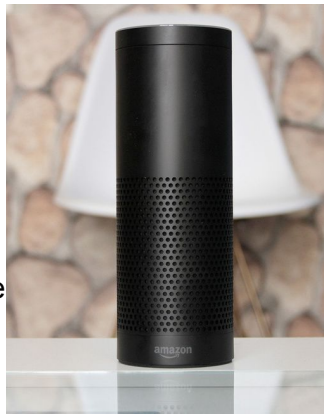
PCs along with the fact that computer can go through data a lot faster than a human this this allow very quick search times when scanning through recordings.

Finally Google picked up on this, and used voice recognition to run their call center, they allowed people to talk to a computer which could understand a caller's need and direct the call the correct person, this saved manpower and time needed for call centers and over time from 2007 to present are many call center of many different companies moving to using voice recognition than having someone sit around and wait for the phone to buzz.



Reaching the main start of voice recognition to the public was Siri, the phone assistant for the modern Apple Iphone. Siri was able to listen to users as they talked to the phone to basic tasks that would normally be done by the user tapping away on the screen to reach their contacts list, play some music or search something on google or even the weather. All these tasks through Siri could be done by voice, this cuts the middleman of needing to navigate through all the menus to reach the point to complete a task but instead through a simple sentence do what 10 or so taps on the screen would've needed.
[19]Siri

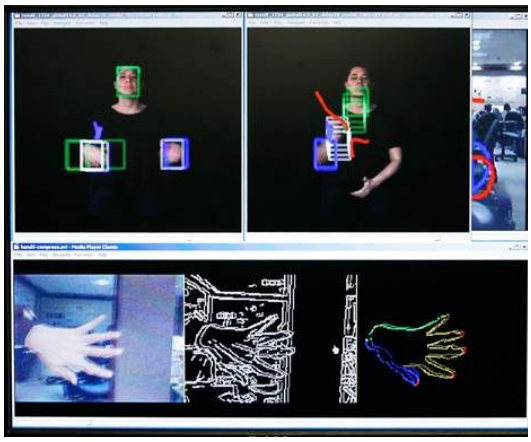
Once Siri took the mobile market, Microsoft was keen to follow through their phone product at the time and also to hit the PC market as well with Cortana, similar to Siri in almost every way this was the personal assistant for the Windows platform for 2014.



This has then led us to the present with the most recent commercial voice recognition technology to hit the market being Amazon Echo, a device that is dedicated to voice recognition rather a simple feature to a phone that has a lot more than talking to the personal assistant on it. The Amazon Echo System Alexa is able to perform tasks of simple and complex level which include controlling other devices, this could be from the lights in the house to simple math questions to even changing the TV channel on your smart TV. The Amazon Echo being designed for the house rather than being portable in your pocket make Voice Recognition slowly reach our daily routines where we would soon be replacing tasks with voice, though with all the voice recognition example is that none of them perfect, dealing with certain accents and languages have proven to be a barrier to the further improvement of voice recognition.
[20]Amazon Echo Alexa

[19] http://cdn.bgr.com/2015/12/siri-iphone.jpg?quality=98&strip=all
[20] http://cdn.pocket-lint.com/r/s/970x/assets/images/phpadneab.jpg

Hand Gesture / Sign Language



Reading sign languages are all down by visual hand motion, so the first prototypes were done through cameras that could visually recognize hand motion and covert hand gestures into words and further into sentences, the basis of this was the sign speaker would stand in front of a camera that would be mounted on a flat surface, speak through hand gestures and the computer could analyse this to then translate that to a given language, presumably english. This method however had no practicality in everyday life, it couldn't be used on the go as you need time to set up the camera, the computer, connect the cables and then open the application just to get talking and if for someone who is constantly on the move that would be no good. Though the technology just started.

Moving on, sign language comes down to the hands and where they are moved, the motion of the hands and the shape formed by them generated a word. From this another method that was portable was invented, glover, big, bulky Sign Language Recognition Gloves, the amount of cables needed went up but they were able to go up the arm, slightly uncomfortable but usable on the go. Going from the camera method to the glove was the allowance for better portability, though with the glove you had a heavy hand, more strain and having the glove on for long times can lead to sweaty hands and with that the need to take a break. This was a huge improvement though as rather than have the computer try and see the hand it 'felt' the hand through measuring the flex in each finger and could generate the letter / word.

The final stage the most recent in advancement wise is the use of Sensors that read the signal from one's arm to the hand. Thalmic Labs's [21]Myo has a way of accurately calculating the hand signs / gestures and unlocking another input dimension through your body with the use of sensors from the upper arm, the whole arm could be used, raising and lowering the arm was another method of input rather than just the shape and angle the hand was at. The fact that this sensor was attached to the arm rather than the hand allowed you to not have your hands covered for precision tasks or to even make contact with water. This was the modern era, the technology to date is under constant improvement to reach a much more commercially viable state than it currently is.

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21 https://static1.squarespace.com/static/5481f3dde4b01afce4483071/t/55aa70f9e4b020360b6ec2be/1437233402594/

Output

Text to Speech (Speech Synthesis)

From humans to inputting their voice into the computer, the computer can do the reverse, this is the computer synthetically making sound waves that are audible to a human. This technology requires the computer to learn linguistics of a language, grammar and different conventions to a language so it can correctly speak from text it reads.

The first concept of synthesised speech was done with a IBM 704 computer, using a Speech Synthesis system first developed by Noriko Umeda which could do general English text-to-speech in Japan was the system used to recreate a song called ‘Daisy Bell’ and this was used in the movie A Space Odyssey 2001. This was due to how impressive the Speech Synthesis technology was at the time and this was the first fiction concept of how computers would talk.

Moving into the advancements of Speech Synthesis, various methods were made in which a computer could speak, using different ways of having a dictionary to how it would pronounce grammar while some also using the Hidden Markov Models like for voice recognition.

In 1999 as the technology of Speech Synthesis was rising, one major use of Speech Synthesis was used, to allow a very powerful mind have the power of speech once again. Stephen Hawking lost his ability to talk in 1985 given he got into a critical condition, in 1990s Hawking was given a [22]Computer which housed a speech synthesiser that changed his way of communicating by typing up on a screen and using spelling cards to communicate to having a voice again. This changed the way he could interact and talk, leaving an incredible mark on the power and uses of Speech Synthesis to come.

From the early production of Speech Synthesis technology was dedicated hardware that held off of the processing and parts to make Speech Synthesis work until later it was able to be developed into software useable on a average computer.

With the use of Text-to-Speech (TTS) being a reality was how more practical it is. From Siri with voice input, speech synthesis was the output and same goes for Cortana and Alexa. While we now have TTS addons for our web browsers and some instant messaging services such as Discord support TTS. This has made it easier for many user, and in terms of HCI we don’t need

22 https://en.wikipedia.org/wiki/Speech_synthesis#/media/File:Computer_and_speech_synthesiser_housing,_19_(9663804888).jpg

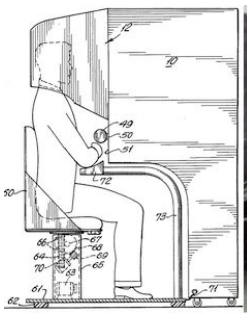
to look at our screen at times to know what was typed, as this a synthetically spoken out to us. For users it cuts the need of having to pick up the phone or look at the PC to the message. This cuts out the need of a screen at all sometimes, making it quicker to get notified about something or read about something.

Virtual Reality

For virtual reality came 5 major events that led up to the modern era, of HTC Vives, Steam VRs and Samsung VR. Over time when VR was being developed was many people rushed to try join something that wasn't ready and led to major companies resulting in failure with VR technology.

First was 1838, the first understanding on how pictures were seen by humans, the fact that the brain uses two images to made a 3D image in our heads. With this understanding the very first 'concept' of VR started, [23]The Stereoscope was a simple hand object that you placed your face on and could see a 3D image from Two 2D images and a couple years later, different designs of this were made, though nothing special they were just different in shape.

1929 brought something incredible to the world of VR and brought out a different path of VR technology other than commercial use we have today, Simulators. 1929 the '[24]Link Trainer' was the first ever flight simulator made and with over 10,000 were made to train over 500,000 pilots during World War II, this was an incredible piece of technology given at the time there were many things it lacked such as there were no screen to these, nothing to see.



In the 1950s the next leap in VR was made and something called the [25]Sensorama was made, this was a giant box that someone would lean into to see a screen that could display to you 3D images, as it displayed two images to have them act as one. But just 3D images wasn't enough as it also had features to simulate all the senses, this was with fans, smell makers, vibrating chair and stereo

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23 https://upload.wikimedia.org/wikipedia/commons/thumb/f/f6/Holmes_stereoscope.jpg/230px-Holmes_stereoscope.jpg

24 http://www.vrs.org.uk/images/link-trainer-1.jpg

25 http://www.vrs.org.uk/wp-content/uploads/2015/12/xsensorama-patent.png.pagespeed.ic.aUScm95aXo.png & http://www.vrs.org.uk/wp-content/uploads/2015/12/xsensorama2.jpg.pagespeed.ic.ePW5KC6z1U.jpg

speakers. This gave the feel of immersion into the video, making it as real as the technology of the time limited them. Though this idea wasn't fully practical it became very popular in areas that manage to obtain one of these large machines, though this marked the start of 3D videos, and the more modern '4D'. Given the size of the Sensorama it wasn't much practical, or accessible as only one person could sit in one at a time and it wasn't much of a common family item to buy. Though this lead to Cinemas such as IMAX to take this 4D concept and make it reality.

Arriving at VR headsets was the first invention ever made in 1960, the [26] Telesphere Mask and created the first example of VR Headset technology, though with no motion or tracking or anything to support immersion other than a 3D image for you to witness other than the basic Stereo sound.

One year after in 1961 the first Motion Tracking Headset was developed called Headsight, though it wasn't made for commercial use instead it was used by the military to remotely view situation that a person would be in danger at. It used a Magnetic system to track the user and relay the camera and the perspective based on where they turned their head.

Alot moved on from 1961 to 1991, arcade machines and more displays of VR built up, nothing that was truly commercial but was exclusive to people and areas that could pay for them until the first game developer to try take the VR market came to play. Sega announced their [27]VR Glasses in 1993 at an Electronics show and showed how the Glasses wrapped around your head and displayed images from the screen in the headset. The first really commercial Head Mounted Display. Supported with Stereo sound made the first Gaming Immersive experience, however. The nature of the technology at the time and the development difficulties proved hard for the users and developers who used the technology especially as there was no more than 4 games developed for the VR Glasses. Causing a huge fail for Sega.

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26 http://www.vrs.org.uk/wp-content/uploads/2015/12/xtelesphere-mask.jpg.pagespeed.ic.ASb3qSRTOa.jpg

27 http://www.vrs.org.uk/images/sega-vr.jpg

Of course this incident didn't stop others from trying and in 1995 Nintendo repeated history, they made the [28]Nintendo Virtual Boy and released it to Japan and North America where it was priced very high for it's time. Though even with a decrease in sales the product once again was a failure, the headset only supported two colours, Red and Black while lacking the software support for any developer of it's time to make a game or anything useable by the headset, another failure for the VR game market.

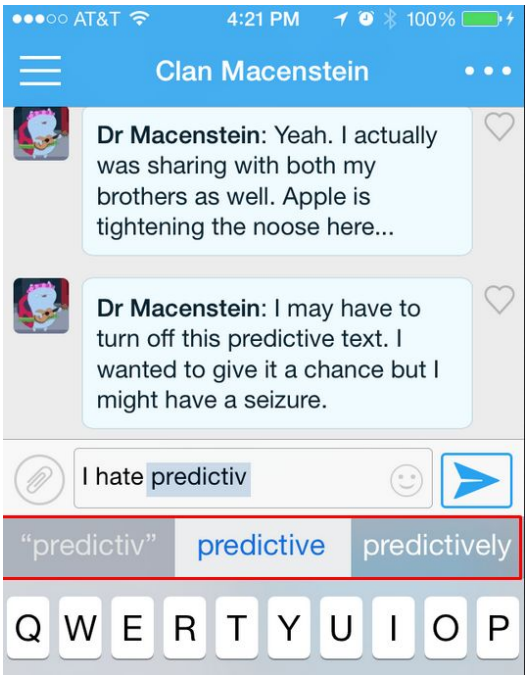
From all of that comes the 21st Century, as other prototypes and fail releases showed, they had to be careful trying to make a commercially viable VR headset for the public, people who rushed made failures that had very little features and nothing to make it 'worth it' over time the first prototypes came out, that being Oculus Rift with their VR headset, making it names and getting the term Virtual Reality a bigger name. Once then other companies joined the mix with the examples of the [29]HTC Vive and even for more immersion the [30]Virtuix Omni and platform that you can walk on to reenact moving in a virtual environment. All over the course of time have meet the need for these products to reach the large audience and to be usable by the average person.

As over time the commercial products that come with controllers and other physical product have all been shaped over trial and error to allow the best user interaction possible, and

[28] http://www.vrs.org.uk/images/virtual-boy-eyes.jpg
[29] http://vrsource.com/wp-content/uploads/2016/08/HTC-Vive-Review-16.jpg
[30] http://fm.cnbc.com/applications/cnbc.com/resources/img/editorial/2015/06/18/102771189-OmniHD1.1910x1000.jpg

without the failure of other companies would this not have been possible as once the first concepts of VR was made it was then time to find the best way people could use it, control it and make it usable for them and right now the best solution. Games.

Machine Learning



Machine Learning has been around for ages, and though you may not think of these it's true. Examples of machine learning would be something such as Google Searches, Amazon or Youtube Recommendations and may autofills that you can see online. Machine Learning took big steps, from beating the world's top Chess and Alpha Go players to being able to predict handwriting and [31]messages.

The idea of computers and machines understanding on a 'human' level has made doing our jobs easier at times, it's saves us time typing things out and making input to the computer a breeze when you use a common google search. But that's not it, like mentioned Google's searches use machine learning and where the whole thing of Search Engine Optimization comes in, as the computer is the one reading the contents of a webpage and learning what it's about. Jumping to the understanding of what search does the website come up under if it was wanted to be found and if the website can reflect that well enough to make it the top of the search list. That has then allowed us finding websites and searching the internet extremely easy for anyone.

Right now in the modern era of machine learning has it taken to computers interacting with human, further than just predicting someone's typing and learning how to recommend items in your weekly browsing on Amazon. Right now Google is invested in Machine learning and has supported a lot of interesting machine learning programmes being developed. Programmes such as a [32]A.I. Duet has been made, something that has learnet the pattern of many musicians playing the piano and used that to

[31] http://i2.wp.com/macenstein.com/default/wp-content/uploads/2014/09/1.png

[32] https://lh3.googleusercontent.com/SK7iorys5N1DNR82MQVyJomG4l2c88f20yyD_7sttUZEgqF0-dFmahNqN1MUJ5eeoyD3QTsBVMmpQA6C-ISVt64glzsPBNLWyw=s640

then develop a responsive piece after a user inputs some notes into a keyboard.

Though right now machine learning other than Google Searches, autofill, predictive text recommendations and personal assistants like Siri hasn't made a big jump to something that has improved a huge crowd of people in accessibility currently there is major development in the topic. Though Machine learning up to now has made the daily experience for many people much easier, it save time for users inputting data and finding the next thing they would want to know about as the computer / machine now just recommends it. Making our interactions with computers much quicker has it made technology that one step faster and more accessible.

User

Users are the reason HCI exists, we need to develop the way Humans interact with a computer to meet their needs, the user's needs and from this leds two paths in getting information about a user, as well as the different types of users that there will be, these all affect how the interaction for a person to interact with a user will change.

When it comes to anything involving HCI your target should start with EVERYONE and then brought down to simply those who need / would use your system

Types of user:

Expert users

These would be people knowing what they would do with the product, experienced in it to the core would mean they require little to no instruction to understand and operate the device since they would already have the understanding and knowledge to do so and would use a device as fully as intended.

Regular users

They are the general audience would will fulfil the device's purpose to a high level using what they have been presented with up front. They would have decent experience though anything new they may need some information and aid in understanding that.

Occasional users

Time to time users, though use it very frequently but will use a device time to time. They would need to be aware of the core basics while knowing the quick shortcuts at an easy level, occasionally needing to be re introduced into the product after a long break they would have the basic grips to use the device

Beginner/novice users.

Extremely new and with little knowledge these users would need a guide to help them simply reach the basics and get an understanding of the computer system while needing to be simple to actually get a grasp of. These would be at the level of Primary School student, or anyone new to devices.

Young Users

For this coursework I was able to interview children of you age from Primary school year 5-6 to ask about how they and their family interacts with technology and what makes them use it.

Our interview was to see how they interacted with technologies and also ask about themselves

Question	Student 1	Student 2
What year are you in	Year 5	Year 6
What did you do yesterday	Okay, went on Iphone	Normal played on your Ipad
What do you have that you commonly use?	Lego, Iphone	Iphone
Likes,	Constructing	Playing games, watching videos
Job dreams	Lawyer (Confident)	Doctor (Confident)
Fav Sub	RE	Maths
Least Fav Sub	English - don't like writing	English
Achievements	Top English Student	Pendarren, caving, rafting, horse riding
Use device	Youtube a lot, Minecraft	Play minecraft, youtube
Plays	AA, Rolling sky, Minecraft on computer	Clash of Clans
Devices the Family Has and Application they may use	Mostly Iphones Samsung Candy Crush	Dad - Samsung Mum - Iphone
Extra	Part of Digital Leaders programme Helps people who don't understand in code | coding club - scratch	
Why you like said Applications and Games	Creative, easy to use and look around (Minecraft) Easy to look find videos I like such as Minecraft (YouTube)	Creative, simple, I can just swipe my finger across the screen to look at the next column of video (YouTube)

	It's not hard and it's got a lot of colours (Candy Crush)	

From this is shows that young kids if this age are generally occasionally to even regular users of mostly mobile devices, Phones and Tablets are devices what younger commonly use and with that they are into application that support being constructive, games such as Minecraft and Clash of Clan both have core mechanics of being able to build and make in the game and this would show what type of application would come to the interest of younger kids generally, hitting the target of ‘everyone’

For HCI all the applications they use are loved for their creativity as well as their simplicity and vibrant colours for most games. This supports the need of easy to use application for Young Users to interact with a computer and shows that they are put off by things that they may not understand how to use and are just there figuring it out.

Other Users

Another task I put in hand was to go out asking a range of people about their opinions in technology and this covered how they felt they were being impacted.

These results were from people from mid-age being 40+ and the questions asked of what they like and hate about technology, their experience with going through the process of boarding a train and their opinions of train drivers being replaced by computers

User 1	Positives	Negatives
	Life is Easier Pays bill with Ease It's Important for it to be around Simplifies things	Occasional delays with Trains due to ‘Signal failures’ Less Staff interactions, it's replacing people

Experience at Train Station

‘Perfect’ - couldn’t really think of much more to be said though asking open ended variants of question

Opinions of Train operated by Computers

Very much for Computer Driven trains but feels that there needs to be reassurance of a Human able to take control if something was to go wrong.

Daniel Fowke

User 2	Positives	Negatives
	Computers Boats Trains Easiers to Travel (through online searching)	Progression of tech is too fast for the user and others to keep up, they felt left behind Loss of Jobs, Replacing ticket office staff at stations ‘We have to do it ourselves’ doesn’t like the fact that it's now down to the customers to do the work such as scanning at self checkouts.

Experience at Train Station

Good Experience with trains, happy to ask staff for help, feels that the ticket barriers would cause emergency situations to be slowed down.

Opinions of Train operated by Computers

Doesn’t agree with computer driven trains, thinks they feel more comfortable knowing that a person is doing it

User 3	Positives	Negatives
	Music Wireless technology	Feels left behind - ‘too old for it’ Not into relying on tech other than doing the managing of bills and daily tasks

Experience at Train Station

Very poor, train routes being canceled due to ‘Signal Failures’ and no one was able to help him replan his journey - less staff at station. Though a plus side is the system allows him to use a freedom pass to get around making it more convenient for him

Opinions of Train operated by Computers

For Computer Driven Train but does feel the concerns for it causing staff cuts and would still want a fair system that doesn’t cut out jobs or mean it replaces full times jobs with part time jobs or even just partial training for a job

Daniel Fowke

User 4 was a working staff member at Tottenham Hale Train Station

User 4	Positives	Negatives
	Great to get information anywhere anytime	Tech has made it worse Loss of Jobs ‘A range of people use to do everything, now it's one person’ - Overworked Addiction to tech Tech can make things complicated

Experience at Train Station

Being overworked makes it harder to deal with an upstream of situations at the same time, when the machine are broken he has to fix it, when the barriers have problems he has to fix it and when someone needs help they have to ask him, before these 3 roles were split among staff at the station but not it's all down to one or two people, the machines do break and are unreliable and just to maintain them is not an easy task. People can do these tasks better as there are ‘here for the customer’

Opinions of Train operated by Computers

For Computer driven trains as long as someone is there to monitor it, doesn’t like the possible loss of jobs and see that it would be good for a big business but bad for the minority of people

Summary

From what the responses gave was showing how that most feel left behind or as if it's now on them to do a job that once was done by someone working either at the station or at a checkout. It's makes them feel left behind and can makes it more complicated rather than simpler, this has made them feel abandoned from having to see another face help them scan their items and place them in bags to how having a computer tell them how to do it. Most of the people of older age see that it's lost the feeling of ‘for the people’ since there is not one for the people, just a computer. They feel insecure letting a computer solely take over and would still want a human to be able to watch out for if something was to go wrong. They feel that the loss of jobs is very important, even if new ones are being opened all to the fact that the middle ages and beyond are way behind to catching up to fill technology based roles.

Accessibility

Not everyone is made perfect, some are unable to perform average everyday tasks due to having a disability somethings that were covered in the developments of input and output technology were made for the main designs of support someone with a disability.

Disability comes up with the main two being Reduced Motor Skills and Reduced Visuals or Visually Impaired, this has lead to technology being developed in order to aid in such disabilities as well as others to target niches such as full deaf.

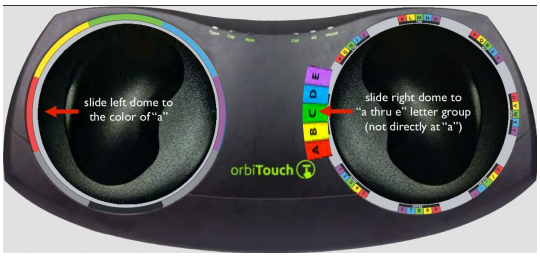
Hearing Impairments

Partial hearing impairments means they struggle to hear clearly, missing out on words when someone speaks. Solution to this are such things like [33] captions on a video, having what is being said be displayed at text so they can match the words with the mouth or the context of the video if they could not hear clearly.

Full Hear Impairments would mean they could not communicate by sound and the new way of communicating to them would be through sign language, fortunately through technology there is the already mentioned sign languages translator that can be attached to your arm, known as the Myo by Thalmic Labs, Technology such as this would replace the method of voice input with sign language input if a keyboard was not going to be used, but also this assistive tech can help them speak with the use of voice synthesis from a computer to speak to others around them

Motor Impairments

Motor Impairments can come in the results of mental disabilities, with something such as autism spectrum discord being an example that it connects to having motor impairments with it leads to technology being developed to allow people with such disabilities to be able to still interact and type to a computer in a way possible



[33] Source with CC turned on - https://www.youtube.com/watch?v=OJe7BUxpoXs

for them this technology would include the [34]Orbitouch, a device with two large joysticks to allow you to select letters to then enter to a computer.

Visual Impairments

A very common and when it comes down to visual impairments we are not in the aims for those with glasses for correcting their sight but those with no sight at all, blind. For this HCI has come through long reaches with the most helpful when it comes to computers being Speech Synthesis, being able to have a computer read out to you what is on the screen makes it easier for someone to be able to interact with the computer and understand what's there, to read something or to check something they may of typed is can be done through voice for someone who would be blind. With the modern era providing more and more hearing aids for those with poor hearing or cannot visually read speech synthesis has become a big help with the development of it shown above.

The other way a visual impaired person would be able to read and type to and from a computer is with braille and the latest in braille technology for computer, braille keyboard and screen have been something very common but only until now has it become ‘affordable’, Braille has been read from books or sheets of paper with specialised printing for Braille so most user of braille are use to reading off paper and such with their finger, so the [35]Braille Screen was designed like a kindle, a thin paper weight screen that can push up braille for visually impaired people to read

Design Principles

Designing an input device or a interface, a way of a user interacts with the system is all down to the purpose of the system and what would be needed from the user to input into the system.

System / Application

For some such as a video game, a user may not want a conventional everyday keyboard but one with the niche features, this would be something such as a more responsive keyboard or even a redesign of a keyboard into a gamepad, similar to a keyboard it's designed to have buttons placed to support single hand of key presses while the other can operate a mouse

[34] http://dev2.blueorb.me/wp-content/uploads/2014/12/orbitouch_overview1.png

[35] http://i.dailymail.co.uk/i/pix/2016/01/14/10/302874C700000578-3399018-Researchers_at_the_University_of_Michigan_are_developing_a_refre-a-23_1452769089773.jpg

Daniel Fowke

Shneiderman's Principles

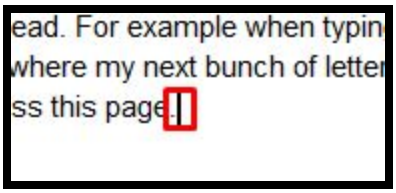
Strive for consistency

The strike for consistency refers to having the layout stay the same through the user interacting with the system, if the way you notify the user of something is through prompts then it should stay like that, having the window control button in the top right always and menu options in the top left running off a bar are all parts of this. This is very critical for a user getting comfortable and use to interacting with a system that they be new to, if it's the same all around then navigating to a new area of the interface will be easy for the user if the layout is consistent and all the common buttons and interactions are in the same place.

Enable frequent users to use shortcuts

Allowing users to use functions keys or a combination of keys can make the user experience just that much easier, mostly for the experienced users will shortcuts, functions keys and macro allow users to do simple to complex tasked in a reduced time due to less keys being pressed and less navigation on the interface but the keyboard

Offer informative feedback



For the user to know what they are doing is important, if they ever need to retrace their steps of show something to someone, they would want to know what it is they are currently highlighted on without having to keep it all in their head. For example when typing text like typing up this sentence, I as a user want to know where my next bunch of letters will be placed, and the is shown by the text cursor going across this page. So for other user that would be the same, and for something such as moving and selecting file, they would be highlighted to inform the user that they have actually selected said files / folders. All so they can clearly see what they are doing.

Design dialog to yield closure

Have it so the user can know what they have done, and not leave them in the dark. It's always about reassuring the user with this and by having a dialogue box to thank them for submitting a form or even feedback to even a proof of purchase are all ways of this, so the user has a record of what they've done or the fact that the system has acknowledged this. This is all for user reassurance.

Offer simple error handling

People don't like errors though they do come eventually no matter how many stops are in place, and in these cases do you need the simple of step-by-step guides for the user on how to fix such errors, ensure the problem can be easy and quick to fix. Something as simple as incorrect password and asking them to try again and check what they typed to a whole programme failure and the steps that they should take to fix it. If the system is high maintenance the system would not be beneficial to the user to even interact with

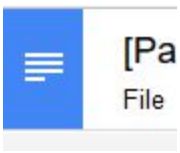
Permit easy reversal of actions

Users will do things that they may not want to, this is where they need a quick way of reverting back to a previous state or even that action the literally did 3 second ago that they didn't want to do is as much as this principle needs. But if the user has to redo an entire process to change something rather than just having it all go back in one click would put off the user when it comes to small mistakes that are bound to happen from anyone, this can also go under shortcuts.

Support internal locus of control

Users want full control, they want to be in charge of what they are doing and be able to do what they want knowing that. The system when interacted by the user should behave as expected and 'do what it says on the tin', so the user can get full control and premtively know what they are doing when using any system.

Reduce short-term memory load



Humans have a very limited attention span, and on average the human brain can only hold 5 items in their short term memory therefore it needs to be simple, it needs something that can just be understood by looking at it, **Recognition** vs Recall, recognizing that the close button is the 'X' while the minimize is the '_'. That the hamburger menu in google docs is the menu to access the rest of my google drive. I don't need to recall it by I can just look at it to recognize what it is since I've used it alot.

Recognition vs Recall

Recognition	**Recall**
Menu driven interfaces or something with a lot of user interaction through something like mouse input supports this, without having to	Recall is still very important for a user's interaction, the amount of accounts the user may have, we all do. Emails, Social Media,

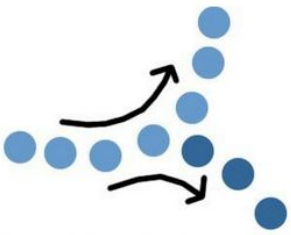
perfectly remember the placements, symbol and purpose of the buttons the use of recognition just mean to a user that it 'makes sense' that this action leads to this result and mean that the user can have their short term memory for something more important, recognizing terms as well as if using a word processor the user would need to format text would they highlight and right click the text to know recognise what it means by font size and the font styles.	Games, YouTube. It's everywhere and the most important thing to those is that for each account does the user need to recall their username and password, this isn't something to recognise, it's something that needs to stay in the user's head to remember at a later date, where the user may need to login again. Also to remember key words and commands is something that recall is needed for, if that be something for a programme or a keyword to search.
For something graphical, using icon and images rather than a lot of text and typed up user input is what recognition is for, easy to navigate just by looking. - In favour for GUI	Something that involves remembering important information and keywords is what this applies to, something where a lot of typing is required and need it very specifi - In favour for CLI

Gestalt Laws / Principles

Simularity

The idea of similarity is the idea that everything that someone would see can relate to one another, this can work create unity in something and for interactions this would mean having menus designs similar to others as this would already be understood by common users of an interface with a system. Something as simple as the layout of the keyboard is all involving similarity as in for different areas there are different keyboard layout but they stay the same across the given areas. Sometimes you would have something out of place, something not stay similar or the rest of a given design and this would be know as an [36]Anomaly in a design

Continuation



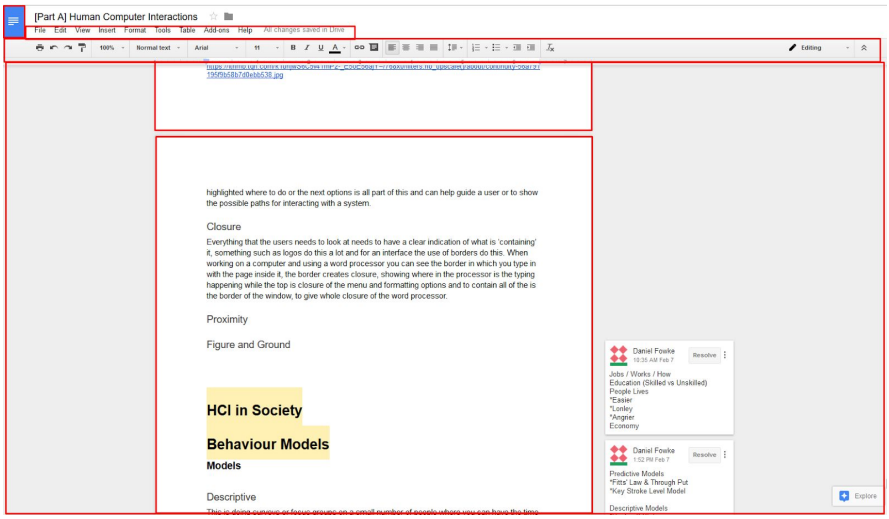
To lead the user onto something continuation is key in designs it would be a clear indication of something for the user to follow, this be a tutorial and showing the continuous steps or something that the system want the user to do, the user needs a clear and smooth [37]Path of where to go, something as basic as clear lines to being

[36] http://graphicdesign.spokanefalls.edu/tutorials/process/gestaltprinciples/similarity/images/anomaly01.gif

[37] https://fthmb.tqn.com/k1uhjwS6C5v41mP2-_E5oE56ajY=/768x0/filters:no_upscale()/about/continuity-56a791195f9b58b7d0ebb538.jpg

highlighted where to do or the next options is all part of this and can help guide a user or to show the possible paths for interacting with a system.

Closure



Everything that the users needs to look at needs to have a clear indication of what is ‘containing’ it, something such as logos do this a lot and for an interface the use of borders do this. When working on a computer and using a word processor you can see the border in which you type in with the page inside it, the border creates closure, showing where in the processor is the typing happening while the top is closure of the menu and formatting options and to contain all of the is the border of the window, to give whole closure of the word processor.

Proximity

For grouping objects, buttons and icons or for separating them is how close they are from one another. For Grouping something like menu options, the menu options are right next to one another, this shows the idea of grouping while if you are leading someone to two clearly different paths there would be something to separate these options or even as much as have them far apart, this is how you can display icons or something as one group and make it clear that they connect to one another in a way while if they are far apart, makes it clear that they are totally different things

HCI in Society

There are many opinions to how technology has changed Human-Computer interactions, with those who think it's made it better and other thinking that it's done everyone worse.

Computer system have been able to take the place of humans in various ways, from the example talking about oyster card machines have replaced someone who would originally be at the ticket office, for many people it provided a platform to talk to someone and see someone with a smile on their face but now touch screen machines are in their place and this would be the same for something such as self checkouts, for most they can find it quick and convenient

but it loses the for the people aspect where they could receive a smile from someone behind a cashier and bring up some small talk to make the experience more lively. These are things the computers cannot replace through Human Computer Interactions.

As for many, what was once the job of someone working behind the counter such as packing products bought into bags and scanning each individual item is now down the the customer / user instead. It really has played a 180* on many people making them feel like they need to do more work then making it any easier for them, as the Survey study results collected, it adds work to them rather than reducing it, making it harder not easier to complete a task of such.

The replacement of people with computers has taken a toll on jobs, many people are not needed as now it's just someone to be there for when it goes wrong, reducing labour, but for the times where if multiple problems with the computer replaced roles were to happen all the load is left on the one person and further from my survey and real life example is how staff at Train Stations are overworked having a roles once done by individual people left on the shoulders of two or even one single person. Making it harder not easier.

Though there has been a loss of Jobs for the roles that have been replaced by machines, more have opened up and mainly in the tech sector, the place that runs the systems that replace human with computer interactions, it's just for those who have lost their job, they are not necessarily in a position to where they can apply to some of the more tech savvy jobs as is where they are thrown out the loop, this has created it where people are angry that their job is replaced by a machine and now there is no other role for them to turn to, because it ends up going with, ‘if you can do it, so can a computer’

Technology for many people has lead to them being addicted, attached to their phone and social media, keeping in contact with the digital screen has made them lost into the digital world. This has lead to people cutting themselves off with the physical work and have made people isolated to them and their devices. Reducing the likelihood that going outside would be fun but rather the next video they find in their social media feed is better.

However the fact that more and more people get attached to their phone doesn’t mean that the amount of communication has been reduced, in fact it has increased it just may be the fact that more people decided to stay inside rather than go out. Social media isn’t killing one’s way of communicating from one person to another but has cause to reduce people’s confidence to speak physically and face to face
[38]Source

In terms of global economy, the rise in technology, smart-phone and other mobile devices as well as more and more technology that is being developed for human to interact with has

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38 http://uk.blastingnews.com/tech/2015/01/is-social-media-killing-our-communication-skills-00244897.html

caused a huge positive impact for many countries that are developing as well as most top economy countries, to support the claim, - “Korea has a solid industrial structure, which captures technological innovation, newer business models, and sound fiscal conditions, which enables the Korean government to develop a higher number of policy options for the economy and the various markets. “ - ***Hong-Rae Cho, CEO of Korea Investment Management***
In areas such as Asia has tech companies made major investments and see very long term values from having technology developments rise as Jobs rise all around the world to develop, more skills are needed to make sure that each company has an edge in their market.

Behaviour Models

Behaviour models is used to determine how a specific interface will do things or how a user will feel when they are using specific interfaces.

Predictive Model

Keystroke Level Model (KLM)

This uses the measurements from 5 stages to predict the time it takes for a user to complete a given task, obviously knowing if it's too long that it is poor for Human Computer Interactions.

This breaks down how the user will;

- Carry out a task or operation through keyboard and mouse movement
- The thinking process of the how they would complete the task or operation
- Time the system needs to allow the user to complete the task or operation

The steps are

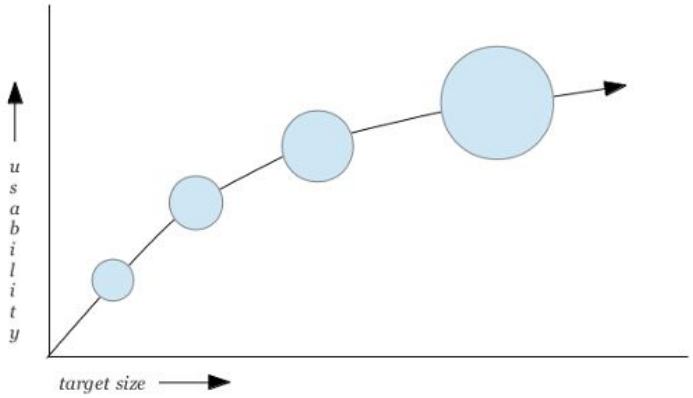
1. Number of Keys Pressed
2. Mouse movement, based on the distance from the target and the size of the target
3. Movement between two devices such as mouse and keyboard
4. Drawing or other movement necessary by the user
5. Thinking time by the user, how long until they know their next step in the task in order to complete it.

Calculating all of that can give you a prediction of your average user and how long it would take them to complete a task or operation through keyboard and mouse. Knowing that if it's too high improvements are needed.

Throughput

Throughput by definition is “the amount of material or items passing through a system or process.”, for a computer system it's the time the system needs when the user interacts with it to respond to the user. This can be used to determine the speed for the computer, knowing if it is the system that's slowing down the user and if the computer requires upgrades to complete said tasks. As a computer gets old it would be suggested that so would response times and therefore meaning that over time upgrades will be needed, this may be due to more software demanding higher performance and if the problems are not fixed with a working solution response time would constantly be rising

Fitts Law



[39]Fitts law is the measurement of the size of a target or button in most a cases and it's distance to then calculate the usability and time it needed to reach the target / button.

As the two factors the correlations are:

- The shorter the distance from origin to target the quicker and more usable the button would be
- The large the target the easier it is to land the cursor on target / button.

From this information you are lead to know the optimal placement of buttons knowing how big and a button should be for a user to be able to reach it and interact with it

Descriptive Models

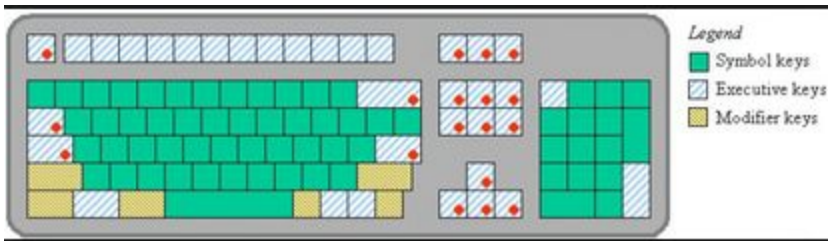
Used to help understand how a user works with HCI and getting key information how they use a certain system or interface and what they would expect from nicher systems.

Key-Action model

Keyboard have many keys and these keys can be separated into categories; symbol keys, executive keys, and modifier keys.

[39] https://www.smashingmagazine.com/wp-content/uploads/2012/11/Non-linear-progression-low-res.jpg

Symbol keys deliver graphic symbols typically, letters, numbers, or punctuation symbols to an application such as a text editor or word processor
Executive Keys tend to carry out specific actions for example the ENTER key or F1 or even multimedia control keys that are found on laptop and more modern keyboard such as volume controls and play/pause.
Modifier keys don't generate the symbols or invoke actions but instead set up a condition that is necessary to modify the effect of a key. Such as Shift key (Modifier) and a Letter (Symbol Key) will type a capital letter on the screen of the letter that was pressed.



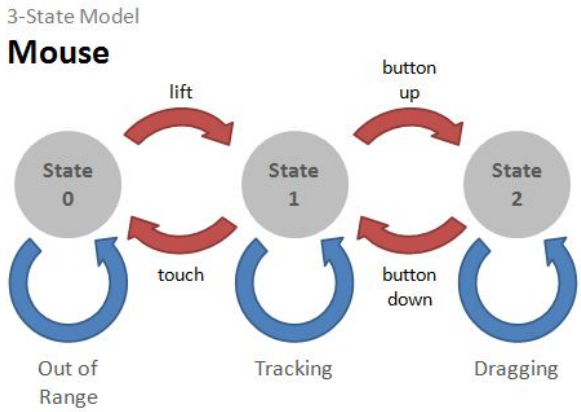
[40]Keyboard labeled with the 3 Categories

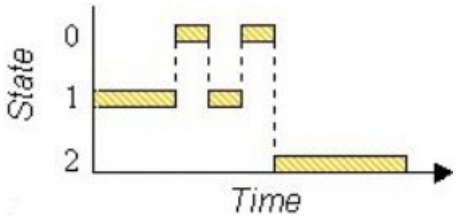
Buxton's Three State Model

This is a way of measuring the ease of use to complete tasks / operations using a mouse as the input and the amount of thinking and effort the users will need to put into the task. Measuring the Speed and ease of the task completion

[41]The Model's three states are;

1. Out of Range - Used for moving the mouse without any action being caused from the mouse being moved
2. Tracking - Following the mouse and acknowledging it position and movements across the screen, for such things
3. Dragging - Time for dragging or moving an object or entity across the screen or to select multiple items for grouping





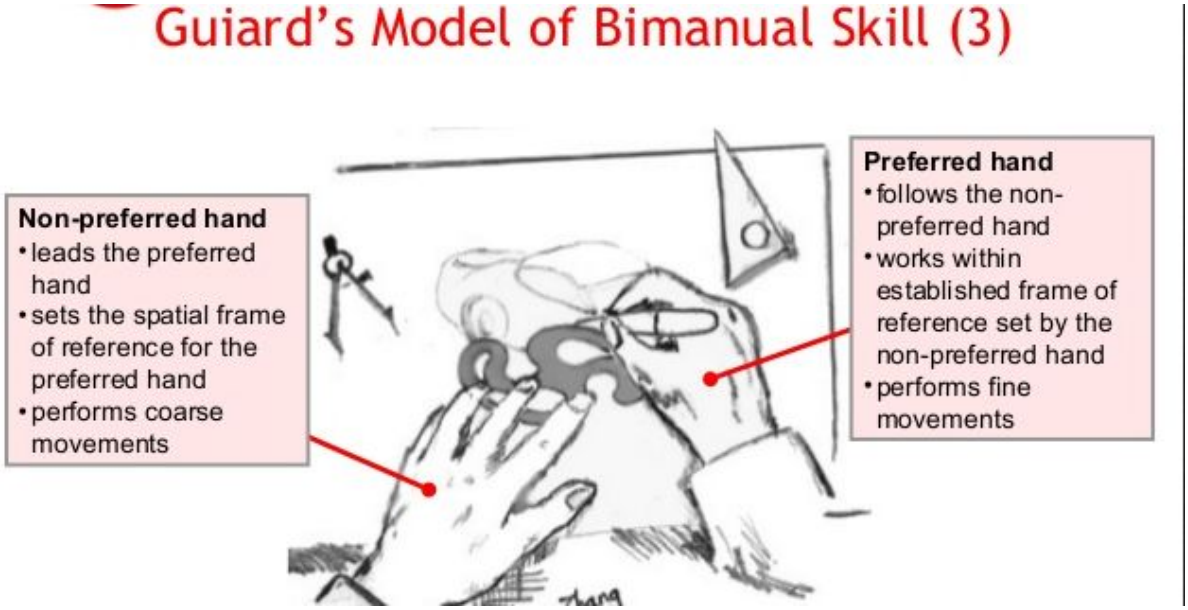
This model is used to calculate the [42]Time of completing actions with the mouse, this doesn't include the thinking time of the user or the presumption of any disabilities

[40] http://www.yorku.ca/mack/mackenzie_chapter-f12.gif
[41] http://stackedui.com/wp-content/uploads/2010/03/3-state-model-mouse.gif
[42] http://www.yorku.ca/mack/mackenzie_chapter-f2b.gif

Guiard's Model

Each hand for a user is used to do certain tasks separate from one another, with each user having a dominant and non-dominant hand, guiard's model is used to understand the role of each hand and the time it takes to do those roles.

These roles can be identified as [43]



The non-dominant hand (non-preferred hand) sets the role of guiding the dominant hand (preferred hand) to it's task, the non-dominant hand has the active role of always leading the dominant which does the 'heavy work' and for HCI on a keyboard it would lead to the design of some keyboards being designed with the left hand being the navigator, for using a mouse, the dominant hand does it, as it's the one tasked with doing the precision task, moving the cursor over buttons and drawing.

43

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