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CRI 2021
CARNIVAL OF RESEARCH AND INNOVATION
VIRTUAL INTERNATIONAL EDITION

# e-PROCEEDING

## CARNIVAL OF
# RESEARCH & INNOVATION
# (CRI 2021)
## VIRTUAL INTERNATIONAL EDITION

*In conjunction with*

INTELLIGENT 2021
POLITEKNIK KOTA BHARU

I N T E R N A T I O N A L
**VIRTUAL INNOVATION CHALLENGE**
**(INTELLIGENT2021)**

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CIC2021

**CREATIVE INNOVATION CARNIVAL**
**(CIC) 2021**

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# SMART FERTILIZATION MANAGEMENT FOR OIL PALM TREE BASED ON IOT AND DEEP LEARNING

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**Highlights:** With the adaptability of Internet of Things technologies, oil palm tree growth data and fertilization management can be utilizing effortlessly and effectively. The context of conceptual framework comprises the IoT technologies, image processing, machine learning and deep learning which focuses on environmental factors that affecting the oil palm tree growth that involve temperature, humidity, soil moisture content, light and nutrient will be analysed. Thus, a prototype framework of IoT and deep learning for smart fertilization management of oil palm trees is suggested will be beneficial in helping and raise the efficiency of oil palm trees management in Malaysia.

***Key words:*** *fertilization management, deep learning, IoT, oil palm tree.*

## Introduction

Oil palm trees contribute economic income to the national and community by generating various types of productions. This will cause an expansion of the area for the plantation of oil palm seeds, then contributes to the stability in distributing good quality oil to accommodate the growing population. Furthermore, degradation occurs when the planting of oil palm trees increases rapidly, especially the occurrence of uncontrolled oil palm cultivation. The degradation can cause loss of soil nutrients due to soil erosion. The lack of macronutrients, Nitrogen (N), Phosphorus (P), Potassium (K) and Magnesium (Mg) on oil palm tree may impact on its growth which includes the quality of crops. Traditional approach to detect macronutrients, can also lead to some improper control in turn leads results in reduction in yield. The existing system has given limited information of dataset and slower classification performance due to limited functions. The development of an uncomplicated, simpler, and affordable method is needed for analyzing the growth of palm oil trees. In oil palm plantation contain nutrient deficiencies either Potassium (K) deficiency, Magnesium (Mg) deficiency, or Nitrogen (N) deficiency, hence these nutrients can be identified using image of oil palm leaf (Culman et. al, 2017). This innovation project combines IoT and image processing to monitor palm oil tree health status and to collect the physical factors that affect plant growth. This is part of an essential criteria in promoting sustainable oil palm tree plantation management using IoT application and deep learning architecture among community in Malaysia so as to sustain the quality of palm oil for the long term.

## Content

The system of an IoT comprising the sensors and devices that connect to the database via several types of connectivity. It begins when the sensors and camera module gather the information. The information will be delivered by the sensors to Arduino device that acts as the sensor node. Next, the Arduino device sends the information through serial communication or I2C communication to Raspberry Pi that acts as gateway. Raspberry Pi will be converting the information into comprehensible digital values and store the information for a while. The Raspberry Pi performs the large amount of processing data while Arduino utilizes when the small amount of processing data is needed. When the Raspberry Pi senses an acceptable wireless network or the Internet, Raspberry Pi will be sending the locally stored data to a Firebase platform. The information will be monitoring in real-time database as well as it will be processed, analyzed, stored and promoted to the end-user devices, display by an application software. Image data will be undergoing image processing for further analysis of nutrient deficiencies of oil palm trees.

IoT-based processing images and data of the oil palm tree will be capturing for the research project. IoT camera module will capture the images in RGB form of the oil palm plant. The prototype of smart fertilization management will be tested on three broad treatments of oil palm tree. There are three treatments where the first treatment, oil palm trees get adequate fertilizer, while the second treatment, oil palm trees are given insufficient fertilizer and fertilizer will not be given to oil palm trees for the last treatment. This research will produce new techniques in deep learning and pattern recognition based on IoT-based processing images. The results from this research would be a high accuracy accomplishment in oil palm industry especially in developing in a nutrient deficiencies detection and better oil palm tree management. By implementing the smart fertilization management based on IoT and deep learning, it will be an advantage for the oil palm industry in overcoming inefficient management of oil palm plantation which may assist the government policy.

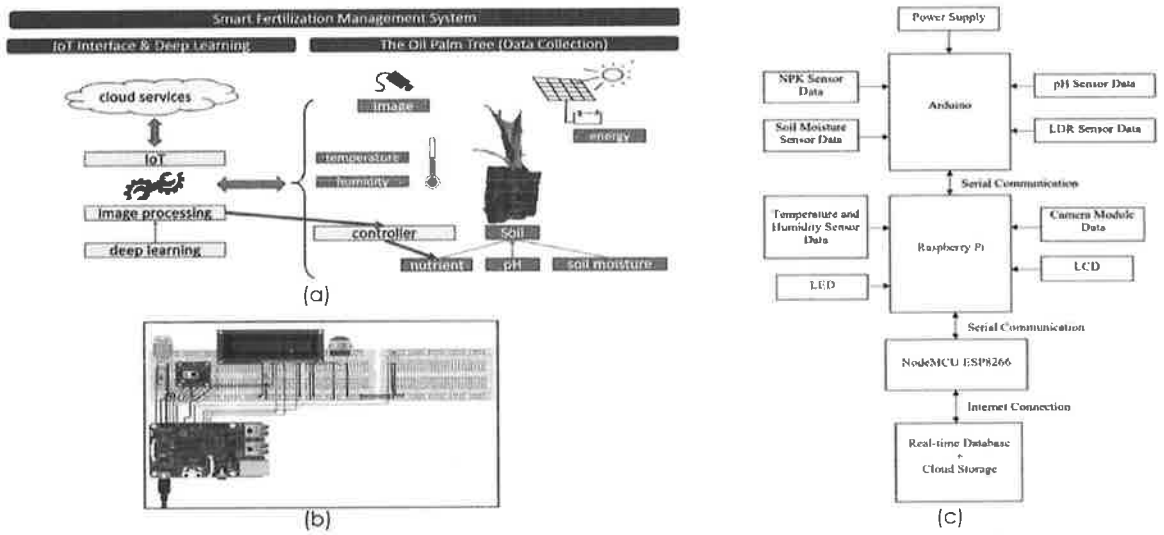


Figure 1: (a) Conceptual framework, (b) IoT circuit design system and (c) block diagram of IoT for smart fertilization management of oil palm tree

This innovation project performs to detect nutrient deficiency of young oil palm trees under several experiment treatments. The outcomes of this study will provide benefit of society considering that IoT technologies will provides a better and well-managed data collection. The collected and processing data are store in a real-time database and cloud storage. This gives a better visualization of data to targeted users such as traditional and modern farmers, and academy researchers through graphs in real-time database. For the farmers and researchers, smart monitoring will help them in contributing valid data by comparing the image processing data with the ground truth data, reduce workload because can be monitoring remotely such as using drone as in Hashim et. al.. (2020), and uncover critical areas in study that many researchers were not able to explore. Thus, it will develop a new theory on using IoT technologies. Smart monitoring using IoT technologies will assist farmers and growers balancing prescriptions of fertilizer or discovering crop diseases before it become spreading. The valid data collection will help in economic and environmental savings. This is very important for the purpose of strengthening knowledge on related oil palm plantation communities and industries in Malaysia and will directly improve the standard of living and income for an oil palm crop community and industry.

## Conclusion

The development of smart fertilization management for oil palm tree based on IoT and deep learning is still on-going. This innovation project can be as a part of a solution for managing the oil palm plantation. Furthermore, this method will be reducing the utilization of fertilizers which can creates environmental pollutions. This system may assist and increases the efficiency of oil palm plantation management in Malaysia.

## Acknowledgment

Authors would like to express appreciation to the members of Faculty of Earth Science, UMK and Malaysian Palm Oil Board (MPOB) as collaborating partner for their support and valuable comments and ideas. Authors also acknowledge the Universiti Malaysia Kelantan (UMK) (through UMK-PRO research grant R/PRO/A0800/01595A/003/2020/00873) for providing financial support to undertake this research and innovation strategy.

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# CUSTOMIZED RAINFALL COLLECTOR FOR ISOTOPE ANALYSIS ($^{2}H$, $^{18}O$, TRITIUM)

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**Highlights:** The setup of the rainwater collection apparatus suitable for for isotope analysis ($^{2}H$, $^{18}O$, Tritium) is by using tube–dip–in–water totalizer collector with pressure equilibration for excellent evaporation protection. A stainless steel table–tennis–sized–ball and debris screen is placed in the collection funnel for extra protection against evaporation and to help in sealing the collector bottle against any debris, respectively. Another advantage of using this type of collector is it facilitates low–cost unattended monthly sampling and eliminates the need for paraffin oil.

***Key words**: Rainfall, collector, isotope, analysis*

## Introduction

In general, the main precautions in precipitation sampling for isotopic analysis are evaporation prevention or exchange with atmosphere and representativeness of the sample to ensure reliable isotopic data. Sample evaporation may occur during sample collection as the collector is left for one month on site and open exposure of a precipitation sample to the atmosphere can result in evaporation that can alter the isotopic composition of the water sample. Rainwater sample collected should represent the integrated natural precipitation of the targeted sampling period which is one calendar month. Rainwater flowing out of a collector from extreme rain events such as monsoon may also result in loss of an important part of a month's precipitation (IAEA, 2014). All these concerns led to the invention of this rainfall collector. The setup of the rainwater collection apparatus suitable for this purpose is by using tube–dip–in–water totalizer collector with pressure equilibration for excellent evaporation protection. A stainless steel table–tennis–sized–ball and debris screen is placed in the collection funnel for extra protection against evaporation and to help in sealing the collector bottle against any debris, respectively. Another advantage of using this type of collector is it facilitates low–cost unattended monthly sampling and eliminates the need for paraffin oil. The rain gauges were placed at the sampling area in the rainfall stations compound on the first day of every month and the monthly accumulated samples or composite samples of precipitation were emptied at the end of the month. The disadvantage of this collector is the amount of rainfall need to be determined volumetrically when there is no rain amount recorder on site. However, the rain amount can be estimated using the equation below:

$$Rainfall\ amount\ (mm) = \frac{10V}{\pi r^2}$$

Where, V = volume of rainwater collected (ml) and r = funnel radius (cm). The bottle size used in this setup is 20L to ensure that the accumulation bottle is capable of accepting all the rainwater collected during the sampling period taking into account the possibility of extreme events (e.g. monsoons). The collector should be mounted approximately 30cm and 1m above ground in natural and developed areas, respectively to reduce the impact of wind turbulence and nearby structure. This method compared favourably with the paraffin oil and performed better than collecting daily rain gauge samples overall (Hughes, 2013) and highly recommended by the International Atomic Energy Agency (IAEA, 1983) due to the advantages mentioned above.

## *Operating Mechanism*

Rainwater enters the collector through the funnel. As the rainwater accumulates, the stainless steel ball will float thus allowing the rainwater to flow down into the collector. The stainless steel ball will act as the first line of defense against evaporation as it return to its original position and therefore sealing the upper part of the funnel hole. When rainwater reaches the bottom part of the collector, the second phase of evaporation prevention mechanism immediately takes place as the water hose end will be submerged. This water hose end is kept in place with the help of the weight. Since the collector will be left for one month at the sampling site and water level will rise when it rains, the long small tubing will equilibrate the pressure inside the collector and further minimizes the evaporation of the water sample.

## *Pro*

Cheap, robust and practical/easy to use.

### *Con*

The prototype lack of aesthetic value.

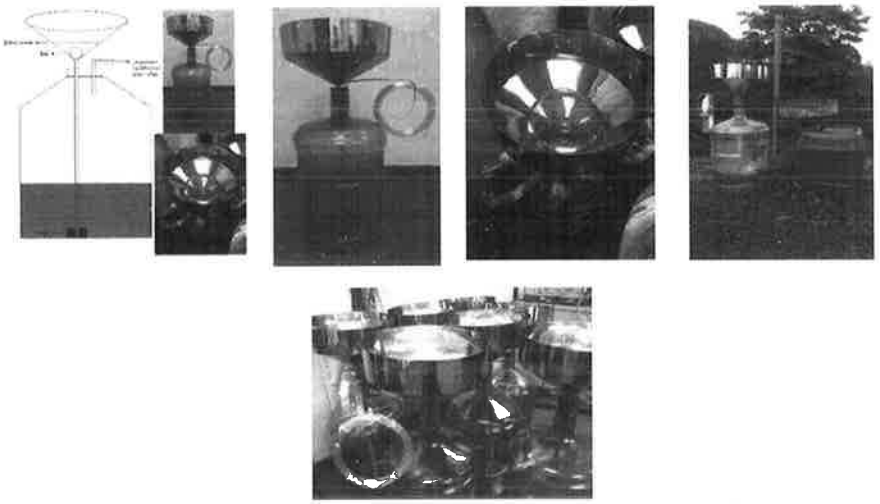

Figure 1: Aboves pictures showing setup of rainfall collector

Table 1: Comparison of rainwater measurement results between old collector and new collector.

| Year | Old Collector[1] | | New Collector[2] | | D | |
|---|---|---|---|---|---|---|
| **2016** | **$d^{18}O$ (‰)** | **$d^{2}H$ (‰)** | **$d^{18}O$ (‰)** | **$d^{2}H$ (‰)** | **$d^{18}O$ (‰)** | **$d^{2}H$ (‰)** |
| **Jan** | -3.85 | -22.81 | -3.94 | -22.67 | 0.09 | 0.13 |
| **Feb** | -0.90 | -8.65 | -2.94 | -11.10 | 2.03 | 2.45 |
| **Mar** | -2.28 | -8.37 | -3.89 | -11.01 | 1.62 | 2.64 |
| **Apr** | -3.17 | -18.86 | -4.46 | -21.42 | 1.29 | 2.56 |
| **May** | -6.78 | -39.48 | -6.86 | -41.66 | 0.08 | 2.18 |
| **Jun** | -9.21 | -70.45 | -12.71 | -69.50 | 3.50 | 0.95 |
| **July** | -9.46 | -60.75 | -10.99 | -62.88 | 1.54 | 2.14 |
| **Aug** | -6.85 | -23.67 | -4.23 | -30.13 | 2.62 | 6.46 |
| **Sept** | -6.05 | -33.78 | -8.11 | -43.62 | 2.06 | 9.84 |
| **Oct** | -6.66 | -47.11 | -7.43 | -50.67 | 0.77 | 3.56 |
| **Nov** | -10.40 | -66.62 | -9.47 | -67.86 | 0.93 | 1.25 |
| **Dec** | -9.92 | -66.72 | -8.86 | -72.65 | 1.06 | 5.93 |
| | | | | Avg | 1.46 | 3.34 |

[1]Old collector using paraffin as evaporation prevention mechanism.

[2]The new Tube–dip–in–water totalizer collector with pressure equilibration.

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(IAEA) (International Atomic Energy Agency) (1983) Guidebook on nuclear techniques in hydrology. 1983 Edition, Technical Report Series No. 91, Vienna: IAEA.

# COMPACT RECIRCULATING AQUACULTURE SYSTEM (CORALS): ASIAN CLAM SAVIOUR

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**Highlights:** Compact Recirculating Aquaculture System (CORALS) is a novel system developed for Asian clam, Corbicula fluminea (etok) juveniles. The CORALS comprises four components and it is divided into filtration and rearing components. The filtration components comprise the biological, mechanical, and chemical components. Four rearing chambers, each of which can accommodate 2000 juveniles/chamber. Newly metamorphosed juveniles are held in this system. The CORALS is reasonable and simple in structure, lower in cost, replicable, and the purpose of rearing the freshwater bivalve in the hatchery is achieved.

***Key words:*** *etok, Corbicula fluminea, juveniles, RAS, CORALS, hatchery*

## Introduction

Aquaculturists are concerned about a freshwater clam from the genus Corbicula because of its potential for food production. Furthermore, the Corbicula has become very valuable as a food source, particularly in Asia. They were heavily harvested from the natural habitat which endangerment their population including in Malaysia. Predominantly, the C. fluminea inhabited our freshwater bodies and well known as etok in a local name (Ramli et al., 2020). Fortunately, Corbicula has a unique life cycle that necessitates the reproduction by an individual which could be maintaining their existence for a certain time.

Attempts to reproduce and culture Corbicula have been made in the past. However, since the Corbicula is considered an invasive species in western countries, their research is mainly for ecological purposes (King et al., 1986). Furthermore, the C. fluminea was cultured and reared in Taiwan in a flow-through raceways system, which requires a huge water amount in comparison to the biomass of the juveniles. Because of the juvenile's clam's small size, a properly built recirculating aquaculture system (RAS) will keep thousands of individuals alive in just a few litres of water. The small size of juvenile clams presents difficulties in handling and confining them in flowing water. The released juveniles of C. fluminea generally range between 170 and 250 µm in length. These juveniles are easily suspended by currents, such that they can be lost from the open containers in flowing water. Furthermore, the juveniles crawl and drift which not surprising, the loss in grow-out, relocation, and death (Sicuro, 2015). Many marine species are successfully grown and survive well in the closed RAS which extensively uses for rearing adults and juveniles (Huang et al., 2013). The uses of RAS were reported in culturing freshwater juvenile mussels such as Chamberlainia hainesiana (Kovitvadhi & Kovitvadhi, 2013), Hamiota altilis (Fobian et al., 2017), Unionidae (Barnhart, 2005) which probably can be applied to culture the C.fluminea juveniles.

Since the C. fluminea juveniles are small enough to occupy the diffusive boundary layer, maintaining enough flow in culture systems is critical. The diffusive boundary layer is a benthic zone closely adjacent to surfaces, where friction reduces water movement to the point that diffusion, rather than convection, becomes the dominant mode of solute transport. The system should be constructed to alleviate stagnant zones while maintaining consistent flow and water quality. The functions of compartments in this recirculating system were defined in this paper. The C. fluminea juveniles were reared for 90 d and the growth and survival rates were evaluated.

## Content

Compared to other freshwater bivalves, the C.fluminea is uncommon to be produced and farmed. Practice in Kelantan, the harvested C.fluminea was placed in a basket for a few days in the river before further use. However, the fluctuation of water current and quality parameters were distressing the live C.fluminea and causing a death. Recently, recirculating aquaculture systems (RAS) received great attention in aquaculture. Still, little information on the RAS for rearing freshwater bivalves, their enhancement is required. Therefore, a compact recirculating aquaculture system (CORALS) that accommodates the Corbicula juveniles is needed to be specific to grow the juveniles and enhance survivability.

The CORALS (Fig. 1) has three filtration compartments namely biological (1), physical (3), and chemical (4). First, biological filtration comprises Bio-balls. Then, water inflow at this compartment and flow to the rearing chambers (2). The water flows through the cups and flows into physical filtration (corals and crushed shells). Finally, the water reaches chemical filtration (activated carbon) and a small submersible aquarium pump circulated water from this chamber to the biological chamber. The nominal flow rate for this model pump is 400 Lh-1.

In the rearing compartment (2), four rearing chambers for confining juveniles were installed made up of polyvinyl chloride (PVC) cone-shaped cups (diameter of top: 6.0 cm and bottom: 3.0 cm). A nylon screen (mesh 200 µm) was placed at the bottom of the pipe. Then, the nylon screen was glued at the top of the coupling, forming a filter cup. Pairs of filter cups were press-fit loosely together to form chambers that can accommodate the juveniles. These

chambers could be opened by separating the two filter cups, allowing access to the juveniles. Each chamber was positioned vertically in the recirculating system so that the juveniles rested on the screen of the lower cup. The CORALS is replicable and can be amplified to increase the seeds production in the future.

This invention had established a culturing technique of the C.fluminea juveniles in the RAS. Then, this invention has successfully grown and enhances the survival of C.fluminea juveniles in a captive system. This novel rearing system enables the C.fluminea juveniles to sustainably be reared and may generate another source for economic purposes. In summary, this work possibly proposes that C.fluminea be farmed due to it feasible as valuable aquaculture species, particularly in this region.

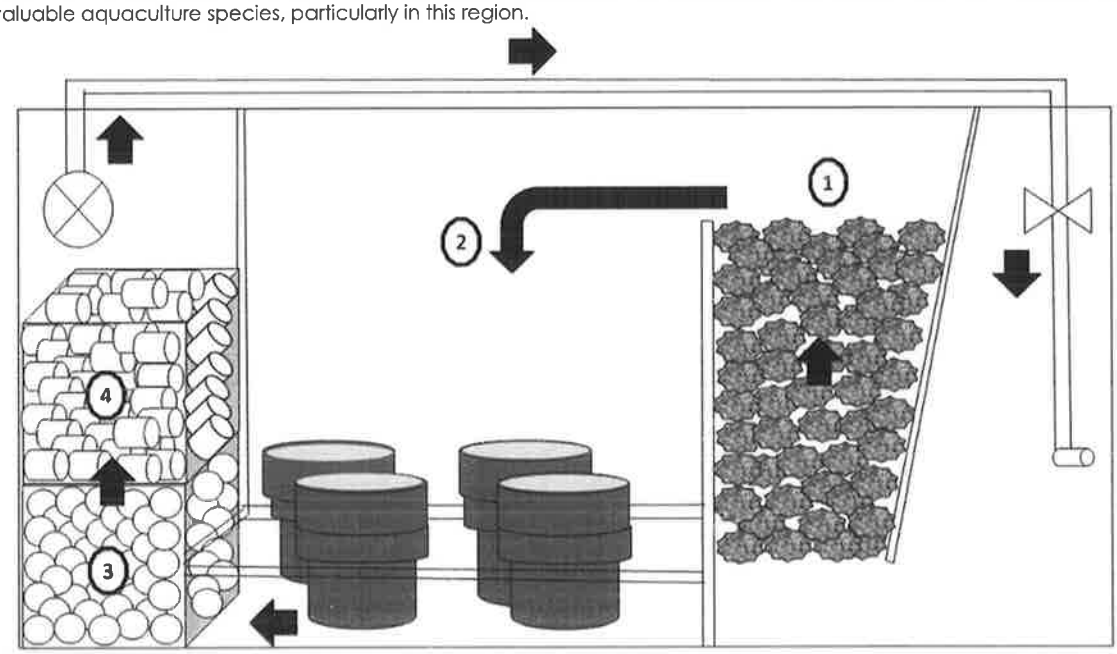


Figure 1: Schematic diagram of CORALS and the water flow direction (arrow).

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# FUELLING FUTURE TREASURE: COMMUNITY-BASED E-WASTE RECYCLING MODEL

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**Highlights**: Billions of precious metals and rare earth elements go to waste annually due to unsustainable consumerist behaviour and management on electronic goods. The current practices of disposal and recycling of electronic wastes (e-wastes) are unsatisfactory due to improper regulations and lack of functional facilities to adopt e-waste recycling practice. A localised youth movement to facilitate nationwide e-waste recycling was innovated. The pandemic-imposed movement restriction order was leveraged to deliver localised experiential learning for youths to collect, sell or dispose of e-waste responsibly. A major outcome of this project is a community-based e-waste recycling model with great potential for commercialisation.

***Key words:*** *e-Waste recycling, climate action, youth empowerment, community*

## Introduction

The rapid technological advancement has resulted in increased consumption of natural resources, especially precious raw metals (e.g., gold, copper) and rare earth elements (e.g., yttrium, terbium) to produce electronic goods. Grave consequence at the end of the goods' lifespan is the accumulation of electronic wastes (e-waste) that have yet seen proper and responsible recycling practices. Globally, the number of e-wastes increase unprecedentedly at the rate of 4 – 5% annually (Islam et al., 2016). In Malaysia, the number of e-waste produced in 2019 was 364 kilotons, an increase of 17% from 2015 (Global Waste, 2021).

The lack of sustainable practices in e-waste management in Malaysia is dampened by lack of (i) educational awareness on the dangers and treasures of e-wastes, (ii) e-waste recycling facilities, (iii) incentives to promote e-waste recycling, (iv) continuity in e-waste recycling campaigns, and (v) poor coordination and performance between governmental agencies (e.g., Department of Environment Malaysia, DOE) and e-waste collectors, to name a few of the challenges.

For instance, despite the effort of DOE in building web- (http://www.doe.gov.my/hhew/) and mobile-based application (MyEwaste), community participation is unsatisfactory (only 100+ downloads of MyEwaste app). The app also received poor reviews on the lacklustre technical and content performance, as well as the already few recycling facilities being limited only in major cities. Moreover, the app is almost pointless in East Malaysia. The incomprehensive list of recycling facilities in the app are likely due to most recycling enterprises being overlooked by the DOE or that they are not registered with the DOE.

Virtual and field surveys from this project found several recycling enterprises in small localities that were not included on the website/ app. Therefore, as initial first step to reduce the gap in the inadequacy and fleeting campaigns of e-waste recycling, a localised, youth-driven movement was deployed to be the catalyst in bringing e-wastes to respective recycling facilities.

## Description of the project

Our **unique approach** is in **leveraging the pandemic-imposed movement restriction order**, turning this restriction into an opportunity to extend virtual distance learning by providing **localised experiential learning with nationwide geographical coverage** and at the same time **solving local community problem** – the build-up of e-wastes and not knowing where to dispose of them.

Google Maps was used as a tool to pinpoint students' home locations and e-waste collection. Collection facilities were then categorised into buying and non-buying collectors and items that are accepted by each collector were identified and sorted into those providing collection services or drop-off services for logistics planning. Social media and e-communication tools were used to circulate marketing posters and videos to reach out to both local communities and netizens.

## Motivation of the project

i. To provide impactful, localised experiential learning to the students.
ii. To solve the largely unaware crisis of e-waste.
iii. To create a conceptual model for community-based e-waste recycling.

## Importance to education

This project is important to education as it provides experiential learning that extends out from their classroom education. Moreover, it serves as a testament that despite the pandemic situation, students are still able to carry out their social responsibility within their means.

## Advantages towards education and community

i. **Meaningful and fulfilling educational activities that elevate youth empowerment and ownership**
Through educating students on both the harmful threats and precious treasures of e-waste, the students were able to internalise this knowledge and transform them into an action that contribute to reducing the adverse impacts of improper e-waste disposal. The action they undertake gave them a sense of pride, ownership, empowerment and achievement in being an agent of change who contribute to positive impacts to the environment.

ii. **Conceptual model for community-based e-waste recycling programme**
The students were able to educate people about the threats and treasures of e-wastes. The people who have reached out to donate their e-wastes were very thankful for such effort as they were able to get rid of their long-kept, broken or unwanted e-wastes, knowing that they are being disposed of responsibly. Figure 1 shows a conceptual model developed from this project.

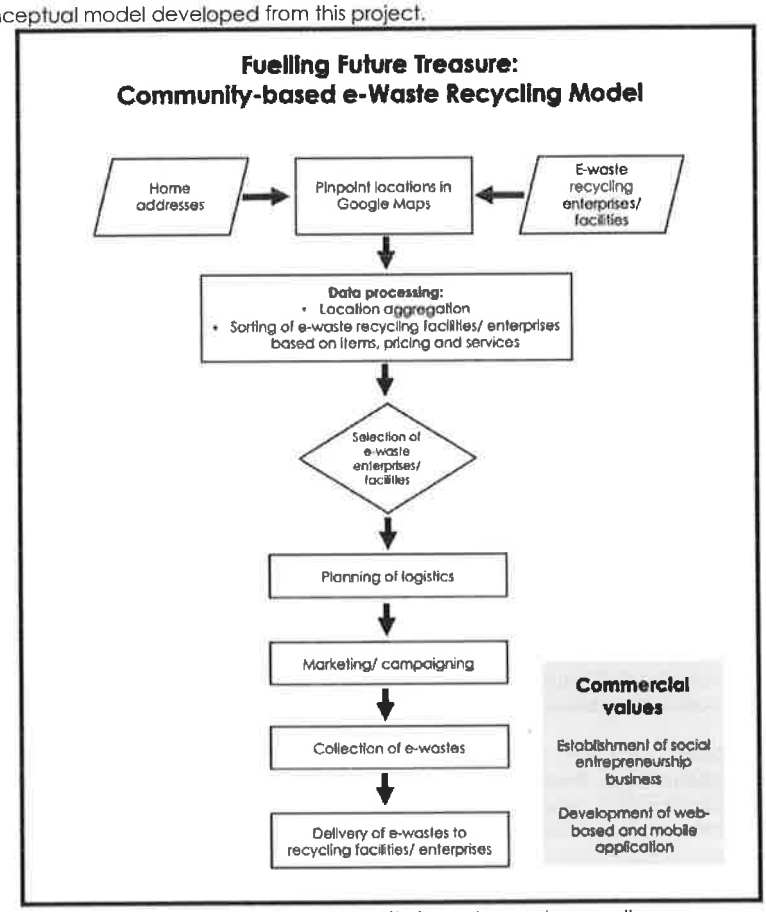


Figure 1 Conceptual model for community-based e-waste recycling programme.

## Commercial values

- Establishment of social entrepreneurship business.
- Development of a more robust web and mobile application for e-waste collection that fulfils the needs of users.

This project is highly adoptable at all levels. Performing collection of e-waste and thereafter selling them to e-waste collectors within the community area reduces transportation costs, thus maximising profit gain. The estimated profit gain from this project trial in 29 areas across Peninsular Malaysia, Sabah and W. P. Labuan is RM 395.30 over a span of one month (May 2021).

## Acknowledgement

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**Notes:**

**Poster**

**https://drive.google.com/file/d/17mZ-PJYgr36X09FGzkv57OeIIFGW9kMY/view?usp=sharing**

**Video**

**https://youtu.be/L-V0n4T4KuM**

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