**Team E.A.R.T.H - COVID 19 Development Plan – Rubbish Sorting Rig**

General Improvements:

* Speed of Operation: Improve the speed of the Sorting Rig, specifically in the X direction. The X direction only has a 0.16A stepper motor whereas the Y axis has a 1.7A stepper motor and subsequently is much faster. Therefore, an easy improvement in the future is to replace the X axis 0.16A stepper motor for a more powerful one using remaining budget.
* Gantry Arm Robustness: During movement in the X axis a wobble in the overall gantry arm and position of stepper motor can be observed
* Grabber Hand Grip: Increase the friction on the pincers on the Sorting Rig grabber hand to reduce amount of dropped or unsuccessful rubbish pickups. This can be achieved by install rubber pads to the contact areas of the grabber hand pincers.
* Implement Raspberry Pi: Install a Raspberry Pi so the RGB Bin Detection can be executed on there negating the need for it to be run via a laptop as it currently is.
* PCB Development: Develop PCB designs to house the different stepper motor drivers, limit switches, microcontrollers etc. This will improve robustness and ensure a more professional and sleek product.
* Cable Management: Due to the large range of component movement on the rubbish sorting rig, cable management can become a problem due to snags for example. To prevent this and massively increase robustness, use igus cable chain to keep all cabling tidy and safe during movements.

Autonomy and Integration:

* The first stage to autonomy within the sorting rig is to implement a home setting on the sorting rig. A point, most likely in the bottom left corner within the rubbish holding area, where the gantry grabber hand returns to after each run. This ensures the sorting rig knows exactly where the grabber hand is starting to ensure it can accurately move autonomously to a given point.
* Install the Rubbish Detection and Classification onto the Sorting Rig using the Raspberry Pi discussed earlier and the currently installed webcam.
  + Once, completed allow this code to talk to the Arduino MEGA used for sorting rig movement, in order to output the X,Y component for centre point of a piece of rubbish in the holding area. The Arduino MEGA will then need to calculate the distance from the ‘home’ position to the rubbish centre point and convert this to X/Y stepper motor movement.
  + Then, once rubbish is picked up by grabber hand, it will travel in a set loop. From the rubbish holding area north over Bin A, then East over Bin B, south over Bin C and finally west returning to the rubbish holding area. When the webcam completing the RGB Bin Detection code detects the bin that correlates with the rubbish classification the sorting rig will stop, drop the rubbish in that bin and then return to ‘home’ before repeating.
* Further, integration between the sorting rig and the user interface via ROS would then be looked into. Data such as amount of rubbish recycled, how full bins are, battery life etc would all be sent back to the user interface. Also, a live webcam feed showing the sorting rig webcam could be displayed.