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Project Portfolio

Social Enterprise

Nucleate

Nucleate – Creating a ripple effect in Society (nucleate.ml)

Lesson 1: Introduction to Arduino and Blink LED

Students with no experience in circuitry and coding learn the fundamentals of Arduino hardware and software.

Learning Objectives

At the end of the class, students will:

- Understand what an Arduino is and can be used for.
- Understand the anatomy of Arduino UNO (5V, GND, Digital Pins, Analog Pins).
- Familiarise with Arduino Software (IDE).
- Understand how a breadboard is wired.
- Understand pinMode and digitalWrite, and able to blink an LED.

Materials

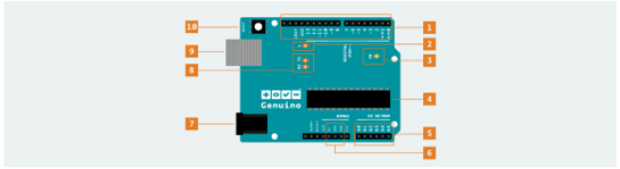
- Arduino UNO
- Breadboards
- Jumper Cables
- LEDs
- Resistors

Program Outline

1. Explain what they will be learning today
   a. Anatomy of Arduino UNO, IDE, breadboard, circuitry, and blink LED.
   b. Programming basics will be taught on the go (Language Reference, Variables, Functions). E.g. A new programming concept will be taught prior to the example.

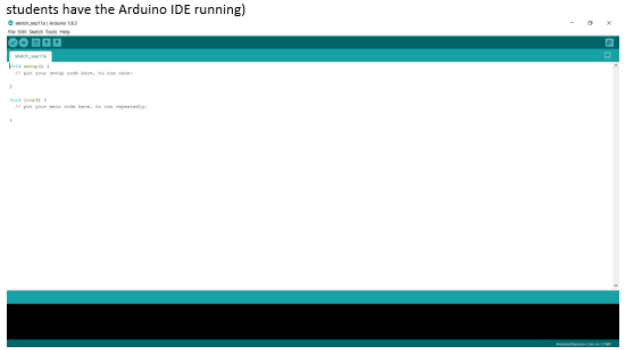
2. Introduction to Arduino and what it can be used for
   a. https://www.youtube.com/watch?v=eJg3yuAAawA (can cut short the video to 5 mins)

3. Arduino Board Anatomy (Make sure students are holding on to their Arduino)



1. **Digital Pins** – These pins can be used for digitalRead() (digital input), digitalWrite() (digital output) and analogWrite() (analog output). analogWrite() only works on pins with PWM symbol.
   a. Explain to them differences in input, output. Differences in digital and analog. Digital is binary, only 2 values (ON/OFF, 1/0, YES/NO). Analog can accept a range of values.
2. **Pin 13 LED** – Useful for debugging.
3. **Power LED** – Indicate that your Arduino is receiving power.
4. **AT Megacontroller** – The brain of your board.
5. **Analog Pins** – Can be used for analogRead().
6. **GND and 5V pins** – Use to provide +5V power and ground to your circuits (+ve and -ve).
7. **Power connector** – Another place for a power source when not using USB. Can accept voltages between 7-12V.
8. **TX and RX LEDs** – Communication between Arduino and computer. Will flicker rapidly when uploading sketch and during serial communication.
9. **USB Port** – For powering Arduino, uploading sketch, and communicating with Arduino (via Serial.println() etc.)
10. **Reset button** – Resets the Arduino.

4. Familiarisation with Arduino IDE (Facilitator to open the IDE on screen, and make sure all the students have the Arduino IDE running)



   a. Explain the whole process of creating, editing, and uploading a sketch. "Sketch is the name that Arduino uses for a program. Everything between /* and */ is ignored by Arduino. You can put your comments in the sketch. Its good practice to do so, to explain what the program does, how it works, or why it's written in a certain way. Another type of comment is //, everything on the line after // is ignored.

   Think of the sketch as an editor. You create and edit your program in the sketch, and once you're done, you upload it to the Arduino. The Arduino will then run what is inside the sketch (what you tell the Arduino to do). If everything is correct, the output will be

Snippet of a portion of the lesson plan for the first Lesson for Microcontroller Programming

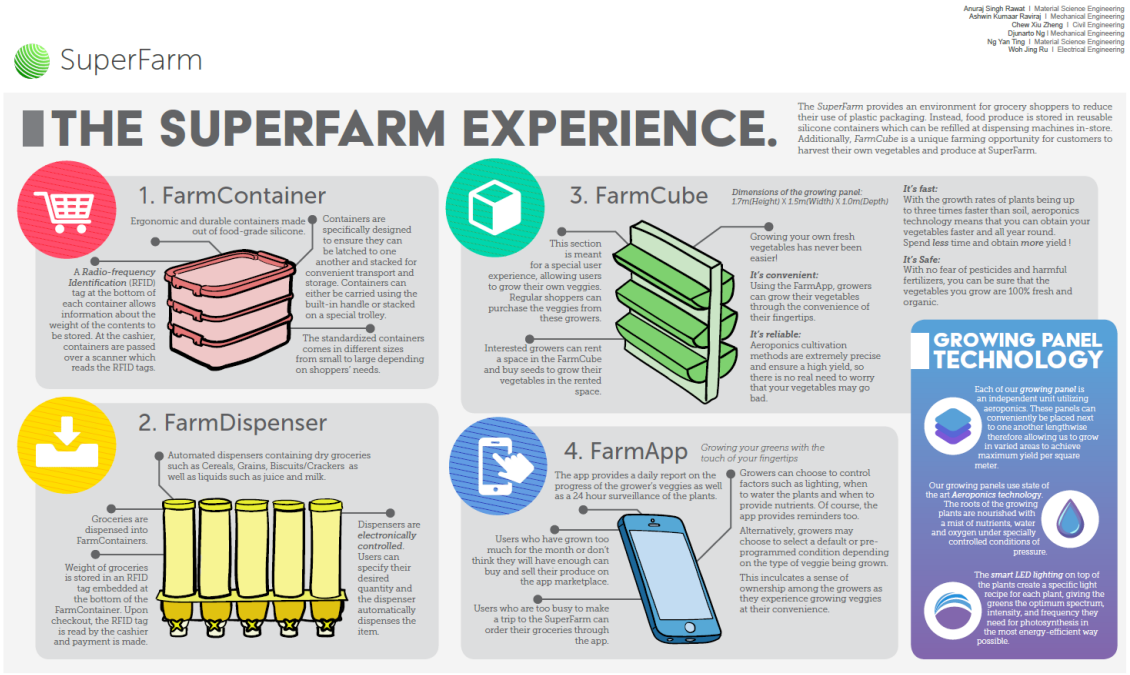
Nucleate is an educational enterprise in the works which is aimed at equipping secondary school students with technical skills in electronics and prototyping.

Once equipped, the students with guidance from the program facilitators work on an engineering driven social project.

We are currently in the validation phase, testing out variations of our lessons plans with different potential users and clients. We have already carried out user testing at **Anglo-Chinese School (Independent).**

We are also building lessons plan for upskilling of the labour industry, given the interest from a **corporate company**

Design Engineering

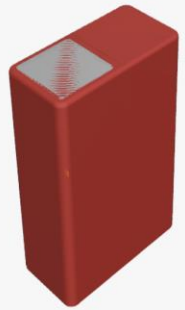


SuperFarm was the result of a design project targeted at redefining the grocery shopping experience.

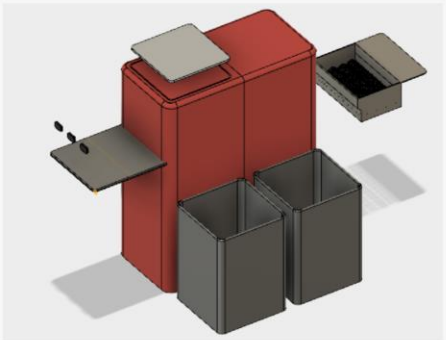
Design thinking methodology was used to study user journeys to iterate a new user experience in order to eliminate the use of unnecessary plastics in the grocery shopping experience.

A systems thinking approach was applied to integrate plastic free groceries in all aspects of the grocery shopping experience rather than focusing on just one aspect.

Plas+



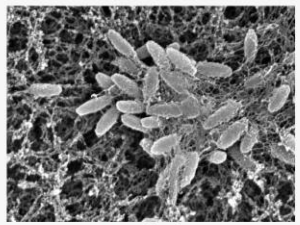
Plas+ external body



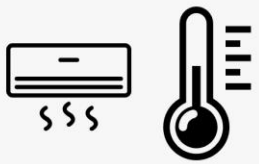
Plas+
Components

Compost Optimisation

Shredder to increase surface area



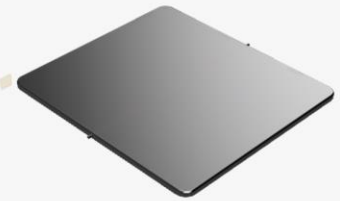
Microbial Inoculant



Customisable Settings

Sorting Mechanism

Optical Laser
Image Sensing



See-saw Flap

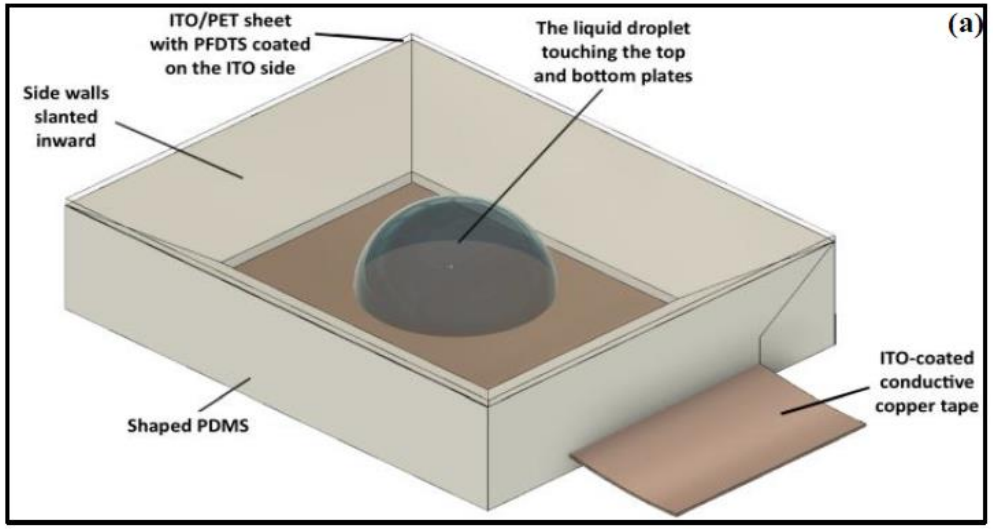
Plas+ aims at decentralising waste management and processing to within households.

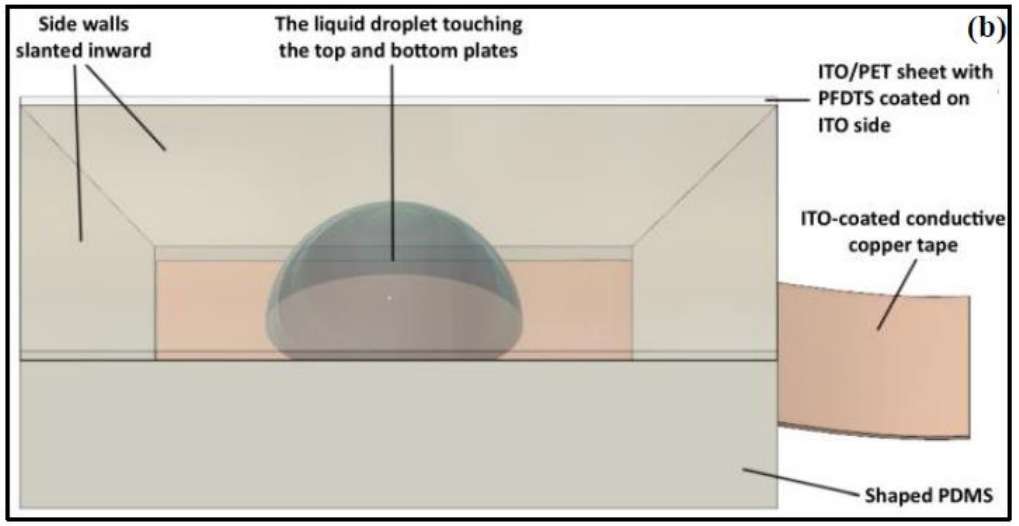
Rather than accumulating household waste and spending government funds and resources to deal with excess waste, specifically organic waste and plastic waste, Plas+'s dual functionality allows for this waste to be processed within a single bin. Hence saving costs and resources and also putting greater accountability on users who actually produce the waste.

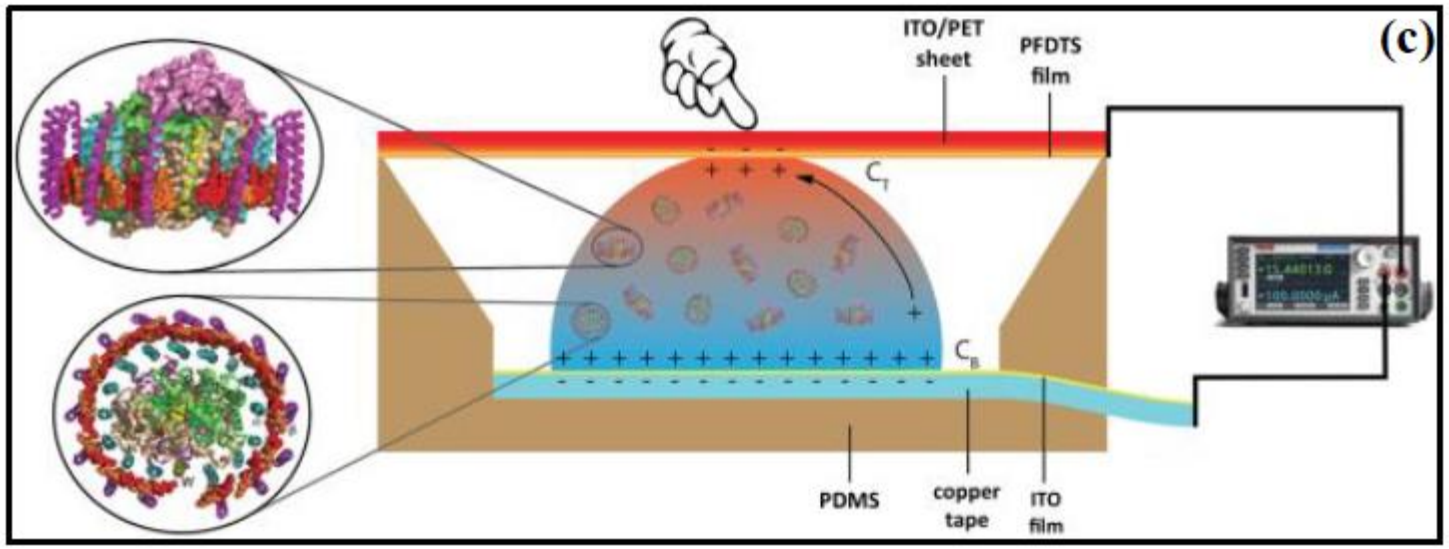
The smart bin not only sorts out the waste for you, but also optimises composting conditions through mechanical and biological processes. Customisable settings of air flow, lighting , temperature and pressure means that the bin can be optimised depending on the type of the waste being processed.

Engineering and Research

Self-Powered Flexible Biohybrid Touch Sensor

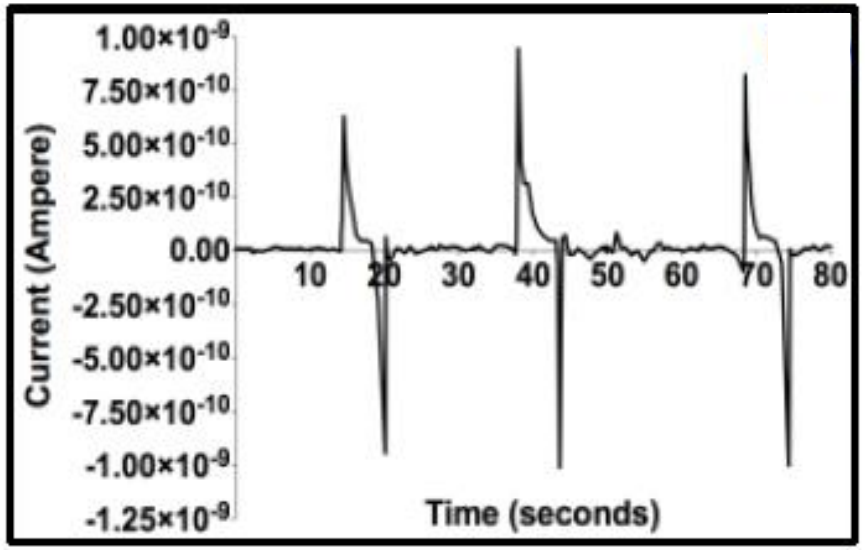


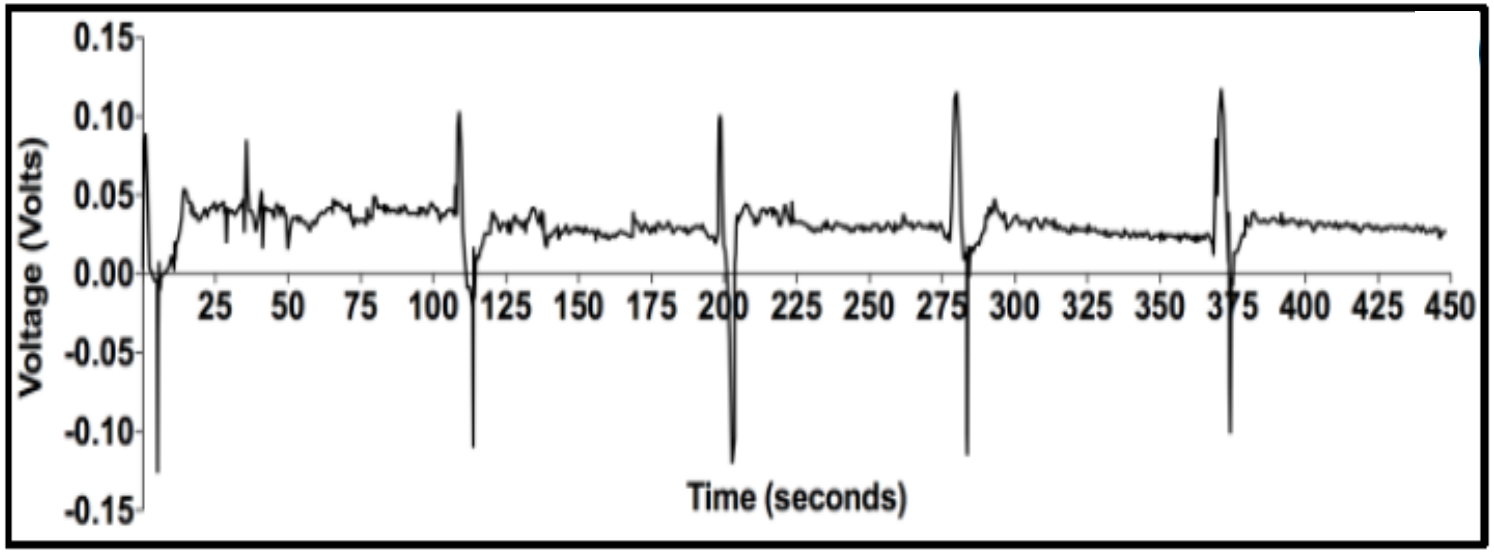




Device design for the touch sensor, which uses a photosynthetic protein embedded liquid droplet to act as a self powered touch sensor using the Reverse Electrowetting on Dielectric Effect

Device Performance

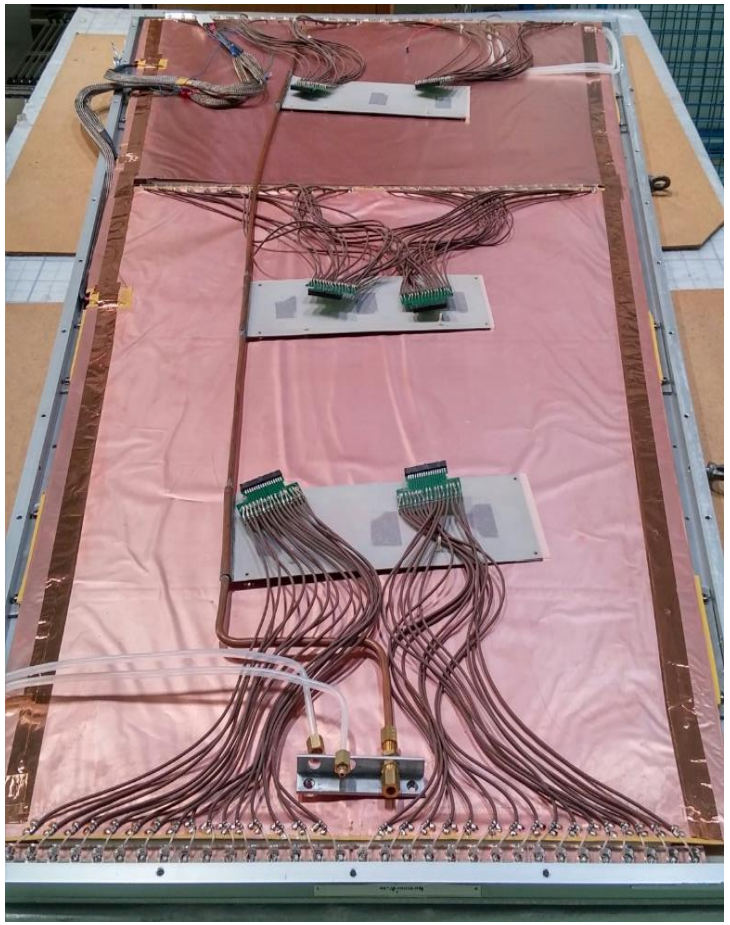




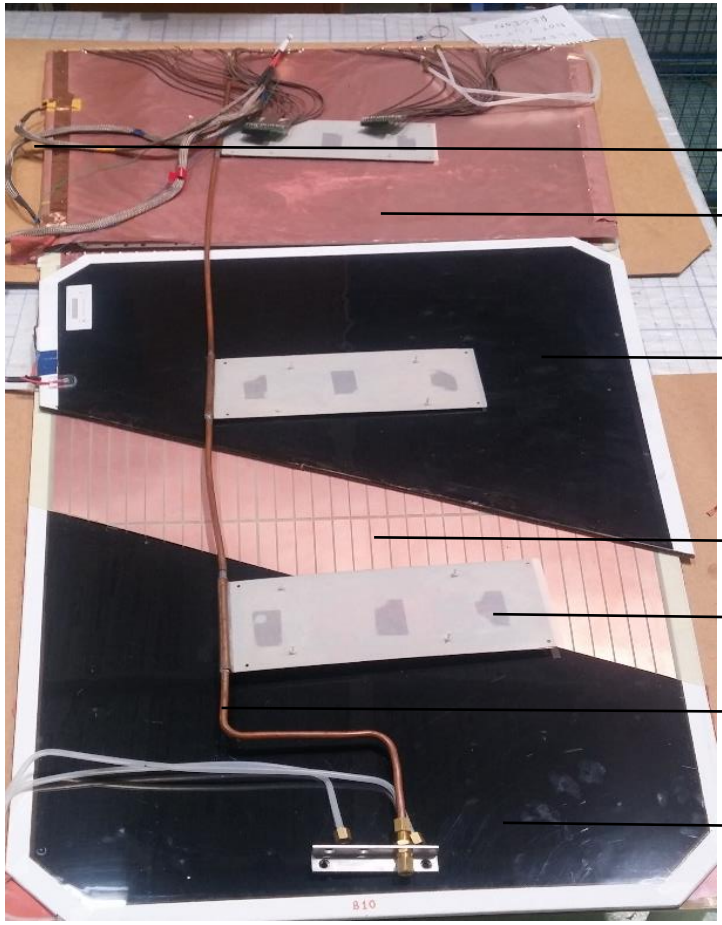
Current and Voltage signals generated for periodic pressure exerted by the tip of the finger.

Testing and Data processing is ongoing for sensor responsivity to light and temperature

Resistive Plate Chambers – **CERN (European Council for Nuclear Research)** Internship



Constructed and assembled Resistive Plate Chamber to be used in the compact muon solenoid experiment for particle detection.



Deconstructed Resistive Plate Chamber showing the various components of the chamber.