Principles Of Tablet Computing For Educators

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ABSTRACT

In the study of modern technology for the 21st century, one of the most popular subjects is tablet computing. Tablet computers are now used in business, government, education, and the personal lives of practically everyone – at least, it seems that way. As of October 2013, Apple has sold 170 million iPads. The success of tablets is enormous and has severely cut into the sales of personal computers. The reason is simple: the mobile tasks performed with tablets are precisely those that people would like to perform with traditional computers, without the inconvenience. Tablets are useful, because they are small and light weight. Tablets are adaptable, because the owner can download applications (called apps) that are useful to them and ignore the rest. Tablets are likeable, because they have a bright screen, a touch interface, and are inexpensive and secure. There are teaching apps, learning apps, news apps, weather apps, music apps, video apps, photo apps, document apps, email apps, presentation apps, calculation apps, electronic book apps, map apps, game apps, Internet apps, and the list goes on-and-on. So a user can select exactly what to do with a tablet, when they want to do it. The introduction of tablet computers has drastically changed the way that academic subject matter is delivered to students and how those students use tablets to enhance their learning experience. The obvious advantages pose a vexing problem. Many educators have neither the time nor the inclination to look into this new subject. This paper covers a brief history of tablet computers, the tablet hardware, tablet operating systems, app development, and a comparison of the various categories of tablet computers. This paper is intended for educators who would like to tap into the convenience of tablet computing.

Keywords: Tablet Computers; Tablet Applications; Tablet Operating Systems

INTRODUCTION

We are inundated with information in modern society, and most of us have become used to having it at our fingertips, so that we can use it when appropriate needs arise. Actually, we depend on it to support everyday activities, ranging from business and educational reports, news, learning, entertainment, opinions, social activities, how-to-do-it information, and access to professional and personal record keeping. In fact, we are so dependent upon instant communications and up-to-date information, that we expect information to be available at a moment's notice. Two technologies underlie our information-rich society: computers and the Internet. There is one additional and very important defining characteristic. We are mobile, and what this means is that we expect to take our computing power with us. Except, perhaps, in organizational settings, most computer systems in general use are transportable such as notebook computers and laptops.

There is another interesting consideration to think about. What do people actually do with their transportable computers? And the answer is that they do things, for the most part, that can be done when they are away from their home or office setting – for example email and messaging, note taking, schedule and address book functions, video watching, music listening, photo viewing, reading books, and Internet access. Also, they take advantage of remote organizational networks to retrieve information from databases and to do e-commerce. What people don't do are traditional office functions that require that a person sit in one place for a long period of time, such as entering a document. So it follows that modern society was ripe for a light and easily transportable device, designed to do the mobile operations just mentioned. In April 2010, Apple Computer delivered the first iPad tablet, and the world of information and Internet access has been forever changed. Briefly stated, the sales of tablet

computers are up, the sales of personal computers are down, and more people are doing what they want to do when they want to do it. Tablet computers aren't exactly new to the world of technology, but the power and scope of the modern tablet is a game-changing phenomenon. Tablet computers may also supplant traditional books in the classroom.

A BRIEF TABLET HISTORY

While the modern tablet is relatively new – circa 2010 – the general concept of a tablet computer has been around for some time. In 2001, a tablet PC operating system was developed that permitted certain touch features by reversing the screen in a laptop computer and interacting with a specially designed stylus. Personal digital assistants, known as PDAs, are also available for routine record keeping and communications.

The tablet with the most interesting history is the Apple Newton produced by Apple Computer from 1993-1997, and named the MessagePad. The Newton, as it is commonly known, was an amazing predictor of today's tablets in that it was a mobile handheld slate device without a physical keyboard; the user was expected to enter commands and information with a stylus. The computing power was an ARM 610 RISC processor[1] that was mated with a special operating system called the Newton OS[2]. The ARM processor, still used today, was selected to lower battery consumption. The Newton included screen rotation, handwriting recognition, a virtual keyboard, sketching and artistic features, connectivity via fax, various calendar and address-book functions, and personal note taking facilities.

Applications denoted by icons were the primary interaction mechanism together with sound response. Many features were built into the operating system via a large built-in read-only memory (ROM) to reduce the requisite amount of required random-access memory (RAM), usually considered when purchasing an electronic computing device. In addition to the features mentioned, such as screen rotation and icons, the Newton OS provided facilities for printing and handling documents, a menu system, and email – features that are relevant today. Available software included programs for graphics and word processing, lists and notes, calendar and contacts, calculations and numerical conversion of various kinds, a clock,, and an e-book reader. Graphic, hand printed text, and cursive handwritten text recognition. Text recognition included learning facilities that improved with use. The Internet was not in widespread use at that time and that is possibly the reason that the Newton was not an extraordinary success.

A BRIEF LOOK AT A GENERIC TABLET COMPUTER

A generic tablet computer is a flat-panel computing device with a touch-screen on the upper layer and the electronics below. Some people refer to a tablet computer as a "slate." It is a one-piece device, which means you can run computer-based applications with just the tablet. The screen is touch sensitive in the sense that if you want to run an application, you just touch an icon that represents the application (hereafter called just an *app*) and the tablet operating system calls that program into action. Where does that app come from? Either it is pre-loaded into the tablet or the user can download it from an app store. Take a weather app as an example. Ordinarily, you would download a small program, typically less than 200 megabytes, from a vendor supplied app store into the static storage unit of the tablet. The static storage unit is used for long-term storage of information and with tablets, is assembled from electronic components. Normally, it – the app program – just resides in static storage. When its icon is tapped, the app is read into the tablet computer's operational memory called RAM[3], and it then accesses the local weather, using the tablet's GPS device to identify the user's location from the app's web site and displays it on the screen. When an app needs temporary storage to operate, it requests a nominal amount from the operating system. When an app needs to store information for a long time, relatively speaking, static storage space is requested and obtained from the operating system. Many apps are less than 500 megabytes in size, so a lot of apps can fit into the storage unit of a small tablet, which can hold at least 16 gigabytes. The upper limit on storage space is nominally 64 gigabytes. Some of the apps that are preloaded into a tablet's storage are a browser, mail, photos,

[1] RISC stand for Reduced Instruction Set Computer, commonly used with small computing devices.
[2] OS is an acronym for Operating System, the software used to control the operation of computers.
[3] RAM refers to Random Access Memory is a volatile memory facility used during computer operation.

notes, and music. A large number of essential apps are free, such as news, electronic books, dictionary, maps, calculator, and so forth. Video and music app programs are also typically free, but it is necessary to pay for the downloaded media content. Office functions, such as document processing, presentation graphics, and spreadsheet apps are typically not-for-free and occupy slightly more storage. Built-in functions such as contacts, calendars, messages, and social features are commonly included with a tablet, but not necessarily for certain.

In most pure tablets, the underlying computer processor is selected to conserve electricity, because there is a lot of "looking time" by users with tablets, and the computing power of the processor is not a high priority. Many apps use a location feature, so GPS hardware is normally included, as well as an accelerometer so the tablet can sense its orientation. Tablets typically have a battery that will be operable for 8-10 hours without a recharge, and most tablets charge up quite quickly.

A tablet nominally contains an on/off switch, a sound-volume switch, a rotation lock switch, a microphone connection, front and rear-facing cameras, an optional keyboard connection, and a connection for external devices. Since a tablet is commonly used as an "Internet connection" device, a Wi-Fi connection is always available, and some systems have cellular facilities. Since Wi-Fi connections are practically everywhere, the cellular hardware appears to be of lesser value to users than originally expected. A Bluetooth connection for an external keyboard, a mouse, and a headset is common, but is not necessary for ordinary use.

A typical "home" screen will hold about twelve icons, and it is easy to run up considerably more than two or three screens worth. One would use a swipe of their fingers to move from one screen to another and use an up-or-down swipe to scroll through a document. Some document readers scroll up-and-down and others scroll left-to-right.

Some tablet apps involve the entry of information into a page. When a user taps the input bar, a virtual keyboard appears to facilitate the data entry. Physical keyboards are frequently available as optional additions for use when entering or editing documents. In this instance, either the tablet fits into a keyboard unit or the keyboard snaps onto the tablet. Most users find that the virtual keyboard is a satisfactory input mechanism.

There is an old saying that 80% of the people use about 20% of the features available with a computer, and tablets are no exception. Tablet computers are commercial products, and features sell products. The competition is strong and there are many innovative software possibilities found in the product marketplace. Tablet apps are extremely inexpensive, so most users download a healthy collection. There is an enormous collection of free apps available for most tablets.

Another important characteristic of a tablet is its size. The prototypical tablet is notebook size with a screen measuring roughly 7.5 by 9.5 inches with a diagonal screen measurement of 9.5 inches. The diagonal measurement seems low, but the screen normally has a border that accounts for the diagonal measurement. A couple of other screen measurements are 4.5 by 7.5 inches with a screen size of 7.0 inches and 10.75 by 6.75 inches with a screen of 10.5.

The screen of a 7.5 by 9.5 unit is usually addressed in the portrait mode, as are the 7-inch screens. It is normally the case to be able to rotate the screen by 180 degrees with the contents being adjusted accordingly. Screen rotation is convenient for games and data entry through a physical keyboard. The portrait mode is convenient for reading – commonly taken to be documents and web pages – but convenience is in the mind of the beholder. Holding a 9.5-inch unit that weighs roughly 1½ pounds gets tedious after awhile, so a stand is frequently available, except when reading in a resting position. A smaller unit is convenient in that regard, if it is possible to adjust the type size as with most eBook readers. A compromise size between 7 and 9½ screens is particularly useful as a size for convenience and flexibility.

A landscape mode tablet, such as the 10.75 by 6.75 unit mentioned above, is a useful compromise, since it is convenient to hold, and a predominant left-right swiping modality is surprisingly efficient. By definition, a tablet incorporates a virtual keyboard, and a physical keyboard, if available, as an added feature. Most tablets are used for Internet access, music and videos, and a variety of personal operations, such as address-book, calendar, photo

management, and variety of other tasks, so that a physical keyboard is not needed. Many professionals and students use a tablet as a repository for needed documents.

FEATURES

The key function of a modern tablet is to execute apps and to handle housekeeping tasks for the user, and as such, it is in a distinct category from desk and laptop computers that provide an open-ended capability. Two sets of elements are of particular interest: hardware and software. From the hardware, you would expect a high definition screen with sufficient fidelity and anti-glare features to enable the tablet to be used in a variety of operational environments. Wi-Fi capability is required for Internet access, since most tablets are used for that purpose. Mobile broadband is a convenient feature, but it normally has a price attached to it. GPS navigation allows the tablet to sense its location to assist the apps that need it. The accelerometer, mentioned above, provides orientation for screen rotation and other tasks. The processor, covered later, supplies fast start-up and shutdown times and supports a long battery life. The weight of the unit should be manageable for the intended tasks, and most tablet units are in fact a reasonable weight. Photographic features support photos and video in various forms. External connections, such as USB, video, and Bluetooth are currently expected with a well-designed tablet. The unit should have a substantial case, usually aluminum or magnesium, since a high level of hand juggling is often experienced. A good tablet should be able to withstand a minimal amount of rough treatment – such as a short drop. Some "tough tablets" have surfaced for extreme conditions, but their widespread use has been limited.

The tablet operating system is specifically designed for a tablet and other devices with similar characteristics. The touch-response system with a good table should be accurate and have sufficient fidelity so the user will not have to touch more than once to initiate the execution of an app or return to a previous operation. The processor's memory allocation capability should permit several apps to reside in memory so that unnecessary reloads are not needed, when switching between apps. There is no overwhelming need to have two or more apps run at once, but allowing multiple apps to reside in memory is a modern convenience. A convenience once experienced becomes a necessity. Software facilities should be available for downloading, using, and storing the following types of information: e-books, PDF documents, songs, videos, and other publications. You should not have to download a special app, for example, in order to read a document in a common file format. This is not the case with all tablets. Typical built-in software features include: a web browser, email, social media, messaging, speaker and headset functions, photo management, and contact and scheduling functions.

TABLET SETTINGS

One set of features is often overlooked, until it is needed. That is the general subject of "tablet settings." Here are some examples of questions that a user would ordinarily ask from time to time. Do you know what apps are loaded on your table, and how much static storage apace they occupy? How do you turn on Bluetooth, or off? How do you turn on-or-off the sharing of usage data with an app provider? What is the name of your Wi-Fi network connection? How do you turn off the capability of storing cookies on your tablet? How do you delete your browsing history? How many photos or videos or apps or songs are stored on your tablet? What is the ID that you used when you registered your tablet with the manufacturer? Who are the registered users for the tablet? How do you change the brightness or the wallpaper on the screen? How do you disable screen rotation? How do you change your email setup specifications? How do you turn on or off the location services? How is the processor time being used? How much free storage is available? Usually, there is a settings icon on the screen to invoke the settings feature of the operating system. The reason this is important is that the tablet operating system uses the settings to govern the operation of the tablet.

TABLET PROCESSOR

The computer processor used in most tablets is known as the ARM processor that stands for Advanced RISC Machine, a low-cost 32-bit processor that uses fewer transistors; it is smaller in size, generates less heat, and uses less power than traditional processors found in most personal computers. An ARM processor is widely used in mobile battery-powered devices, such as smart phones and tablet computers. When the computer is waiting for input in conventional devices, the processor cycles in a wait mode until it is interrupted by an input event. The wait

cycle uses electrical power and is the main reason that laptops and notebook computers have a relatively short life between re-charges. With an ARM processor, the processor "effectively" turns off, conserving battery power. The special processor coupled with a static storage device, in lieu of disc storage, enables a tablet to have a relatively fast start-up and shutdown time. Widespread use of 64-bit processors is expected in the near future.

Some hybrid tablets designed to span the gap between a tablet and a personal computer use a conventional processor found in conventional desktop and laptop computers. The future of hybrid tablets is uncertain at this time. This subject is covered in the operating system section.

SCREEN INTERFACE

Touch is the basic operational mode that underlies modern tablet computing. A simple touch invokes an app that does something for the user. Navigation between screens and within documents is achieved through left-right and up-down swiping. The notion of "multi touch" is realized by swiping two or more fingers together to perform more complicated gestures that result in functions, such as exiting the current app and returning the user to the home screen. The screen itself is of general interest. A touchscreen is essentially the main feature that gives a tablet computer its personality, since it contributes to its lightweight and operational convenience. To get something done, all a user need do is touch its icon and the app is read into memory and executed. The app may access the outside world to do what it does, but the touch interface gives a tablet its charm.

There are two kinds of technology used to implement a touch screen: the kind where you have to press the screen to get action and the kind where you just have to touch the screen. The pressure sensitive screen is known as a *resistive touchscreen* that responds to any sort of pressure, such as a finger, fingernail, or stylus. This type of screen, used with older PDA devices, normally requires a stylus, but possesses a high degree of accuracy. A *capacitive touchscreen*, used with almost all modern tablets is slightly less accurate and requires the conduction of electricity, such as with a fingertip. Modern tablets primarily employ capacitive screens and are in widespread use. Touching, swiping, and pinching are the major operations, so that the use of a capacitive technology is a prudent design decision.

Some tablet computers permit handwriting and voice input for supplying textual input and also audio output in some instances. The direct storage of handwriting, as well as other graphics, and audio input would appear to be the most useful form of non-keyboard input.

APPLICATIONS

There are so many apps available for modern tablet computers that it is impossible to note all of them or categorize them in a useful fashion. Because screen space for app icons is limited, it is possible in most tablets to group the app icons into collections and assign the various collections a name, so that the user can tap on a collection name and get a sub-display of included icons. Here is useful taxonomy for grouping apps:

- Productivity (Presentation graphics, Spreadsheet calculations, Word processing, Notes, Calculator, Tablet users manual, Books and documents)
- Communication (Messages, Calendar, Contacts, People, Reminders, Downloads)
- News and Weather (News apps, Weather apps, Periodicals, Newspapers)
- Entertainment (Videos, YouTube, Game center, Movies, Music, Sports, Travel)
- Social (Photos, Maps, Earth views, Visual media, Message media, Camera and photo studio)
- Operational (Browser, Mail, Settings, App store, Book store)
- Reference (Medical, Dictionary, Encyclopedia, Finance)
- Collections of Web references

There are, of course, other categories, since thousands of apps exist on the Internet.

TABLET OPERATING SYSTEMS

Without the slightest doubt, the most important component of a tablet is the event driven operating system that controls the total system operation. The touch form of operation in modern tablets evolved from the smartphone that has similar characteristics. The application domain is expanded somewhat with tablets, because of extended functionality and end user expectations. The key point, however, is that a tablet is not a conventional computer, such as a desktop or a laptop, and it is also not a smart phone. For example, extensive document processing and storage is not expected with a tablet; on the other hand, the ability to support expanded music and video offerings is a practical necessity.

Here's a snapshot of what a tablet operating system can do. When you touch or otherwise invoke an icon representing an app, the tablet operating system brings that app from storage into the computer's memory and executes it. The operations that can be performed are severely restricted, although they commonly interact with devices that contact resources external to the tablet. The exact nature of the devices that can be referenced by an app is clearly defined beforehand. For the most part, each app is unique, self-contained, and unable to interact with other apps. At the end user level, there is no file system structure that enables files, associated with an app, to be cataloged and shared with other apps. A device driver, such as for a special printer, cannot be installed, as with a conventional computer, unless it is part of an app. In a sense, the tablet environment is determined by the apps that the owner installs. Some people refer to a tablet as an "Internet appliance," and in a real sense that is absolutely correct.

HYBRID TABLETS

One of the salient properties of a modern tablet is the distinct lack of a file system, useful for managing information. Heretofore, apps are designed to manage their own files. This doesn't mean that information can't be stored – only that files from diverse apps cannot, for the most part, be combined into a common folder. With a hybrid tablet, the underlying operating system does make a file system visible, but primarily for office documents managed on the tablet. In general, the tablet operating system manages internal and external storage dynamically, which is suitable for the application domain of a tablet computer. It is expected that hybrid tablets will continue to erode the portable PC market.

SUMMARY

The tablet computer represents a concept that transcends the limits of an ordinary computer experience, by being a device that differentiates a run-of-the-mill Internet connection device and a truly useful mobile companion. The essential concepts of tablet computing are covered, ranging from a generic view of the subject to a brief description of the necessary characteristics. The key point is not what the device looks like but how it does what it does that is important. For any set of applications, the size of the tablet is of paramount importance. For a learning environment, the student must be able to navigate between the various tutorial modalities. Clearly, the screen must be clearly visible and robust enough to withstand extended use. The hardware has to be reliable and the software must be accurate enough so as not to require frequent updates by the manufacturer. There is no sense in having a lot of esoteric features that are so complicated to use that students and teachers can't use them. The hardware, software, applications (apps), and connection facilities are of prime importance. Lastly, there is one point not covered in the paper. Knowledge of the subject matter goes a long way in modern education. The purchase of a $25 book or the download of a free user's manual can eliminate a multitude of headaches.

AUTHOR INFORMATION

Professor Harry Katzan is the author of many books and papers on computer Science, Decision Science, And Service Science. He teaches in the MBA program at Webster University and is the founding editor of the Journal of Service Science, published by the Clute Institute.

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