AGROTES DE L'ESPACE

Biotic Inter-Operable Plant System

PROJECT DETAIL

The BIOS - 1 is an advanced, scalable, fully autonomous, and self-sustaining space plantation pod system. Built for a team of six astronauts, BIOS - 1 can run on both, spacecrafts, and terrain.

Executive Summary

- *The BIOS - 1 is a supplementary crop production system which can uphold the supplementary food supply of six astronauts for an exploration journey from earth to the lunar surface or even the Martian surface.*
- *The method implemented to cultivate the crops is hydroponics with future insight on including aeroponics as a means as well.*
- *The whole crop production system can cultivate the required amount of food while in transit to the Martian or the lunar surface and will still function when its touched down.*
- *To tackle the lack of gravity while in transit to the destination, we adapted pseudo gravity technique via rotation which creates centrifugal force but only limited to the system and not to the station.*
- *To maintain crops growth in terms of data the sensors will come into play, those sensors will share the data to the life support system which will take necessary actions which will boost up the growth of an individual crop.*

Planetary Gears & HydroDRIP Water System

The planetary gears are ideal for BIOS - 1, a cylindrical shaped closed environment which requires 0.1 g to create a sense of gravitropism required for the growth of the seeds to plants. This generates the required low pressure in the plants which is needed for the water to be able to be used by osmosis.

The water pipe system is a unique method adapted and designed by the team for the project. This internal infrastructure runs along the wireframe of the BIOS - 1. A common centrifugal water pump is used to pump water to all pods which is further modulated as-per individual requirements using electronically (relay) controlled check-valves.

Environment Controller (ECC)

The life support of the crop production system is designed in such a way that it monitors each seedling's growth. It analyses the data received from the CAPS and directs just the nutrient amount required for the crop, coordinating with the nutrient delivery network. The water system which is responsible for accepting polled sensor data and accordingly deliver the required water for each plant as per instructions from the operating code and is internally connected to the wireframe of the design further assist the ECC in nutrient delivery by employing its existing infrastructure to dual uses. The water also features individual per-pod electronic check-valves to ensure each plant gets just the amount of water it needs and no more.

Light system

For growing plants on the BIOS -1, an efficient lighting system is required for the proper functioning of the system. Adjustable spectrum COB (chip on board) LED grow lights that emit light with wavelengths between 280nm and 800nm are used to maximize the efficiency of plant growth and energy usage on the BIOS - 1. The entire light system is controlled by a centralized automated computer software that controls the quality, quantity and duration of light received by each plant. To do this it uses available plant growth data and keeps updating this database as it gains experience. The photosynthetic photon flux density (PPFD) is measured with a full-spectrum quantum sensor also known as a PAR meter.

The CAPS (Computerized Automated Production System)

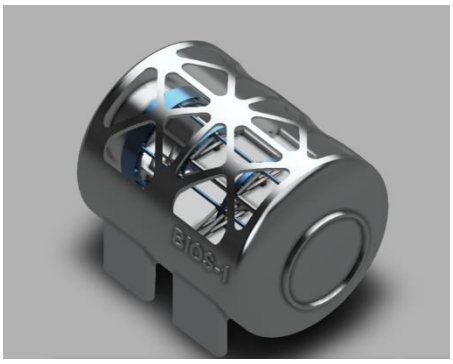
The CAPS is the central "managing authority," the operation code of the BIOS - 1 which manages all inputs, analyzes them, and accordingly acts.
CAPS takes data from multiple PH, temperature, light sensitivity, water level, water constituent, electrical conductivity and IR imaging sensors and matches the same with the *CAPS PLANT RESEARCH DATABASE*. This database is a collection of records with details on the nutrient, light, water, and other requirements for each plant. When planting, the astronaut registers in CAPS the plant planted in a particular pod which CAPS uses to do this. CAPS uses specialized sensors made to operate in the BIOS - 1's-controlled environment.
It takes *scheduled actions* like renewing the water, adding nutrients, managing lights et cetera and automated ***detection-based actions*** where it compensates for the lack of a certain thing.
It also serves as the central link which images roots and informs the astronauts of possible harvesting chances.

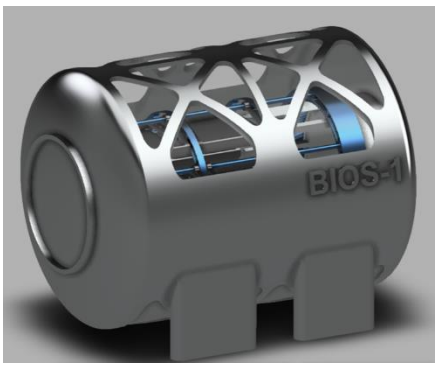
Not only does CAPS take actions, but it passes the same through a neural network each time it does this, to improve itself by learning.

Further to-do

- ☐ Create presentation for tomorrow
- ☒ Put into words, the lighting network
- ☐ Research about equipment for the sensor matrix
- ☒ Complete renders with gearbox changes as observed
- ☐ Update the website with newer information
- ☐ Improve CAPS connectivity to make it serve more like an IoT platform

Gallery





Crunching the Numbers

Pod volume	=	0.409 kg/m3
INFILL USED > 20%		
Pod volume with infill	=	0.0818 kg/m3
Material density	=	1800 kg/m3
MATERIAL USED > T800 (TRIBALOY® T-800®)		
Mass per pod	=	147.24 kg
Mass for 12 pods (1 BIOS - 1 UNIT)	=	1766.88 kg
Gravity induced by rotation	=	0.1 * acceleration due to gravity (g)
THE BIOS - 1 ONLY USES 10% OF ACCELERATION DUE TO G TO USE GRAVITROPISM TO ITS ADVANTAGE BY NUDGING THE PLANT ABOUT THE INTENDED GROWTH DIRECTION		
Mass for central spine	=	3630 kg
Estimated water mass	=	2871.36 kg
TOTAL MASS OF THE INTERNAL SYSTEM	=	8268.24 kg
Force required in Newtons	=	(the total mass * 9.80665) * radius of the arm (2)
	=	162167.472 Nm
Gear system and motor calculations:		
DRIVING TEETH	=	60 teeth
SUN TEETH	=	20 teeth
OUTPUT TEETH	=	100 teeth
GEAR RATIO	=	0.6:1
MECHANICAL ADVANTAGE	=	1.67
INPUT RPM	=	11.667 RPM
OUTPUT RPM	=	5 RPM
INPUT TORQUE	=	97300 Nm
OUTPUT TORQUE	=	162165.818 Nm
Input torque (97300 Nm) in ft-lb	=	71765 ft-lb
Torque in terms of horsepower	=	95.7 HP
Horsepower in terms of POWER	=	**71.36348 kW POWER USAGE**