Vertical, Hydroponic, Smart Garden With Global and Universal (Space) Applications

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Abstract

Today, according to the World Food Programme, the world produces enough food to feed everyone, and nevertheless there are still individuals going to bed hungry. According to the food aid foundation, world wide "795 million people in the world do not have enough food to lead a healthy active life". Hunger causes societal problems; approximately 3 million children die each each due to poor nutrition, 100 million children are underweight and 1 in 4 children are stunted due to a poor nutrition. This is a crucial issue which needs immediate solving. To help solve this issue a group of undergraduate students at Salt Lake Community College are working on a project involving vertical farming, hydroponic watering, and making the plant growing process smart.

Methodology:

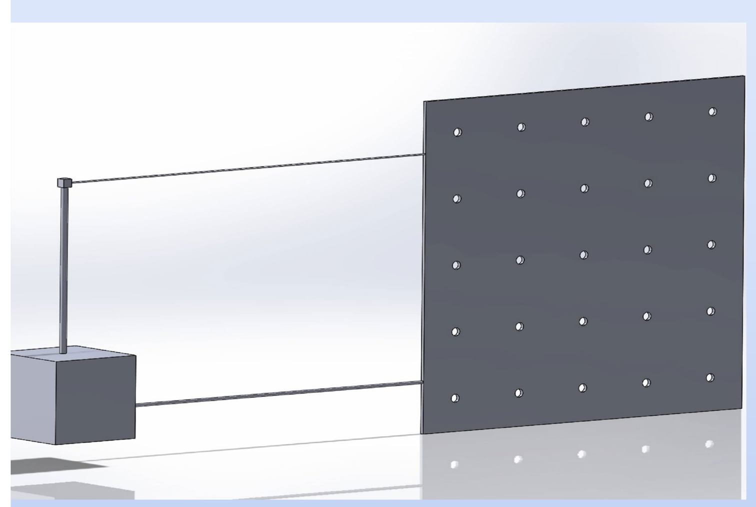

Figure 1 Hydroponic System

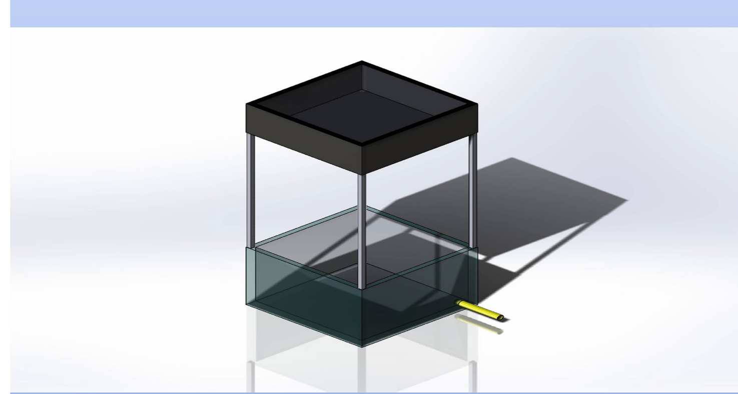

Figure 2 Tank

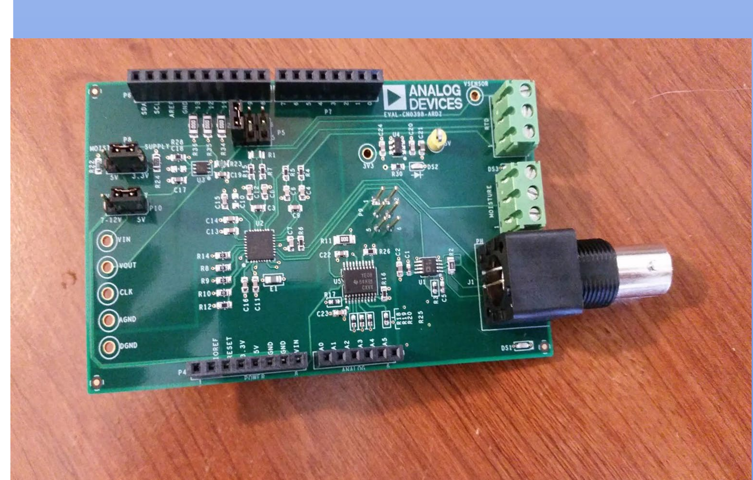

Figure 3 Analog Devices Agricultural Board

To implement the following project three main technologies must be intertwined in order to be able to have a successful project. Mainly, vertical farming, hydroponic watering, and making the growing process smart through embedded systems, and machine learning. There are multiple ways for the structures utilized to be build vertically. One method is to stack another plot of growing section on top of another, and continue making this stacking for multiple times. Another method to build these structures is to take the horizontal growth space and tilt it vertically then stack multiple of these vertical growth walls as close together as possible horizontally. This system must be strong enough to hold the stress of multiple levels of crops one of top of another.

Within a hydroponic system the plants are grown in other material to hold the roots of the crops. A drip irrigation system is then developed to deliver the plant solution to the roots of the plants directly. All of the water that is not utilized by the plants returns to the tank system. Embedded systems on the growth plots as well as with the climate controls of the enconclosed room ensure that the crops are grown to the best qualities. These systems monitor a solution's flow rate and pH value, light intensity, tank's solution level, as well as temperature An embedded system expands on environment control as well as crop analysis. The sensors within the plots of growth analyse constantly the conditions of the plants.

Results/Benefits:

According to the Sustainable Table Food Program the primary areas of concern for food security or, "access by all people at all times to enough food for an active, healthy life." (United States Department of Agriculture), are food distribution, political-agricultural practices, and environmental factors. Due to these challenges we developed this proposed system. According to Dickson are " supply enough food in a sustainable fashion to comfortably feed all of humankind for the foreseeable future; allow large tracts of land to revert to the natural landscape restoring ecosystem functions and services; . . . significantly reduce populations of vermin (e.g., rats, cockroaches); . . . creat(e) a much needed new strategy for the conservation of drinking water; . . . allow year-round food production without loss of yields due to climate change or weather-related events; eliminate the need for large-scale use of pesticides and herbicides."

Conclusion:

As human beings we are the stuarts of the well being of our planet, and human kind. Because of this reason we implemented this project at our local community college; because this growing process helps to ensure food access for all. This has been a major crisis throughout our planet's history, but one we can solve now that we have the technology, and ability to perfect this technology needed to ensure food access to all. With vertical farming, hydroponic irrigation, and embedded systems we can grow food in a controlled environment year round, with less water consumption, and less pesticides while restoring and conserving natural ecologies.

This project is a work in progress and continued research is being conducted.

References:

World Hunger Statistics. (n.d.). Retrieved December 1st, 2018, from http://www.foodaidfoundation.org/world-hunger-statistics.html

Zero Hunger. (n.d.). Retrieved December 2, 2017, from http://www1.wfp.org/zero-hunger

Foundation, G. C. (n.d.). Food Security & Food Access. Retrieved January 27, 2018, from http://www.sustainabletable.org/280/food-security-food-access

Dickson, D. (n.d.). The Vertical Essay. Retrieved March 15, 2018, from http://www.verticalfarm.com/?page_id=36

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