In this article we discuss Intel's MMX technology and its integration as part of multimedia PCs.

In late 1996 Intel announced an enhancement of the Pentium Processor architecture and christened it *MMX technology* or *multimedia extensions*. The Intel MMX technology is purportedly the most significant enhancement to the Intel architecture since the extension of the x86 architecture to 32 bits in 1985 when Intel first introduced the 80386 processor. The primary motivation behind this extension is the realization that a large number of computer intensive applications such as 3D graphics, interactive video games, speech processing, animations and virtual reality demands much more of the current day processors than what could be obtained by increased clock speed and complexity of processors. Hence, a new and simple approach incorporating some of the oft-used techniques in digital signal processing chips had to be adopted. A constraint faced by the designers of MMX technology was that any processor incorporating this technology had to be fully compatible with existing Intel architecture PC designs and all x86 based operating systems and application programs. This meant that an MMX technology extension could not create new modes or states.

Intel's microprocessor architects and software developers ran a wide range of applications that included video and audio processing and reported a performance gain of about 50%-100% over the same applications run on the same processor without using MMX technology. The new technology has been crafted to ensure that increased clock speed will give proportionate improvement in speed of...
processing. All future generation Intel processors (P6 and its successors) will have MMX technology integrated in their design.

**Characteristics of Multimedia Applications**

Multimedia\(^1\) applications place a high demand on the computing resources of a media processing computer. For example, let us suppose that we want to display compressed video data on a screen consisting of \(640 \times 360\) pixels\(^2\). The screen has to be rendered at a rate of 30 frames per second. Also, the amount of processing that has to be done on a pixel before it can be displayed is of the order of 1000 operations. Thus the number of operations that have to be performed per second to display a screen is of the order of a billion. Displaying video or audio is but one of the many applications that have to be done in a media processing application. Media processing\(^3\) often involves coding and decoding frames of image or audio data, compressing them or enhancing them.

While the previous paragraph might suggest that drastic measures have to be taken to enhance the performance of current day processors, a more pragmatic approach would be to borrow the wealth of ideas from the experience gained in designing special purpose Digital Signal Processors (DSP). Most multimedia applications operate on small data types i.e. 8-bit pixels, 8-bit color component of a color frame and 16-bit audio data. Also many of these applications perform certain operations repeatedly on these data types and have a lot of data parallelism (see *Box 1*). These have been the main features that have been exploited in designing special purpose hardware for DSP. In a conventional DSP one can add small pieces of hardware to meet the demands of the application. In a general purpose processor such an approach is not possible since the application is not known a priori. To remedy the situation the architects of media processing enhanced processors support operations on what are called *packed data types* in an SIMD fashion.

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1 Multimedia: Includes information media such as images, video, audio, text, 2D and 3D graphics and numbers.

2 Pixel (Picture element): The smallest element on a picture that can be manipulated in a graphics operation.

3 Media Processing: A term used to describe processing of digital multimedia information. It usually consists of encoding, decoding, dithering, enhancing and rendering multimedia information.