Intelligent Space Resource Management

NASA SPACE APP

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Contents

Introduction:

In this world the more we explore the space the more we understand our world , I devolved a smart steam that will help the space astronaut to monitor the food that integrated with LLM beside monitor oxygen and water and electricity , the system focused on dynamic change and creating recycle management for main resource food , water , oxygen and electricity

System Overview:

For ISS (International Space Station) the size for it around 109 m^3 I will make it as reference , so I need this seniors

1. **2× O_2 sensors** → monitor breathable air and redundancy.
2. 2× **CO_2 sensors** → track buildup, make sure Sabatier reaction is effective.
3. **2× Humidity** sensors → water recovery + comfort.
4. **1× Temperature sensor** → thermal control.
5. **2× Water tank sensors** → redundancy for life-critical water supply.
6. **1× Hydrogen tank sensor** → needed for Sabatier reaction input.
7. **1× Food storage sensor** → simple mass/weight/RFID counter.

wateSr system :

we will use 3 independent source

1. Urine
2. CO_2
3. Humidity

Water system

Urine/wastewater recovery→ standard ISS tech (85–90% recovery)

human breath O_2 and reduce CO_2 using this formula :

$CO_2 + 4H_2 \rightarrow CH_4 + 2H_2O$ the water will go to the another phase to filter it or no based on the senior

Humidity $2H_20_{(vaper)} \rightarrow 2H_20_{\ (leq)}$

This system makes sure the water will be extended

O_2 system

For Oxygen we will have another 3 source

1. Oxygen Generation via Electrolysis
2. Solid Fuel Oxygen GenerationSystem over view

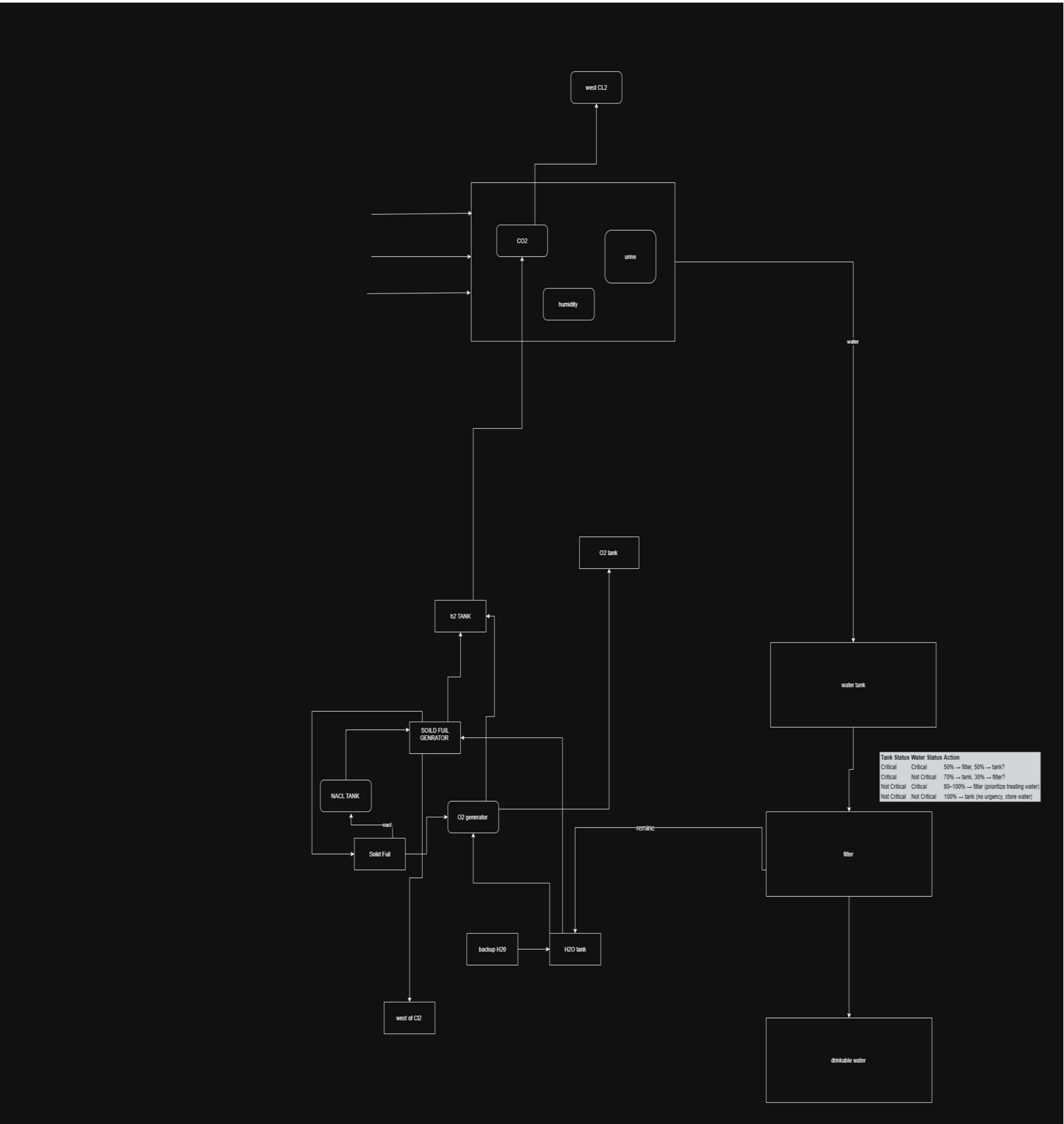
Solid fuel

NaClO3 + H2O → Nacl+3o2 then Nacl + 3H20 → Cl + H2 + NaclO3 the H2 will go to H tank to combine with CO2+4H2 also H2 can be used later as fuel

Electric system

We will use a voltage glass with electric panel to generate needed electricity to power all sensors and as helping agent to convert water to o2 + H

System diagram



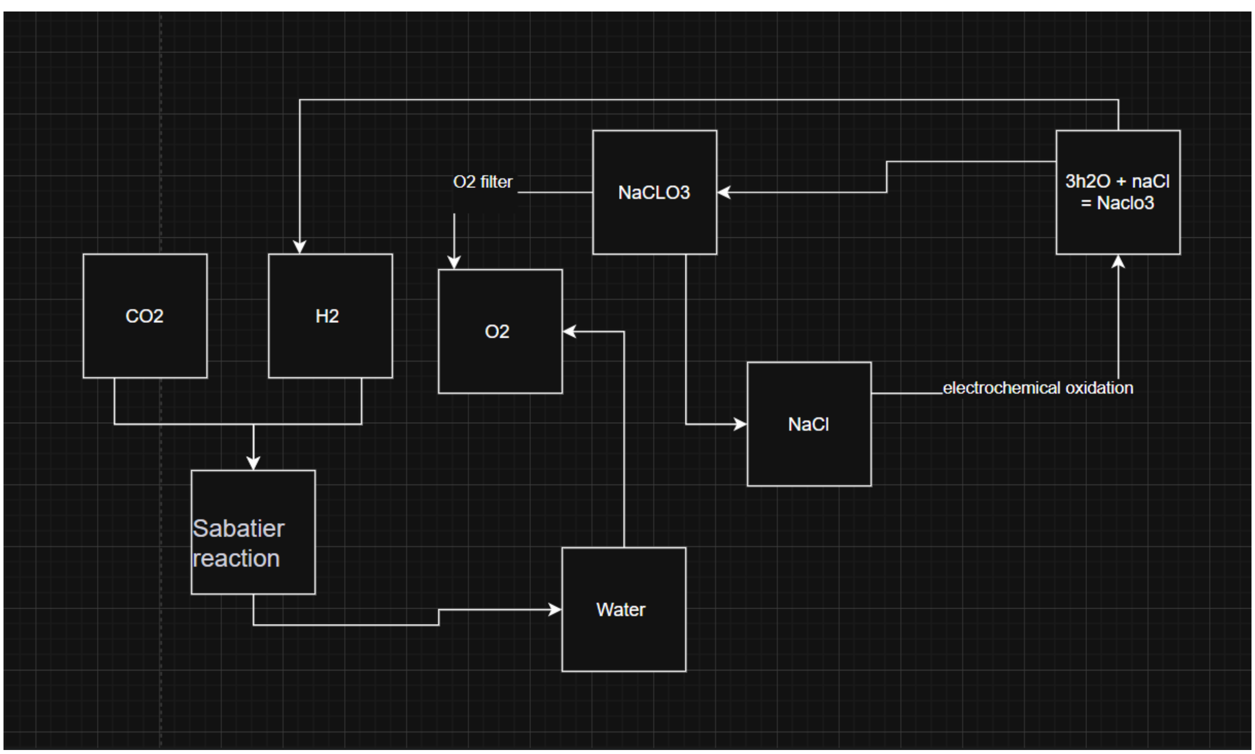
Tank Status	Water Status	Action
Critical	Critical	50% → filter, 50% → tank?
Critical	Not Critical	70% → tank, 30% → filter?
Not Critical	Critical	80–100% → filter (prioritize treating water)
Not Critical	Not Critical	100% → tank (no urgency, store water)

System describe

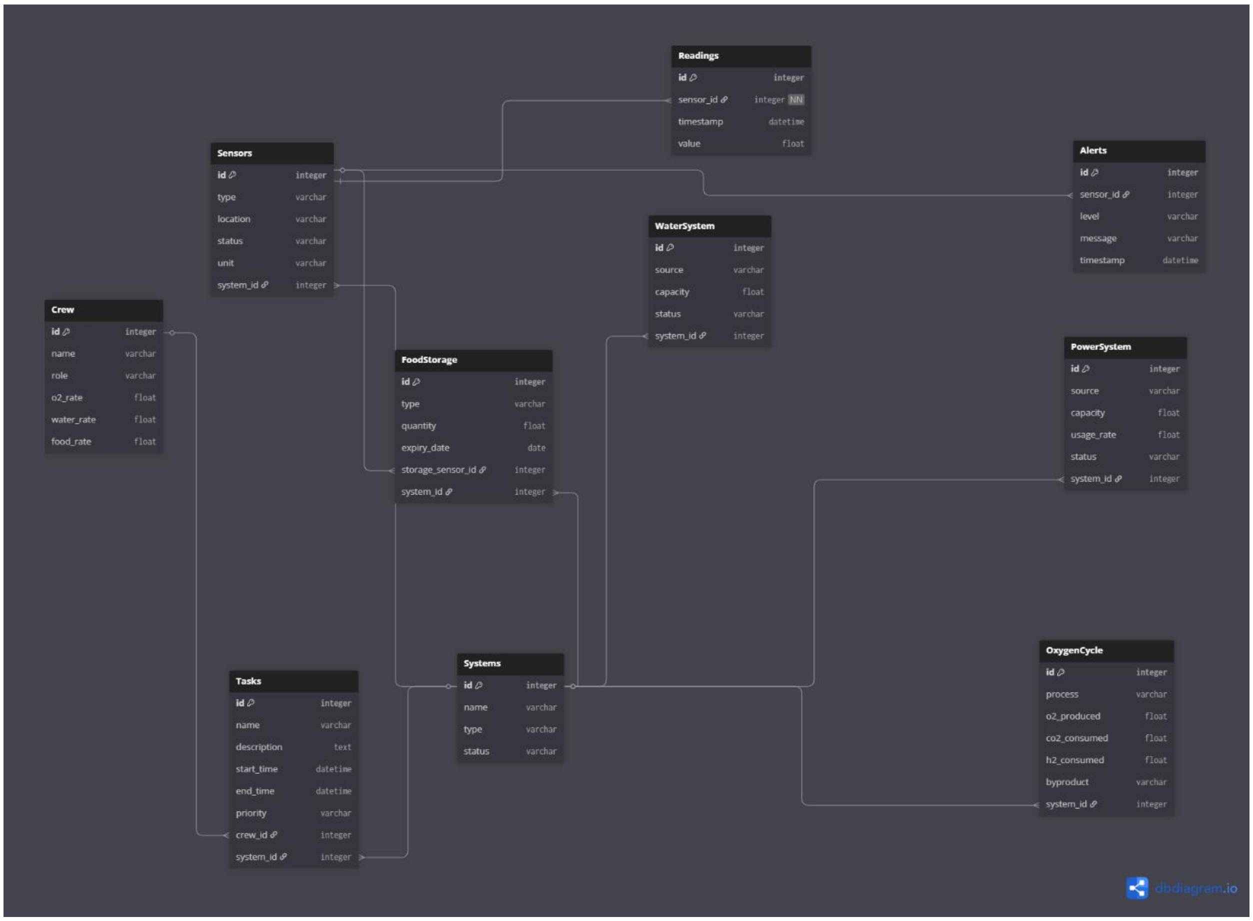
First the system will take there independent source to produce water then the system will monitor two factor, the o2 tank and drinkable tank based on that it will choose the amount to filter the water

In O2 phase it is consider as closed loop or recycle the elements for example if the water was in critical condition we will use the backup fuel to produce O2 after filter it and with enough agent it will give me NaCl , that in theory could convert to electrochemical oxidation NaCLO3 + 3H2 , and H2 will use in CO2

Theoretical Closed-Loop



Database Diagram

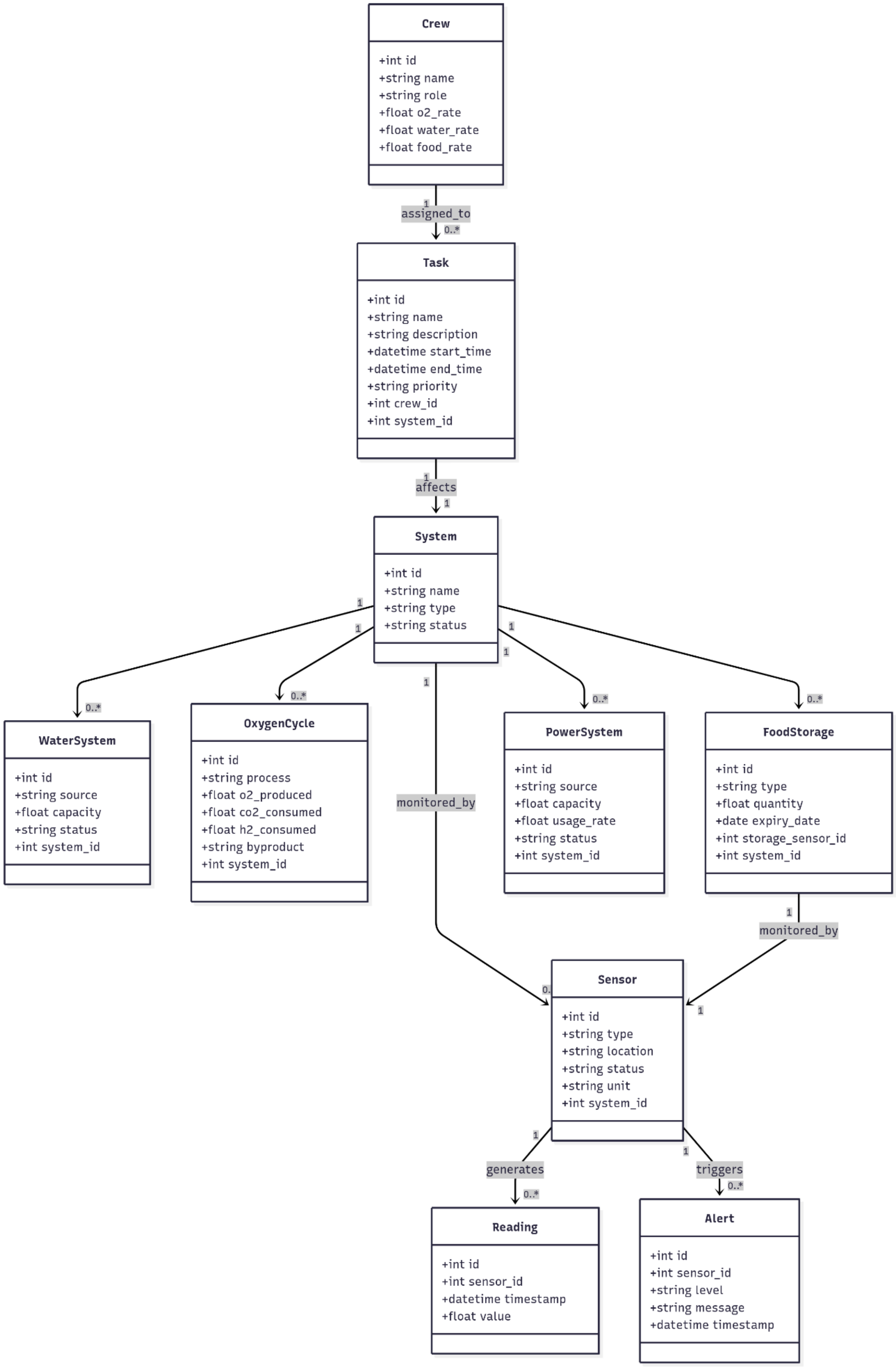


Normalization

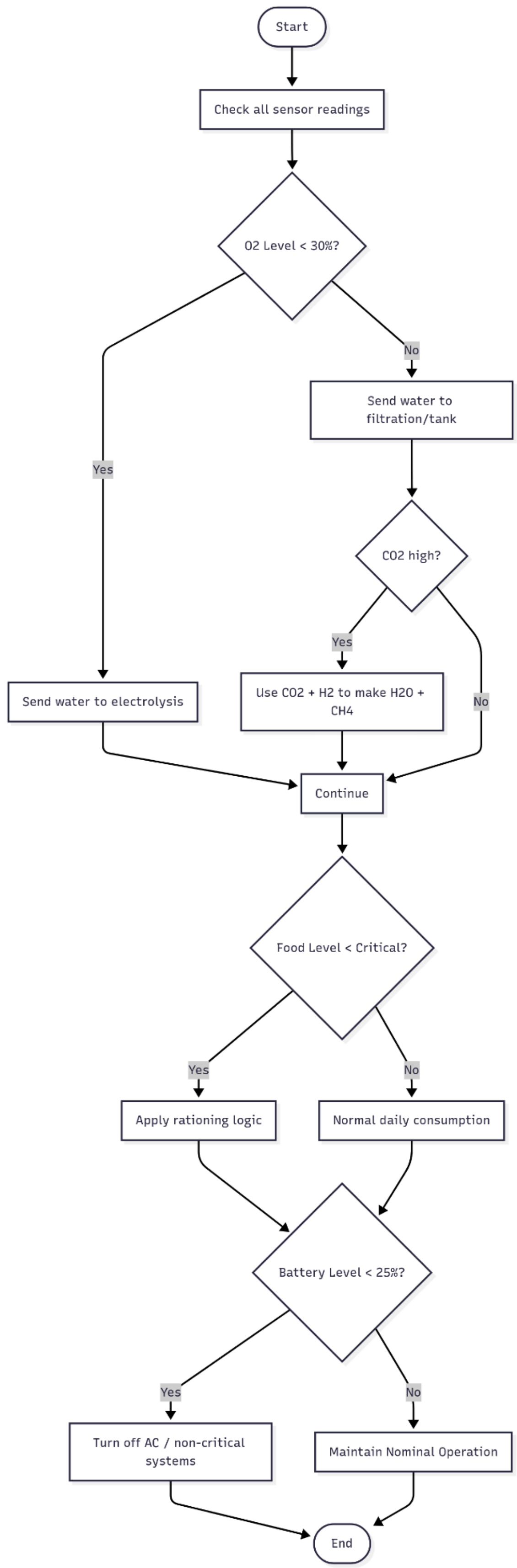
1. 1st Normal Form (1NF) - All tables hold atomic values; each column contains a single value, and there are no repeating groups. For example, each sensor is in its own row with the proper values for type, status and location.
2. 2nd Normal Form (2NF) - All non-key columns are dependent on the full primary key
3. 3rd Normal Form (3NF) - There are no transitive dependencies; all non-key attributes are dependent on the primary key.

This normalization makes the system **efficient, easy to update, and reliable** for managing space resources

UML diagram


Crew
+int id
+string name
+string role
+float o2_rate
+float water_rate
+float food_rate
assigned_to
1
0..*
Task
+int id
+string name
+string description
+datetime start_time
+datetime end_time
+string priority
+int crew_id
+int system_id
affects
1
1
System
+int id
+string name
+string type
+string status
WaterSystem
+int id
+string source
+float capacity
+string status
+int system_id
OxygenCycle
+int id
+string process
+float o2_produced
+float co2_consumed
+float h2_consumed
+string byproduct
+int system_id
monitored_by
PowerSystem
+int id
+string source
+float capacity
+float usage_rate
+string status
+int system_id
FoodStorage
+int id
+string type
+float quantity
+date expiry_date
+int storage_sensor_id
+int system_id
monitored_by
Sensor
+int id
+string type
+string location
+string status
+string unit
+int system_id
generates
triggers
Reading
+int id
+int sensor_id
+datetime timestamp
+float value
Alert
+int id
+int sensor_id
+string level
+string message
+datetime timestamp

Activity diagram



Food system

We can use LLM to find best calorie for each crew and calculate if the critical level for example

We have 4 crew member each one wight about 70 Kg , we will use there wight to calculate how many kg of food they will consume

Promat:

We have a space mission with the following parameters:

- Crew: 4 members, each weighing 70 kg
- Daily calorie requirement: 30 kcal per kg of body weight
- Food energy density: 1 kg = 2500 kcal
- Mission duration: D days
- Current stock: S_kg of food
- Critical threshold: 15% of remaining mission requirement

Calculate and provide **only** the following in a single response (no extra explanation):

1. Daily food per crew member (kg/day)
2. Total daily food for all crew (kg/day)
3. Total food required for the mission (kg)
4. Critical threshold (kg)
5. Whether current stock is critical (Yes/No)

Output the results in **JSON format** so it can be directly used in a system.

LLM respond

"daily_food_per_crew": 0.84,

"total_daily_food": 3.36,

"total_food_required": 100.8,

"critical_threshold": 15.12,

"is_critical": "No",

So what if the food in critical here we will design a smart system based on 2 factor

1. Critical threshold
2. The crew have task

Lets assume that the Critical level was 20% and total food was around 100 KG , and today supply was 19KG and we have 8 crew and 1 crew have a task we can assume the following logic

If (food > threshold and task != 1)

Food consummation = 100%

Else if (food > threshold and task == 1)

Food consummation = 90 %

Assigned crew for the task = 110% (or more based on the task difficulty)

Else if (food < threshold and task != 1)

Food consummation = 70

Else

Food consummation = 60 %

Assigned crew for the task = 80% (or more based on the task difficulty)

Other algorithm

For water

if tank_is_critical and water_is_critical:

send_to_filter = 0.5 * water_amount

send_to_tank = 0.5 * water_amount

else if tank_is_critical and not water_is_critical:

send_to_tank = 0.7 * water_amount

send_to_filter = 0.3 * water_amount

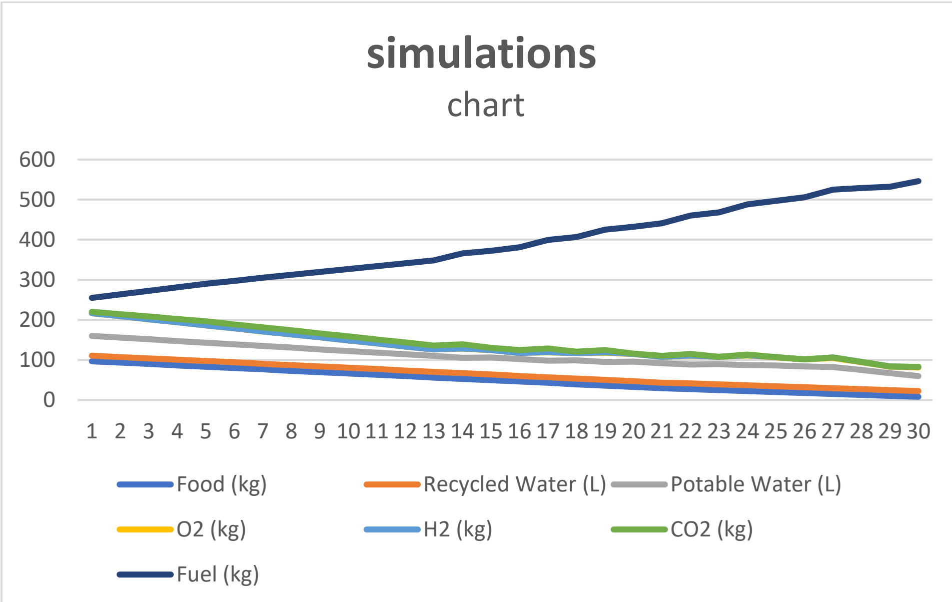
else if not tank_is_critical and water_is_critical:

```
   send_to_filter = 0.8 * water_amount

   send_to_tank = 0.2 * water_amount


else:

   send_to_tank = water_amount

   send_to_filter = 0

for battery

if battery < 25%:

   reduce non-critical systems (AC, lights, lab instruments)


else:

   normal operation
```

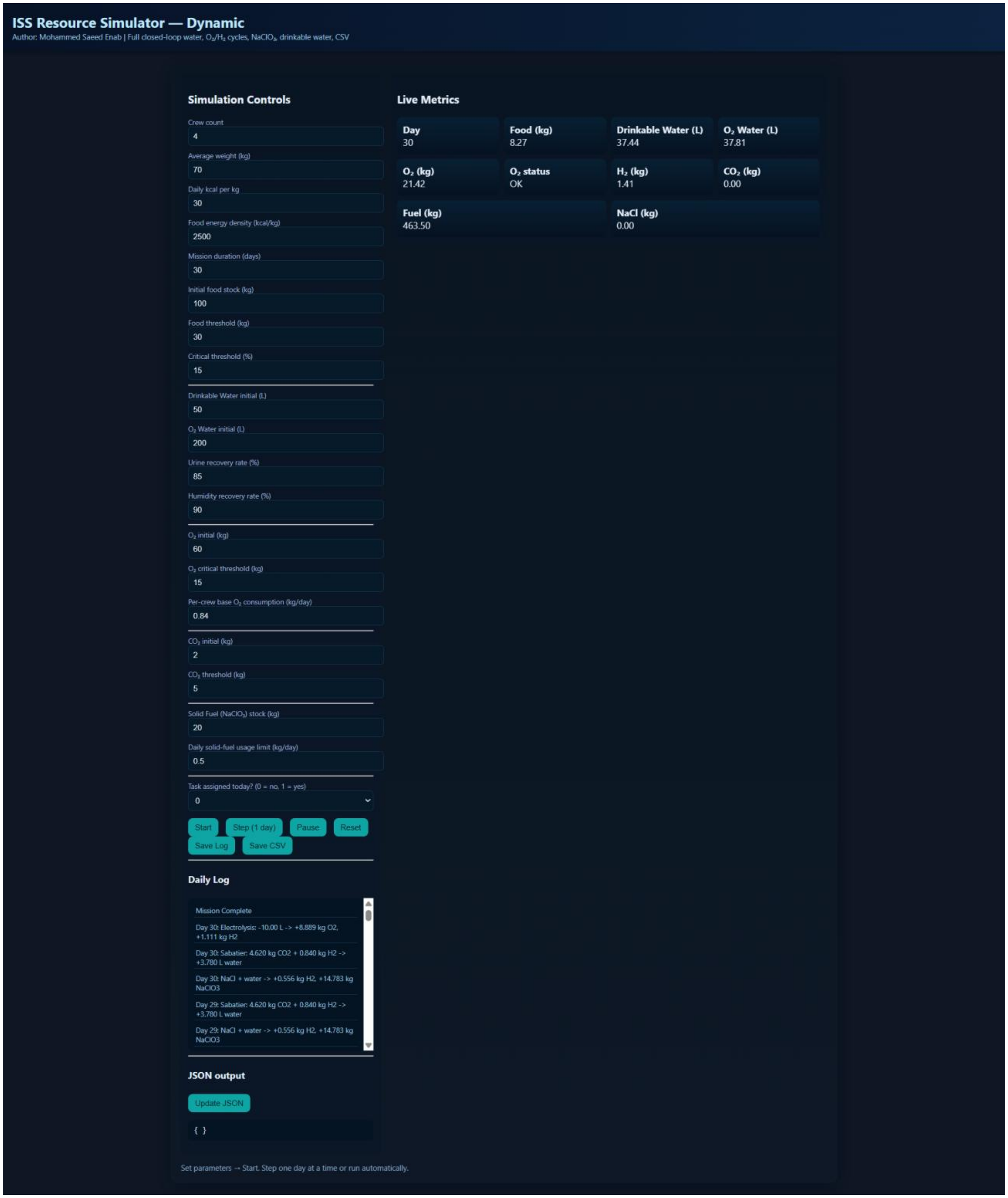
CO_2 Management

```
if CO2 > threshold:

   activate CO2 scrubber

else:

   monitor only
```

simulations



The scenario is



Log

Mission Complete.

Day 30: Sabatier consumed 3.696 kg CO_2 & 0.672 kg H_2 -> +3.024 L drink water.

Day 30: Electrolysis -10.00 L => +1.111 kg H_2, +2.237 kg O_2 (vented 6.652).

Day 30: Solid Fuel used 0.50 kg -> +0.451 kg O_2, +0.275 kg NaCl.

Day 30: Recovered 14.40 L water → drink:9.02 L, o2:20.88 L.

Day 30: Crew used 12.80 L water (drinkable+O_2 tanks).

Day 30: Crew consumed 2.688 kg O_2 → +3.696 kg CO_2.

Day 30: Food consumed 2.016 kg (60%). Crew efficiency factor 80%.

Day 29: Sabatier consumed 3.696 kg CO_2 & 0.672 kg H_2 -> +3.024 L drink water.

Day 29: Electrolysis -10.00 L => +1.111 kg H_2, +2.237 kg O_2 (vented 6.652).

Day 29: Solid Fuel used 0.50 kg -> +0.451 kg O_2, +0.275 kg NaCl.

Day 29: Recovered 14.40 L water → drink:11.60 L, o2:23.68 L.

Day 29: Crew used 12.80 L water (drinkable+O_2 tanks).

Day 29: Crew consumed 2.688 kg O_2 → +3.696 kg CO_2.

Day 29: Food consumed 2.016 kg (60%). Crew efficiency factor 80%.

Day 28: Sabatier consumed 3.696 kg CO_2 & 0.672 kg H_2 -> +3.024 L drink water.

Day 28: Electrolysis -10.00 L => +1.111 kg H_2, +2.237 kg O_2 (vented 6.652).

Day 28: Solid Fuel used 0.50 kg -> +0.451 kg O_2, +0.275 kg NaCl.

Day 28: Recovered 14.40 L water → drink:14.18 L, o2:26.48 L.

Day 28: Crew used 12.80 L water (drinkable+O_2 tanks).

Day 28: Crew consumed 2.688 kg O_2 → +3.696 kg CO_2.

Day 28: Food consumed 2.016 kg (60%). Crew efficiency factor 80%.

Day 27: Sabatier consumed 3.696 kg CO_2 & 0.672 kg H_2 -> +3.024 L drink water.

Day 27: Electrolysis -10.00 L => +1.111 kg H_2, +2.237 kg O_2 (vented 6.652).

Day 27: Solid Fuel used 0.50 kg -> +0.451 kg O_2, +0.275 kg NaCl.

Day 27: Recovered 14.40 L water → drink:16.75 L, o2:29.28 L.

Day 27: Crew used 12.80 L water (drinkable+O_2 tanks).

Day 27: Crew consumed 2.688 kg O_2 → +3.696 kg CO_2.

Day 27: Food consumed 2.016 kg (60%). Crew efficiency factor 80%.

Day 26: Sabatier consumed 3.696 kg CO_2 & 0.672 kg H_2 -> +3.024 L drink water.

Day 26: Electrolysis -10.00 L => +1.111 kg H_2, +2.237 kg O_2 (vented 6.652).

Day 26: Solid Fuel used 0.50 kg -> +0.451 kg O_2, +0.275 kg NaCl.

Day 26: Recovered 14.40 L water → drink:19.33 L, o2:32.08 L.

Day 26: Crew used 12.80 L water (drinkable+O_2 tanks).

Day 26: Crew consumed 2.688 kg O_2 → +3.696 kg CO_2.

Day 26: Food consumed 2.016 kg (60%). Crew efficiency factor 80%.

Day 25: Sabatier consumed 3.696 kg CO_2 & 0.672 kg H_2 -> +3.024 L drink water.

Day 25: Electrolysis -10.00 L => +1.111 kg H_2, +2.237 kg O_2 (vented 6.652).

Day 25: Solid Fuel used 0.50 kg -> +0.451 kg O_2, +0.275 kg NaCl.

Day 25: Recovered 14.40 L water → drink:21.90 L, o2:34.88 L.

Day 25: Crew used 12.80 L water (drinkable+O_2 tanks).

Day 25: Crew consumed 2.688 kg O_2 → +3.696 kg CO_2.

Day 25: Food consumed 2.016 kg (60%). Crew efficiency factor 80%.

Day 24: Sabatier consumed 5.082 kg CO_2 & 0.924 kg H_2 -> +4.158 L drink water.

Day 24: Electrolysis -10.00 L => +1.111 kg H_2, +3.245 kg O_2 (vented 5.644).

Day 24: Solid Fuel used 0.50 kg -> +0.451 kg O_2, +0.275 kg NaCl.

Day 24: Recovered 14.40 L water → drink:23.35 L, o2:37.68 L.

Day 24: Crew used 17.60 L water (drinkable+O_2 tanks).

Day 24: Crew consumed 3.696 kg O_2 → +5.082 kg CO_2.

Day 24: Food consumed 3.024 kg (90%). Crew efficiency factor 110%.

Day 23: Sabatier consumed 5.082 kg CO_2 & 0.924 kg H_2 -> +4.158 L drink water.

Day 23: Electrolysis -10.00 L => +1.111 kg H_2, +3.245 kg O_2 (vented 5.644).

Day 23: Solid Fuel used 0.50 kg -> +0.451 kg O_2, +0.275 kg NaCl.

Day 23: Recovered 14.40 L water → drink:29.59 L, o2:40.48 L.

Day 23: Crew used 17.60 L water (drinkable+O_2 tanks).

Day 23: Crew consumed 3.696 kg O_2 → +5.082 kg CO_2.

Day 23: Food consumed 3.024 kg (90%). Crew efficiency factor 110%.

Day 22: Sabatier consumed 5.082 kg CO_2 & 0.924 kg H_2 -> +4.158 L drink water.

Day 22: Electrolysis -10.00 L => +1.111 kg H_2, +3.245 kg O_2 (vented 5.644).

Day 22: Solid Fuel used 0.50 kg -> +0.451 kg O_2, +0.275 kg NaCl.

Day 22: Recovered 14.40 L water → drink:35.83 L, o2:43.28 L.

Day 22: Crew used 17.60 L water (drinkable+O_2 tanks).

Day 22: Crew consumed 3.696 kg O_2 → +5.082 kg CO_2.

Day 22: Food consumed 3.024 kg (90%). Crew efficiency factor 110%.

Day 21: Sabatier consumed 5.082 kg CO_2 & 0.924 kg H_2 -> +4.158 L drink water.

Day 21: Electrolysis -10.00 L => +1.111 kg H_2, +3.245 kg O_2 (vented 5.644).

Day 21: Solid Fuel used 0.50 kg -> +0.451 kg O_2, +0.275 kg NaCl.

Day 21: Recovered 14.40 L water → drink:42.07 L, o2:46.08 L.

Day 21: Crew used 17.60 L water (drinkable+O_2 tanks).

Day 21: Crew consumed 3.696 kg O_2 → +5.082 kg CO_2.

Day 21: Food consumed 3.024 kg (90%). Crew efficiency factor 110%.

Day 20: Sabatier consumed 5.082 kg CO_2 & 0.924 kg H_2 -> +4.158 L drink water.

Day 20: Electrolysis -10.00 L => +1.111 kg H_2, +3.245 kg O_2 (vented 5.644).

Day 20: Solid Fuel used 0.50 kg -> +0.451 kg O_2, +0.275 kg NaCl.

Day 20: Recovered 14.40 L water → drink:48.31 L, o2:48.88 L.

Day 20: Crew used 17.60 L water (drinkable+O_2 tanks).

Day 20: Crew consumed 3.696 kg O_2 → +5.082 kg CO_2.

Day 20: Food consumed 3.024 kg (90%). Crew efficiency factor 110%.

Day 19: Sabatier consumed 5.082 kg CO_2 & 0.924 kg H_2 -> +4.158 L drink water.

Day 19: Electrolysis -10.00 L => +1.111 kg H_2, +3.245 kg O_2 (vented 5.644).

Day 19: Solid Fuel used 0.50 kg -> +0.451 kg O_2, +0.275 kg NaCl.

Day 19: Recovered 14.40 L water → drink:54.56 L, o2:51.68 L.

Day 19: Crew used 17.60 L water (drinkable+O_2 tanks).

Day 19: Crew consumed 3.696 kg O_2 → +5.082 kg CO_2.

Day 19: Food consumed 3.024 kg (90%). Crew efficiency factor 110%.

Day 18: Sabatier consumed 4.620 kg CO_2 & 0.840 kg H_2 -> +3.780 L drink water.

Day 18: Electrolysis -10.00 L => +1.111 kg H_2, +2.909 kg O_2 (vented 5.980).

Day 18: Solid Fuel used 0.50 kg -> +0.451 kg O_2, +0.275 kg NaCl.

Day 18: Recovered 14.40 L water → drink:61.18 L, o2:54.48 L.

Day 18: Crew used 16.00 L water (drinkable+O_2 tanks).

Day 18: Crew consumed 3.360 kg O_2 → +4.620 kg CO_2.

Day 18: Food consumed 3.360 kg (100%). Crew efficiency factor 100%.

Day 17: Sabatier consumed 4.620 kg CO_2 & 0.840 kg H_2 -> +3.780 L drink water.

Day 17: Electrolysis -10.00 L => +1.111 kg H_2, +2.909 kg O_2 (vented 5.980).

Day 17: Solid Fuel used 0.50 kg -> +0.451 kg O_2, +0.275 kg NaCl.

Day 17: Recovered 14.40 L water → drink:60.44 L, o2:63.04 L.

Day 17: Crew used 16.00 L water (drinkable+O_2 tanks).

Day 17: Crew consumed 3.360 kg O_2 → +4.620 kg CO_2.

Day 17: Food consumed 3.360 kg (100%). Crew efficiency factor 100%.

Day 16: Sabatier consumed 4.620 kg CO_2 & 0.840 kg H_2 -> +3.780 L drink water.

Day 16: Electrolysis -10.00 L => +1.111 kg H_2, +2.909 kg O_2 (vented 5.980).

Day 16: Solid Fuel used 0.50 kg -> +0.451 kg O_2, +0.275 kg NaCl.

Day 16: Recovered 14.40 L water → drink:59.70 L, o2:71.60 L.

Day 16: Crew used 16.00 L water (drinkable+O_2 tanks).

Day 16: Crew consumed 3.360 kg O_2 → +4.620 kg CO_2.

Day 16: Food consumed 3.360 kg (100%). Crew efficiency factor 100%.

Day 15: Sabatier consumed 4.620 kg CO_2 & 0.840 kg H_2 -> +3.780 L drink water.

Day 15: Electrolysis -10.00 L => +1.111 kg H_2, +2.909 kg O_2 (vented 5.980).

Day 15: Solid Fuel used 0.50 kg -> +0.451 kg O_2, +0.275 kg NaCl.

Day 15: Recovered 14.40 L water → drink:58.96 L, o2:80.16 L.

Day 15: Crew used 16.00 L water (drinkable+O_2 tanks).

Day 15: Crew consumed 3.360 kg O_2 → +4.620 kg CO_2.

Day 15: Food consumed 3.360 kg (100%). Crew efficiency factor 100%.

Day 14: Sabatier consumed 4.620 kg CO_2 & 0.840 kg H_2 -> +3.780 L drink water.

Day 14: Electrolysis -10.00 L => +1.111 kg H_2, +2.909 kg O_2 (vented 5.980).

Day 14: Solid Fuel used 0.50 kg -> +0.451 kg O_2, +0.275 kg NaCl.

Day 14: Recovered 14.40 L water → drink:58.22 L, o2:88.72 L.

Day 14: Crew used 16.00 L water (drinkable+O_2 tanks).

Day 14: Crew consumed 3.360 kg O_2 → +4.620 kg CO_2.

Day 14: Food consumed 3.360 kg (100%). Crew efficiency factor 100%.

Day 13: Sabatier consumed 4.620 kg CO_2 & 0.840 kg H_2 -> +3.780 L drink water.

Day 13: Electrolysis -10.00 L => +1.111 kg H_2, +2.909 kg O_2 (vented 5.980).

Day 13: Solid Fuel used 0.50 kg -> +0.451 kg O_2, +0.275 kg NaCl.

Day 13: Recovered 14.40 L water → drink:57.48 L, o2:97.28 L.

Day 13: Crew used 16.00 L water (drinkable+O_2 tanks).

Day 13: Crew consumed 3.360 kg O_2 → +4.620 kg CO_2.

Day 13: Food consumed 3.360 kg (100%). Crew efficiency factor 100%.

Day 12: Sabatier consumed 4.620 kg CO_2 & 0.840 kg H_2 -> +3.780 L drink water.

Day 12: Electrolysis -10.00 L => +1.111 kg H_2, +7.131 kg O_2 (vented 1.758).

Day 12: Solid Fuel used 0.50 kg -> +0.451 kg O_2, +0.275 kg NaCl.

Day 12: Recovered 14.40 L water → drink:56.74 L, o2:105.84 L.

Day 12: Crew used 16.00 L water (drinkable+O_2 tanks).

Day 12: Crew consumed 3.360 kg O_2 → +4.620 kg CO_2.

Day 12: Food consumed 3.360 kg (100%). Crew efficiency factor 100%.

Day 11: Sabatier consumed 4.620 kg CO_2 & 0.840 kg H_2 -> +3.780 L drink water.

Day 11: Electrolysis -10.00 L => +1.111 kg H_2, +8.889 kg O_2.

Day 11: Solid Fuel used 0.50 kg -> +0.451 kg O_2, +0.275 kg NaCl.

Day 11: Recovered 14.40 L water → drink:56.00 L, o2:114.40 L.

Day 11: Crew used 16.00 L water (drinkable+O_2 tanks).

Day 11: Crew consumed 3.360 kg O_2 → +4.620 kg CO_2.

Day 11: Food consumed 3.360 kg (100%). Crew efficiency factor 100%.

Day 10: Sabatier consumed 4.620 kg CO_2 & 0.840 kg H_2 -> +3.780 L drink water.

Day 10: Electrolysis -10.00 L => +1.111 kg H_2, +8.889 kg O_2.

Day 10: Solid Fuel used 0.50 kg -> +0.451 kg O_2, +0.275 kg NaCl.

Day 10: Recovered 14.40 L water → drink:55.26 L, o2:122.96 L.

Day 10: Crew used 16.00 L water (drinkable+O_2 tanks).

Day 10: Crew consumed 3.360 kg O_2 → +4.620 kg CO_2.

Day 10: Food consumed 3.360 kg (100%). Crew efficiency factor 100%.

Day 9: Sabatier consumed 4.620 kg CO_2 & 0.840 kg H_2 -> +3.780 L drink water.

Day 9: Electrolysis -10.00 L => +1.111 kg H_2, +8.889 kg O_2.

Day 9: Solid Fuel used 0.50 kg -> +0.451 kg O_2, +0.275 kg NaCl.

Day 9: Recovered 14.40 L water → drink:54.52 L, o2:131.52 L.

Day 9: Crew used 16.00 L water (drinkable+O_2 tanks).

Day 9: Crew consumed 3.360 kg O_2 → +4.620 kg CO_2.

Day 9: Food consumed 3.360 kg (100%). Crew efficiency factor 100%.

Day 8: Sabatier consumed 4.620 kg CO_2 & 0.840 kg H_2 -> +3.780 L drink water.

Day 8: Electrolysis -10.00 L => +1.111 kg H_2, +8.889 kg O_2.

Day 8: Solid Fuel used 0.50 kg -> +0.451 kg O_2, +0.275 kg NaCl.

Day 8: Recovered 14.40 L water → drink:53.78 L, o2:140.08 L.

Day 8: Crew used 16.00 L water (drinkable+O_2 tanks).

Day 8: Crew consumed 3.360 kg O_2 → +4.620 kg CO_2.

Day 8: Food consumed 3.360 kg (100%). Crew efficiency factor 100%.

Day 7: Sabatier consumed 4.620 kg CO_2 & 0.840 kg H_2 -> +3.780 L drink water.

Day 7: Electrolysis -10.00 L => +1.111 kg H_2, +8.889 kg O_2.

Day 7: Solid Fuel used 0.50 kg -> +0.451 kg O_2, +0.275 kg NaCl.

Day 7: Recovered 14.40 L water → drink:53.04 L, o2:148.64 L.

Day 7: Crew used 16.00 L water (drinkable+O_2 tanks).

Day 7: Crew consumed 3.360 kg O_2 → +4.620 kg CO_2.

Day 7: Food consumed 3.360 kg (100%). Crew efficiency factor 100%.

Day 6: Sabatier consumed 4.620 kg CO_2 & 0.840 kg H_2 -> +3.780 L drink water.

Day 6: Electrolysis -10.00 L => +1.111 kg H_2, +8.889 kg O_2.

Day 6: Solid Fuel used 0.50 kg -> +0.451 kg O_2, +0.275 kg NaCl.

Day 6: Recovered 14.40 L water → drink:52.30 L, o2:157.20 L.

Day 6: Crew used 16.00 L water (drinkable+O_2 tanks).

Day 6: Crew consumed 3.360 kg O_2 → +4.620 kg CO_2.

Day 6: Food consumed 3.360 kg (100%). Crew efficiency factor 100%.

Day 5: Sabatier consumed 4.620 kg CO_2 & 0.840 kg H_2 -> +3.780 L drink water.

Day 5: Electrolysis -10.00 L => +1.111 kg H_2, +8.889 kg O_2.

Day 5: Solid Fuel used 0.50 kg -> +0.451 kg O_2, +0.275 kg NaCl.

Day 5: Recovered 14.40 L water → drink:51.56 L, o2:165.76 L.

Day 5: Crew used 16.00 L water (drinkable+O_2 tanks).

Day 5: Crew consumed 3.360 kg O_2 → +4.620 kg CO_2.

Day 5: Food consumed 3.360 kg (100%). Crew efficiency factor 100%.

Day 4: Sabatier consumed 4.620 kg CO_2 & 0.840 kg H_2 -> +3.780 L drink water.

Day 4: Electrolysis -10.00 L => +1.111 kg H_2, +8.889 kg O_2.

Day 4: Solid Fuel used 0.50 kg -> +0.451 kg O_2, +0.275 kg NaCl.

Day 4: Recovered 14.40 L water → drink:50.82 L, o2:174.32 L.

Day 4: Crew used 16.00 L water (drinkable+O_2 tanks).

Day 4: Crew consumed 3.360 kg O_2 → +4.620 kg CO_2.

Day 4: Food consumed 3.360 kg (100%). Crew efficiency factor 100%.

Day 3: Sabatier consumed 4.620 kg CO_2 & 0.840 kg H_2 -> +3.780 L drink water.

Day 3: Electrolysis -10.00 L => +1.111 kg H_2, +8.889 kg O_2.

Day 3: Solid Fuel used 0.50 kg -> +0.451 kg O_2, +0.275 kg NaCl.

Day 3: Recovered 14.40 L water → drink:50.08 L, o2:182.88 L.

Day 3: Crew used 16.00 L water (drinkable+O_2 tanks).

Day 3: Crew consumed 3.360 kg O_2 → +4.620 kg CO_2.

Day 3: Food consumed 3.360 kg (100%). Crew efficiency factor 100%.

Day 2: Sabatier consumed 5.129 kg CO_2 & 0.933 kg H_2 -> +4.196 L drink water.

Day 2: Electrolysis -10.00 L => +1.111 kg H_2, +8.889 kg O_2.

Day 2: Solid Fuel used 0.50 kg -> +0.451 kg O_2, +0.275 kg NaCl.

Day 2: Recovered 14.40 L water → drink:48.92 L, o2:191.44 L.

Day 2: Crew used 16.00 L water (drinkable+O_2 tanks).

Day 2: Crew consumed 3.360 kg O_2 → +4.620 kg CO_2.

Day 2: Food consumed 3.360 kg (100%). Crew efficiency factor 100%.

Day 1: Sabatier consumed 6.111 kg CO_2 & 1.111 kg H_2 -> +5.000 L drink water.

Day 1: Electrolysis -10.00 L => +1.111 kg H_2, +8.889 kg O_2.

Day 1: Solid Fuel used 0.50 kg -> +0.451 kg O_2, +0.275 kg NaCl.

Day 1: Recovered 14.40 L water → drink:46.96 L, o2:200.00 L.

Day 1: Crew used 16.00 L water (drinkable+O_2 tanks).

Day 1: Crew consumed 3.360 kg O_2 → +4.620 kg CO_2.

Day 1: Food consumed 3.360 kg (100%). Crew efficiency factor 100%.

Conclusion

This project illustrates a smart system support to astronauts that manages the most important resources: food, water, oxygen, and electricity. Use of sensors, recycling solutions, and dynamic rules, when combined, allow the system to accommodate dynamic changes while keeping the crew out of harm's way even in the most critical situations. LLM support was also used during the design of food calculating and decision making. Though it is still in the prototype stages, the creation of the idea is proof of concept that using systems and intelligent management a more sustainable future for the mission in space can be developed to limit waste.