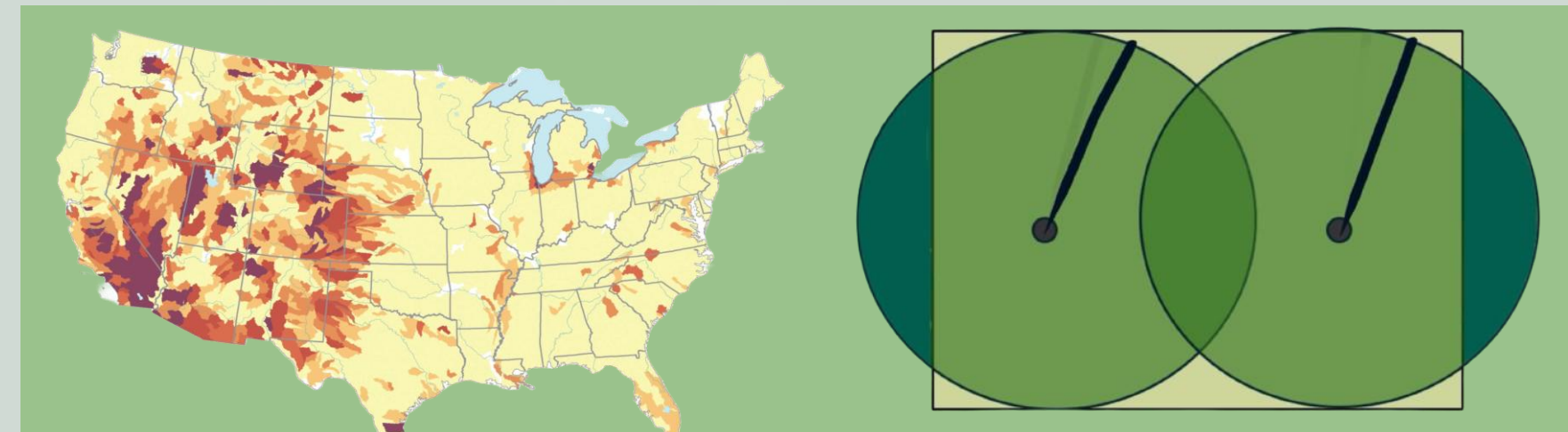
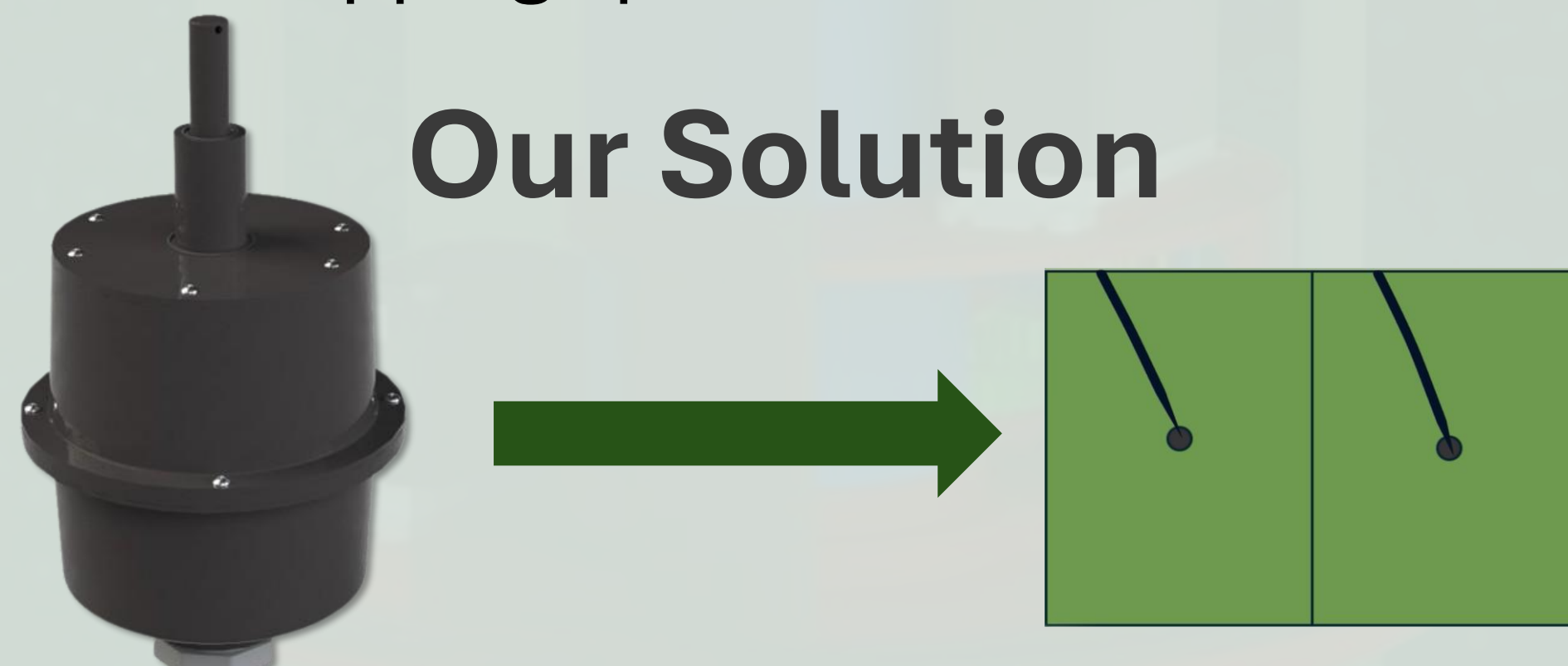


## Problem



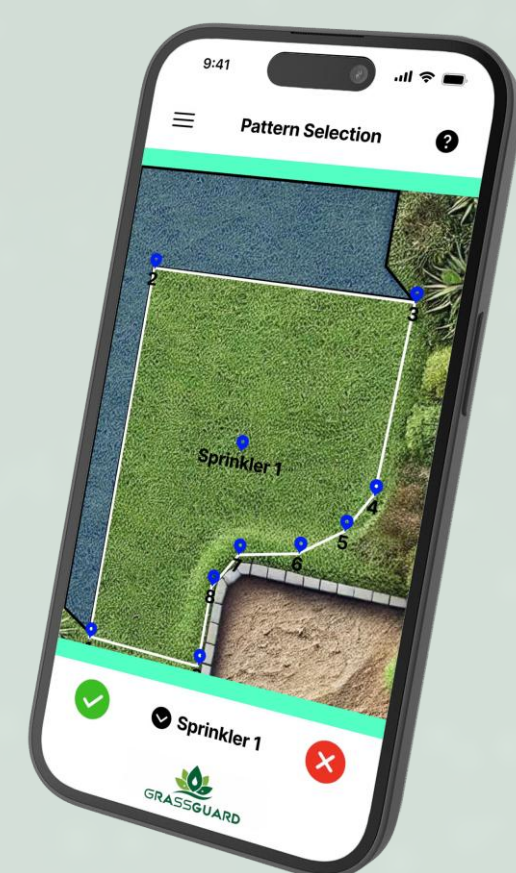
- 9 billion gallons of water are used daily in residential landscape irrigation
- 50% of this water is wasted due to overlapping sprinkler flow

## Our Solution



### The GrassGuard

- Up to 40% more water efficient
- Self-powered
- Works with existing sprinkler systems
- Pays for itself in as little as 11 months



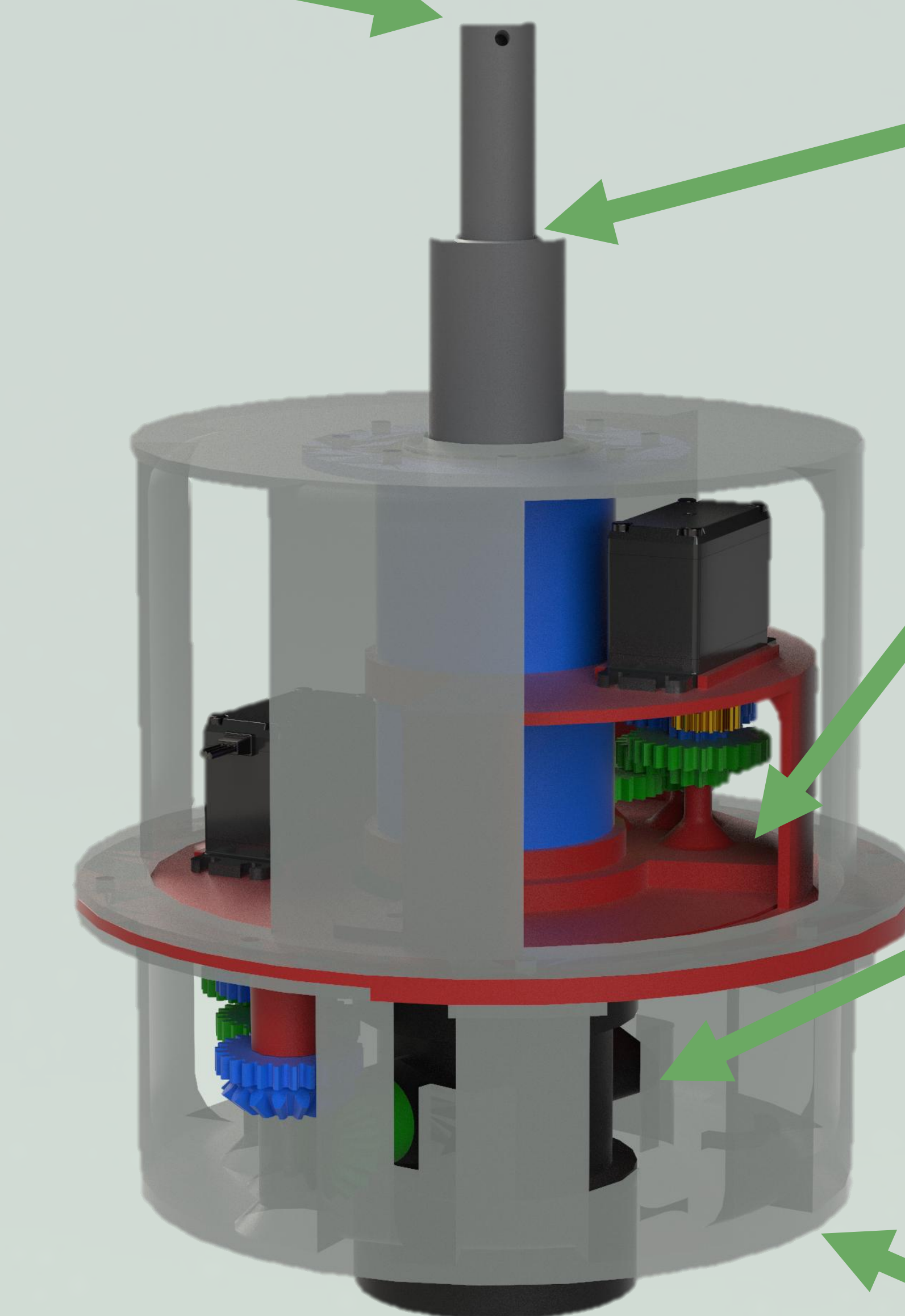
Easily programmable to the shape of your lawn through the app

## Requirements

- Spray distance of up to 30'
- Backwards compatible with standard system (3/4" NPT)
- Waterproof and dust resistant (IP67)
- The sprinkler head shall operate for a minimum of five 8-month seasons
- The generator shall produce a minimum of 9W to charge the battery and power all electronics
- Spray distance shall range from 5-30' at 25-65 psi line pressure and flow rate between 3-10 gpm

## Product Components

Nozzle



Threaded Adapter

### Pop-up

Telescoping pop-up activates with water pressure and returns flush to the surface.

### Power Generation

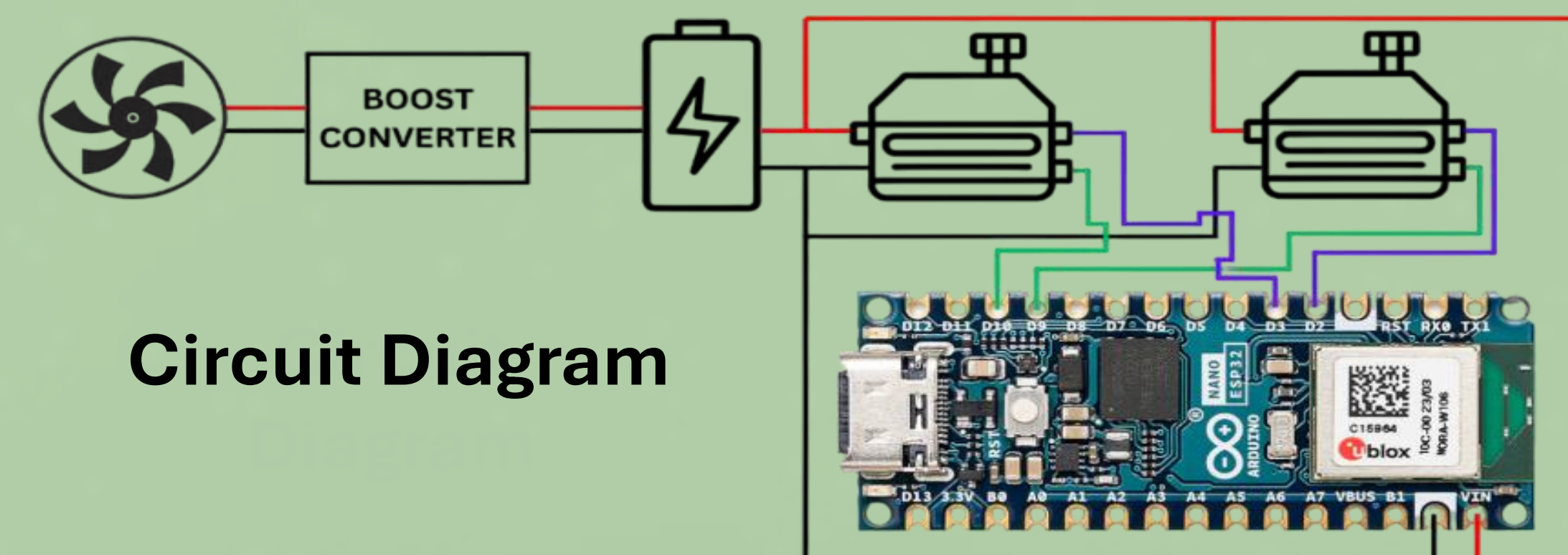
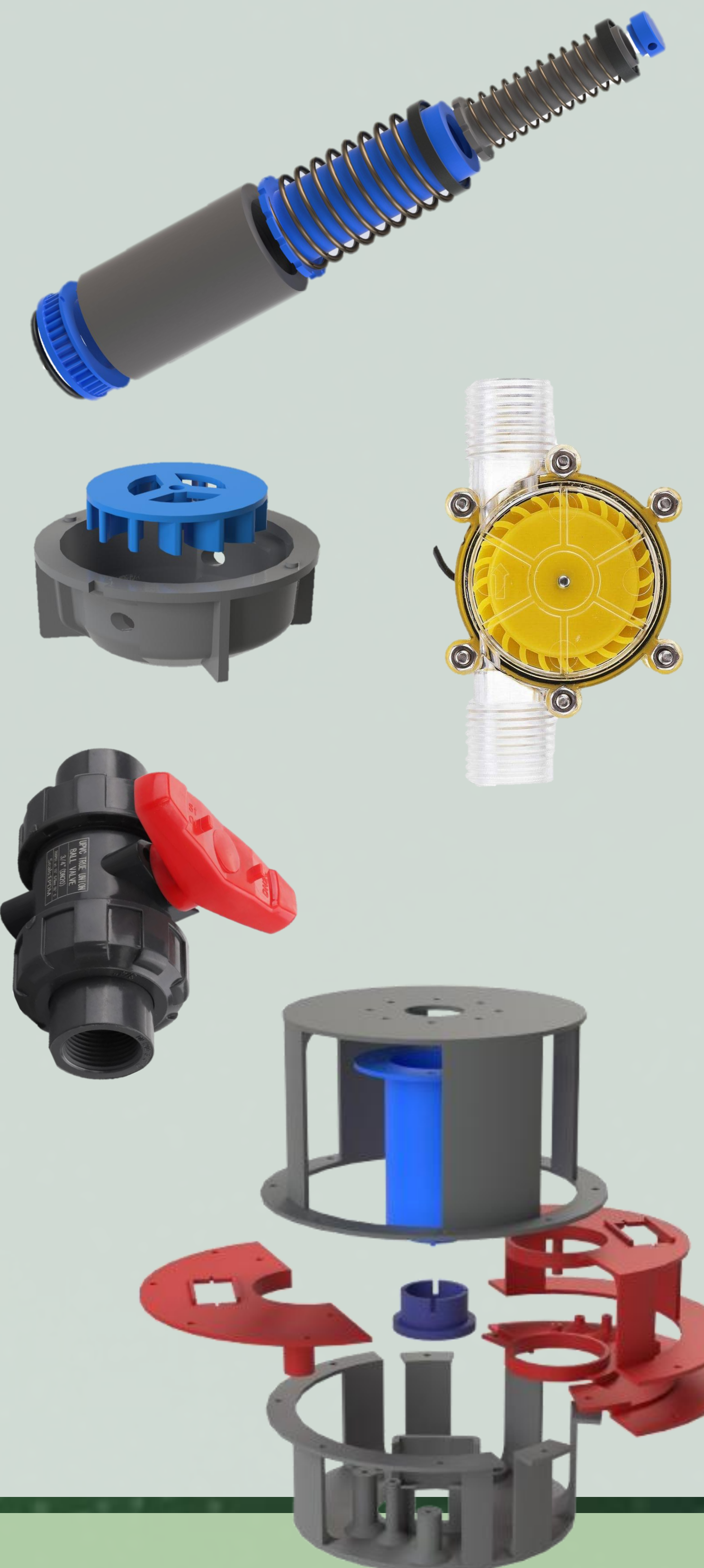
Water is directed through a hydroelectric generator, which charges the battery when the sprinkler is on.

### Valve

The flow rate is modified using a ball valve to control the spray distance.

### Housing

Protects the sprinkler from the surrounding environment and keeps the electronics dry while holding them in place.

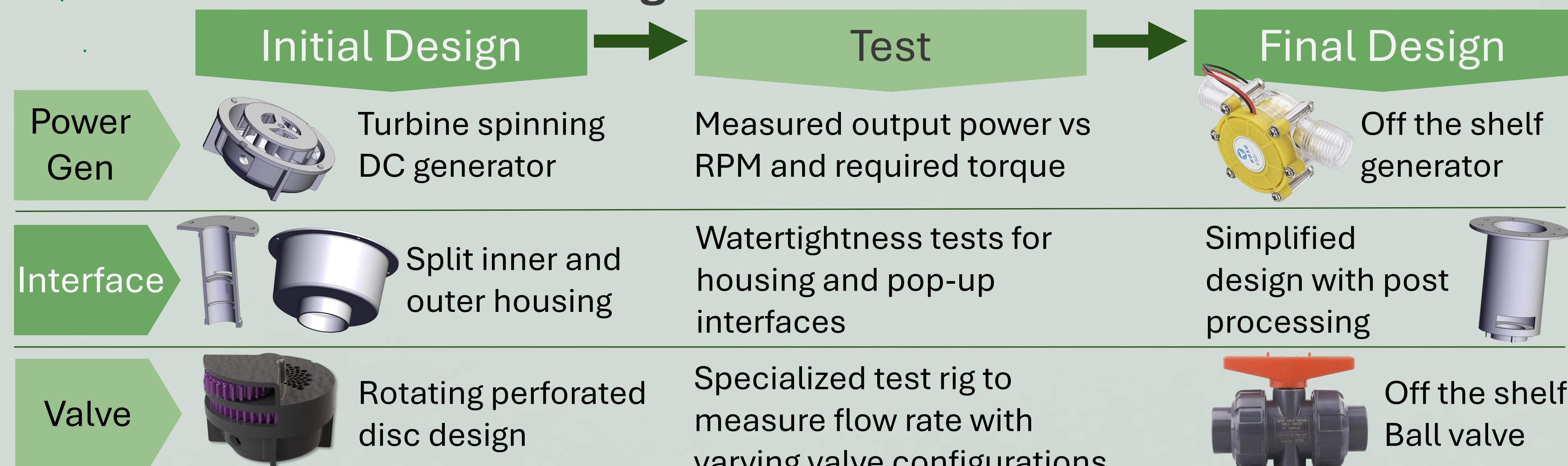


Circuit Diagram

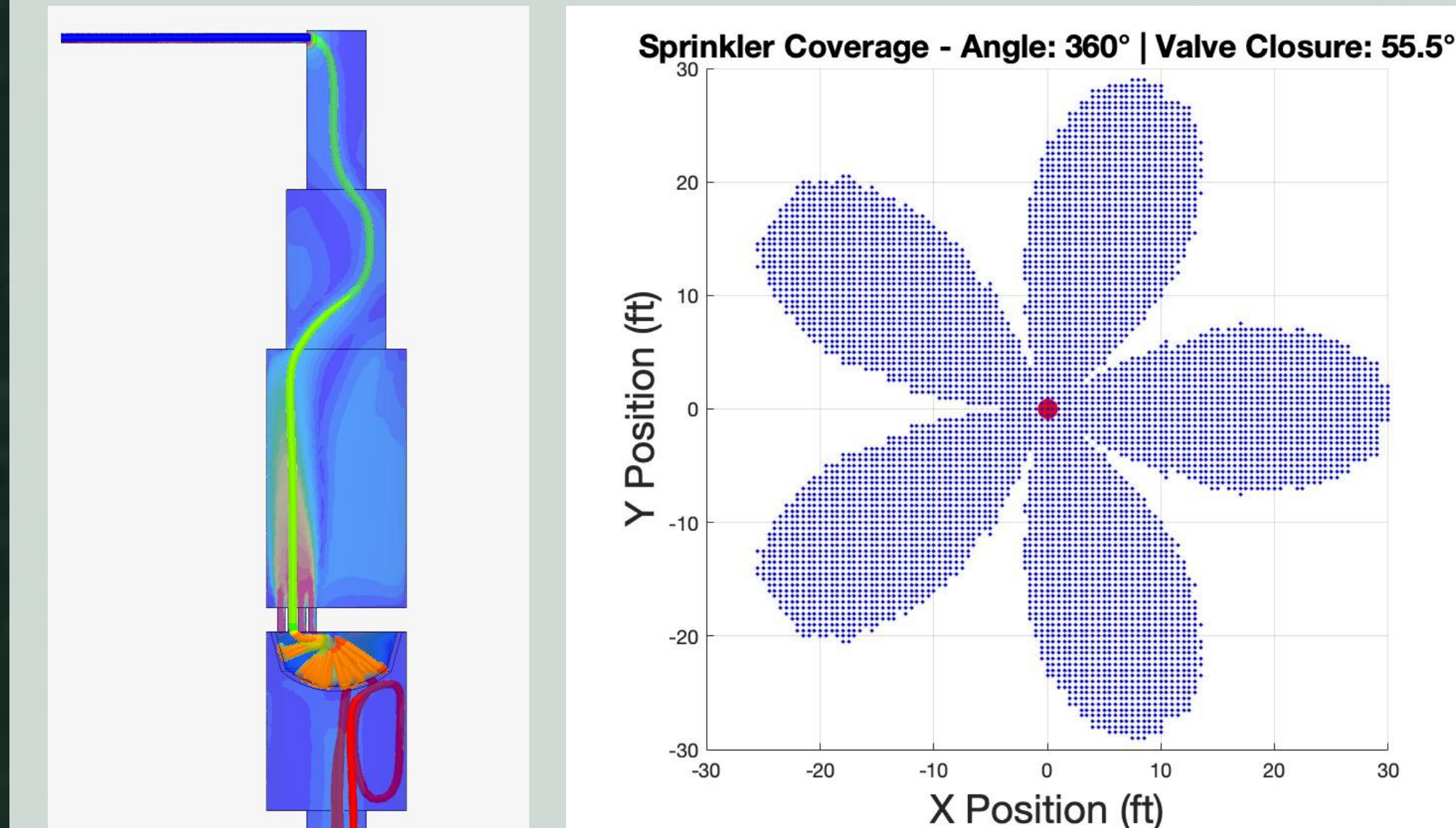
### Electronics

Two servo motors control the pop-up and valve rotation to achieve accurate spray patterns. The PCB allows for connecting to the sprinkler over Wi-Fi.

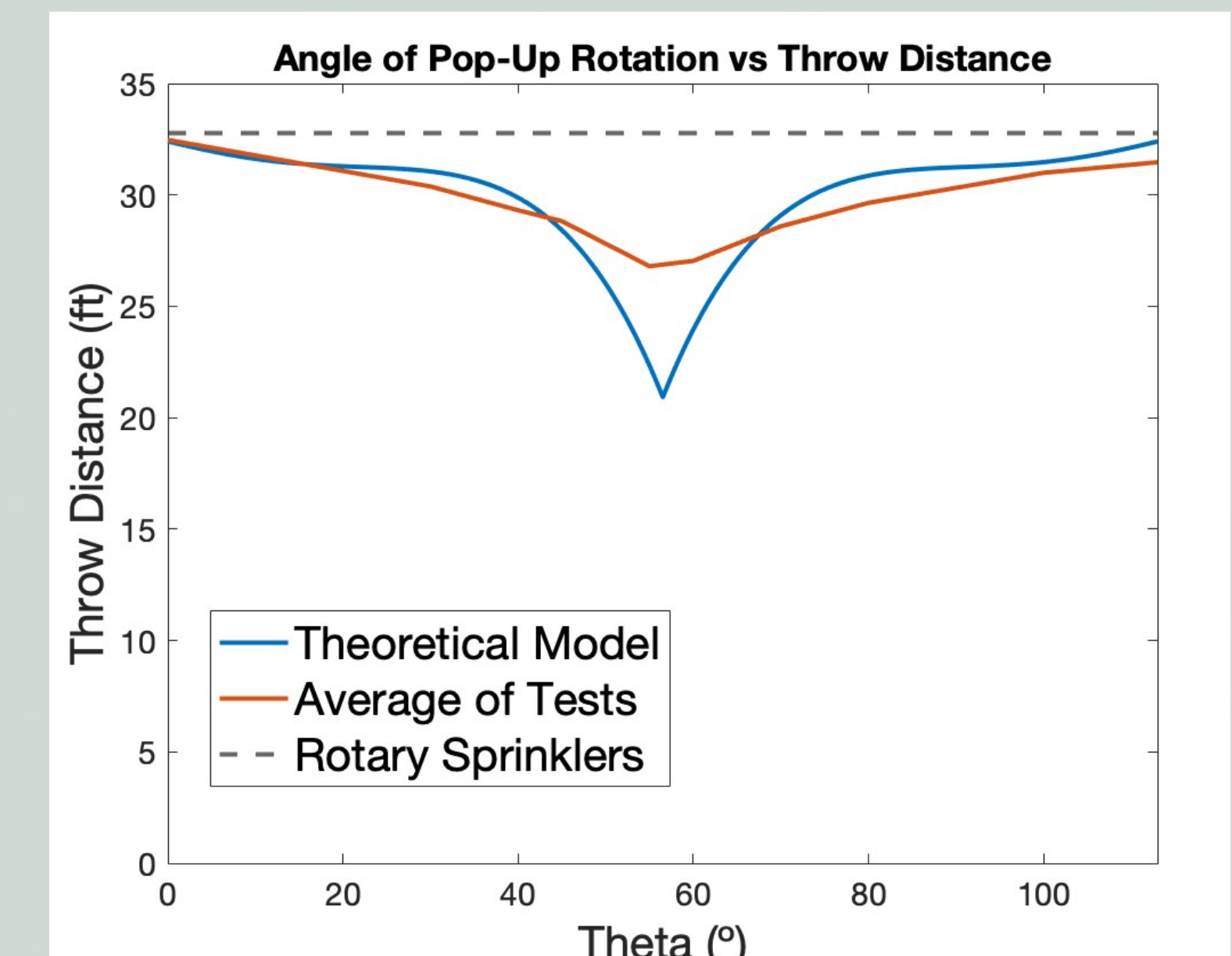
## Testing Backed Evolution



## Theoretical Model



## Functional Testing



- Tested one petal of the theoretical model
- Results averaged over all 10 tests
- Variation attributed to precision of adjustments on non-linear valve
- Validates key functionalities

## Lessons Learned

- Design for manufacturing and assembly
- Crucial to work on and test different subsystems in parallel
- Seeking expert advice to solve problems
- Iterative design process and pushing through failure

## Future Work

- Improve valve accuracy and repeatability
- Injection molding design modifications
- Condense electromechanical systems to reduce overall diameter
- App development and user testing

Thank you to Dan Riffell, Howard Gerwin, Diana Manning, and the IdeaForge staff for their support.