MEng Innovation by Design
## 2019/2020 Ideate-Prototype-Realize

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This project presents an AI driven Energy Efficient Recyclable Bin which sorts the recyclables into 4 types including metal, plastic, paper, and glass.

The image of the recyclable object is captured via camera, and will be classified and processed by the depth neural network. After processing, the operating system drives the servo mechanism to complete the classification of recyclables. Through this energy collection system, the above embedded system can be guaranteed to run without power grid.

Processing Unit
Sorting Bowl
Rigid Plastic Flap
Solar Panel
Storage Bins
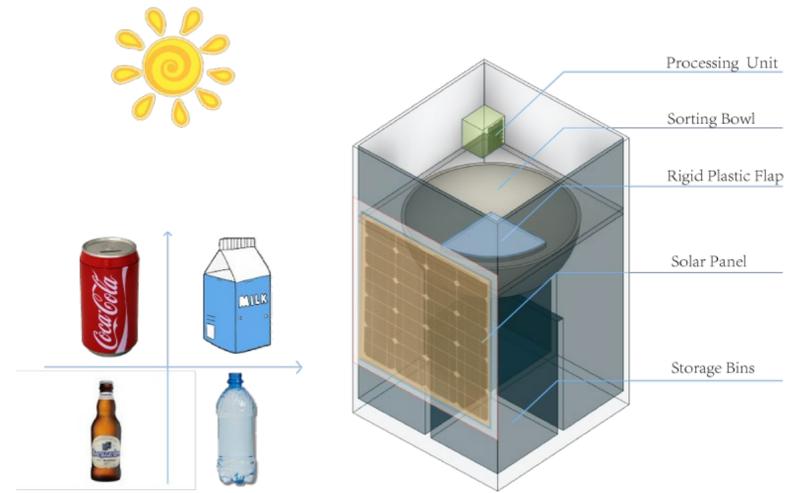
The design of an AI driven energy efficient recyclable bins

Background

From the perspective of economic and social development, it is an **inevitable trend** to realize efficient **utilization** of resources through garbage classification.
But there are some problems.
>Due to the lack of knowledge in garbage classification, it is difficult to **promote** garbage classification at the **individual** level.
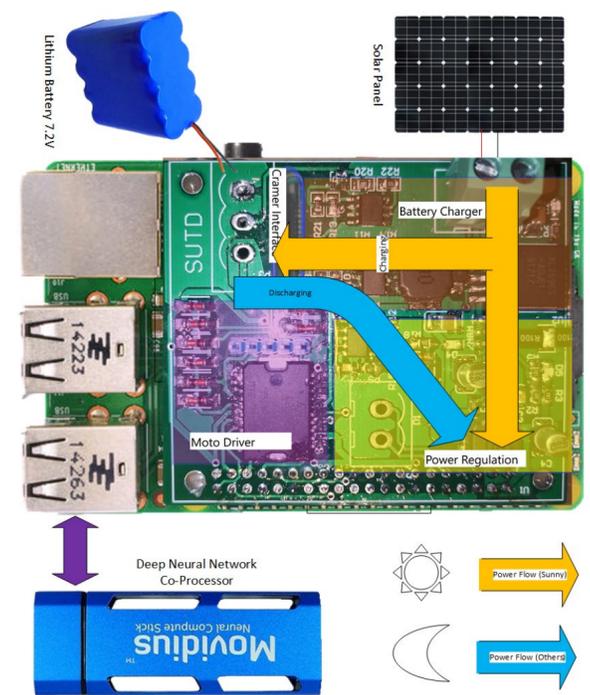>With the development of deep neural network(DNN), there are many complex networks that can complete the task of garbage classification and recognition. However, most DNNs require a lot of **computing resources**, which is not **conducive** to garbage classification at the personal level.

C1:Feature Map 7*7 ,64

Input Image (224*224*3)

C2:Feature Map 3*3 ,64

FC

*Tips:
ME – metal
PA – paper
GL – glass
PL – plastic

PL GL PA ME

The picture shows the deep neural network(DNN) structure customized ResNet-18 which has deployed on PC and our embedded computer vision system. ResNet DNN is less likely to degradant comparing to others DNN.

Research goal

> To develop an energy efficient solar energy harvesting system;

> To develop a low-power embedded computer vision processing system;

> To develop a less computing cost neural network framework which can be deployed on multiple platforms;

> To improve clock allocation of computing system to balance the power consumption and computing performance;

Question & Approach

Research Questions:
RQ1: What build an **efficient** energy harvesting system?
RQ2: How can the system wake up to ensure the **timeliness** of processing?
RQ3: What **data types** should be used in neural networks to reduce computational cost?

Research Approach

Research Clarification
Descriptive Study 1
Prescriptive Study
Descriptive Study 2

RQ1
RQ2
RQ3

Literature Review
Case Study
Simulation
Experiment

Expected results

➤ The development of a device can realize the automatic classification and recovery of common garbage which can be deployed in a variety of **public places** e.g. out space of HDB, outdoor park;
➤ Develop **a large scale** collecting system based on a amount of deployment of our former devices to establish a resource **recovery system**;

Lithium Battery 7.2V
Solar Panel

Camera Interface
Battery Charger
Charging
SUTD
Discharging
Moto Driver
Power Regulation
Deep Neural Network Co-Processor
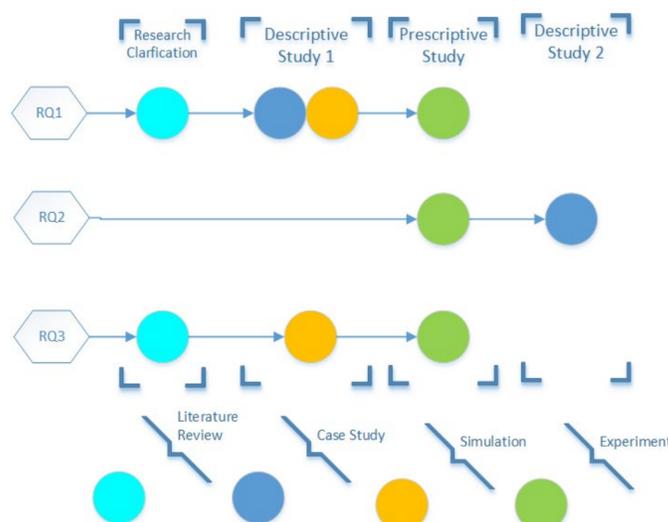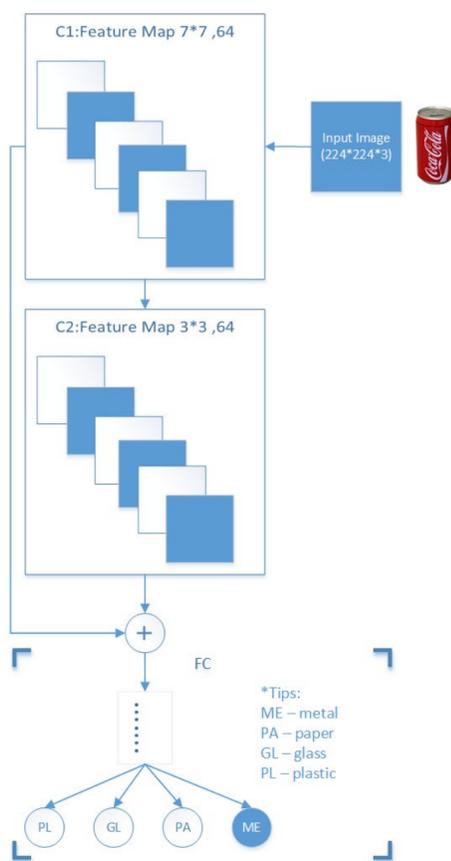Movidius Neural Compute Stick
Power Flow (Sunny)
Power Flow (Others)

When it's sunny and brighten, the solar panel(19.1V) collect the solar energy which charge the Li-ion battery and transfer to the regulator to supply the processing unit and driver(5V).

Your participation

Our project is followed MIT License. The source code is available on Github. Scan the following QR code and join us.