

PRESS RELEASE

28 June 2010

A*STAR SHOWCASES 17 INNOVATIVE SOLUTIONS FOR TACKLING URBAN LIVING CHALLENGES AT WORLD CITIES SUMMIT 2010

1. Seventeen innovative solutions from the Agency for Science, Technology and Research (A*STAR), that hold promise of enhancing lifestyle, improving healthcare delivery and making urban living more sustainable and liveable, will be showcased at the World Cities Summit (WCS) from 28 June 2010 – 1 July 2010, at Suntec Convention Centre.
2. Among the A*STAR innovations are:

A) Future home technologies to enhance lifestyles

- Home Robots. One of A*STAR's social robots that will make its debut at the WCS is MIKA. A home robot implanted with award-winning technologies such as speech recognition and human gesture tracking, MIKA has been designed to understand instructions, perform fetch-and-carry functions and do household chores. With MIKA, homeowners, particularly the aged, can be relieved of much of their housework and be able to enjoy a higher quality of life.
- Linguistics technology for on-the-fly translation. This offers real-time translation and subtitling of TV news programmes into the Southeast Asian language of the viewers' choice. With this technology, audiences in the region will now be able to easily understand the news delivered when they read the on-the-fly translated subtitles in the language of their choice. This technology also extends to document translation with format retention, as well as SMS messages.

B) Epidemic control and medical technology to improve healthcare delivery

- Contact-network-based simulator. This innovative solution is able to model the contact network and simulate the spread of infectious diseases in a community by analysing the statistical pattern of social connections in a society. This is particularly useful for densely populated urban cities such

as Singapore where the population is highly mobile and the outbreak of infectious diseases are generally hard to track.

- Variable and Wireless Health Monitoring System. This system-on-chip is a fully-integrated wireless portable ECG device that can be attached to the patient's body for ECG signals to be transmitted to the patient's mobile phone, and for them to be further sent to a centralised database so that qualified medical professionals can instantaneously interpret the readings. This device consumes five times less power than the conventional sensor nodes, and eliminates complicated wire connections.

C) Alternative and sustainable materials for sustainable urban living

- Flexible electronics. This novel and energy-efficient technology prints electronic circuits on numerous surfaces such as paper, plastics and textiles. For example, maps printed with such circuits can now be easily read in the dark without the help of an external light source, as the maps can be "self-lighted". Another example will be the blood-bags that are printed with electronic conductors. The integrated heating circuits on the blood bags will allow the blood they contain to be "self-heated" to match the temperature of the patient's body before a transfusion. This will greatly reduce the risk of complications that may arise as a result of the transfusion of chilled blood.
- Biocomposites - A New Generation of Sustainable Materials. Cups and flower boxes moulded from biocomposites made from recycled plastic filled with bran are not only economically viable, but also reduce the carbon footprint by at least 30%, compared to petrochemical-based virgin plastics. The use of these degradable biocomposites will greatly reduce dependency on fossil fuels and ease waste management issues.

Details of all 17 technologies on showcase are appended in the Annex.

3. Said Prof Low Teck Seng, Deputy Managing Director for Research at A*STAR: "The world continues to face global challenges in urban living, and cities around the world are striving to be more sustainable and liveable. Science and technology can be tapped to push the technological frontiers and tackle issues such as alternative energy and materials, healthcare and the greying population."
4. He added: "A*STAR builds upon its research capabilities across a spectrum of domain expertise to develop integrated solutions and technologies at the systems levels. Such innovations can then be easily adopted by the industries, enhancing economic activities and making a positive impact on the community. This will help establish Singapore as Asia's Innovation Hub for knowledge creation and sharing in the area of Sustainable Development."

Journalists/photographers are cordially invited to visit the A*STAR booth at the World Cities Summit 2010 (Level 2 Ballroom, Singapore Inc. Pavilion).

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Encl:

Annex: A*STAR Technologies at World Cities Summit 2010

AGENCY FOR SCIENCE, TECHNOLOGY AND RESEARCH (A*STAR)

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About the Agency for Science, Technology and Research (A*STAR)

The Agency for Science, Technology and Research (A*STAR) is the lead agency for fostering world-class scientific research and talent for a vibrant knowledge-based and innovation-driven Singapore. A*STAR oversees 14 biomedical sciences, and physical sciences and engineering research institutes, and seven consortia & centres, which are located in Biopolis and Fusionopolis, as well as their immediate vicinity.

A*STAR supports Singapore's key economic clusters by providing intellectual, human and industrial capital to its partners in industry. It also supports extramural research in the universities, hospitals, research centres, and with other local and international partners.

For more information about A*STAR, please visit www.a-star.edu.sg.

A*STAR Technologies and Solutions Packages at World Cities Summit 2010

Home: Future Technologies to enhance lifestyles

Home Robots

With an ageing population, there is an increasing need for home assistance for ease of chores and a better quality of life. MIKA is designed as a configurable robotic platform for home use. It is equipped with award winning technologies such as speech recognition, and human gesture tracking. With such a platform, home robots are able to understand instructions and perform fetch-and-carry functions.

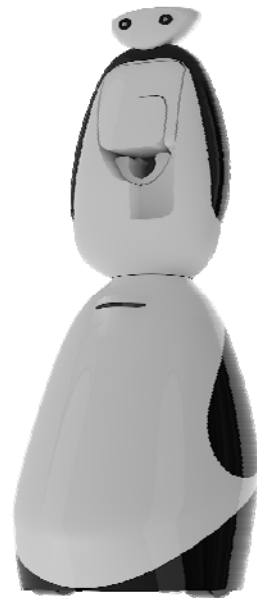
MIKA's useful abilities are powered by the following technologies:

Human-Gesture Tracking and Object Identification: vision technologies that understand human gestures and identify objects in a real-world environment. It was the best performing vision understanding system demonstrated at the 9th International Workshop 2006 on Performance of Tracking and Surveillance (PET 2006)

Robotic Operating System: a unified framework that allows developers and users to modify the workings of the robot through simple XML script to easily configure the robots for different purposes ranging from domestic help to elderly care.

Speech Recognition: a robust speech recognition engine that understands human commands or keywords in a noisy environment through a far-talk microphone. A*STAR's Institute for Infocomm Research's (I²R) Abacus speech recognition was ranked first in National Institute of Standards and Technology (NIST) 2009 Rich Transcription Evaluation International Benchmarking.

APOLLO: a spoken dialogue management system that is easily configurable & "pluggable" for real-world human-robot interactions for home robot applications. MIKA is an example of such a quick prototyping of spoken dialogue.



Translation On-The-Fly

In increasingly multicultural and pluralistic societies, people are required to communicate across linguistic barriers and access content in different languages. As such, accurate, high-speed translation is necessary to meet real-time needs. An adaptable translation model able to cope with variations in language styles, terminologies and structure for different domains of language use is essential for usable translated output.



A*STAR's Institute for Infocomm Research (I²R) has created linguistically motivated, rule- and statistical-based systems to effectively model translational equivalence and structure divergence between two different languages. This system combination framework exploits and leverages on the strength of different translation models for better, more fluent output. Besides, model optimization and dynamic beam-thresholding improve speed performance without compromising translation accuracy.

Currently able to provide high quality, real-time translation for news programmes in Southeast Asian languages, this technology can toggle from English to Malay, Chinese and Indonesian, and translate from the latter three languages to English. Translated subtitles can be read as you watch the news feed simultaneously.

This technology is also extended to document translation with format retention features, as well as SMS messages.

3D Face Modelling As Web Service

Developed by A*STAR's Institute for Infocomm Research (I²R), this technology takes a 2-dimensional frontal portrait image and instantaneously processes it into a full 3-dimensional face object file that can be incorporated into games, virtual worlds, and other applications involving photo-realistic human avatars.

Delivered as a Web Service, this technology has been designed to provide low cost, real time and with automatic feature extraction feature.

Some of the applications include:

- Online e-greeting cards
- Virtual agents and avatars
- Character animation in entertainment (e.g., games and movies) and advertising
- Computer synthetic facial surgery
- Model-based teleconferencing

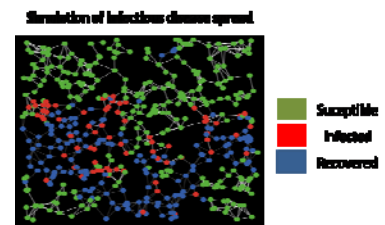
Cities: Epidemic Control and Healthcare Delivery

Urban cities, with their large mobile populations and open streams of people, need to be prepared and resilient in case of potential pandemics. A*STAR has developed an integrated array of technologies to help predict how disease spreads, rapidly identify infected patients, treat them and monitor their progress.

Epidemic Control

Contact Network Modelling for Infectious Disease Spread in Urban Cities

A*STAR's Institute of High Performance Computing (IHPC) has developed a contact network generator which can output social contact networks with social contact data as inputs. The contact-network-based simulator developed can show users a simulation of disease spread in a community. As the contact network reflects the statistical pattern of social connections in a society while taking heterogeneity of social contacts into consideration, it enables us to investigate spread of disease at a macro level.



On a micro scale, this modelling can also focus on specific groups of people or locations. Moreover, the individual-based simulator has the capacity to evaluate the spread of disease under different specific scenarios. The simulation model can provide evaluation on hybrid control strategies and is a very useful tool for healthcare workers and policy makers in their decision making processes when countering a pandemic emergency.

The contact network modeling concept can be extended to apply in business and city development plans, for instance in identifying the locations of new shops or residential locations.

Mobile Influenza Test Kit

The conventional method for influenza diagnosis requires several manual processes, including the lysis of virus particles, viral RNA extraction and molecular diagnosis, which are often conducted within the confines of centralised laboratories. The entire protocol takes 5 to 6 hours, and requires skilled operators who are put at risk of accidental virus exposure and disease contraction.



When Influenza A surfaced, the global fear of its spread demonstrates the need for a fully automated system to rapidly identify infected patients. This system allow diagnosis in decentralised locations such as airports, train stations and immigration check points to contain the spread of highly contagious diseases, and to alleviate the burden of healthcare personnel in the diagnosis of an overwhelming number of suspect cases.

A*STAR's Institute of Bioengineering and Nanotechnology (IBN) has developed a novel desktop system that integrated virus particle lysis, viral RNA extraction, and 1-colour, 3-channel multiplexing RRT-PCR (real-time reverse transcriptase-polymerase chain reaction) for rapid influenza diagnosis with WHO-recommended protocols. All necessary chemicals, including any process waste generated, were self-contained and completely sealed within a polymer cartridge, minimising the possibility of human contamination and accidental virus exposure. The operator would only need to load the patient's nasopharyngeal swab sample into the cartridge, and the system would automatically perform the entire sample preparation and molecular diagnosis within 2.5 hours.

Tracking Patients' Progress

Smart Bed

A non-invasive, continuous method of tracking post-hospitalisation patients can be found in the Smart Bed, developed by A*STAR's Institute for Infocomm Research (I²R), where a system of measuring key vital signals such as respiratory and pulse rates, monitoring sleep disorders and detecting pressure points on patients' limbs help to prevent bedsores, can track the well being of patients, their sleep patterns and bed-occupancy in case of those prone to falling.



Fibre Bragg Grating (FBG) sensors are strategically placed under the patient's mattress and calibrated to react through a given mattress thickness, detect and track a patient's physiological vital parameters, such as breathing rate and heart beats. Agitation ratings can be taken from these sensors, as they can trace movements to the body parts, so caregivers will know steps to take. Information can be sent as alerts to hospitals and caregivers to take the necessary actions.

Variable and Wireless Health Monitoring System

A*STAR's Institute of Microelectronics (IME) has designed and developed a fully-integrated wireless sensor node system-on-chip that consumes only 700 μ W from a 0.7 V single supply, five times less than a reported similar wireless device that runs on 3600 μ W. It eliminates complicated wire connections, as the device has a sensor node directly attached to a patient's body, which transmits ECG signals to a personal server or mobile phone. The server or phone then stores and sends the ECG information to a centralised database for instantaneous or subsequent interpretation by a qualified medical professional.

Throughout the signal acquisition process, the patient can carry out their normal day-to-day activities with ease, as long as they are within a 10-metre distance

from the personal server. In addition to convenience through (much greater) mobility conferred by the mobile technology, there is greater accuracy in ECG signals acquired by the wireless device since data within a larger sampling window of up to 7 days can be captured.

The sensor node solution can be extended to monitor other vital biological signals such as temperature, blood pressure, respiration rate and pulse oxygen reading. This technology is also applicable for continuous health status monitoring of pilots or space tourists on board commercial space flights to ensure their safety during flight and training routines. It can also be developed further to support medical emergency contingencies during long duration flights.

Mobile Healthcare Framework (Mobicare)

Capturing and analysing ECG signals, this mobile healthcare framework, developed by A*STAR's Institute for Infocomm Research (I²R), generates context data that are important information for ambulatory and continuous monitoring and examination of patients out of hospitals.

Through local online processing of data with/without telecommunication services and sending critical data to hospital when abnormalities (eg. Atrial Fibrillation) are detected, this technology can significantly contribute to early detection of high risk cardiac problems and reduction of hospitalisation.



Industries: Alternative Materials and Energy for Sustainable Living

Flexible Electronics

This novel technology prints electronic circuits on numerous surfaces such as paper, plastics and textiles. Significantly less bulky and able to curve, bend and slide into confined spaces, it is energy efficient and generates almost no heat, according to its several advantages and versatility in usage. The 'printable' nature of such roll-to-roll techniques, developed by A*STAR's Singapore Institute for Manufacturing Technology (SIMTech), allows flexible polymer substrates and electro-luminescent materials to be custom-patterned, coloured and integrated with graphics.



For example, maps can now be read without an external light source. Another example is printed conductors printed on blood-bags, where integrated heating circuits enable the blood to be self-heated to match the temperature of the patient's body before transfusion, thereby reducing the risk of complications owing to transfusion of chilled blood and improve the safety standards of healthcare delivery.

Some key unique characteristics in printed lighting are its ultra-thinness (thinner than 1mm), ability to bend and curve (can be mounted on pillars), ruggedness (is able to function even with a hole drilled through it) and energy efficiency (comparable to LED, generates almost no heat). The current focus of this flexible lighting option is on surface lighting, for instance as ambient light in commercial spaces such as restaurants or as backlights for advertisements. As it generates very little heat, this technology serves dual functional and decorative purposes in spaces such as the swimming pool, aquarium, gaming platforms requiring human touch-and-play interaction and alongside display units for items as diverse as artwork and dairy, which typically need heat filters and careful temperature regulation. Its robustness and rugged nature enables it to withstand impact (eg. of falling object) and drilling makes it suitable for use in the construction industry as safety features.

Biocomposites - A New Generation of Sustainable Materials

Biocomposites, developed by A*STAR's Singapore Institute of Manufacturing Technology (SIMTech), made from recycled plastic filled with rice or coconut husks, or even by products such as bran, can reduce carbon footprints by 30%, compared to petrochemical-based virgin plastics, and is an economically viable choice. The use of recycled materials and agricultural based by-products to create sustainable materials reduces both dependency on fossil fuels and discourages depletion of finite resources. When degradation properties are added to biocomposites, these sustainable materials will also reduce waste management issues.



To quantify greenhouse gas emissions associated with a product's lifecycle, a carbon footprint assessment toolkit has also been developed. An A*STAR industry partner, Winrigo, is able to use this kit to carry out a "cradle-to-gate" study of its recycled and degradable polymers and associated products, enabling the company to establish strategies to improve its sustainability performance and enhance its competitiveness in the green business. Winrigo is currently in a project with homegrown company Prima, which supplies it with bran for its biocomposite cups, used for serving coffee at WCS.

Carbon-fibre-reinforced polymer (CFRP)

Developed by A*STAR's Institute of Molecular Research and Engineering (IMRE), Carbon-fibre-reinforced polymers (CFRP) consist of nanocomposites incorporated with a small percentage of nanometre-sized fillers, exhibit significantly enhanced thermal-mechanical properties. These new materials provide effective low-cost alternatives to current high-strength and low-weight materials such as titanium.

Superior CFRPs can expand their application as structural materials for construction by incorporating nano-fillers into the material's epoxy system. They can be used to forge high performance coating materials, mould components for packaging and to craft thermally and mechanically stable materials for building parts. Extremely strong, chemical- and heat-resistant, such material is ideal for constructing building walls and furniture. These polymers are recyclable as carbon-fibres can be extracted to create other constructs. Existing structures built with these nanocomposites can also be re-cut and reused for lower strength materials.



Fuss-free self-cleaning coatings for building exteriors

Dirt collection on building exteriors have always been a maintenance problem for facility managers and owners as it affects aesthetics. Building surfaces are generally cleaned using detergents, accompanied with scrubbing or high-pressure water jets. These naturally lead to high maintenance costs.



In recent years, "self-cleaning" coatings using photocatalytic Titanium Dioxide (TiO_2) has gained considerable industry attention as they are effective and environmental-friendly. A*STAR's Singapore Institute of Manufacturing Technology (SIMTech) has successfully built a pilot production plant to produce a TiO_2 photocatalytic solution, and commercialised the technology.

Sunlight, in particular the ultra violet component, activates the titanium dioxide to trigger the self-cleaning process. Two unique properties of TiO_2 enable this: its high oxidation power breaks down dirt and unwanted material, while its super-hydrophilicity repels water to drain off rain and with it the oxidized material, from coated surfaces. This technology allows a dramatic reduction in building maintenance costs and resources. The TiO_2 coating lasts for up to three years, and surfaces can be recoated when it wears off.

This technology is highly suitable for countries like Singapore with year-round sunshine and high precipitation to facilitate such a cleaning process. Exterior surfaces which can benefit from this are painted areas, tiles, glass windows and panels, and other glass surfaces that are exposed to sunlight.

Efficient Conversion of Industrial Organic byproducts into Biogas

The lignocellulose-based bioethanol and FAME (fatty acid methyl esters) biodiesel industries generate a large amount of byproducts such as xylose, arabinose and glycerol. Converting these cheap and renewable carbon sources into value-added fuel such as biogas (methane and CO₂), creates great commercial value: cheaper and greener waste management is encouraged, and supplants the need to bury them in landfills, which are highly costly spaces.



Biogas, which is a low-cost biofuel, can be used directly to produce thermal energy, or it can be used to power a gas or diesel engine to run a generator to produce electricity. Refined biogas can be injected into existing gas networks for use.

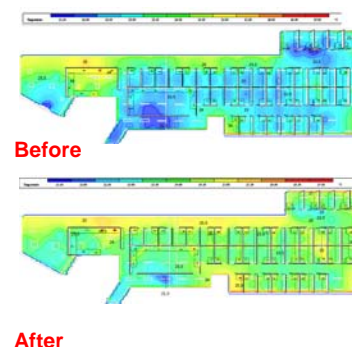
The organic byproducts are traditionally taken as “hard substrates” in the conventional anaerobic digestion system of biogas production. This method requires substrates to be added directly into the conventional anaerobic digestion system to be converted, but microbes have difficulty digesting these substrates as they are more fibrous. As such, little biogas is generated.

A*STAR’s Institute of Chemical and Engineering Sciences (ICES) has developed a method for efficiently converting these “hard” substrates into biogas by introducing exogenous microbes that are able to convert these hard substrates into the intermediates of biogas production, which are then easily converted into biogas by the existing methane-producing microorganisms. The methane produced from these hard substrates using this technology is about 3 – 7 times higher compared to the conventional method.

Using energy efficiently - Environmental sensing, modelling

An **adaptive control system** has been developed by A*STAR’s Singapore Institute of Manufacturing Technology (SIMTech) to reduce unnecessary energy wastage, especially in large spaces such as data centres, clean rooms and open manufacturing floors. Preset air-conditioning temperatures are not adjustable even when the loading conditions, such as number of occupants, vary at different times.

With the use of strategically distributed wireless sensor nodes, actual environmental parameters are captured at critical locations and realistic environment models can be created for analysis. The airflow can then be regulated and monitored to conserve energy.



*To position Singapore as an energy-smart city, A*STAR launched a thematic research programme in Intelligent Energy Distribution Systems (IEDS). The following projects at WCS are part of the IEDS programme:*

Temperature-cascaded Co-generation Plants

In the industrial and building sectors, co-generation plants have been developed to replace conventional Combined Heat and Power (CHP) systems, resulting in higher energy efficiency and fuel energy savings. In such plants, power, cooling and steam are supplied simultaneously from one energy source. A*STAR has optimised a co-generation plant for maximum energy utilisation by applying a temperature-cascading analysis. By evaluating the optimal temperatures needed for heat-activated cycles to be activated in the plant, waste heat can be converted efficiently into useful energy.

The optimised system can be implemented in power plants, factories, hotels and buildings to help maximise and improve efficiency of energy conversion. This would translate into cost savings and reducing the carbon footprints of buildings.

Modular Distributed Energy Resource Network (MODERN)

An IEDS project, MODERN aims to develop environmentally-friendly, resilient, and sustainable energy supply systems that provide energy independence at the least cost. Specifically, it aims to develop:

- Distributed energy generation and storage systems using diverse energy sources and storage methodologies.
- Optimal logistics network/s for the uninterrupted and timely supply of a variety of traditional (oil, gas, coal, etc.) and alternative fuels (bio-diesel, methanol, hydrogen, etc.) to the above systems.
- Interface for plug-n-play microgrids of energy generation and storage systems, which can be integrated into an existing power grid as and when required.
- Optimal mix and configuration of alternative fuels and storage systems.

The proposed project will enable the future energy generation and distribution to be flexible, respond fast to energy demands, and facilitate energy trading and energy independence through a judicious mix of generation and storage technologies and their management.

Energy Distribution Systems - Security Architecture and Techniques for Communications, Control and Management

Another project under IEDS, this research aims to tackle emerging security threats, especially in critical and distributed infrastructures such as energy distribution systems. By creating and demonstrating novel security techniques, this project focuses on two areas:

- Secure and trusted data acquisition from the low-cost sensor network which ensures any manipulation on the reading of the sensed data in transmission can be detected and prevented. This includes efficient implementation of crypto algorithms on resource-constraint sensor motes, efficient key management, efficient detection and revocation of compromised sensor motes.
- Authentication and access control for mobile and pervasive computing environments. This includes resilient authentication techniques against both insider and outsider attacks, and access control on mobile users allowing for their legitimate access to the network and services anywhere at any time.

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