Analysis of flash memory wear based on cache configuration and available memory

To most people the term "flash memory" doesn't say much. However, in reality, every time one uses an electrical device the probability that you are unconsciously depending on flash memory, for vital data saving, is high. Even among those more experienced in flash memory, many might still be unaware that it has a limited lifetime. Considerable research has been done in prolonging this limited lifetime, and this thesis also attempted to optimize flash memory lifetime, as much as possible, by exploring different cache configurations and the effects of free memory space.

The purpose of this thesis was, as stated above, to explore different cache configurations that would result in a longer lifetime for flash memory. This was and still is important to ensure that flash memory doesn't get worn out prematurely, causing frustration for both users and manufacturers. Cache configurations were chosen as they do not require any hardware alterations and are easily changed in software. Finding good cache configurations, that do not cause excess wear, would allow manufactures to use the most efficient configuration, thereby improving their lifetime.

The configurations measured were file cache and disk cache. Simply put, file cache temporarily stores file data in the system cache and disk cache temporarily stores file metadata such as file size, name and location. To test these different cache configurations the effects of them were measured on Beijer Electronics hardware products by measuring how much data was written by the OS to the flash memory by the same writing operations but different cache configurations. Since writing (not reading) data from memory is what causes wear in flash, this is the most relevant metric.

In addition to cache configurations, this thesis also conducted research about the life time effects depending on free memory space in the memories used. To achieve this some of the memories used was deliberately filled with scrap files until a threshold of 90% of the total memory spaced was used.

It was found that for small file sizes(below 1000 KB) only having disk cache enabled caused the highest amount of writes, for sizes of 1000 KB and higher, activating both disk and file cache caused an equal or higher amount of writes as only disk cache. The lowest amount of writes was by HMI:s with only file cache or neither enabled. However, these two configurations were all slower in writing than having both enabled. So when choosing a configuration it is important to

decide if a slow writing speed is more important than a durable flash memory. It was found that using HMI:s at 90% filled memory significantly slowed down writing speed. This was attributed to internal shuffling of data being done to level the wear of all memory cells. This, however, would also cause excess wear of the memory cells since extra writes are being done. Therefore it was deemed that operating flash memories with as much free space as possible was best for both speed and durability.