Technical Review Paper Evaluation Form

(attach this form as the cover page for your report)

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_____ / 30 Technical Content

- Current state-of-the-art and commercial products
- Underlying technology
- Implementation of the technology
- Overall quality of the technical summary

_____ / 30 Use of Technical Reference Sources

- Appropriate number of sources (at least six)
- Sufficient number of source types (at least four)
- Quality of the sources
- Appropriate citations in body of text
- Reference list in proper format

_____ / 40 Effectiveness of Writing, Organization, and Development of Content

- Introductory paragraph
- Clear flow of information
- Organization
- Grammar, spelling, punctuation
- Style, readability, audience appropriateness, conformance to standards

_____ **/ 100 Total - Technical Review Paper**

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Acquiring and Storing Books on an E-Reader

Introduction

In a modern society where a single memory storage device the size of a fingernail can hold gigabits of information, physical copies of books have become unnecessary. E-readers have allowed users the ability to carry around hundreds of books on a notebook sized tablet that weighs less than a pound. This paper reviews the methods of acquiring books to be read on an e-reader and how these devices are able to store the thousands of pages of text to be displayed.

Acquiring Books for an E-Reader

The two main modes of downloading books onto an e-reader are through Wi-Fi capabilities that the device has or by connecting the e-reader to a computer via cable. Wi-Fi capable devices cost more than solely cabled devices, consume a larger amount of battery power, but also have the option of connecting a cable to a computer. Solely cabled devices are cheaper but are limited in the location at which reading materials can be downloaded; however, these are no longer readily available to consumers.

Each company that produces an e-reader device has a different format in which the materials can be viewed. For example, Amazon's Kindle Fire uses its own Kindle format while the Nook from Barnes & Noble uses .epub, which is the industry standard [1]. This limits where a book can be downloaded from because of the formatting needed for display and storage. Generally, applications for book downloads are developed by each company to cater to their specific devices, so reading materials cannot be transferred between the applications and devices of competitors.

Storage Inside an E-Reader

The internal drives inside of e-readers typically range from 4GB to 32GB, with the e-reader costing between $80 to $150 depending on the storage size [2]. Each e-reader can generally store about 1000 to 22000 e-books, respectively. One of the most widely used form of storage methods for hand-held consumer devices is NAND flash memory because of its size, speed, and low power costs [3]. In order to write or remove information, it requires a pulse of voltage to memory. This is referred to as flash memory, which is a type of EEPROM (electronically erasable programmable read only memory). This works by using one transistor with two gates, a floating gate and a control gate, which creates the NAND [4]. When a positive voltage is

applied to the bitline (the contact on the drain) and the word line (the contact on the two gates), electrons flow from source to drain, while a small number of electrons tunnel through the narrow oxide layer and become trapped on the floating gate. This creates a negative bias on the transistor, in turn preventing the current from flowing through the transistor. To return the cell back to a connected state, a negative voltage is applied to the wordline, which flushes the electrons from floating gate, allowing for current to once again flow through the cell; this is the only way to give the electrons the requisite energy to tunnel through the oxide layer. Typically, when a block is empty, a '1' is outputted from the block which signifies a high signal from the flowing charge; when the block is filled, it outputs a '0' which signifies a low signal from the lack of current. This method of applying charge to add and delete data can erase entire blocks of the chip at once instead of single bytes at a time, because the in-circuit wiring can apply the charge to multiple sections within the drive at once, and can also prevent data from being written onto already used blocks [5].

NAND flash has a limited number of times data can be written to and erased from a card due to the application of voltage [6]. However, the number of uses before wear-out occurs is in the tens of thousands and takes several years for the casual consumer to reach. As this number is approached, the time it takes to perform write and erase operations slows down drastically [5]. At this point, the operating system may not be able to recognize the drive and data loss, or corruption, occurs.

Memory Expansion Slots

External hard drives can often be added for even more storage space. Usually found in the format of an SD (secure digital) card or a micro SD card, these can be plugged into a built-in slot on the tablet and use flash memory, as explained above, to store data. The size of an SD card is 32x24x2.1 mm and costs $8 for 32GB while a microSD card is 15x11x1 mm and costs $12 for 32GB [7] [8] [9]. The cost of the two different types of cards goes up with the storage capacity. Both types of SD cards are often the top choice for external storage because they are solid state devices and a form of non-volatile memory [10]. This means that they do not have any moving parts to function and do not lose information in the case of power loss. However, the use of the external card slot in e-readers has drastically decreased since 2010 because of the advancements on internal storage capacity, and the most recent e-readers now lack this slot.

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