Demo : Adaptive Display Power Management for Mobile Games

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Introduction

The current generation of mobile smartphones are frequently used as mobile PC replacements that are used to edit documents, browse the web, check email, and play games. However, providing this functionality while maintaining their slim form factor (which impacts the amount of battery that can be put into the phone), often leads to their battery lifetimes being significantly shorter than previous generation of "dumber" phones.

In modern smartphones, the three main sources of power consumption are, 1) the CPU, 2) the display, and 3) the network interfaces. Games are popular applications which tend to consume a lot of system resources. In this demonstration we aim to show our system[1] for reducing power consumption of the LCD display during game play. The Demonstration will involve Quake 3 Running on an Android powered Mobile phone.

Categories and Subject Descriptors: I.3.3 [Computer Graphics]: Picture/Image Generation

General Terms: Algorithms, Measurement

Keywords: Game, display, lcd, power saving

System Design

TFT LCD displays have two major components: LCD panel and a Light source at the back of the LCD panel. The backlight illuminates the panel . The panel has a filter which filters the backlight based on the values of the pixels in the display buffer. The brighter the pixel, the more light passes through. Thus we can see that to save power, we can brighten the frame content and reduce the backlight intensity, maintaining the resultant image as it is.

In our system we use OpenGL's Alpha Blending technique to brighten the scene, while reducing the backlight intensity of the device, thus saving power. We have determined through power measurements that the power consumption of LCDs depends only on backlight intensity, and it is a linear relationship.

We have then performed experiments to determine the following.

- Mapping between amount of backlight reduction and the amount of gamma (brightness) boost needed, through light sensor experiments.
- Maximum thresholds (conservative and aggressive) of gamma (brightness) boost for scenes of different brightness levels, through informal user study.

With this information our run time algorithm was implemented on Quake 3 for Android (Kwaak3)

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(a) Original Image

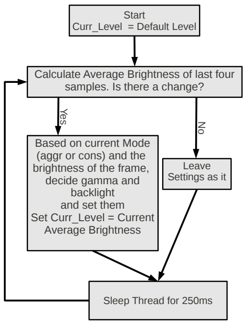
(b) Image with increased Gamma (brightness) and Decreased backlight intensity

Figure 1: Compensation Effect

Run time Algorithm

During run time the system works as shown in Figure 2

Figure 2: Run time algorithm



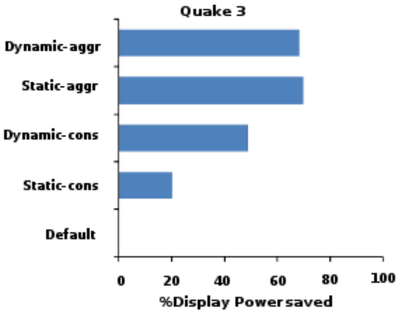


Figure 3: Power Savings on Quake 3

Results

We present here power and user study based evaluation of our system on LCD Laptops. The evaluation of the mobile implementation is work in progress.

Power measurements were done to measure the actual power saved when using our system on the laptop. The results for Quake 3 are shown in Figure 3. Here Dynamic - ** refers to our algorithms using the different thresholds, while Static - ** refers to static cases in which the settings were set to be the best quality of the dynamic cases. Extensive user study was also performed for this system, in which it was seen that the effect of the conservative thresholds was barely, if at all, noticed by the user. Thus we can save around 50% of the display power with negligible loss to quality.

References

[1] Anand, B., Thirugnanam, K., Sebastian, J., Kannan, P. G., Ananda, A. L., Chan, M. C., and Balan, R. K. Adaptive display power management for mobile games. *Proceedings of Mobisys*, 2011.