

# 'Special' Technologies Make The World More Accessible To All

Various technologies, products and services are available today that supplement the abilities of specially-challenged people, enabling them to lead life on par with the others. Here we look at some of such technologies from India and outside that serve as an inspiration to those willing to adapt existing technologies or develop new ones for people with special needs



Access4Kids wireless input device

JANANI GOPALAKRISHNAN VIKRAM

**A**ccording to a recent report in *The Guardian*, titled 'Technology Makes Higher Education Accessible To Disabled Students,' technology plays a huge role in bridging the gap between special and normal people. It cites America's Student E-rent Pilot Project (STEPP) as an example. The programme offers e-textbooks specifically modified for accessibility. In a subsequent survey of 1185 students, 77 per cent reported having saved money by renting their textbooks, and 80 per cent who needed

an accessible textbook were satisfied with the quality of accessibility.

This is just one example of how technology makes life much simpler, more exciting and normal for people with various disabilities. There are a variety of electronic aids like hearing aids, implants, prosthetic limbs, assistive canes and wheelchairs that help special people overcome their disabilities. Today's operating systems are accessible to people with hearing, visual, comprehension and other impairments. Technologies are available that enable challenged people to play great music. Specially-designed user interfaces and devices help autistic

children to use touchscreen-equipped computers. Advanced text-to-speech converters and a vast library of audio books enable visually-challenged people to complete higher education smoothly. Speech, auto-recognition and other technologies enable special people to use ATMs and other facilities in much the same way as others do.

Identifying the need, assessing the requirements in detail, developing suitable technologies and testing them is an intense task. It is quite different from developing normal technologies. Designers and developers of special technologies need to have an empathy and complete understanding of the requirements, behaviour and usage patterns of the people concerned. They need to keep the product cost-effective and simple. The product needs to be tested with the target users, with complete patience and understanding of their sentiments. Whenever possible, the product must also be adaptable to the needs of people with other kinds of impairments. (In fact, this is a consideration that developers of mass-market products should also keep in mind.)

Developing technologies for special people requires as much thoughtfulness and people skills as technical prowess. The results, of course, are worth the efforts, as such projects offer total 100 per cent personal satisfaction.

We salute the special people of this world, who march ahead, succeed and make things happen despite all odds. And, the technologists who help them do so. Whilst it is not possible to speak of all or even most of such technologies, here we have chosen and described a handful of them that seemed different.

## Voice-guided ATMs for the visually-challenged

"India has one of the largest visually-impaired populations in the world. The Reserve Bank of India, in its circulars in 2008 and 2009, stated that all banking services including ATM cards should be offered to customers with disabilities, and without any discrimination. NCR Corporation—India's largest ATM manufacturer—wanted to reach out to this population and give them a chance to transact independently. Through research, NCR understood the banking challenges that a visually-impaired person usually faces and thereafter developed the Talking ATM—a customised ATM that will benefit such customers while also maintaining the safety of the transaction. We've been in constant discussions with the Xavier's Resource Centre for the Visually Challenged (XRCVC) to identify the needs of visually-impaired people before launching the Talking ATMs," says Navroze Dastur, managing director, NCR India.

The Talking ATM is also attractive to banks because they don't have to issue any special cards—a regular ATM card will work on the Talking ATM too!

NCR's Talking ATM uses a text-to-speech engine, which allows voicing-out the text on the screen in multiple languages for consumer convenience. This machine is incorporated with unique software and hardware features that ensure that a person with a disability can operate the machine on his own while maintaining the safety of the transaction. It comprises accessible keypads and Braille stickers too.

When a visually-challenged person attaches his headphone set to this ATM, he can hear the instructions, which enables him to fill-in the required data using the numeric keypad. Apart from reading aloud screen messages, the machine provides complete orientation, making it easy for the customer to use the machine.

An important security feature of this ATM is that it provides the person an option to blank out the screen as a safety mechanism to avoid shoulder-surfing by bystanders.

The system is completely Access for



Union Bank Talking ATM for visually impaired (Courtesy: [www.addressofwealth.com](http://www.addressofwealth.com))

All (AFA) compliant, and also includes ramps for those with other physical disabilities. Banks can also make their existing ATM network AFA-compliant by customising the ATM software stack and upgrading the hardware configuration of the ATM fleet.

NCR has showcased its 'Talking ATM' at different workshops conducted by XRCVC over the last couple of years. "In June 2012, NCR got the order of a hundred Talking ATMs from the Union Bank of India for deployment in passport offices and other UBI branches across India. This shows that Indian banks and financial institutions are quickly realising the need to adapt self-service technologies to include millions of differently-abled people into the financial stream. NCR is committed to helping these institutions by providing innovative technologies, most of which are conceptualised, created and manufactured in India," says Dastur.

These ATMs can be procured from, deployed and serviced by NCR. Any financial institution can upgrade its existing ATM to a Talking ATM by making minor changes in the hardware and software configuration, which is not very expensive. Thus the price of the ATM depends on the features added and the scale of the ATM roll-out.

## Touchscreens and virtual reality open new windows for autistic children

Autism experts feel that touchscreen technology is a boon to children with Autism Spectrum Disorder (ASD), as it helps expand their skills and explore new worlds all at the touch or even

bang of a button! Of late, we saw a lot of groups developing smartphone-based apps and devices for young children with autism.

Access4Kids, for example, is a wireless input device for children with fine motor impairments. Developed by Ayanna Howard, Giancarlo Valentin and Hae Won Park from Georgia Tech, the device may be worn on the forearm or placed on a wheelchair arm. It includes three force-sensitive resistors that measure pressure from physical movements such as rough hits or swipes, and converts them into fine-motor gestures that translate to touchscreen commands.

Coupled with an Android-powered tablet computer and a special software stack, it becomes a holistic therapeutic system for children lacking upper-body control. The open source software library developed by the team is a critical component of the system, as it enables the kids to access popular applications like Facebook and YouTube as well as custom-made apps for therapy and education. The first prototype has been successful, and clinical trials are likely to begin this year.

This year's *Consumer Electronics Show* also showcased several products with features that could be used by autistic children too.

One interesting example is Big Bird's Words, which could help parents of special children to convert nightmarish shopping trips into fun-filled learning experiences. The outcome of collaboration between Sesame Street and Qualcomm, Big Bird's Words lets kids use their parents' phone to scan the world around them for printed words. Big Bird then helps them learn to read by sounding out the first letter. For example, when you go shopping, you could get the kids to match the items on your list (preloaded into your mobile as images) with the boards on the shelves. The game starts by asking the users to pick a word with an associated image. The users then have to find that word in the real world by pointing the camera of the device at the text.



Nabli 2 tablet (Courtesy: [www.nabli2.com](http://www.nabli2.com))

Nabli 2 is a tablet with an integrated learning system that helps parents of autistic children to gain better control over the time that the kids spend with technology. The tablet has features such as the Chore List and Treasure Box that integrate incentives into a child's playtime.

Nabli 2 uses a basic token system in which predetermined chores are set. The list can be changed over time as kids finish playing with the loaded activities. It also allows parents to use a timer that prompts children to hand the tablet over to a parent or sibling after a configured duration of time is over. This is very helpful in the case of autistic children, because once they get comfortable with a technology there is a constant fear of them getting addicted to it.

Another interesting product is NeuroSky's Focus Pocus—an interactive game controlled by the player's brainwaves. Priced less than \$100, the goal of this product is to help people with concentration problems, especially children with Attention Deficit Hyperactivity Disorder (ADHD), to improve their impulse control, attention span and memory. The device utilises EEG to read brain wave states, electrophysiological activity and metabolic rate—and converts changes in these into instructions for the play characters to follow. Hence the children have to concentrate in order to get the characters to do what they want.

However, it is important to note that great care has to be taken while developing tools for special children—as one problem could lead to another. At last year's Icare4Autism's Interna-

tional Autism Conference, Professor Tamar Weiss of the Haifa University expressed her concern that while kids are attracted to technology and it could help them discover new concepts, it comes with a huge risk of them becoming glued to the devices for long hours ignoring social interactions—which is indeed more important for such kids. She explained that the trick is to devise games or activities that can be played on accessible touchscreen devices but involve more than one player. Her team, along with another at the University of Trento, is using Mitsubishi's touchscreen table, to devise several activities and puzzles that will draw autistic children out of their shell and improve their social skills by encouraging them to play in teams or with more than one player.

### An indigenous iPad application for children with ASD

Last year, SAP Labs India unveiled an iPad application called Bol that helps autistic children to learn and communicate better. This simple, easy-to-use application was developed by the team based on their experiences in working with the Autism Society of India for over a year. The application is highly user-friendly and customisable to suit the needs of autistic children in India.

Jayananda Kotri, product manager, SAP Labs India, says, "Working with ASD-affected children has been a learning experience throughout. We learnt to respect their disabilities and appreciate the special skills they possess. Our first step was to explore the use of technology (primarily tablets like iPad) to assist them in learning through their formative years. We realised that the biggest challenge families of ASD-affected children face is to make them independent from their support so that they can lead a normal life. We realised soon that communication is a primary need and is surprisingly least addressed in the available applications. There are only a handful of apps available, which are also expensive

and localised to a Western audience. For example, the available apps had references to Western food items like burgers and kiwi fruit with an American voice-over, which gave an unfamiliar experience to the children. We conceptualised this communication app with a goal to make it available to all, free of cost, language, accent or region."

Bol, which can be downloaded for free from <https://itunes.apple.com/us/app/bol/id579955668>, integrates two key elements—auditory (record a voice-over description) and visual (take a picture). This allows autistic children to not just associate objects with sounds but also gain a comprehensive understanding of the materials being taught to them.

Kotri explains that the app uses pictures and voice for effective communication. The interface primarily displays a set of images in the form of a gallery/flash cards for learning or communicating. Pictures can be added into the app from a photo library or by taking a photograph using the built-in camera. Speech capability comes via voices that can be recorded to give the app a more human and personal touch or using the default text-to-speech (TTS) converter. The app stores everything into one file, which can also be exported via iTunes for backup. Future versions will allow sharing as well.

The app includes several small but significant features developed with a close understanding of the needs of ASD-affected children. For example, the app enlarges the image or item touched and also plays the recorded voice to enable them to communicate with others or for reinforced learning. If there are further items under that category, those are then displayed below that. This needs no special training. A child can explore everything on his own. The voice recording capability helps the app to connect to the child in a better manner giving a more personal feeling. The overall user experience is kept very simple and clutter-free to avoid distraction.

When asked about current work on this, Kotri says, "The Android version of the app is under development

to address affordability of the devices. An online free resource called DAKSH that caters to the computer skills training and special skills related to ASD has been hosted at <http://www.learn4autism.com/>. This also allows people to collaborate and share content, specific to the field of autism, with each other. We aim to make this the largest free content resource for the field in the coming years. There are a few other initiatives that are at a very early stage focusing on other special needs."

### Automated prescription reader for visually-challenged patients

En-Vision's ScripTalk Station is an automated prescription reader for visually-impaired, dyslexic and illiterate users, who find it difficult to read the label information on prescription medication. It uses radio frequency identification (RFID), TTS technologies and Analog Devices' Blackfin processor to transform drug-label printing into audible, spoken words.

When a sight-impaired patient places a prescription bottle on the ScripTalk unit, a digitally-generated voice reads out the prescription label loud, clearly communicating both the drug name and the recommended dosage. As a result, people can manage their medical needs in a safe and private manner using a technology that is easy and affordable.

ScripTalk is a light-weight, portable, battery-powered device. Pharmacists connect the base station to a computer via a USB or serial port and upload prescription data from standard pharmacy-management software to the En-Vision device. With the press of a button, a special RFID-tagged label is encoded with all warnings, side effects and the patient's personal information. At home, the sight-impaired patient uses a similar device to hear the label information.

En-Vision partnered with Mistral Solutions, a concept-to-deployment design engineering firm based in India, to develop ScripTalk. They chose the Blackfin processor as it met all their needs in terms of price, power consumption, processing performance,



Bol categories

peripheral interfacing and technology-ecosystem. Mistral was able to leverage its rich experience with Blackfin processors to enhance the ScripTalk Station's marketability by integrating multi-lingual TTS using Nuance RealSpeak for high-quality speech processing.

Narayanan Bhattachiripad, senior vice president-Product Engineering Services, Mistral Solutions, says, "ScripTalk was developed to cater to the needs of the visually-challenged. The solution, developed for the US-based En-Vision America, is an RFID tag based prescription reader. The reader eliminates dependency on human assistance for taking prescription medication. The prescription label information is programmed into RFID tags and pasted on drug containers used by patients. Patients use their own private ScripTalk Station Reader to read the label information, including medication name and dosage, instructions, warnings and other prescription details."

He also explains that containing the overall cost of the product was extremely critical as it dictated how well the product would be received in the market. Given its cost-effective core, Blackfin was found to be the best fit for this requirement.

Kanethi Srinivas, Processor and DSP Applications director, Analog Devices, explains, "One of the simplest ways to reduce the cost of a device is to combine

separate devices into one. With the programmable Blackfin processor, En-Vision found a single device that can simultaneously implement control functions and TTS processing that requires significant amount of DSP processing, reducing time-to-market, as well as bill-of-materials (BOM) and development costs. With Blackfin's on-chip power-management feature, designers were able to fine-tune the processor's power consumption profile without using an external power management IC."

As regards ScripTalk's USP, he says, "The product is lightweight and portable and works with any prescription in multiple languages. This works well with the visually-challenged, who have to refer to their prescriptions that are usually not embedded with the Braille script."

ScripTalk is used extensively in the US. Its developers have a tie-up with leading pharmacies like Walmart and CVS, providing ScripTalk an immense reach in the US market. The number of patient readers out in the US is now over 15,000. Today, patients obtain their reader for free, with a large pharmacy network partnering with En-Vision. Although the product is currently not available in India, En-Vision is fast expanding its markets globally.

### Making music truly universal

Music is solace for the soul, for all. There have been brilliant examples in the past, of people with disabilities taking to music like fish to water. The famous solo percussionist, Dame Evelyn Glennie, for example, lost her hearing at the age of 12. Yet, she learnt to 'feel' the sound through sight, vibrations, etc, and went on to become one of the world's most renowned percussionists.

Thankfully, things are much easier today for people with disabilities who wish to learn and play music. Technology has helped prove that music is felt rather than simply heard—and if a special person has an innate talent, she can definitely bring it out for the world to see. There are, for example, apps that turn the iPad into touch-sensitive



synthesisers, movement-to-audio converters, etc., so people can create music without depending on sight, speech or even hearing!

Then, there are people such as Doug Briggs, the pioneer of the term Assistive Music Technology (AMT), who are constantly developing new products or customising existing ones to enable special people to tap the talent within them or to help established musicians who are suddenly crippled by an illness or accident.

Briggs, along with his Adaptive Music Technology Research Group (AMTRG) at Huddersfield University, has adapted many pieces of existing technology for special needs education. A graduate student at their centre, for example, has developed an iPad app with a very simple and intuitive interface for controlling surround sound by drawing a path, then manipulating it with the iPad's two-finger squeeze or three-finger rotation. It is easy for everybody to use, and can also help a person who can move only three fingers to control the mix.

In a recent article in *Sound on Sound* ([www.soundonsound.com](http://www.soundonsound.com)), Doug Briggs explains that AMT involves three stages: input stage, processing stage and output stage. This is kind of similar to a typical modern digital recording situation where the input corresponds to playing an instrument, processing to sequencing and/or processing, and the output to listening to your mix.

### A hearing aid that relies on vibrations

Med-El recently launched Bonebridge—a vibration-based hearing implant developed in collaboration with a London-based hospital. Bonebridge is surgically embedded under the skin, into the



Bonebridge—a hearing implant launched by Med-El

temporal bone. An external microphone worn under the hair captures sound and sends it to the implant, which transforms the noise into vibrations. The vibrations are transmitted to the inner ear, where they are processed into natural sound.

With Amadé BB audio processor, Bonebridge features the latest signal processing technology for improved auditory experience. As the audio processor can be renewed, the Bonebridge system can also be upgraded with state-of-the-art technologies, even many years after the implant surgery.

The specialty of this device is that it enables sound transmission directly to the inner ear by means of bone conduction. It is a suitable solution for people in whom sound cannot be transferred to the inner ear via the natural path of hearing through the outer and the middle ear. Plus, since the microphone is worn under the hair, it is not seen outside either.

The device has been approved for medical use in Canada, and costs between \$3000 and \$5000.

### An all-new mobility platform

Matia Robotics has developed the Tek Robotic Mobilisation Device (Tek RMD) as a brand new mobil-

ity platform that brings exciting new possibilities for individuals with paraplegia and other walking disabilities to move around. It enables them to independently and safely sit, stand and navigate environments that were once inaccessible. It also overcomes many of the disadvantages of wheelchairs.

For example, wheelchairs can only be front-mounted. This is a problem because when a person is sitting, his front side is always free and his body is always resting on his back. So he has to lift his body with his arms and throw himself onto the wheelchair in order to transfer himself from a bed or a chair. This motion of throwing the body is difficult, dangerous and almost impossible to do without assistance, especially for older or overweight people.

On the other hand, Tek RMD can easily be summoned to come near the person using a remote. Then the user can easily pull the device closer, and mount it directly from its back.

It also enables people to sit or stand without much effort. So paraplegics can even use it to assist in common physiotherapy. The suspension system containing a gas spring balances the weight of the user so that standing up requires just a gentle pull.

From the moment they wake up, users can board the device and stand up without needing assistance from others. This comfort encourages the users to stand up countless times, and do various daily activities while standing up. It also includes braces to ensure a proper standing position and an advanced balancing system to avoid falls.

Presently, Tek RMD is also the world's smallest motorised standing movement device. It is only 39 cm wide and 75 cm long, so users can pass through narrow spaces too.

It is truly amazing to see how technology is helping make the world truly accessible to all. If you have developed, use or know of such technologies, do write to us or e-mail us to let more people know of the innovation. ●



Tek Robotic mobilisation device (Courtesy: [www.matiarobotics.com](http://www.matiarobotics.com))

The author is a technically-qualified freelance writer, editor and hands-on mom based in Chennai