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# A historical overview of tablet computing, GUIs and hypertext.

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**Abstract**

In this paper we will present an historical overview of tablet computing, graphical user interfaces (GUI) and hypertext regarding all its modifications within 50 years of development. The goal of this paper is to show the important progression and also to compare different aspects. Therefore we classified all developments into three main timetables within the 20<sup>th</sup> century, starting from the 1940 to 1980, afterward continuing from the 1980 till 1990 and finalizing with the late 20<sup>th</sup> - and the beginning of the 21<sup>st</sup> century.

**Keywords**

GUI, hypertext, tablet computing, history, overview, WIMP

**ACM Classification Keywords**

H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

**General Terms**

GUI, hypertext, tablet computing, history, overview, WIMP

## **Introduction**

Our understanding of using the modern computer devices has evolved some major “breakpoints” through history of the 20<sup>th</sup> century. How we use and interact today with computers, mobile-phones, tablet computers and so on is the result of nearly 50 years of development and improvement. Whereas in the beginning the human was like an operator, - a person who interacted with the computer within a various of non standard ways -, in the proximate decades he or she got more and more in touch with a suitable and standardized interface, that helped to control and operate the devices in comfortable ways. In order to show how this development has been evolved we will present you in the following chapters the main development of human interfaces where the focus lays at hypertext, graphical user interfaces (GUI) and tablet computing. The following chapters will be presented in time tables, containing different periods of time and technologies. The beginning marks the time between 1940 and 1980, in which the main aspects of hypertext, the early GUI and tablet computing development will be presented. Following this, the next chapter marks the standards within the GUIs and tablet computing during the 1980 and 1990 and also will show how the involvement of Apple, Microsoft and Palm have taken a big influence to the technology used in that time period. The last chapter takes a look into the development of the late 20<sup>th</sup> and beginning of the 21<sup>st</sup> century, where Windows Operating System (OS), Mac OS X and Tablet PCs become important technologies.

## **1940 – 1980: The Beginning**

This chapter will present the leading technologies and inventions of the given time period. Before GUI and tablet computing devices have arisen, there had been introduced one important concept. It is called “Hypertext”.

### ***Definition of Hypertext***

Nowadays most of the people understand this as synonym either for hypertext markup language (html) or hypertext transfer protocol (http). But the term itself is more than just a acronym and has a lot different definitions. One of the most popular description can be used as followed: Hypertext is a text displayed on a computer or other electronic device with references (hyperlinks) to other text that the reader can immediately access [1]. Along with the definition of hypertext, there are also four specific characteristics [2] which can be described as following:

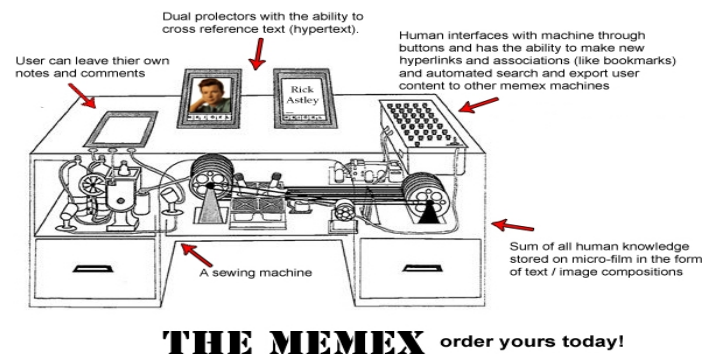
- Non linear.
- Synesthesia/multimedia aspect.
- Operational/virtual aspect.
- Interactivity aspect.

So far hypertext can be seen as something which is not read like a book or like this paper which means that it cannot be perused from the first to the last chapter. It is not linear and therefore more like a lexicon in which you are free to jump from specific point to various other points. Another important fact of hypertext is related to multimedia. This means that it can be combined additionally to simple text also with picture, audio and picture animation. Furthermore, one aspect describes that hypertext is not limited to a specific

amount or time like the print runs of newspapers and also that hypertext can be extended within nearly infinite amount whereas newspapers have physical constraint. Last but not least since the days of WEB 2.0 the user is more and more included to update or alter processing of hypertext media.

### ***Memex, the memory extender***

In his paper "As we may think" (1945) [3] Vannemar Bush introduced the concept to a machine called memex. He described there memex as machine in which an user stores all his books, records, communications and so on. One important aspect of this machine which already performed a early concept of hypertext is that each content has to be linked together, so that the user is able to jump from one position to another and feels free to edit or update the select content. Figure 1 shows an image how such a memex would have looked like in reality. Bush had the idea of using a desk where translucent screens are



**figure 1.** A schema of how the memex might have looked like.

placed for reading the selected content. There is also a keyboard, buttons and levers which are used for interacting with the system, e.g. write a comment to a picture and link it to this picture. Also there is transparent platen at the desk which is like scanner that is making photos of the content that is placed there. And in its inner life, the memex stores every content in microfilms. Although this was just a concept which was never really implemented the obtained findings helped to develop the fundamental ideas of GUIs and hypertext.

### ***Nilson & Lee: HES & Enquire (Hypercard)***

After the concepts of memex it took until the year 1965, where finally the term hypertext was introduced by Ted Nilson [4]. He also began two years later with the work on the Hypertext Editing System (HES) [5]. The goal of this system was to organize given data into two main types of text: links and branching text. It allowed already hyper linking within the texts but the main focus laid at structured document printing, since it was used for documentation purpose for the Apollo space program of the NASA.

Also one important pioneer in designing hypertext system is a well known person in the world of our internet, Tim Berners Lee. In 1980 he invented the enquire [6] system, a simple hypertext program. This program was used to write down all the relations and dependencies between people, programs, project, hardware of CERN and so on. Lee described that the program worked like a card index with links between the card. For example the links could have had the meaning "A" is part of "B", "A" made "C" and so on. This system allowed the users to trace through such implications and get feedback before to him or her whether he or she does an update, change or delete.

Another approach in the hypertext programming had been released in 1987 by apple, called hypercards [7]. This program was similar to enquire, by using so called cards that hold data. But additionally to enquire the data in such cards was not limited to text and could also contain pictures, links to other cards, buttons, pop up windows and so. For organization purpose the cards were organized in stacks.

So far this was the overview of the hypertext history, even though there would have been much more to show up. The next sub-chapters will continue with the focus on early GUIs and tablet computing devices.

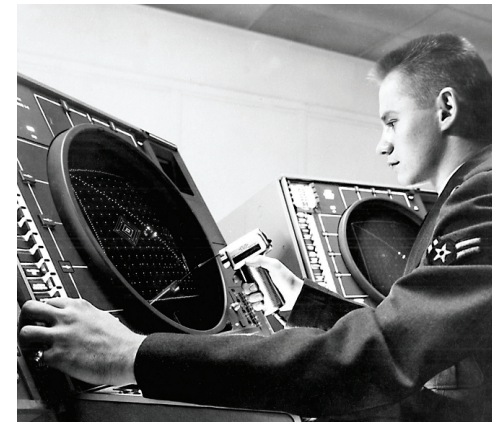
### ***Definition of GUI***

According to wikipedia.org<sup>1</sup> the definition to GUI is defined as a type of user interface that allows users to interact with electronic devices with images rather than text commands. So far, a *GUI* represents the information and actions available to a user through graphical icons and visual indicators such as secondary notation, as opposed to text-based interfaces, typed command labels or text navigation. This group is also called GUI structural elements. The actions are usually performed through direct manipulation of the graphical elements by mouse, cursors and so, which more or less represent the GUI interaction elements.

### ***Project Semi Automatic Ground Environment***

At the beginning of the cold war in the 1950s the North American Aerospace Defense Command (NORAD) started the SAGE Project [8], a computer aided air defense system. The goal was to find and track enemy bombers and perform counteractive measures. Therefore a lot of AN/FSQ-7 computer systems were

used for command and control functions for the SAGE. The collected radar information was displayed in up to 150 operational terminals, that were handled by human operators. As it can be seen in figure 2 these terminals had a build on radar display that represented a specific geographic area. Buttons and switches helped the human operator to interact with the system by getting more specific information about an interesting object displayed on the radar. Furthermore the human operators were able to select an interesting object with a light gun that was used for displaying the object on a central summary board for emergency and tracking purpose. Although the system was not only for tracking purpose, it was also used for executing commands. In the early version, the human operator gave the necessary interception commands which was then automatically be sent via teletype to local controllers who would take control. In later version the system was also able to automatically direct and command interception to aircraft 's autopilot system.



**figure 2.** A SAGE operational terminal executed by an human operator who is using a light gun.

<sup>1</sup> See <http://en.wikipedia.org/wiki/GUI>

One major novelty of the SAGE system was the fact, that the human operators were simple soldiers with no specific technical background and so that the system had to be designed for the usability of this target group.

### ***oN-Line System (NLS)***

In 1962 Douglas Engelbert presented a framework of the so called NLS system [9]. This system helped to support the creation of "online" content such as digital libraries and storage. And of course the system managed also the retrieval of electronic documents using hypertext links, mainly used for offering cross-reference of research papers for sharing among remote-distance researchers. Furthermore the system introduced also the usage of the computer mouse, raster scan video monitors, video-conferencing, document version control system and much more



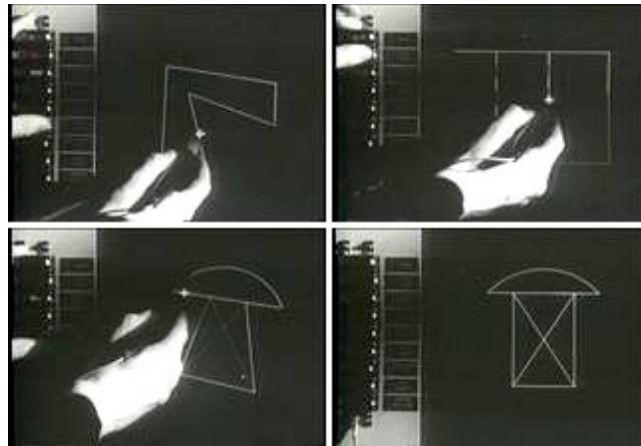
**figure 3.** Showing the raster scan video screen and keyboard in the middle, the chord-keyboard left and the mouse right.

things that are influenced the modern usage of computer interaction. Figure 3 shows how the NLS system looked like and demonstrates the similarity of this "old" system to the one we use today.

### ***Sketchpad***

The Sketchpad System was invented by Ivan Sutherland, an American computer scientist and Internet pioneer. For the invention of Sketchpad he received later in 1988 the Turing Award. The Sketchpad can be named as an early forerunner of a modern Graphical User Interfaces as we know it nowadays from Computers, Tablets and Smart phones. Sketchpad tried to influence alternative forms of interaction between humans and computers. The main goal or target of Sutherland's work [10] was to make the communication with the System easier in the way, that the speed of the communication gets enhanced. Sketchpad's input was not done via text-based statements, it was done via drawing lines and creating geometrical figures. The input was primarily done with the so called Light-Pen. Additional input and special control commands like "center" or "draw" were done over special command buttons. Figure 4 shows the basic operation of drawing lines and stick them together to figures. Sketchpad ran on the Lincoln TX-2 Computer[11], which was one of the first Computers at this time using transistors instead of vacuum tubes. Another special feature of the TX-2 was interactive use of this Computer. This means not to submit a task to the Machine and wait for the result of the calculation, as it was the traditional way to use Computers at that time. This means that the TX-2 was reacting directly on input. For I/O Communication responsibilities the TX-2 offered a Light-Pen for input and a 7" Vector display with a resolution of 1024x1024 pixels. A Light-Pen is a light-sensitive computer input

device, which allows direct pointing on a CRT Screen. The first Light-Pen was introduced by the Whirlwind project on the MIT around 1952[12]. With regard to the usage of the Light-Pen on the Sketchpad application, one can say the Sketchpad was also a predecessor of nowadays CAD Systems.



**figure 4.** Using the Light-Pen on Sketchpad to create a figure.

### ***Rand Tablet***

The Rand Tablet, was a graphical computer input device developed by the RAND Corporation. RAND Corporation was founded after World War two in the US for advisory and guidance of the US Armed forces. In 1948 the RAND Project changed into a non profit organization, since then the RAND Corporation did not only work for the US Army but also for economic Institutions. The Rand Tablet was developed in 1963, and it can be named as the first two-dimensional Input device which was digital. Furthermore it was a very cheap device for such a purpose at that Time. The Rand Tablet had a size of 10"x10" an could address  $10^6$  positions on the

control area, which consisted of a matrix of crossed conductors. The circuitry of the tablet used switching techniques to apply pulses to the conductors in sequence, thus coding their individual locations. When a stylus was touched to the surface of the tablet, it picked up pulses capacitive from the closest of the horizontal and vertical conductors which was converted into an (x,y) coordinate value. [13]

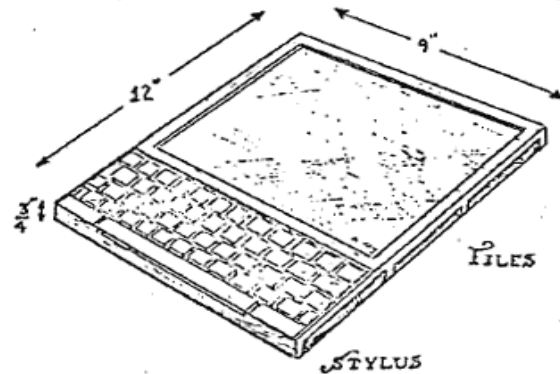


**figure 5.** The Rand Tablet.

### ***Dynabook***

The Dynabook was a conceptual Computer system which was introduced by Alan Kay at the Xerox PARC in the late 1960s and early 1970s. The first idea was created in 1968. The Dynabook described a device which has a powerful but affordable Hardware, combined with a graphical Interface with a great usability. The target user-group were children, as described in the work of Alan Kay.[14] A lot of Ideas concerning the usability of the Dynabook and usage by children of all ages, were discussed with educators. The

look of the Dynabook concept reminds strongly towards modern Tablets as for example the Apple iPad. A mockup of the Dynabook is shown in figure 6.



**figure 6.** Mockup of the Dynabook concept.

As the Mockup shows the Dynabook consists of a Hardware keyboard and a screen. The inputs and the interaction with the device was considered not to be done via the keyboard only. Furthermore the sensorimotor skills of the users should be concerned, as it is used nowadays already in Tablets and Smart phones. After the work by Alan Kay, his understanding of human computer interaction was that the computer has to fit one hundred percent to the skills and needs of the humans. He concluded that the Dynabook will not only be controlled and used the symbolic way. The Screen should be directly integrated in the device and a graphical user interface was planned. The size was estimated 12"x9"x0,75", which is not much larger than a conventional paper based notepad. The Price should be in a range around 500,- USD, so that a much wider range of potential users would be able to afford the

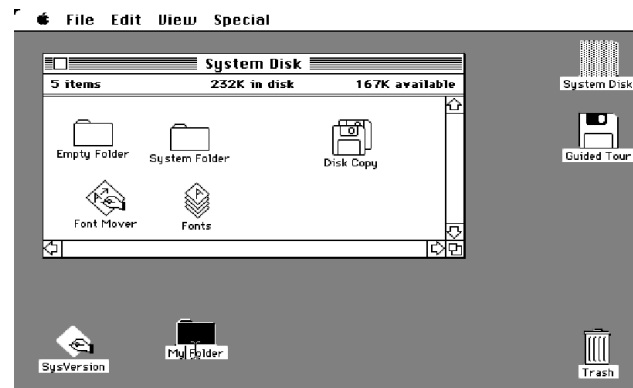
Dynabook. The Dynabook was it's decade far ahead, due to the fact that the hardware as it was desired was not until now available.

### **1980 – 1990: The new Standard**

After the high point of the cold war leading to high technology development which had a big influence human computer interaction, several companies started competing for the upcoming costumers. The following sub-chapters will present those precarious times in which consequences two companies emerged victorious: *Microsoft and Apple*.

### **Apple & Digital Research: Mac Os Classic vs GEM**

With the year 1984 apple came up with its third OS version, called Mac OS or System (later classified as "Mac OS Classic") [15]. The major purpose of Apple was to create a user friendly operating system. As a result the Mac OS Classic had no command line interface but was operated only through GUI elements with keyboard and mouse. The system also introduced the so called "desktop metaphor", a graphical representation of the operating system which used typical icons of bureau working places and window managers of those icons. In figure 7 the default file manager called finder can be seen which is still nowadays in use. One major impact for which Apple came in at this time had been the invention of the Styleguides. Those Styleguides were defined for the programmers, in order to follow specific standards and rules while programming a software so that the user interaction was within a predefined norm.



**figure 7.** Showing the “finder” file manager and also giving a picture of the icon desktop metaphor.

Another similar approach of GUI was designed 1985 by the company Digital Research. The so called Graphical Environment Manager (GEM) [16]. Due to the similarity of the Mac OS, Digital Research was charged by Apple and as result the GEM had to have a reduced functionality and also had to remove several functions of its file managers, like overlapping windows and the trash bin icon.

### **Microsoft: Dos, Windows 1/2**

Jumping back from the year of sub-chapter before to the year 1981 leads to one of the most famous non GUI OS referred as QDOS [17] (also named 86DOS or just simple DOS). Although DOS was a command line driven OS, resulting that the user had to enter different commands as a text form in order to interact with the computer. Any GUI specific item like buttons, icons and so on was missing, but due to the application program interface of the early DOS and the hardware of the IBM Personal Computer, it was able to run GUI-based programs like the well known file manager DOS-Shell

which was capable of controlling the file content with the mouse. After four years of success with the DOS operating system, Microsoft introduced then the successor Windows 1 [18]. Though it was just an GUI update to the DOS OS it used a kind of DOS-Shell file manager in that the user navigated around and was able to start different programs and also allowed to perform copy, edit or delete operations with files without the need of knowing DOS specific commands. Despite this operating system and also its successor Windows 2.x [18] which was more or the less another update to DOS, both did not become very successful. Another interesting fact was that Apple started a charge against Microsoft, because of the usage of a GUI. But this time and after four years of judicial proceedings Apple’s claim were denied, due to the fact that Apple was not allowed to get a patent protection for a GUI.

Of course at this precarious times there had been a lot of invention of other GUIs, for example the Amiga workbench, the GeOS, the X-Window System and so on, but their impact and their importance for the upcoming years were very few and except for the X-Window System, none of them persisted until the end of this decade.

### **Pen Computing**

In the 1980s the understanding in the field of Tablet-computing changed. The new term which was used to describe or name computer systems of that type was Pen-computing. This name comes with using a pen or stylus as an input device for tablets. Historically Pen-computing was established much earlier then in the 1980s if we think on the RAND Tablet or also the Sketchpad, which were used on a comparable way. Pen-



computing is also used till today describe the interaction and communication users and interfaces of modern mobile devices such as PDA's, GPS receivers and wireless tablet computers.[19] The general techniques of pen-computing could be addressed as handwriting and gesture recognition.

### ***Pencept - Penpad***

The Pencept Penpad was one of the first examples for a pen-computing device in the 1980s. Pencept was one of a small number of pioneering companies developing devices and technologies known as pen-computing nowadays. This had happened and started earlier before the the market entry of companies like Microsoft and Go Corporation. Pencept was also the leader in developing handwriting and gesture recognition algorithms that might have worked with already available hardware at that time beginning in 1980. This was done through the creation of a proprietary technology for on-line character recognition, based on the way human-reading is done. This algorithm needed no training for the individual users writing style. The PenPad200 was the first handwriting-only computer and figured the innovation which was driven by the algorithms of Pencept. Later versions of the PenPad were based on DOS and focused mainly on graphical and CAD applications. The Products and ideas of Pencepts PenPad focuses directly the meaning and understanding on Tablet-computing as Pen-computing in the 1980s.

### ***Grid Pad***

The Grid Pad was released in 1989 and it can be addressed in computers history as the first so called "Pad" device according to our current understanding.



**Figure 8.** The Grid Pad.

The Grid Pad was a portable device with a 10 inch display which had 32 gray scales. The weight of 5 lbs was at that time the big deal of the Grid's new innovative device. It ran on a quite powerful hardware which was used also in desktop computers this time. A 386SL with a frequency of 20 MHz was the processor in use with a 80387SX coprocessor and 20MB RAM. The available hard drives had sizes from 40, 60, 80 to 120 Megabytes. It had a built in PCMCIA card slot, an internal fax/modem card, a floppy drive port and a standard keyboard port. The Operating time was limited to 3 hours on Ni Cad battery pack. Furthermore the operating system, the Grid OS, based on another milestone in computer history – MS DOS. Grid is today specialized in developing of computer based defense systems. While the development of Grid Pad, the ideas of inventory management played a major role. One reason was to avoid for example the mass of papers and written documentations while the maintenance of tanks or planes, were already mentioned in the work of

Alan Kay the Dynabook[14]. The Grid Pad was used at Chrysler for inventory management in the fabrication process and also in the Army.

### ***PDA***

Electronic Organizers, for example the Psion Series started in 1984[20], were inspired from simple electronic calculators. The main disadvantage of electronic organizers like the Psion Series was its Hardware keyboard regarding the size of the normal keyboard. Much more developed organizers may have a touchscreen, which can be used by fingers or a pen. Out of this evolution a new device category was established, the PDA. The Personal Digital Assistant is defined as a portable computer, used mainly for calendaring, e-mailing and address- and task management. Furthermore most of those PDA's have also the capacities to deal with office files like spreadsheets or text documents. The term PDA can be found at the beginning of the 1990's when Apple released the first version of the Newton Message Pad. Since then the PDA got to be a synonym for a portable computers. Nowadays the PDA's were fully replaced by Smart phones which are covering now all the functions a PDA provided. This features and functions in combination with a 3G connection and Internet access are the main success reasons on the growth of the Smart phone market.

### **Tablet Computing in the 1990s**

In the following paragraphs to major representatives of the last decade and its device category are presented. The Apple Newton Message Pad and the Palm. Other devices, with less success then them, but also to be mentioned in that case, are the Amstrad Penpad and the EO880 from AT&T.

#### ***Apple Newton***

The Apple Newton Message Pad[21], shortly Newton, was released for the first time in 1993 and part of Apples product portfolio till the restructuring of the group in 1998. The name Newton is originally used for the operating System Newton OS, while the devices were called Message Pad. The great benefit of the Newton was its learn-able handwriting recognition. Through the Touchscreen of the Newton Message Pad, the operating System was able to detect words and characters directly from a handwritten input. The first version of Calligrapher, the responsible software piece for handwriting recognition in Newton OS, was developed by Paragraph International. This software caused performance problems in the first versions of the Newton Message Pad, especially because of a lack of processor performance. In 1996 the Newton OS 2.0 was launched with the new handwriting recognition software Rosetta, developed by Apple itself, on a more powerful Hardware, called the Message Pad 2000 which can be seen in Figure 9. With this version the performance issues were solved and the text recognizer was improved so that it was now possible to recognize printed text.

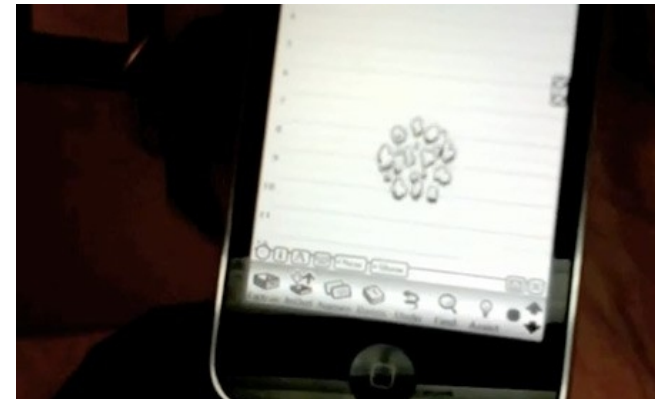


**figure 9.** The Newton Message Pad 2000.

The Newton Message Pad and its Newton OS created some pioneering new features, as for example the so called "soups", which are program - independent databases that can be used simultaneously by different programs for example calendaring, task management and E-Mails. This concept was reused in Mac OS X. Further the handwriting recognition itself can be seen as a pioneering function of the Newton.

In 1998 the Newton was skipped from Apple's product portfolio after selling more than 300,000 devices due to the fact that the new Apple CEO Steve Jobs, decided to focus on the development of the Macintosh computers. Till today there is a supporting community of the Newton and furthermore there is an emulator available

for jailbroken iOS to boot the Newton OS on iPad or iPhone as shown in figure 10.



**figure 10.** Newton OS running on iPhone 3G.

### **Palm**

The second big player in the History of the PDA is Palm. Palm announced just a short time after Apples first release of the Newton, its own first product the Zoomer[22]. The Zoomer had no commercial success on the new established market of Personal Digital Assistant's and so Palm got into financial troubles. In 1996 Palm was overtaken by US Robotics and released the Pilot on the market. To the end of 1996 Palm sold more than 350,000 pieces of the Pilot, seen in Figure 11. This initial success has led Palm and the Palm Pilot to a synonym for PDA that time. The Pilot is same as the Newton from Apple, a Touchscreen-only device controlled via a pen. Like its Apple pendant Palm also developed an special operating system – the Palm OS. In 2009 Palm released the Palm Pre due to the evolution of smart phones on the market. The Palm Pre and its software based webOS were not competitive enough to the newly established smart phones

Android, iOS and Blackberry basis, which caused again financial troubles. In 2010 the shattered Palm company got overtaken by Hewlett Packard. HP announced to sell a Tablet PC in 2011 based on the webOS.



**figure 11.** The Palm Pilot from 1996.

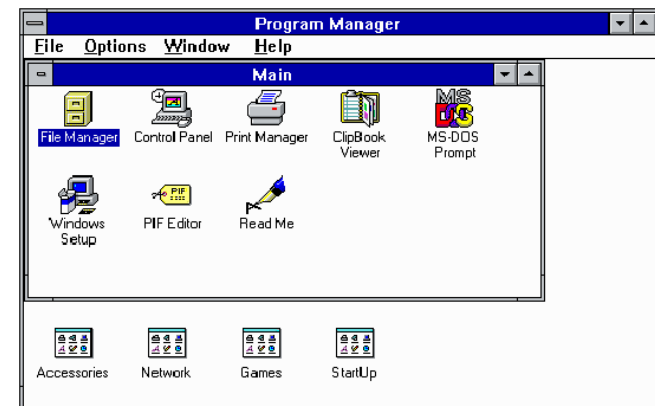
### GUI since 1990: The Alterations

The last chapter discusses the ongoing triumphal procession of Microsoft Windows and shows also the comeback of Apple's Mac OS after several years of stagnation. Furthermore a view into the future of human computer interaction will be showed by 3D file

managers. Also the current state and future of tablet computing will be presented.

### **Microsoft: Windows 3.x,95,98,....**

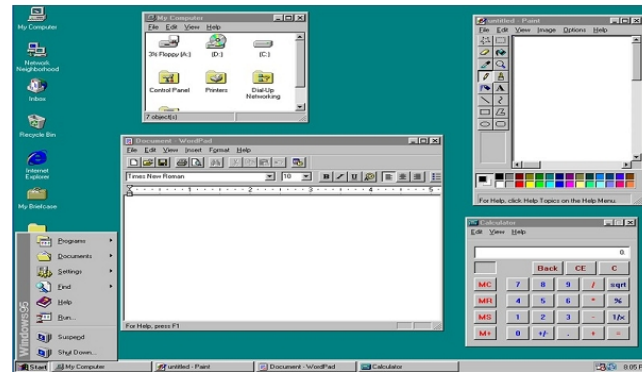
The 1990 started with the fresh released version of Windows 3 [18], Microsoft's third GUI version of a OS which became very successful. With its capabilities of using the VGA's 16 color mode, the OS also marked the beginning for a redesigned GUI with more colorized icons and also the usage of a more precise desktop metaphor similar to Apple's Mac OS. One central unit for human interaction was the so called Program Manager that can be seen in figure 12. It was the representation of a task oriented GUI shell using icons as shortcuts for programs and arranging them into



**figure 12.** A typical image of the windows 3.11 program manager with arranged groups of icons.

separated program groups. After the success of the Windows 3 series, Microsoft came in 1995 up with one of its most successful operating system, Windows 95 [23]. Also like the change from Windows 1/2 to Windows 3, the major impact came along with the GUI.

The Program Manager from Windows 3 found now its way into a selection Menu with categorization for the preferred user action. This menu which can be seen in figure 13 was entered through the task-bar, a new GUI element that was used for launching, switching and



**figure 13.** The Windows 95 GUI is shown with open programs that have a reference of their instances in the task-bar. Also the open selection menu can be seen which is marked through the start button.

monitor all kinds of programs. Within the next 10 years several different new versions of Windows were released by Microsoft, better known as Windows 98/2000/NT/ME/XP/... [24]. Although they featured new functions their impact was more due to hardware aspects but less importance for the GUI and the human computer interaction. Not until Windows Vista which was released in January 2007, the GUI and the interaction got new concepts. Also two years later in the year 2009, Windows 7 came up with several new concepts. One of this changes had been done by introducing a new kind of user interface called Aero [25] (Authentic, Energetic, Reflective, Open) that was also part of Windows Vista. The major aspect of Aero is

to be a more touch friendly user interface by introducing special effects. For example the Aero Peek that allows a preview window of a selected program in order to organize the windowing of the desktop. The Aero Shake that can be done by shacking a selected window replaced the icon that was used in previous Windows Versions for switching immediately to the Desktop by reducing all open programs to the task-bar. Another new feature is the usage of Thumbnails which



**figure 14.** Gives a preview of the Aero Thumbnails which are used for preview effect.

is shown in figure 14. This effect allows the user to see small preview of an open program in the task-bar, so that the user can decide whether he or she needs to pay attention to the program. Last but not least Windows Vista and 7 also allow 3 dimensional interaction and organization of different programs within the desktop, named as Flip 3D.

### **Apple: Mac OS X**

After Microsoft had released Windows 3 in the year 1990, Apple's stagnation began. Although the Mac OS Classic was a very user friendly operating system, it lacked because of severe software errors and failures. Over the years Apple was able to handle and deal with those problems, but was not able to stop the success of



Windows. New inventions had been rare. But with the overtake of the company NeXT [26] Apple was able to use the NeXTStep, a UNIX based operating system. By alterations and modifications this OS was the predecessor of the modern MAC OS X System that was released in the year 2001. Besides the usage of the standard GUI features and paradigms, the major impact to the Mac OS X 10.0 GUI was the so called DOCK [27]. This feature was similar to the Windows task-bar that contained icon links to different programs. Although the DOCK had a limited size, it only contained the user's favorite programs and allowed also quick switching between beforehand open programs. Similar to Microsoft's Windows modifications and alterations the later versions of the Mac OS X operating system contained major impacts for the hardware. Anyway with the 10.4 Version called "Tiger" Apple introduced a new



**figure 15.** Shows an activated Dashboard with a lot of mini applications called widgets.

GUI feature, named as Dashboard [28] that can be seen in figure 15. This function is a semi transparent layer, which is at the beginning invisible for the user but can be activated within the DOCK. When activated the Dashboard provides access to so called widgets<sup>2</sup>. A widget is small and easy usable mini application that provides limited functions to the user, for example allowing to write down simple notes, retrieving business information about stocks, weather forecast and so on.

## Tablets today

The first recognition on the term "Tablet PC" was used by Microsoft defining it's Tablet PC standard in 2001[29]. This standard was not much more as a type of Hardware recommendation to their new version of Windows the Windows Tablet PC edition. As defined by Microsoft their initial understanding of Tablet-computing was the usage per writing on the screen. An usage simply with the fingers was not considered in this first concept, because of the missing ability of touchscreens to distinguish between fingers and pens. This followed in 2005 by adding the finger usage on touchscreens to the specifications. As already mentioned the specifications of Microsoft only characterizes the Hardware on which the Tablet Edition of Windows must be sold.

Nowadays the concepts of Tablet-computing can be divided into categories[30]. The convertible which has the form of a conventional Laptop with the difference that the screen can be turned around and flipped over the keypad to use it as an notepad with a pen. Then there is the slate category. This is the Tablet PC category which is the most famous today because of its representative the iPad. The Slate has no hardware

<sup>2</sup> See [http://en.wikipedia.org/wiki/Widget\\_engine](http://en.wikipedia.org/wiki/Widget_engine)

keypad at all and is only controllable via the touchscreen. One more type of Tablet PC is the hybrid one, which is a mixture of a convertible and a slate. This means that the screen of the convertible is removable and can be used as a standalone slate Tablet. Finally there is the category of Ultra Mobile PC which is a fully portable type of computer. UMPC's could be categorized devices such as Multimedia devices, Navigation Systems in cars, MP3 jukeboxes and so on.

Finally one must separate between a Tablet PC and a Tablet Computer. The Tablet Computer is a device category founded by the release of Apples iPad, which is mainly user for media consumption in contrast to Tablet PC's.



**Figure 16.** The Apple iPad a slate tablet with an embedded operating system. The iPad has led to the separation between Tablet PC and Tablet Computer.

## Future aspects of GUI

A lot of the future aspect of the GUI is used already nowadays. One of them is the 3 dimensional interaction within the desktop. As presented in the chapter "*Microsoft: Windows 3.x, 95, 98, ....*" before, in Windows Vista/7 the Flip 3D function is implemented. A similar approach but still with 2 dimensional interaction can be found in Mac OS X, named as Exposé [31] which is used for opening and switching between all open windows within the desktop area. Another approach is the Compiz [33] feature for unix-like operating system.



**figure 17.** Presenting an example of the composting window effect where several desktop windows are merged together within a 3 dimensional cube.

This feature introduces a composting window manager with different options of managing several desktop windows using OpenGL effects and is shown in figure 17. Anyhow those system are like ad-dons or built-ins for the operating system which are always mapping from the 3D to the 2D desktops, there exists one approach which is used within a 3D environment. It is called Tactile 3D [32], a file explorer that allows the

organization of a file-system within a 3D world. Instead of using a traditional tree based interface the user is allowed to move freely around the world and searching, editing, deleting or repositioning his or her files. Various of effects are helping the user to define different operations and options for this kind of file-system. For example read-only files have a different lightning-effect so that the user can see this information already before trying to edit. Still this system has a lack of environmental balance as it can be seen in figure 18. The usability that measure the effectiveness and efficiency of the user interaction is very slow, but the user-experience, - how the personal experience of the user is measured -, is very high since

so on are less capable of using the full capacity of those systems and therefore have to be modified for future human-computer interaction.



**figure 18.** An image of the tactile3d system showing the content of one folder that contains a lot of cues with whom the user can interact.

the file explorer creates the atmosphere of a 3D game. As for the future trend of GUI, it seems that 3D navigation will play a major role and as showed before several inventions did already came up. So far our current interaction systems like mouse, keyboard and



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