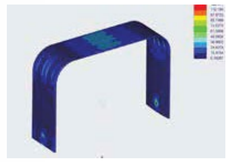
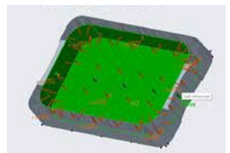
TetraGrow

Vengg Sathevil

Vengg Sathevil, a Malaysian innovator has been inspired by a passion for plant cultivation, he envisions a hydroponic product to make growing fresh vegetables accessible and affordable for those without gardens. His journey is all about blending creativity, technology, and sustainability in product development.





Research approach

TetraGrow, my final year project, is a device that applies the principles of hydroponics, a method of soilless plant cultivation nourishing roots with a nutrient-rich solution. Existing hydroponic products occupy an undersaturated market, offering an opportunity to develop a design solution that caters to an underserved customer base. Conducting primary research through interviews and surveys along with analysing existing competitors in the market helped to establish the starting point for delineating various concepts and designs.

Interviews were conducted to investigate the behaviour of people living in compact accommodations. Some key points from the survey showed that people in cities are more inclined to purchase less expensive shop-packaged vegetables rather than growing their own green produce due to lack of accessible gardening space, cost, and convenience. I also analysed anthropometric data to understand the ergonomic considerations that needed to be included in the design for people to operate the product.

Prototyping and iteration

The next step was to turn the concept into a product. I investigated the use of different pumps to achieve the ideal rate of water flow needed for optimal plant growth performance utilising a nutrient film transfer (NFT) system which is one of the most highly efficient hydroponic systems highlighted by academic research papers. I also experimented with different spout outlet designs to investigate their effects on influencing the rate of flow at different heights to assimilate its behaviour when the device is modularly connected. One of the biggest engineering challenges within the project was to ensure the product was light enough for users to carry and stack multiple units vertically with ease.

Through conducting a failure mode and effect analysis (FMEA) using PTC Creo I tested different materials and designs of the frame and main body for it to withstand the expected load experience in real-world conditions. By running multiple tests, I was able to optimise the weight reduction by ensuring the design met the safety factor.

The main body of the design consists of High Density Polyethylene (HDPE) and was refined with adequate draft angles for it to be suitable for injection moulding. The frame made of aluminium is designed for sheet metal to be bent into shape. Both materials were chosen for their lightweight properties, ease of manufacturability and recyclability.

Throughout my prototyping development, I discovered that a miniature 3V submersible pump proved to be better suited to meet the design objectives compared to other pumps I tested. This led me to redesign the entire system of the product to adapt to a new irrigation method which is called 'Ebb&Flow'. In the redesign of this new system, the miniature pumps would be integrated with each unit instead of being a detached external unit. This would enable more precision control over the rate of flooding and draining of nutrient solution, and lower power consumption. It also minimises the complications of the modular approach where connecting multiple units could lead to confusion. Simplifying the initial idea helped to produce a more intuitive and practical design for everyday users to operate efficiently.

Next steps

The next step is to get the parts manufactured as intended to create a working high-fidelity prototype and to perform more tests and rectify potential design flaws when in use. The biggest barrier is the high cost of manufacturing and tools needed to complete this phase of the project. Currently, I am saving up to finance the next development stage of TetraGrow to get a step closer towards turning this idea into a market-ready product.

Innovation within the realms of hydroponics has the power to be a game-changer in the consumer market to reform the relationship between people and plant cultivation. It not only provides users with access to fresh, green produce but also serves as an amazing educational tool for young minds to explore and learn about horticulture.