

Eyes-Free Computing — Past, Present And Future

Electronic information is display-independent. This simple idea was the underpinning of my PhD thesis work on Audio System For Technical Readings (AsTeR). 30 years later, this simple idea continues to drive much of my research in creating ubiquitous information access that matches the user's needs and abilities at any given point in time.

This talk will explore the space of eyes-free information access by using concrete examples from past projects. Eyes-free information access is no longer a niche application — with the arrival of smart speakers and other devices that provide seamless access to an AI-powered Assistant, creating effective eyes-free information access is now a mainstream need. In parallel, our physical world continues to be increasingly digitized and available online — where the World Wide Web was once considered to be a means of disseminating electronic documents, today we can share everything from digitized maps to 3D scanned models of physical artifacts. Looking forward, what will eyes-free information access bring in the next 25 years?

My experience of using assistive technology for communication

I will speak about my experience of using AAC starting from my childhood. Assistive technology has been an integral part of it as from the very beginning I started using a computer to write. For last 25 years, I have seen development of technologies that helped people like us to exert one of the most basic human rights that is communication. AAC does not only provides us the opportunity of self expression, builds self confidence and advocacy skills but also builds confidence in others, the communication partners, especially strangers, as they can understand us well and can accept and respect us as equals. That is the marvel of AAC and I will talk about it emphasizing with my personal experience.

Assistive Technology Products: Best practices for Development, Commercialization and Scaling

Children with neurological conditions like Autism, Cerebral palsy, Down 's syndrome etc. face challenges in speech and are unable to communicate. In this talk, we discuss our experience in developing innovations in assistive technology for the children, and successfully building a scalable global business based on them. Avaz (www.avazapp.com) is a picture and text based communication product to help people with such conditions to express their needs, thoughts and ideas and hence get access to education and social inclusion. Today, Avaz is being used by thousands of children across the globe - in India, Sri Lanka, USA, France, Sweden, amongst other countries. After Avaz, we developed multiple assistive tech products like Avaz FreeSpeech – a picture based app for children with language disabilities to learn sentence structure and develop language; and Avaz Reader – a reading assistant app for children with Dyslexia. This presentation will use Avaz and other assistive tech products as real life examples and cover some best practices in Product development, Marketing and “Growth hacking” for assistive technology products. This presentation will also explore how Assistive Technology products can benefit immensely from adapting several techniques from the mainstream product development and scaling processes.

Software for Alternative and Augmentative Communication

With the advent and popularity of mobiles and Tablets, the use of Alternative and Augmentative communication (AAC) software in a public setting such as a classroom, or a playground has become very easy. Keeping this in mind, and with the focus on areas like Communication, Education, Leisure and various software's are being developed and are described below. The primary mode of communication for children with Cerebral Palsy is picture charts and flash cards, which are difficult to prepare, expensive to buy and gets worn out with usage. To meet these needs, we have designed KAVI-PTS (picture to speech). The software is highly configurable and has many customizable features include selection modes (scroll, click or crosshairs), color selection (for the background, scan and text), language (more than 10 Indian languages, Bahasa and Vietnamese), and a comprehensive picture library with options for additional categories and images. KAVI-PTS can be also used with various kinds of access switches for children with disabilities and is available for Android via the Google Playstore. The software thus enables the children to have access to a tailor-made communication solution.

Building on the success of KAVI-PTS, we have now designed KAVI+, as a desktop and web-based solution for teachers to create communication aids and digital lessons for students with speech and language difficulties. KAVI+ allows teachers to create customized digital lessons and exercises and assign it to students. They can access a large picture library available to create these lessons. Students with disabilities can access this material independently as it supports scan mode and use of access switches, and also provides an audio output.

AAC software can also support people with disabilities in the workplace. VBill is a simple billing android app accessible by all, and it too uses the various modes like scan, click and cross hair modes for operation made popular by KAVI- PTS. The user can add the categories and subcategories and products. Vbill is a cloud-based app and supports multiple users. The billing procedure also provides an audio output and the bill generated can be shared via mail, or even social media such as WhatsApp.

Enabling Solutions for INCLUSIVE TOMORROW: Making Abilities Work

Solutions thinking is a critical skill in the workplace today, and for persons with disability, this attitude helps overcome several functional and mind-set barriers. Thanks to the development of assistive technology/solutions and work done by organisations like Enable India, we have been able to open up over 272 job roles for persons with disability across 27 sectors.

How has this been possible? We believe that solutions are critical to open up jobs. This presentation showcases some of the solutions/assistive devices that we have designed/leveraged to open up jobs and how they have been created.

All our solutions are based on the ability model. The ability model believes that for persons with disability to be integrated well into employment and daily life, there is a need for solutions that identify a person's abilities – and build on these strengths. Too often we find that approaches to inclusion of persons with disability places undue emphasis on what is NOT possible, while discounting all the other abilities that the person may have. These solutions are all poised to leverage this gap.

Solutions for persons with vision impairment to work simultaneously on the computer and on the telephone Many jobs for visually impaired involve working on the computer and talking to clients/colleagues on the phone. In some cases, like customer service, this is a critical component of the work done. This can be a challenge for employees with vision impairment. Enable India has designed a solution to overcome this challenge.

This solution is called Listen123, and allows for one side of the headphone to connect to the computer output, and the other to the telephone line. The user can then seamlessly switch between listening to the screen reader and the telephone. This solution leaves the person's hands free to switch between typing on the computer to handling the phone. The impact of this solution is that persons with vision impairment have been able to improve their efficiency at the workplace, and companies that have hired visually impaired are seeing the benefits of this improved efficiency.

Re-imagining existing solutions for persons with multiple disabilities to work on computers

Existing in-built or open source technologies – like Speech Recognition and Pedable (to work with a foot pedal) – are leveraged to open up jobs like project report analyst, software developer and financial analyst. The solution is not just technology itself, but also the training methodologies to use each of these solutions.

Further, at Enable India, we focus on reusing alternatives. One successful example of this is the use of the joystick mouse. The joystick mouse, originally designed for gaming on computers, is ideally suited for persons who can only make gross motor movements to navigate on the computer. This has also been effectively deployed in the employment space.

Solutions for Skill Development

Persons with vision impairment are working in departments like journalism, human resources and content writing – which require very high level of written English communication. If the

persons with vision impairment placed in these roles are not braille users, but auditory learners, they may have difficulty with spellings. This is particularly a challenge in India, where English could be the second or third language. To this end, we have created the SpellTree Application – for android users to learn spellings in context. This app has over 300 words, including words that are commonly confused,

A sighted user can see different elements on the computer screen at a time. Sound can be heard only in sequence. Screen reader can read the information on the screen only one after the other. To be able to work on par with sighted, visually impaired have to be quick on the computer. To be able to work at that speed, one requires lots of practice. Practical exercises on each concept are designed at Enable India to give practice on the concept and enable the user to be quick on the computer. Computer training for persons with vision impairment at Enable India is designed to emphasize on quality, process discipline, efficiency in each concept. However, this approach has high dependency on trained trainers and we find that there are not enough trained trainers who are equipped to teach computers to persons with vision impairment. This challenge is aggravated by the fact that there is a very large supply aspiring visually impaired computer learners, and a comparatively small number of trainers. Enable India has designed the Educate Yourself Easily (EYE)

Tool to overcome this challenge. The EYE Tool automates the process of correction of computer exercises. It covers concepts in basic computers, MS-Word, Excel, and Internet, and is designed for students to learn on their own with minimal trainer intervention. This tool is also useful to Increase the number of educators to train candidates with disability to use computers.

The application monitors the actions of the trainees during the test and at the end of the test; it comes up with an evaluation of how much knowledge the trainee has.

The EYE Tool has two modes: Learning mode and testing mode. These modes help the trainee to learn, test and get instant feedback at the end of the exercise. It also helps develop interest in learning computers and become independent. The EYE tool also has more than 450 exercises which enable the learner to gain proficiency on how to use the computer effectively and be on par with the sighted colleagues at workplace. The exercises have a special emphasis on understanding the requirements of a sighted world, preventing errors and gain competency required. Exercises on EYE tool are in a structured manner, which enable trainers/volunteers to frame the curriculum easily and also enables them to give better feedback to the learners with vision impairment on their progress.

Building attitude to solve problems through personal solutions

We not only actively encourage use of technology and assistive devices; we also create an attitude of solutions thinking. For instance, in our trainings, we challenge our candidates to identify and resolve their own challenges – through local, personalized solutions that they create. Our candidates have identified some daily living challenges – like not being able to identify medicines, or reading menu cards, or identifying denominations of currency. In small teams of 3 to 5, our candidates go about solving these challenges by designing solutions – an accessible medical kit, labelled in braille and large fonts, menu cards for local restaurants that are made

accessible, and by designing an easy to use money pouch with different sized compartments for different denominations. The key here is not the solution itself, but rather is the attitude that is being created in these candidates – which holds them in good stead in employment and daily life.

Research, Development and Deployment of Assistive Technology in AIISH

Assistive technology plays a vital role to help persons with hearing disorders to comprehend the speech more clearly and to support people with Voice, Speech, or Language Disorders to express thoughts overcoming their barriers. Activities pertaining to Research, Development and Deployment of Assistive Technology in All India Institute of Speech and Hearing, Mysore are three fold :- i) Centre for Rehabilitation Engineering develops Assistive Technology for rehabilitation as well as customized devices catering to the individual Assistive Technology needs of the clients, ii) Centre for accessible technology is engaged in developing devices that help people with varying degrees of hearing loss to improve their listening in difficult environments and iii) Collaborative efforts with IEEE Special Interest Group on Communications Disability to motivate young minds to design and develop Assistive Technology.

Ongoing projects at the Centre for Rehabilitation Engineering include Articulate+ and Nasospeech. Articulate+ is an assistive, intuitive and user friendly system for rehabilitation of persons with articulation disorders which can be used at home, schools and clinics. Nasospeech is a comprehensive system to determine how much the disordered speech is deviant from the normal speech and provides the option for self assessment to monitor the progress of speech therapy for persons with cleft lip and palate. Customized devices developed according to the individual Assistive Technology needs of the clients include a communication system for paralyzed persons. The communication for basic needs can be initiated with the air expired out of the nose. Recent work at the Centre for accessible technology involves development of an assistive device to overcome the acoustic barriers for museum visitors with hearing impairment.

An Assistive technology hackathon is being organized annually by AIISH in collaboration with IEEE Special Interest Group on Communications Disability under IEEE standards association. Selected proposals from this hackathon are mentored at AIISH and the clinical trials are conducted.

TARANG - An affordable feature rich Hearing Aid

People with disability are often cut off from health, education and other social services. This impacts their employment opportunity and participation in civic life. An assistive technology can enhance the quality of life of the disabled as well as their family. It was the vision of the Indian government to provide persons with disability with affordable and feature rich assistive technology products like hearing aids. To fulfill this vision, a project was initiated through Ministry of Electronics and Information technology to indigenously develop a hearing aid with advanced features. This mission was under taken by C-DAC and has successfully developed an entire eco-system consisting of a multi channel programmable Hearing Aid ‘TARANG’, a programming software ‘SHRUTHI’ and a programming interface.

We have built our TARANG series of Hearing Aid products based on *Affordability*, *Adaptability*, *Acceptability* and *Quality*. Our Hearing Aids are the most *affordable* Digital Programmable multi channel Hearing Aids currently available in India. The major cost of any Hearing Aid is due to the Integrated circuit electronics which implements the Hearing algorithms. We were able to reduce the cost by designing India’s first Hearing Aid chip ‘NAADA’. The *adaptability* factor plays a major role in the success of a Hearing Aid product. Our TARANG Hearing Aid model can be programmed to suit mild, severe and profound category of Hearing impairment. This helps in adapting a Hearing Aid to the appropriate need and requirement of a particular individual at the time of fitting. In addition, any physical change in the individual also needs to be accommodated; since our Hearing Aids are reprogrammable all future needs of the individual can be taken care of. The factors such as reliability, simplicity, aesthetics etc. are vital for the *acceptability* of a product. To improve the *acceptability* factor of our hearing aids, we have developed multiple models of Behind-the-Ear Hearing Aids in different form factors. All our products have undergone extensive field trials at all major institutions across India and we have incorporated and redesigned our products according to the feedbacks we receive. This has enabled us in improving the *quality* as well as acceptability of our products.

My life and how I live it

A person who is deafblind, with appropriate education, training in special skills and availability of technology and accessible environments, can live a fulfilling and happy life. The presentation follows Pradip Sinha, through a typical day, allowing the audience to learn about the value and the problems of technology in enabling access.

I am chairman of SEDB, an organization of the deafblind, for the deafblind, founded by my friend and classmate from school, Zamir Dhale. We are both independent adults, educated and in good jobs, living full lives – and technology has been a major enabler in our lives.

I am Pradip Sinha, I was born deaf and became blind as a young child. Today, I live independently in Bengaluru, work at Dell and am able to send money home to my elderly mother. I have friends in Bengaluru and go out with friends, go to church on Sunday and have a flexible work schedule that allows me to travel to meet my friends, to volunteer and to do work for SEDB.

1. Daily Life: Caring for myself and my house

Every night I set my alarm on my smartphone, but after all these years, I wake up automatically at 5 a.m. I live alone in a small apartment. I don't need a cane and can find my way around easily as I organize my space well. I clean my own place so that I don't have to worry about things being moved around by others. I have a little stove and make myself a cup of tea before I quickly take a bath and dress for work. My day starts early because I have to travel several hours to reach my work place.

2. Transport: getting to work and anywhere else Booking cabs is easy, but what about when they want to call you?! It is a nightmare. I can type on my phone, but since they don't know I am also deaf, they often call instead of messaging for asking directions. After a lot of problems with taxis, we have solved the problem by having a regular cab organized through my company so I can get to work ontime.

Going out in the evening to visit friends and traveling out of town by train, bus or flight:

People don't believe we can travel independently. We can – we use our phones or computers to type so the person serving us can understand us and they can type on our phone and our screen reader will allow us to read the text in refreshable braille. We can write on your palm, spelling out the alphabet, we can gesture and mime to make ourselves understand, we use readymade cards with sentences like – 'I am deafblind. Please write on my palm using capital letters'. Or please lead me to the 'check-in desk'. We are very flexible and skilled in finding ways to convince people to not be afraid and to pay attention to what we are saying! When I travel by train, I always chat with the people around me – they are always surprised and by the time I reach my destination, I hope at least one more person is convinced that impairment doesn't mean lack of ability.

3. Work: access, respect, and companionship

I have held many different jobs over the years. At first I was in the Tactile Braille Press within the Helen Keller Institute for the Deaf and deafblind. I was teaching other students and was also responsible for layout and accuracy of the materials we were producing. That was my first job and it was also the first time I could live independently, travel alone in Mumbai buses and trains and send money home to my parents. I learnt to operate a bank account and learnt the hard way about the importance of being able to do this independently.

Today, with the ATM's being accessible, and a lot of banking being online or apps like Tez, I can do most transactions safely and independently

The computer skills I gained while in school and during training in Bengaluru are invaluable in my life. Because of it, I can work at Dell and get a good job and I can learn complicated tasks. People respect me automatically because they are amazed that I can do these things.

Respect is important and so is finding quick and easy ways to converse. Otherwise people hesitate to engage with me since they don't know how to talk. I am part of a team at work and the computer with the power braille attachment allows me to be a part of discussions and conversations. BUT.....

If there is a problem with technology, and there often is, while I am at Dell, surrounded by so many highly abled people, someone can help me. However, if I am at a friend's house or in a hotel in another country, it is like losing my voice where no one can help me.

All over the country today there are children who are deafblind and their parents and teachers don't know what providing them with technology can do for their lives. Spreading awareness, providing training on technology for teachers, parents, volunteers and people who are deafblind are some of the goals of SEDB. Parents are willing to spend 50000 on a wheelchair but not on a communication device! What should we do to change their minds?

Technology is expensive, but without it, I would live a very boring and limited life. With it, I travel all over India and the world, I talk with people who don't know sign, I surf the internet and keep in touch with friends and family and make new friends. If we hadn't fought for computer education (which we first saw at a school for the blind), if we hadn't convinced our teachers that this was essential for us, they would have never seen our potential.

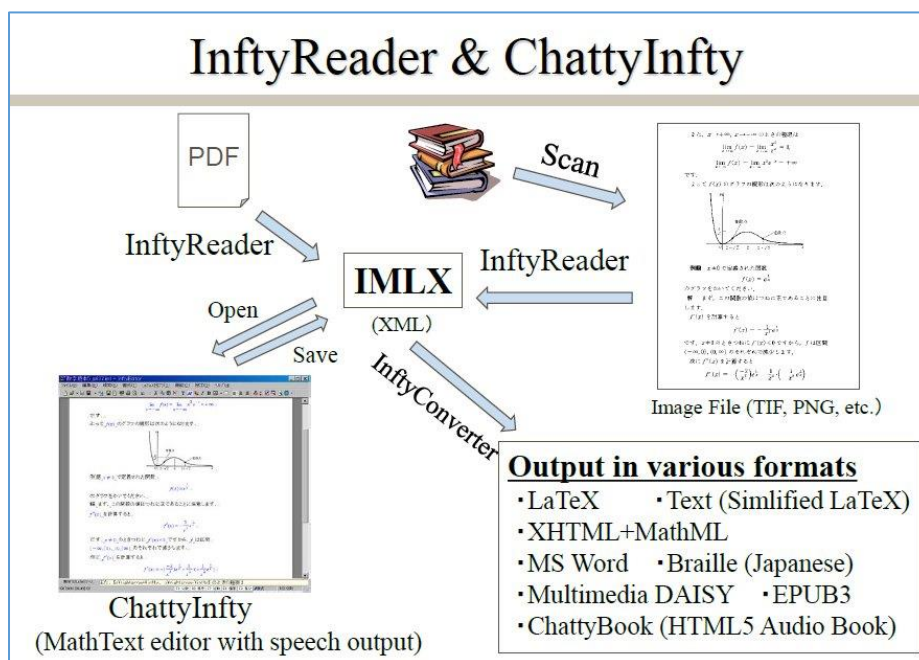
Perhaps I would be working in a boring factory job, or even just sitting at home. Technology doesn't just make my life easier, it makes it possible.

InftyProject - Aiming at Improvement of STEM Accessibility

For more-than-20 years, our research group, "InftyProject," has been developing assistive tools for print-disabled people to access STEM (science, technology, engineering and math) contents. In 2005 we founded the Non-Profit Organization: "Science Accessibility Net" (sAccessNet) to provide our assistive technologies and services to print-disabled people.

Our OCR (optical character recognition) software for STEM documents, "InftyReader" (See [1]) can properly recognize a STEM document in print or PDF, which includes complicated math expressions or many other technical notations, and convert it into accessible one such as LaTeX, MathML, Microsoft Word, ChattyInfty (imlx), etc. For the present, it is the only math OCR system in the world, which is actually put to practical use. In the current version, combined with a PDF parser, it becomes much more powerful in recognizing e-born PDF (originally produced from an electronic file such as Microsoft Word, LaTeX, etc.).

"ChattyInfty" (See [2]) is an accessible editor for STEM contents. Using it, print-disabled people not only can read but also author those contents easily with speech output. Furthermore, its current version, "ChattyInfty3," can convert recognition results with InftyReader into various accessible formats including DAISY/accessible EPUB3 and ChattyBook (HTML5 audiobook playable with any browser). The foreign-language versions of ChattyInfty3 use Microsoft Speech API, Ver.5 (SAPI5) as a TTS (text-to-speech) engine. It can export an edited document as a DAISY/accessible EPUB3 book, in which literal sentences and math expressions are synchronized with audio generated by the SAPI5 voice. All the math expressions are represented in MathML or SVG (scalable vector graphics). Combining InftyReader and ChattyInfty3, users can convert e-born PDF quite efficiently into DAISY/accessible EPUB3. The Infty software gives a total solution for making a book in print/PDF for STEM be accessible for print-disabled people.



In 2016, Prof. Balakrishnan and his team inquired of us if the Hindi version of the Infty software could be developed. We have been working on improving our assistive tools so that they can treat various languages other than English and Japanese. Here, we show a new build tool for

ChattyInfty3. It allows end users to localize the software without any help of the developer so that it could treat STEM contents in their own languages. We believe that our assistive tools could contribute to improve accessibility, especially STEM accessibility much more in developing countries.

[1] URL: <http://www.sciaccess.net/en/InftyReader/>

[2] URL: <http://www.sciaccess.net/en/ChattyInfty/>

Contact Information:

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Implementing affordable AT solutions : the CATI way

The Centre for Assistive Technology and Innovation (CATI) at NISH strives to meet the Assistive Technology (AT) needs of persons with disability (PwD), especially the accessibility needs of students and clients of National Institute of Speech & Hearing (NISH), Trivandrum, Kerala. CATI was envisioned to be a state-of-the-art resource centre on the lines of Assistive Technology Centres (ATCs) in leading Universities in the USA. However, working in a low-resources environment, we have evolved our own strategy to come up with affordable and scalable innovations, which can be easily replicated to raise the quality of living of PwDs. Over a period of three years with a lean staff strength, we have implemented solutions to improve communication and education for PwDs; we have partnered with the Speech Language Pathologists at NISH to rev up the Alternative and Augmentative Communication (AAC) unit; we have been mentoring student projects and startups working on AT products; and we are trying to develop DIY solutions, also using digital fabrication methods. We collaborate with AT developers by assisting them with need identification; testing their products or prototypes and giving them the consolidated users' perspective on their product.

A few approaches that are consistent across all our projects are as follows: (1) Need identification and refinement, in collaboration with end-users and rehabilitation professionals, (2) intense market survey and making best use of trial and demo options to screen a range of products before choosing one for procurement, (3) preferring software over hardware solutions, (4) preferring universal design, mainstream market solutions over specialized AT solutions, (5) developing an AT device lending library to further awareness and provide options for the users, (6) Training and following up with the users to ensure minimal AT abandonment and (7) Documenting and sharing our knowledge as widely as possible, towards developing an AT ecosystem in the country.

The strange case of the unused, assistive device

Is affordability everything? Why do products that are reasonably priced and well researched remain unsold? Why do products lie in cupboards unused? What are the reasons for their premature discarding? Understanding and addressing the bottlenecks is as important as the creation of affordable AT. We outline and discuss the multilayered factors that shape the acquisition of assistive aids and suggest indicators for optimal usability of assistive devices.

Assistive Technology - An users perspective

The paper presentation starts with introducing myself and the various assistive technology solutions I have been using so far. As an user of assistive technology ,I would like to present some of the problems encountered on a daily basis .There is a huge potential for assistive technology in India but the lack of coordinated effort is delaying and denying the AT solutions to many. There is a need for a service delivery system to streamline the whole assistive technology sector. The presentation highlights the need for a partnership be it with government or like minded organizations to ensure that the stake holder remains the key factor in assistive technology.

Responsible Digital AI & ML to create an impact in lives of blind and visually impaired people

Artificial Intelligence & Machine Learning can create an impact on lives of assist blind and visually impaired people to live independently. India and the developing countries are a Android first world and it imperative to see how do we impact people's lives with solutions in their hand.

As a starting step, 6 by 6 is a toolkit of solutions developed by BarrierBreak to solve some challenges faced by visually impaired people in their day-to-day life, such as identifying currency notes, detecting if the light is on around them, difficulty in reading tiny size fonts etc. 6 by 6 use TensorFlow to train large data sets at the back end in order to predict the currency notes. It also provide a high quality magnifier to help people to read small print effectively. Last but not the least, it uses the ambient detector to identify the level of light near the person.

Dyslexia Now and the Use of Assistive Technology

A sizable percentage of school going children have a Specific Learning Disability-Dyslexia, Dyscalculia and/or Dysgraphia. Statistics are available only for urban school going population, so it may be more prevalent than we know. We have bright, intelligent kids who are not able to their full potential because they do not have access to services which children with dyslexia should. This is a generation born to technology; they are comfortable with it.

So our first step for any next steps should be Assistive Technology. Assistive technology can be designed to enhance the remedial programme. In certain cases, it may be the only thing available and should be designed to replace or work in lieu/in the absence of special needs teachers.

We need to work together and find the best way forward to ensure that our children with dyslexia become successful citizens and contributing members of society. Our collaboration will ensure that we create a future ready generation.

Specific Learning Disabilities: Nature & Interventional Strategies

In India, for the first time Specific Learning Disabilities has been considered as one of Bench Mark Disability in the Rights of Persons with Disabilities Bill, 2016. There are totally 21 categories of disabilities recognized by this Bill.

The paper discusses the Nature of Specific Learning disabilities. Specific Learning Disabilities refer to a number of disorders which may affect the acquisition, organization, retention, understanding or use of verbal or nonverbal information. These disorders affect learning in individuals who otherwise demonstrate at least average abilities essential for thinking and/or reasoning. The deficits include, but are not limited to language processing; phonological processing; visual spatial processing; processing speed; memory and attention; and executive functions. They may have some co-morbid disorders also.

Indian studies indicate the prevalence of different types of SLD as 3% of dyslexia, 5.8 to 6.0% of dyscalculia, 6.84% of with oral language disabilities in Kannada Language and 7.46 percent of writing disabilities in English.

Children with SLD can be identified with a set of exclusionary and inclusionary criteria. Achievement tests and diagnostic tests have to be administered in order to understand the specific academic difficulties. The paper gives a brief account of different models of intervention. Educational interventions are discussed by highlighting the important principles and strategies for enhancing academic skills among them. The significance of Assistive Technology in supporting children with SLD is also discussed.

A Prototype of an ICT Enabled Intervention Tool for Dyslexia

Dyslexia is a neurocognitive disorder which currently affects around fifteen percent of the Indian population. The symptoms include difficulty in reading alphabets and words and can be screened through some psychological tools. Once the disorder is detected, as a remedial measure, often personalized intervention is given by the experts (clinical psychologists, special educator, and trainer). However, very low expert-to-population ratio is a major hindrance in effectively treating the disorder in a fully human-guided intervention set-up. This paper proposes a prototype of an ICT enabled home-based intervention program for children which supports interactive interface for expert, parents, and students. The main objective of the work is to reduce the dependency of experts by providing a unified platform that supports various facilities. The tool is being built upon android platform and supports assessment, monitoring and intervention for reading and writing.

Empowering Children with Specific Learning Disabilities

The talk is about how Madras Dyslexia Association strives towards empowering children with Specific Learning Disability.

First we will discuss the condition called Dyslexia and its impact on a child's journey through life. Then we go on to delineating the role being played by Madras Dyslexia Association in spreading awareness and providing coping up strategies

Finally we will list out the route map for the future which includes leveraging technologies to extend the impact every dyslexic.

Innovations in Assistive Devices for People with Locomotor Disability in Developing Countries

WHO estimates 1 billion people in the world are in need of assistive devices. The technology available in a developing country like India falls into 2 distinct segments. At one end, the technology is low-cost but primitive, and at the other end of the spectrum, the technology imported from the west may enhance the quality of life of some users but may not be suitable or affordable to the majority. The TTK Center for R2D2 and its start-up, NeoMotion, strive to deliver quality functional assistive devices in an affordable manner to people in the developing world and beyond. This talk will present some of the devices developed that are in the process of commercialization, such as, the Standing Wheelchair, Customized Wheelchair, Ultra-light Wheelchair, NeoBolt (Wheelchair Scooter), Polycentric Knee joint and EZ-LOK Orthotic Knee.

Affordable Saksham Technology solutions in Indian languages for VI

Initiatives at Saksham have led to availability of several enabling assistive technologies such as computers and mobile phones with screen reading software in Indian languages, speech enabled clocks, watches, thermometer, weighing scale, etc. Saksham partnered with IIT Delhi in the development of affordable solutions such as Smart Cane and refreshable braille display.

Saksham has established a robust distribution network so that the solutions reach beneficiaries anywhere in the country. Saksham now introduces DAISY player that supports all Indian languages and is directly connected to online libraries Sugamya Pustakalaya and bookshare to deliver right into the pockets of the users and read them in 14 Indian languages.

Affordable Assistive Devices for the Visually Impaired: Take Note and Tactograph

Affordable Assistive devices for the visually impaired enable people with disabilities to function independently and take advantage of schooling and social opportunities. TAKE NOTE and TACTOGRAPH are two such products developed focusing on affordability and utility.

TAKE NOTE:

TAKE NOTE is a compact, easy to handle note taker specially designed for people with vision impairment to take notes on the go in the classroom or in any official meeting. The device has 9 buttons, 6 corresponding to keys arranged as on a Braille and 3 buttons for enter, space and backspace. An inbuilt memory unit is used to store the notes typed in Braille. It provides various vibrational feedback to use the device effectively in a classroom.

The device establishes connection via bluetooth to a system or an android device to transfer the notes that are stored in it. The android phone can also be used for giving audio feedback while using the same.

The software can be configured to interpret all grades of Braille, and also different languages. In addition, the software will enable automatic features such as word and sentence prediction, grammar and spell check and audio output of the file.

TACTOGRAPH:

Tactile pictures and diagrams, tactile maps and graphs, are images that use raised surfaces so that a visually impaired person can feel them.

A person with a visual impairment can feel these raised lines and surfaces in order to obtain the same information that people who are sighted get through looking at pictures or other visual images. A Tactograph enables schools to print their own tactile books and worksheets at an affordable price.

Tactograph is a motorized x-y stage that traces a predefined picture using an adhesive fluid, creating a tactile image on a normal A4 sized paper. It also has the ability to reproduce the tactile image as an outline on printed books, by using software-based image processing to correct for any translation and rotational changes while placing the book.

AT for people with cerebral palsy and multiple disabilities – scopes and challenges, a user's perspective

Indian Institute of Cerebral Palsy, one of the national level NGOs with for than four decades of experience in providing services to children and adults with cerebral palsy and other neuro motor challenges has been using AT to improve the quality of life for the beneficiaries from the very beginning. We have worked especially in the complicated areas of AAC and access to computer and such other technologies. The institute has been involved in the research and development of indigenous technologies in partnership with IITs and other institutes, field tested prototypes with users and provided user's feedback for the developers. I will talk about the scopes and challenges that we face in using AT for the users with various levels of physical and cognitive challenges. AT for the target group needs to be pragmatic, user-friendly, versatile and affordable and we (technologists, professional working in the disability sector and users) have to work together to find solutions to provide better quality of life for our users. I will use video clips of the users in my presentation to highlight these issues.

Assistive Technology for people with multiple disabilities

The paper looks at the various needs of students with multiple disabilities and how assistive technology can meet the need. The paper brings into perspective the curricular needs ,communication needs from pre -school to higher education and work. The paper brings into focus the lack of assistive technology in India and how it is impacting the lives of people with disabilities.

Web Accessibility and Entertainment Devices for People with Cerebral Palsy

We talk about a group of applications for people with cerebral palsy. Specifically, our focus user group comprises of people with severe form of spastic cerebral palsy and highly restricted motor movement skills. These disabilities make the computer access via traditional means of keyboard and mouse extremely difficult for them. Consequently, they face challenge in accessing popular social-networking as well as entertainment application. The application presented here, aim at circumventing this problem. Our systems have two major components: access mechanism and applications. The toolset facilitates easy dissemination of information through World Wide Web and allow access to Education, Entertainment, popular social-networking and communication mediums like, Reading E-Books, watching/listening movies/songs, Facebook and E-mails. The systems use intelligent auto scanning for easy access and navigation through different applications. The applications are developed in such a way that minimum effort is required to perform the essential operations. The developed tools use special access switch based scanning technique for easy navigation in different applications.

Barrier-free, Eyes-free, Platform-free: Accessible STEM on the Web

The web is everywhere and everything is on the web. This is true for nearly every aspect of life, including the sciences. Both in teaching and research, using printed paper is already rare and the use of electronic formats that model print, like PDF or RTF, is getting rarer as well.

This is a great opportunity for accessibility: the days of proprietary formats, individual desktop applications, and specialist software is over. Everything can be presented in a single medium, using common and open standards, allowing us to provide homogenous accessibility solutions even for very heterogeneous content, such as formulas, charts, graphs, and diagrams. Consequently material is not only available but also accessible anywhere, anytime, and in particular affordable and on any platform.

But there is also a great threat from the fickle nature of the web. Web documents are ephemeral, they can change easily overnight; a formula is updated or a diagram is changed making even the most carefully crafted textual description obsolete. Consequently, new and foremost automatic ways of making STEM content accessible have to be developed so they can keep up with the ever changing nature of web content.

I shall present a number of solutions for making STEM content accessible fully automatically. In particular, I shall talk about the rendering of web accessible mathematical formulas, the transformation of STEM diagrams from bitmap images into accessible online graphics, and the generation of data visualisation straight from statistical models. I shall discuss the web technologies behind these efforts and shed light on some of the shortcomings of the current accessibility web standards.

Design and development of an affordable passive polycentric knee joint and dynamic ankle joint with different advanced features for trans-femoral amputees

According to WHO, there are about 30 million amputees currently living in developing countries and the number of disabled population in India is increased from 2.1 to 2.21% of total population, where the movement disability stood at 20.2% of total disability. As 75% of amputees live in rural area, suffering of them aggravated due to poverty, and lack of rehabilitation services. The commercially available devices are complex in design, expensive, and difficult in maintenance though it provides good functional mobility. The objective of work is to upgrade the existing design of IITG polycentric knee joint with many improved functions.

The dynamic ankle joint is designed to provide the required kinematic motions and FRP composite foot will be used to get flexible foot to provide a gait pattern at par with sound leg pattern. A socket system with suction and suspension module is developed and incorporated with prosthetic leg to have improved quality of life, independence and comfort level of doing daily activities of different subjects. The gait lab will be used at different stages of rehabilitation to confirm the improved gait pattern of different subjects.

Clinical dilemmas in assistive devices prescription- clinician's perspective

Any successful outcome for patients is highly possible only by a team based approach. The present day medical sciences approach is moving from dependence to interdependence to independence, thanks to the innovation happening in the field of technology driven assistive devices. By saying this, at the same time, clinicians faces lots of challenges and dilemmas when selecting and prescribing any supportive devices for people who needs special care for their mobility or for that matter to bring out functional outcomes with regards to day to day life activities.

Rapid changes in the field, technologies and its utility, poses a large array of models and frameworks to be adapted by the clinicians to bring out better outcomes in their clinical practice. The following are few dilemmas faced by clinicians:

- When to prescribe an assistive device
- What should be the criteria in choosing the patients for this prescription
- What are the pre- requisites to be assessed in a patient to receive an assistive device
- Affordability and cost effectiveness
- Compliance of the patients to it

Moreover, the phenomenon of technology disuse or underuse leaves a question to check the effectiveness of device selection process and its concerns. The International

Classification of Functioning, Disability and Health, the Matching person and Technology (MPT) and the Human Activity Assisitive Technology (HAAT) offer some amount of standardization of provision of AT process but doesn't give any detailedclinical guidelines.

The clinical reasoning power and the decision making skills of the clinicians should match the patients characteristics, needs, abilities and participation restriction. The prescription of assistive devices should optimize quality, improve efficiency and cost effectiveness and as well improve the quality of life of the patient.

In this technology driven evidence based era, choosing the right modality at the right time for the right patient is the key for reducing the disability burden of our country and in improving the quality of life of patients.

Affordable Saksham Technology solutions in Indian languages for VI

Initiatives at Saksham have led to availability of several enabling assistive technologies such as computers and mobile phones with screen reading software in Indian languages, speech enabled clocks, watches, thermometer, weighing scale, etc. Saksham partnered with IIT Delhi in the development of affordable solutions such as Smart Cane and refreshable braille display. Saksham has established a robust distribution network so that the solutions reach beneficiaries anywhere in the country. Saksham now introduces DAISY player that supports all Indian languages and is directly connected to online libraries Sugamya Pustakalaya and bookshare to deliver right into the pockets of the users and read them in 14 Indian languages.

Automatic Annotation of Voice Forum Content

Voice forums are an effective intervention medium for marginalized communities to access information in a structured and localized manner. Users actively contribute by posting questions and responses in the form of audio messages, and thereby help in enriching the voice forum content. In order to build an audio library using the voice forums to disseminate information, a significant manual effort is needed in analyzing and curating the data. This is one of the key impediments to the successful implementation of voice forums for knowledge dissemination and training.

In this work, we explore the effectiveness of automated approaches to analyze and curate voice forum content in Hindi, a native language in the northern part of India. We study the use of standard techniques such as topic modeling and extractive summarization on Hindi speech transcripts (with WER of 67%) to cluster audios thematically and create summaries for individual audios respectively. These curated audios are used to build an IVR-based library for community health workers in rural India. We evaluated the relevance and preference of the automated annotation using a field trial. We find that the relevance perception varied between human and automatically generated annotations, but automatically generated summaries were still found to be useful to access the voice forum audios.

Vision and Language to aid Visually Impaired Users

Visual dialog agents and visual question answering agents are of great relevance to visually impaired users. There has been substantial interest in this topic with rapid increase in the capabilities. However, it is necessary to understand the nuances based on which an agent answers the questions or responds to the questions. Moreover, if an agent is able to generate questions that are similar to those asked by humans, then just using a dialog between two agents one can improve the abilities of both agents. In this talk I will be able to provide an overview of the challenges towards solving these problems and some of the work towards understanding the solution of these problems.

Standards and Universal Design

Assistive technology tools such as Screen Readers, Magnifiers, Refreshable Braille Display, Voice input, Modified keyboard/mouse is enabling even the severely disabled to use the digital content. However, none of the above would be of any use if digital content such as eBooks, digital publications, websites and LMS are not prepared in compliance with established standards.

It is also necessary to incorporate accessibility concerns in ICT manufacturing and procurement policies. Standards such as EPUB 3, Unicode, WCAG and DAISY ensure accessibility for all. This presentation will share more details on these standards and their role in implementation of UNCRPD and the Indian law to protect the rights of persons with disabilities.

Integrated models to promote digital literacy for visually impaired

According to the estimates of the World Health Organization, there are approximately 285 million 1 persons with vision impairment of different kinds in the world today. Over 90% of this number live in low income settings.

Closer to home, India has one of the largest visually impaired populations in the world – 48.5% of India's total population of persons with disability are persons with vision impairment 2 . Further, we often fail to account for the fact that 69.61% of this number live in rural India. Approximately 23% of the visually impaired population falls in the age group of 20-39 years, and the loss of this talent pool is particularly felt in countries like India where employers always fall short of suitable and skilled manpower. These statistics also give us a clearer perspective on the challenges faced by people with vision impairment.

According to the International Classification of Functioning Disability and Health by World Health Organisation 3, vision is one of the important senses, and the absence of this affects functioning in 8 major domains of a person's life, which are:

1. Learning and application of knowledge
2. General tasks and its demands
3. Communication
4. Self- care
5. Mobility
6. Domestic life
7. Interpersonal interactions and relationships
8. Community, social and civic life

The lived experiences of persons with vision impairment in our communities and societies attest to these challenges. While there has been increased awareness on eye donation, and a significant decrease in cases of preventable blindness, there is a much stronger need for rehabilitation of persons with vision impairment, particularly in the context of education and employment.

One avenue is technology – which has changed the game for persons with vision impairment. With screen reader software, one of which is open source (NVDA), is free and available in many regional languages; there is a whole range of opportunities now available to persons with vision impairment that were formerly inaccessible. Computers have become eyes for persons with vision impairment – and allow for a greater variety of choices in terms of chosen fields of study and careers. Besides screen readers, there is a whole host of products (like smart phone applications and daily living solutions) that persons with vision impairment can use. However, these are frequently very expensive, and may not be ideally suited to the Indian context. To complicate this issue further, purchasing power and economic independence for persons with disability in India has historically been low – so choices on which solutions and technology to procure for better quality of life may not

rest in the hands of persons with disability themselves. From our experience, when we have enabled persons with vision impairment on the computer and using assistive aids, this has changed mindsets and ecosystems. With a large catchment of persons with vision impairment, and a wide range of solutions – the challenge that is apparent is one of bridging the gap – connecting those with the need, to the solutions that they require.

Over the years, we have evolved different models ranging from awareness to holistic development training programs to address this gap. This presentation will showcase these different models and discuss the impact.

What will audience gain?

1. Government officials and organisations working in the space of vision impairment will learn how to replicate/localise the different models to suit to their needs.
2. Assistive technology developers, researchers will gain insights on user experiences.
3. Persons with vision impairment and their communities will learn about how to get ready for 21st century skills.

Empowering the vision impaired: Two ongoing research projects at Microsoft Research India

The majority of efforts around the world to create technologies for the vision impaired focus on accessibility to functional aspects of everyday living: assistance for navigation, skills for employability, unassisted shopping, independent indoor mobility etc. We describe two projects where the focus is on empowering the vision impaired who want to accomplish more. CodeTalk, the first project, is focused on enhancing productivity of blind programmers in using IDEs like Visual Studio. With CodeTalk, we identify four classes of barriers for access to IDEs namely, discoverability, alertability, navigability and glanceability, and provide solutions to overcome these barriers. The second project Video Games for the vision impaired, is focused on making mainstream video games accessible to the blind. This is akin to the enhanced access to mainstream movies provided by audio descriptions. We describe how a spatial audio based interaction toolkit could enable a blind person to play and enjoy mainstream video games.