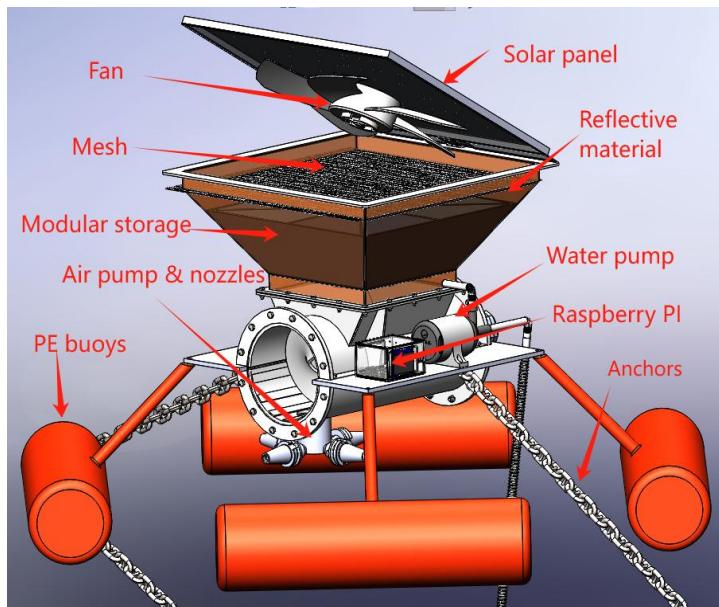


Smart self-cleaning fish feeder

Automated, Modular, and Eco-Friendly Solution for fish feeding

Overview & Key features



Overview: My design consists of five main function parts which are as follows and several auxiliary modules such as display, self-cleaning system, anti-clogging System.

Food store: Modular storage

Measuring device: Scale in modular units and screw conveyer

Distributor: Air pump + nozzles

Power and control: solar panel + battery + Raspberry PI + sensors

Structure and floats: PE buoy + anchors

Requirements:

- Disperse food uniformly over an area of 28-80 m²
- Release 2kg of fish food every 24h
- Have a food capacity for at least a week
- With a maximum cleaning frequency of 2 weeks.
- Display the battery capacity and food

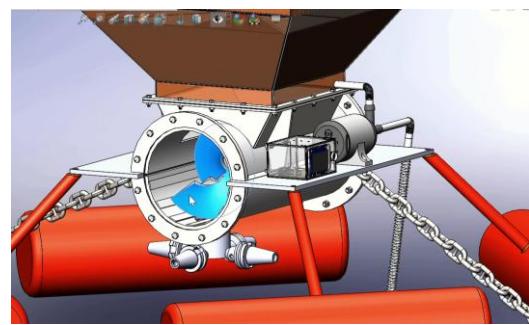
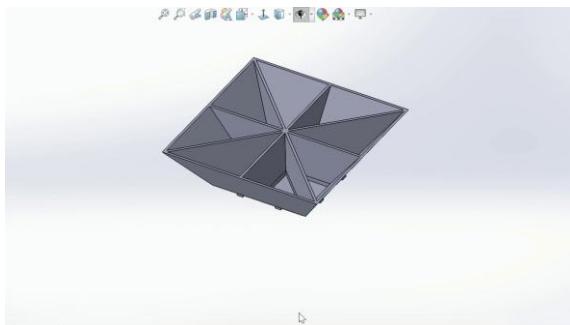
capacity.

- Stable and buoyant in winds up to 80 kmh⁻¹
- Withstand temperature ranging from 0 to 35 degrees centigrade
- Protection from birdlife

Key Features:

- Triple Bird Deterrence:** Reflective PET layer + stainless steel mesh + dynamic alarm.
- Solar-Powered Lid:** 20W monocrystalline panel with dust-resistant design.
- Anti-Clogging System:** Fan-assisted drying + pressurized air injection.
- 8-Module Smart Storage:** Triangular compartments with quantitative scale.
- Spiral metering feed:** Double food metering guarantee.
- Raspberry Pi Control:** Real-time scheduling, remote monitoring, and fault alerts.
- Status Display:** 2.8" LCD screen for battery level and food capacity tracking.
- Anchor-Stabilized Flotation:** 4 PE buoys with corrosion-resistant cables.
- Self-cleaning water pump system:** reduces fish food residue.

Technical details of subsystems

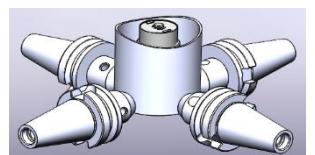


1. Modular Food Storage (with scales inside)

- **Geometry:** Volume can be calculated by $V = \int_0^h A(z)dz = 0.006167m^3$ meet the requirement (3).
- **Material:** ABS plastic with silicone O-ring (Food-graded, Cover working temperature (requirement (7)), Elastic durability, Corrosion-resistant, Light).
- **Release Mechanism:** Raspberry Pi-controlled flip-lid valves for precise portioning.
- **User Benefits:**
 - **Extended Storage Capacity:** Holds 1.5× the baseline requirement (7 days → 13+ days), ideal for travel or remote operation.
 - **Dual Functionality:** Integrates metering and storage into a single modular unit
 - **Easy Refill & Maintenance:** Modules detach individually for cleaning or replacement.
 - **Anti-Clogging:** Top fan prevents food from sticking, getting damp and spoiling

2. Screw conveyer

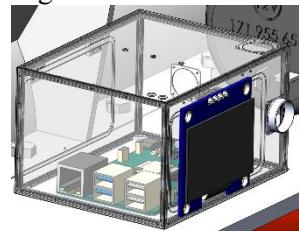
- **Function:** Accurately measures and transfers food from storage modules to the pneumatic ejection chamber drive by step motor
- **Key Components & Material:**
 - **Auger Blade:** 304 stainless steel helix ($\varnothing 313.6\text{mm}$, pitch 30mm) (Corrosion and Wear resistance, Easy to clean: Polished surface, Meet temperature requirement)
 - **Stepper Motor:** 57HS22 step motor (12V DC) + Reducer with ratio of 10:1 ($T_{rated}'=12\text{Nm}>5.1\text{Nm}=T_{need}$, $N_{rated}'=3\text{RPM}$, convey time: $t = \frac{8.62\text{cycle}}{3} = 2.87\text{min}$)
 - **Hopper Interface:** Funnel-shaped inlet to prevent bridging or residual.
- **User Benefits:**
 - **Anti-Clogging Design:** Polished inner surface minimizes friction. + Top-mounted fan provides airflow to reduce humidity.
 - **Energy Efficiency**
 - Consumes 1.15Wh per day and sleep mode activation between cycles.



3. Sprinkler system

- **Function:** Ejects feed pellets horizontally via pressurized air, achieving uniform dispersion over 28–80m². (Meet requirement (1), Consider horizontal projectile motion, we find we need $V_{out} = 14.616 - 32.675 \text{ m/s}$, to drive food spray with this velocity we need $P_{input} = 1.01046 \text{ bar}$ and combine with the spray time $t=172.2\text{s}$ we can calculate the consumption $E = 12.096\text{Wh}$ per day detail in excel)

- **Key Components:**
 - **Nozzles:** 4× 316L stainless steel nozzles ($\varnothing 28\text{mm}$) + PTFE lining coating with adjustive angles (Food-safe, Corrosion and Wear resistant, Durable, Low Cost, Minimize friction).
 - **Portable Air Pump:** 12V DC, pressure (0.7–10 bar meets the $P_{need} = 1.01046 \text{ bar}$).
 - **Ejection Chamber:** Same as nozzles 316L stainless steel nozzles with coating (PTFE) (Minimize pellet friction, Corrosion and Wear resistance, Food-safe).
- **User Benefits:**
 - **Large-Caliber Nozzles:** $\varnothing 28\text{mm}$ nozzle diameter enables high-speed discharge (deliver 2kg food in within 3 mins).
 - **360° and adjustive Coverage:** 4 nozzles with rotating bases achieve 360° dispersion. Adjustable emission angle allows adjustable coverage
 - **Pneumatic Durability:** Air-driven system eliminates mechanical wear and fatigue



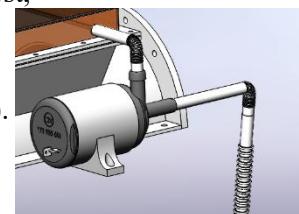
4. Power and control system

- **Function:** Manages energy harvesting, storage, and automated feeding schedules. (Meet requirement (2) and (5))
- **Key Components:**
 - **Solar Panel:** 10W monocrystalline with MPPT charge controller. (Generate 602.25Wh/day far larger than E total consume=219.773Wh detail in excel, Light and High energy supply)
 - **Battery:** 12V 20Ah LiFePO₄ (Used for 7-day backup, Compatible with solar panel).
 - **Raspberry Pi 4B: Runs custom MATLAB scripts for:**
 - Valve timing control
 - Sensor data logging (food gravity, battery capacity, Temperature/humidity)
 - Remote access via Wi-Fi/Bluetooth
- **User Benefits:**
 - Integrate multiple information into the display interface
 - Convert excess solar energy into batteries for backup power (extreme weather)



5. Structure and Floats

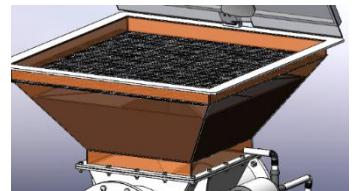
- **Core Design (All parts select corrosion-resistance material):**
 - **Floats:** 4× rotationally molded PE buoys: $\varnothing 400\text{mm}$, L=1.06m buoyancy each. (PE selection reasons: UV resistant, High buoyancy, Shock and Wind resistance GM=2.043m>0 Meet the requirement (6))
 - **Frame:** two powder-coated aluminum plates separated by screw feeder (Al provides light and high strength, corrosion-resistant, high thermal conductivity to dissipate heat)
 - **Anchors:** Two galvanized steel chains with quick-release shackles. (Low cost, corrosion-resistant and high strength)
- **User Benefits:**
 - **Storm-Proof:** Withstands 80km/h winds (detail calculation proved in excel).
 - **Modular Assembly:** Disassembles into 8 compact parts for transport.



6. Self-cleaning system

- **Function:** Flushes residual food from auger and nozzles weekly by pumping seawater to prevent blockages.

- **Key Components:**
 - **Water Pump:** 12V DC, 2L/min flow rate.(After calculating, we need t=7.85min to clean the full conveyer, and to deliver water across H=1.772m it consumes 2.527Wh)
 - **Inlet and output hoses:** Ø32mm at each side
- **User Benefits:**
 - **Water Recycling:** Uses pond/lake water, zero external supply needed.
 - **Hands-Free Cleaning:** Fully automated via Raspberry Pi.



7. Protection

- **Bird Deterrence:**
 - **Reflective PET outer layer** (Lightweight, waterproof and low cost, vibrant protection Meet the requirement (8))
 - **304 stainless steel mesh** (Cover an area of 1.2*1.2 m², Material provides Corrosion resistance, high strength and high temperature resistance Mesh structure Provides breathability and physical protection)
 - **Dynamic alarm**
- **User Benefits:**
 - **Multi-Sensor Monitoring:** Sensor detection pauses feeding during storms.
 - **Eco-Friendly:** Zero chemical repellents.

8. Standard Part

- **Bearing** (SKF 6201-2RS) for **Screw feeder shaft** and **Flip Lid shaft** (to reduce friction)
 - **Selection reasons:** **Waterproof and dustproof + Low friction design + Long life**
- **Screw and nuts**
 - **Specification:** A2 stainless steel hexagon socket bolt (ISO 4762 M6×20)
 - **Selection reasons:** **Corrosion resistance + High Strength + Standardization**
- **Seals**
 - **Specification:** Silicone O-ring (ASTM D2000 M3G614)
 - **Selection reasons:** **Food-graded + Temperature resistance + Elastic durability**

Specifications

Technical Specifications & Key Calculation Results

Component	Details	Component	Details
Solar Panel	10W, monocrystalline	Display	0.14*0.13 m ² LCD
Li Battery	12V LiFePO ₄ , 20Ah	Convey time	2.87 min
Portable Air Pump	12V 2A P=0.7-10bar	Solar Power Supply	602.25 Wh/day
Water pump	12V 2A 24W Q=2L/min	Spray velocity	14.616-32.675 m/s
Fan	2W 48 Wh/day	Volume capacity	8 * 0.006167 m ³
Step Motor	57HS22 12V 2A	Food Capacity	16kg (8-day food)

