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Raising the bar: Better battery life for mobile gaming enthusiasts

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Remember how, in the 1970s, mobile phones were introduced as basic tools of communication on the go? Less than 50 years later, the handheld device has evolved into a multi-function device that most people consider their lifeline to the world at large.

After BlackBerry phones began offering push mail functionality, it was no longer enough to just call and send messages on the phones. Then Steve Jobs, the former CEO of Apple, introduced the world to mobile gaming and many innovative applications.

Games have become one of the most popular applications for mobile phones. Market research firm Mintel observed that the sales in the mobile phone and tablet gaming market in the US has more than doubled between 2005 and 2010, to reach US$898 million. It forecasted that sales of gaming applications will increase 82 per cent to US$1.6 billion by 2015.

But no matter how far the experts in Silicon Valley have come in revolutionising technology, certain limitations remain: prolonged usage dramatically shortens the battery life and heats up the battery.

A solution to improving the user experience may now be found in a recently concluded three-year research project by Singapore Management University's (SMU) Rajesh Krishna Balan from the School of Information Systems.

Speaking at the Profiles of Excellence Lecture Series organised by SMU's Office of Research, Balan, who is also the director of LiveLabs Urban Lifestyle Innovation Platform, explained that the display function of a phone is its biggest battery consumer— using 45 to 50 per cent of the power.

Together, the display and network components of a mobile phone account for up to 70 per cent of the total power consumption of the phone when playing a mobile game. If these elements can be improved, it would preserve the battery life of a phone for as long as possible, felt Balan, who revealed how his team came up with a solution for each element.

Tackling the LCD screen

There are two types of mobile phones displays: the liquid crystal display (LCD) and organic light-emitting diode (OLED) screens. The key challenge for Balan's team was to cut down the energy consumption of both types of screens without affecting the end user experience.

The power of a LCD screen is largely consumed by its backlight, which illuminates the screen from the side or back of the display panel. Balan and his team surmised that brightening the image on the screen and darkening the backlight would save considerable power on the phone. Their tests showed that the adjustments reduced 50 to 70 per cent of display power usage with no significant impact on user experience.

"The images look almost similar. If you play the games on a small screen, you can't really tell the difference," Balan said.

But there is a limit to how much one can brighten an image — colour saturation is affected and details are lost. It is possible to use a non-linear adjustment approach and brighten different parts of an image in varying degrees. While this can cause a loss in contrast, the quality difference is still "less obvious" on a small screen, said Balan.

Then there is another challenge – at what point does the human eye notice a difference in the image? To find out the answer, Balan conducted an experiment with 60 undergraduates who played three different versions of a computer game and then rated the playability of the game on a 5-point likert scale.

The original version of the game received a 4 rating; the version with a conservative threshold (where the image is comparable to the original) received a 3.8 rating and the version with an aggressive threshold (where image quality is affected at an acceptable level) was rated a 2.9. So while the aggressive threshold can save up to 68 per cent of power, there is a noticeable difference in usability. In contrast, the difference between the original and conservative threshold (which saves up to 49 per cent of power) was not significant.

Balan proposed that the technique can be applied to different operating systems. He said: "We have an amazing solution for LCD screens. It works pretty well. It saves as much as 50 per cent, or even up to 70 per cent, for free."

Tackling the OLED screen

For OLED displays, which are increasingly common and are used, for example, on Samsung phones, Balan proposes a solution that consists of blacking out, literally, the boring parts of an image.

An OLED display does not use the backlight and each pixel is individually lit by electricity. The display's power consumption is dictated by the number of pixels lit and colours used. This means the colour black consumes the least energy amongst all colours. So, the researchers came up with the idea of dimming the areas around the user's focal point on the screen. "Our eyes like to see the peripheral image, but it does not need to be super clear. It just needs to be good enough," said Balan.

With this technique, it is possible to achieve a "reasonable" 15 per cent savings on overall system power usage, he shared. But Balan added that the technique is only applied when the player's character is moving in the game and the user will not notice the quality of the peripheral image. Balan's research team plans to focus next on how to apply this technique to other applications like email and internet surfing where the user's visual focus is not predictable.

Tackling Network Consumption

Traditional networks are on standby mode all the time to wait for packets of information that come their way. This is why the 3G connection on a mobile phone consumes so much energy. Battery usage can be reduced if the network knows when to sleep and when to wake up to send and receive the packets of information, hypothesised Balan.

To do this, the gaming system will need to predict when and where the player will need to take action after seeing an opponent. This led Balan to design an algorithm to generate the predictions. He found that the method allowed savings of up to 25 per cent in network power.

An initial user study has provided good feedback but there are still limitations and difficulty to predicting the movement of a character who, for example, teleports or re-spawns. Going forward, Balan and his team are exploring and expanding the applicability of their techniques to other platforms such as computers.