Emerging Trends in Home Computing

PC Enhanced Toys

A vision for tomorrow

Interactive Toys - a leading segment

Interactivity is playing an increasingly important role in toys. Over the last decade, toy designers have incorporated greater amounts of electronics to create interactive toys, and the interactive toy category is one of the industry's fastest growing segments. Early examples of interactive electronic toys such as Speak and Spell* and Teddy Ruxpin* captivated children who were thrilled to play with toys that could actually speak and respond to them. A particular category of electronic toys, known in the toy industry as Electronic Learning Aids, has exceeded $200M in annual hardware sales in the US[1] over the past two years.

Last year saw the emergence of a new toy category. So-called PC Enhanced Toys provide a richer and more compelling play experience when used with a PC. Two leading examples are the Talk To Me Barbie* from Mattel and ActiMates* Interactive Barney* and Friends from Microsoft. This year, the LEGO Group announced MindStorms*, an intelligent "brick" that children can program with the aid of a personal computer, and Microsoft expanded their interactive toy line with Arthur* and D.W.* In addition, PC peripherals such as the ComfyKeyboard* have been developed to make it easier for smaller children to interact with the PC.

What sets PC Enhanced Toys apart is their ability to use a PC to enhance the child's play experience. The PC can be used to "program" new capabilities into the toys, thus keeping the experience fresh and providing endless variety. Even though these toys can be played with on their own, they take on new abilities when connected to a PC.

PCs: A must-have item in the home

Another very significant trend is that children are spending more and more time using personal computers. PCs are now in over 40%[2] of US households. Furthermore, over half of the PCs sold in the US are bought by families with children. A growing number of kids are also getting connected. According to Jupiter Research[3], over 4 million children went online in 1996 and the number is expected to grow to greater than 25 million by the year 2000. Consumers now consider the PC as a "must-have" item in the home. All of this represents an opportunity and a mandate for the toy industry to develop toys that work with and alongside the PC.

The personal computer has also significantly evolved since the early multimedia PCs. Today's PC, based on the Pentium® II processor, is capable of arcade-quality 3D graphics, surround sound, laser disk-quality video and ample performance to make interactive play more lifelike and exciting than ever before. In addition, standard PC configurations include Internet connections that make it easy to go on line and connect with other users; for example, to share creative work such as greeting cards, or to play games with other kids.

Enhancing toys with the power of the PC

Easy access to the PC's abundant resources (computation, communications, multimedia, storage, etc.) will open up fresh possibilities for new toys as well as established favorites. Imagine, the following three near-future scenarios:

Jennifer has assembled a collection of her favorite dolls and is creating an animated story on her PC. She creates sets using a collection of backdrops and props and uses her dolls to stage the action. Low-cost Radio Frequency (RF) tags embedded in the dolls make it possible for the PC to track the movement of each doll in three dimensional space and render corresponding movements of animated characters on screen. Jennifer records the dialog and selects the voice that will be used by each character. Finally, she adds her choice of music, background noises and action sounds. The completed production can be proofed on the PC or played back in all its glory on the home theater system. If it's a keeper, she can share it with her friends over the internet.

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Tommy and his sister take turns using a PC Enhanced Toy robot. The robot has a

[1] Toy Industry Fact Book 1997-1998, Toy Manufacturers of America (*www.toy-tma.com*)

[2] Dataquest, November '97

[3] Jupiter Research (*www.jup.com*), 1997 Online Kids Report

wireless link to the PC and contains a small camera, speaker and microphone. The robot (with the help of the PC) recognizes each child's face and greets them by name.

Tommy is using the robot to help him with his guitar lessons. While tuning his instrument, the robot uses thumbs up/down signals to tell Tommy whether each string is sharp or flat. Tommy speaks the name of the piece he is working on, and the robot plays it through once so Tommy will know how it is supposed to sound Then Tommy plays the piece while the robot counts out the rhythm. When he's ready, Tommy tells the robot to accompany him, and the robot plays the accompaniment, matching Tommy's tempo.

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Tommy's sister also enjoys the robot. She's not in school yet, but loves to have the robot read her favorite books to her. She holds a Curious George book in front of the robot. The robot relays the image back to the PC where the book is recognized and the appropriate set of sound files (one for each page) are accessed. "Want me to read Curious George?" the robot asks. Then she sets the robot next to her and opens the book. As she turns each page, the robot reads the words in the voices of the various characters, complete with music and sound effects. She likes to have the robot help her learn her letters, shapes and numbers too. When she has the robot read her an alphabet book, the robot asks her to point to the letter 'D', and praises her when she does so.*

The technologies behind PC Enhanced Toys

To transform these scenarios from near future to reality, Intel is beginning to work with the world's leading toy manufacturers, and is an active participant in the Toys of Tomorrow research consortium led by MIT's Media Lab. Working together, these companies and others will strive to make the following ingredient technologies, as well as products based on them, widely available:

USB – ultimate simplicity for tethered connectivity

For simple and low-cost PC connectivity, the Universal Serial Bus cannot be beat. Already shipping on millions of home PCs, USB offers a no hassle, plug and play solution for toys that need occasional connectivity to the PC or that are used in close proximity to it. With up to 12 Mbps of capacity and built-in support for time-sensitive media streams, USB is ideal for toy audio and video, imaging, input from paddles and joysticks, connection to toy docking stations, etc. Complete USB design information can be found at *www.usb.org/developers*

Instant-on and instant comm

The power of the PC can only enhance the play experience if the PC is on and able to communicate. The time required to boot up the PC and launch needed communication applications puts a damper on even the most enthusiastic child. Fortunately, this will not be necessary, as PCs are expected to soon have full instant-on capabilities. When idle, the PC will drop down to a very low power state that gives it the appearance of being turned off. When a wake-up event occurs from, say, a toy being switched on or plugged in to a USB port, the PC resumes full-power operation and is ready for action within seconds.

IrBus – key to low cost, untethered communications

Infrared (IR) is a low cost, in-room, communications technology that has been used for years in the remote controls of consumer electronics. To date, most IR links have been unidirectional, and have not been standardized. Currently, Intel, and other members of the Infrared Data Association (IrDA), are working on a technology called IrBus, a, two-way wireless link operating at 75 Kbps that is on its way to becoming a standard. With an IrBus transceiver connected to a PC's USB port, handheld devices located almost anywhere in the room will enjoy robust connectivity to the PC. When an active IrBus device is sensed by the PC, the appropriate drivers are identified and loaded, and within seconds the device is ready to be used. This works even if the PC had been sleeping in its low-power state.

Prototypes of keyboards, mice, game pads and joy sticks have already been publicly demonstrated, and the plug and play drivers for Windows* are expected to be widely available. Visit *www.irbus.org* for more information.

For situations when a toy needs to work in rooms where no PC is available, a remote IrBus hub will be able to fill

the need. Such a hub will communicate back to the PC through the electrical wiring already present in the home. Installing such a bridge will be as simple as plugging it in to the wall and switching it on. The PC will sense its presence and use it to work with remotely-located IrBus devices, just as if they were in the same room as the PC.

Once IrBus becomes a standard, consumers will be able to use IrBus base stations and bridges with toys and devices from any number of manufacturers, thus eliminating the need for a single toy to carry the entire cost burden.

Whole-house RF – the power to roam

For devices and toys that need to work anywhere in the house and yard, even while wandering around, whole-house RF will fill the bill. Operating in bands such as 900 MHz or 2.4 GHz where no license is required, whole-house RF will provide up to 1 Mbps of bandwidth anywhere within approximately 150 ft of the PC's USB-connected base station.

Whole-house RF's greater versatility comes at a higher price point, however, and thus will be most appropriate for higher value toys. Again, because standards are emerging, the PC's RF base station will be able to be simultaneously shared by a number of compatible toys and devices, thus distributing the cost burden over multiple purchases.

More information can be found at *www.homerf.org*.

RF Tags for very low- cost, short range scenarios

There is a much shorter range and lower cost RF technology that will also be useful to some toys. Called RF tagging or RF ID, this technology is similar to that used by retail stores to prevent shoplifting. RF tag technology uses a very low cost tag device embedded within the toy or within some accessory associated with the toy. Some tags are passive devices, and hence do not require battery power to operate. Other systems use active tags, that allow the PC to sense location within three dimensional space. Also required is an active device that uses an RF signal to interrogate the tag and retrieve an ID code. This interrogation device is frequently built into a larger, less mobile part of the toy, which in turn is connected to the PC via a USB port, or via one of the longer range communications links mentioned above.

So, for example, when an army action figure is placed inside the fort, the PC will be able to become aware of this and adjust its associated audio and video presentations accordingly.

Always connected, high-speed Internet access

Today a significant barrier stands between the connectivity and vast information resources of the Internet and home applications that desire to access them. That barrier is slow-speed modem connections that typically take 40 seconds or more to establish. This barrier will be eliminated soon when ADSL and Cable modems become broadly deployed. These devices will provide full-time Internet connectivity at rates between 1 and 10 Mbps. A PC equipped with this technology will be able to provide instant connectivity for head-to-head games, and immediate access to web content. This in turn can then be made available to remotely connected toys via the various communications links described above.

Digital Cameras

An exciting area for easier interaction with the PC involves the use of cameras as an input device. Face recognition is one compelling capability that could be incorporated into a camera-equipped toy. The toy's camera would capture an image and relay it to the PC. Image analysis algorithms, designed to take advantage of the powerful Intel MMX™ instructions, perform the recognition operation and communicate the results back to the toy or to the PC application that is controlling the toy.

A different way to make effective use of a camera-equipped toy is gesture recognition. A wave or a salute could be used to make selections or step through the various toy actions. In this scenario, the toy would capture several successive frames and relay them to the PC, which again would do the algorithmic heavy lifting and supply the results.

Toys interacting with other consumer electronics devices

While the vision of toys and the family PC working together is certainly compelling, expanding this to allow toys to interact with home entertainment systems and other con-

sumer electronics devices throughout the home is even more exciting. Imagine the possibilities if toy audio were played with realistic three-dimensional effects through the family's surround sound home theater system, while at the same time custom DVD content was being played on the TV screen.

In order to accomplish this the PC would serve as an integration point between toys and other smart devices located within the home. Using standard interfaces and protocols, the PC will soon be able to configure and operate home entertainment components, and route media streams among them. Applications could then be written that combine the fun and spontaneity of toys with the familiarity and richness of consumer electronics equipment. Intel is fully engaged with the consumer electronics industry in specifying interfaces and protocols for interconnect schemes such as IEEE1394 and CEBus so that these capabilities can be realized.

The time is now

For toy manufacturers, the time to design these capabilities into next generation products is now. Home PCs are shipping with incredible amounts of power and capacity that is ready and waiting to be tapped by creative and imaginative toys. Communications standards are either in place or are rapidly being prepared, and the needed technology ingredients are beginning to appear. The results are lower costs and shortened development cycles for manufacturers who are ready to deliver the next wave of interactive toys.

To Inquire Further

This white paper can be found on the web at *developer.intel.com/ial/ind_init/pctoys*, where we also maintain up-to-date links for the other technologies and standards discussed in this paper. Visit this site frequently, since the area of PC Enhanced toys is evolving very rapidly.

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