Type It Anywhere

An alumni reunion leads to technology that could banish undersize keypads

By MIKE MAY

In 1998 two inventors, Nazim Kareemi and Cyrus Bamji, struck up a conversation with an informal gathering of alumni from the Massachusetts Institute of Technology in Santa Clara, Calif. Bamji mentioned his concept for controlling electronic devices from a distance—in essence, a new form of remote control. "This idea was humming in my head for some time," he says, "but it didn't gel."

Kareemi, an electrical engineer who had founded PenWare (now owned by Symbol Technologies), a producer of machines that record signatures electronically, took a pragmatic interest in the problem. His experience in the technology business complemented Bamji's ongoing supply of ideas, making the two an ideal team. For his part, Bamji is a jack-of-all-trades and an expert at most. He earned a collection of degrees, from math to computer science, plus a doctoral degree in electrical engineering and computer science, from M.I.T. Then he worked as an architect of electronic devices and systems at Cadence Design Systems in San Jose, Calif.

The two men followed up on their original discussion by starting to think about developing a low-cost gadget that could make a three-dimensional map of its surroundings. After pondering that problem for half a year, they decided that an ideal application would be a virtual keyboard: an image of "q," "w," "e," "r," "t," "y" and the other keys projected on a desktop, where someone could press down fingers. The sequence of keystrokes would be recorded by a nearby personal electronic device or a cellular phone equipped to send electronic mail. The apparatus would register which key had been pressed by using a three-dimensional depth map, which provides information about where a particular key is located.

VIRTUAL KEYBOARD projected onto a tabletop allows a user of a personal electronic device to type faster and more comfortably than with input devices furnished by the manufacturer.

This invention was conceived early in 1999, but financial backing for their brainchild did not come readily. "We presented the keyboard idea to a couple of venture capitalists," Bamji says. "My recollection is that they merely smiled." Yet Kareemi and Bamji believed in their invention, and by April they and an engineer colleague, Abbas Rafii, launched a company called Canesta, based in San Jose, Calif. (The company name is an acronym made from the given names of the founders, plus a few added letters to give it a ring.) They funded the company themselves for a year and then, in 2000, went after their initial round of venture capital and raised $3 million. By that fall they had gone as far as to concoct a working version of the keyboard.

To devise a way for electronics to see in three dimensions, the team wanted to

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avoid mistakes made by others who had pursued similar technologies. Earlier researchers who had attempted to create 3-D images had relied on dual cameras and compared images pixel by pixel, a method that demands considerable computer processing. "We took a step back," Bamji explains, "and tried to have a more holistic approach. We needed a 3-D sensor to get away from problems with interpreting light from dark."

Just such a sensing apparatus was incorporated in a product, the Integrated Canesta Keyboard, and introduced in September at a mobile and wireless conference. The product became one of several virtual keyboards that are entering the market.

The electronic guts of this keyboard lie in the Canesta Keyboard Perception Chipset, which includes three parts: a pattern projector, an infrared light source and a sensor. The pattern projector uses a small laser, only nine millimeters on each side, to produce what looks essentially like an ordinary keyboard on a desk. The light gets projected so close to the surface that the user's fingers do not even block it until they touch the desktop. The cylindrical infrared source, a mere 6.5 millimeters in diameter, sends out a beam of infrared light, which bounces off objects and returns to an infrared sensor, an array that can be as small as 100-by-20 light-sensing pixels and that takes up as much room as a pea. When the infrared light is turned on, a timer starts at each pixel, and it stops when the light returns. The time gets converted to distance—how far the light traveled before it hit something—such as a finger touching a virtual key on a tabletop. The sensing mechanism is radar with light.

The collection of distances from the array of pixels provides a 3-D map of the area scanned. Moreover, this device can survey its surroundings more than 50 times every second. Like the pattern projector, the infrared light stays close to the surface. The sensor's view can get blocked if a user hits two keys at once that are exactly in line from the sensor. That happens rarely. But if it does, the keyboard's software makes the shift key "sticky," so even if it gets blocked by a finger on the E, the keyboard will interpret it as the two keys hit together.

The Canesta Keyboard Perception Chipset, according to Kareemi, will cost only tens of dollars, much less than the roughly $80 that current compact keyboards cost for PDAs, and it is now available in sample quantities to companies that will put the chips in their products. The chips are expected to be incorporated in cell phones, PDAs and other electronic products beginning in the first half of 2003.

The first users found it somewhat disconcerting to type without tactile feedback from the virtual keys. So the inventors added click sounds when someone taps a virtual key on the Integrated Canesta Keyboard. As a result, Kareemi says, "it takes 10 to 15 minutes to get used to the virtual keyboard, and then you can type very fast." To find out how fast, Kareemi and his colleagues gathered a group of 20 people who regularly use cell phones, computers and PDAs. On average this group scribbled out 14 words a minute on devices that get input from a stylus, increased that to 25 words a minute on thumb keypads and climbed to 45 words a minute on Canesta's keyboard. The same group, though, pounded out an average of 65 words a minute on an ordinary keyboard. So it seems to take users some time to get used to typing in a virtual world.

Twenty people who regularly use electronic devices typed faster on the Canesta keyboard than with a thumb keypad but slower than on an ordinary keyboard.

The applications, however, go far beyond keyboards. Instead of watching only a person's hands, a Canesta 3-D map could observe an entire person. If the technology were added to a kung fu video game, for instance, a user could stand in the middle of a room and kick and chop as a figure on the screen mimicked the movements. It could also be built into a car to see if other drivers got too close or if a child were in the front passenger seat and the airbag needed to be turned off. Kareemi says, "It could even see if someone was sitting with their legs on the dashboard, and then it could set off the airbag differently in an accident. We can do that easily." Canesta is currently discussing these technologies with three leading automakers, but their names remain secret.

Kareemi and his colleagues have already been granted one patent, and 29 more have been filed. The big question that remains is whether PDA and cellphone users are willing to embrace the typing of e-mails, memos and addresses on the bare surface of a diner lunch counter or an office desktop. SA