COLD AND CALCULATING

The demands of the current generation of slot machines requires ever increasingly sophisticated and efficient hardware solutions

Casino floors are awash with vibrant, immersive graphics, enticing sounds and the din of players reveling in the hope of winning a jackpot.

Each slot machine is skillfully crafted to attract slot players away from competing machines to enjoy the richly interactive and visually spectacular games which are now the mainstream. For most slot players, the technology that beats at the heart of the slot machines is neither familiar nor of interest to them, but they are indirectly benefiting from a silent revolution in the technology underpinning the machines.

One of the most noticeable evolutions in recent times to the slot machine has been the move from electromechanical spinning reels to video slots, the latter of which provide game developers with more flexibility to interact with the players and create more dynamic games. In video slot machines, the spinning reels are replaced by a video display which often shows an animation of virtual spinning reels. Often, machines now boast multiple video screens which enable game developers to host exciting bonus games and other multimedia content to augment the spinning reels.

The electronics hardware or 'logic box' which was used to drive the electromechanical reels was historically

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Quixant General Manager.

often based on bespoke, single purpose embedded electronic controllers. Developing and programming these devices is time consuming and requires specialist knowledge and, once designed, the flexibility of the devices to be repurposed is limited. As one might imagine, the transition to video slots has required reconsideration in the design and type of electronics hardware or 'logic box' which is responsible for driving the video screens. Such demands brought about the introduction of general purpose personal computer (PC) technology to the slot machine.
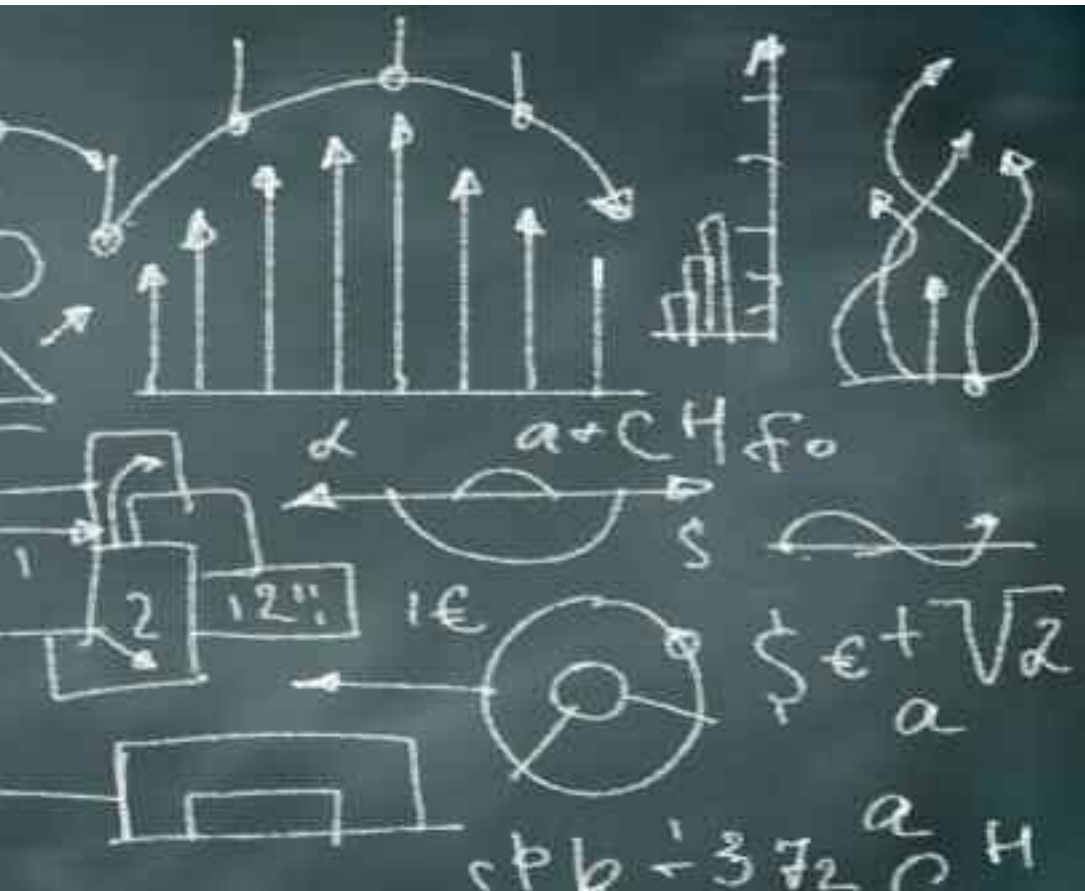
On the face of it PC technology, as exemplified by the desktop computers and laptops which reside in offices and households worldwide, seems a poor fit to provide the foundation of the electronics in a slot machine. The reliability of mainstream PC technology is often lower than that demanded for use in a casino environment, there are major deficiencies in security of the systems to malicious attack, few of the features which are required to drive a slot machine are integrated and the technology is notorious for being obsolete soon after it has been released. After all, the economics of the consumer PC marketplace is based upon the premise of regular replacement cycles!

On the flip side, PC systems are immensely powerful, offering unrivalled multi-screen graphics and processing capabilities at a low cost. Incredibly powerful, dedicated Graphics Processing Units (GPUs) are available to augment the multipurpose Central Processing Unit (CPU) to enable multiple displays to be filled with realistic 3D graphics and high definition video. They are also almost entirely reprogrammable to perform any function desired and the skills required to write these programs are widespread among the programming community.

A new breed of all-in-one embedded computer gaming platforms has emerged which are designed to take the best bits of PC architecture and address the deficiencies to make high performance, secure, reliable and cost effective platforms which can form the basis for market-leading slot machines. These gaming platforms are tailor-made for slot machines and therefore aim to cater for stringent regulations to make achieving approvals for new machines far more straightforward. They also integrate into an all-in-one logic board all the features required to drive a gaming machine, such as non-volatile memory, intrusion detection and hardware security. Through the careful integration of low power components which are available on long term supply, these gaming platforms can be made into compact logic boxes which produce little heat (therefore require no fans for cooling) and can be distributed over a number of years without the fear of a decline in availability.

The last couple of years has seen the

processing elements (such as the GPU) for anything other than dedicated tasks.

According to Kelly Gillilan, a product marketing manager at AMD Embedded Systems Group, "The APU is a heterogeneous system that incorporates discrete level GPU capabilities for graphics processing and other mathematically intensive computations, to handle visual tasks such as 3D rendering as well as certain fixed functions. The APU continues to utilise a CPU to run the operating system and most traditional PC productivity applications. Heterogeneous computing brings together the best of both CPUs and GPUs—all in lower and lower power envelopes for smaller and smaller form factors — yet, with increasingly rich visual experiences."

To capitalise on the benefits of the APU architecture requires a more flexible software environment, which can seamlessly allocate the execution of code to the most efficient processing element that is present in a given system. As such, a powerful cross-platform, non-proprietary programming framework has evolved called the Open Computing Language (OpenCL).

CORPORATE POWERHOUSES HAVE EMBRACED HETEROGENEOUS COMPUTING AND IT LOOKS SET TO BE A KEY PART OF FUTURE DEVELOPMENT.

"The OpenCL architecture equips game developers with a framework upon which to write program code that takes maximum advantage of the computation resources available in the computer platforms at the heart of slot machines," explains Andres Garcia, Senior Embedded Software Engineer at Quixant. "With OpenCL APIs, developers can also repurpose code across CPU, GPU and APU platforms from the leading processor vendors, such as AMD, Intel, Nvidia and IBM, thereby ensuring that the investment into source code development remains secure regardless of the processor manufacturer".

Next month, we will be investigating some practical examples of how OpenCL is changing the landscape in the gaming industry and enabling the development of ever more eye-catching games which run on lower cost, lower power hardware.

technology available in these specialist gaming platforms adopt new tactics to meet the relentless demands of ever more vibrant games. The degree to which processing power (both in terms of CPUs and GPUs) can drive more screens, provide more spectacular graphics and sound effects and provide greater and greater levels of security is limited by the amount of heat and power consumption which is tolerable from the logic box in the slot machine cabinet. As such, there is a trend towards integration and clouding of the discrete CPU and GPU functions into a single all-purpose device: the Accelerated Processor Unit (APU), as envisioned and designed by Advanced Micro Devices (AMD). The benefits to this approach may not immediately be obvious, but, if adopted in the right manner can result in huge benefits in terms of available computer performance, power consumption, heat dissipation and total system cost.

In theory, a CPU has the processing tools necessary to display all the amazing graphics which are showcased in today's slot machines. The problem would lie in the amount of CPU horsepower which would be necessary to perform all the calculations needed to produce these graphics, hence the introduction of specialist GPUs to perform the graphics calculations. At the heart of the benefits to the APU approach is the fact that, with

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an environment consisting of a discrete CPU and GPU, only pure graphics calculations can be processed by the GPU and everything else must be processed by the CPU. This is not the most efficient use of computing power for a slot machine because there are functions which would be more efficiently processed on the GPU which, by nature of the segregation of the two devices, must still be processed by the CPU. The APU approach gets around this problem because both the CPU and GPU processing capabilities are equally at the disposal of programmers to exploit, regardless of whether the calculation is graphics related or otherwise. As such, the most efficient method of performing each calculation can be used. This approach to system design has been termed 'heterogeneous computing,' a trend that is rapidly gaining momentum.

The PC industry corporate powerhouses have embraced the heterogeneous computing approach and it looks set to be a key part of the development of PC architecture over the next few years. To facilitate this radical change in the method used to access the computation tools available in heterogeneous systems equally requires a change in mindset in how developers write games. In the past, when the CPU was really the only resource for general purpose execution of program code, it was difficult for software developers to make use of the other