

1 Meter of Pi - Space Vegetables

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Design Challenge: [1 Meter of Pi](#)

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Image:



Reason for the Design Challenge:

Going in Space is not an easy task.

Since weight is a problem and resources are limited and scarce, everything we can do while on board with the available space and materials is of great benefit.

The voyage to Mars takes between 150-300 days. During this time, people must eat, drink, survive and keep busy in the spacecraft.

Problem

Because of costs, taking all the food for the (worst case scenario) 300 days (multiplying by the number of crew members) on board is not feasible.

The best solution is to grow some of the food on board. This way, the crew have access to fresh vegetables.

My proposal is to grow lettuce, potatoes and tomatoes.

Resources

- Because weight is a big problem, the vegetables will be grown using hydroponics.

- 1 m³ will be occupied with PVC pipes for the hydroponics system.
- Initial water needs will be brought from earth, but the little water needed can be sourced onboard, from recycled urine. It will be a closed system, reusing the water.
- Power for the water pump will be the one available on the spacecraft, but can also be sourced from the sun, using a solar panel - probable the same powering the craft.
- The system will be enclosed (like a greenhouse) to save all the water possible (through condensation).
- Nutrients for the vegetables will be brought from earth and also be sourced from waste from the crew (Hello Martian movie 😊).
- To speed the growing process, the vegetables will be grown from seedlings (when possible).
- When not possible, a lamp will be used to simulate the sun light.

This will allow fresh vegetables to be consumed and some work will be available for the crew members, taking care of the vegetables garden.

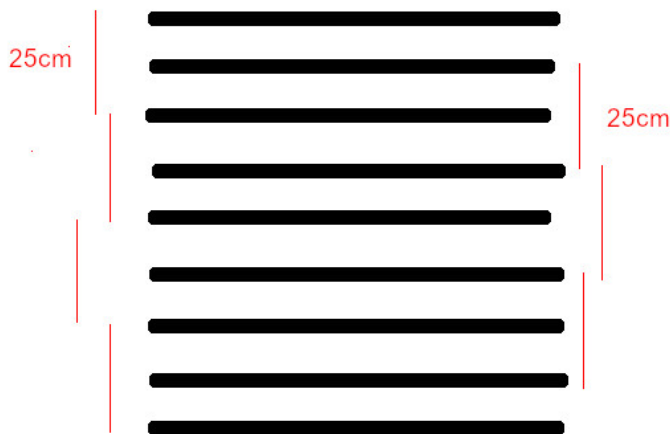
Hardware

Assuming no other hardware will be available (Except a big dome push button light type for status - Red, Yellow and Green), a warning buzzer and a ultrasonic sensor for water level monitoring:

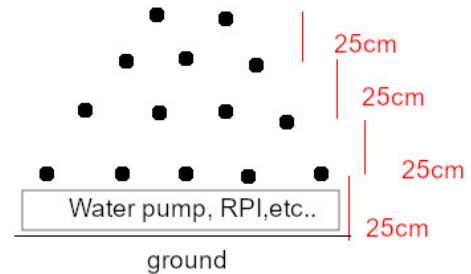
- The Raspberry PI will be the brains of it all, monitoring all the parameters of the system and giving alerts on the LCD of the Enviro HAT, the Buzzer and the Light status. An RTC will be added
- The Enviro HAT will be monitoring:
 - Water temperature (not directly)
 - Humidity
 - Pressure (this will help to detect some leak in the environment for Space - thus protecting the crew)
 - Using the light sensor it will be able to turn on or off the LAMP
 - By using the MICS6814 (present in the Enviro HAT) sensor will be able to detect dangerous amounts of harmful gases to humans, like Carbon Monoxide, Nitrogen dioxide, etc... and others harmful to the crops.
- Automation PHAT will be used to control the lights, the water pump and the FAN to let some air out or in from the greenhouse.
- Water PH and conductivity monitoring (using sensors) for nutrients analysis.

The garden will be assembled in the following fashion to maximize space occupation and stability:

TOP VIEW



SIDE VIEW



The pipes and overall frame will be secured with smaller PVC pipes and/or wood.

Final notes and expected obstacles

This is a huge undertaking, with a lots of fun in it. Hydroponics is a science and yielding crops at first try will be a surprise... But lives depend on it.

The frame and greenhouse construction will not be easy and for a sturdy construction the PVC will have to be of great quality. It will be assume the frame will be assembled after take off, when already in space.

The programming will be in Python language and no problems are expected.

A Twitter account will be created for daily updates (automatic and manual), including photos and data from the sensors. This will include construction and monitoring of the crops.

Probably some problems may appear in finding the PH and conductivity sensors. It will not be easy with the greenhouse lightning but efforts will be made to get it right.

This project will be fun. I've been interested in hydroponics for some time, but this is an opportunity to explore more the subject. I've already done some research into the subject, but a lot more will have to be made. Learning by practicing.

An opportunity to dive a lot more into I.O.T. in the Real World (instead of the proverbial Weather Station) .

Resources

Application icon made with the following images from icon-library.com

<https://icon-library.com/icon/veggie-icon-27.html>

<https://icon-library.com/icon/rocket-png-icon-14.html>