

Technical Requirements:

1. **Seed density/distribution:**
 - a. **Metric Explanation:** Seed density at any given square inch of the grow tray
 - b. **Quantifiable Goal:** Each square inch seed density can have a maximum of 33% higher than target density
 - c. **Reasoning:** Based on growth data from Johnny's Seeds, significant reductions in yield occur at around 33% higher-than-optimal seed density
2. **Water spread/coverage:**
 - a. **Metric Explanation:** Speed at which the watering system can fully saturate the grow medium and then drain in to avoid waterlogged plants
 - b. **Quantifiable Goal:** 100% coverage/saturation and drainage within 20 minutes
 - c. **Reasoning:** 20 minutes is about how long it takes for standing water to begin to affect root oxygen levels
3. **Seed weight dispensing accuracy:**
 - a. **Metric Explanation:** Acceptable accuracy range, by weight, of seeds dispensed from storage hopper into seed distribution hopper. Takes into account the worst case of sensor accuracy along with dispenser accuracy
 - b. **Quantifiable Goal:** Within 1 gram of target
 - c. **Reasoning:** Based on Johnny's Seeds stats and ESP32 ADC granularity of 4095 values
4. **Watering Frequency:**
 - a. **Metric Explanation:** How often the device is able to water the plants
 - b. **Quantifiable Goal:** At least once every 12 hours
 - c. **Reasoning:** Based predominantly on prior experience with growing microgreens, they should be watered roughly twice, daily
5. **Website latency:**
 - a. **Metric Explanation:** How quickly the website can communicate with the user
 - b. **Quantifiable Goal:** Time-to-first-byte latency of ≤ 2 seconds
 - c. **Reasoning:** The average time-to-first-byte latency across all desktop webpages is about 1.2 seconds, so we decided to shoot slightly slower than that to keep expectations reasonable.

Results Requirements:

1. **Yield Ratio:**
 - a. **Metric Explanation:** The ratio of seed weight to end harvested produce weight, compared between manually-grown control group and MiGroBox-grown group
 - b. **Quantifiable Goal:** MiGroBox yield ratio must be no less than 85% of the manually-grown yield ratio. This metric takes into account the worst-case acceptable loss of 1 gram of seeds (technical requirement #3), which results in a worst-case yield loss of roughly 3% outright.
 - c. **Reasoning:** The manually-grown seeds will likely have much better care than the MiGroBox grown seeds, as they will be better spread, better watered, and more meticulously looked after/observed.

2. Labor Hours Reduction:

- a. **Metric Explanation:** Time taken to cultivate microgreens. This includes set up, seeding, care throughout the week, harvesting, packaging, and cleaning. Labor hours for the MiGroBox will be compared against those for manually-grown control groups.
- b. **Quantifiable Goal:** Labor reduction of at least 30%
- c. **Reasoning:** A lot of time is taken in harvesting, packaging, and cleaning - all functions the project device does not target. Thus the automation of the seeding and weekly care processes is expected to not cover more than $\frac{1}{3}$ to $\frac{1}{2}$ the total time involved in growing greens. A 30% reduction would be significant in improving the viability of microgreens cultivation while remaining an achievable goal for the semester.

3. Wage:

- a. **Metric Explanation:** Based on the yield ratio and the time saved, as well as seed costs and overhead, we can calculate how many dollars per hour we're saving by using the machine instead of manual labor. This metric will use greens sale prices derived from averages observed in grocery stores.
- b. **Quantifiable Goal:** Surpass minimum wage (\$7.25/hr); increase manually grown wage by at least 20%
- c. **Reasoning:** Surpassing minimum wage makes our device worth using over a human laborer

Features Requirements:

1. Climate control/monitoring:

- a. Irrigation
- b. Lighting
- c. Air circulation
- d. Temperature sensing
- e. Humidity sensing

2. Seed storage, distribution, and care:

- a. Long term seed storage
- b. Seed dispensing
- c. Seed rinsing and soaking
- d. Seed distribution
- e. Seed pressing

3. Seed grow regime pre-sets:

- a. Saved optimal values for at least the plant varieties grown over the course of the semester project

4. WiFi user interface:

- a. Custom website
- b. Device connected to WiFi 24/7