A CYBERMEDIA Publication

technology review INDIA

MIT's Magazine on Innovation

www.technologyreview.in

THE GRAND CHALLENGES FOR TECHNOLOGISTS IN INDIA

Winning Solutions p31

Electronic Toilet, Haptic Shoe, Low-Cost Ventilator, Needle-Free Diagnostic Kit For Anemia, Plastic Morph, Power Saver, Pre-screening Opthalmology Device, Solar Multi-Effect Distillation System, and TB Breathalyzer.

India's Tech Innovators Dazzle Again

They rise to the 2nd Technology Review Grand Challenges with many relevant solutions.

When we launched the 2nd edition of Technology Review's Grand Challenges (TRGC) program in July 2011, we were keeping our fingers crossed. Will the novelty of the program wear off after the first year? Can we keep the passion levels of the nation's tech innovators alive for some more time as we sought their assistance to suggest ways to solve some of India's unique challenges that cry for some attention from the tech community?

The solutions poured in thick and fast. We were overwhelmed when nearly 150 responses came to us within the deadline. In fact, this made the task of the TR editors tough. After several days of discussions, we shortlisted 40 of these solutions for detailed evaluation by the panel of 15 eminent jury members, many of whom volunteered to do this task for the second year in a row and committed quality time to pore over the minute details of each of the entries for a few weeks in early December.

We have presented in this issue the eight top solutions selected overwhelmingly by the jury members through a scoring mechanism and curated by TR India editors. In addition, TR India team decided to pick the Haptic Shoe developed by Hewlett-Packard's Anirudh Sharma as the Editor's Choice from the list for its sheer novelty and immense usefulness to millions of visually handicapped people in the world.

Healthcare dominates the list once again. This is to be expected as it is one area where the appropriate solutions to the multitude of challenges facing nearly two thirds of our planet's population will make a difference very quickly. So we have a simple, cost effective solution to detect anemia, a simple diagnostic solution to identify some widely occurring eye defects, a revolutionary new way to detect tuberculosis just by analyzing the breath of people, and a low cost ventilator which will work effectively in the most challenging environments in the world's poor countries.

Energy conservation, environmental degradation and sanitation segments too have found favor with technologists. A genetically engineered bacteria that feasts on plastics that have wreaked havoc on our environment is tailor-made for most nations facing this gigantic challenge. PlasticMorph will convert most waste plastics into biodegradable forms. Environment enthusiasts and entrepreneurs would be highly thrilled by this solution developed by Pravin Bhat Gurpur during his spare time while working for a drug discovery services company.

Another interesting solution tackles two challenges: how to increase the use of renewable forms of energy and mitigate water shortage. The tech team at KG Design Services has provided a two-in-one solution through its desalination plant which runs on solar power. A novel technology uses solar energy captured using reflectors to generate steam from salty sea water and uses condensation technologies to collect drinking quality water. This is believed to be a highly cost effective solution compared to high cost, commercial sea water desalination plants in use in many countries. The results from a pilot plant running in southern Tamil Nadu are very encouraging.

Technology Review India has taken the lead in highlighting some of the most appropriate technologies, which if adopted successfully will make a difference to the lives of millions of people not only in India but in many poor countries of the world. What we have done is the easiest part of the long and complex exercise of taking the benefits of modern technology to the people who need it the most. Most of the solutions which we showcased during the 1st edition of TRGC 2011 have caught the attention of society in the past year. Last year's solution providers have informed us that they are moving to the next stage of making their unique inventions accessible to the people.

Hundreds of organizations in the country have started looking at the solutions proposed through the TRGC program and many other such initiatives. The innovation ecosystem is responding to the needs of the society slowly and surely. But is this enough? Considering the gigantic nature of the challenges and sheer size of population that is crying for such solutions, there is further need to speed up the process. It is clear that finding appropriate tech solutions is just one part of the complex process. Other steps such as business innovation and creative funding mechanisms too are required to be in place to complete the loop.

Let us give some attention to this task too in the coming year. I wish you all a very Happy New Year. Do write to me with more relevant solutions to sureshn@cybermedia.co.in.

—Narayanan Suresh

THE GRAND CHALLENGES FOR TECHNOLOGISTS IN INDIA

TOP SOLUTIONS:

ELECTRONIC TOILET, HAPTIC SHOE, LOW-COST VENTILATOR, NEEDLE-FREE DIAGNOSTIC KIT FOR ANEMIA, PLASTIC MORPH, PRE-SCREENING OPHTHALMOLOGY DEVICE, SMART ENERGY SAVER, SOLAR MULTI-EFFECT DISTILLATION SYSTEM, TB BREATH ANALYZER

Technology Review India features innovative technologies and solutions relevant to solving some of the most urgent challenges facing the nation. In our second anniversary issue (July 2011) we published a core list of technological challenges that India is grappling with so that technologists have enough reason, passion, and single-minded focus in solving the problems. The objective was to generate useful new ideas that could have a widespread impact on India's technological temper in general. After an extensive search for solutions over three months, in November, we shortlisted 50 solutions from over 150 that we received. Helped by a panel of expert judges, we now present you top nine winning solutions which we believe can tackle problems in a way that is likely to benefit society and business. We look forward to see them implemented in the near future. Hope you like the selection.

—The Editors

Process

Technology Review is happy to announce the list of winners of The Grand Challenges for Technologists in India (TRGC), 2012. This is the second edition of the program.

The first list was announced in January 2011. The first list saw 12 jurists selecting seven solutions. The winning solutions were mKrishi, an advisory app for farmers, developed by Tata Consultancy Services' members; Future of school on cloud from Hewlett-Packard Labs India; Smart power management solution, iSmart, from Software Engineering and Technology Labs, Infosys Technologies; SiteOnMobile, a solution for delivering health care on phone, from Hewlett-Packard Labs India; automated traffic management solution, Smart key, Nokia Siemens Networks; low-cost water purifier from Tata Consultancy Services. The editors choice was for SignnTalk, an online communication aid for the deaf from BarrierBreak Technologies.

Our goal is to recognize new technology solutions or the creative application of existing technologies that are required to solve problems and inspire the technologists of India to develop ingenious and elegant solutions that matter primarily to India. The motivation is to generate useful new ideas that can have a widespread impact on the technological temper in general and it is mainly purposed to provide the architects a platform to take their ideas, prototypes, and pilots to the next level of commitment and execution.

A panel of experts, comprising of technology evangelists, entrepreneurs and innovation specialists from industry as well as academia select the winners. The candidates submit their solutions in the form of papers till end of October. The papers cover the project goals and outcomes; detailed description of the proposed solution with graphs and other technological/design aspects; and other content repositories. Each of the shortlisted entries are then sent to at least three jury members. The jury is asked to rate the proposed solution on a scale of 10 along with their views. The jury evaluates the entries critically and then recommends its choice. The evaluation is on the basis of the content and the concept of the project; the level of innovation compared with the current available state-of-the-art technologies; usefulness to the user and novelty; and the project's potential for realization in practice. This year's list of eight winning solutions and one editors' choice solution has been arrived using the same mechanism of seeking nominations, shortlisting of the solutions by the editors, evaluation by the jury, and finalization of the list by editors of *Technology Review* India.

The challenge is open to all participants who are eighteen (18) years of age or older and mostly as teams and any personal data of the participants collected by the publication is used for the purposes of this contest. All participants retain ownership of any product or technology that they develop or any other intellectual property rights they create.

Read the ensuing sections and pages to find out what the jury said and what the winners developed or accomplished.

Jury Comments

I. VIJAYA KUMAR

"Waste management is one of the focus areas for clean technologies and developing markets like India suffer from lack of awareness and facilities to treat both waste water and solid waste. One of the biggest challenges in managing solid waste is plastic waste which is not naturally degradable. The **Plastic Morph** solution proposed here is very innovative in its approach and unique in its formulation. Its operational scaling needs to be explored further but the solution is environment friendly."

"**Le Chal** is a very simple but an innovative idea to solve the challenges of navigation for the blind. The solution proposed uses the current advances in technology in navigation and electronics but combines it with a daily use object to make it a natural choice for the blind. As it does not demand any extra gear but requires only an enhancement in the footwear used, it is both pragmatic and non-intrusive for daily usage."

"**Vayu Ventilator** is a classic example of emerging market innovation with low cost engineering and high scale as focus. It addresses the twin challenges of lack of pressurized air pipes and continuous power supply in critical care segment. Its design is region centric and relevant to the operating environment of developing countries by providing a battery backup and pressurizing the ambient air with an on-board turbine. It significantly enhances the affordability and usability which can drive main stream adoption beyond metros in countries like India."

TRI GRAND CHALLENGES 2012 JURY

Aravind Chinchure
Assistant Vice President - Innovations
Reliance Innovation Leadership Centre, Reliance Industries

Balamuralidhar P.
Head
TCS Innovation Labs - Bangalore
Tata Consultancy Services

Gautam Biswas
Director
Central Mechanical Engineering Research Institute
Council of Scientific and Industrial Research, Durgapur

Harshal J. Shah
CEO and Founder
Reliance Venture Asset Management

I. Vijaya Kumar
Chief Innovation Officer
INK

Mano Manoharan
General Manager
GE Global Research

Mohanjit Jolly
Managing Director
Draper Fisher Jurvetson, India

Sameer Mehta
Cofounder and Director
Atlas Advisory

Shankar MV
Innovation Differentiation Leader
Honeywell Technology Solutions Lab, Honeywell India

Sudhir Dixit
Director
Hewlett-Packard Labs, India

Sumitesh Das
Chief
Global Research Programs
Tata Steel

Umesh Malhotra
Founder
Hippocampus

Venkatesh DK
Vice President -- Innovations
Global SAP Labs Network
SAP Labs India

Viswanath Poosala
Head - Bell Labs, India
Alcatel-Lucent India

YV Prakash
Founder and CEO
GAV Incubator, Bangalore

ARAVIND CHINCHURE

"The pulmonary tuberculosis (TB) is a serious public health concern in India and globally. The proposed innovative solution **Electronic Nose** provides affordable means of onsite TB diagnosis and monitoring anti-TB therapy based on sniffing disease-specific volatile organic compounds (VOCs) biomarkers from non-invasively collected urine and/or breath of the patient. This solution should also be extended to infants, pregnant females and elderly patients for whom limited TB diagnostic solutions are available today."

"The innovative solution **3Nethra** is an intelligent, portable, non-invasive, non-mydriatic, low cost device that helps in pre-screening of five eye major diseases — cataract, diabetic retina, glaucoma, cornea, and refractive index measurement with inbuilt auto detection software that generates a pre-screening report on the problem detected within less than five minutes of screening. This kind of inclusive innovation should lead to the building of affordable healthcare solutions touching the lives of millions people."

YV PRAKASH

"The electronic toilet, **Delight Bharat**, is comprehensive and complete in all aspects. The innovator is addressing a very important issue that has huge implications on healthcare in addition to general cleanliness and convenience. The solution has potential to scale up beyond rural areas and work well in urban and public places like melas/exhibitions and also in other geographies like Africa. The completeness and the potential impact this could have on our society has impressed me the most."

GAUTAM BISWAS

"The innovators have solution to produce low-cost desalinated water in abundant. They want dependable water supply employing only renewable energy sources in the form of solar and biomass. The **Solar Multi-effect Distillation System** idea has been implemented and tested successfully."

VISWANATH POOSALA

"Energy consumption inside buildings is clearly a prominent issue in the society. Corporates as well as householders have started to take 'Green' and 'Sustainability' as important issues. The **Smart Energy Saver** is an innovative, low-cost solution for reducing energy consumption in buildings. The basic idea is to turn power on or off inside a room based on the number of people present in the room. The whole solution costs less than ₹1,200 and has been shown to work in a trial by the inventor. The counter module in the solution should be upgradeable for many other applications, including emergency evacuations, disaster rescues, and so on."

India's first e-toilet can save water while providing quality sanitation. Electronic Toilet

Nearly two and half billion people in the world do not have access to improved sanitation, including 1.2 billion who have no facilities at all and are forced to engage in the hazardous and demeaning practice of open defecation. According to the WHO/UNICEF Joint Monitoring Programme (JMP) for Water and Sanitation report, sanitation coverage is the lowest in South Asia and in sub-Saharan Africa, where two-thirds of people do not have access to improved sanitation. To effectively address this inherent issue of public urban sanitation, Indian startup Eram Scientific Solutions has adopted a full life cycle approach to develop an integrated technology solution.

The researchers at Eram Scientific Solutions in Thiruvananthapuram, Kerala, have fabricated a fully integrated public sanitation system using convergence technologies. Made up of steel, fiber, and aluminum, the electronic toilet called Delight Bharat promises improved sanitation through built-in facilities which automatically flush, clean, and sterilize the toilet.

Eram has designed the electronic toilet or the e-toilet on the basic premise of saving water and ensuring clean, hygienic toilets in public areas across India. The washroom occupies an area of 45 square feet and comprises components such as motion and infrared sensors to sense if the toilet is occupied or not, an FM radio system, and an automatic system for opening and closing of the door. The e-toilet works on auto mode: the insertion of a coin opens the door for the user, switches on the light--thus saving energy--and even directs the user with audio commands. The toilet's functions are all backed by SMS alerts to inform the control room about the status of water tank and bio gas plant in the event of any errors or failures, thus minimizing the downtime.

Delight Bharat's design incorporates both the manual and automatic features, such as the flush sensor that automatically flushes the toilet bowl when the user forgets to flush. The urinal is also equipped with an automatic floor cleaning solution. If the floor outside the urinal gets dirty the floor is automatically cleaned with pressurized steam and a jet of water. The motion sensors ensure that the floor is cleaned only in absence of a user.

The auto sterilization and cleaning of the e-toilet happens usually after every five users. This frequency can be changed manually by the administrator by altering the settings on the e-toilet's dedicated website. The changes in the settings are immediately put into effect via a GPRS system. The research team at Eram has also incorporated an algorithm in the e-toilet to check the time of usage and release water in the flush accordingly, minimizing the wastage of water. For example, if the toilet is used for three minutes or less then the system releases only 1.5 liters of water and 4.5 liters of water if the usage is longer.

Besides its auto functions, Delight Bharat has electromagnetic doors and a coin validator for entry. The coin validator at the door requires the user to place a coin (the preset denomination can be of ₹1 to ₹5) and once the machine calculates and validates the amount the voice prompts follow. On receipt of the correct amount, the e-toilet door automatically slides aside, allowing the user to step in and manually unlock or lock the door from inside. The digital displays on the façade let others know that the space is occupied.

Delight Bharat also offers a sustainable model for revenue generation, public social infrastructure and an effective medium for mass communication. It is equipped with a control panel at the back that allows audio advertisements. In case the administrator has a sponsor and wants that an advertisement be played while a person is using the facility, he or she needs to just plug a portable storage device in the control panel to play the content.

The team has also placed vandalism and theft protection sensors to monitor the system and alert accordingly. Through the remote monitoring system,

HIGHLIGHTS

SOLUTION ARCHITECTS
Ria John and Vinod MS

COMPANY
Eram Scientific Solutions

the overall health, cleanliness, water levels, and air conditioning of the e-toilet can be periodically monitored by an administrator. Eram has also installed solar panels on the roof top to provide electricity for the e-toilet. The Delight Bharat unit comes with a bio-membrane reactor that is used to treat solid wastes, rendering the sewage tanks smell-free, and the water used is purified for reuse.

Delight Bharat is a patent pending product. Even though it is loaded with interesting features, Delight Bharat is an easily portable unit and can be dismantled and assembled in a few hours. Currently, Eram is charging ₹150,000 for installation of one unit of the basic e-toilet model. tr

E-TOILET The Delight Bharat promises improved sanitation through built-in facilities which automatically flush, clean, and sterilize the toilet.

Vayu is a cost-effective intuitive ventilator for emerging markets.

Low-Cost Ventilator

There is a severe shortage of affordable critical care facilities in most health care centers in semi urban and rural India. The biggest bottleneck is trained manpower, followed closely by availability of low cost, simple and intuitive equipment such as ventilators in the intensive care unit. Only one in three ICU beds are ventilated in semi-urban India and the number is lesser in both government and private secondary health care centers in peripheral towns and villages, according to Synovate Market Research - India Healthcare Market and Intensive Care Ventilation 2010 report commissioned by GE Healthcare. While in a country such as the U.S., there is one critical care ventilator for 4,300 people, in India the statistic is one for every 53,000 people. This dismal statistic indicates that people with respiratory and other diseases that can easily be treated by intensive care ventilation are either forced to travel long distances to procure health care or are denied proper medical care. Many lives can be saved with first level critical care ventilator and monitoring facilities proximal to high populations.

To address this challenge, researchers at GE Healthcare have developed a high performance, low-cost ICU ventilator named Vayu, which is a Hindi translation for air or wind. At a cost proposition of almost one third compared to other state-of-the-art ventilators in the market, Vayu is a easy to use, simple ventilator that provides key modes of ventilation, including noninvasive capabilities.

Given infrastructure constraints such as lack of pressurized air/oxygen pipelines and power outages, Vayu is capable of pressurizing ambient air through an inbuilt turbine to provide ventilation. It has about four hours of battery backup. The product is certified with CE Mark of reliability, safety and performance and is compliant with all international medical electrical equipment and critical care ventilator standards. It supports better breath delivery with basic monitoring. Vayu is a compact unit that can

HIGHLIGHTS

SOLUTION ARCHITECTS
Andreas Tzanetakis, Chandra Aloke Kopalli, Guru Honawad, Jyoti Gera, Mikael Tiedje, and Vinay Joshi

COMPANY
GE Healthcare

BREATHING LIFE The Vayu ventilator is capable of pressurizing ambient air through an inbuilt turbine.

be used in emergency/transport situations.

The product was developed by GE Healthcare's engineering team in India with technology that is very advanced and is used in various respiratory care and anesthesia devices across the portfolio. Its performance is driven by a very high end turbine in combination with pneumatics to mix air and oxygen from cylinders/pipelines to meet needs of the patients. Vayu offers high performance in a small, compact, low cost package and has advanced control system algorithms based on high end ventilator and anesthesia products from GE which deliver very high synchrony with patient effort. Few pilot clinical studies on patients show that Vayu can effectively ventilate patients across disease patterns and varying ventilatory performance envelopes. GE Healthcare recently launched Vayu in India. A patent has been filed by inventor Mikael Tiedje, GE Healthcare, Sweden for Vayu. tr

ToucHb is an easy to use portable device to diagnose anemia.

Noninvasive Diagnosis of Anemia

With scientific advances in complex diseases such as cancer and human *immunodeficiency virus* revolutionizing the medical world, a majority of the world's population is still grappling with basic nutritional deficiency disorders due to lack of timely diagnosis. In India over 50 percent of women are anemic with approximately one million women and children dying every year due to anemia.

Anemia is a condition in which the body does not have enough healthy red blood cells. Red blood cells provide oxygen to body tissues. In an anemic state the amount of oxygen available to each organ is low, a condition that can be very critical during pregnancy. Nearly 40 percent of pregnancy-associated deaths are linked directly or indirectly to anemia. Maternal anemia is also one of the most common causes of low birth weight (LBW) infants.

One of the major problems with diagnosing anemia has been the apparent lack of a low cost portable diagnostic tool. Another factor that comes into play in a rural population is the general aversion to a needle prick, especially in the absence of any severe symptoms of a disease. Existing methods to diagnose anemia are either invasive or highly subjective. At the outset of such a scenario, Biosense Technologies, a young startup consisting of individuals from diverse backgrounds, has developed a portable device to measure hemoglobin in the blood without a needle prick.

ToucHb is roughly the size of a netbook and can work in tandem with an Android smart phone or a computer. The portability of the device allows health care workers to screen large populations, by going door to door in villages that cannot easily access public dispensaries. On diagnosis, anemic women can be promptly started on the required regime of nutritional supplements.

The idea of developing ToucHb stemmed from a pulse oximeter, a medical device that indirectly measures the blood oxygen levels. On passing a ray of light of a specific wavelength through an object, the resultant light is observed to be of different wavelength. This fundamental principle of spectrophotometry is at play in ToucHb where the extremity of the subject, a fingertip or an earlobe,

DIAGNOSTIC KIT ToucHb works like a pulse oximeter in tandem with an Android smart phone or a computer.

HIGHLIGHTS

SOLUTION ARCHITECTS
Abhishek Sen and Aman Midha

COMPANY
Biosense Technologies

is probed with diffused light from three-wavelengths in the near infrared region. The resultant light is then collected by a photo diode in the instrument.

Hemoglobin is known to display differential absorption in the near infrared region. After the background noise involving respiratory artifacts and movement errors are eliminated using an algorithm, the degree of absorption of the specific infrared wavelength can be measured. On comparison with a linear regression model, the hemoglobin levels can then be displayed in conventional units of gram per deciliter.

What makes this device truly user friendly is that in addition to not requiring any recurring consumables other than a pair of batteries, it does not require any skill to operate. The device gives instant results in less than a minute, allowing the healthcare worker to decide on the necessary therapeutic action without being dependent on the doctor, thus enabling him or her to work easily in remote areas. With over 74 percent of India's population living in villages, a solution such as ToucHb has the potential to go a long way in empowering the people at the grassroot level and provide an easy way to better health in the most vulnerable population of children and pregnant women. tr

EDITORS' CHOICE

Le Chal is an unobtrusive navigation aid for the visually impaired.

Haptic Shoe

Imagine walking down to the nearest grocery shop or a bus stop with your eyes blindfolded and you'll probably get a sense of how tricky outdoor navigation for the visually impaired can be. Close to 285 million people are visually impaired worldwide of which 39 million are blind and 246 million have low vision. And about 90 percent of the world's visually impaired live in developing countries. In India nearly 53,000 people are visually impaired per million population according to a WHO survey in 2010. And most of such people have to depend on others, such as a friend or spouse or relatives, for their day-to-day commutation purposes. The problem increases manifold when they don't have anyone to assist around while traveling and commuting to new places. Sensitive towards the needs of the visually impaired people, Anirudh Sharma, 24, a young researcher at Hewlett-Packard Labs in Bangalore, has designed a haptic shoe for the blind.

Sharma has developed a non-obtrusive navigation aid that can assist the blind in their independent commutation in public spaces. The navigation aid is embodied within a shoe and condenses global positioning system about pathways into tactile vibration feedback. And therefore, the shoe is aptly named "Le Chal" which is a Hindi translation of "Take Me There". Unlike other existing aids that are available in the market for people with limited or no vision, Sharma's haptic shoe is simple in design and uses low-cost readily available components.

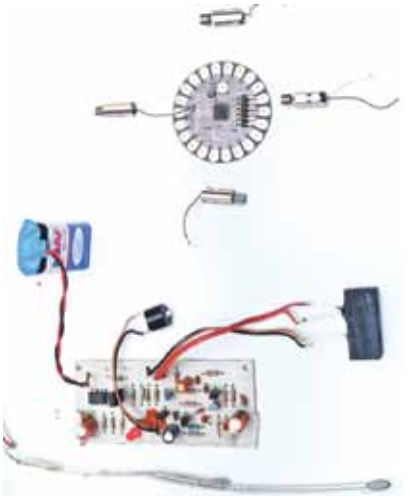
At present people with limited or no vision depend either on walking canes, which help them detect obstructions, or seek help from friends and other people for assistance, or use voice-based navigation aids. The existing form of voice-based navigation aids can be very distracting for the blind as they mostly depend on their sense of hearing. Such devices are prohibitively expensive to buy too. Sharma's Le Chal shoe can navigate the route for the visually impaired and lead them to their desired destination without hampering their hearing power or making them wear bulky stuff and look awkward on the street.

The unobtrusive design of Le Chal is its most significant feature. The vibrators and proximity sensor put in one shoe of the pair enables the user to walk without any physical aid. All that the user requires is a Le Chal shoe and a Le Chal-app-running Android smart phone with global positioning system (GPS). Once the user sets a destination on the phone before starting the journey, the phone communicates via Bluetooth with a LilyPad Arduino circuit board, located in the heel of the shoe. Following the Google-supplied turn-by-turn directions, along with locational data from its own GPS unit, the phone gets the control-board to

HIGHLIGHTS

SOLUTION ARCHITECT
Anirudh Sharma

COMPANY
Hewlett-Packard India



POWERFUL ELECTRONICS Do-It-Yourself Components of Le Chal on display: Four mini vibrational motors to inform the user about the directions; a sole of the defined dimensions to house the components; a Bluetooth Arduino Lilypad to sync devices; and a smart phone with compass enabled global positioning system to pull location data from satellites.

activate each of the shoe's four vibrators as needed. The built-in compass in the GPS module calculates the direction user is walking in. When the turning point is approached a mild vibrational feedback activated in the shoe informs the user the direction he or she needs to turn to. For example, a vibration on the front indicates that the user should keep going straight, a vibration on the left side means that the user should turn left, and so on. The strength of the vibration depends upon the overall proximity from the destination, that is, vibration is weak in the beginning and is incrementally stronger at the end of the navigation task. The built-in proximity sensor in the front portion of the shoe can detect up to 10 feet, informing the user of the surroundings and allowing him or her to make decisions and plan the next move.

Sharma is currently obtaining funding for the next phase to develop first 20 shoes enabled with the technology. He has tried to minimize the cost by using readily available components. He says the same could be further reduced if cheaper GPS devices could be sourced. He is also planning to release the code of Le Chal Android application and schematics to public through Arduino community channel. He is creating a Do-It-Yourself (DIY) guide through an editable Wikipedia where users can participate and help him create better version of the technology. tr

The device conserves electricity through an embedded system.

Smart Energy Saver

It is a common case in most of our households and workplaces that we forget to switch off the power when we leave the room or area. There are a large number of devices designed to monitor and prevent the wastage of electrical energy. The major concern that remains unaddressed till date in all such devices is that they use expensive sensors like cameras to monitor the presence of people inside a room to switch off-and-on the electrical power. Those devices at times can be an unviable option for the consumer. It is with this mission that the inventors from Lovely Faculty of Technology and Science, Lovely Professional University, have designed a low-cost module that would be affordable and can be used by every small office to accrue substantial energy saving on the whole.

SEES, the Smart Electrical Energy Saver, is an embedded system which counts the number of persons entering a room and also counts downwards when the person leaves it. When the net result of persons entering the room and leaving the room becomes zero, the system automatically switches off all the electrical appliances in the room. Again when the first person enters the room, all electrical appliances are automatically switched on.

SEES consists of a micro-controller that is connected with two sensors, one display LCD and one relay point. The relay instrument is connected to the electrical appliances of that particular room. The sensors installed sense the entry-exit of visitors and give inputs to the micro-controller. The micro-controller processes the information to check if the total number of persons entering/leaving the room is zero or not and accordingly gives command to the relay to either put off or on the electrical appliances of the room.

This system consumes only 300 milliwatts, that is, 0.3 watt energy and the overall cost of SEES is approximately ₹1,000-₹1,200. The usage of this device is estimated to result in additional saving of 20 percent on the consumer's bill. tr

HIGHLIGHTS

SOLUTION ARCHITECTS
Bikash Kant, Kirti Patyal, and Lovi Raj Gupta

COMPANY
Lovely Professional University

Genetically engineered microbes can enzymatically breakdown plastic into biodegradable end products.

Plastic Morph

The world's plastic waste management situation is in a crisis. On one hand, we continue to generate over 200 million tons of plastic products and on the other hand, there are no clear methods to turnover/degrade plastic. Plastic is highly resistant to natural decay and degradation, thus posing enormous burden on the environment. Millions of tons of plastic waste exists in landfills, oceans, rivers, soil, and more. Burning of plastic is not a remedy since it generates toxic fumes and releases harmful chemicals into the environment. Recycling offers only a temporary solution. It is therefore imperative and urgent to have an alternative method to tackle the menace of plastic waste and develop technologies that can convert plastic into biodegradable matter.

The innovation of Praveen Bhat Gurpur of Jubilant Biosys, Bangalore, is the PlasticMorph, which is proposed to systematically bio-engineer microbes to synthesize enzymes capable of degrading the plastic polymer into simpler, biodegradable monomers.

Gurpur's team is currently in the process of building a working prototype of the PlasticMorph. They are working out the conditions needed for the plastic membrane, the pore-size, the nutrients which are limiting, the microbial species, and more. The patent filing process will be completed as soon as they have the working prototype ready.

The central principle of the PlasticMorph is to force bacteria to survive in an environment where their only source of energy is obtained by degrading plastic and selecting for survivors. These survivors will have mutations in genes that produce special enzymes to degrade plastic. This gives them an advantage over their peers and they will survive, whereas the non-mutated ones will die. In PlasticMorph essential growth nutrients are separated from bacteria by a semi-permeable plastic membrane. This process is based on directed evolution.

According to the developers, most of the small- to medium-gauge thick plastic products like polythene bags, plastic water bottles, plastic coverings and protectives can be degraded into biodegradable end-products in their reactors. This has the capability to impact multiple spheres of life. tr

HIGHLIGHTS

SOLUTION ARCHITECT
Praveen Bhat Gurpur

COMPANY
Jubilant Biosys

Solar multi-effect distillation system to produce low cost desalinated, potable water.

Desalinated Potable Water

Drinking water scarcity is higher in coastal regions in comparison to the interior parts of India as the the groundwater is saline and not suitable for drinking. Therefore, desalination of sea water becomes an ideal solution to bridge the widening gap between growing drinking water needs and scarcity of the same in major coastal cities of India. Transporting water tanks has been proved costlier than water supplied by desalination. And a continuous effort to amend the desalination technology can prove beneficial. The conventional desalination plants are usually centralized, require huge capital cost, and enormous amount of concentrated energy from fossil fuel. The team from KG Design Services has looked at seawater desalination using solar thermal energy.

KG Design Services has developed an indigenous method of concentrating solar energy by the linear fresnel reflector (LFR). A solar collection field with 1,404 square meter of mirror area works regularly in KGDS research cen

ter in Coimbatore, Tamil Nadu. On a hot day, with directed solar insolation around 850 watts per meter square, this field collects 480 kilowatts of heat energy and produces about 640 kilograms per hour of steam. The field can produce a peak output of 6,000 liters per hour of desalinated water. For a small rural community of a thousand people this system can provide the vital potable water requirement.

Multi-effect distillation (MED) is a thermal distillation process. The seawater is sprayed onto the surface of the evaporator tubes of different chambers (effects) in a thin film to promote evaporation after it has been preheated in the final condenser. The evaporator tubes in the first effect are heated by steam from the LFR. The steam produced in the first effect is condensed inside the evaporator tubes of the next effect where again vapor is produced. The surfaces of all the other effects are heated by the steam produced in each preceding effect. Each effect must have a lower pressure than the preceding one. This process is repeated to bring about six effects. The steam produced in the last effect is condensed in a separate heat exchanger called the final condenser, which is cooled by the incoming seawater.

KGDS is working on both solar desalination done with solar energy as well as solar energy integrated with the solar-biomass hybrid power plant and desalination done using the steam output from the turbine. The first approach is understood to be India's first indigenous industrial scale solar thermal desalination of seawater. The plant in Narippeiyur village, Ramanathapuram, when completed at the end of Phase II in April 2012 may be the largest solar thermal sea water desalination plant in the world. The cost of desalinated water through both approaches is estimated to be ₹479 per 1,000 liters.

In India, around 20 major cities are on the coastline and the water requirement for all these cities in 2008 stood at 6,267 million liters per day (MLD). And the five cities of Mumbai, Chennai, Surat, Kolkata, and Visakhapatnam account for 93 percent of the total water requirement. The projected water requirement for all coastal cities in 2026 is estimated to be 23,607 million liters per day (MLD), a four-fold increase from 2008. By 2026, Mumbai would alone account for 55 percent share of the total water requirement from the coastal cities. As a consequence, Mumbai would require a desalination capacity of 2,600 MLD and this calls for an estimated investment of ₹230 billion. tr

HIGHLIGHTS

SOLUTION ARCHITECTS
MP Ramaswamy, Raju Abraham, RV Pujeri, and SP Viswanathan

COMPANY
KG Design Services

THERMAL DISTILLATION The linear fresnel reflector steam generation in Coimbatore.

3nethra is a non-invasive eye pre-screening device with multiple imaging functions.

Eye Screening

In India's poor health care infrastructure, 3nethra ushers a ray of hope for preventing avoidable blindness. As per WHO reports, there are 12 million blind people in India and more than 80 percent of the cases are avoidable. Some eye diseases like diabetic retina, glaucoma do not show any early signs and are often too late for treatment. The problem combined with illiteracy, scalability, and rural reach increases manifold. Furthermore, only 14,000 ophthalmologists practice in India and a mere 800 ophthalmologists graduate every year. Ophthalmologist to patient ratio in India is very poor, at approximately 1:70,000.

Identification of eye diseases serves the biggest bottleneck even for bigger hospitals to direct appropriate treatment. Only around seven percent of people at various stages of blindness are screened and treated as of today. Present healthcare system needs expensive diagnostic devices for screening (single device for every problem) coupled with the availability of highly skilled ophthalmologist or a technologist. Rural market remains grossly under serviced. It is in this context that the need of an easy to use, low cost, single device arises that can be operated in a village environment with the help of few technicians.

The 3nethra solution is a single, intelligent, portable, low-cost, non-mydriatic, non-invasive eye pre-screening device which can be operated by a trained technician in an integrated telemedicine and remote diagnostic enabled ecosystem. With the help of the device the technician can provide diagnostic advice for all five major eye ailments like diabetic retinopathy, cataract, glaucoma, cornea defects, and refraction problems.

3nethra incorporates multiple digital imaging functions (retinal imaging, cornea imaging, auto refraction) in one device built around innovative optics system. Its patented intuitive control software facilitates rapid detection of diabetic retinopathy, cataract, symptoms of glaucoma and refraction errors. The automatic software reduces the need for special skills. It promises a complete solution rather than only detection service. It is a single device and integrated solution with minimum deployment needs and hence reduces cost of service and increases reach. The device consumes 10 watts of power, and thus can be used with simple power pack.

"The product has combined three functionalities: anterior imaging, posterior imaging and refraction in single equipment. Getting all these three functionalities in a single optical line is a great technology challenge. Most of the optical equipment don't even offer warranty if you move them outside the hospital," says Shyam Vasudeva Rao, president and CTO, Forus Health. 3nethra is an exception, as it has been ruggedly designed so that one can take it anywhere for usage. tr

HIGHLIGHTS

SOLUTION ARCHITECTS
K. Chandrasekhar and Shyam Vasudeva Rao

COMPANY
Forus Health

DISEASE PREVENTION The 3nethra solution is a single, intelligent, portable, low-cost, non-mydriatic, non-invasive eye pre-screening device that combines three functionalities: anterior imaging, posterior imaging and refraction. Its patented intuitive control software facilitates rapid detection of diabetic retinopathy, cataract, symptoms of glaucoma and refraction errors.

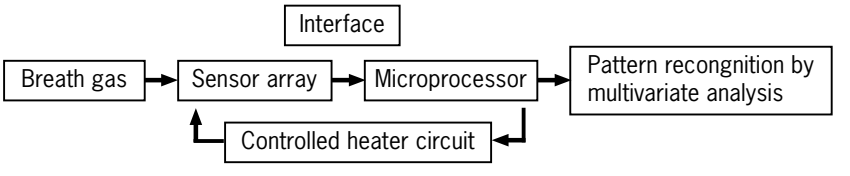
New technology enables to sniff and detect tuberculosis.

TB Breathalyzer

Tuberculosis (TB) is an infectious disease caused by Mycobacterium tuberculosis (MTB). According to World Health Organization reports, over 10 million cases of TB are registered every year leading to about three million deaths globally. And one third of the world's population is infected with latent MTB. This is a challenge in countries like India where most of its citizens suffer from this disease because of late detection. Since the beginning of Revised National TB Control Programme (RNTCP) in India, more than 40 million TB suspects have been examined of which 10 million patients have been placed on anti-TB treatment, with more than 1.6 million lives saved during its course. Despite serious efforts by the government, the coverage of TB diagnosis and detection is lower than 60 percent. Current diagnostic techniques include sputum smear microscopy, chest X-rays, molecular, and culture tests. The most commonly used test for TB, smearic test, lacks sensitivity (~60%) and cannot differentiate live and dead bacilli, leading to high false positive/negative cases. TB diagnostics have remained unchanged for decades despite their acknowledged poor performance. Molecular and culture tests provide good sensitivity (>90%) but need a cost-intensive setup and trained manpower to operate and analyze the results.

A team of researchers from International Center for Genetic Engineering and Biotechnology (ICGEB) has developed a specialized electronic nose (EN) that can detect TB by sniffing the disease's volatile organic compounds (VOCs) biomarkers from noninvasively collected urine/breathe samples.

The ICGEB scientists have developed a battery-operated hand-held prototype that requires limited training similar to the use of a breathalyzer. It is aimed to be efficient in tropical climate as the temperature and humidity will have negligible effect on the instrument's performance. It involves noninvasive and noninfectious mode of sample handling and can monitor response to anti-TB therapy.



BREATH ANALYZER Schematic presentation of the proposed electronic nose.

The EN prototype is developed by assembling an array of sensors specific to identified VOCs markers and integrated with decision algorithm to help in TB diagnosis. The technology is based on sensor arrays, including conductive polymers, non-conductive polymers, metal-oxide semiconductors, fluorescent dye, and chemo-responsive dye, optic or acoustic wave devices, combined with neural network classifiers to measure VOCs from breath or urine. The TB breathalyser works by detecting the presence of about half a dozen biological chemicals in the air expelled from someone's lungs. The scientists have proven that patients with TB have a different signature on their breath compared with people who do not. Portable breath analyzer for asthma and lung cancer has been attempted successfully. Some of these technologies used in commercially available e-nose devices claim sensitivities in parts per billion (ppb) ranges.

VOCs biomarkers have been reported for various disease conditions including TB, chronic obstructive pulmonary disease (COPD), lung cancer, cystic fibrosis, and rheumatoid arthritis. Biomarker discovery is usually carried out using very sensitive cost intensive GC-MS. However, the real challenge after the discovery of VOCs based biomarker is how to translate these findings into an inexpensive and easily-administered diagnostic tool at point of care (POC). The EN developers are quite hopeful that VOCs based TB diagnosis will yield high degree of success but have to deal with lots of technological changes especially during sensor development. If EN technology could provide little more than 60 percent sensitivity, it will be a high demand product both in India as well as across the globe. tr

HIGHLIGHTS

SOLUTION ARCHITECTS
Khalid M. Banday, Ranjan Nanda, and Virander S. Chauhan

COMPANY
International Centre for Genetic Engineering and Biotechnology