

MACHINE DESIGN

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Talky toys listen up!

Loaded with sensors, servos, switches, and other high-tech stuff, today's toys push the envelope.

Amy Higgins
Associate Editor

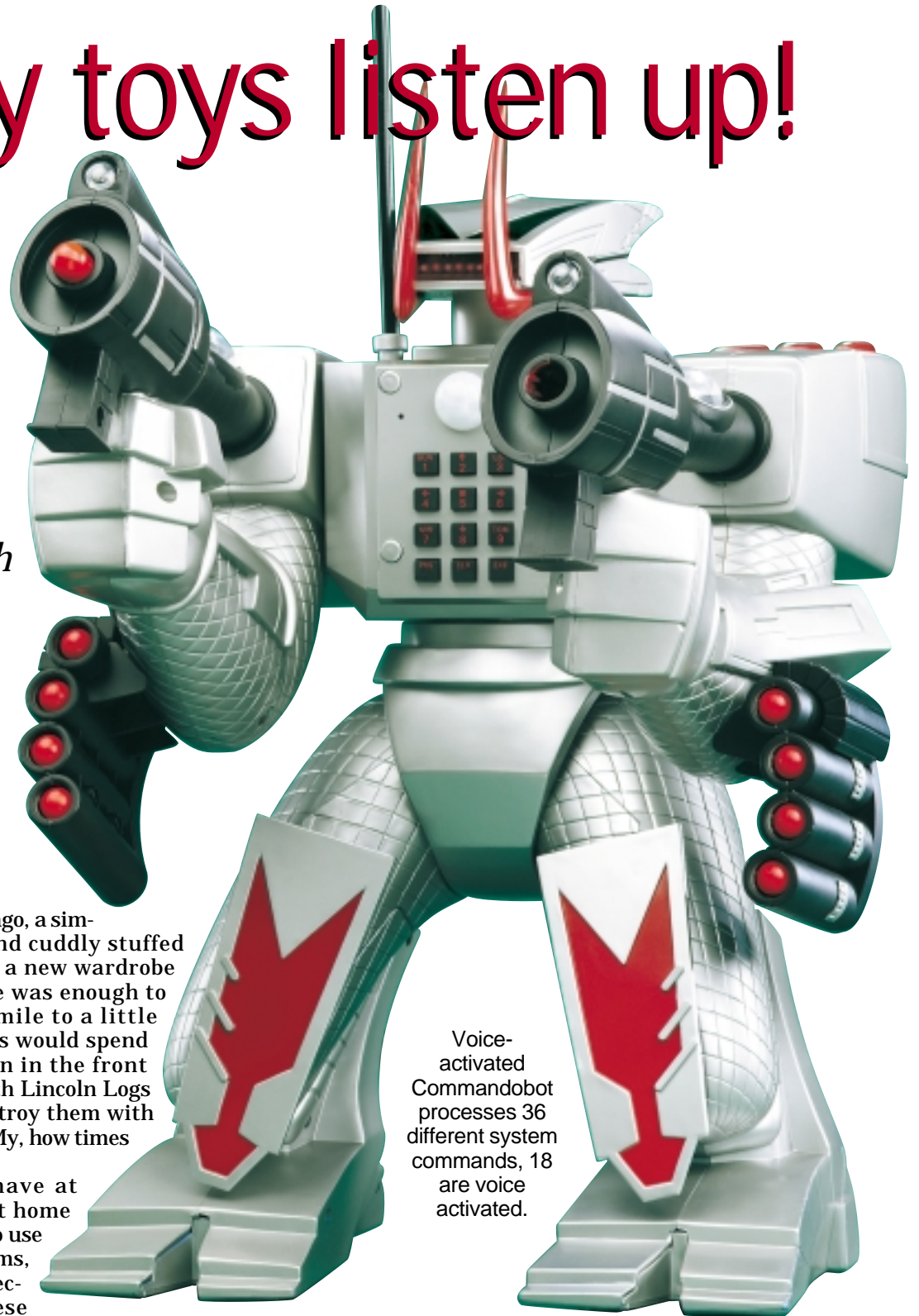
Not so long ago, a simple soft and cuddly stuffed animal or a new wardrobe for Barbie was enough to bring a smile to a little girl's face. Young boys would spend hours hunkered down in the front yard building forts with Lincoln Logs just to attack and destroy them with tiny green army men. My, how times have changed.

Now, many kids have at least one computer at home and several at school to use everyday. Kids, it seems, can't get enough of electronic technology these days. This has toymakers scrambling to bring more sophisticated offerings so they won't be disappointed.

Luckily for both toymakers and parents, electronics have become much more affordable and accessible in the last five years. Toy companies are using many technologies to create truly amazing toys with reasonable price tags. Some of the leading technologies being

Voice-activated Commandobot processes 36 different system commands, 18 are voice activated.

used today are radio and infrared communications, sensors, and voice-recognition chips. Toys embedded with the latter two essentially take on lifelike qualities. As it is, kids already talk to their toys whether they respond or not. But with sensors and voice recognition, dolls, for instance, actually react to touch, giggling when they are tickled, crying when they are



hungry, and cooing when they are happy, some even answering a child's simple commands or questions.

Thanks to huge technological advancements, high-tech toys not even possible five years earlier have become the norm.

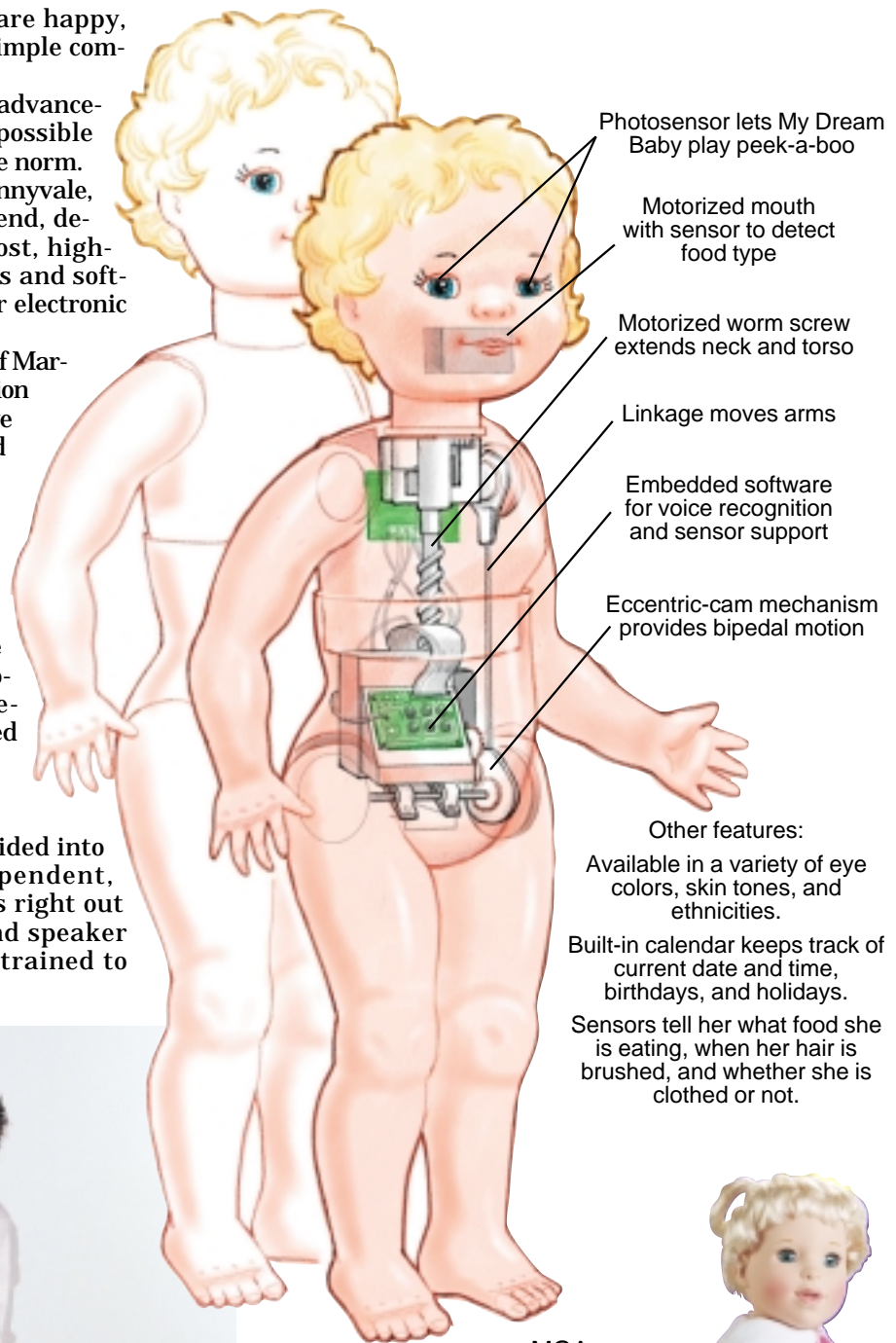
One company, Sensory Inc., Sunnyvale, Calif., has capitalized on this trend, developing small-footprint, low-cost, high-quality speech-recognition chips and software for toys and other consumer electronic devices.

According to Sensory's Director of Marketing, Erik Soule, speech-recognition technology is on a high growth curve right now because silicon prices and memory costs are dropping, algorithms are more sophisticated, and semiconductor technology is better than ever.

In fact, several toy companies are using Sensory's RSC 300/364 Series chips. These chips have fully programmable 8-bit micro-controllers on board with integrated speech, I/O, and embedded memory.

VOICE RECOGNITION 101

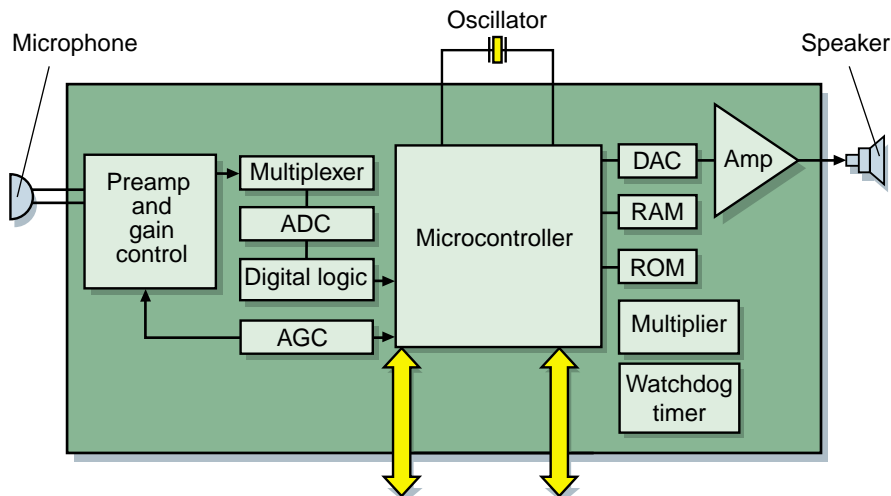
Speech recognition can be divided into two categories: speaker independent, which means the product works right out of the box without training; and speaker dependent in which the toy is trained to



- Other features:
- Available in a variety of eye colors, skin tones, and ethnicities.
 - Built-in calendar keeps track of current date and time, birthdays, and holidays.
 - Sensors tell her what food she is eating, when her hair is brushed, and whether she is clothed or not.



MGA Entertainment's My Dream Baby moves through four growth stages where she learns to speak, recognize her name, sing songs, recite ABCs, play peek-a-boo, and eventually gain a 500-word vocabulary, all while physically growing about 2 in.



Sensory's RSC-300/364 next-generation chip, used in MGA's Commandobot, runs a full suite of speech and audio functions.

General-purpose I/O
External memory

understand voice commands and so forth.

Beyond these basics, Sensory's chip has features that even smart toys aren't using yet. For instance, music synthesis lets the chip play four-voice music, that is, four instruments can play simultaneously. An audio record and playback feature essentially lets users operate the chip like a digital answering machine, and 16 I/O lines lets it interface to sensors, motors, and lights. In continuous listening mode, the chip is always on and needs no prompt or buttons pressed. Yet another function, word spotting, lets it recognize a word in the middle of a sentence.

"The chips offer a lot of flexibility

LEGO MY ROBOT

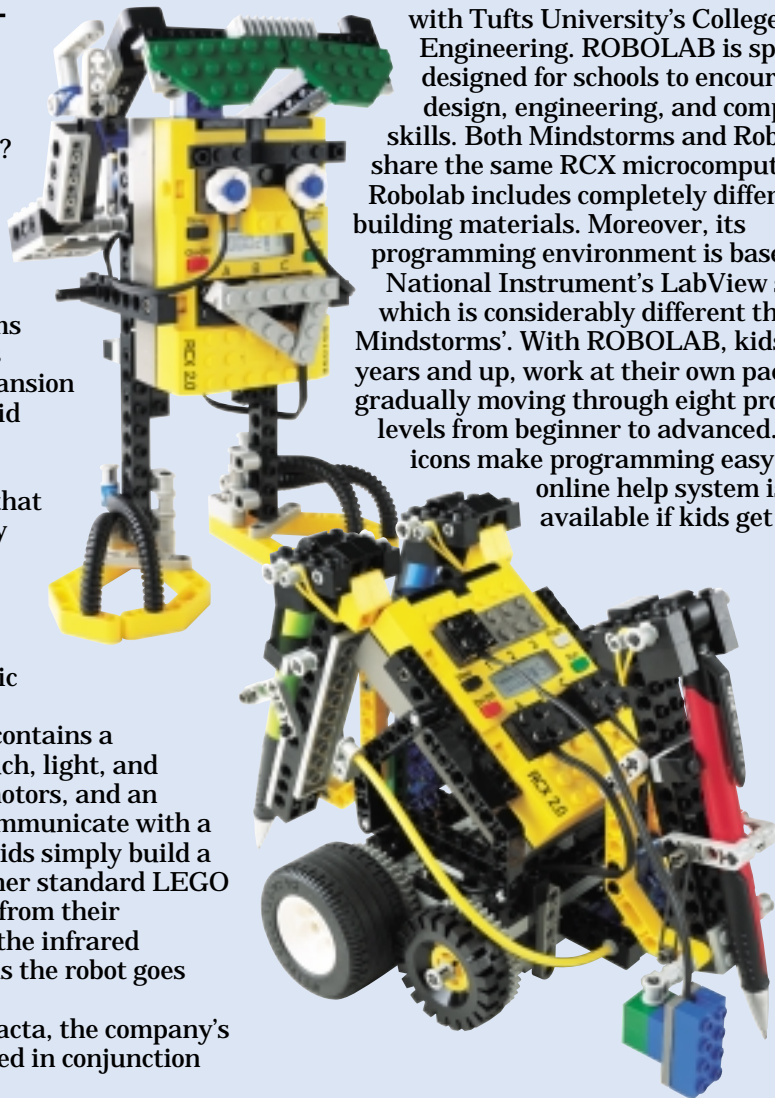
Secretly hoping your son or daughter will follow in your footsteps and become an engineer? Introduce them to LEGO Co.'s Mindstorms products and you might get your wish.

Developed in cooperation with researchers at MIT's Media Laboratory, the LEGO Mindstorms product line includes the Robotics Invention System (plus three expansion sets), Robotics Discovery Set, Droid Developer Kit, and the Ultimate Accessory Set. A new kit, Vision Command, lets kids build robots that actually see and hear using a fully functional PC video camera and built-in microphone.

All of these kits use traditional LEGO bricks, CD-ROM software, and what's called the RCX (Robotic Command Explorer) brick.

The programmable RCX brick contains a microcomputer equipped with touch, light, and temperature sensors, I/O ports, motors, and an infrared eye that lets the brick communicate with a PC via an infrared transmitter. Kids simply build a robot using the RCX brick and other standard LEGO bricks, then download a program from their computer to the RCX brick using the infrared transmitter. Sit back and watch as the robot goes through the programmed moves.

Another product from LEGO Dacta, the company's educational division, was developed in conjunction



with Tufts University's College of Engineering. ROBOLAB is specifically designed for schools to encourage early design, engineering, and computing skills. Both Mindstorms and Robolab share the same RCX microcomputer but Robolab includes completely different building materials. Moreover, its programming environment is based on National Instrument's LabView software which is considerably different than Mindstorms'. With ROBOLAB, kids, eight years and up, work at their own pace, gradually moving through eight program levels from beginner to advanced. Picture icons make programming easy but an online help system is available if kids get stuck.



Unlike other robotic dogs on the market, Me and My Shadow is soft like a traditional stuffed animal.

for interactive toys because the person writing the software can pick and choose only the functions they need," says Soule. "This also saves memory and lowers cost."

BIONIC BOTS

MGA Entertainment, a growing toy company in North Hills, Calif., is using Sensory's voice-recognition chip, among other technologies, to build spying robots, obedient puppies, and babies that actually grow. Honestly, who would have ever thought they would see the day when a baby doll would not only recognize her name and obey simple commands, but physically and emotionally grow from a crawling infant to a walking toddler? Ladies and gentlemen, meet MGA's My Dream Baby.

Much like real babies, My Dream Babies are individuals, available in a variety of hair and eye colors, skin tones, and ethnic backgrounds. Dream Babies run off three C-cell batteries and one 9 V. Once she's been loaded up and turned on, My Dream Baby immediately prompts for programming saying, "Now its time to name your baby." Once a name has been established and verified, a simple programming sequence follows so parents can set the current date and day, and the birthday and holidays the child celebrates.

My Dream Baby is highly interactive, moving through four growth stages where she learns to speak, recognize her name, sing songs, recite ABCs, count, play peek-a-boo, and eventually gain a 500-word vocabulary, all while physically growing. She even recognizes what food "mom" is feeding her and specifies what she wants to eat, also knowing if she is clothed or not, and when her hair is brushed.

Mechanically speaking, Dream Baby is simply a work of art. Inside are three motors: one for walking, one for growth, and one for mouth movement. Crawling and walking are accomplished using eccentric cams. The cams shift weight to one side of the doll while the arm and leg on its other side move forward. Then the weight shifts again to its other side, allowing the doll to crawl and walk.

While crawling and walking comes naturally to humans, it took plenty of effort to give a doll the same ability. According to MGA Entertainment's CEO, Isaac Larian, five teams of mechanical engineers, two in Hong Kong and three in the U.S., spent 11 months, and 1.8 million dollars, tackling the walking feature.

Says MGA's project manager, Jonathan Buford, "Bipedal motion is really kind of a holy grail in robotics. I show our doll to my hard-core roboticists friends and they are amazed saying, 'how did you do that?'"

In addition to the motors, cams, and electronics packed inside Dream Baby's body is a worm screw running along the length of the torso used to make her grow. "One end of the worm screw stretches the lower torso down and away from the middle section," explains Buford, "while the upper portion telescopes the head and the neck." All in all, Dream baby grows about 2 in.

In a long list of firsts for this doll, she is also the first baby doll with such features to retail for just under \$100.

MGA is using similar technology in some of its other high-tech toys. For instance, Me and My Shadow, a plush voice-recognition puppy, responds only to his master's voice, obeying 10 commands including come, sit, left, right, speak, and tug-of-war. Inside, the gearbox that accomplishes these feats in this \$60 toy is incredibly intricate, says Buford. In basic terms, driving the motor forward activates one set of gearing, while driving it backward activates another. In reality, it's more complicated than that. For example, as the motor drives backward, a gear rotates for one or two revolutions and then engages another mechanism that allows

Fisher-Price's electromechanical robotic puppy, Rocket the Wonder Dog, responds only to its owner's voice. An IC preprogrammed with motion sequences



lets him walk, pant, scratch fleas, and move his eyes and eyebrows. Sensors on Rocket's legs, neck, and eyes track his position for each motion.

Shadow to sit down. Then, the motor is driven forward to let Shadow sit back up. As it continues to drive forward, yet another mechanism engages, allowing forward walking. The steering mechanism is based on Ackerman steering which is markedly similar to rack-and-pinion steering in a car. The system consists of four-bar linkages for each leg and a universal joint for the front legs, which not only lets the legs rotate but also move forward for walking.

From a kid's standpoint, operating Me and My Shadow puppy is easy. They simply slip on a small headset, imprint their voices, turn Shadow's power switch to on, and wait a few moments while he goes through a series of movements, barks, then waits for a command. Communica-

The newest voice-activated gadgets from Radica USA's Girl Tech line include a real, working Password Phone, and Password Notes, a portable safe for keeping secret items secure. Both items respond to only one *girl's* voice.



tion is accomplished by infrared technology: The headset includes IR-transmitting LEDs while Shadow's eyes are made of an IR-transmissive plastic.

At a development cost of more than \$2 million, MGA also introduced an 18-in. voice-activated robot. Commandobot, as he is called, employs Sensory's advanced RSC-300 speech-recognition chip and can process 36 different system commands, 18 being voice activated. The commands are radio transmitted through a combination remote headset and antenna that functions as far as 50 ft away and out-of-sight range. Commandobot can be directed to emit sounds, launch missiles, blink laser-like lights, and move in any direction. The robot takes advantage of speaker-dependent voice technology, learning to respond only to its "master's" commands. And, for all you paranoids out there, Commandobot features a walkie-talkie that operates in "spy mode." Here, the robot can transmit conversations in one room to its master, who listens from a remote location. The master controls all robot functions, though in-robot sensors establish where

the upper torso is located in relation to the lower torso, keeping them aligned. Engineers are now working on a more intelligent version. Actually, behind many of MGA's developments is ongoing robotic research at Carnegie Mellon University.

MECHANO MUTT

Other companies have similar high-tech toys on the market. Fisher-Price has recently introduced Rocket the Wonder Dog, an electromechanical robotic puppy that, like Me and My Shadow, responds only to its "owner's" voice — through Sensory's voice-recognition technology — with lifelike actions, emotions, and sounds. Rocket, retailing for \$120, uses an IC preprogrammed with motion sequences to walk, pant, scratch fleas, and move its eyes and eyebrows. Sensors on Rocket's legs, neck, and eyes track his position for each motion. A child simply chooses which action he would like Rocket to do, and the programming creates variations in the way he responds. Rocket also has touch

sensors in his nose, mouth, and back to detect when he's being fed, petted, and when he's on a collision course with a wall. Communication through Rocket's PPT (personal puppy trainer) uses IR transmission similar to a TV remote.

Rocket performs 12 actions plus additional variations that let him move or express himself in more than 30 different ways — he can speak, beg, and even stand on his head — anything for a treat! Electric motors with belt-driven gearboxes and torque-limiting clutches are used to keep noise down while providing adequate torque and speed for his many movements. Rocket was styled in Alias and then engineered using Pro Engineer design software.

GIRL POWER

Radica USA, a Dallas-based electronic game manufacturer, is satisfying a girl's need for privacy by incorporating high technology into its Girl Tech line of toys. These popular gadgets include Password Journal, Password Doorpass, and most recently, Password Phone, and Password Notes — all employing Sensory's voice-recognition technology. Password Notes is a portable safe that keeps notes or other items secret and can only be opened by one owner's password. Password Phone works off the same principle but is actually a real working phone in which girls can create a voice-activated personalized friends list of up to 10 numbers. In case of an emergency, a safety feature lets the phone bypass the password in order to make a 911 call. ■

To get your hands on these and other cool toys in time for Christmas, check out:

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What related topics would you like to see covered? What additional information on this topic would you find useful?

Sure, toys aren't what they used to be, but is that so bad?



Amy Higgins
Associate Editor

Let's go back to the days when popular toys consisted of Lincoln Logs, baby dolls, and Styrofoam airplanes. Basic toys left plenty to the imagination. Kids would have to imagine their dolls walking, talking, crawling, and being potty trained. How many readers spent their weekends setting up plastic army men and make-believe forts, then bombing them to smithereens with whatever stray block was available? Remember when a toy laser gun and a goofy plastic helmet made you an astronaut?

Fast-forward to today. Video games and high-tech toys such as those described in the preceding article contain

more computing power than that available to the real-life astronauts who set foot on the moon.

Some may believe that the recreational wizardry available for children today does nothing but stifle the mind, leaving very little at all to the imagination. True, kids are less likely to build a fort with sticks or bend balsa wood a certain way to achieve more stable flight for a two-piece airplane model. But another school of thought holds that, given the gee-whiz factor of today's toys, children may actually learn the tools required to succeed in a high-tech world. Is it possible that immersion in the wonders of science and engineering by the very young may lead to new generations of thinkers who continue to push the envelope? Time will tell.

But in the interim, before you get the urge to say, "Kids today...they don't know what hard work and simple pleasures are," show a little faith. After all, that phrase has been around for generations, and through it all humanity has managed to move ahead, live longer, and continue to develop. (I picture a scene probably played out thousands of years ago as an older generation laments of the younger, "Kids today, with their fire and stone tools, don't know what hard work and imagination are.")

So, at the next birthday or holiday, when you give a high-tech toy to Susie or Johnny, take a minute or two to explain why it works the way it does. Of course, the key is not to throw a toy in front of a kid and walk away. Instead, like anything in a youngster's life, parental involvement and mentoring are musts. And as they play for hours and hours with their new gadget, the seed of knowledge and sense of wonderment may grow. For sure, attributes such as these will serve humanity well.