

Research Magazine of the University of Moratuwa

# BOLGODA PLAINS



University of Moratuwa, Sri Lanka

August 2021

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The Faculty of Graduate Studies was established in January 2015, with the goal of enhancing the University's research degree programmes. High quality research has become as important as teaching to gain better international recognition and competitiveness. Research, being the cornerstone of an academic career, is a key factor in retaining the high-calibre academics that the University is home to.

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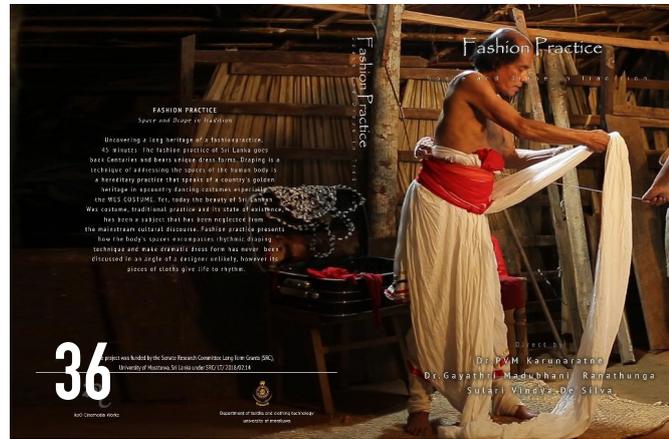
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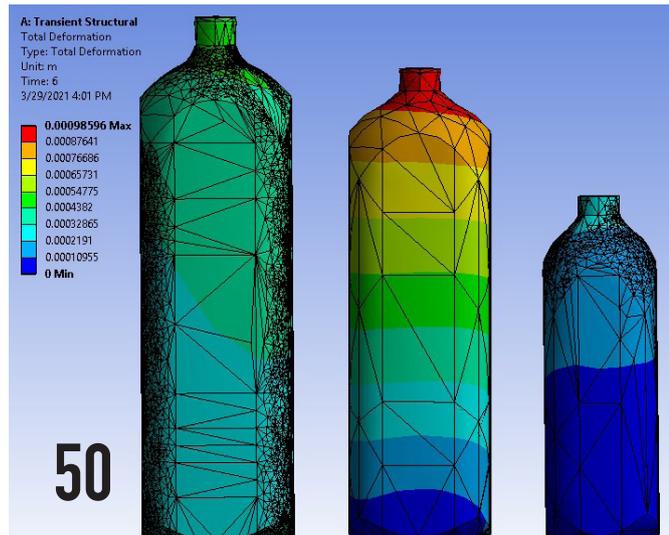
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## Editor's Note

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# *Our University - Our Research*

On behalf of the Editorial Board, we welcome you with great pleasure to the inaugural issue of the research magazine of the University of Moratuwa, the Bolgoda Plains.

Research is not complete unless the findings are promptly communicated. A good part of the high value of research conducted at our university goes literally unnoticed because of this. The downside of this are that, the knowledge transfer does not occur, the same research problems are quite likely to be addressed repeatedly, and the institution seldom gets credit for being socially responsible.

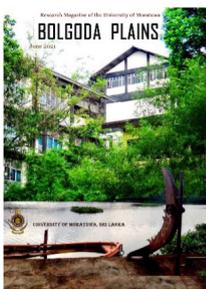
Bolgoda Plains creates a platform for you to showcase your research, at whatever level it stands, in a more engaging narrative. Neither being a scientific journal nor a research newsletter, Bolgoda Plains places itself in-between. It serves a balanced mix of research briefs, research features, research news, interviews, picture articles, and young researcher portraits.

Works of the undergraduate and graduate students are a treasure that the universities often have missed out on. In a haste to graduate, the students would merely fulfill mandatory requirements and leave the place. Their research, worth months and sometimes years, end up on a desk in the form of theses or reports. The experimental methods, data, or observations never make their way to the society. There must be a mechanism for the university to capture these research endeavors, recognize the people and personalities behind, and reward them. Bolgoda Plains is an effort to give this space.

There is no research without a story attached. Bolgoda Plains captures this story. Be energized and join the ranks.

This maiden issue comes with some extraordinary effort and contributions. Our special thanks go to those members challenged by the virus, at times personally too, who yet put together remarkable sixty pages. Enjoy a walk over the plains.

Dr. Sanjeeva Witharana  
Editor in Chief



**Cover Story:** Bolgoda Plains aims to give a voice to the University of Moratuwa Researcher. University of Moratuwa at present has a physical footprint of 25 Acres on the Bolgoda Plains! Our eco-system spans 6 faculties with 35 departments and 9 centers. The University of Moratuwa provides research facilities at 155 laboratories under the supervision of 396 academic staff. Postgraduate research students' community has just exceeded 600.

Communicating and dissemination are key ingredients of any research endeavor. The goal of this magazine is to realize the impact the society expects.

Enjoy and reflect on the 'UoM Researcher' and their exploits!

# Impacts of the first COVID-19 Lockdown on Mobility and Consumption of Households in Sri Lanka | Results of a Survey

Sri Lanka was introduced to an unnamed virus on 27th January 2020 when a Chinese tourist was diagnosed with it [1]. Within 8 weeks, the virus named COVID-19 had begun infecting the local population, and the government was taking measures to prevent its spread in Sri Lanka. The government imposed an all-island curfew on 20th March 2020 [2]. Starting from 20th March, the government encouraged Work-from-Home (WFH) and allowed agricultural activities while imposing restrictions on all physical movements [3]. With curfew, the government allowed the distribution of essential items and goods transport by issuing curfew passes. In spite of these measures, people faced many hardships during this time. The department of Transport and Logistics Management, Faculty of Engineering, University of Moratuwa, conducted a survey on 12th April and completed on 20th April 2020, during a period that the country was having curfew almost all the time. The purpose of this survey was to determine the immediate impact of the government's steps on people's lives and their impressions on the future. Over 1100 respondents from all districts of the country took part in the online and email survey. As this would return a biased sample, we normalised the collected data across the

districts and by educational profile to make the representation as accurate as possible [4]. The analysis led to the following 3 noteworthy findings that would be useful for any future emergency or return to curfew if the need so arises.

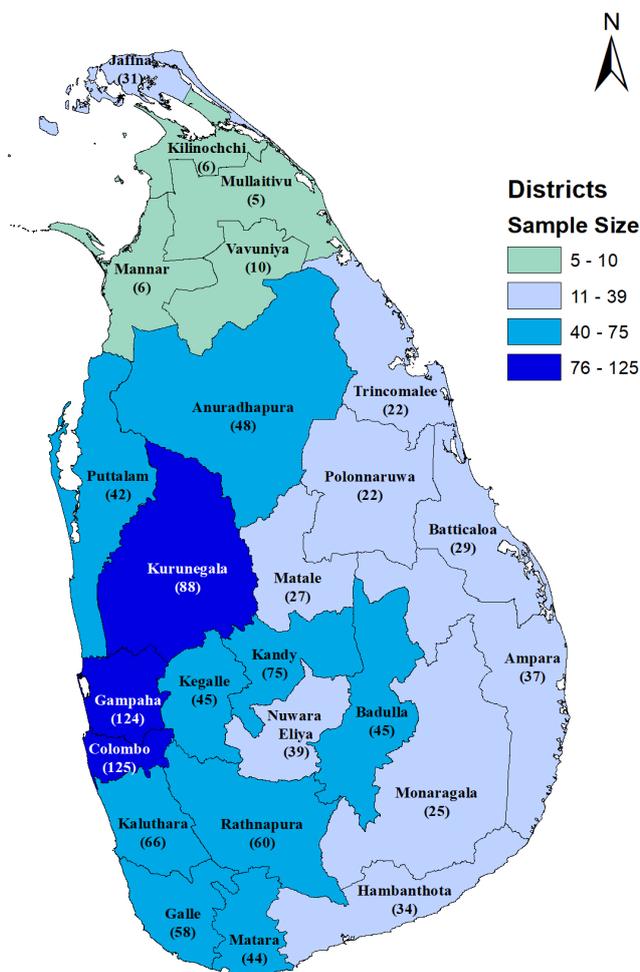


Figure 1: Spatial map of survey coverage

## 1. The Impacts of Health Advisories and Lockdown on Personal Mobility

Prior to COVID-19, only 21% were allowed to WFH by their employers and this shot up to 46% during the curfew. Of this, 35% were working all 5 days or more which was a significant increase from the previous 8%. However, there were very few people who worked for less than 5 days. It appears that while some people were fully engaged in WFH, others were not engaged at all. Although there are more 'positive' changes than 'negative' changes in WFH policy adaptation during the pandemic, we made use of inferential statistics to know the different 'directions of travel' that the participants took for granted in future policy derivatives. We found that the change in the proportion of respondents who think there will be additional WFH related policies in the future ( $p < .05$ ) was statistically insignificant. Even though there is a trend in WFH practices during the pandemic, the



same trend cannot be expected under the post-COVID-19 circumstances. This implies that positive changes in WFH practices are provisional in the population parameters (95% CI).

## 2. Overall Impact on Households

Most households indicated that they were affected by the inability to travel, with a majority of households indicating an impact of 80% or more from the normal baseline. On the other hand, as shown in below figure, the impact on household income has been more uniformly spread with almost equal spread of the degree of impact across households. Access to essential items was also not reported acutely, with the majority indicating moderate to high impact levels.

Since lower-income households represent mostly those in informal employment, including agriculture, construction, etc., we attempted to correlate the degree of impact on income with the percentage of the population engaged in informal employment in each district. The results shows this to be highly correlated with an  $R^2$  of 93%. We observed an almost identical relationship for the impact on accessing essential items ( $R^2$  of 92%), indicating that those in informal employment were the worst

affected in both the loss of income and facing difficulties in accessing essential items. This could be due to a lack of employment and the inability to access online services, credit, etc., commonly associated with informal and temporary employment.

## 3. Changes to Travel and Consumption Patterns of Households

There were approximately 13% new adopters for online purchasing, an increase of 29% using online shopping to buy dry goods and 23% buying medicine. Overall, the proportion of people using online services to buy perishables, protein, as well as sanitary and personal protective equipment increased within the range of 12%-20% though recording relatively smaller gains in medical services (8%) and banking services (5%). However, banking services marked a special case with 50% of the households using online sources after the curfew was imposed as many banks already had an online presence before the pandemic. We can elaborate this notion as an explosion in e-commerce/online/teleshopping services due to a lack of access to food and other essentials through traditional brick and mortar retailers.

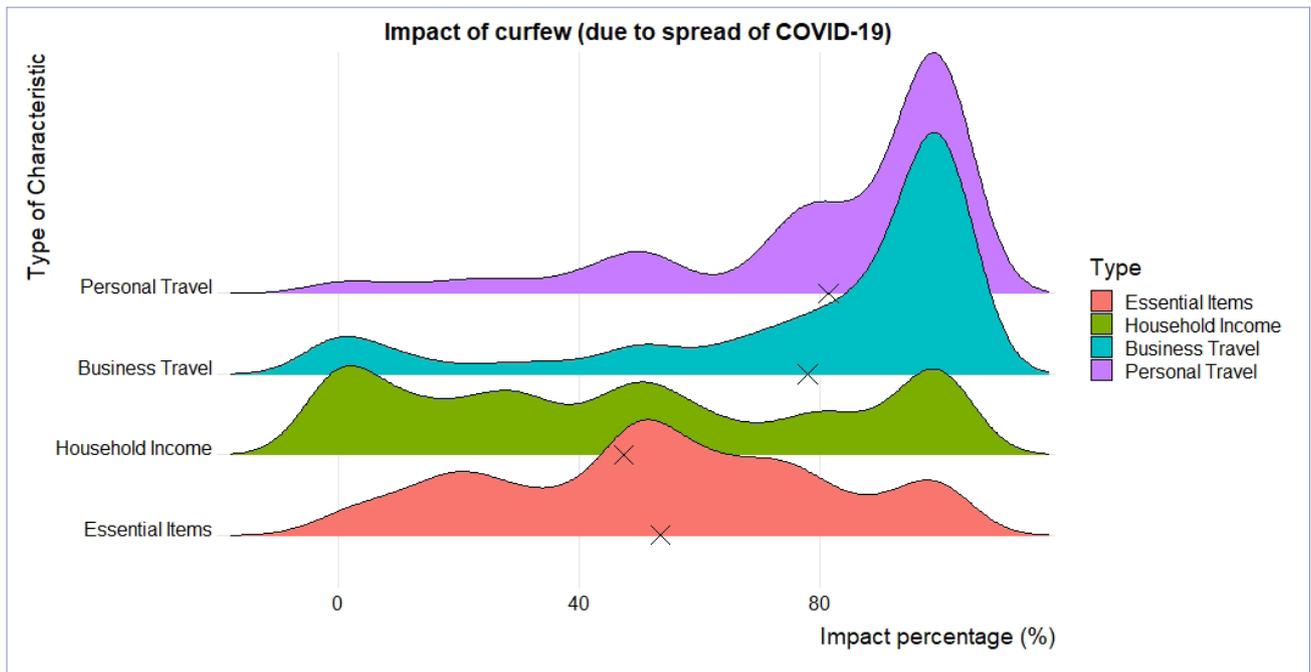


Figure 2: Impact of curfew on access to selected needs

“ The responses indicate that consumers still prefer the brick and mortar shopping experience over buying online. The decreased trend in the long run further confirms the competition that can occur between online retailers and offline retailers. ”

With respect to accessing essential goods during the COVID-19 related curfew, around 2/3rd of all households have experienced difficulties, with the least being for perishable goods, where 58% of the respondents rated it difficult to access. Dry goods (59%), protein (64%), medical (65%), banking services (68%), medical services (69%), and house-

hold repairs at 75% are the remaining pain points endured by the public with the said numbers facing accessibility challenges. Overall, the supply chain activities within Sri Lanka have become comparatively unusual, resulting in a significant deviation from the usual route due to travel restrictions between supply and demand.

As shown in below figure, during the COVID-19 pandemic, "visiting the outlet" or "street vendor deliveries" became the widespread adoption in accessing essential items. Online shopping and mobile order deliveries were more popular when accessing medicines and sanitary items than other product categories. Despite the curfew, the government relaxed it for people to attend to basic needs in low-risk areas from time to time. As such, essentials were kept open for limited time windows for physical access.

Survey results highlight that the trends in online shopping services might flatten in the long run. The responses indicate that consumers still prefer the brick and mortar shopping experience over buying online. The decreased trend in the long run further confirms the competition that can occur between online retailers and offline retailers.

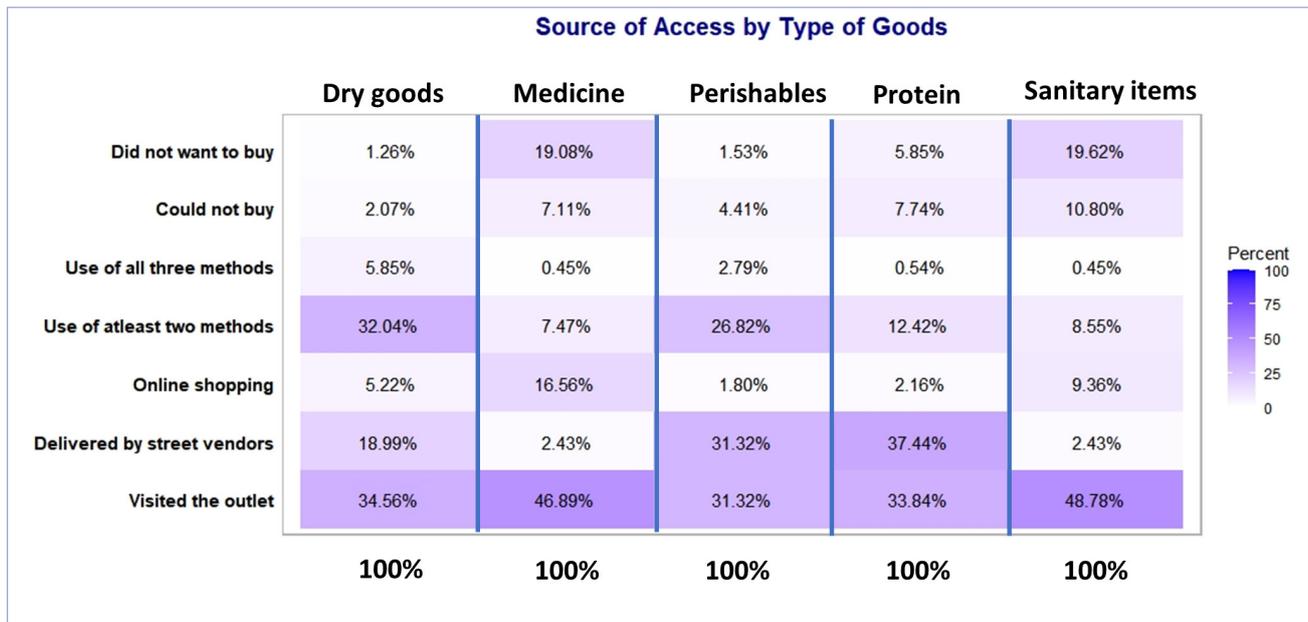


Figure 3: Essential item fulfilment sources during the curfew

The following five conclusions were reached from this survey-based work.

1. Bringing only the essential workers to the workplace and letting others WFH will reduce the number of passenger movements and, therefore, minimise traffic congestion, leading to optimal resource usage.
2. Public transport sector in Sri Lanka can be recalibrated as a result of the COVID-19 pandemic to provide safe, improved, less crowded and convenient demand-driven services.
3. Lack of confidence amongst the delivery players and online vendors is the prominent reason customers prefer going to brick and mortar stores. Thus, it is the role of policymakers and practitioners to ensure that the entire consumer purchasing cycle seamlessly reaches completion.
4. Overall deterioration in access to essentials was a major concern during the COVID-19 pandemic, and supply chain activities in the country must be recalibrated to ensure benefits to all stakeholders.
5. These results would be useful in understanding how society would deal with a similar unforeseen event in the future if it were to arise. It also provides vital learnings on the important role of transport and logistics on the economic fabric and the lifestyle of people in a developing country.

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Article by

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# Enterprise Robotic Process Automation

Robotic Process Automation (RPA) is an emerging technology widely used across multiple sectors such as human resources, healthcare, finance, accounting, manufacturing, higher education and supply chain management, etc. RPA, also known as 'software bots', replaces manual, rule-based, repetitive tasks humans perform. These software bots are currently in a journey, evolving to be more sophisticated, mimicking human activities and enabling humans to achieve higher-valued tasks. Hence, RPA impacts the overall operational efficiency in organisations through multiple facets by its integration with employees, existing technologies and infrastructure, and business processes. It reduces the burden on IT as it does not disturb the underlying legacy systems. It increases reliability as bots can work 24x7 effectively. It is used as a time and cost reduction technology as it reduces the size of the manual workload. The tasks performed through RPA is accurate as it is less prone to errors. It increases compliances as it follows the rules and keeps audit trails. The productivity rate of organisations increase as the execution time through RPA is faster than tasks being performed by human employees. Furthermore, RPA is introduced as a low code technology that uses drag and drop functionalities with little to no programming knowledge [1].

Organisations begin the RPA implementation after a readiness and a feasibility study. The first stage of any RPA implementation is the "Proof of concept (PoC)", and most organisations are currently in their PoC stage of the RPA journey. However, Gartner predicts that RPA is on its way towards becoming

a mainstream technology and will disrupt the market in the recent years to come. RPA is usually surrounded by scepticism as a technology that will steal human jobs, a mere automation strategy hyped by vendors and service providers, a short-term solution to organisational efficiency issues. The lack of case studies and business cases publicly available, discussing the benefits and disbenefits of RPA is also a reason for this scepticism.

Nevertheless, Garner states that RPA has already proven its value by delivering significant returns on investments in short payback periods. RPA is predicted to be deployed on a large scale in the future. With the steady maturity of the RPA market, different toolboxes such as maturity frameworks, readiness frameworks, etc., for RPA have also come into play at global levels. This large-scale deployment leads to the new field of study, 'The enterprise-wide RPA.'

## What is Enterprise RPA?

Research has investigated that most organisations implementing RPA is at its Proof of Concept or Pilot phase and are experiencing difficulties scaling up [2]. The main reason for the struggle in scaling up is that RPA's implementation approach as a new technology is different from implementing other technologies. RPA is rapid automation that must be embedded into the organisation with high involvement of business area, IT department and



finance department. In contrast, most other new technologies are mainly embedded and aligned into the IT department.

RPA's institutionalisation has to be associated with a holistic change management approach, with proper and structured alignments with organisational employees, RPA implementation team, business processes, legacy systems and existing infrastructure, and the organisational structure and strategic alignment. The scaling up of the RPA implementation from a PoC stage to an organisation-wide stage is the enterprise RPA. Enterprise RPA is built on multiple facets such as bot development, maintenance, security and risk management, software quality assurance, deployment and scalability. Each of these facets has its unique challenges to overcome in the enterprise RPA journey. However, most organisations' key challenge is aligning the RPA rollout to the organisational people, process, and structure [3].

## Challenges to overcome in RPA deployment and scalability

When embedding Robotic Process Automation to organisations, there are two key issues. Separation

“ RPA has already proven its value and is expected to be adopted and deployed well into the future”

of business and automation responsibilities, and having an enterprise-wide approach and support are the key challenges faced by organisations when deploying and scaling RPA.

### 1. Separation of business and automation responsibilities

RPA implementations are typically initiated and governed by business areas with limit-

ed IT department involvement, unlike traditional IT solutions. However, scaling up towards enterprise RPA is a journey that needs to go hand in hand with business areas, IT and finance departments.

When scaling up beyond the proof-of-concept stage, it is necessary to integrate IT knowledge and other facets such as governance, project management, risk management, quality assurance. Even though the deployment of RPA is relatively easy and quicker compared to other technologies, RPA bot licensing is quite expensive. Therefore, it is essential to identify the right business processes to be automated. To ensure the bots are properly utilised, choosing standardised business processes and reusing the modules during automation is crucial. Business area involvement is vital in understanding and identifying the right processes to automate, modelling the processes to identify the repeatable and reusable tasks in some aspects. Hence, business knowledge is important in setting up the long-term vision for RPA in an organisation. The finance department should also be involved as they dictate the expenses for the technology and the return on investment. Therefore, the governance of RPA technology should be shared between finance, business and IT departments in organisations, which contradicts the existing organisational structure when introducing new technologies. The need for ongoing business, IT and finance alignment challenges the enterprise-wide deployment of RPA and calls for new alignment approaches [4].

## 2. Enterprise-wide approach and support

Unlike traditional and heavyweight IT solutions, RPA does not impact organisational legacy systems and existing IT infrastructure. As a lightweight and more flexible rapid automation technology, RPA has less risk in ad-hoc automation solutions with no end-to-end improvements in business processes.

However, this also means that RPA can be implemented on a smaller scale within one department in one business process, communicating within that specific department and creating a local impact. Therefore, the other departments in organisations would have limited visibility on the technol-

ogy and its value, which might hinder the enterprise-wide adoption of RPA. This is another challenge that needs to be addressed by proper change management and institutionalisation of RPA.

## Where to next?

RPA is moving towards hyper-automation by marrying other technologies such as Optical Character Recognition, artificial intelligence, machine learning and chatbot integrations. This will enable the organisations to automate more complex and less rule-based tasks and handle exceptions that currently need human interventions. Smart RPA is also predicted to be cognitive. The bots will learn by acquiring information, reason using the context and rules, and self-correcting through their learning experiences.

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Article by

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# Enhancing the Power of Understanding



Power of understanding is a rewarding cognitive capacity required by all of us from early childhood to the highest level of intellectual settings. Among other things, the concept of understanding plays a vital role in education. When I was a second-year undergraduate, I was so curious to know why some of my colleagues could understand subjects much faster than the others, and this curiosity compelled me to research on how understanding manifests in our minds. My literature review revealed that the ultimate happiness/truth stated in Buddhism is a matter of understanding the world differently from the way we do it generally. Literature also showed that many people in Buddha's time understood the ultimate truth while listening to the discourse of the Buddha. Those who could not understand a matter then and there had to develop certain cognitive skills through various cognitive tasks such as further listening, discussing, thinking, and meditating. This is equally applicable to our educational settings as well because some students understand the subject matter during the lecture itself, while the others need to involve in additional reading activities, discussions, tutorial work, and so on.

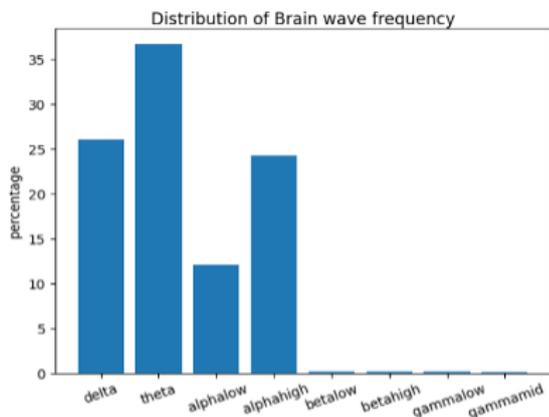


Figure 1 – Higher mindfulness due to Higher Theta

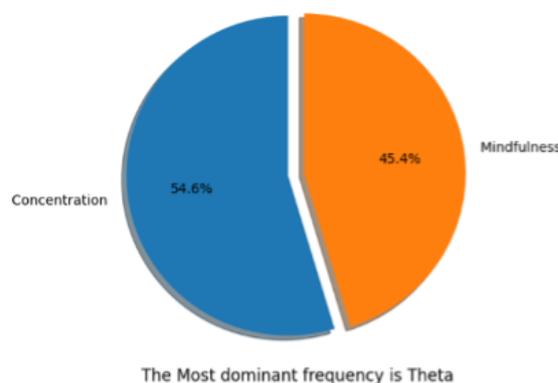


Figure 2 – Lesser Mindfulness when Theta is dominant?

Having read the discourse on Satipatthana [1], I discovered mindfulness as the foundation for understanding a subject matter. Mindfulness can be primarily seen as the present moment awareness of anything we experience in an impartial manner. Literature shows two major benefits of mindfulness (sampajano satima) to enable understanding. The first benefit of mindfulness is the effortless and swift recalling of the relevant knowledge at the correct time. The exciting second benefit of mindfulness is the ability to facilitate the understanding of new knowledge. Bringing the relevant subject matter to the surface effortlessly and solving previously unsolved problems are two phenomena that we experience in answering at examinations. If the mindfulness is low, the correct answer might surface after the examination. This finding reminds us that reading notes and books, answering past papers, doing practical work, and participating in discussions are techniques we used to improve mindfulness required for exams.

It should be noted that in addition to reading, discussing, working out past papers, etc. there are general exercises that help to cultivate mindfulness. Certain tasks such as medical surgeries, mathematical calculations, shooting, and walking on uneven surfaces etc. naturally require higher levels of mindfulness. Accordingly, people have introduced various exercises for improving mindful-

“ The findings encourage the conduct of further research to benchmark mindfulness based on EEG waves and to set a standard for mindfulness research and practice ”

ness. In the recent past, a huge volume of research has been conducted on mindfulness interventions and to study the effect of mindfulness for various purposes including stress reduction, emotional balance, and enhancement of retention power and capacity to think [2]. Much of such research have been focused on realizing mindfulness through the analysis of EEG signals [3].

With this background, I have been engaged over the last decade, in investigating how the current

research findings in mindfulness comply with the original Theravada literature on mindfulness. Undisputedly, Sri Lanka is an ideal place to conduct this kind of research due to the availability of access to original literature on mindfulness and long-established traditions/schools of the practice of mindfulness. In my research, I have used EEG technology to capture brain waves emitted from Fp1 location in the brain when people are involved in mindfulness practices. This experiment is based on mindfulness practitioners of Sati Pasala Foundation established under Nissarana Vanaya monastery at Meethirigala, Sri Lanka.

The first finding of the research is that although current literature predominantly talks of  $\theta$  waves of the frequency range 4-8Hz to describe mindful-



ness, our research shows in many instances, the other waves such as  $\delta$  (1-4Hz) and  $\alpha$  (8-13Hz), which are in the proximity of  $\theta$ , also contribute to determine the level of mindfulness. Fig. 1 shows the presence of  $\delta$ ,  $\alpha$  and  $\theta$  together in a wave spectrum of a particular mindfulness session.

Thus, the findings shown in Fig. 1 and Fig. 2 are not comparable. The disparity might probably be due to

the ignorance of the contribution of  $\delta$  and  $\alpha$  waves on determining the mindfulness. This anomaly is quite possible since many people have a confusion between mindfulness and concentration. Therefore, the discovery of a comprehensive brain wave spectrum for mindfulness remains a research challenge.

The above findings encourage further research to benchmark mindfulness based on EEG waves and to set a standard for mindfulness research and practice. It is planned to conduct a series of control experiments with experienced mindfulness-practitioners and to collect EEG signals. The experiment will be designed to practice mindfulness according to Theravada tradition of mindfulness. The findings of the further research would enable the novice mindfulness-practitioners to cultivate mindfulness effectively, and it would result in individuals getting the benefits of mindfulness training to energize cognitive skills such as understanding, analytical thinking, retention power, emotional balance, and social well-being.

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# Cognitively Intelligent Models for Human-Robot Interaction with MIRob

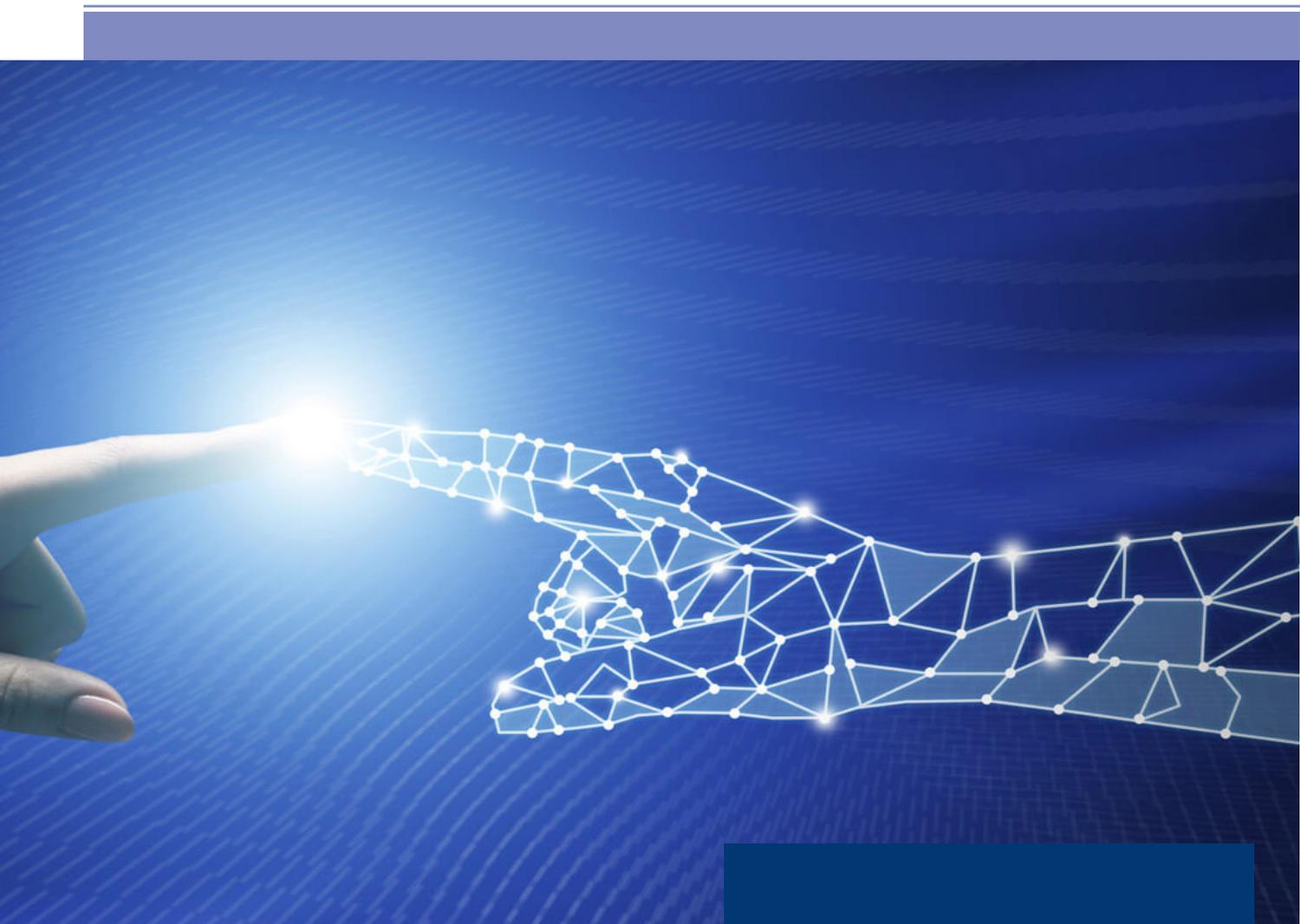


Moratuwa Intelligent Robot, shortened as MI Rob, is the first successful outcome of the research conducted by the Intelligent Service Robotics Group (ISRG) of the Department of Electrical Engineering-UoM. The tremendous effort of a team of Masters, MPhil and PhD students made MI Rob project a success. Chapa Sirithunge is the most recent graduate from the team, who recently defended her PhD with the Intelligent Service Robotics Group. Her research: Framework for Adaptive Human-Robot Interaction Initiation for Domestic Environments, was supervised by Prof. Buddhika Jayasekara, lead of the group.

This research explores how a robot should gather knowledge upon a scenario between a robot and its user and then generate appropriate intelligent responses towards its user. Therefore, cognitive models were developed to act as a robot's intelligence or the brain to make situation-specific decisions. Such insightful decisions will help the robot

act in a social environment without disturbing its user or other humans around.

Intelligent robot companions contribute significantly to improve living standards in the modern society. Therefore human-like decision-making skills and perception are sought after during the design of such robots. On one hand, such features enable a robot to be easily handled by a non-expert human user. On the other hand, the robot will have the capability of dealing with humans without causing any disturbance by its behavior. Mimicking human emotional intelligence is one of the best and reasonable ways of laying the foundation for such an emotional intelligence in robots. As robots are widely deployed in social environments today, perception of the situation or the intentions of a user should be identified prior to an interaction. Proactive, social robots are required to understand what is communicated by the human body language before approaching a human. Social con-



straints in an interaction could be demolished by this assessment.

Chapa's thesis addressed the problem of perceiving nonverbals in human behavior and fusing human-environment semantic representations with a robot's cognition before interacting with humans. The novelty lies in laying the background to relate nonverbal human behavior and the features of the environment to generate context-aware interactive responses during robot-initiated interaction. That informs the robot about its environment. Toward this end, she introduced novel methods of perceiving human nonverbals and spatial factors in the environment which make up a context. Chapa and the team integrated that knowledge to determine appropriate responses from a robot to assist its user. Visual information acquired by a vision sensor was analyzed, and the level of emotional engagement demanded by the user's nonverbals was evaluated, before a robot initiates an interac-



MiRob

tion. After such an analysis, a robot's conversational and proxemic behavior was adjusted to maintain an empathetic relationship between the user and the robot. These algorithms efficiently sustained the empathy between user and robot so that the interaction resembles human-human interaction to a larger extent. To assist the main problem, the research team formulated novel methods to recognize human nonverbals such as postures, gestures, hand poses, psychophysiological behavior of humans and humanactivities, and decode the emotional hints displayed to the outside world. In support of this work, the team conducted a series of human studies to explore the patterns in human behavior which could be perceived by a proactive robot using its cognitive capabilities. The team also introduced separate systems which can decode the sentiments of humans using observable cues based on accepted social norms. They detail the meanings of human nonverbals by observing human behavior over time and evaluating the context for any patterns in behavior. Ambiguities in human behavior and random, meaningless behaviors could be omitted through this approach. This approach further omits the negative effect of human responses that can be faked, such as facial expressions and words. Finally, they introduced an adaptive approach towards robot-initiated human-robot interaction by letting a robot observe a context and generate responses while changing its responses continuously as human behavior changes. They first developed algorithms based on a limited number of observable human cues and decoded their sentiments based on modern psycho-physiological interpretations of human behavior. Next, they expanded such approaches towards multiple observable human cues. Finally, observations from the human and the environment that create the context during Human-Robot Interaction (HRI) were integrated.

Basic cognitive models of the robot were developed with techniques such as fuzzy logic and Auto-regressive models etc. However, at a later stage deep learning and reinforcement learning techniques were deployed to train a robot coop well with the environment. The team created an artificial domestic environment with actual furniture and equipment for experiments with MI Rob.

A depth camera, microphone and a stereo vision camera have been used to acquire information from the environment in which the robot walks. MI Rob was equipped with a navigation platform to walk around and map the environment and has a structure with a hand to manipulate objects. It further had a microphone and a speaker to communicate with people. Later MI Rob has been improved with more sensors such as LIDAR sensors and advanced depth sensors to improve its cognitive capabilities and the perception of its surrounding.

A considerable amount of outstanding research articles was originated with MI Rob, including Chapa's thesis. With these improvements, several other students are working at present on improving locomotion and environment mapping of MI Rob as a continuation of preexisting research.



Article by

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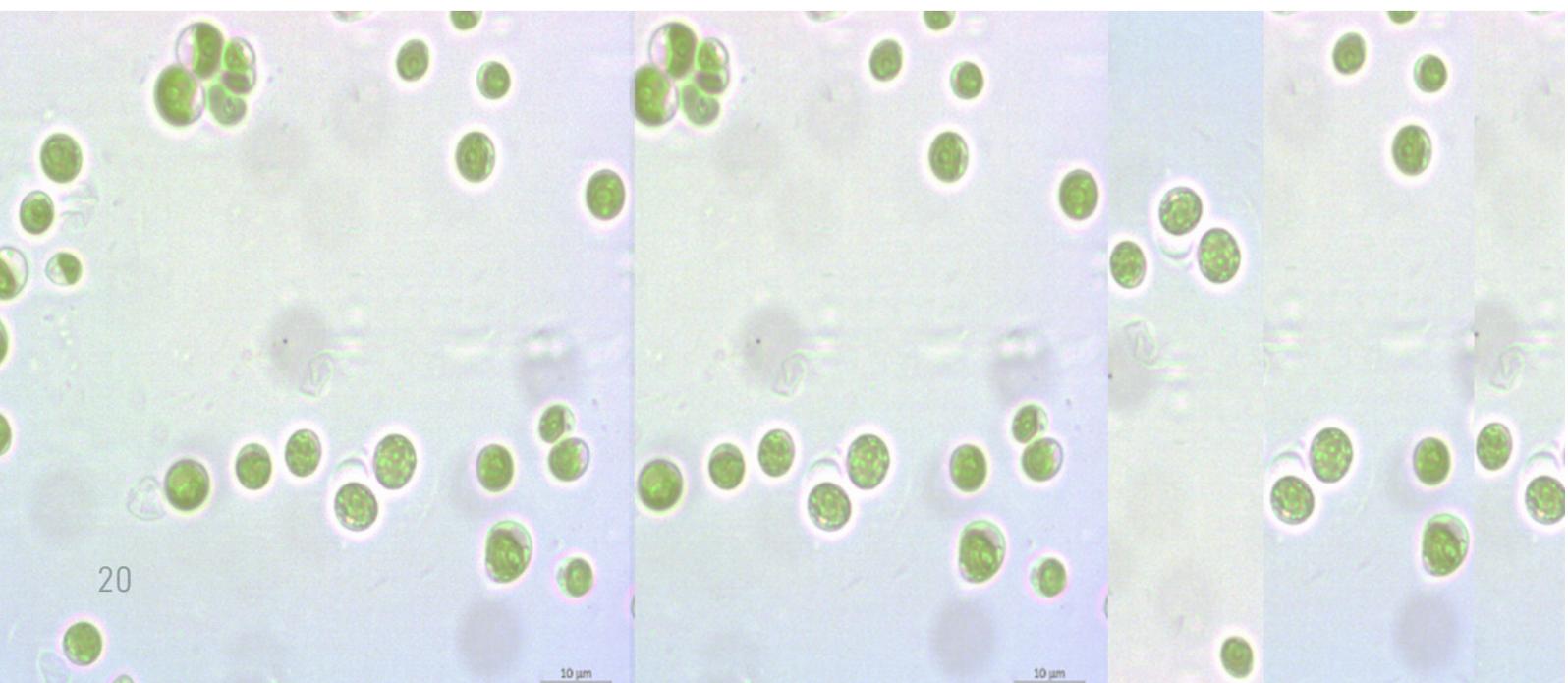
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# Microalgae:

## A Promising Bioresource for a Sustainable Future

Microalgae are highly diverse unicellular photosynthetic organisms found in aquatic environments. Microalgae produce oxygen during their proliferation, contributing to nearly 50% of the total oxygen production in the world. Concurrently, microalgae consume carbon dioxide in the atmosphere, thereby serving as carbon sinks to alleviate the effects of global warming. In comparison to terrestrial plants, microalgae exhibit rapid growth rates, higher photosynthetic efficiency, shorter harvesting time and higher biomass productivities. Moreover, they do not require arable land or potable water to facilitate their growth, hence becoming a more sustainable feedstock as compared to conventional crops. Altogether, microalgae have been identified as a bioresource with great industrial potential due to their ability to accumulate commercially valuable metabolites that can be extracted and subsequently processed into diverse bioproducts such as biofuels, pharmaceuticals/nutraceuticals, biofertilizer and animal feed.



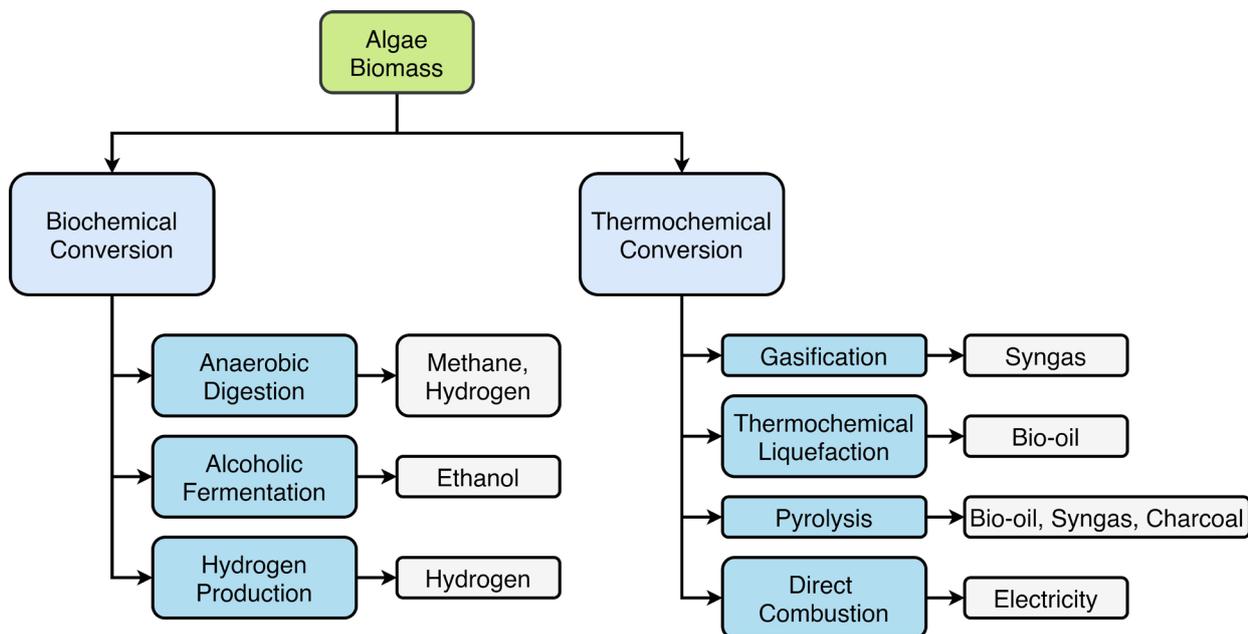


Figure 1: Biofuel production from microalgae [1]

Microalgae can be converted to biofuels via a variety of processes, as illustrated in Figure 1. Some microalgal species are capable of accumulating lipids or carbohydrates up to 60-70% of their dry cell weight, which can be used to produce biodiesel or bioethanol via transesterification or fermentation respectively. Various microalgae-based biofuels can also be produced via anaerobic digestion or thermochemical conversions such as pyrolysis, hydrothermal liquefaction and gasification. The most suitable process for biofuel production should be selected based on the biochemical composition of microalgae as well as comprehensive techno-economic and life cycle analyses.

Microalgae can also synthesize compounds with nutritional value, including carotenoids, proteins and vitamins. Compared to biofuels, bioactive compounds synthesized by microalgae secure a significantly higher market value. Thus, the use of microalgal biomass for pharmaceutical or nutraceutical applications is a far more lucrative and economically feasible option for biomass valorization compared to biofuels and bioenergy production. Sri Lanka, being an island surrounded by the ocean and comprising of numerous inland water resources, is undoubtedly teeming with diverse

microalgae species. Despite the multitude of potential applications, the valorization of microalgae biomass is not well established in Sri Lanka. Considering the lucrative nature of microalgal bioproducts, the exploitation of this valuable bioresource would lead to the development of local bio-based industries in the country.

At the Department of Chemical and Process Engineering (DCPE), University of Moratuwa, the Microalgae Research Group is working with dedication to make this concept a reality. As an initial step, different water bodies in Sri Lanka have been sampled and numerous microalgal strains have been isolated. Thus, the department hosts a vast culture collection of microalgae under controlled conditions. Following isolation, microalgal strains are screened for their capability to accumulate target metabolites, and most promising strains are identified using gene sequencing. Starter cultures of these strains are cultivated in flasks, and further scaled up in lab-scale photobioreactors (Figure 2). Experiments are carried out in photobioreactors to identify the optimum culture conditions for their growth and accumulation of target metabolites. Mathematical and neuron modeling techniques are often employed for this purpose as they can



Figure 2: Microalgae cultures maintained in incubators (left) and cultivated in lab-scale photobioreactors (right) at the Department of Chemical and Process Engineering, University of Moratuwa

be used to identify the synergistic effects of different culture parameters [2]. In addition, the research group conducts experiments on process development for the extraction and purification of high-value compounds from microalgae for nutraceutical and pharmaceutical applications.

Developing sustainable microalgae-based biorefineries is another line of research undertaken by the group. This is to be achieved through the integration of target metabolite production and microalgae-based bioremediation. Microalgae have higher photosynthetic efficiencies than terrestrial plants. This enables them to fix carbon dioxide from flue gas streams that contain CO<sub>2</sub> concentrations far exceeding the atmospheric levels. The production of 1 kg of microalgal biomass can fix approximately 1.83 kg of carbon dioxide, and hence this can contribute significantly to alleviating the carbon footprint of industrial manufacturing processes. The ability of microalgae to assimilate nutrients and other constituents present in effluents can also be employed in the bioremediation of wastewater. It has also been reported that microalgae could successfully remove heavy metals, dyes, and other toxic compounds from wastewater through adsorption and biodegradation.

“ Developing sustainable microalgae-based biorefineries is another line of research undertaken by the group. This is to be achieved through the integration of target metabolite production and microalgae-based bioremediation ”

Such integrated microalgae-based bioremediation processes also serve the dual purpose of enhancing the sustainability and economics of microalgal biomass production via waste resource recovery. This is a new paradigm in global research on microalgae, which lies within the framework of a circular bioeconomy. Recently, a study conducted at DCPE followed this concept to successfully inte-

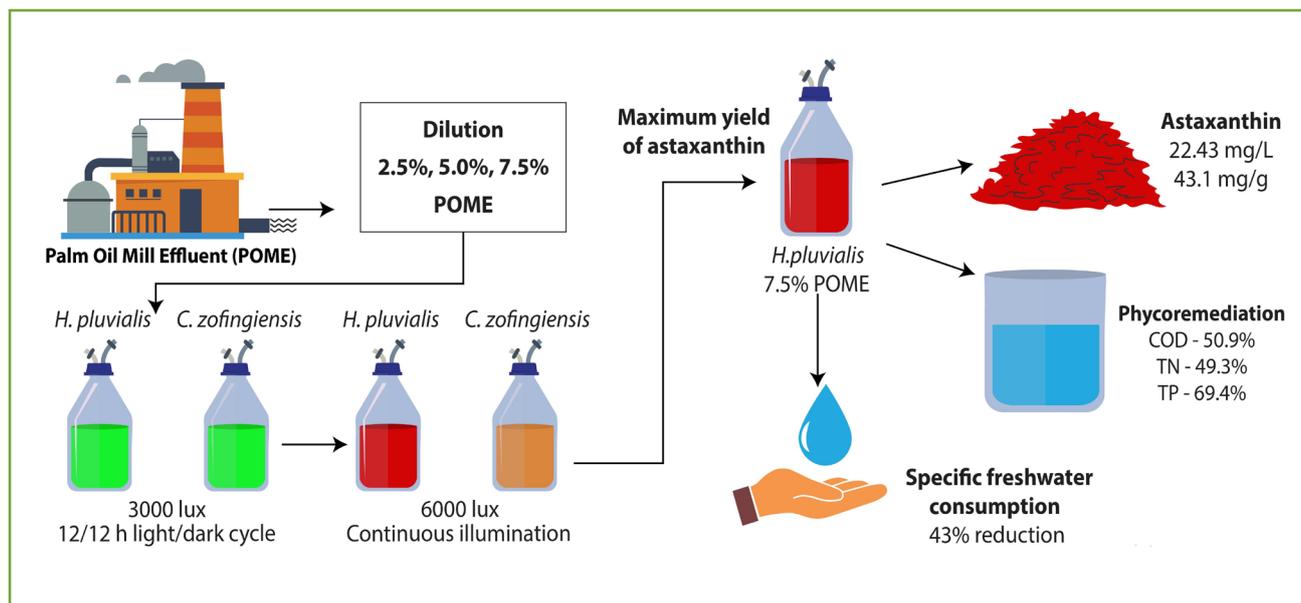


Figure 3: Integrated bioprocess for microalgae-based treatment of palm oil mill effluent (POME) and production of astaxanthin

grate the treatment of palm oil mill effluent (POME) and production of the high-value compound astaxanthin [3], as illustrated in Figure 3. Characterization of POME from an industrial facility revealed high concentrations of total nitrogen (TN), total phosphorous (TP) and low concentrations of heavy metals, indicating its suitability as an alternate growth media for microalgal astaxanthin production. High yields of astaxanthin were achieved while successfully reducing the specific freshwater consumption for astaxanthin production by 43%. The heavy metal content in biomass was within the permissible limits for food/feed products. Furthermore, a moderate performance in bioremediation was achieved, with removal of 50.9% chemical oxygen demand (COD), 49.3% TN and 69.4% TP.

From the research conducted thus far, it is evident that the microalgae is a valuable bioresource with potential applications in biofuels, nutraceuticals/pharmaceuticals, biofertilizer, food/feed industries and bioremediation. The Microalgae Research Group of DCPE conducts research in the field of microalgal bioprocess development with the ultimate goal of initiating sustainable microalgae-based industries in Sri Lanka.

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Article by

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# Use of Videography for Traffic Surveys in Sri Lanka

Traffic Surveys are crucial for different transport studies like Origin-Destination studies, Traffic Volume estimations, Vehicle Flow characteristics Determinations, Speed and Delay Studies, Turning Movement analysis, Parking Analysis etc. Currently, Sri Lankan researchers are using mostly human-based manual surveys and semi-automated methods for Traffic Surveys. However, there is an issue in cost, effort, the value of time, and the accuracy of data gathering in the above methods. Therefore, under Accelerating Higher Education Expansion and Development (AHEAD) grant, we are researching the possibility of doing surveys using videography and Artificial Intelligence technologies for continuous and accurate data collection to reduce the burden that is currently facing.

Using CCTV video cameras, we have done surveys in different locations in Western Province to check

the possibility of implementing the developed system in Sri Lanka. Fig. 1 elaborates the basic setup of the study. Four cameras were used simultaneously for 12 hours in a particular location. Fig. 2 indicates actual scenarios in the field survey.

After data collection from this CCTV video footage, videos are processed through a DeepSORT algorithm for vehicle tracking and customized trained YOLOv4 model for detecting vehicles by vehicle type.

The developed model also provided the individual vehicle speed in addition to the identification of the vehicle type [1]. These speeds are an improvement to Google speeds since it carries the vehicle type too. The classified vehicle count from the custom trained YOLOv4 model has provided better accuracy than on-site manual counting [2], [3].

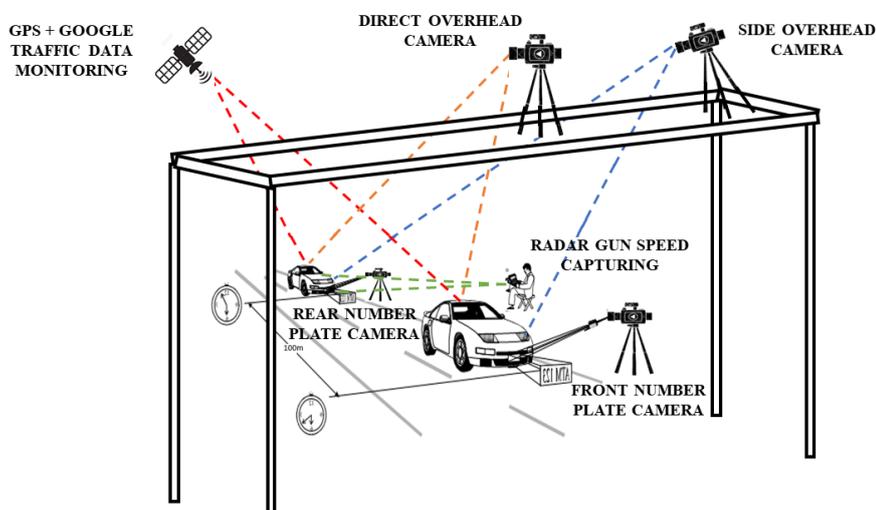


Figure 1: Camera Setup and orientation



## Materialising Gender-fluidity through Fashion

As the final year comprehensive design project for the Honours Degree of Bachelor of Design, Department of Integrated Design, Faculty of Architecture, University of Moratuwa, I have selected a project which is based upon my own clothing brand. It is an emerging ready-to-wear clothing brand based in Sri Lanka, which was launched in August 2020 through the Colombo Fashion Week named "HARID". Currently, HARID retails at the Design Collective store in Colombo for a consumer group based upon it. The brand philosophy of HARID is to challenge gender-related stereotypical concepts. As the brand identity, HARID uses heritage craft practices.

As the next milestone of a Sri Lankan based clothing brand, I want to expand the brand for an international market to get a better global brand presence as well as to open global retailing opportunities.

According to the brand philosophy, I have considered "Gender-fluidity" as the next initiation for the concept. A Gender-fluid person could be either more masculine, more feminine, both masculine and feminine, or neither of them. That means their gender identity or gender expression shifts from time to time. When a person has more masculine gender expression or identity, that means that person has more masculine qualities compared to feminine qualities. Even though masculine and feminine qualities may differ from context to context, there are universal masculine and feminine qualities defined by the World Health Organization.



“ Even though masculine and feminine qualities may differ from context to context, there are universal masculine and feminine qualities defined by the World Health Organization ”

Since my goal is to expand the brand into an international market, by using an online survey among the Facebook group which is "Gender-Fluid", I conducted an online survey and gathered geographic, demographic, and psychographic attributes of them. As further research, I interviewed a London based fashion designer "Eden Loweth" through Instagram. From the research study I was able to find out their overall silhouette preferences as well.

As a Sri Lankan based designer who is aiming to reach the international market, I wanted to incorporate Sri Lankan essence, and so that I researched about the philosophical background of Sri Lankan clothing. I was able to find out that Sri Lankan traditional attires, which are "Mulu aduma" and "Ohoriya", have been influenced by foreign culture, yet adopted according to suit the local context as dynamic and hybrid entities. Therefore, I have used that rationale in developing my collection.

After a comprehensive research, I have selected to expand the brand through London Fashion Week, since it has different platforms for upcoming designers and brands, supports gender-related concepts and can show off brand stories. London Fashion Week has different designer application categories. After personally contacting the British Fashion Council, which is the mother company of London Fashion Week, they suggested me to go through the designer application category, "Digital Profile" based on the status of my brand.

According to the brand identity, for this collection I have used local hand weaving as the heritage craft practice since, London Fashion Week also encourages designers to use ethical and locally manufactured materials and as well as I can promote it to the international audience with a contemporary approach. Therefore, I have materialized the initially identified masculine and feminine qualities by experimenting different types of local hand weaving techniques with different yarn types. With the initial experiments I have selected plain weaving, "pick-up motifs" technique and "gatapismenthu" technique to execute this collection.

As the colour palette, I have selected black and off white since, they are neutral and hence there



would not be any biasness towards either masculinity or femininity and as well as I can highlight the technique. This collection can be used as an inspiration to come up with more wearable clothing for people who identify themselves as Gender-fluid.



Article by

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Consumption of chilled water stored in a PET bottle multiple times:

## ARE WE QUENCHING THIRST OR GULPING PHTHALATES?



### Another Pandora's box opened:

The statistics forecast that the production of polyethylene terephthalate (PET) bottles worldwide in 2016 was about 485 billion, and the same in 2021, has been approximately 583 billion. Although such productions in many countries have the ear of prominent political and social leaders, high production rates still reign the global market. In parallel, revered scientists globally conflate plausible and incontrovertible medical canons against the use of PET bottles for the protection of public health. Nevertheless, the unwashed masses worldwide dislodge or disparage such public health doctrine but face a myriad of health hazards. For many years, mainly beneath the public's ignorance, the solid collective rhetoric expressed by PET-bottle manufacturing companies has not let such medical dogma take hold in the society, instead purposefully manipulating the market with conflating pure baloney or fallacies.

One of the firmly believing health-related doctrines against the use of PET bottles would be the migration of phthalates – commonly added as plasticizers to PET during manufacturing. Since the phthalates are not covalently bonded with the polymers that make up the plastic bottle, phthalates could easily detach from the bottling materials and migrate to bottled water un-

der adverse environmental and storage conditions. Phthalates composed of high molecular weights (e.g., di(2-ethyl-hexyl) phthalate - DEHP) are suspected carcinogens and are toxic to organs such as the liver and kidneys. Further, phthalates are lipophilic compounds with increased solubility in lipids, which enhance the adverse effects on human organs. Such compounds and their metabolites can, on the other hand, induce detrimental effects on the reproductive system with negatively affecting semen volume and positively affecting sperm malformation.

Despite such health hazards, quenching thirst with chilled potable water stored in PET bottles has been a global scenario, particularly in tropical weather conditions. In many developing countries, people reuse PET water bottles many times because of convenience, ease, and scarcity of light-weight water carrying containers. Further, the lack

“ People often consume chilled water stored in the same PET bottles multiple times, and practice of this kind is observed with a majority of the working population, particularly in Sri Lanka ”

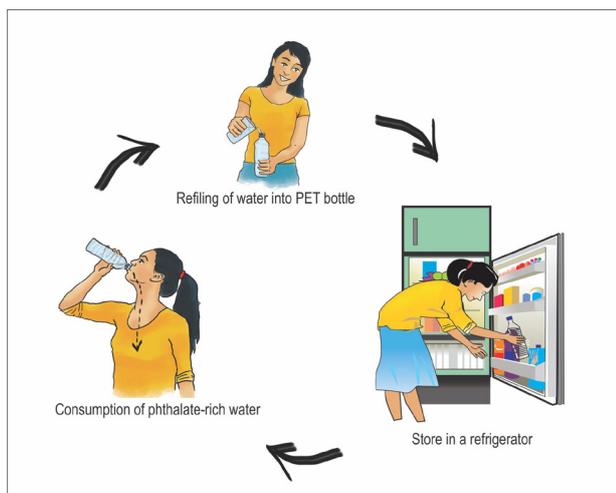


Figure 1. Cycle of refilling potable water into a PET bottle

of awareness on the associated risks of reusing PET bottles does not prevent people from practicing such unhealthy efforts. In many tropical countries, the prevalence of prolonged high temperatures associated with elevated humidity levels persuades people from consuming chilled water to quench thirst. People often consume chilled water stored in the same PET bottles multiple times, and this practice is observed among a majority of the working population, particularly in Sri Lanka (Figure 1). Such a phenomenon has not yet been investigated in detail; hence, this study.

Our line of actions – something that has never been experimented by anyone

We obtained the PET water bottles of two commercial brands (500 mL) available in the local market, emptied the water in them, and refilled them with phthalate-free potable water from a shallow dug-well. Two desired temperatures ( $27 \pm 2$  °C and  $4 \pm 2$  °C) were selected for the study based on the common practice of reusing the PET bottles in Sri Lanka (One to simulate the ambient temperature and the other to represent chilled conditions). After six hours of contact time under each temperature condition, refilled water in bottles was taken out, and a liquid-liquid extraction method was followed to extract the phthalates from the respective water samples. The bottle, as mentioned earlier, refilling and the phthalate extraction procedure was repeated for additional five consecutive identical reuse events using the same phthalate-free water in triplicate. After each reuse effort, refilled water was emptied from the PET bottles, and they were air-dried before the next reuse event. During every reuse event, a control experiment was also conducted in triplicate using glass bottles refilled with the same well water to confirm that the water used to refill the bottles during the experiments was not contaminated with phthalates. We then analyzed six phthalates: DMP, DEP, DBP, BBP, DEHP,

and DnOP using a Gas Chromatograph coupled with Mass Selective Detector (GC/MS). We also investigated the possible changes of main functional groups of bottled materials during the refilling and reuse events using Fourier transform infrared (FTIR) spectroscopy. Further, we were inquisitive to investigate the possible spillover of materials from the bottles under each reused event using a Scanning Electron Microscope (SEM). We did not forget to estimate carcinogenic risks associated with the whole experiment.

### Our disclosure – a smoking gun or a technical critique

Among six phthalate compounds tested, only DEHP was detected in the levels greater than the detection level for every reuse event. Our results manifested copious traces of DEHP in both brands after every event of reuse (Figure 2).

In the practical sense, what it triggers is that when a healthy person consumes 3.0 L of chilled water for a given day, he will ingest about 74.4 and 96.6  $\mu\text{g}$  of DEHP from brands 1 and 2, respectively. Assuming a person with a bodyweight of 25 kg (probably, a child) consuming chilled water, if we put these levels in the form of comparable norms with permissible levels, these values then come down to 3.0 and 3.9  $\mu\text{g}/\text{kg}\cdot\text{bw}/\text{day}$  for brands 1 and 2, respectively. Conversely, most European and North American countries report that DEHP levels in bottled water, when used only for one time under different storage conditions, are incredibly lower ( $<0.2 \mu\text{g}/\text{kg}\cdot\text{bw}/\text{day}$ ). In contrast, the tolerable daily intake (TDI) for DEHP established by the European Food Safety Authority is 50  $\mu\text{g}/\text{kg}\cdot\text{bw}/\text{day}$ , which is estimated for a bodyweight of 70 kg. One can be complacent that this scenario guarantees that no acute health hazard is plausible by quenching thirst with

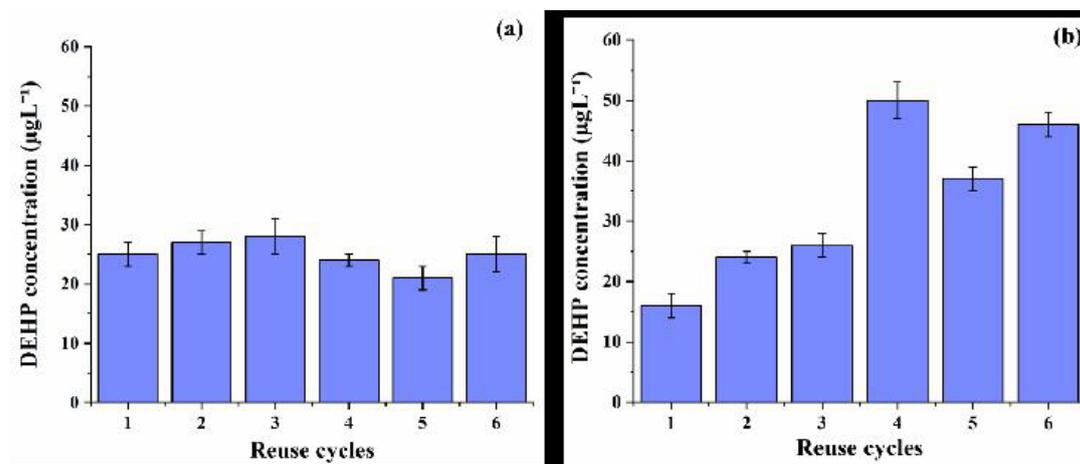


Figure 2. DEHP levels in refilled water in PET bottles of (a) brand 1 and (b) brand 2 after each reuse event with chilled water at  $4\pm 2\text{ }^{\circ}\text{C}$

chilled water stored in PET bottles. However, this hindsight from today's perspective is conspicuously inconclusive, and there exist many yawning gaps in understanding the biochemistry of such material and their fate at the human cell level.

Another argument that can be laid out is that micro- and nano-plastic particles are detached from the inner walls of the bottles when subject to repeated temperature-drop events. Figure 3 shows tell-tale signs of such detachments from the inner surfaces of both brands after six rounds of reuse events. Such detachments were also confirmed

with FTIR spectra by way of diminishing functional groups of virgin PET bottles (data not shown for the brevity of this feature article).

Our assertions mentioned above then become ludicrous and need to be revisited because the actual DEHP ingested in dissolved form is attributed to another fraction of solid form, which we have stunningly underestimated or unknown. Our simple scientific critique is that, in total, one may gulp DEHP in higher quantities than one may imagine at all, with actual health consequences being far more severe. In pursuit of this mind-boggling rid-

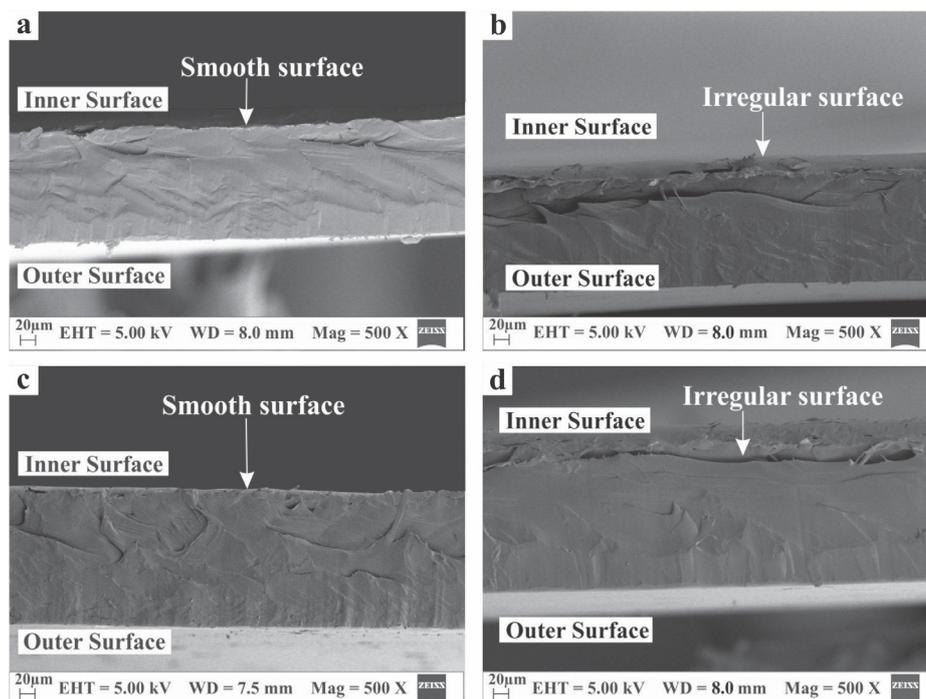


Figure 3. SEM cross-section morphologies of brand 1 (a) before reuse (b) after six consecutive reuse events with water at  $4\pm 2$  °C and of brand 2 (c) before reuse (d) after six consecutive reuse events with water at  $4\pm 2$  °C

dle, one has to establish the maximum DEHP levels inserted in manufacturing PET bottles. The chronic cancer risk evaluation revealed that there is no incontrovertible evidence on the likelihood of inflicting cancer. Still, yearslong consumption certainly creates an inkling in one's mind to do away with such habitual practices.

### Our message to the society – a stirring rallying call

A defining mark of any good piece of scientific work would be going to great pains to establish a story that would uncover the crux of the unknown enigma, at least with reasonable conjectures than throwing out thick clouds of obfuscation. We, with this study, observed a stirring rallying call against the consumption of chilled water stored in a PET bottle multiple times. Our findings asserted that the reuse of empty PET bottles multiple times for chilled water storage should be averted altogether. The daily phthalate ingestion by a Sri Lankan is more than ten times the same recorded in developed countries. We, therefore, constantly ensue a high-stakes uproar against the use of PET bottles for storing any beverage in Sri Lanka. Our humble request for the scientific fraternities of this

country is to remain proactive against the use of PET bottles rather than largely being off-limits. We, then, only believe that the beaming light will shed to stem the infusion of PET bottles into the Sri Lankan market – even not a single bottle in a remotely located, scruffy boutique in sight – in the foreseeable future.

Article by

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# BOLGODA CHAT

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## *Crossing the borders in his own way.....*

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An interview with  
Emeritus Professor P A De Silva

### *The Start of the journey*

My first school was Patuwatha Seelakkanda Sinhala School. Instead of my mother or father, my grandmother took me to my first school. Then, I was enrolled in Hikkaduwa English School. From there, I transferred to Panadura Sri Sumangala because I wanted to study in the science stream, and I passed my SSC exam (GCE O/L nowadays) with a first division pass from that school.

I had to transfer to Ananda College after that, since I wanted to do engineering for my HSC studies (GCE A/L). The entrance was through a competitive exam. While applying for that, I also applied for the Technical College. Most people told me to focus on one thing instead of trying to do both. However, Senator D.W. Perera (the Vice Principal of Sri Sumangala) had the faith that I could succeed in both. Therefore, I studied at Ananda College in the morning, while studying Mechanical Engineering 1 and 2 at the Technical College in the afternoons. By the time I gained university entrance, I had passed both ME1 and ME2 and also completed a workshop course.

There was only one faculty of engineering at that time, and that was on the Thurstan Road, at the University of Ceylon. Those days, engineering faculty papers were shipped off and graded in London by examiners there, and that was how we obtained IMechE recognition. I was recruited to the CTB after the completion of my bachelor's degree and was sent to the Rathnapura depot. Then, I was asked to go to the Kurunegala depot and to be a "trouble-shooter". Later I was posted to the Werahera Central Workshop.

## *The turn*

### Early days in the University

IPT gained university status in 1972. However, in 1966 we had received a status equivalent to a university, under the name "Ceylon College of Technology". I remember one interesting incident from that time. The first vice chancellor was Dr. Upali Kuruppu. I was responsible for selecting Junior Technical Officers (JTO), and these were highly capable students who had missed engineering by a narrow margin. There were around 80 deserving candidates, and we were only admitting 40. Late Prof. Patuwathawithana and I (we were both young and junior staff members at that time), approached the administration to request an increase in the intake. Indeed, we had space to accommodate. There was a fear that, if we produced more, there will be no demand. The University of Ceylon was thus unwilling to increase the intake beyond 25 students. Finally, we managed to increase the JTO intake from 40 to 60. The JTO students were very capable. Prof. Patuwathawithana and I started to teach IMechE part II subjects to them. While I taught Heat Engines and Materials, he used to teach Thermomachines etc. Some of them went on to become chartered engineers, and that too paved the way for the Ceylon College of Technology.

At that time, this area was not called Katubedda but known as "කුඹි කැලේ" (ants' forest). There used to be an infectious disease hospital in the same location as the present-day the university. No one dared to be on the



Emeritus Professor P A De Silva

"The car exceeded 35 mph, yet over 95% of the car's components were developed in-house. We drove it around, even displayed it in exhibitions. We believe this was the first car in the world to use regenerative braking technology"

Electric car being assembled at Mechanical workshop ▼





Electric car on a test drive in Moratuwa.

roads after 6.00 p.m. On my way home from Werahera CTB, I took the Moratumulla road bypassing koombi kale. Sumanadasa Building was the first multi-storey building put up for the University. It hosted the Architecture department on the top floor, and Mechanical engineering on the first and second floors.

## *The landmarks*

### Memories from career

It was 1977, I was 42 years old and was preparing to go on sabbatical. Right at that time, the president J. R. Jayawardene appointed me as the Chairman of the Ceylon Steel Corporation, which was a great place for a mechanical engineer. We completed stage II of the plant, and developed lathe, drilling, and grinding machines in-house. After my stint at the steel corporation, I was sent to the State Hardware Corporation. I was the one who introduced the "Lan-Lo" (ලාන්ලෝ) mamoty. Remember, at that time we did complex calculations on a 16 kB ZX 81 computer. Later, they gave us a 48K spectrum computer, and we designed a 50 MW steam plant using that. Such was the capacity of the best computers of that era.

I developed a fully electric battery-operated car at the University. The project was started in 1970s. The car exceeded 35 mph, yet over 95% of the car's components were developed in-house. We drove it around, and even displayed it in exhibitions. We believe this was the first car in the world to use regenerative braking technology. Had we done it in large scale, Sri Lanka would be exporting electric cars to the world. We also developed windmills, gem cutting machines, and equipment for boiling and drying rice in Sri Lanka.

The CAD CAM centre of the Department of Mechanical Engineering was opened during my time. I retired from the Department in 2001. However, I did some visiting lectures until recently. I also served as the chairman of the Ceylon German Technical Training Institute.

## Memories elsewhere

I bought my Morris Oxford in UK for £600 which was not bad when compared to the price of a calculator, £100! I drove it all the way back to Sri Lanka with my family. We crossed 12 countries, bypassing Afghanistan. All those lands were quite peaceful at that time. There were long stretches across the desert without human habitats. The desert had sandstorms that were quite dangerous, and we never left the beaten track out of caution. At the Pakistani border, we were recognised as "Mrs. Bandaranaike's people" and they treated us amazingly well with a lot of respect. Such was the respect towards Sri Lankans at that time. After a long & adventurous journey across different lands, we arrived in Sri Lanka. As soon as the car was pulled out from the ship, we saw thieves trying to steal the parts of the car.

There are many unforgettable people who I met during my time. Late Prof. Patuwathawithana especially was a very good friend and was like an elder brother to me. He had a courageous and inspiring personality. He used to give me a lot of advice, especially about not getting personally involved in political conflicts.

## Now...

### Driving forward....

I am still engaged in several projects and developments with the support of my son. I developed an electric harvester that can also be converted to a plough. I am planning to prototype it at the Ceylon German Technical Training Institute once the pandemic situation is resolved. Today, I am thinking of developing a machine to fight COVID, by purifying air through compression instead of direct heating. Another idea in my mind is the development of a solar powered water pumping technology for irrigation. I am eager to develop the actual prototypes of all these things as soon as possible.

I have written several books in both Sinhala and English languages. My first book is titled "The Lay of the Sinhale" and the last book I published is "Ayesha at the Himalayan Foothills". I also wrote an e-book "Hanuman Tower" about a lady engineer. Now I am writing a book on Thermodynamics in Sinhala, and I am currently working on the last chapter.



On the way from London to Colombo ▲

## Food for your journey...

### A piece of advice for future engineers and academics

We have progressed since the inception of this university. However, we need to develop "engineers who build" instead of "engineers who import". If we made use of all the theories we learn, we may not need to import. The trend of importing indeed is one reason why none of the Sri Lankan inventions took off.

I feel that Sri Lanka is not a country that cannot be developed but is rather a country that "is not being" developed, and we need to escape from that state. We need to build things within Sri Lanka if we are to develop. We should try to develop scientific equipment for our local use. In the early days, we used to develop many things in Sri Lanka including wheelbarrows, bicycles, and scales. All that was stopped, and now we do not produce any of those things. Even though there is a belief that imported things are "cheaper", what exactly does cheap mean? We should not look at the short-term costs but should rather focus on developing goods locally in order to gain true long-term benefits.

<https://doi.org/10.31705/BPRM.2021.90>

### BOLGODA CHAT

Interviewed & transcribed by  
Hirushie Karunathilake & Sanjeeva Witharana

# Curating Kandyan Traditional Clothing in the UNESCO world cultural heritage in Digital Paradigm

Historical notions of cultural values in the heritage sector have been identified by holders of curatorial expertise based at institutions with large collections of artifacts. However, the rise of new digital technologies has facilitated not only active two-way engagement with heritage, but also a broadening of what we mean by heritage and how it can be accessed, through the co-production of exhibitions, oral histories, and other forms of display and archive based on personal remembrance, recollection and interactivity.

Costume history collections are critical for preserving and understanding past and present costume diversity because they reveal the structure of historical costume communities and how they have changed through time. Yet, noticing a lack of research on preservation of traditional costumes, the research team at the Fashion Design & Product Development Degree Course came forward with the 3 video documentaries to bridge the gap. The research outcome was producing three documentaries based on the research project of preservation of the Kandyan traditional dress through digital media. These video collections provide us with an insight into past and present draping clothes on the human body, acting as snapshots of unique dress forms of Sri Lankan culture. These videos can be used to inform future conservation of varieties of unique dress forms and diversity as we know it today.

These documentaries help researchers to see how communities have reacted to previous cultural occurrences, providing significant insight into future outcomes and ensuring that costume diversity is protected. There is a probability to assume that these videos may be integrated into the global visual costume databases. The researchers attempt to visualize the selected costumes discussed in an angle of a designer, signifying technicality of the unique draping technique of our culture enabling to improve sustainable design concepts for fashion designers in order to allow them to understand how its pieces of yards of cloth give life to the rhythm of the human body. The costumes that are interpreted in the videos provide important teaching material, expand opportunities for researchers and improves understanding of diversity of cultural costume.

Documentaries





**FASHION PRACTICE**  
**Space and Drape in Tradition**  
**FASHION PRACTICE:** Uncovering a long heritage of a fashion practice, 2 hrs and 28 minutes. Fashion practice presents especially the WES COSTUME and how the body's spaces encompass rhythmic draping technique and make dramatic dress form has never been discussed in an angle of a designer, however its pieces of cloth give life to rhythm.

Figure 1. Cover pages of Video Documentary 1 : Fashion practice

### Recording the past

Kandyan dress has been up to now preserved and carried ahead by traditional Kandyan elites as well as the dancers and drummers of the commoners or lower service castes who were bound for the traditional professions under the feudal system that ended with the colonial rule. The changing socio-economic forces in the country bring about the rapid disappearance of these caste-based professions and this transformation affects the prevalence of traditional families and rajakarya system [1] (compulsory service and a duty to the King based on feudal tenure system) that transmit the Kandyan traditional dress from generation to generation.

Since the introduction of the open market economic system to the country in the 1970s this situation has aggravated and the descendants of these people and families do not adhere to their traditions any more. On the contrary, some dress forms have now been either shortened or filled with innovations since the traditional forms have wholly disappeared, there are no any initiatives for conservation of traditional clothing from both museum and visual documentation intervention in the country [2]. The need for conservation of this traditional dress form in video format is necessary for future generations of the country to witness the current tradition faced with the risk of extinction.

In this context, preservation of traditional Kandyan dress has to be undertaken very soon as the present generation is undoubtedly the last generation of practitioners. The need for preservation of this traditional dress in video format is necessary for future generations and its visual exploration is very much critical before the tradition and contexts fade away along with the immense treasure of the cultural heritage. This type of video documentation can be considered as a practice of visual ethnography to construct understanding of the world based on visuals, processes and experiences rather than on abstract knowledge thought induced or language-based [3]. As highlighted by Kalay[4] preservation of cultural heritage through video documentation is a 'new approach for the pedagogical attributes in documentation and management, representation techniques, dissemination of knowledge and awareness generation' In this study these attributes are tested and accomplished through gaining an understanding of the problems and concerns associated with planning and conducting such an ethnographic video documentation as this hands-on approach always creates unpredictable conditions and situations.

### The notion of the research: Ethnographic Video Method

The strategies of collecting, sorting, categorizing, analyzing, retrieving and presenting information



Figure 2. Cover pages of Video Documentary 2 : Dignified bodies



**DIGNIFIED BODIES**  
 Extravagant Volume and Wrapping Techniques in Kandyan Elite Costume  
**DIGNIFIED BODIES:** brings to light a heritage of the incomparable beauty of the country's upper class dressing up style, 2 hrs and 28 minutes. **DIGNIFIED BODIES** cast the system of elite dressing styles and admit its dress forms and etiquettes are subjected to established social stratification, yet to preserve cultural heritage. This is an attempt to preserve the dress tradition of Sri Lanka which continues to this day.



Figure 3. Cover pages of Video Documentary 3 : Ceremonial bodies



**CEREMONIAL BODIES**  
 Cloth Wrapping and Draping systems in Tradition  
**CEREMONIAL BODIES:** cast insights of social contribution of artisans and officials who served in the Temple of the Tooth Relic where the prerogative powers, and obligation visible through a distinct form of official costumes which prevails hereditary during feudal system in Kandyan era 2 hrs and 28.

through ethnographic video methods are very much complex. The whole process of the research cannot be undertaken by a single person. It is time consuming and expensive more than any other content medium or method, but it is often the most effective. The cost however depends on the type of video, the location, subject to be video graphed, production crew, equipment, post production etc. This method always requires complex technology and expert crew to produce artistic and archival video documentation. Final outcome, the rendered work of a video documentary should be in an artifact form to create a lasting presence of cultural heritage for what would otherwise be ephemeral. It will become central in visual cultures' investigation of memory and history. Through this study, the video archives will conserve records of the full process and the paraphernalia involved in the Kandyan traditional dress forms such as accompanying rituals, accessories and decor used and the process of making and wearing the dress. It then becomes a mode of a portrayal of people's lives in a historical perspective to preserve facts and artifacts of a cultural heritage. This is a

tremendous task of situation oriented and ethically challenging. The outcome of this can entirely depend on the researcher's knowledge and perception but affects the whole subjects of the study.

#### Findings of the cultural dress today: A philosophical viewpoint

The research found that the traditional dress is subjected to concurrent socio-political factors. Development features on dress challenge its definitions. It was observed, some modifications of the dress features. It has been found that due to globalization and technological advancement the community experiences economic changes and it affects losing purity and authenticity in traditional dress. Furthermore, it is also revealed that the physical features of the dresses are modified. It was also found that some dresses may have new forms while keeping with the traditional culture. The study revealed that traditional dress is considered as part of a dynamic culture. The dress is accountable to be pretentious by the changes that happen inside culture. Meanings and usage of traditional dress therefore change with the passage of time and reconstruction and re-packaging of ideas about culture.

**Research paper publications:** The researchers of this study have presented 2 two papers in 5th International Conference on Emerging Trends in Academic Research (ETAR) Bali, Indonesia in 2018 signifying the importance of preserving traditional dress in the context of faith and beliefs of Sri Lanka.[5][6]. There is another research paper published in refereed journal informing the relevance and need of preserve the cultural heritage in videography.[7]

**Acknowledgement:** The researchers would like to give gratitude to the stakeholders of preserving traditional Kandyan costumes, who are the towering pillars of the success of this massive ethnographic research. They include the lay custodian of the Temple of the Tooth Relic Kandy, hereditary dignified officials, hereditary dancers and the instrument players of Maligawa thewawa (an official ceremony), elite families who had direct link to the predecessors of lay custodians of Temple of the Tooth Relic, and the elite family members who had lineage to the last King of the Kandyan era.

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Article by

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# INCREASING THE POLITICAL INVOLVEMENT AND POLITICAL LITERACY OF SRI LANKAN YOUTH

## A Communication Design Aspect

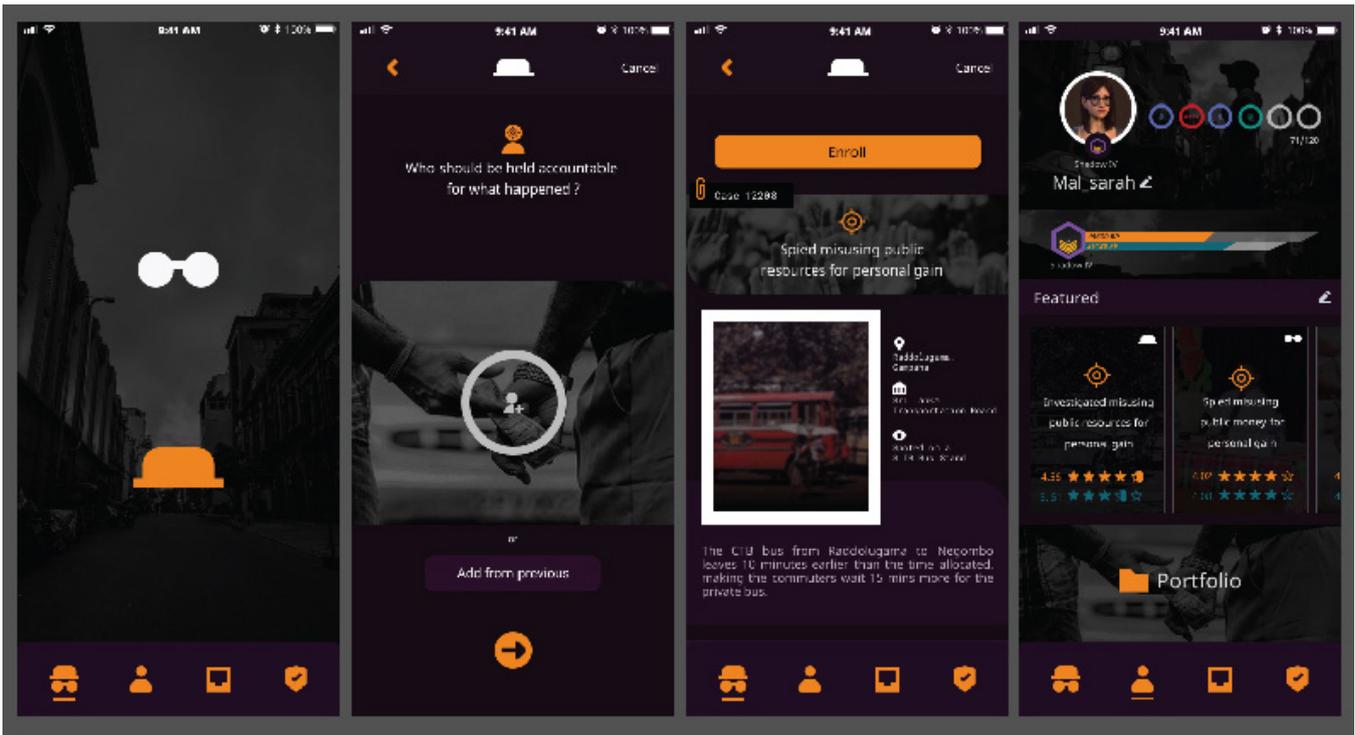
The majority of the younger generation of Sri Lanka in particular have a very low regard for the whole subject of politics. The reason for this has been the political dysfunction that they witness in their day-to-day lives. The most common dialogue they hear concerning politics is one where the older generations acknowledge that the political landscape is an utter mess.

This has created an unsavory attitude among the younger generation towards politics. Hence, they feel little or no necessity in pursuing knowledge about the existing political climate and its intricacies and how it affects their own fate and the future of Sri Lanka. This is not a very promising situation for the country as the next generation is unavailable and unable to make sustainable and rational political decisions for the betterment of Sri Lanka.

To address this critical scenario, the essential political literacy component, or the skill that a youngster in Sri Lanka should possess was identified as the "Democratic Literacy". Democratic Literacy is the ability to analyze and evaluate political situations in a democratic setting or simply a democratic system. This includes analyzing and identifying undemocratic trends and democracy violations of the society and acting with integrity towards overcoming these issues.

Through narrative inquiries done with new voters it was identified that they do not have a clear understanding about the true meaning of democracy. To add to this, it was identified that they are influenced by the undemocratic patterns. The authoritarian trends and shifts that can be identified when looking at the Sri Lankan political climate and the perception about democracy among Sri Lankans being not very accurate in political terms could be identified as examples of these patterns. The youngsters who are influenced by these undemocratic patterns of the society enter the same loop of unjustifiable political decision making that has happened in Sri Lanka in the past few decades. Hence, to balance this out, the solution lies in equipping the younger generation with essential tools to increase democratic literacy.

“ Democratic Literacy  
is the ability to  
analyze and evaluate  
political situations in a  
democratic setting or simply a  
democratic system ”



Interface of the Designed Application

As a communication designer, when analyzing the methods to equip these youngsters with the democratic literacy, it was identified that there should be a communication system that gives these youngsters the voice in the society to discuss democracy by making politics more accessible and interesting, which provides them with an interactive tool to support their first steps in the journey as responsible citizens who are involved and politically literate.

Based on the testing and research two user groups were identified. The first users were the ones who are likely to be involved in this political discussion and the second being users who are unlikely to be involved in the political discussion about democracy. The proposed solution of the project aimed to provide these users with a mobile based interaction that enables them to practice said required democratic literacy skills, specifically the skill of spotting and analyzing democracy violations in the country. By doing that, this communication mechanism was designed to increase political involvement and the democratic literacy. Through the same mechanism, the option of identifying the accountable authorities for

the democracy violations and exposing them to the society was enabled to raise their voice as a young responsible generation.



**Thimith Rodrigo**

Media and Communication Design,  
Department of Integrated Design, Faculty of Architecture,  
University of Moratuwa,

# iGrasp Robotic Prosthetic Hand



Figure 1. CAD Model of the iGrasp Hand ➤

We are living in an era in which technology is shaping the world at an incredible speed. In this wake, the Bionics laboratory of the Department of Mechanical Engineering of the University of Moratuwa is doing inspiring research to improve the quality of life of differently-abled people. The latest product of this effort emerged as the iGrasp Hand, a robotic prosthetic hand that can mimic the grasping patterns of a human hand.

The focus of the iGrasp Hand is trans-radial amputees, the amputees who have undergone partial removal of the forearm due to trauma or other conditions. Such amputations restrict a person's mobility and activities of daily living, instilling a plethora of challenges that have forced the technology behind the transradial prostheses to shift from merely cosmetic devices to complex, biomimetic devices over the ages. Commercial prostheses such as Bebionic [1], i-Limb [2], and Michelangelo prosthetic hand [3] are a few biomimetic devices that have captured the essence of the human hand to a certain degree.

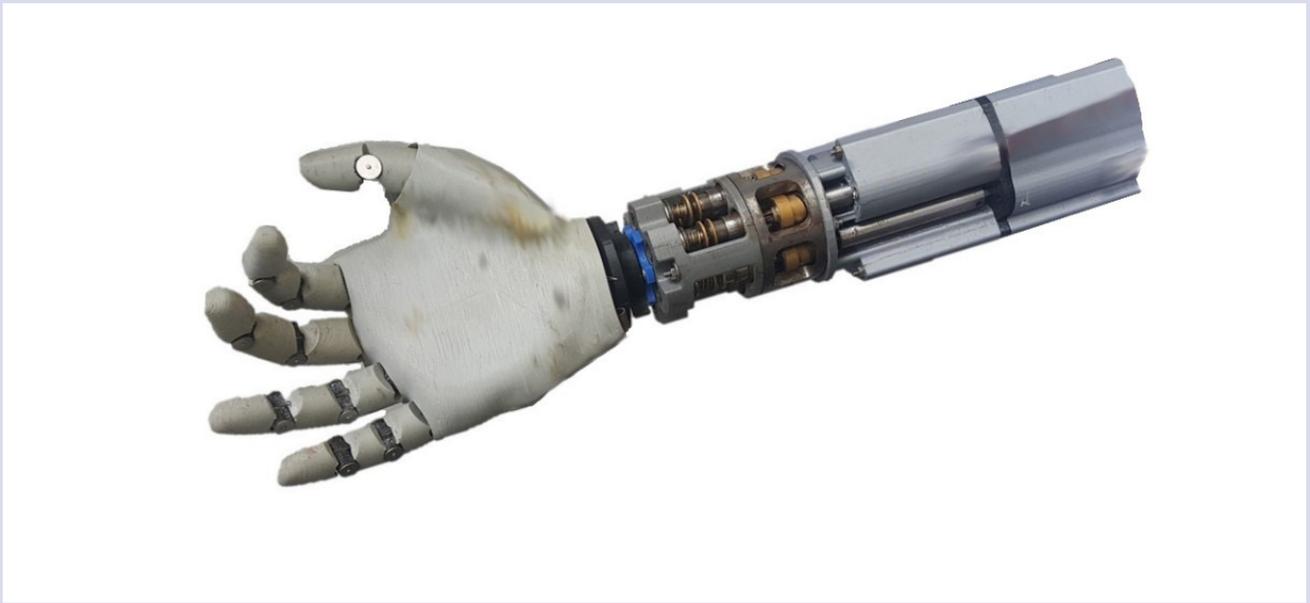


Figure 2. Prototype of the iGrasp Hand

To achieve the anatomical and functional aspects of a human hand, a prosthetic hand should imitate several salient features in addition to the flexion and extension of fingers. Recent research on transradial prostheses has focused on mimicking such features including but not limited to arching of the palm, function of the opposable thumb, and isometric hold of the hand. Yet, noticing a lack of research on devices with all three features above, the research team at the Bionics Laboratory came forward with the iGrasp Hand to bridge the gap.

One of the main features of the iGrasp Hand is its aesthetically attractive appearance resembling the human hand. The researchers have compacted the actuators and related mechanisms at the forearm section of the iGrasp Hand, facilitating the palm to acquire the geometry and the texture similar to the human hand. This has improved the dexterity of the iGrasp Hand.

The iGrasp Hand closely matches the anatomy of the human hand through its finger, thumb, and palm design. While the index and middle fingers of the iGrasp Hand possess three joints mimicking the human fingers, each additional joint at the ring and little fingers facilitates the arching of the palm. Three joints in the thumb of the iGrasp Hand can

“ The motion analysis of the fingers of the iGrasp Hand revealed that the under-actuated finger mechanism can adapt to the shape of the grasping object. ”

provide flexion and extension motions similar to a biological hand, while an additional joint provides the functionality of the opposable thumbs.

The iGrasp Hand achieves motions similar to that of the human hand through a tendon-based operation. Five motors control the flexion-extension motions of the under-actuated fingers and the thumb

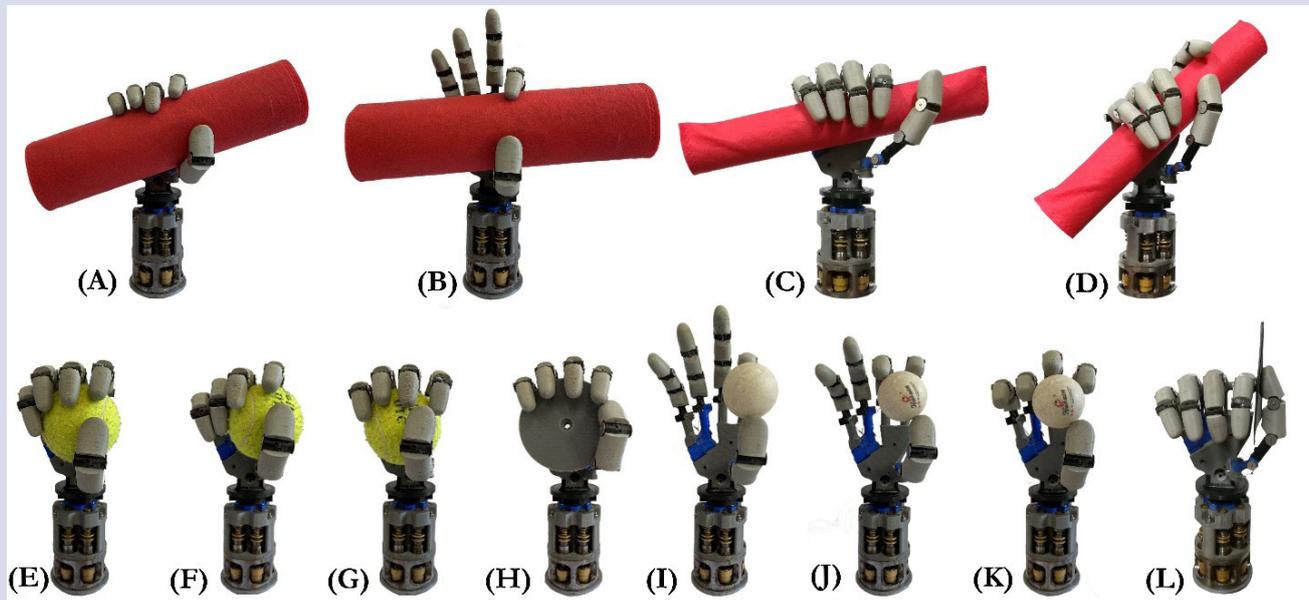


Figure 3. Grasping patterns achieved by iGrasp Hand; (A) Large diameter, (B) Ring, (K) Medium wrap, (L) Index finger extension, (C) Sphere 4-finger, (D) Sphere finger, (E) Power sphere, (F) Power disk, (G) Inferior pincer, (H) Tripod, (I) Quadpod, (K) Lateral pinch.

while a separate motor provides the motion for the opposable thumb function. Additionally, the torsional springs in the designed joints offer the passive stiffness required for adaptive grasping. The users can manually position the wrist joint orientation of the iGrasp Hand with their functional hand.

The research team has introduced a clutch unit for the iGrasp Hand to simulate the isometric holding of a human hand. The one-way-bearings incorporated in the clutch unit act as a locking mechanism that can sustain the grasp without the need of continuous actuation, thus reducing the power usage.

The fabrication of the prototype of the iGrasp Hand was an important step in evaluating the effectiveness of the designed prosthesis. The research team used the hand of a person matching the 50th percentile male population to obtain the anatomical structure of the hand and the palm geometry. They utilized these data to 3D print the structural components with Polylactic acid and the supple components with Thermoplastic Polyurethane while machining the other related components bringing the final mass of the prototype, excluding the power source, to 1.5 kg.

The control system used, for the proof-of-concept of the iGrasp Hand, includes a model-based controller with closed-loop proportional-integral-derivative (PID) control. An off-board desktop computer feeds the grasp labels in terms of motor rotation angles relevant to each grasping pattern to the microcontroller, which then drives the actuators through an intermediate motor controller. This control system facilitated the generation of motions and grasping patterns required for evaluating the performance of the iGrasp Hand.

During the performance evaluations, the iGrasp Hand demonstrated its ability to perform 12 power and precision grasps corresponding to the grasp taxonomy published in [4]. While the opposable thumb function of the iGrasp Hand supported inferior pincer, tripod, quadpod, and lateral pinch grasp patterns, the arching of the palm facilitated sphere four-finger, sphere finger, and index finger extension grasps. According to statistical analysis on the activities of daily living [5], the iGrasp Hand displayed the capability of performing more than 70% of the day to day tasks.

The research team evaluated the iGrasp Hand in terms of the Anthropomorphism Index of Mobility

(AIM), which is an indicator that compares the mobility of a prosthesis with respect to that of the human hand. Considering factors such as the degrees of freedom and joints of the prosthetic hand, the ability to control these degrees of freedom independently, and the topology of the whole hand [6], the iGrasp Hand presented an AIM of 40%. This is comparable with the commercially available robotic prostheses such as Michelangelo, Bebionic and iLimb whose AIMS are 14%, 40% and 45% respectively.

The motion analysis of the fingers of the iGrasp Hand revealed that the under-actuated finger mechanism can adapt to the shape of the grasping object. During the test conditions, the proximal digits of the fingers touched the cylindrical object first and then the distal digits came into contact by increasing the angle at the distal joint of the finger. This verified the ability of the iGrasp Hand to achieve adaptive grasping.

The research team further evaluated the power usage of the hand during the grasping and isometric hold positions. The results revealed that the current drawn by the actuators drops to zero at the isometric holding positions, thus verifying the power reduction capabilities of the iGrasp Hand.

The researchers at the Bionics laboratory of the Department of Mechanical Engineering have published a full account of the design and evaluation of the iGrasp Hand as a conference paper presented at the 2021 Moratuwa Engineering Research Conference [7].

iGrasp Hand is one research from many similar works done at the Bionics laboratory. Over the years, the undergraduate and graduate researchers affiliated to the Bionics laboratory have engaged in the development of many types of the upper limb and lower limb prostheses. Additionally, the laboratory has research of various calibre, focusing on the control of bionic devices through biological signals such as electromyography and electroencephalography. Several affiliated research teams have worked on exoskeletons targeting both rehabilitative and industrial applications.

As the research team of iGrasp Hand has proved yet again with their innovative transradial prosthesis design, the researchers from the Bionics laboratory continue research in the field of Bio-mechatronics to improve the lives of humans.

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Article by

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# Urban Food Security of the Colombo Metropolitan Region (CMR) in Covid times

## ▼ Outstation vegetables for CMR (Kotte) during COVID 19 Lockdown



Home Visits: Mobile Vegetable Vendors from Upcountry Nuwaraeliya

## ▼ Interviews with CRFS actors



Author Interview a wholesale trader in Dambulla Economic Centre



Co-Author interview commercial farmer in Welimada & explore the solutions for vegetable logistics in Bandarawela

Colombo Municipality Region (CMR) consists of a highly complex food system that relies on the supply from distant outstations which literally collapsed during the pandemic situation. A requirement exists for empirical research to derive guidelines and recommendations to increase the sustainability and security in the food supply in CMR during a disaster situation.

### Research Objectives

To investigate sources of urban food supply in CMR; identify the impacts for the City Region Food Supply System (CRFS) components during the COVID 19 & recommend guidelines & policies to address problems in the supply side of Urban Food System (UFS).

### Design/methodology/approach

Qualitative thematic data analysis with purposive sampling with 25 respondents and face-to-face interviews were performed at the domicile of the CRFS actors, with many case studies.

### Originality/Social Value

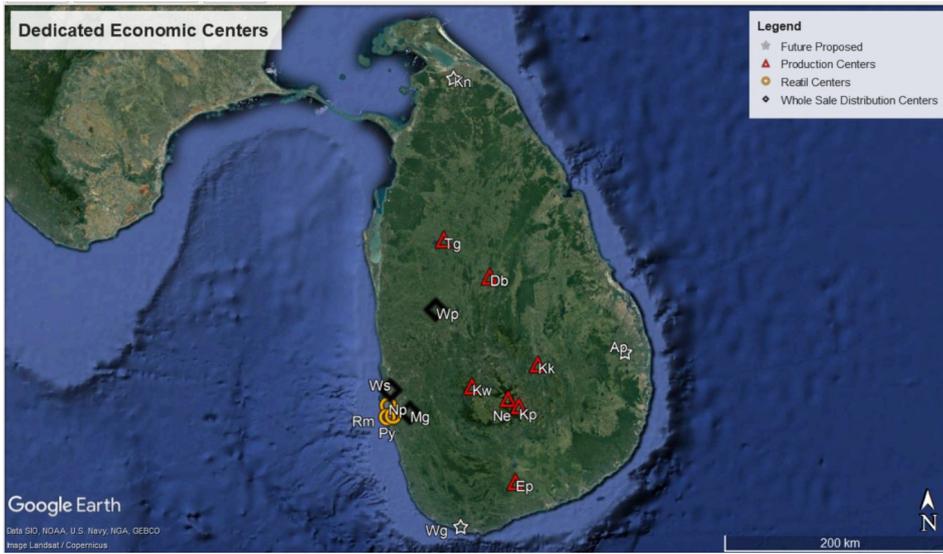
The first study is to use primary data to address the sustainability of UFS in CMR and helping farmers at origins and end urban consumers.

### Findings and Policy implications

#### Sustainability of the food security within CMR,

+ Need some form of central and regional intervention during a pandemic to maintain the supply chain.

+ Alternative sources of food supplies - Peri-urban agriculture, Home gardening, Community farming at Grama Sevaka levels.

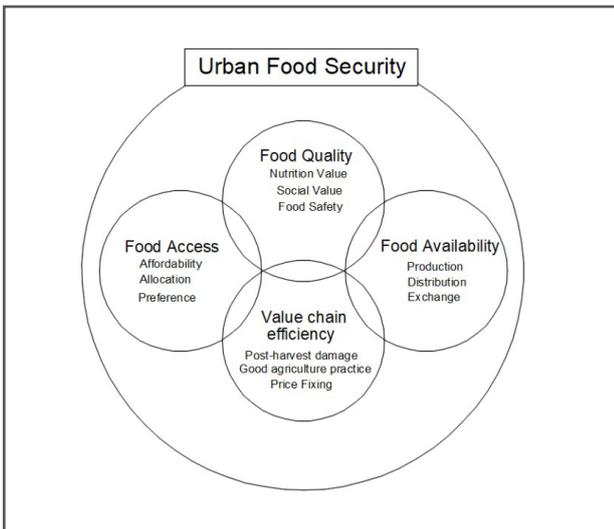


◀ Strategically located 'dedicated economic centres'

Dedicated economic centres in Sri Lanka

Exploiting the price slumps at outstations, converting retail to the wholesale business model during COVID 19 - Narahenpita Economic Center

▼ The study derived Urban Food Security Framework



Author defined UFS framework built upon (Ford,2008)



Retail business switching to wholesale model

▼ Bad transportation - one of the root causes of post-harvest damage



Dambulla Economic Center – wholesale vendor about to transport purchase to Colombo

▼ Key Player in UFS discussion - Price fixing by commission broker damage



Commission Broker (In the middle of the picture) at Keppetipola Economic Center

▼ Refurbish abandoned and unused/under-utilized railway for vegetable transport



Abandoned logistic hub in Bandarawela linking road & railway network

▼ Why the use of Wooden Crates rather than Plastic ones?



Cheaper, practical solution for safe storing & transport

Efficient and effective vegetable value chain,

- Increase connectivity within value chain partners.
- Increase information transparency of demand & supply.
- Encourage traditional 'attam kramaya' which has the character of EOS & resource sharing.

Information sharing platform

- SMS service to communicate with farmers.
- Web platform to communicate with consumers.

Post-harvest damage mitigation,

- Safe sorting & storing.
- Introduce railway for vegetable transport.
- Promote GAP to produce quality products, minimize chemical use, minimize hybrid seed use, create a niche market for organic vegetables.
- Reduce stress on outstation farmers, by urban agriculture.
- Promote Traditional knowledge – ex: maze farming in Guatemala
- PAW- state-of-the-art technology.

Eliminate price fluctuations in the value chain

- A data-driven approach for price-fixing.
- Need an independent authority to determine prices.
- Encourage more alternative trading platforms, ex: Embilipitiya – pola & EC.
- Sorting & grading of vegetables – sorted vegetables need price discrimination to encourage farmers.

Article by

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University of Moratuwa, Sri Lanka.

# ENTC TEAM FROM UOM WON FIRST PLACE IN THE IEEE SP CUP 2021 COMPETITION IN THE ICASSP 21 CONFERENCE

A team of undergraduate students (Team T- Cubed) from the Department of Electronic and Telecommunication Engineering (ENTC) under the supervision of Dr. Prathapasinghe Dharmawansa from ENTC, University of Moratuwa, won first place in the IEEE Signal Processing Cup (SP Cup) 2021 competition at the International Conference on Acoustics, Speech, and Signal Processing (ICASSP) 2021 conference. ICASSP is the annual flagship conference of the IEEE Signal Processing Society which is the world's premier association for signal processing engineers, academics, and industry professionals. This year it was held from the 6th to 11th of June 2021, virtually in Toronto, Canada. The IEEE SP Cup competition is the most prestigious competition in signal processing for undergraduate students. About 50 teams participated in the competition with nearly 300 students from all over the world.

This year's challenge was to develop a control algorithm to configure the behavior of an Intelligent Reflecting Surface (IRS) for wireless communications. An intelligent reflecting surface is a two-dimensional array of metamaterial whose interaction with electromagnetic waves can be controlled. This might be utilized in 6G wireless networks to direct wireless signals from a transmitter towards a receiver to improve the communication performance.

The Team T - Cubed developed a novel and efficient algorithm by leveraging various statistical signal processing and mathematical optimization techniques to achieve optimal configurations with low latency requirements for real world implementations and was able to secure first place in the final round.

Signal Processing, a branch of electrical engineering that models and analyzes data representations of physical events, is at the heart of the modern digital world. For instance, the technology we, use, and even rely on, in our daily lives-computers, radios, videos, cell phones-is enabled by signal processing. It uses advanced mathematical, statistical, optimization, computational, modeling techniques, and algorithms for



The winning team comprises of four students from the second year and four students from the third year of the Department of Electronic and Telecommunication Engineering : Amashi Niwarthana, Harindu Jayarathne, Kithmini Herath, Pamuditha Somarathne, Ramith Hettiarachchi, Tharindu Samarakoon, Tharindu Wickremasinghe, Thieshanthan Arulmolivarman. The team was supervised by Dr. Prathapasinghe Dharmawansa

generating, transforming, transmitting, and learning from signals. Last year's recipient of this prestigious award was the Technion-Israel Institute of Technology, and the second place was secured by UOM. Therefore, this remarkable accomplishment cements the capabilities of the Department of Electronic and Telecommunication Engineering, UOM and hence further enhances its image within the signal processing community in the world.

Link to the video presentation of Team T-Cubed: <https://youtu.be/pnJxF8NjyMs>





## LIFE CYCLE THINKING FOR PACKAGING

Unsustainable packaging practices are one of the leading problems in today's world, leading to unnecessary resource consumption, increased waste generation, environmental pollution, and an overall negative impact on ecosystems. Global statistics show that 8 million metric tons of plastic ends up in the oceans every year. It has been estimated that approximately 79% of plastic produced since 1950 has been sent to landfills or otherwise released to the environment. With the current trends, the United Nations predicts that the plastic content will outweigh the fish in the ocean by 2050 [1].

Plastics used for food packaging accounts for approximately 42% of the global plastic production, and only 5% of these plastics is recycled [2]. Packaging waste accounts for 30%-35% of municipal solid waste in industrialized countries and food packaging contributes over 60% of the packaging waste [3]. Food packaging has multiple purposes including containing, marketing, protecting, and preserving food while also communicating essential

information to the consumers. Unnecessary plastic or other material usage can be seen in packaging for various applications, due to various reasons including aesthetics, poor strength calculation etc. The environmental burden created by plastic food packaging can thus be reduced by improving food packaging designs, providing streamlined guidelines for sustainable packaging, and imposing standards on the food packaging industry.

In the waste management hierarchy, replacement and reduction are identified as proactive strategies for waste prevention and minimisation while reuse, recycle and recovery are categorised as reactive strategies for impact mitigation after the waste is generated. Since food packaging is normally associated with food residues, cleaning is essential which creates an extra burden for reuse and recycling [3]. Thus, proactive measures are preferred. The recent approaches of sustainable food packaging focus on mitigating the overall impact on the environment by using the optimum amount of material while maintaining the other essential functions of packaging [1]. Various mandatory and voluntary policies and initiatives have been adopted across the world to ensure

that the packaging industry follows acceptable sustainability standards.

The existing packaging policies in Sri Lanka focus on restricting material usage. Several progressive guidelines and policies have been introduced during the recent times, such as banning the lunch sheets and polythene less than 20 microns and lunch boxes made of expanded polystyrene. Yet, in addition to minimising material use, maximising water and energy efficiency, using recycled and renewable materials, minimising risks to ecosystems and human health during various life cycle stages, sourcing responsibly, and designing for transport, recovery, reuse, accessibility, and litter reduction have been identified as important strategies in sustainable packaging design. Therefore, a holistic framework based on life cycle thinking is clearly needed in order to truly mitigate the adverse impacts of packaging use, as the environmental impacts are not created merely due to higher material use.

Pollution due to the irresponsible disposal of polyethylene terephthalate (PET) bottles in particular is a major concern for Sri Lanka. PET has

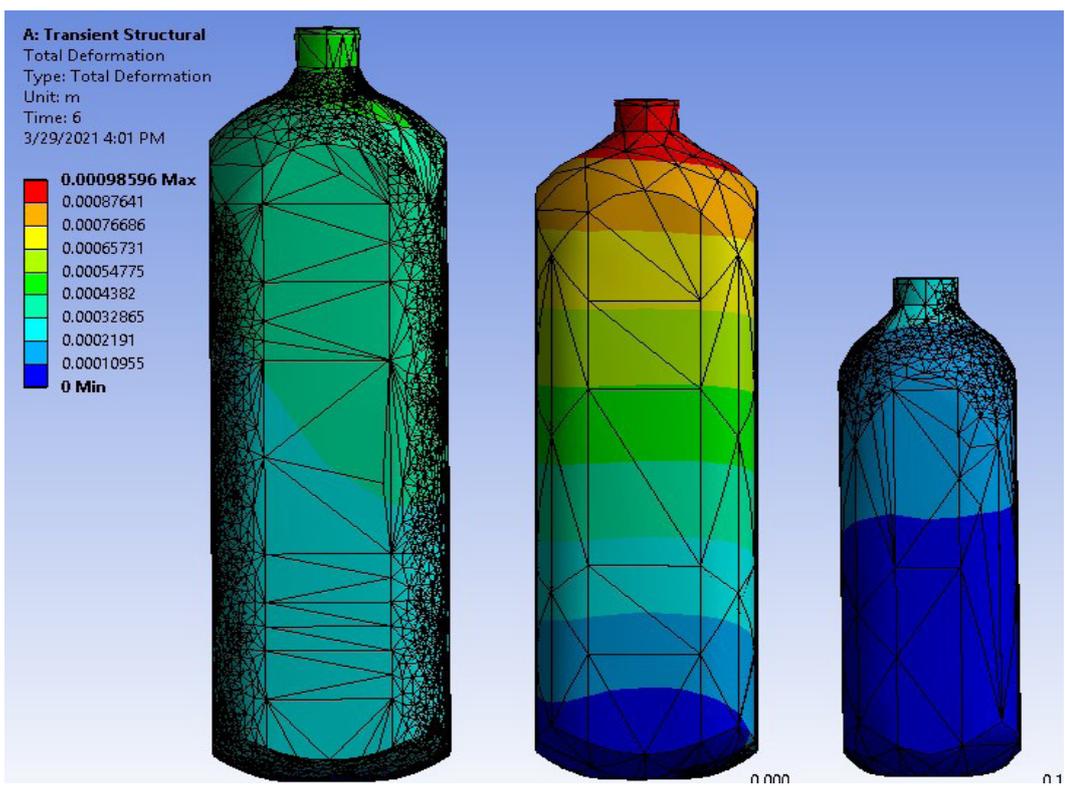


Figure 1: Deformation under calculated force

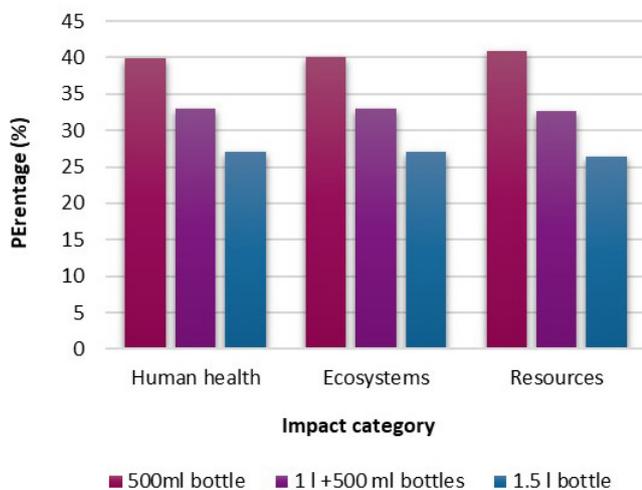


Figure 2: Impact assessment 0303 for the case study of delivering 1.5 litres of water to consumers

a worse environmental performance than high-density polyethylene (HDPE) and multilayer carton packs. It is identified that that the environmental impacts of PET bottles are highest during the assembly and the disposal phases. Redesigning PET bottles for sustainability needs to take structural, environmental, and economic considerations into account.

Considering this need, an initial study was carried out on developing a methodological framework to evaluate PET water bottles in terms of environmental and structural parameters, and to compare their performance based on life cycle thinking. SolidWorks 2017 was used to develop the 3D model and Ansys was used for computational finite element analysis. The structural performance of popular existing PET bottle designs and their stackability were analysed using the simulation results. The environmental impacts of the PET life cycle were evaluated on a cradle-to-gate basis using the SimaPro LCA software. The ReCiPe Endpoint (H) LCIA method was used to identify the bottle design with the highest environmental impacts, for a functional unit of "packaging to deliver 1 litre of water". The results indicated that 500 ml PET bottles have the highest and 1500 ml bottles have the lowest negative environmental impacts from a life cycle perspective, when normalized for a specific volume of the product. However, there is a potential for eco-performance improvement with material reductions for all

"The results indicated that 500ml PET bottles have the highest and 1500ml bottles have the lowest negative environmental impacts from a life cycle perspective, when normalized for a specific volume of the product"

analysed designs, especially with the introduction of rib features and neck redesign.

These aspects need to be stringently studied and incorporated to design guidelines and policies that streamline the PET bottle production in the Sri Lankan market. A policy framework of this nature will be helpful for the food packaging designers, product manufacturers, and policymakers to make decisions on selecting the feasible and most eco-friendly packaging alternative.

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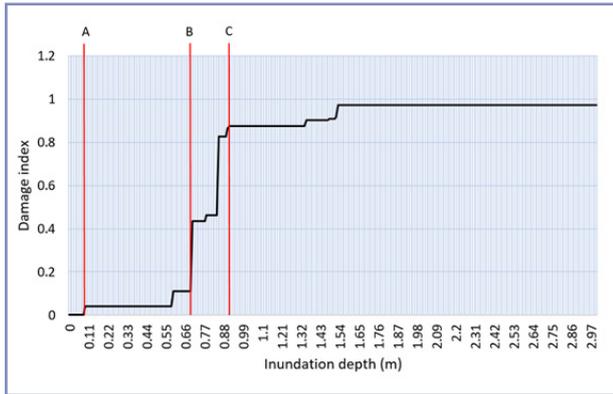
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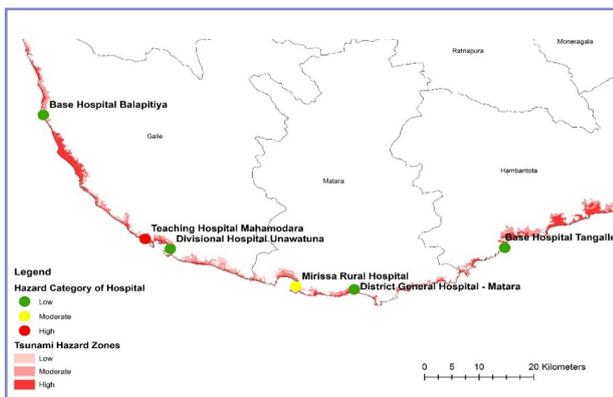
# Ensuring the Safety of Sri Lankan Hospitals: Adaptation of the WHO “Safe Hospital” Initiative to Sri Lanka

As critical infrastructure, hospitals play a pivotal role in the health and well-being of a community. Specially during a disaster, hospitals are expected to treat victims while continuing their day-to-day functions. At the same time, a hospital has to withstand the impacts of the disaster itself while safeguarding patients, staff, and visitors. Therefore, 'Making hospitals safer' emerged as a major concern that is included in global disaster reduction frameworks. The Sendai Framework for Disaster Risk Reduction (SFDRR) 2030 emphasizes the need for strengthening disaster resilience of critical infrastructures such as hospitals. Sustainable Development Goals (SDGs) for 2030 also prioritize the concept of safe hospitals under the goals, Good health & well-being; and Industry, innovation, and infrastructure.

World Health Organization (WHO) initiated the 'Safe Hospitals' programme to enhance the disaster resilience of hospitals. Later, WHO introduced an evaluation tool called the 'Hospital Safety Index' most commonly known as the HSI to evaluate hospital safety. This tool was initially developed for the Latin American Region where earthquakes and hurricanes are predominant hazards. Since WHO provides provisions to other countries for adaptations in this tool if necessary, countries worldwide started adapting the framework into their contexts. In Sri Lanka, the Disaster Preparedness and Response Division (DPRD) of the Ministry of Health prioritized the adaptation of the Safe Hospital initiative to the Sri Lankan context as one of the key strategic areas. In collaboration with the DPRD, a research team from the Department of Civil Engineering, University of Moratuwa conducted a set of pilot studies to evaluate the perception of a 'Safe Hospital' for Sri Lanka and the applicability of the HSI in the Sri Lankan context. Pilot studies highlighted the need for alterations in HSI before applying it in Sri Lanka, thus the research team proposed several adaptations to this tool.



▲ Figure 1: DDF for Premature Baby Unit in District General Hospital Chilaw [9]



▲ Figure 2: Locations of the hospitals selected for the case study to apply SSH-SL toolkit

▼ Figure 3: Pictures captured during the rapid visual inspections in hospitals



“ In Sri Lanka, the Disaster Preparedness and Response Division (DPRD) of the Ministry of Health prioritized the adaption of the Safe Hospital initiative to the Sri Lankan context as one of the key strategic areas ”

The initial step was to develop a framework for Multi-Hazard maps to identify the natural hazards which affect the safety of Sri Lankan Hospitals [1]. Taking a step ahead, a research collaboration named 'HEART-SL' was formed by the Department of Civil Engineering, University of Moratuwa, and University College London (UCL) to strengthen the 'Safe Hospitals' project in Sri Lanka. Multi-Hazard Structural Safety Toolkit (SSH-SL) which can be used to assess the structural vulnerability of Sri Lankan hospitals for natural hazards, is one of the outputs of this research collaboration. It was developed based on a pilot study that was carried out for evaluating the applicability of the PPATHOMA Tsunami Vulnerability Assessment (PTVA)-4 model in Sri Lankan hospitals [2]. Currently, SSH-SL has been validated as more suitable to be utilized in Sri Lanka compared to the PTVA-4 model [3]. The Tsunami Relative Risk Index (TRRI) that quantifies the impact of tsunamis on critical units in hospitals is another outcome of the HEART-SL project [4].

'Safe Hospitals' research team has attempted to address the risk of fires in Sri Lankan hospitals by developing a comprehensive Fire Risk Management Framework for hospitals [5]. In addition to that, the research team has developed a flood vulnerability assessment framework for Sri Lankan hospitals since floods have caused severe damages to healthcare facilities. This framework consists of vulnerability curves that were developed for critical care units in two selected Sri Lankan hospitals. These developed curves consist of three zones named, alert zone [O-A], action zone [A-B], and damage zone [B-C] which can be incorporated in evacuation plans for particular units (Figure 1) [6]. Currently, with the impacts of the COVID-19 pandemic, the research team has focused on cascading impacts and dynamic behavior inside a hospital system during an emergency. As the next step, DPRD, Ministry of Health, and Department of Civil Engineering, University of Moratuwa expect to conduct more assessments in Sri Lanka hospitals to validate the developed safety assessment toolkits. Since hospitals are considered complex systems the research team expects to improve the previously developed safety/resilience assessment frameworks incorporating systems thinking and characteristics of hospitals as an adaptive system.

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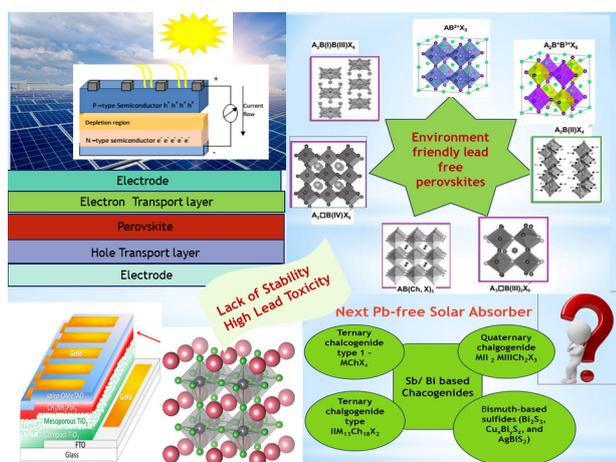
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Article by

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# First-Principles Calculation on Electronic Properties of Bismuth-halide Inorganic Perovskites for Solar Cell



Solar energy is a commonly used alternate source of energy and it can be utilized based on the principle of the photovoltaic effect. The photovoltaic effect converts sun energy into electrical energy using photovoltaic devices (solar cells). A solar cell device should have high efficiency and a long lifetime to be commercially beneficial. Presently, silicon and thin-film solar cells are widely employed. The crystalline solar cells are more efficient but they are also expensive. Thin-film solar cells are formed by placing one or more thin layers of photovoltaic materials on different substrates. Although these cells have a lower cost, they are also less efficient compared to Si-based solar cells. Organic-inorganic hybrid lead halide perovskite solar cells are one of the most promising low-cost power conversion efficiency technologies that could exceed the 26% threshold. However, the lack of environmental stability and of high lead toxicity are the main bottlenecks that impede the future industrialization and commercialization hybrid lead halide perovskite. Hence It is important to achieve high power conversion efficiency while also maintaining stability and non-toxicity in the development of new lead-free perovskite materials.

Bi-based halide perovskites are an interesting class of material because of their rich structural diversity and semiconducting properties. The ability of Bismuth to exist in a wide range of coordination geometries (from cluster to 1D, 2D, or even 3D) makes it particularly useful for designing novel compounds for optoelectronic applications. Studies on the coordination chemistry of Bismuth halides over several decades conclude that the network of metal anionic motifs can be easily manipulated by varying the size and geometry of cations, reaction environments, and crystallization conditions. Based on recent success with Pb based halide perovskites, similar attempts have been made to synthesize Bi-based perovskites which crystallize into  $[\text{Bi}_2\text{I}_9]^{3-}$  family of compounds. Herein, we examined the electronic properties of  $\text{Cs}_3\text{Bi}_2\text{I}_9$  as a prototype Bi-based iodide perovskite for photovoltaic applications.

The electronic structure calculations are performed through the Vienna ab initio simulation package (VASP) with the standard frozen-core projected augmented-wave method (PAW). The atomic positions are relaxed till the force/atom is less than  $0.05 \text{ eV}/\text{\AA}$ . All structural relaxations were performed with Gaussian smearing of  $0.05 \text{ eV}$ . Cs, Bi, and I atoms are described by  $5s^25p^66s^1$ ,  $5d^{10}6s^26p^3$ ,  $5s^25p^5$  valence electrons respectively. The simulations of the band structures were carried out in two steps. Initially, the unit cell was relaxed by a self-consistent run. Finally, a non-self-consistent run was performed using earlier charge density and the energy states were calculated along high symmetry direction on discrete K mesh. The high symmetry path is shown in Figure 1 from Brillouin zone center  $\Gamma_m$ , with the coordinates  $(0, 0, 0)$  to M  $(0.5, 0, 0)$ , K  $(0.333, 0.333, 0)$ ,  $\Gamma$   $(0, 0, 0)$ , A  $(0, 0, 0.5)$ , L  $(0.5, 0, 0.5)$ , and H  $(0.333, 0.333, 0.5)$ . All schemat-

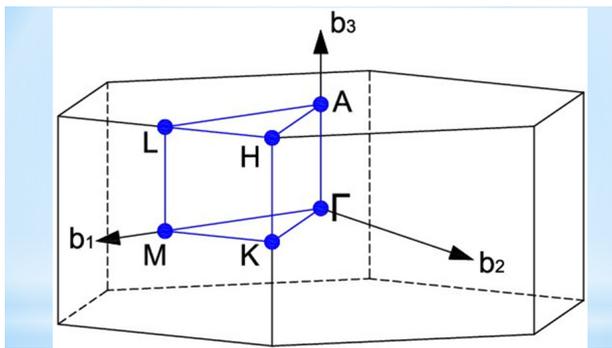


Figure 1: High symmetry path in the hexagonal Brillouin zone

ic representations of the crystal structures were generated using the VESTA program [1].

### Crystal Structure

$\text{Cs}_3\text{Bi}_2\text{I}_9$  exhibits hexagonal crystal symmetry at room temperature with the space group  $P6_3/mmc$  and undergoes a ferroelastic phase transition to a monoclinic structure at 220 K [2]. The hexagonal structure can be considered as a distorted and defect modulated face-sharing perovskite structure in which every third layer of octahedral Bi sites is depleted for charge compensation. Consequently, two neighbouring  $[\text{BiI}_6]^{3-}$  octahedrons form a face-sharing  $[\text{Bi}_2\text{I}_9]^{3-}$  bi - octahedra which are separated by  $\text{Cs}^+$  cations, eventually forming a 0D crystal structure.

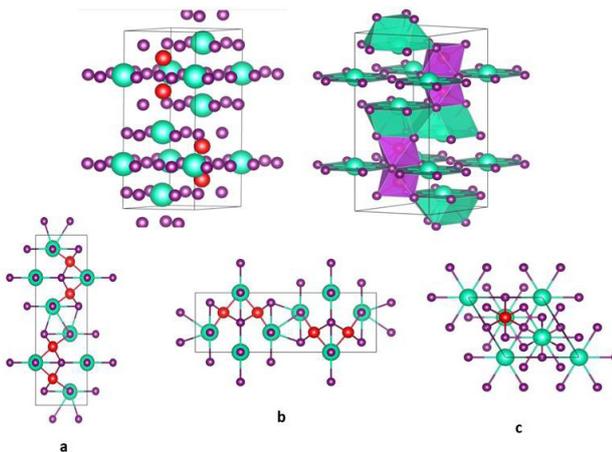


Figure 2: Schematic crystal structure of  $\text{Cs}_3\text{Bi}_2\text{I}_9$  (red, green, and violet colours represent Bi, Cs, and I atoms) as seen along (a) a-axis, (b) b-axis, and (c) c-axis

### The Density of state and Band Structure of $\text{Cs}_3\text{Bi}_2\text{I}_9$

The VBM is arbitrarily set at 0 eV and is located at the M point. According to our calculations, the electronic bandgap is indirect between  $\Gamma$  and M

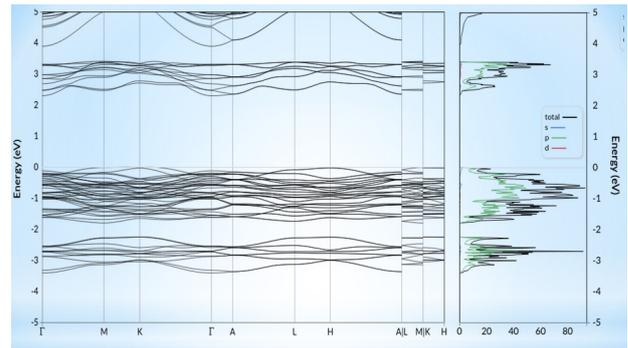


Figure 3: Density of state and band structure of  $\text{Cs}_3\text{Bi}_2\text{I}_9$

point. The calculated bandgap value is found to be 2.34 eV.

The orbital contribution of the  $\text{Cs}^+$  ion can easily be recognized by the vertical line in the density of state; this indicates that the electronic states of Cs are fully localized in space, without substantial interaction with inorganic bioctahedra. The valence band of  $\text{Cs}_3\text{Bi}_2\text{I}_9$  consists of the predominant contributions from p orbital of I and a little contribution from Bi(s) orbitals. The CBM is composed of nearly equal contributions from I(p) and Bi(p) orbitals. From these results, a paramount feature of this compound emerges: Cs and inorganic  $[\text{Bi}_2\text{I}_9]^{3-}$  cages are decoupled from the electronic viewpoint and therefore, Cs do not interfere with the active region of the perovskite. Its only role, regarding the electronic properties, is to donate one electron to the surrounding environment.

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Article by

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# An Innovative Approach to Produce Soil-Based Building Products

Soil has been used as a building material in different forms, such as mud, adobe, rammed earth, and bricks. Compressed Stabilized Earth Block (CSEB), a form of soil blocks with different additives including cement, fly ash, and lime, is a sustainable building material with many advantages compared to other conventional building materials. The usual practice of past researchers in producing CSEB was to add different materials like sand to the soil to control its clay and silt (finer) content. A high level of finer content is not desirable when it comes to the strength and durability of CSEB. This study proposes to reduce/ extract the finer content in the soil by washing it using a conventional concrete mixing machine.

The concept of particle packing optimization was suggested to modify the soil grading to produce CSEB, so that strength and durability properties can be enhanced. The study also proved that CSEB can be produced using the conventional cement block making machine with this soil modification process.

Soil washing process ended up with residual finer content that could be used for other soil-based building materials such as burnt-bricks and roof tiles. The study outcomes recommend the production of burnt-bricks and roof tiles with the extracted finer content mixed with fly ash. Fly ash is an industrial waste that causes many environmental issues. Therefore, the method suggested through this study has environmental benefits as well.



Used soil, Separated Finer and Gravel



Innovative soil-based products



#### ◀ Use of Block Making Machine for CSEB Production

The cost analysis of blocks showed that the production cost of a block is around Rs. 35.00. Compared to the average selling price of cement blocks available in the market, around 20% profit can be secured from this innovative soil blocks. A significant cost reduction in the production of roof tiles and bricks can also be achieved.

Finally, this study concluded that the soil washing process can be used to separate the finer particles and the coarse particles to produce sustainable building materials through an innovative integrated approach. With this process, waste and abundant soil can be utilized effectively by minimizing the adverse effect to the environment.

## Recently completed PhD

Research Title  
An Innovative Approach to Produce Soil-Based Building Products

Candidate Name:  
S.N. Malkanthi

Supervisor:  
Prof. Aoska Perera,  
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Present occupation:  
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# Is Cues of Contagious Diseases in Advertising a Friend or Foe?

Dr (Mrs.) Achini Ranaweera, a Senior lecturer from the Department of Textile and Apparel Engineering, Faculty of Engineering and Dr (Mrs.) Amali Wijekoon, a Senior lecturer from the Department of Management Technology, Faculty of Business in collaboration with two international researchers from Australia and the UK are all geared up to examine if cues of contagious disease in advertisements can influence consumption behaviour by eliciting negative emotions such as anxiety, disgust, and fear.

We are all well aware of how the Covid-19 pandemic has caused devastating economic and social disruptions globally. The pandemic caused serious health, economic, social, business, travel, education, and workplace challenges to almost all the consumers across the world. From a marketing perspective, these challenges have led to dramatic changes in how consumers behave [1], [2]. In fact, Covid-19 pandemic represents one of the most significant environmental changes in modern marketing history [3]. Thus, understanding the changes in consumer behavior is critically important to marketers going forward. Given this background, this proposed research seeks to examine the impact of Covid-19 on consumer behavior, in particular consumers' impulsive buying behavior, hoarding behavior, and consumers' intention to recycle. We further predict that consumer's negative emotions evoked by both visual and written cues of contagious disease in advertisements will act as a mediator on this relationship. We further predict that individual differences in perceived vulnerability to infectious disease will moderate the contagious disease cue effect on the predicted relationships.



Image: Council of Europe (2021)

This research will adopt an experimental research approach, thereby designed three marketing experiments, which will also be conducted using a large sample of real-life consumer samples from USA. This research aims to contribute to the ongoing discussion on how Covid-19 pandemic influences CSR, market, and consumer behaviour.

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Article by

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# University of Moratuwa **RESEARCH WEEK 2021**

Organized by the Faculty of Graduate Studies from 30th Nov-04th Dec

*Connecting academics, practitioners and society*

University of Moratuwa invites you to participate in Research Week 2021 multidisciplinary event comprised of a three international research conferences of the Faculty of Architecture, Faculty of Business and Faculty of Information Technology. This is to explore how excellent and relevant research is delivered at the University and beyond.

## Faculty of Information Technology



### ICITR 2021 1-3 December

The purpose of ICITR conference is to promote research in ICT and scientific exchange among researchers and scholars and engineers. ICITR 2021 will have a diverse technical tracks, student abstracts, invited speakers and workshops, all are selected according to the highest reviewing standards.

More Information



## Faculty of Business



### ICBR 2021 3 December

The Faculty of Business of University of Moratuwa proudly announces its 4th International Conference on Business Research. This forum will provide great opportunity for both academics and practitioners worldwide to exchange and share their knowledge, experience and research on all the areas of business.

More Information



## Faculty of Architecture



### FARU 2021 3-4 December

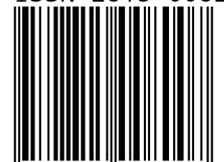
The aim of the FARU is to open up a platform to discourse theoretical and empirical studies through discussions, debate under its main theme 'Dimensions of Space'. It looks at research, practices, scholarly work and industry contribution on 'space' and different dimensions of it within the discipline of Built Environment, Town and Country Planning, Building Economics and Design.

More Information





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