PeaPod - Design Report

Primary Written Deliverable for the Deep Space Food Challenge Phase 1

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2.1 Description

An automated and isolated aeroponic crop growth system, able to generate any environment from a combination of independent environment parameters, with both environment and crop growth data collection.

Operations concept follows Figure 1:

2.2 Innovation

Wide, continuous, precise control Environment optimization for output metrics

2.3 Adherence to Constraints

Power Consumption Heating/cooling Lighting

2.4 Performance Criteria

2.4.1 Acceptability

Process

Food Products

2.4.2 Safety

Process

Products

2.4.3 Resource Inputs and Outputs

Inputs

Outputs

Optimization

Maximizing output is perhaps the greatest strength of PeaPod. Since it is fully automated, growth cycles have a high degree of certainty that let researches hone in on the perfect conditions—and then repeat them ad infinitum. By collecting data in an isolated environment like this, optimization can be done on any number of parameters, including quantity of inputs. As trials are conducted and PeaPod gathers data, it measures the quantity of inputs taken and a plethora of plant data related to usable quantity, bringing PeaPod to the most efficient conditions over time. In addition, the array of sensors used to collect data double as input for PID control, letting PeaPod react to unpredictable events such as poor seed health and salvage otherwise poor outputs.

2.4.4 Reliability and/or Stability

Process Reliability Input and Output Stability

2.5 Terrestrial Potential

2.5.1 Customer-facing Food Service

At present, a restaurant requires either a local supplier or a substantial amount of outdoor space (and labour) to serve fresh produce. Both of these are cost-prohibitive, and the latter is entirely impossible in many situations. Local suppliers' high costs are the result of a few things:

- Limited seasonal availability
- Frequent transport need
- High costs with little demand

PeaPod has the potential to reduce these barriers in a cyclic way. Partnerships between local suppliers and restaurants will provide these restuarants with space- and time-efficient PeaPod units with the purpose of generating both produce and data. The increase in produce will reduce the frequency at which suppliers need to make deliveries, while the data produced will let suppliers maximize output. Over time, this can increase efficiency to the point where local suppliers can

provide produce at a lower price.

2.5.2 Crowdsourced Research

Due to PeaPod's automated nature, off-site research is a feasibile method of collecting data. As a result, universities and other institutions can save costs related to space and energy usage by subsidizing PeaPods to consumers, schools, or even restaurants. Users would receive sets of paramters within which to grow crops, and the data would be sent back to the institution. The user can use the produce, at the cost of space and energy, while the institution continues to provide parameters with which to grow. The end result is a massive set of data, conducted in identical conditions in different places, verified by comparison with the myriad devices conducting the same tests.

2.5.3 De-centralized Production

Many crops are only feasible in certain climates, making global transport a necessity to sell them worldwide. This reduces freshness, necessitates various preservatives, and increases carbon consumption. By upscaling PeaPod technology to a farm scale, it becomes possible to produce climate-bound crops in any location. This creates region-based farms that can produce a tremendous variety of crops, vastly reducing transport needs and making it easier to have a local food diet.