Team #4

Photoreactor

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Customer Background

The customers for this product are small to average cottage manufacturers and home growers of cannabis products. The device needs to be easy to use while also allowing safe disposal of chemicals down the customer's drain.

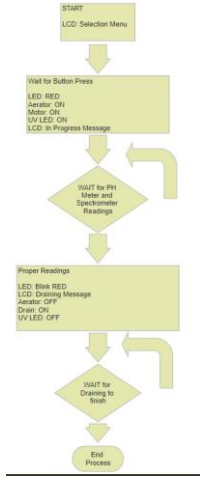
Problem Statement / Scope of Work

Testing hemp for different cannabinoids is required by the 2018 Farm Bill. This testing leaves behind toxic chemicals that are not safe to dispose of down the drain. These chemicals break down into water when exposed to a mixture of Titanium Dioxide, and a certain wavelength of UV light. Our goal is to construct a Photoreactor to induce this reaction in a controlled environment to allow for safe disposal of these chemicals.

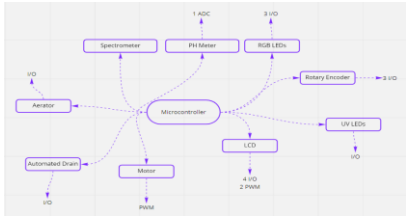
Requirements

- **TiO2 Coating:** Coating surfaces within the reaction chamber ensures that the liquid flowing reacts with the TiO2 and the LED's.
- **Reduce chemical levels to standard:** The reaction should breakdown the solution so that output fluid is diluted enough to safely dispose within 2 hours
- **Adequate capacity:** Reaction chamber should be able to hold at 500 ml of liquid
- **Design within Budget:** Overall design shouldn't surpass set budget of $1000
- **Proper aeration of the solution:** Liquid input needs to be aerated to help reach the desired reaction

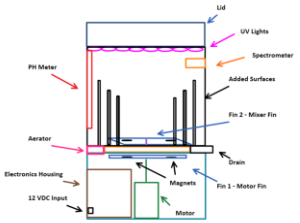
Experimentation and Concepts



Programing Flow Chart



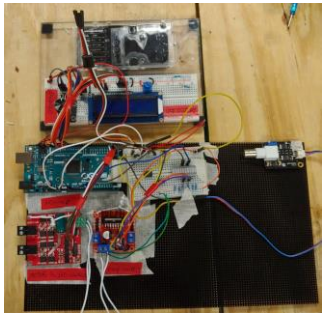
Electrical Flow Chart



Initial sketch of mechanical design

Final Design

Final 3D printed casing design



Overall Electrical Design

Closeup of inside of the final design

Close up of PCB

FMEA

Requirement	Failure Mode	Effect	Action
Stir Solution.	Motor fails to spin turbine	Solution does not properly mix, reaction is hampered	Ensure that motor adaptor is made of a strong material that will not fail
Container is watertight	Water leaks into electrical components	Electrical components short	Ensure that all openings in the container are fitted with a watertight seal
UV LEDs close enough to the liquid to induce reaction	Water shorts electrical connections of the LEDs	LEDs fail to work and potential fire hazard	Treat PCB with a watertight coating to prevent water from interfering.
Pumps Aerate the liquid	Tube from pump is pinched	Pump cannot pump enough air to properly aerate	Ensure that the tubes from the pumps cannot move enough to pinch.

Testing

- The motor applies enough torque to the turbine to stir the water and uniformly mix the solution.
- The pumps were verified to fill the container and drain it at an adequate rate, as well as provide proper aeration for the solution.
- A test was performed to determine the most effective method of applying Titanium Dioxide to the inside of the container. The most effective method was determined to be to mix the Titanium Dioxide with water to form a paste which was applied to a replaceable sleeve to be fitted to the inside wall of the container.
- The initial PCB design did not work as intended, as some of the wires were not properly connected to the LEDs, however the second iteration of the design worked as intended, powering all the LEDs simultaneously when powered.
- The spectrometer was tested by using code provided by Adifruit to demonstrate that it can accurately determine a change in colors
- The pH meter was tested to show that it does decern between different pH levels by using code provided by Robotshop to detect the pH of various liquids.