

# VIDYA

The Quarterly Newsletter of the National Science Foundation

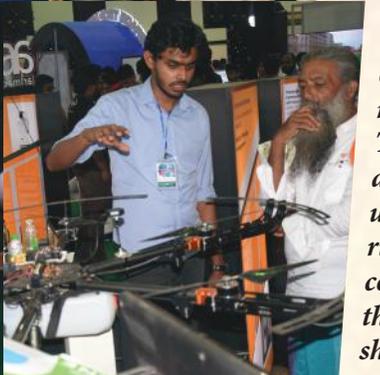


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## NSF Promoting Artificial Intelligence at the “Shilpa Sena Exposition, Sri Lanka Technology Revolution”



*A four-day National Exposition on Science, Technology & Innovation to bridge the gap in communicating new technologies to the society was held at the BMICH from 18 - 21 July 2019. The NSF organized the stall under the theme “Artificial Intelligence (AI)” with the help of AI experts from the universities and the private sector. AI is the simulation of human intelligence processes by machines, especially computer systems. These processes include learning (the acquisition of information and rules for using the information), reasoning (using rules to reach approximate or definite conclusions) and self-correction. More than 20 such simulations used today were showcased at the AI stall.*





Item	Exhibits of AI	Description
1.	Sinhala - Tamil Computer Assisted Translation System	Si-Ta is a computer-assisted translation system to help translate official government documents between Sinhala and Tamil using Machine Learning.
2.	Driverless Cars	AI is used heavily in the process of building self-driving cars. Several components of a self-driving car using AI was demonstrated.
3.	Adaptive Authentication Demonstration	An AI technique to identify suspicious login attempts.
4.	AiGROW	Hydroponics and Vertical Agriculture powered by AI.

Item	Exhibits of AI	Description
5.	Autochatic Chatbot	Autochatic is the only multilingual chatbot comes with a built-in natural language understanding backed by AI.
6.	AI for Industry	Deep learning, a complex technique of AI and also a subset of machine learning that utilizes neural networks with many hidden layers that brings high predictive power and understanding of complex and unstructured data types such as natural language, images and video.
7.	Computer Vision: Semantic Image Segmentation	Computer vision, a key component of AI, is the science of making computers understand images and videos.
8.	Computer Vision: Object Recognition	A deep neural network for object recognition. The networks identify different object classes.
9.	Dengue AI web interface	In the absence of proper data sources, Call Details Record (CDR) data provides a useful source for forecasting Dengue with the facility to get access through mobile communication devices.
10.	Agri AI web interface	Agri AI web platform can be integrated with the existing mechanism enabling precision decision making of accuracy level over 96% for detecting Brown Planthopper attacks.
11.	AI Drones for Precision Agriculture	A drone with a multispectral camera is used to get the photos of the crop field. These photos are stitched together to create the entire image of the crop field. An AI algorithm processes the image to identify various anomalies such as pest problems, weed invasions, and poor health of the plant.
12.	Manufacturing execution system	A system with AI that can plan the production schedule in less than 03 minutes based on the requirement. It also can re-plan the production schedule within 15 minutes or less and optimizes the machines, WIP and resource allocation across all production lines, saving over LKR 5 million every month (estimation).
13.	Identification of skin diseases	The system uses image processing techniques, nature-inspired algorithm, and machine learning. System isolates and extracts the affected areas and identifies the exact skin disease.
14.	AI Powered Intelligent Agent	Integrating all tools with semantic-aware AI lets deliver relevant conversions, better customer relationships, enhancing the customer journey by reducing the waiting time with a call center agent for support.
15.	Personalized Privacy Assistant	Captures, communicates and enforces permission configurations and raise awareness on privacy through AI using Machine learning techniques.
16.	Optimise Customer Journey through Review Analysis	Review Spotter is an all-inclusive review platform solution infused with AI to harness the power of user reviews.
17.	Sanbot – humanoid robot	Sanbot is a humanoid robot which can be used as a first level customer interaction in Retail, Hospitality, Health Care, Entertainment and Security. Sanbot utilizes next-generation robotics AI technologies both in design and manufacture. It has an open API platform which enables developers to programme the robot with customized Android applications for their business.
18.	Intelligent Transportation System	This solution demonstrates how to track the movement of buses in a crowded city. This is very useful for travelers to check real time the position of the bus they plan to travel.

## NSF marks its presence at the Shilpa Sena National Exposition

The NSF demonstrated the outcome of its major activities at the Shilpa Sena National Exposition which took place at the BMICH, from July 18-21. Popularizing the schemes supported by the NSF and displaying the role played to enhance S&T development, the stall widely attracted the attention of the general public towards its key services. A simple method of cardiopulmonary assessment, split skin harvester, non-invasive blood glucose measurement system and bio-conducting of diamond black moth were among the most attractive exhibits in the stall. While facilitating the registration of scientific & technological personnel in the Science & Technology Management Information System (STMIS), a database managed by the NSF, the public was attracted to the NSF book stall too. The book stall was the most popular among the visitors where they were able to purchase NSF publications including "Vidurava", the Science Magazine which is very popular among school children.



## Exposure Beyond Boundaries

### A Sri Lankan student wins Grand Award at the Intel International Science and Engineering Fair 2019

The National Science Foundation (NSF) in collaboration with the Institution of Engineers, Sri Lanka (IESL) organizes the Sri Lanka Science and Engineering Fair (SLSEF) annually with the objective of enhancing innovative thinking, creativity and investigative ability amongst school children in the country. National level winners of the SLSEF are eligible to represent Sri Lanka at the Intel International Science and Engineering Fair (Intel ISEF) which is held in USA.

The SLSEF 2019 was successfully held on the 11<sup>th</sup> February 2019 at the main auditorium of the IESL. Twenty participants competed at the SLSEF and a Selection Panel comprising eminent scientists/ academics and engineers evaluated the candidates and selected three projects to compete at the Intel ISEF which was held from 12<sup>th</sup> - 17<sup>th</sup> May 2019 in Phoenix, Arizona, USA.

Intel ISEF is the World's largest international pre-college science competition, a program of Science for Society. Approximately 1,800 high school students from more than 75 countries, regions, and territories get the opportunity to compete at the Intel ISEF.



*Grand Award Winner  
Master W A K B Udapola  
Sandalankawa Central College,  
Sandalankawa  
Invention: Safe gas regulator*



*M Z M. Ayyash, Zahira College, Mawanella - Invention: Safe branch cutting device  
W A K B Udapola, Sandalankawa Central College, Sandalankawa - Invention: Safe gas regulator  
R S R Senavirathna, H C D Hashela, S S R De Silva, Gnanodaya Maha Vidyalaya, Kalutara - Project Title: Effect of acidity on seed germination of selected varieties of paddy*

The safe gas regulator invented by Master W A K B Udapola won the third place in Grand Awards at the Intel ISEF 2019 under the category "Embedded Systems". This is a device to protect lives and properties from the hazardous situations/accidents caused by unexpected gas leakages which occur from the LP gas cylinders fixed to different types of burning instruments. The main purpose of developing this apparatus is to ensure human safety in using LP gas for different purposes.

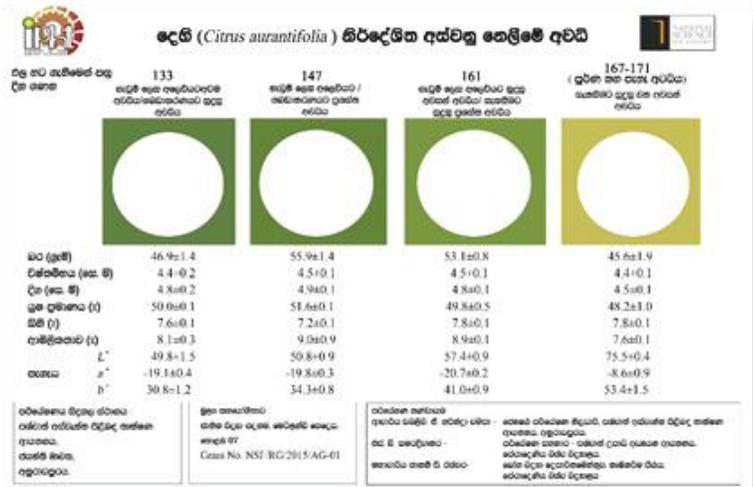
## Research at Bench and Beyond

### Improving fruit quality and post-harvest life of lime

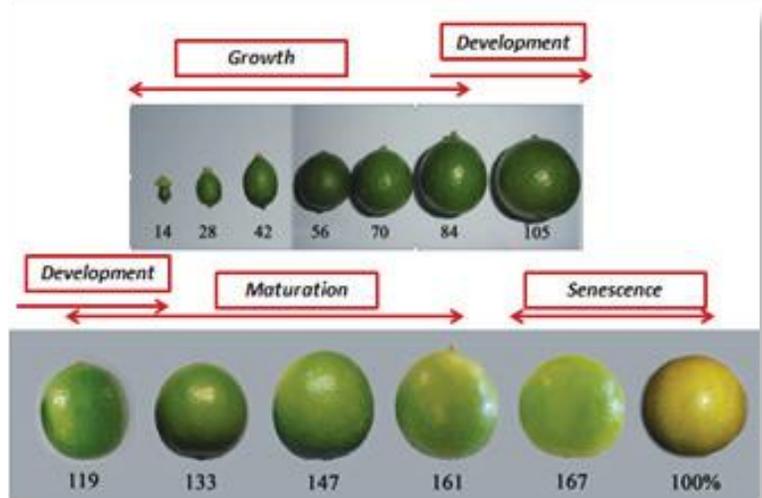
There is a constant demand for fresh lime throughout the year as it is used domestically, in the food processing industry and as an ingredient in indigenous medicine. It is also identified as one of the high priority crops. According to FAO statistics (2017), the area under cultivation of lemon and lime in Sri Lanka is 12.14 ha with an annual average production of 6,640 tons in 2014. Lime crop thrives well in the dry and intermediate zones of the country, where it can be found as medium-scale orchards or as scattered trees in home gardens. There are growth variations and the peak season falls between April to July. During the peak season, the lime growers leave the fruit without harvesting as the income is insufficient to recover the cost of production. Therefore, study of fruit phenology & development of maturity indices, manipulation of narrow fruit season targeting early or late season marketing & developing appropriate storage strategies for programmed year-round marketing would be highly beneficial for sustainable lime production and processing.

A Competitive Research grant completed in 2018 from the discipline of Agriculture and Food Science resulted in developing a color chart that can be used by lime growers to identify the best harvesting maturity based on the peel color which will aid in fetching a better market price and maintaining fruit quality for an extended time period. This grant was awarded in 2015 to Dr W A Harindra Champa of the Institute of Postharvest Technology and the study was carried out with the aim of studying fruit phenology, maturity manipulation, fruit season and development of appropriate storage strategies for year-round marketing.

The study resulted in finding optimum harvest maturity for fresh market and storage purpose and the optimum doses of pre-harvest foliar sprays of gibberellins, brassinosteroids and salicylic acid to advance, accelerate or delay the development stage of lime. These major findings are directly beneficial to lime growers in Sri Lanka which can aid development of lime-based agribusiness leading to generation of employment opportunities.



Lime Colour Chart



Variation in phenological stages of lime (*Citrus aurantifolia* Swingle) fruit (14, 28 etc are days after fruit set)

## Safer Communities with Hydro - Meteorological Disaster Resilient Houses

Damages to human lives and habitats due to torrential rains and floods have intensified in the recent past in Sri Lanka. Identifying the importance of this area, NSF facilitated the research project on “Safer Communities with Hydro-Meteorological Disaster Resilient Houses” conducted by Prof. Chintha Jayasinghe, Professor in Civil Engineering, University of Moratuwa in collaboration with Bath University, United Kingdom.

This research project was successfully completed and the NSF organized a Knowledge Sharing Programme on 30<sup>th</sup> January 2019 to disseminate the findings of this research project which was held with the participation of senior academics of universities and senior officials from several government institutions. The resource persons were Prof. Chintha Jayasinghe and Prof. M T R Jayasinghe, University of Moratuwa.

During the study, nature and magnitude of the problem related to flood damage including socio-economic impact was investigated for selected areas in Matara, Kalutara and Galle Districts, the areas highly affected due to floods in 2016 and 2017. Experimental models for minimizing the damages to structures were studied at Bath University, UK. The study was concluded with the findings to improve the flexural strength of masonry walls using steel reinforced mesh, constructing a cost-effective refuge space which can be used as part of the house or building and having upper floors to escape in case of flash floods. Implementing these findings at field level will enable to minimize structural damages to buildings and negative socio-economic impacts due to floods in future. Further, improvement of cost-effective construction of the refuge space by incorporating innovative building materials (e.g. waste-based building materials) are being researched at the laboratory level.



*3D graphical illustration of a model rescue house (before flood)*



*3D graphical illustration of a model rescue house (after flood)*

## Locally Manufactured Pulse Oximeter

Medical equipment and devices (MED) account for a major portion of Sri Lanka’s total healthcare expenditure, including importation of these equipment. In Sri Lanka, the MED market has increased steadily over the past five years. Even though timely accessibility to healthcare equipment in public hospitals has been identified as a basic need, the required numbers have not been met by the state sector hospitals due to the high cost. Local manufacturing of healthcare equipment is one possible alternative to mitigate this problem.

A commercial prototype of medical grade Pulse Oximeter as a competitive product on par with other similar products in the local market has been developed by a team of researchers of the University of Moratuwa with the financial support under the Technology Grant Scheme. The Premium International (Pvt) Ltd. has linked up with the university team to bring this product to the market. The Pulse Oximeter is a non-invasive device which is used to monitor blood oxygen level. It is a critical life-saving



*Locally developed Pulse Oximeter*

electronic medical device which is used in situations where continuous monitoring of the blood oxygen saturation is required, *e.g. surgeries and critically ill patients*. The demand for this device is high in hospitals, yet they only get a limited number due to the high cost. The government imports around 400 Pulse Oximeters annually for about 80 million rupees for national hospitals, but the demand is more than twice the number imported. The locally designed Pulse Oximeter guarantees that it exceeds or is comparable with the existing high-end products in all specifications.

It has the following features superior to any existing model currently available in the local market.

- 90% less power consumption: The locally developed Pulse Oximeter consume only 2VA (Max) whereas almost all other Pulse Oximeters consume around 20VA or more.
- Use of 4.2V, 4800 mAh Li-ion battery instead of conventional lead accumulators: Battery size and weight is small compared to lead accumulators and the device can run up to 12 hours using fully charged battery without charging. Usually, this value in most of the available Pulse Oximeters is 4 - 6 hours or less.
- Low power mode focusing on ambulatory applications to handle situations such as transferring patients from rural areas to Colombo. The device can run up to 20 hours without charging (starting from a fully charged battery) in the low power mode.
- Measuring range: 30% - 100% of Pulsatile Oxygen Saturation (SPO<sub>2</sub>) with an error of 1% at the perfusion index of 2%, calibrated using patient simulator. This range is comparable with all competitive products in the global market.

This is yet another successful story of University-Industry Partnership supported by the NSF which has led to a marketable product, giving great impetus to local researchers to be engaged in more University-Industry Partnerships.

## Events

### Initiative to Authenticate Medicinal Plants with Uncertain Identity

Sri Lanka is one of the famous "Biodiversity Hotspots" in the world. Further, Sri Lankan people use diverse plant varieties for indigenous medicine. Except for most commonly and frequently used medicinal plants, majority of these plants are not identified properly, which creates mismatches with so far documented evidence (*e.g. in Ola scripts*).

In the same way, there are botanically described single species having different local names in culturally different regions of the island being used to treat different/ same ailments. Therefore, an in-depth systematic survey and analysis of the congruence in the botanical nomenclatural system and the traditional medicinal pharmacopeia according to a scientific methodology is urgently needed for quality assurance,

safety and effective use of medicinal plant products in Sri Lanka.

Considering the existing complications in identifying the medicinal plants in Sri Lanka, the National Science Foundation is planning to conduct a study to authenticate those plants with uncertain identity. The Working Committee on Indigenous Knowledge of the NSF takes the lead role in this study getting the expertise of various individuals and institutions. Several planning sessions were held at the NSF to formulate a proposal for this study with the assistance of experts. It is expected to provide policy prescriptions and guidelines to all stakeholders for sustainable management and utilization of medicinal plants in Sri Lanka based on the outcomes of this study.

## Exploring the Indigenous Knowledge of Ancient Water Civilizations in Sri Lanka

With the increasing demand for resources, the world is now facing numerous crises in the management of natural resources. In the past few decades various scientific and socio-political theories were introduced with the aim of understanding the above-mentioned crises and finding solutions to them. At present, the issue has been narrowed down to the concept of "sustainability", and the whole world is now trying to define "sustainable development" and to develop strategies to realize it. In the journey of finding ways to sustainably manage natural resources, it is important to find out how our ancestors co-existed with the environment for thousands of years.

Having understood the enormous potential of Indigenous Knowledge in Sri Lanka to address certain issues with national importance, the NSF with the help of the Working Committee on Indigenous Knowledge is in the process of identifying different thematic areas in Indigenous Knowledge that warrant further studies. The ancient water civilization in Sri Lanka is one such thematic area that has been identified for further exploration. The main objective of this study is to explore the sustainability and cyclicity of ancient irrigation systems in Sri Lanka and to understand the social-cultural-hydrological and ecological dimensions associated with it. Several preparatory discussions were held at the NSF to develop this concept with the help of experts who have various insights into the topic.



*Preparatory discussion on ancient water civilization*

## From JNSF to VIDYA

### A mathematical model with control to analyze the dynamics of dengue disease transmission in urban Colombo

Dengue has been an important public health problem particularly in the tropical and sub-tropical regions in the world, for which no vaccine or successful treatment has yet been found. Therefore, prevention and control play a vital role in minimizing the risk of dengue in vulnerable populations.

Various mathematical models such as the SIR (Susceptible, Infected, Recovered) model have been developed to understand the transmission dynamics of dengue. The main drawback of these dynamic models is the lack of predictability with respect to external factors such as climate, geography, demography and human behaviour due to usage of fixed parameters. The mosquito density, which depends heavily on various external factors such as climate is a critical parameter of these models and is responsible for the local transmission of the disease.

A study was conducted where the mosquito density was modelled with respect to changing levels of climate favorable for mosquito reproduction. A climate risk index developed using fuzzy set theory was used to vary the mosquito density with respect to rainfall and temperature which is included in the SIR model.

Based on the results, two measures were introduced to control adult mosquitoes and growing juveniles. The first method is theoretical while the second method involved continuous and constant control measures over time. The numerical results of the SIR model suggested that the dynamics of infections had changed, and the number of infections was reduced once the control measures increased. The results also indicated that a high level of efficient control measures can be used to eradicate the dengue infections in Colombo.

The research was conducted by a team of scientists from the Open University of Sri Lanka and the R & D Centre for Mathematical Modelling, Faculty of Science, University of Colombo. The research paper is published in the Volume 46 (1) of the Journal of the National Science Foundation of Sri Lanka (JNSF).

## Prebiotic carbohydrate profile and in vivo prebiotic effect of pumpkin grown in Sri Lanka

A prebiotic is defined as “a non-digestible food ingredient that beneficially affects the host by selectively stimulating the growth and/or activity of one or a limited number of bacteria in the colon”. Recently, researchers have ventured into exploring prebiotic rich foods with the identification of its health benefits, such as anti-carcinogenic effect, ability to lower the risk of obesity, cholesterol level, constipation and ability to improve mineral absorption. Research was conducted to characterize the prebiotic carbohydrate profile of pumpkin varieties grown in Sri Lanka by high performance liquid chromatography technique and prove its prebiotic effect through an in vivo study, using the pig (*Sus scrofa domestica*) as an animal model for the human. Two local pumpkin varieties (Villachchi, Moragollagama) and five imported hybrid varieties (Arjuna, Suprima, Abishek, Lara, Pragathi) were used in this study.

Results revealed that local pumpkin varieties are rich in soluble dietary fibre compared to hybrid varieties. Interestingly, several prebiotic compounds were detected in pumpkin grown in Sri Lanka, namely sorbitol, mannitol, stachyose+raffinose, verbastose+kestose and nystose. Collectively, the highest content of prebiotic was recorded in the local pumpkin variety, Villachchi. Furthermore, in vivo studies confirmed the prebiotic activity of pumpkin, since pumpkin-supplemented diet increased beneficial microorganisms (Lactic acid bacteria and bifidobacteria) in the gut of the pig while reducing detrimental microorganisms (Coliform bacteria).



Villachchi



Moragollagama

With the emerging concept of healthy lifestyle, most people are aware of health benefits of consumption of fruits and vegetables. Therefore, they seek strong scientific evidences to select their foods. Investigation of locally available vegetables or fruits is important in this matter. At present, majority of Sri Lankan pumpkin growers tend to cultivate hybrid varieties due to the smaller size of fruits, despite valuable quality characteristics of local varieties. However, Sri Lankan consumers believe that local varieties are more nutritious than hybrid varieties. This is the first scientific investigation that proved their perception. Therefore, cultivation of local pumpkin varieties should be promoted by considering their high nutrient value together with pest and disease tolerance.

As a rich source of fiber, pumpkin can be incorporated into functional foods such as beverages, traditional foods, baked products, and dairy products. Therefore, future studies should specially focus on optimizing the conditions for pumpkin incorporated product developments. Findings of this research are also helpful in breeding programmes to develop new hybrid varieties and conservation of genetic diversity. All in all, local pumpkin varieties deserve much greater attention in research and development in future.

The Volume 46 (4) of the Journal of the National Science Foundation of Sri Lanka (JNSF) contains the findings of this important research carried out by a team of scientists from the University of Peradeniya, National Institute of Fundamental Studies (IFS), Regional Agricultural Research and Development Centre, Makandura in collaboration with the Clemson University, USA.

## Feature Update for the Year

### **Prof. Ananda Jayawardane wins the IESL “Eminence in Engineering Award”**



Prof. Ananda Jayawardane, Director General of the NSF was awarded the “Eminence in Engineering Award” by the Institution of Engineers Sri Lanka (IESL) at its Engineering Excellence Awards Ceremony 2018 held recently at the BMICH. Eminence in Engineering Award is a life time award and is the highest and the most prestigious award given by the IESL for those demonstrating eminence in the practice of engineering. The Excellence in Engineering Awards scheme was founded by the IESL in 2008 with the aim to encourage and celebrate the excellence in the science and practice of engineering, by rewarding the best and the finest of its members, individuals, organizations and enterprises in Sri Lanka for their outstanding accomplishments and achievements related to engineering.

Prof. Ananda Jayawardane is also a Senior Professor in Civil Engineering and former Vice-Chancellor of the University of Moratuwa. He is a Chartered Engineer, International Professional Engineer, a Fellow of the Institution of Engineers, Sri Lanka, a Fellow of the Institute of Project Managers, Sri Lanka, a Fellow of the National Academy of Sciences of Sri Lanka, a life member of the Sri Lanka Association for the Advancement of Science, a Graduate Member of the Sri Lanka Institute of Directors, and a Member of the Society of Structural Engineers Sri Lanka. He is also the past NDB Bank Endowed Professor in Entrepreneurship at the University of Moratuwa and a Past President of the Institution of Engineers, Sri Lanka.

He has also served as a member of the governing Councils/Boards of National Institute of Education, Institute for Construction Training and Development, State Engineering Corporation, Post-graduate Institute of Management, Miloda Academy of Financial Studies, Sir Arthur C Clarke Institute for Modern Technologies and the Open University of Sri Lanka. Currently, he is a member of the Board of Management of the Construction Industry Development Authority and a non-executive Board Member of the Commercial Bank PLC and Sierra Cables PLC. He has served in several other National Committees in Science & Technology and Education policy making.

He has received several awards for his research publications - two awards for his undergraduate research, the IESL Award for the best paper published in the Engineer Journal thrice. He has co-authored several textbooks and has published and presented over 80 research papers both locally and internationally. He is also the recipient of the National Achiever's Award 2013 under the category of Engineering by Lions Clubs International - District 306A1, the IESL President's Award 2012 and the Asia's Education Excellence Award 2016 for outstanding contribution to education, Sri Lanka Education Leadership Award 2017 for education leadership and Sri Lanka Education Leadership Award 2018 for outstanding contribution to education presented by World Education Congress and CMO Asia.



*Ms M Shamila, receiving the Award at the Annual General Meeting of the Sri Lanka Library Association*

Ms M Shamila, Management Assistant, National Science Library & Resource Centre of the NSF, was awarded with the S.C. Block Memorial Scholarship Award for her great achievement (rank of island first) in Diploma in Library and Information Science Level I, 2017/2018.



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