A Future Projection of Hardware, Software, and Market Trends of Tablet computers

Honors Project

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ABSTRACT

A FUTURE PROJECTION OF HARDWARE, SOFTWARE, AND MARKET TRENDS OF TABLE COMPUTERS

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We investigated hardware and software trends in tablet computers released during the market explosion. Market explosion was defined by the release of 4+ devices in a fiscal quarter. We compared a total of 82 tablet computers released between February 2011 and December 2012. Computers were analyzed on processor speed, weight, battery life, and pixel density. Data was analyzed in accordance to the fiscal quarter. Our results indicate the market trending toward a hybrid device between tablets and laptops.

Background

Increasing trends in mobile computing has led to the development of the tablet computer. When first released it created a new technological niche in the private sector. As a major area of innovation in hardware and software, tablet computers offer a unique outlook on how mobile touch screen technology is progressing. With eighty-two tablet devices released in the 2011 and 2012 fiscal years it becomes evident that we are in a phase of competition between major corporations seeking to define the industry standard. Thus it becomes important to understand trends in the hardware and software capabilities of these devices as they develop. Several characteristics of tablet computers were identified as major areas in which innovation could be achieved: processor speed, pixel density, weight and battery life.

Processor speed was selected as a major component of the tablet computer. Processor speed is a measure of how many instructions a CPU can handle per second from a process. Processes are programs which have been loaded into memory and are executing (Silberschatz, Galvin & Gagne, 2008). Pixel density is a measure of how many pixels are present on a monitor. Images seen on computer screens are made up of different colored dots, which are referred to as pixels. Generally speaking the greater a device's pixel density the greater the screen resolution. Pixel density was used as a measure of how screen technology was progressing for this reason.

The reported battery life and weight in pounds of each device was also used to help analyze the portability of devices. Being portable is a major function of tablet computers, and the ability to operate independent of an external power source is paramount.

For this study we defined tablet computers as any mobile device with a screen size of at least six inches diagonally which could operate independent of an external power source.

Materials and Methods

Study area

We compared and analyzed trends in tablet computers. These metrics include processor speed, weight, release date, and pixel density. Each of these was graphed in accordance to the fiscal quarter in which they were released. When plotted, this data produced eight points, which represented averages in the data for that fiscal year. Fiscal averages were appropriate for this analytical approach to understanding the data due to the nature in which corporations report and analyze sales trends (Quarterly). In all data for 82 tablet computers dating back to 2011 up until the end of 2012 were found and used in this study.

Processor Speed

Data was collected in regards to processor speed from manufacturers, major retailers and Cnet. We used values on processor speeds reported by major retailers as well as manufacturers. Values were divided into fiscal quarter, and plotted against time.

Battery Life

Data on battery life was collected for each device from manufacturers, major retailers and Cnet. Battery life was identified as one of our primary measures of portability. The longer the device can operate without being docked, the more it lends itself to portability.

Pixel Density

Due to variability of screen size it as necessary to calculate pixel density to compare all devices. Data for calculating pixel density was gathered on the reported resolutions for each device from manufacturers, major retailers and Cnet. Pixel Density was calculated by the given formula.

$$\text{Pixel Density} = [\ \text{Sqrt}(\ (\text{pixel length})^2 + (\text{pixel width})^2\ )\ ] / \text{screen size}$$

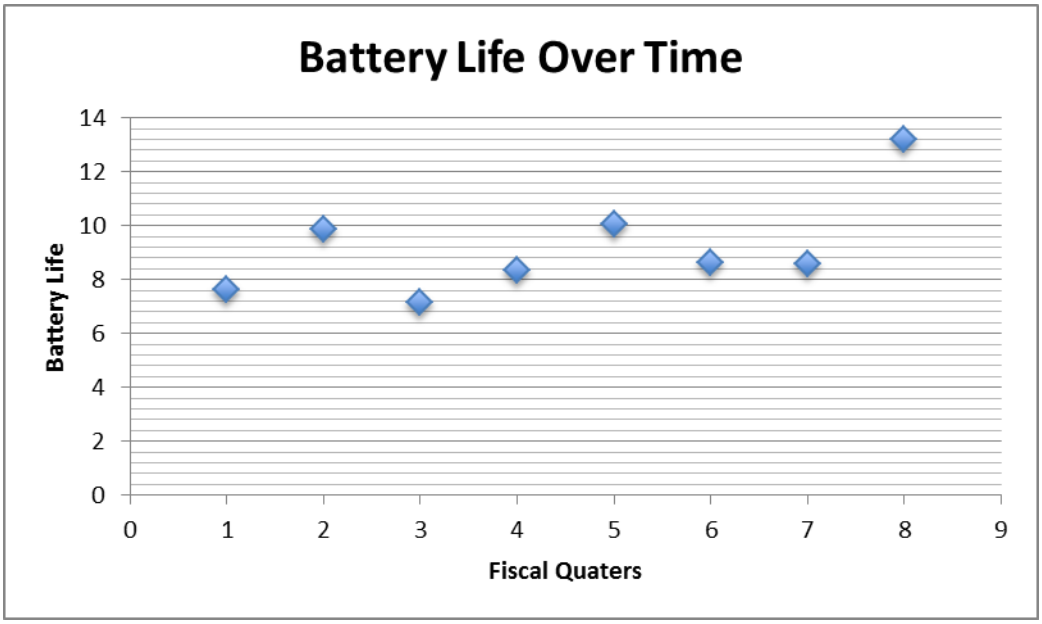
Squaring the pixel length and the pixel width, adding them together and taking the square root. The resulting number was then divided by the reported screen size to give pixel density. Using the averages for each fiscal quarter, this data was plotted against time.

Weight

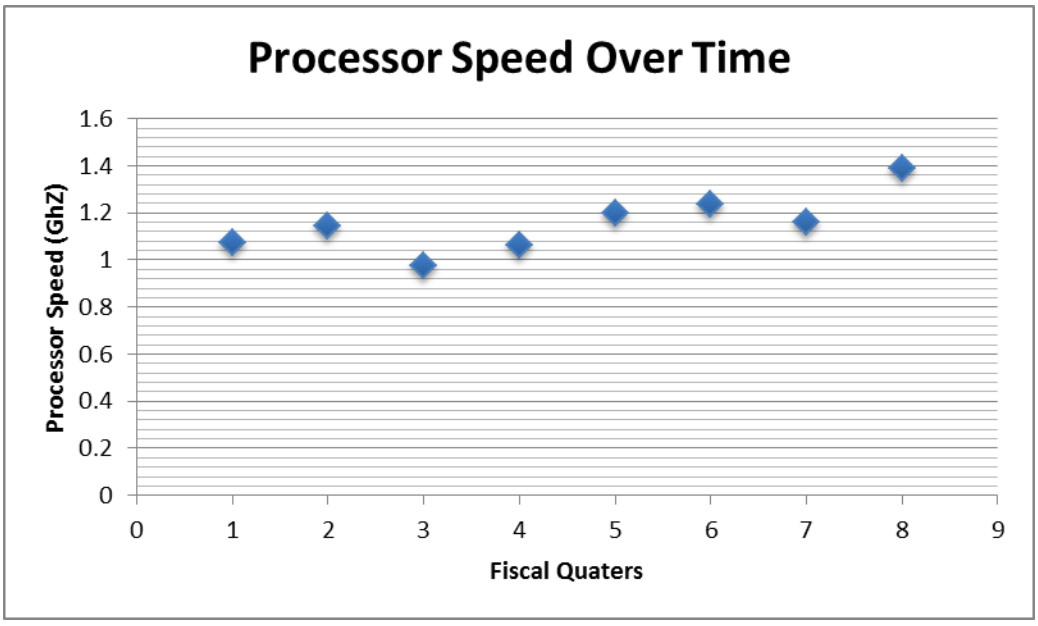
Data on the weight for each device was also collected (in pounds) from manufacturers, major retailers and Cnet. The devices for each fiscal quarter was averaged and plotted against time.

Results

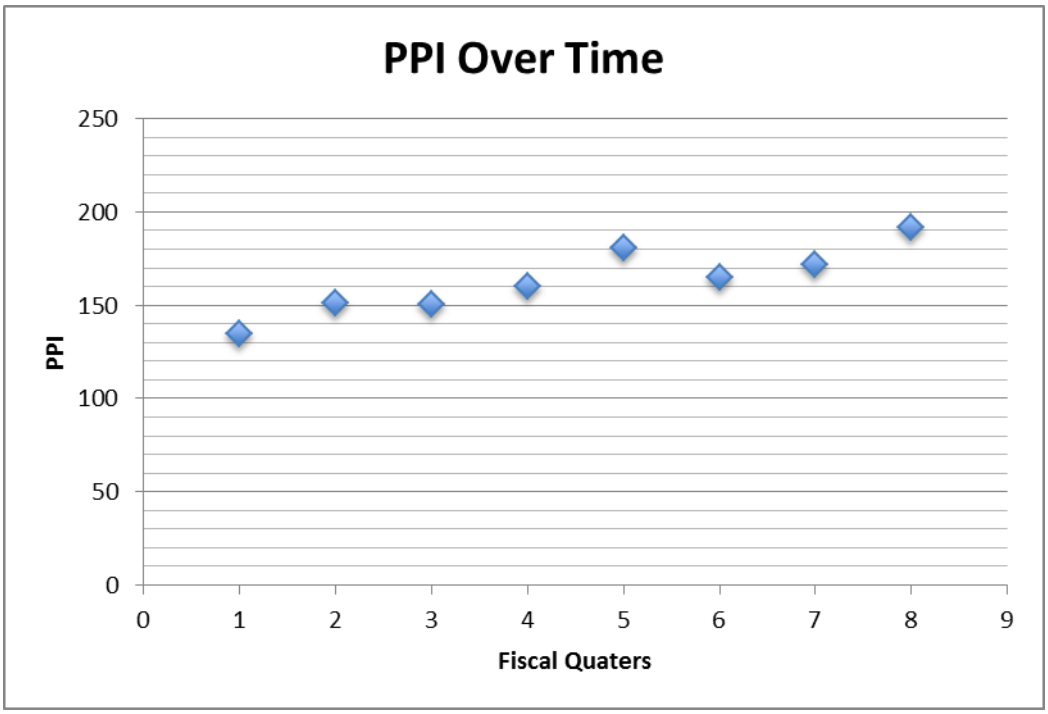
In **figure 1**, data on battery life produced a linear correlation of .5963 and demonstrated a general increasing length of operational time independently available of an external docking station.



There was also an increase in processor speed over time demonstrated by **figure 2** with a .7048 linear correlation.



Additionally the market experienced an overall noteworthy increase in pixel density supported by **figure 3** with a linear correlation of .9061.



Conversely there was a general decrease in weight of the devices released each fiscal quarter with a linear correlation of .6915 as shown in **figure 4**.

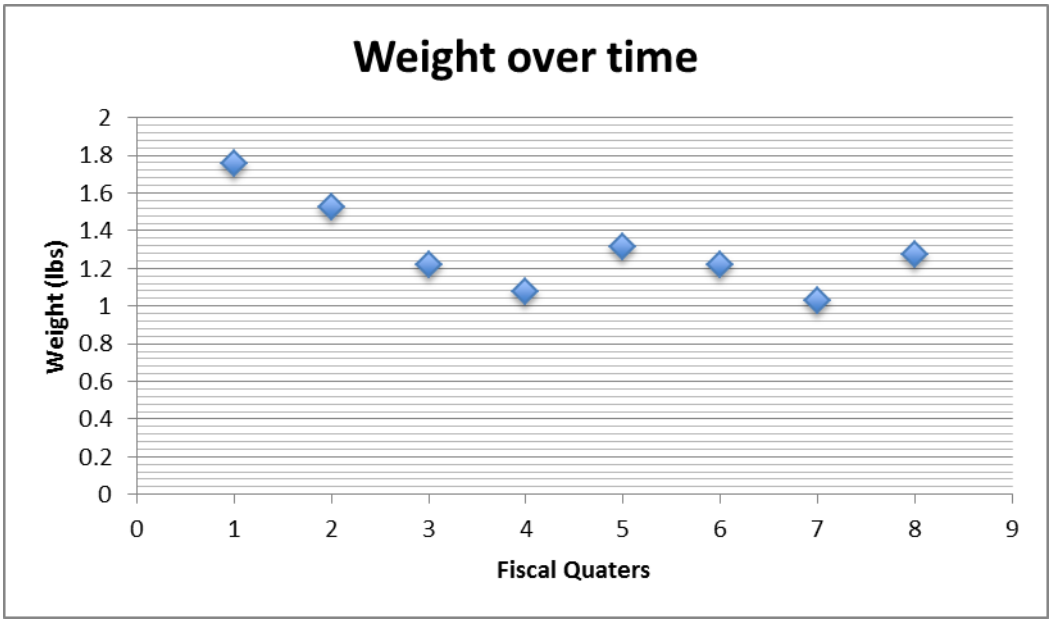
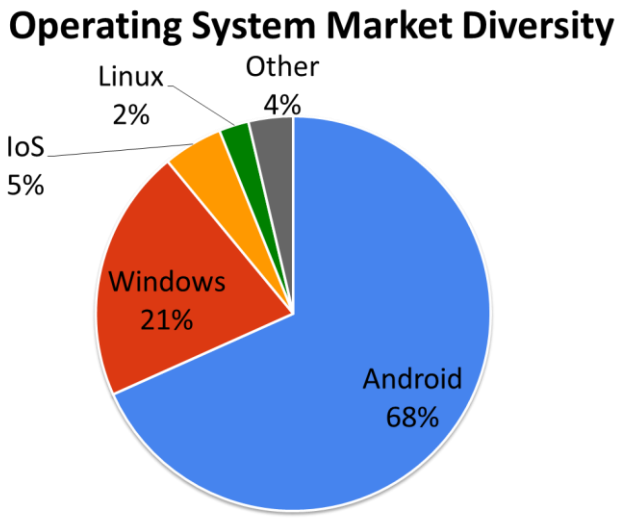


Table 1 summarizes the number of released devices which support in-house, non-third party docking stations.

Quarter	Stations with Native Dock
Q1 2011	0
Q2 2011	3
Q3 2011	0
Q4 2011	2
Q1 2012	0
Q2 2012	2
Q3 2012	0
Q4 2012	8

This value saw a general increase with an astounding fourfold increase between the second and fourth fiscal quarters in 2012. The operating system software packages were compared and revealed a market majority of the android operating system. The open source operating systems Linux (2%) and Android (68%) make up the majority of the table computer software market as demonstrated by **figure 5**.



Discussion

This experiment evaluated data from 82 different table computers. This data was plotted against fiscal quarters for the 2011 and 2012 fiscal years. The data demonstrated positive correlations over time of battery life, processor speed, pixel density and weight. The quarterly averages produced graphs that were relatively linear and thus a linear correlation was used to analyze the data. This study hypothesized that as processor speeds increased, more power would be necessary to accommodate the increase in productivity. Therefore the prediction was that processor speed and battery life would be inversely proportional. The data indicated however that processor speed and battery life were directly proportional suggesting that manufactures accommodated for the increased usage of batty power by providing larger batteries with greater efficiently. It was concurrently expected that larger batteries would weigh more, resulting in an increase in tablet weight. Interestingly, the data shows a positive correlation of processor speed and battery live over time, but a decrease in overall weight. Further research into this relationship between processor speed and weight should be considered, as a number of factors remain which could explain the results obtained in this study. For instance, while processor speed increased it could be that the new chipset yielded a more efficient processor which consumed less energy than previous models. Additionally it is possible that as battery pack technology developed, more efficient means of powering devices were being implemented. Either one of these scenarios could explain why the variable of tablet weight decreased over time. While decreasing weight was not what we had hypothesized, it supports the overall hypothesis that tablet computers are becoming increasingly mobile. As processor speeds increase towards the threshold of entry level laptops processor speeds, new software operating systems such as Windows 8 are being released offering a dual purpose graphical user interface. This interface is optimized for tablet function and traditional laptop computers. While this hybridization is first entering the market, it remains important that manufactures maintain the essence of the tablet computer. These include maintaining a relatively portable system which can operate independent of docking for several hours. Despite the growing demand users placed on tablets, producers continue to deliver the desired battery life that experiences a steady increase each fiscal quarter. Additionally, this portability is also seen in the

weight of the tablet which experiences a linear decrease as a function of time. Weight averages continuously decrease with each fiscal year. Thus the combined factors of weight and battery life, accommodate users with a sense of lightweight mobile computing capability which can run an average 9.74 hours without recharging. Pixel density was calculated in this study as a metric for comparing resolution of devices with differing screen sizes. This variable was used to understand how the overall picture quality of tablet computers developed over time. The data indicates a high correlation of ppi over time, suggesting that as subsequent models are released, manufactures are conscious of the picture quality they present to users. These results were as we hypothesized, and in the advent of high definition media, the results suggest producers are in a picture quality race to dominate the market. The data regarding software demonstrated the open source operating system Android was used in 68% of the devices released in the fiscal years 2011 and 2012. Combined with the 2% of devices released during the same time period that utilize the open source operating source Linux there is a resulting 70% of devices that are released with an open source operating system. The use of open source software and its resulting greater numbers of potential software developers could possibly explain the rapid advancements made in the field of tablet computing software. In theory, systems which utilize open source software would be able to facilitate increased advancements as multiple sources are able to contribute to the product's evolution. In this respect it would be reasonable to conclude that such rapid advancements would allow for the domination of the tablet computer software market by open source operating systems as shown in **figure 5**.

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