Faculty of Computer Science and Information Technology
Universiti Malaysia Sarawak
www.fcsit.unimas.my

Research @FoCuS-IT

TO BE A CENTRE OF EXCELLENCE, INTERNATIONALLY ACKNOWLEDGED IN THE FIELD OF COMPUTER SCIENCE AND INFORMATION TECHNOLOGY

The Faculty was established in November 1993. Set in the backwoods, away from the major IT hubs, the first task of the day was to simply "get connected". The Faculty's landmark then was a projection of a little VSAT satellite antenna dish by the window of Prof. Zahran Halim's (the founding Dean) office in late 1993. That brought instant electronic globalisation right to the desktop, albeit to just a few test desks at first. Today the little dish is long gone as the campus-wide fibre optic backbone is established with leased lines to the national network, JARING and the Internet.

Today, the Faculty of Computer Science and Information Technology is located in the new campus, with the view of the famous UNIMAS towers and lake.

Making Research Our Way of Life

We now find ourself in a unique situation where "software is going to dominate everything", and thus changing our lives beyond anything we have ever seen before. We need to capitalize on this situation to bring out our best in everything we do, well inline with emerging developments. We want to be able to shape the world, and make a significant impact this emerging era.

In response to this challenge, we have systematically expanded our research activities by both nurturing a research culture and enhancing our capacity for knowledge creation. This is also well inline with our university's vision to become a leading research centre, internationally acknowledged for our scholarly activities.

We have charted out our research directions and technological focus for the next 5 years in strategic areas, well aligned with the national R&D roadmap. Our emphasis is now directed towards building the foundations for effectively generating intellect property and value-adds power by our enterprising and empowered human capital. Research and continuos knowledge creation will then be at the centre of everything that we do.

This research update highlights both the proposed strategic focus as well as the core areas of our research, based on our targeted research profile, and exemplified by our research projects.

We challenge you to share our dreams and vision and invite you to collaborate with us as partners in bringing about a meaningful change to our society and world.

Prof. Dr. Narayanan Kulathuramaiyer
Dean of Faculty of Computer Science and Information Technology

Editorial Team

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FCSIT R&D Roadmap 2010 - 2020

The Faculty of Computer Science and Information Technology (FCSIT) has been very active in research since its establishment in 1993. To date, it had received more than RM20 million in research and commercialization grants from both national and international sources. The core research areas of the faculty are centered on five research clusters that reflect common research interests and collaboration among faculty members.

The faculty realizes that an R&D Roadmap is required for the next 5-10 years as it will form the basis for all future R&D efforts at the faculty and is expected to catalyze and boost many initiatives. The R&D Roadmap will be based on the National ICT roadmap which was developed by the National ICT Human Resources Taskforce in October 2010, spearheaded by UNIMAS Vice Chancellor, Professor Datuk Khairuddin Abd Hamid, the faculty's former dean. The taskforce involves 3 other VCs, IPTA ICT Deans, PIKOM, MNCC, MOSTI, MOHE and other relevant parties.

The R&D roadmap for the faculty encompasses:

- Technology Components Development Roadmap (TCDR)
- Flagship Applications (FA)

The FCSIT R&D Roadmap is a living document which shows commitment of the researchers as it provides and shows clear **directions** of the faculty and provides **focus** on strengths and niche areas of the faculty. The document will also support synergies of efforts and teamwork and facilitates prioritization of budget and grant applications. The Roadmap will also assist in aligning newcomers (staff, postgraduates, project students) in their research activities and thus making projects more independent of individuals.

The R&D Roadmap will indeed revolve around the current strengths of the faculty (based on R&D grants, postgraduate supervision, etc.), namely in the following 5 domains:

- Computational Modeling
- Software Engineering
- Computer Networks
- Image Processing
- Knowledge Technology

The groups' efforts can also be mapped onto the National R&D TCDR as shown in the diagram below.

FACTS & FIGURES:

FCSIT Research & Publication 2009 - 2011

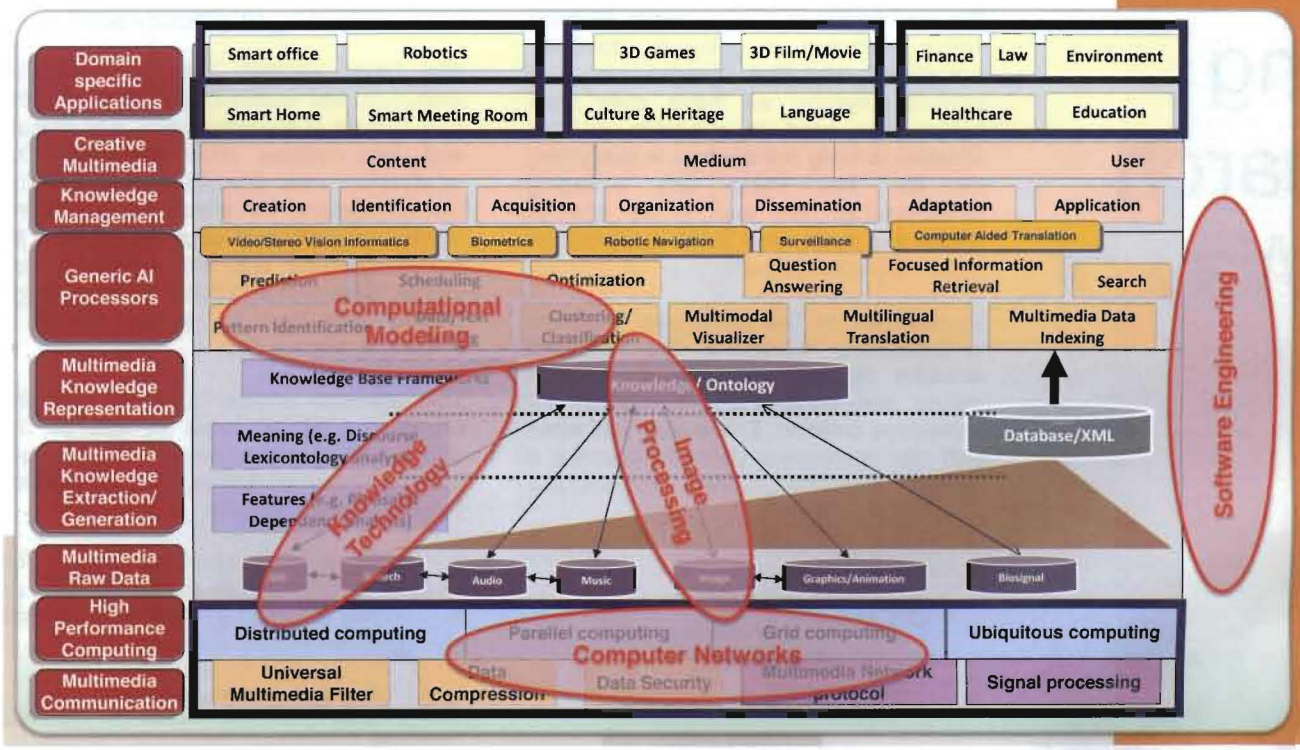
Total number of research grants: **40**

Total amount of research grants: **RM 12,240,817.10**

Postgraduate students: **41**

Refereed conference papers: **116**

Refereed Journal papers: **20**



Source: ICT Human Capital Development Framework

In essence, each of the five R&D Groups will have their own internal TCDR and a Flagship Application – hence forming a mini-roadmap. The FCSIT R&D Roadmap will be formed by combining the TCDRs from the R&D Groups (in this case under the umbrella of the Software Engineering's TCDR, since theirs is the most generic), and by providing a bigger picture to cover all the Flagship Applications.

The TCDRs plan for the development of applications/modules/data in a modular, reusable and incremental manner, such that the results can be readily put together to build various applications or provide solutions to varying problems. The Flagship Application for each group is designed to use as many of the modules/data developed for their TCDR.

The TCDRs may clearly be synergised across the R&D Groups as well as with external partners. For potential collaborators and/or users, of major interest would be the Flagship Applications, which have clear tangible results and very visible socio-economic impacts.

The following provide a brief description for each of the R&D Groups.

Computational Modeling

TCDR - Computational Modeling Workbench
A generic software workbench with 3 top-level modules – Problem Characterisation, Techniques Multiplexor, and Analysis. Problems to be resolved are first characterised by the first module, then a model is formulated using one (or a combination) of the techniques in the second module, and analysed by the third module (which contains many statistical but also other types of analysis modules).
FA - Within GEOHAZARD: for landslides and floods
Modeling is applied to wind, rainfall, soil, terrain, etc., to predict landslides and floods as well as to mitigate them. The same workbench may also be used for current problems being worked on, e.g. river pollution, water seepage in oil palm plantations, etc.

Software Engineering

TCDR - Software Engineering Workbench for software developers
A generic software workbench with 5 main modules – Analysis, Design, Development, Testing, and Delivery.
Applications/modules to be developed and go through the 5 phases by using the workbench that provides software tools to carry out each phase, with emphasis on automatic generation of software code ready for execution.
FA
Application development within the FA by the other R&D Groups.

Computer Networks

TCDR - Computer Networks Toolkit
A devices and software toolkit for network specialists, with essentially 3 compartments – Infrastructure, Technology, and Network Services. This will be for setting up network infrastructures, in terms of network design and choice of appropriate devices, etc.; for enabling the network in terms of protocols, inter-domain communications, etc.; and for setting up services, such as for security, monitoring, communication and application management, etc.
FA - Affordable Ubiquitous Broadband Platform for Mobile Internet
Setting up network/internet accessibility, especially in very rural areas (Zone 5), taking advantage of newer technologies, involving backhaul set-up from the main trunk to the targeted locations (e.g. Wimax 450 Mhz), and then distributing to the widest possible areas (e.g. wifi, mobile devices).

Image Processing & Knowledge Technology (combined roadmap)

TCDR - Intelligent System Builder
A generic software tool to develop intelligent systems, with 3 main (large) Technology Platforms – Language, Knowledge, and Knowledge Management. The first is for the acquisition of knowledge from various multi-media, multi-modal, multi-lingual sources (as well as for generating such forms for knowledge dissemination); the second is for knowledge extraction and representation, together with intelligent retrieval services; and the third is for the development/assembly of the actual intelligent systems for users.
FA - Social Informatics for Minority Groups: Preservation of Languages & Culture/Heritage
There are 66 minority groups in Sarawak with their own languages and very rich culture & heritage that should be developed, or at least preserved. These may be recorded and represented using the appropriate knowledge acquisition and representation techniques and modules. Many applications may be conceptualised, designed and developed with such a repository – minimally multilingual dictionaries/thesauri, translation systems, etc., multimedia ontologies of tools, handicrafts, architecture, etc.

The R&D Roadmap will be a major impetus to push forward R&D efforts in FCSIT. Not only will it help synergise all initiatives and promote teamwork in the faculty, it will also lay the grounds for possible collaborations with external parties, with R&D institutions and industry, nationally and internationally. The full Roadmap document is targeted to be completed within 2011, after several more workshops for brainstorming, technical discussions and very spirited documentation.

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Lee Jun Choi
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Noor Hazlini bt Borhan
Noralifah Annuar
Phang Piau
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Ling Yeong Tyng
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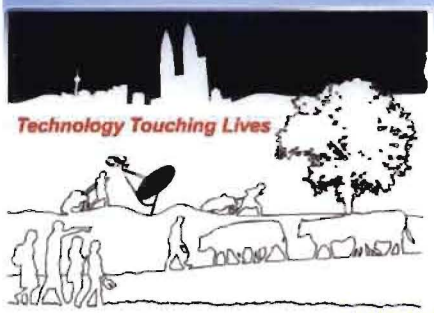
Terrin Lim
Azlina Ahmadi Julaihi
Sze Jeeu Fong
Nadianatra Musa

CENTRE OF EXCELLENCE FOR RURAL INFORMATICS



Centre of Excellence for Rural Informatics (CoERI)
Director: Assoc. Prof. Dr. Alvin Yeo

In December 2010, Universiti Malaysia Sarawak approved the formation of the Institute of Social Informatics and Technological Innovation (ISITI). The Centre of Excellence for Rural Informatics (CoERI) which was previously anchored at the Faculty of Computer Science and IT, is now anchored at ISITI. After the successful experiment of multi-award winning project eBario, the institute developed expertise in many niche areas including but not limited to Rural Informatics, Green Technologies, ICTD and ICT4D.
To push the core concerns of community participation, bottom up development, participative approaches to ICT and so on—out and systematically into a range of research areas and academic disciplines ISITI-CoERI has set up a range of research clusters including education, information technology, social and culture, engineering, telecommunication, business and marketing, knowledge management and so on; each of which includes a number of associated faculty members as research fellows (and project contributors) and graduate students (both Masters and Ph.D) as part of the project team.

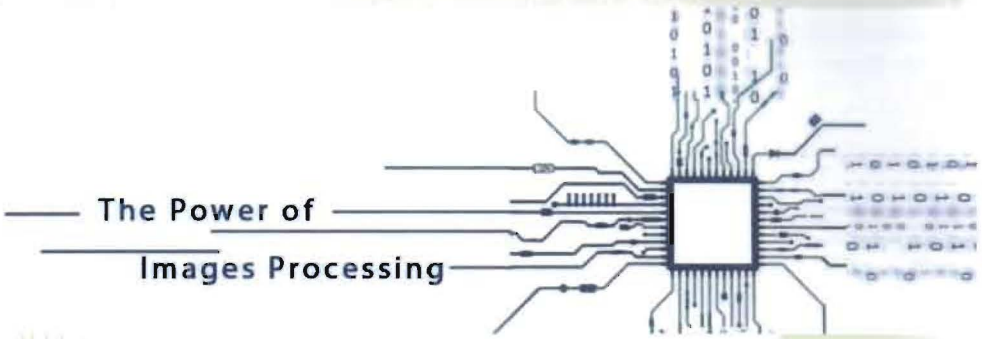
ISITI-CoERI has also an Expert Standing Committee. The members of Expert Standing Committee are well known international researcher that provides the conceptual vision, setting the directions and planning of the institute.

The ISITI-CoERI projects are in East and West Malaysia with a very large and diverse indigenous population both urban and rural and in some instances extremely remote. The research project of the institute got recognition from all over the world by winning Gold Medal from CAPAM in 2006, eAsia Award 2004, IT Premier Award, presented by Prime Minister of Malaysia 2003 and Industry Innovators Award for Systems Development & Applications by SSPI Washington DC in 2002. Further to the recognition the institute also got funding under Demonstrator's Application Grant Scheme (DAGS) to replicate the eBario model to five other sites in Malaysia.

I.M.A.S.T Centre of Excellence for Image Analysis and Spatial Technologies

Centre of Excellence for Image Analysis and Spatial Technologies (IMAST)
Director: Prof. Dr. Wang Yin Chai

Established in 2007, the Centre of Excellence for Image Analysis and Spatial Technologies (IMAST) is one of two research centres anchored in the Faculty of Computer Science and Information Technologies, Universiti Malaysia Sarawak



IMAST main vision is to be the leading and internationally known in Image Processing & Spatial Technologies research and consultation by providing innovative and creative solutions and services.

IMAST promote research and consultation activities mainly specialise in Image Processing and Spatial Technologies fields. We also focus on development of software products with reliable and robust to provide high business values to our clients and hence meet their business objectives.

IMAST research focus is in the area of image processing & analysis and spatial technologies. The main research activities are related to Content Based Image Retrieval (CBIR), biometrics, medical images analysis, satellite images interpretation, spatial data acquisition tools, spatial visualisation, spatial modelling and analysis, spatial data mining, environmental and natural disaster, disease control and spatial related problem, and agriculture based management tools. The core expertise of IMAST is in the delivery of image processing based applications such as CBIR based search engine, satellite image interpretation for agriculture industries, spatial modelling and tools for planning, medical application related to disease control & monitoring and biometrics solutions which are of high commercial values. IMAST currently has 12 research fellows and 15 researchers. More than 100 papers related to spatial technologies and image processing are published at national and international journal and conferences.

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Graduate Research Assistants

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Mathematical Modeling of the Transmission Dynamics of Malaria

Grant: UNIMAS 02(S34)/691/2009(07)

This research focuses on the development of appropriate compartmental models to describe the transmission dynamics of malaria so that the spread of this disease and its impact on the population can be comprehended in a deeper level. Firstly, a basic model is constructed where we have a system of differential equations for both the human and mosquito population. The Basic Reproduction Number is defined and the stability of disease-free equilibrium points as well as instability points are analysed using the Routh-Hurwitz criterion and Descartes rule. Existence of an endemic equilibrium point (a state where the disease persists in the population) is proven by using the intermediate value theorem and the point is unique for a special case. Simulations of the model are carried out using the parameter values obtained from a chosen literature and then compared with the basic model.

The basic model is then extended to incorporate recovery with and without immunity build up. In addition, recovered humans are considered as still capable of transmitting the disease although at a lower rate. The existence and stability of both disease-free and endemic equilibriums for the Immunity model are analysed using similar methods as before. Numerical results of this model are analysed and compared with the literature used earlier and also with the previous model which is the basic model. The disease-free equilibrium demonstrates that there exists a state where mosquito need not be totally extinguished for malaria to be eradicated. This can be achieved if humans recover fast from malaria. Thus, early detection and prompt treatment of patients are essential to combat malaria.

Finally, a brief modification on the Immunity model gives us the Modified model which incorporates the duration of building effective immunity in Infectious humans. Theoretical analysis is carried out in similar manner as done in the other two models. Validation of this model is done by comparing the simulation with the actual cases in Malaysia from 1993 to 2007. It is observed that when the value of q, which is the per capita rate of building effective immunity is increased, the maximum number of Infectious humans decreased. Hence, if an effective immunity can be built in a short period of time for those who recover from the disease, the number of cases could be significantly reduced. It is also found in the Modified model simulation that if the probability of bites which causes transmission from Infectious mosquito to Susceptible human, is reduced to a value which is low, malaria can be eradicated. Hence, malaria can be controlled by reducing the transmission from mosquitoes. Intermittent prophylactic treatments which are used in pregnancy and infants to protect without the knowledge of whether the individual has been exposed to malaria or not, can be taken into account. This is the administration of a full course of an anti-malarial drug at specific time points and is done whether or not parasites are present, such as when the children receive vaccinations against other diseases.

Publications:

1. Kon, M. L. C. (2010), *Mathematical Modeling of the Transmission Dynamics of Malaria*, MSc. (Computational Science) Thesis, UNIMAS

2. Labadin, J., Kon, M. L. C. and Juan, S. F. S. (2009), *Deterministic Malaria Transmission Model with Acquired Immunity*, Proceedings of the International Conference in Modeling Health Advances (ICMHA'09), San Francisco, USA, 20-22 October. **Awarded as Best Paper**.

3. Kon, M. L. C. and Labadin, J. (2009), *Mathematical Modeling of the Transmission Dynamics of Malaria*, Proceedings of the 5th Asian Mathematics Conference, 23-26 Jun

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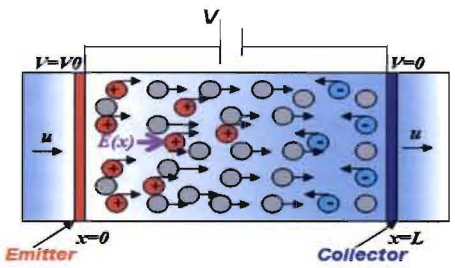
Mathematical Modeling and Simulation of EHD Ion-Drag Micropump for Optimum Performance

Grant: eScience 06-01-09-SF0066

Electrohydrodynamics (EHD) is concerned with the dynamics of electrically charged fluids and their applications. Among the various microfluidic devices and micro electro mechanical systems (MEMS), electrohydrodynamic (EHD) micropump is a promising option, offering the unique advantage of no moving parts, and thus high reliability. Low cost, low power consumption and minimal maintenance are other benefits of the EHD pumping technique. The EHD ion-drag micropump, also known as injection pump, uses the interaction of an electric field with electric charges injected into a dielectric fluid. The electric field is imposed between an electrode called emitter and another called collector. The ions, traveling from the emitter to the collector, drag by friction the working fluid in order to generate a net flow.



Ion-drag micropumps have extensive applications in various fields of technology and life sciences, particularly, pumping fluids in cryogenic cooling microsystems for cooling of sensors, detectors and super-conducting devices, dispensing liquids in miniature systems for chemical and biological analysis, fuel injection loops, and gas and liquid pumping where small quantities of dielectric fluids need to be pumped. Because of the attractive features of ion-drag micropumps the scope of their applications is rapidly increasing from traditional pumping of fluids to drug delivery systems and lab-on-a-chip devices. The intense research is going on to design and analyze different aspects of ion-drag micropumps for better performance. In the last two decades many researchers have made significant contribution in this field but EHD pumping is a complex phenomenon involving diverse unknown electrostatic and hydrodynamic parameters and is still not well understood. Therefore, for the better understanding of the EHD pumping phenomenon and reproducible results, the working fluid characteristics and overall design geometry of ion-drag EHD micropump, still needs to be properly analyzed for optimum performance.

The proposed research aims to study and analyze numerically the EHD pumping phenomenon in an ion-drag micropump by determining its characteristics and design geometry effect on its pumping performance. More explicitly, the major objectives of our research comprise:

- Formulating the mathematical models and simulating the performance of micropump using computational fluid dynamics. This will allow us to find ways to improve and predict the pumping performance.
- Studying and understanding the physical phenomenon that occurs in the flow of fluid within micropump.
- Analyzing numerically the overall design geometry for optimum performance.

In order to achieve the optimum pumping capability different emitter designs will be investigated that can maximize electric field gradients between the electrodes. This can be done by incorporating and analyzing numerically several different geometric parameters and their effects on electrodes that take part in the pumping process of EHD ion-drag micropump. A high performance computer program MATLAB will be used for handling computations and visualization.

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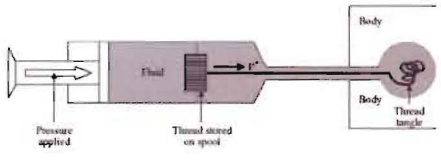
Mathematical Modeling of Thread-Annular Flow

Grant: UNIMAS 02(S33)/690/2009(06)

The pressure-driven axial flow between two cylinders, where the inner cylinder is in a slightly eccentric position and moving at a constant velocity, is studied. Such a flow is often known as 'thread-annular' flow and is relevant to the procedure of thread injection, which is a surgical technique that allows the injection of porous medical implants (consisting of synthetic biocompatible materials) into the body in a minimally invasive way. The porous thread is stored on a spool and injected within a fluid by applying a pressure gradient.



As most of the fluid flow is transparent and the actual fluid motion is not readily apparent to the human eye, thus modeling of the problem is needed in order to obtain a better understanding of the way in which key parameters, such as the speed of injection, affect the fluid flow characteristics within the syringe. It is hoped that with this investigation, the injection can be carried out more proficiently. We are particularly interested on the mathematical modeling of the thread injection by considering the incompressible and steady flow between eccentric cylinders.

The mathematical modeling of this application is presented using non-dimensional Navier-Stokes equations and the governing equation is solved analytically. In this study, a perturbation solution for the fluid flow is derived with the aim to investigate the eccentric effects on the basic flow due to the discrepancies between experimental measurements and theory based on a concentric flow model. From the basic solution, we also derived the expressions of the force on the thread and the friction factor for the flow. A comparison between concentric basic flow and eccentric basic flow is made. It is found that there is difference between concentric and eccentric basic flows. The expression of obtained basic flow becomes complicated when the eccentricity is included. A relatively small eccentricity value is also confirmed in order to satisfy the no-slip boundary condition. A good agreement between our results and experimental results for thread force and friction factor is achieved. Due to this, we believe that the discrepancies mentioned are caused by the eccentric position of thread.

With the aim to have a smooth injection, the linear stability of the obtained basic flow is studied. The circular Orr-Sommerfeld equation, which governs the linear stability of the flow is formulated and solved numerically at finite Reynolds number by applying a collocation method using Chebyshev polynomials. Attention is restricted to axisymmetric disturbances. In reality, there will be some small disturbances exist in any flow and the disturbances may either die away or grow exponentially. To visualize the stability of obtained annular flow, it is best for us to obtain the neutral curves so that we can characterize whether the flow is stable, neutrally stable or unstable. Generally, neutral curve is a curve plotted in the wavenumber versus Reynolds number plane along which the growth rate is zero. Based from the neutral curve, the critical Reynolds number at which instability arises is obtained. Comparison is made to the stability of the obtained basic flow when the thread is in concentric position. Our results suggest that a moderately thick thread in a slightly eccentric position with a relatively small thread injection velocity should be used in this medical application in order to keep the flow laminar.

Selected publication:

1. Walton, A. G., Labadin, J., and Yiiong, S. P. (2010) *Axial Flow between Sliding, Non-concentric Cylinders with Applications to Thread Injection*. Quarterly Journal of Applied Mathematics and Mechanics, Advance Access published on May 19, 2010; doi: doi:10.1093/qjmam/hbq009

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3D Wind Prediction within Sarawak Highlands

Grant: ERGS/3/11/SG/UNIMAS/03/03

Nowadays, the applications of modeling 2D and 3D wind flow are not only focus on buildings, bridges and vehicles but also on hills, escarpments and complex terrains. Most of the applications of wind flow over the hills or mountains are intended to build or evaluate the wind farm (a collection of wind turbines) in order to generate electrical power through their mechanical motions when they are pushed by the wind. In recent years, the study of wind flow past through obstacles such as mountains and terrains have become well known. This is due to the highly increasing of the demand for wind turbine that caused by its potential as a renewable energy and "green" energy with the fact that it does not actively deplete the resources as it generates the power. Therefore, it is obvious that wind flow modeling is always a need at present. The evolution in computational fluid dynamics and numerical modeling technique makes the evaluation of air flow over complex terrains very attractive. Related works on such tool include computational fluid dynamics packages: STARCD, VirtualWinds, COMSOL, to name a few.

In this project, the modeling of wind flow patterns around the ground surface of terrains is proposed. We are particularly interested on the modeling of wind flow around terrains for the reason that helicopter accidents often occurred at the Bakelalan area in north Sarawak. We believe that the wind flow study in this project can help in preventing such accidents. This project will focus on the mathematical modeling of high Reynolds number fluid flow encountering multiple obstacles since terrains can be modeled as multiple objects within the atmospheric boundary layer. And, it is important to keep in mind that the behaviour of the atmospheric boundary layer is significantly influenced by topography.

The motivation for this study includes the environmental impact of proposed buildings and the effect of the flow field on pedestrians walking past the ground corner of a tall building, where the building is considered as a well-defined obstacle. Typically, wind flow can be modeled using the physical laws described in a set of differentiate equations, Navier-Stokes equations. Mostly, the Reynolds-averaged Navier-Stokes (RANS) equations are used in the studies which dealing with wind flow over complex terrains. To simulate the wind flow numerically, there are three main numerical techniques have been widely used, which are finite-difference method, finite-element method and finite-volume method. As the accuracy of these numerical techniques used in RANS method is relatively low, thus, fine grids with the desired horizontal and vertical resolutions are required in order to obtain accurate results although it will be time and resources consuming. In this project, the topographical information will be defined with a Digital Elevation Map of the 3D domain and incorporated on specified locations on the terrains.

The mathematical models developed earlier for a tall thin building will be tested on the topographic data. To do this, the representation of topographic data into the existing mathematical model needs to be investigated. The findings from the earlier works on the well-defined obstacle found that the fluid flow near the ground corner will become complicated as the obstacle gets steeper. Thus, the current numerical methods employed from earlier works might not be suitable for the complex terrains. Due to that problem, we have to assess the suitability of the existing numerical procedure in solving the modified model in this project.

The outcome of this project will give insights into the air flow patterns near the surface of terrains and thus will make relevant recommendations towards the deployment of helicopter flight warning system with the aim to prevent helicopter accidents.

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Network Modeling of Malaria Transmission

Grant: FRGS/2/10/SG/UNIMAS/02/04

Scientists have realized the applicability of Network Concept in diverse fields. The tempo therefore appears to be high in the scientific research world, in what appears to be a race to tap the huge potential of network computing. This has led to the evolution of such research fields as Social Networks, Biological Networks, Communication Networks, with more proliferations still expected. We are currently developing state-of-art algorithms and computational models to study the transmission of malaria using Contact Network Modeling approach. This research which is already in its advanced stage has led to a number of important discoveries.

RESEARCH SIGNIFICANCE & FOCUS:

Malaria is one of the most dangerous and widest spread tropical diseases. There were an estimated 247 million malaria cases worldwide in 2006, causing nearly a million deaths, mostly of children under 5 years. Malaria is one of the root causes of poverty, and has been reported to seriously cut economic growth rates in countries with high disease rates. It has also been linked with anemia and several complications such as stillbirth during pregnancy. Eradication of malaria is one of the key highlights of the Millennium Developmental Goal (MDG). Without doubt, any scientific research geared towards eradication of malaria should be judged as worthwhile.

The focus of the ongoing research is on the development of contact network algorithms and methodologies to study the transmission of malaria in public places. A number of public places (eg. schools, markets, restaurants, football fields etc) have been reported to experience what a researcher in one of our surveys described as "100billion mosquitoes' invasion". Since transmission of malaria results from bites of anopheles mosquitoes which are carriers of Plasmodium parasites, it means that vector control is an important key to malaria eradication. The existence of malaria vectors in public places was confirmed in our surveys in Sarawak in June 2010. The current research seeks to first build a malaria network, based on the fact that malaria is transmitted through bloodsucking bites (contacts) between female anopheles mosquitoes and human beings. The dataset comes from public places, and human beings who already have vector control in their homes but still suffer from malaria. Series of analytical tools are being developed for modeling the resulting network. The research seeks to deal with such issues as determination of most critical public places, and possibly specific human beings who contribute to highest degree of disease transmission. Effort is also made to discover how infection in a particular public place could affect or lead to infection of other public places, or how effective control in one can reduce transmission in others. This research also seeks to understand the structure of malaria network, vis-à-vis other forms of network and how modern search engine can be applied in malaria research. Visualization tools are being developed, among other deliverables. Several results from this on-going research have been presented in peer-reviewed international conferences, and some others are currently being reviewed for journal publications.

Selected Publications:

1. Monday Eze , Jane Labadin, & Terrin Lim. "Emerging Computational Strategy for Eradication of Malaria". In Proceedings of 2011 IEEE Symposium on Computers & Informatics (IEEE ISCI 2011), Kuala Lumpur, 20-22 March 2011, pg. 715-720

2. Monday Eze , Jane Labadin, & Terrin Lim. "Mosquito Flight Model and Applications in Malaria Control". In the Proceedings of 3rd International Conference on Computer Engineering and Technology (ICCET 2011), Kuala Lumpur, June 17-19, 2011, pg 59-64

3. Monday Eze , Jane Labadin, & Terrin Lim. "Contact Strength Generating Algorithm for Application in Malaria Transmission Network". In the Proceedings of 7th International Conference on IT in Asia (CITA2011), Kuching, Sarawak Malaysia, July 11-14,2011, pg.20-26

4. Monday Eze , Jane Labadin, & Terrin Lim. "The Binary Tree-Based Heterogeneous Network Link Model for Malaria Research". In the Proceedings/ Bk of Abstr. of 7th International Congress for Industrial and Applied Mathematics Conference (ICIAM2011), Vancouver Canada, July 18-22, 2011, pp546-547

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Mathematical Modeling of the Hand-Foot-Mouth Disease in Sarawak with Climatic Dependent Transmission Coefficient

Grant: UNIMAS DPK/13/2010

Hand, Foot and Mouth Disease (HFMD) is a common illness that affects mainly infants and children. A major outbreak of HFMD in Sarawak, Malaysia in 1997 marked the beginning of a series of outbreaks in the Asia Pacific region. Previous research work had revealed that immunity and transmission coefficient play vital roles in understanding the dynamics of HFMD. The researchers initiated work on the transmission dynamics of the disease in Sarawak by constructing a system of nonlinear ordinary differential equations where all the coefficients of each term were assumed to be constant.

In this current study, the research is extended by focusing on the transmission coefficient as it is hypothesized that the biological properties of the organism may be affected by the climatic changes and thus may influence the transmission coefficient. It seems to have a seasonal cycle for HFMD epidemic in Sarawak. However, there are limited studies that discuss the associations between weather and the dynamics of HFMD. Hence, a study to examine the relationship between the weather and the HFMD cases in Sarawak, Malaysia was done by utilizing the weather data obtained from the only five meteorological stations in Sarawak. However, the weather data obtained from those stations were too few to represent the whole Sarawak, which account for unreliable results.

To reach a better understanding of the effect of climate changes on the transmission of HFMD, the relationship between climate changes and HFMD incidences was quantified in Singapore instead of Sarawak due to the smaller area of Singapore and the similar weather conditions for Singapore and Sarawak. The weather variables and incidences of HFMD during the period of 2006-2008 had been collected on a weekly basis. The correlation analysis was conducted between weather variables and HFMD cases. Air temperature, pressure and wind speed were found to be significantly correlated with the number of HFMD cases in Singapore. This shows that weather variations may affect the transmission of HFMD in Singapore. It is suggested that air temperature could be used as a predictor of the number of HFMD cases in tropical countries.

The Susceptible-Infectious-Recovered (SIR) compartmental model for HFMD from previous work was modified into Susceptible-Exposed-Infectious-Recovered (SEIR) compartmental model to model the dynamics of HFMD which associated with weather factor. A function of transmission coefficient was incorporated into the system of ordinary differential equations. The air temperature data was plotted and compared with the actual HFMD incidences to analyze the relationship between air temperature and the actual cases.

From our findings, there is a clear relationship between HFMD occurrences and weather patterns in Sarawak. It is suggested that public health interventions should be conducted during this stage in order to adapt and overcome the possible effects of climate change in the future.

Publications:

1. Leong, P.F., Labadin, J., Rahman, S.A., and Juan, S.F.S. (2011). Quantifying the Relationship between the Climate and Hand-Foot-Mouth Disease (HFMD) Incidences. In the Proceedings of the Fourth International Conference on Modeling, Simulation and Applied Optimization, Kuala Lumpur, April 19th-21st.

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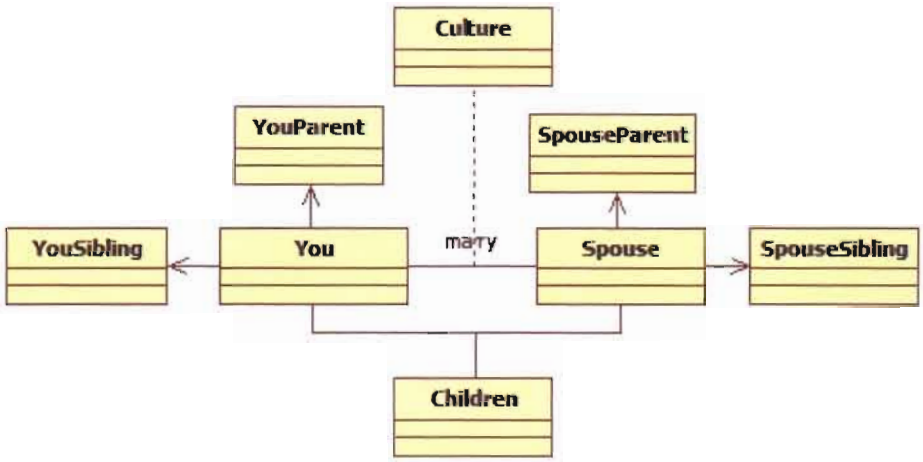
Integration of Cultures and Events in Remote Community Genealogy Software

Grant: UNIMAS SGS 02(S76)/811/2011(10)

The main focus of this research is on designing and developing new genealogy software based on cultural model for remote community in Borneo. The propose genealogy software (tool), not only provides the function for creating family tree, but also recording the marriage process such as pre-preparation, the event during the ceremony, the history of a married couple, also the natural event that occur during the marriage. In the olden day, the remote communities in Borneo believe that natural events or omen are indicators to what going to happen or their fate in life. Therefore, by integrating events in the genealogy software will preserve their cultures and beliefs so that the younger generation can learn good values (some logics) from it.

Preserving oral history is a critical first phase of genealogical research and data preservation. The owner of information normally older folks, both their lives and their memories are at risk of being lost to time. Study on the older folk is important to prevent any risk of losing these data. In addition, the modern living style and technologies make traditional cultures slowly die as young generation reluctant to practice it. By integrating cultures into technologies (e.g., genealogy software) is expected to vitalize their culture. This study is based on the remote communities of Long Lamai, Sarawak, and other ISITI-CoERI sites.



Publication:

1. Edwin Mit, Cheah Wai Shiang, Muhammad Asyraf, and Noor Hazlini Borhan Integrate Cultures and Beliefs into Genealogy for Remote Communities in Borneo, 2nd International Conference on User Science and Engineering (i-USEr 2011), 29 Nov – 2 Dec 2011, Kuala Lumpur (submitted).

2. Alvin W. Yeo, Edwin Mit, Po-Chan Chiu, Jane Labadin, Ping-Ping Tan, Cultural Modelling of Remote Communities, 3rd International Conference on Applied Human Factors and Ergonomics 2010 (AHFE 2010), 17-20 Jul 2010, Miami, Florida

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Agent Oriented Modelling for Ubiquitous Computing

Agent technology has been used in building various domain specific applications. This kind of software supports sophisticated applications like ambient intelligence, e-business, peer-to-peer, bioinformatics which demand the software to be robust, effective, co-operative to wide environments, customizable to support user needs, secure and to evolve over time to cope with changing requirements.

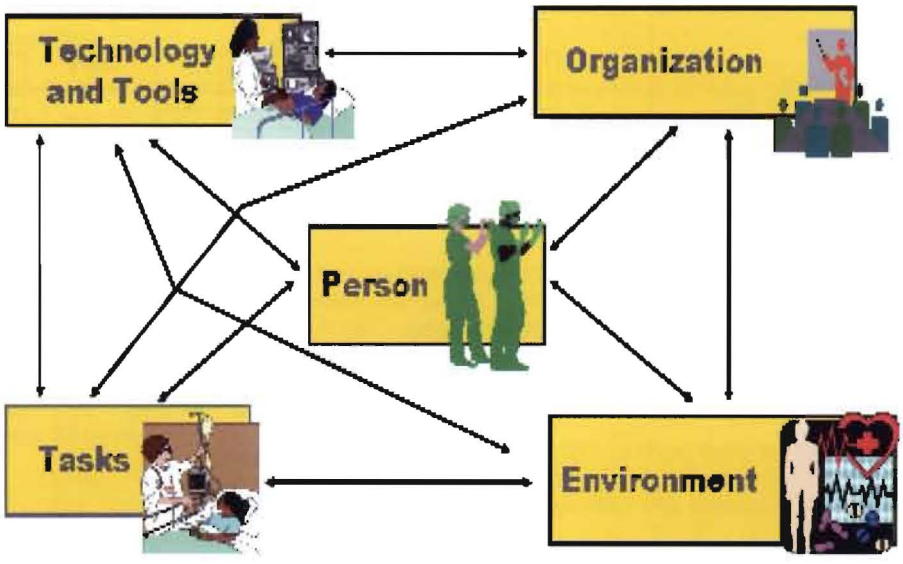
To date, various agent oriented methodology, tools, and modelling has been introduced in engineering the agent system. The area of agent oriented software engineering has attracted lots of research in finding a systematic way to develop a multi agent system. On the other hand, it has been indicated that the agent concepts are able to model a complex software system. The agent concepts has introduced various abstraction level that is able to explicitly model the complex software system and support the maintainability and evolutionary of the system.

Agent oriented modelling reflects various agent concepts that are used in developing an agent system, which is able to reduce the ambiguity when modelling a complex system. Our group will adopt the agent oriented modelling that has been introduced by our collaborators Professor Leon Sterling and Professor Kuldar Taveter.

Continuing the work in adopting the agent oriented modelling in modelling the complex system with system, user and mobile, this group will contribute towards the fundamental of agent oriented software engineering especially how to model the multi-agent system and also how to model the complex software system through agent oriented modelling.

Some of the existing projects are:

1. Model driven agent development using task knowledge patterns
2. Ontology patterns classification for multi agent system
3. Model based interactive ubiquitous system projects



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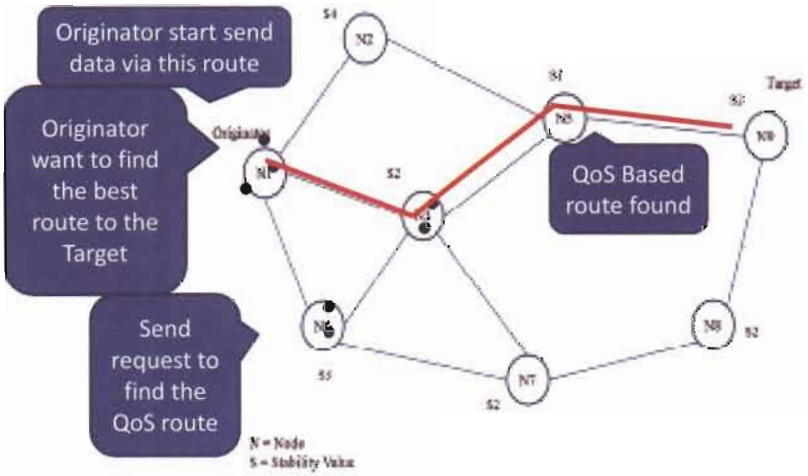
QoS Based Routing for IPv6 in Ad Hoc Networks

This research is proposing an adaptive routing scheme for IPv6 in ad hoc networks where nodes in within have different speeds and moving directions. Despite the quick deployment and conveniences of ad hoc networks, nodes in within are wirelessly connected. Other than facing the wireless disruptions, there is no routing management in the decentralized ad hoc networks. Owing to that, all nodes are mutually agreed on forwarding data packets on behalf of the sender nodes to their respective destinations wirelessly.

In highly dynamic ad hoc networks, mobility of each distinct node are varies and subsequently with such unpredictable movement, topology of the ad hoc network changes at unknown time. Whenever a participating node leaves a network without any notification beforehand, it often leads to retransmission via another possible route. Hence, routing in such networks often raise questions on their Quality-of-Service (QoS) in each transmission as mobility brings unpredictable disruptions. Consequently, network performance is affected where QoS remains doubtful.

Improving the network performance of ad hoc networks is crucial. Data transmission especially real-time applications such as video conferencing or multimedia transmission require high bandwidth and low delays. In preserving the quality of the real time applications, routing in the ad hoc network where mobile nodes move at the unpredictable time must be adaptive. Therefore, adaptive routing scheme based on a stability value of nodes is proposed by utilizing IPv6 Flow Label field. IPv6 Flow Label field consists of 20 bits in the packet header will be utilized to improve the QoS of ad hoc networks.



Publications:

1. W.Y. Tai, C.E. Tan and S.P. Lau, Enhanced QoS Based Routing in IPv6 Ad Hoc Networks: Current Initiatives and Challenges, A Comparative Study, in Proceeding of Young ICT Researchers Colloquium, FCSIT, Universiti Malaysia Sarawak, Kota Samarahan, 12- 13th May 2010.

2. W.Y. Tai, C.E. Tan and S.P. Lau, Enhanced QoS Based Routing in IPv6 Ad Hoc Network, in Proceeding of 8th Asia-Pacific Symposium on Information and Telecommunication Technologies, Kuching, Sarawak, 2010.

3. W.Y. Tai, C.E. Tan and S.P. Lau, Improving IPv6 Wireless Ad Hoc Networks QoS via Enhanced Flow Label with Stability Based Dynamic Source Routing Scheme, in Proceeding of the 17th Asia-Pacific Conference on Communications, Kota Kinabalu, Sabah Malaysia, 2011.

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Efficient Load Balancing Algorithm for Domain Name Services (DNS) in Web Based Application and Services

Grant: FRGS/03(05)/773/2010 (4)

This project focuses on proposing a new load balancing algorithm that runs on the local Domain Name Service (DNS) server for web based applications and services, to cater for sudden increase in request for the services. The main problem for the current load balancing algorithm is the inability to cope well with sudden burst demand of request for the provided services. This problem results in the slow connection to the system by the end user. This is mainly due to unbalanced distribution of workload and the inavailability of enough physical computing resources by the service provider.

To solve this problem, most web based application service providers opted on upgrading their physical infrastructure (e.g. adding new server nodes to the existing cluster) or renting cloud computing resources from cloud computing service provider. This results in increment of operation cost to the service provider that later translated to the end user. By having a more efficient load balancing algorithm that can adaptively utilizes the resources available in the pool of service provider computing resources, the operation cost can be sustained and web-services won't be interrupted by sudden high demand of traffic request. This research will be conducted via computer simulation and modeling where the performance of the proposed new algorithm will be verified against the selected few existing algorithms.

The rationale of using Domain Name Service (DNS) as the load balancing medium is most organizations (e.g., government agencies and service providers) have already owned their own local DNS service. DNS setup is standard and similar all over the world, as their databases are maintained and updated through the process of request by the user every day. By introducing the load balancing algorithm via DNS, only minimal changes are required and it does not tampered the architecture of the services provided (e.g., the coding) as well as the physical set up of the server farm itself. Hence, optimization at this level can be adopted without much complication.

Publication:

1. Mei Lu Chin, Chong Eng Tan & Imran M., DNS Oriented Load Balancing for Web Based Application, International Conference on Science and Technology: Applications in Industry & Education 2010, held in Penang, Malaysia on 16-17th December 2010.

2. Mei Lu Chin, Chong Eng Tan & Imran M., Efficient Load Balancing for Bursty Demand in Web Based Application via Domain Name Services, 8th Asia-Pacific Symposium on Information and Telecommunication Technologies (APSITT) held on 15-18th June 2010.

3. M.L Chin, C.E.Tan & M.I. Bandan, Load Balancing Architecture for Web Application Services, in proceeding of Young ICT Researchers Colloquium 2010, Universiti Malaysia Sarawak, Kota Samarahan, 12-13th May 2010.

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Compression Scheme for High Latency Networks to Improve Quality of Service of Real-Time Application

Grant: FRGS/02(16)/737/2010(23)

High latency network is increasingly important in today's telecommunication for bridging the digital divide. VSAT (Very Small Aperture Terminal) satellite network, one example of it, is one of the easiest deployment technology and cost effective way to interconnect two networks, when other wired technologies are practically impossible and unsuitable due to geographical distance or accessibility. With new applications and shifts in target markets, VSAT based solutions are being adopted at increasingly higher rates since year 2002. Up to December 2008, VSAT market statistics show that the total number of Enterprise VSAT terminals being ordered is 2,276,348, the total number of VSATs being shipped is 2,220,280 and the total number of VSAT sites in service is 1,271,900 throughout the world. VSAT satellite network provides communications support for a wide range of applications, which include point-of-sales transaction, financial management, telemetry & data collection, private-line voice services, virtual private networks, distance education, high speed internet access and more.

However, VSAT satellite network has two major issues which are high latency and relatively low bandwidth. In many cases, the limited bandwidth of VSAT satellite network is shared among multiple concurrent users in a contention basis. This leads to serious network threats like network congestion, packet loss and results in substantial delay in packet delivery for real-time interactive applications. These have reduced the Quality of Service of real-time applications as well as user experience. Owing to many compression techniques work in a bursty basis, they may not be suitable for network environments with high latency. Therefore, to fully utilise the limited bandwidth effectively, an efficient compression scheme that can accommodate high latency is mandatory.

This research study is aimed to propose a real-time adaptive packet compression scheme for high latency networks. It is capable of compressing incoming network packets adaptively in real-time basis. The main purpose of this scheme is to reduce the network packet overhead by eliminating redundancies in the packet to achieve reduction in packet size and hence, increasing the effective bandwidth usage and allowing more packets to be transmitted over the link at any one time. With the proposed scheme, the Quality of Service of real-time interactive applications over high latency satellite network can be greatly improved as the main constraints of satellite network which are low bandwidth and high latency are now not the issues concerned. Real-time interactive applications and software, which have high bandwidth demand, will now gain good user experience and satisfaction over bandwidth limited high latency satellite network.

Publication:

1. Ling-Sun Tan, Sei-Ping Lau and Chong-Eng Tan, Compression Schemes for Improving Network Quality of Service: A Comparative Study, Young ICT Researchers Colloquium 2010, 12-13 May 2010, Kuching, Sarawak, Malaysia.

2. Ling-Sun Tan, Sei-Ping Lau and Chong-Eng Tan, Enhanced Compression Scheme for High Latency Networks to Improve Quality of Service of Real-Time Applications, Asia-Pacific Symposium on Information and Telecommunication Technologies (APSITT 2010), 15-18 June 2010, Kuching, Sarawak, Malaysia.

3. Ling-Sun Tan, Sei-Ping Lau and Chong-Eng Tan, Quality-of-Service of Real-Time Applications over Bandwidth Limited Satellite Communication Networks via Compression, In *Advances in Satellite Communications*, InTech – Open Access Publisher, 2011, Rijeka, Croatia.

4. Ling-Sun Tan, Sei-Ping Lau and Chong-Eng Tan, Quality of Service Enhancement via Compression Technique for Congested Low Bandwidth Network, 17th Asia-Pacific Conference on Communications (APCC 2011), 2-5 October 2011, Kota Kinabalu, Sabah, Malaysia.

5. Ling-Sun Tan, Sei-Ping Lau and Chong-Eng Tan, Real-Time Adaptive Packet Compression Scheme for High Latency Networks, IEEE Conference on Computer Applications & Industrial Electronics (ICCAIE 2011), 4-7 December 2011, Penang, Malaysia.

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Automation System Generated SVM Model Based on User Feedback

People are likely to use high level semantic concepts in nature when querying for images. However due to different culture, knowledge and regions, people tend to have different perspectives and preferences. Therefore, the same image will have different meanings for different people.

Besides, images are commonly indexed based on low level image features like color and texture, or manually entered text annotations when searching through conventional images database. This often fails to meet user's information needs which are based on high level semantic concept.

Thus, there is a need for solution that bridge high level semantic concepts with low level features of images. In this research, an automatic system generated Support Vector Machine (SVM) model based on user feedback is proposed. The proposed framework is shown in Figure 1.

The SVM model is used to map the low level features of images with a list of descriptors. Meanwhile, considering that different people will have different preferences and perspectives on images, a relevance feedback component is added in this proposed framework. Using the relevance feedback, the weight of each feedback images are re-calculated and re-trained in order to generate new SVM Model.

The outcome will be a dynamic SVM model, which can be applied in keyword-based or content based image retrieval systems.

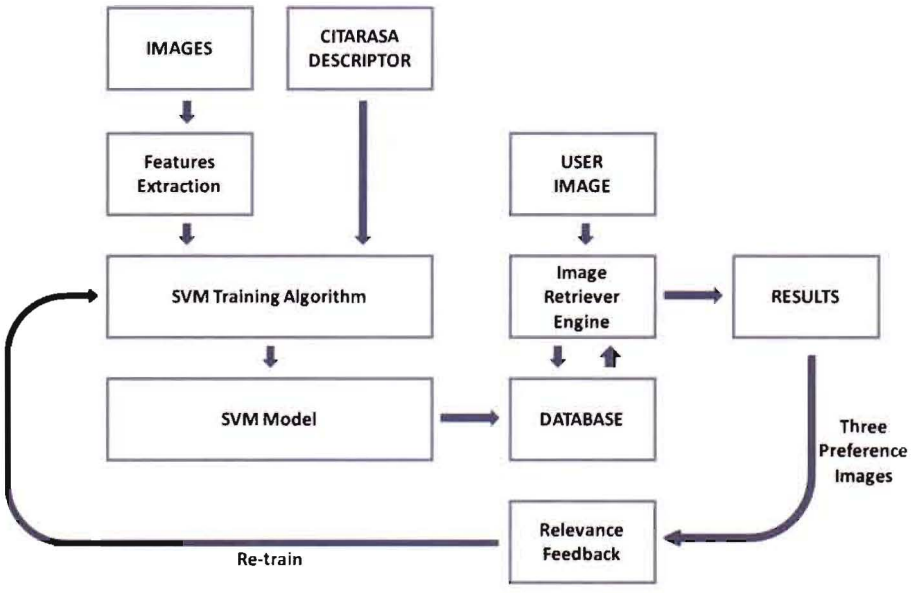

Figure 1: Proposed Framework

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A Wavelet-Based Feature Extraction Technique for Partial Iris Recognition

Feature extraction is an important task in the overall processing of iris biometric in an iris based biometric authentication system. The existing approaches are using complete iris image to extract iris features. But, it is difficult to get complete iris image for feature extraction because a person's eyes are covered by the eyelids, eyelashes and other extraneous artifact in most of the cases. Thus, the correct recognition rate decreased in the existing approaches due to occluded eyelids and eyelashes classified as an iris region. The localized and normalized iris images depicted in the Figure 1 have manifested the occurrences of unwanted elements on the iris images and this is always happen while iris images are being captured in unconstrained and even in constrained environment. Quite a number of researches have performed eyelids and eyelash detection algorithm but reported that the performance has slightly improved as compared to the prior rather increased computational time in the overall processing of iris recognition.

Localised Iris Image Normalized Iris Image

Fig. 1 The problem of occlusion that causes incorrect recognition

Therefore, this research proposed an iris image model and a feature extraction technique for partial iris recognition. Several issues that are investigated in this research i.e. which parts or regions of the iris are more stable and provide distinctive texture patterns, what is the optimum coverage area of the iris that is required to extract discriminant texture features for partial iris recognition, the existing feature extraction methods and the nature of features whether they can be used for partial iris recognition.

The three different kinds of partial iris image models have been proposed and designed to identify the significant part of the iris for feature extraction of the partial iris image. And then, a wavelet-based feature extraction technique has been proposed to extract discriminating texture features of the partial iris image which gives better performance in iris image texture analysis as compared to other methods used in the existing approaches. This research also highlighted a sign quantization technique that explains how the texture characteristics of the partial iris image are encoded into binary feature vector for unique binary feature vector representation.

The proposed feature extraction technique for partial iris recognition has been tested with CASIA iris image datasets. The intra-class and inter-class comparisons have been performed based on Hamming distance similarity measurement technique among the feature vectors generated from the partial iris image of individual's eye image available in the database. The intra-class and inter-class comparisons results demonstrate that distinctive texture features are identified in the inner-right and inner-left sub image of the collarette boundary of the iris. The experiments have been conducted in verification mode in order to measure the accuracy of the proposed method. In the verification mode, the False Accept Rate (FAR), False Reject Rate (FRR) and Equal Error Rate (EER) are calculated at a certain threshold. The correct verification rate (CVR) is calculated from the obtained FAR and FRR. The remarkable CVR obtained in this research has validated the proposed feature extraction technique that is comparable with the existing methods although the partial iris image has been used in this research for feature extraction.

Publication:

1. Md. Rabiul Islam, Wang Yin Chai and A. Khatun, Partial Iris Image Recognition Using Wavelet Based Texture Features, 3rd International Conference on Intelligent & Advanced Systems (ICIAS2010), pp. 1-6, 15-17 June, KLCC, Malaysia, 2010.

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3D Object Representation and Recognition

As an emerging technology, 3D shape recognition continues to be one of the best research areas in computer vision and image understanding. The main aim of this research is to recognize 3D objects with high rank of retrieval in a robust (with different movements such as different transformations) and effective (such as in the case of large databases) way.

This study observed that the retrieval accuracy is an open problem of existing 3D object recognition system. Regarding the problem of accuracy of the existing shape recognition system, we investigated that representing 3D shape with geometrical characteristics is not trivial. Shape representation is one of the major challenges to address recognition problem. Majority of current existing researches on sphere and sphere surface do not fit well to the body of the object which lead to higher shape approximation error and poor recognition rate. Figure 1(a) shows that mapping a sphere to a 3D object exposes high divergence manner. A non-uniform shape sampling will cause a non-compact shape representation which lead to abundant loss of characteristics information. Furthermore, minimum approximation error which is required for discriminating feature extraction is lacking in existing object recognition systems to increase the accuracy of the object retrieval. Hence more compact and uniform shape representation method which is ubiquitous is required to address recognition effectively.

This research aims to design and develop a new 3D shape representation system to address the recognition problem in a robust and effective way. In order to perform uniform and robust shape representation, we introduce ellipsoid mapping methods for surface visualization processing to preserve the characteristics. The techniques of ellipsoid mapping schemes enable approximation improvement which is very close to the body of the shape as shown in Figure 1(b) and remove the convergence problem caused by non-uniform sampling of sphere along with near the poles. This research is expected to improve the accuracy of recognition and shape approximation and also to reduce shape representation dimensions for large databases.

Figure 1(a) An example of 3D shape representation of car model by sphere and (b) by ellipsoid

Publication:

1. A. Khatun, Y. C. Wang, DNF A. Iskandar and Md. R. Islam, Ellipsoids in principal planes as a shape representation method for 3D object retrieval, Communicating with Journal in Machine Vision and Application, Springer-Verlag, (2012).

2. A. Khatun, Y. C. Wang, DNF A. Iskandar and Md. R. Islam, The Effectiveness of Ellipsoidal Shape Representation Technique for 3D Object Recognition System, 7th International Conference on IT in Asia (CITA'11), pp. 239-244, July 12-14, Malaysia, 2011.

3. A. Khatun, Y. C. Wang and Md. R. Islam, An Ellipsoidal 3D Shape Representation and Wavelet Transform Feature Descriptor for 3D Shape Retrieval, International Journal on Computer Science and Engineering, Vol. 2(3): pp. 504-509, (2010).

4. A. Khatun, Y. C. Wang, DNF. A. Iskandar and Md. R. Islam, 3D Shape Recognition using Wavelet Transform based on Ellipsoid, 3rd International Conference on Intelligent & Advanced Systems (ICIAS2010), KLCC, Malaysia, pp. 1-6, 15-17 June, 2010.

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Intelligence Video Surveillance

Intelligent video surveillance (IVS) involves the study of computer vision technologies to detect, to track and to understand objects and events in videos monitoring. IVS has received a good acceptance in several applications such as security and business intelligence due to its ability to assist human supervisors to monitor many real time video feeds simultaneously.

Typical IVS consists of several components namely video acquisition, recording, motion detection, object detection, object tracking and event analysis as shown in Figure 1. Some of these components such as video acquisition video recording and motion detection are established and can be easily obtained from off-the-shelf commercial software.

However, many current IVS solutions are designed with pre-requisite limitations and only work for a specific application or domain. For instance, the component of tracking in IVS, which is responsible to generate trajectory of objects over time by locating its position in every frame of the video, is often limited due to unpredictable direction change and occlusion of objects. Also, using features derived from colour, shape and texture to detect object are difficult due to inconsistent of object appearance and orientation in video.

A successful IVS must be able to have robust performance under all environment situation and user friendliness. Therefore this research focus on the objective to improve object detection features to enable IVS to perform uniformly across varies environment. The research also aims to improve object recovery after occlusion in video sequences to enhance object tracking accuracy and performance.

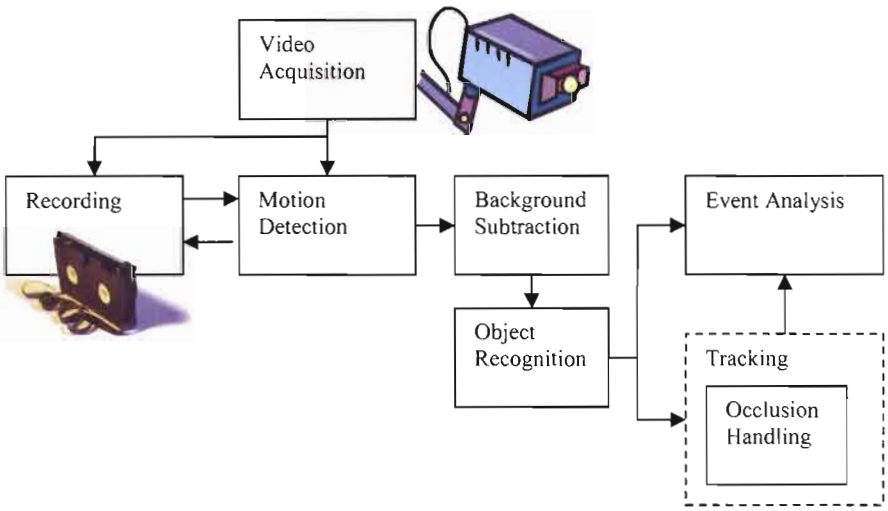

Figure 1: Components of Intelligence Video Surveillance

1. Publication:
   Lee Beng Yong, Wang Yin Chai and Cheah Wai Shiang, Intelligence Video Surveillance: Problems and Challenges, 7th International Conference on Information Technology in Asia (CITA'11), 12 – 14 July 2011, Kuching, Sarawak (Poster and Oral Presentation)

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An Intelligent Approach of Spatial Image Rectification for Aerial Images

Aerial images are widely used in ecological management, crop growth monitoring, digital maps generation and region surveying. With the development of digital technology, the study of aerial images acquired from a non-metric digital camera has become an active research field nowadays. In an ideal case, accurate aerial images should have zero distortion. However, it is impossible to achieve due to distortions that are caused by different sources such as lens distortion, earth curvature, topographic relief and inconsistencies in the attitude of the aircraft. These distortions could be reduced through image rectification.

Ground control points (GCPs) play an important role in the accuracy of aerial image rectification. GCPs are points on the surface of the earth where both image coordinates and map coordinates can be identified. The aerial images could be rectified by generating the mapping transformation through the matching with the map coordinates from the aerial image to the ground reference. The traditional procedure for selection of GCPs is at significant visible landmarks in images such as road intersections, building corners, edges and small circle points. The selection is commonly carried out manually which involves human factor such as experience, work attitude and ability to judge that might influence the accuracy of rectification. In general, GCPs are advised to be distributed evenly in the image. However, it is subjective to define the concept of evenly or uniformly distribution of GCPs.

This research focuses on non-parametric method which uses a set of GCPs in image rectification. This research investigates the effect of GCPs' selection, density and distribution in aerial image rectification by using the uncalibrated aerial images taken from helicopter with flying height of 3000 to 4000 feet and a non-metric digital camera mounted vertically. An example of aerial image captured is shown in Figure 1. Figure 2 illustrates the study of simulated test on distortion using grid image. The aim of the research is to propose an intelligent approach of spatial image rectification for aerial images.

Figure 1: Example of aerial image captured with flying height of 4000 feet

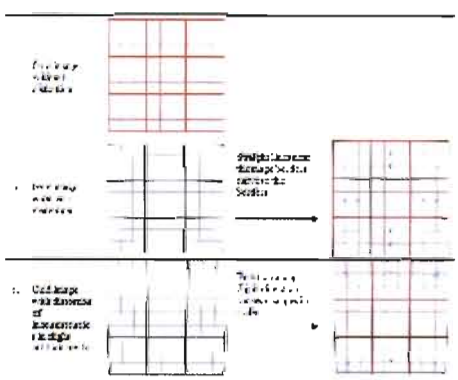

Figure 2: Simulated test on distortion using grid image

Publication:

1. Liew Lee Hung, Wang Yin Chai and Cheah Wai Shiang, Towards Intelligent Ground Control Points' Selection for Aerial Images Rectification, 7th International Conference on Information Technology in Asia (CITA'11), 12 – 14 July 2011, Kuching, Sarawak (Poster and Oral Presentation)

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A Generic Text-to-Speech System for Sarawak Languages

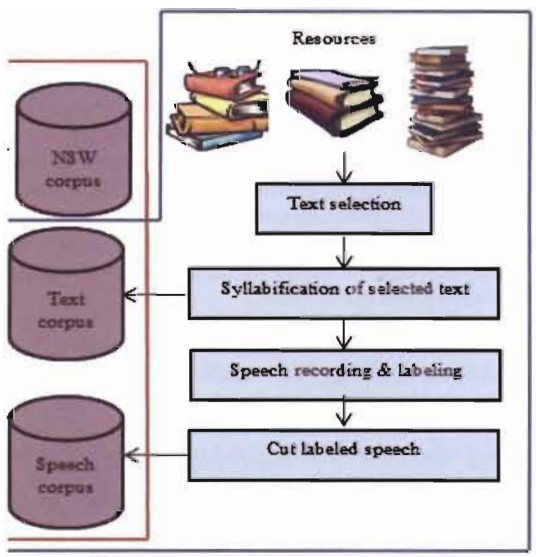
Grant: eScience 01-01-09-SF0056

A Text-to-Speech (TTS) system is an application to convert written text in a specific language, into artificial, machine generated speech. User will input text into the system, then, the system will process/ analyze the text and generate speech according to the input text.

This research aims on building a TTS system that could read Sarawak languages out loud. Sarawak is rich with different languages however, there no such TTS systems available yet, that could read text in these languages.

The study involves adopting linguistic information on Malay language to help in preparing data collection. Malay language is chosen as it is closely related to Sarawak languages its linguistic information has been properly defined (e.g.; syllables, morphology, phonemes).

Expected results are the TTS prototype and speech as well as text corpus in Sarawak languages. The project aims to preserve local languages and bring benefits to those who are visually impaired or has reading disabilities. Moreover, anyone who are interested to learn how to speak in any Sarawak language would find the system to be useful.



Framework of Speech Corpus

Publication:

1. S. F. S. Juan , V. Edwin, C. Y. Cheong, J. C. Lee, & A. W. Yeo , "Adopting Malay Syllable Structure for Syllable Based Speech Synthesizer for Iban and Bidayuh languages". International Asian Language Processing (IALP 2011), Universiti Sains Malaysia, Penang, 15-17th November 2011 (accepted).

Achievement:

Vyonne Edwin, "Syllable-based Speech Synthesizer for Bidayuh language".UNIMAS Research and Development Expo 2011 (Bronze award)

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Malay Text Processing

Grant: L18403/F04/00/R&D ILUAR-MIMOS

Natural Language Processing is a major research domain in computer science research. It is the foundation for any other intelligent system, especially systems that deals with human interaction. Malay language had been the national language for Malaysia since the founding of the nation, and Malay text processing is always an interest for local computer scientists and linguistics researchers in Malaysia. A group of researchers in the institute are dedicated in expanding the text processing technology for Malay language. Under this group several researches regarding Malay Text had been initiated:

Malay Text Understanding

This project is initiated under the collaboration with MIMOS through Center of Excellent for Semantic Technology and Augmented Reality, UNIMAS. This study aims to investigate a method for perform automatic generation of Malay conceptual graph through the use of Malay Knowledgebase. The main purposes for this project are to design and implement an intelligent system that can be used in content analysis for Malay text. Intelligent system to extract knowledge from Malay text and represent it in knowledge representation model is still a challenge in Malaysia due to the lack of Malay knowledgebase and also the limitation in natural language processing for Malay text. To address this issue, this study is proposing to design and develop a method that able to automatically extract conceptual graph from Malay sentences based on basic natural language processing tools and the use of a basic Malay knowledgebase. The final outcome of this study will be a Knowledgebase in Malay context that consists of Concept Type, thematic role and concepts, a general architecture for automatic generation of conceptual graph from Malay sentences and its prototype.

Rimed-Based Syllabification Algorithm for Malay

Syllabification is a process to separate a word into syllables based on the identification of syllable boundaries in a word. It plays an important role in many Natural Language Processing (NLP) processes, as it can identify the structures of a word in processes such as morphological analysis and text-to-speech processing. Currently, most of the existing syllabification algorithms are based on the matching of Onset with the possible Rime (nucleus and coda) to identify a syllable.

Providing an effective syllabification algorithm for Malay language will help in the advancement of Malay NLP studies. With the new proposed Rime-based syllabification algorithm, it changes the tradition of using Onset to identify a syllable. Based on the three main syllabification rules identified in this study, the syllabification algorithm identifies the boundary of a Malay syllable based on the Rime, which is the combination of Nucleus (vowel) and Coda (consonant).

Syllable-based Malay Word Stemmer

In natural language, a stem is the morphological base of a word to which affixes can be attached to form derivatives. Stemming is a technique used to find root of words that is to conflate or reduce morphological variants of words to a single index term. Various stemming algorithms have been developed in wide range of languages which to be used for different purposes.

A stemming algorithm for Malay word is very essential for the Malay language text processing. A syllable-based Malay stemmer has been designed and developed for stemming the Malay words. This Malay stemmer consists of two components which are syllabification and Malay morphological rules.

The syllabification is used to separate a Malay word into syllables, which a syllable represent a unit speech sound for the pronunciation of a word. The new designed stemmer uses the syllables from the syllabification process to identify the morphological structures of a Malay word using the Malay morphological rules. There are three set of rules to be considered in a word stemming process: (1) Prefix rules, (2) Suffix rules and (3) Morphographemic rules.

The Malay stemmer remove prefix and suffix of a Malay word based on the identified Prefix rules and Suffix rules respectively. The Morphographemic rules are identified to handle for spelling variations and exceptions.

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Preserving Indigenous Languages through Localisation and Internationalisation Approaches: The Sarawak Ethnic Languages Context

SALT
SARAWAK LANGUAGE TECHNOLOGY RESEARCH GROUP

The number of speakers of Sarawak languages is decreasing due to the dominance of the two major languages, Bahasa Malaysia and English, in the urban areas. Therefore, the Sarawak Language Technologies (SaLT) Research Group, at Universiti Malaysia Sarawak (UNIMAS), has initiated a number of projects with the end goal of revitalising and maintaining the ethnic languages of Sarawak through internationalisation (i18n) and localisation (l10n) approaches. The possible l10n and i18n projects include Multimodal Integration of Sketch and Speech in Spatial Queries as well as Machine Translation by using the corpus based approach. Other projects in the pipeline include adopting open-source software through l10n and i18n of word processor. The ultimate goal of this project is to bridge the digital divide between the rural and the urban community via the application of technology and the local contents.

Since the formation of SaLT in 2007, we have focused on six indigenous languages, namely, Iban, Melanau, Kayan, Sarawak Malay, Bidayuh as well as Kelabit. Nevertheless, there is an ongoing process of adding documents into both monolingual and bilingual corpus. Most of the resources are in hardcopy. They are books, printed materials, magazines, dictionary and articles.

SaLT has already completed six funded research projects, i.e. Minority Languages Online (MiLO), Bario Lakuh Digital Library (BLDL), Multimodal Integration of Sketch and Melanau Matu-Daro Speech in Spatial Queries (MInt), Methodologies for Translation of Indigenous Languages: English-Iban (TrIbE), Spoken Language Dialog System (SLaDs), and a Generic Text To Speech For Sarawak Languages.

There are a number of challenges that SaLT researchers are facing. Most of the Sarawak languages have never been processed and do not have any electronic documents, with the exceptions of Iban and Bidayuh. Therefore, the digitisation of these under-resourced languages has to start from scratch.

Selected Publications:

1. Ng, E.L., Chin, B., Yeo, A.W. and Malancon, B.R. 2010. Identification of Closely Related Indigenous Languages: An Orthographic Approach. International Journal on Asian Language Processing. Vol. 20. No. 2. (ISSN 0219-5968)

2. Talita, P., Yeo, A.W., and Kulathuramaiyer,N. 2010. Challenges in Building Domain Ontology For Minority Languages. International Conference on Computer Application & Industrial Electronics (ICCAIE 2010) (Kuala Lumpur, 5-7 Dec)

3. Chin, B. and Yeo. A.W. 2010. Machine Translation of Indigenous Languages: Pivot Language Approach in Iban-English Translation. Proceedings of the Malaysian Joint Conference on Artificial Intelligence (MJCAI) (26-30 July, Damai, Sarawak, Malaysia).

4. Chin, B., Yeo, A.W., Robert, A.J., and Norazian, M.H. 2010. Preservation of Cultural Heritage through the Sarawak Language Technologies (SaLT) Initiatives: An AI Perspective. Proceedings of the Malaysian Joint Conference on Artificial Intelligence (MJCAI) (26-30 July, Damai, Sarawak, Malaysia).

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CHERITAR: Culture and Heritage Repository for Sarawak Languages

As read on UNESCO website, "languages are powerful instruments for preserving and developing culture". Besides, languages are tangible heritage. As written and highlighted here and there, half of the known 6,900 living languages are likely to disappear within the century, and according to UNESCO, a language dies out every other week. Ethnologue, the database and encyclopedia for languages of the world, has recorded 46 languages in Sarawak with 44 living languages, three endangered languages (Punan Batu, Sian, and Kanowit), and two extinct languages (Seru and Lelak). CHERITAR is an ambitious and long term project that aims to build a large language resources repository to preserve the knowledge and diversity of Sarawak languages. CHERITAR repository is planned to be an online repository allowing the access to anyone anywhere and should contain (at least) several kinds of language resources: a collection of raw and annotated textual and spoken data, lists of words, dictionaries, spelling checkers, sentence splitters, tokenisers, morphological analysers, part-of-speech taggers, syntactic parsers, and named-entity recognisers. To realise the "dream", CHERITAR has to go through successive steps. The first steps concern the digitisation of some artifacts, the development of orthographies for unwritten languages, the standardisation of existing spelling, and the design and implementation of (generic) language processing tools. CHERITAR will make use of all resources that were compiled and developed previously by the SaLT group. CHERITAR will undertake its research with the members of the language community, language experts, and government agencies.

DIGITISATION

Often textual contents reside within physical artifacts like books, newspapers, dictionaries, etc. To be accessible through the online repository, these contents need to be captured and transferred into a machine-readable format. Currently, different approaches, such as OCR technology and key-in, are tested to capture the content of a large set of digital images of early publication of the Sarawak Gazette. Due to the complex layout of the newspaper and the degradation of the images, the accuracy of the tested OCR is very low. Besides, manual key-in is unfeasible due to the size of the source data. The current challenge is to optimise the OCR process with the objective of reducing the time for manual correction.

ORTHOGRAPHIES FOR UNWRITTEN LANGUAGES

CHERITAR has inherited a few spoken materials, which have to be converted into written textual documents for further language processing. The conversion is not straightforward as many issues arise on the phonological and orthographic transcriptions. Our current proposed solution is to combine a community-driven approach and an automatic-approach. The main objective is to produce some recommendations and guidelines on the orthographies of the unwritten Sarawak languages.

STANDARDISATION OF SPELLING

It is known that the orthographic and grammatical standardisation of a language will enable its dissemination, and thus the sharing of new ideas. Some of the Sarawak languages have already their own spelling system, generally based on Latin script, but only Iban has been codified. The rest of the languages are lack of standard spelling. The researchers in CHERITAR aim to provide a standard spelling system for each of the Sarawak languages by using their competency and expertise in language processing.

DESIGN AND IMPLEMENTATION OF (GENERIC) LANGUAGE PROCESSING TOOLS

To be useful for knowledge discovery and for the development of applications like machine translation, information retrieval, etc., the raw written language data need to be processed. The main objective is to annotate these data with linguistic information such as part-of-speech and named-entity.

Publications:

1. Yong Soo Fong, Bali Ranaivo-Malançon, & Alvin Yeo Wee. "NERSIL – the Named-Entity Recognition System for Iban Language". (accepted as a Poster in The 25th Pacific Asia Conference on Language, Information and Computation (PACLIC 25), Singapore, 16-18 December 2011) .
2. M. O. Rosita, R. Fatihah, K. M. Nazri, Alvin W. Yeo, & Daniel Y. W. Tan. "Cultural Heritage Knowledge Discovery: An Exploratory of the Sarawak Gazette". In Proc. of Second Semantic Technology and Knowledge Engineering (STAKE 2010), Kuala Lumpur, 28-29 July 2011.

Distinguished Speakers

Prof. Dr. Pieter Hartel
University of Twente, France

Prof. Bebo White
SLAC, Stanford University, USA

Prof. Dr. Hermann Maurer
Graz University of Technology, Austria

Prof. Dr. Thomas Ottmann
University of Freiburg, Germany

Prof. Leon Sterling
Swinburne University of Technology, Australia

> *"Nobody can predict the future of the Web. It just happened and will continue to happen beyond our control. Predictions for the future Web worry me as they are largely based on technologies, not so much on the way people are using the Web, which should be the most important variable."*
>
> — Prof. Bebo White
> During the Future Web Workshop held in the faculty

Prof. Christian Boitet
Universite Joseph Fourier, Grenoble, France

AP. Dr. Seng Wai Loke
La Trobe University, Melbourne, Australia

David Wortley
Serious Games Institute, Coventry, UK

Assoc. Prof. Dr. Farid Meziane
Salford University, UK

Prof Klaus Tochterman
Graz University of Technology, Austria

Distinguished Speakers

Prof. Dr. Byun, Hyung-Gi
Kangwon National University, Korea

Prof. Dr. Henry Lieberman
MIT Media Laboratory, USA

Prof. Dr. Michael Gurstein
Centre for Community Informatics Research, Development and Training, Canada

Prof. Dr. Graeme Hirst
University of Toronto, Canada

> *"Don't worry about getting jobs because you will get jobs; what you should think is on whether the job is right for you ... and whether you contribute to the society. You should be grateful that you are doing computer science because believe me people will get jealous of you."*
>
> — Prof Dr Henry Lieberman
> Talking to our First Year Students

Prof. Dr. Jasbir Dhaliwal
University of Memphis, USA

Prof. Dr. Zaharin Yusoff
Multimedia University, Malaysia

Prof. Robert Clift
University of Tasmania, Australia

Assoc. Prof. Dr. Douglas Gentile
Iowa State University, USA

Prof. Dr. Koh Hock Lye
Universiti Sains Malaysia, Malaysia

Prof. Dr. Vijay V. Raghavan
University of Louisiana, Lafayette

Journal of Universal Computer Science and Journal of IT in Asia

The Journal of Universal Computer Science (JUCS) is a publication of the Graz University Technology, Austria, the Know-Center, Austria and the Universiti Malaysia Sarawak (UNIMAS), Malaysia.

The journal was founded by TU Graz in 1994 and UNIMAS joined into the Managing Editors in 2010. The 5-year impact factor of the journal has increased to 0.788 (2010).

The Journal of IT in Asia (JITA) published its first volume in 2005. JITA is an International peer-reviewed publication of original works by researchers in the Asia Pacific region covering Information and Communication Technologies and its innovative applications. This journal serves as a platform to promote the exchange of ideas with researchers around the world.

BGM@FCSIT

Brain Gain Malaysia (BGM) is a programme under the auspice of the Ministry of Science, Technology & Innovation (MOSTI). In 2010, the faculty's application for BGM programme to bring Prof Bebo White was successful and during the visits, few activities were done:

- The first Future Web Workshop was held in March 2010.
- Numerous seminars were conducted which includes "e-Government" where a number of government agencies in Sarawak attended.
- Establishing collaboration with Stanford University through the "Pinger Project". PingER (Ping End-to-end Reporting) is the name given to the Internet End-to-end Performance Measurement (IEPM) project to monitor end-to-end performance of Internet links, developed by the IEPM group at the SLAC, Stanford University. The network performances of more than 300 hosts are monitored worldwide.

Multi-Dimensional Responsible Rural Tourism Capacity Framework for Sustainable Tourism

Multi-Dimensional Responsible Rural Tourism Capacity Framework for Sustainable Tourism (RRTC) is a LRGS funded project. The project involves collaboration between 10 universities and spearheaded by Taylor University.

Increasing market demands for development in tourism particularly for nature and rural tourism has brought about the need to examine and identify indicators and parameters to determine responsible tourism practices. This study investigates the impact of tourism activities upon the physical environment, socio-cultural and economies of rural areas.

The overall objective is to establish an ICT framework which leverages on state-of-the-art technologies, i.e. innovatively and appropriately apply these technologies into a new context, specifically, Responsible Tourism. The prototype will provide access in utilisation and alerts on degradation of the environment.

The expected outcomes will support the Multi-Dimensional Responsible Rural Tourism Capacity (RRTC) Framework in mobilising and assisting stakeholders for decision making towards achieving responsible tourism.

International Network Linkages

The International Conference on IT in Asia (CITA)

This international forum first introduced and organized by the Faculty in 1999. CITA aims to investigate how the technology can be adapted to improve local needs as well as to bring technology within reach of the communities.

It marks its 10th year anniversary in 2009 where the conference has been held for the sixth time. CITA covers various areas such as data mining, high performance computing, image processing, distributed computing, language technology, wired and wireless technologies. Researchers and industry practitioners in these fields are invited to participate, to share and collaborate research works with experts in this conference.

The quality of papers submitted is assured to be of high standard. Submission of full paper is required and goes through strict review by the chosen international programme committee. CITA maintains its 40% acceptance rate since its initiation.

Since the 4th run, CITA introduces CITA Best Papers Award to recognize high quality research papers. There are normally five chosen papers where extended version of those papers will appear in the Journal of IT in Asia (JITA).

CITA Themes

Each run the faculty carefully chose a theme for the conference to reflect how technology is advancing in this part of the globe:

CITA '99 : Information Equality in the Next Millennium
CITA '01 :Advanced ICT for the New Millennium
CITA '03 : Transforming Knowledge into Insight
CITA '05 : Pervasive and Ubiquitous Computing: Computing Anytime, Anywhere for Everyone
CITA '07 : Social Computing: Engaging Communities
CITA '09 : Towards Human-Centered Computing
CITA '11 : Emerging Convergences and Singularity of Forms

In the recent conference, the Faculty has managed to gather International leaders in the field: Prof Bebo White who is one of those responsible for the World Wide Web seen today; a leading researcher in the field of Agent-oriented modeling, Prof Leon Sterling; leading Professor in Japan, Prof Yoshiyori Urano, Professor in Computer Science; Prof Geoff Holmes of Waikato University and a pioneer in Malaysia Ubiquitous Library, Assoc Prof Indah Sidek of MCMC; Dr George Zhang and Asif Baki of Google USA courtesy of the co-located conference i.e. The International Workshop on Internationalisation, Products and Systems (IWIPS).

The International Workshop on Internationalisation, Products and Systems (IWIPS 2011)

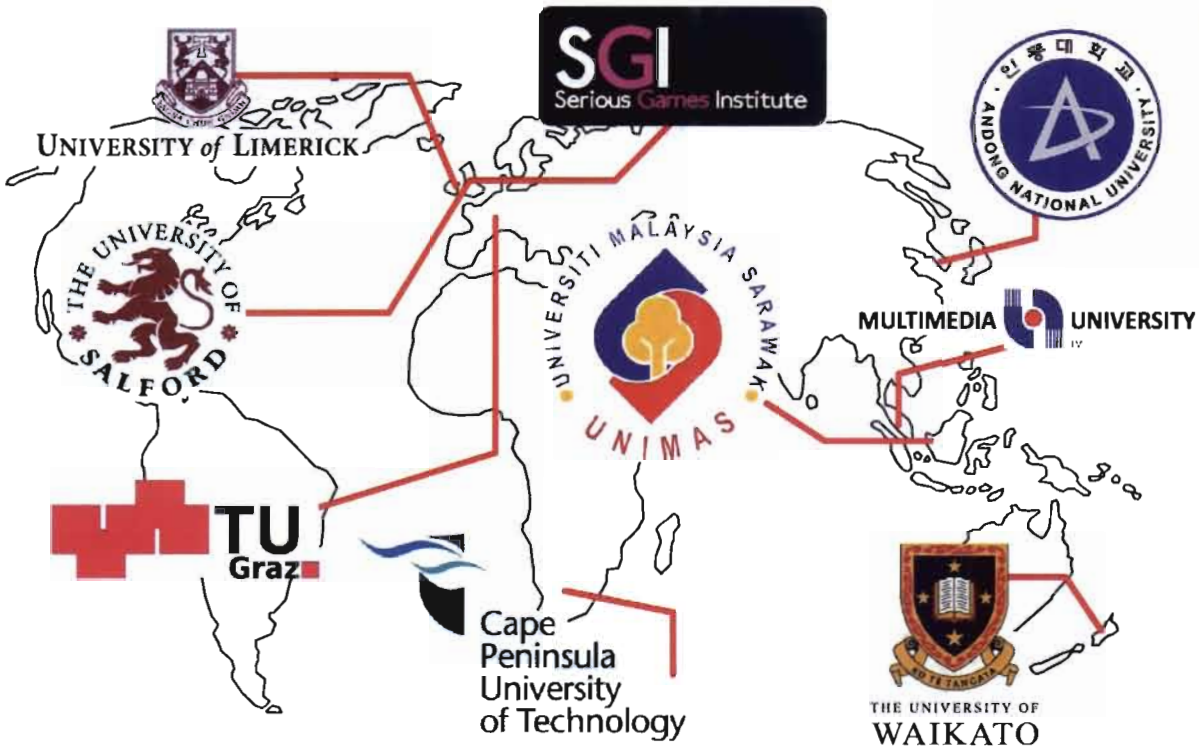
This international conference was held for the first time in Asia. IWIPS 2011 provides an appropriate platform in addressing issues and aspects that accommodate the different cultural differences to transcend cultural boundaries in internationalising and localising products and systems. The issues of internationalisation of products cover product design, usability, policies, ethnographic methods, cultural data collection methods.

This year's theme was 'The New Silk Route: Eastern Products and Services, Western and Global Markets' have attracted over 60 participants over the world for the workshop. We are proud to have Google Inc., U.S. to conduct the workshop and to give a keynote address this year. The next IWIPS would be held in Goa, India in 2012.

C omputerized
A utomotive
TE chnology
R econfiguration System for Mass Customization

Pangaea - Digital Learning Playground for Children of Remote Rural Communities in Sarawak

Memorandum of Understanding



The faculty has been maintaining linkages with different international institutions and organizations to promote greater academic and research cooperation. This collaboration will foster good relationships and in recognizing the mutual interest and benefit in attaining excellence and leadership in education as well as in research.