R-CROP

Robotics Contributing to Renewable Organic Planting

Home gardening is an important aspect of sustainability. By growing your own food, you help eliminate the cost and energy usage involved in growing, packaging, and shipping food. However, not everybody has the time to tend a garden daily, and automatic devices, such as watering systems, are often inefficient and unable to adjust to changes in the environment. The R-CROP (Robotics Contributing to Renewable Organic Planting) was created to help you maintain a successful and efficient garden almost effortlessly.

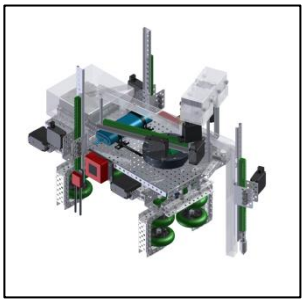
R-CROP Functions:

- Seed planting
- Soil and weather monitoring
- Intelligent watering
- Harvesting notification
- Simple user interface

Sustainable design elements:

- Completely powered by solar energy
- Waters during the night to reduce water loss due to evaporation
- Works at night to protect the robot from exposure to the sun thus increasing its lifespan.
- Takes weather and moisture measurements to prevent overwatering/underwatering
- Mobile robot is built with recycled aluminum to reduce weight
- The monorail track, seed changer and charging garage are built from bamboo, a renewable wood source, and reclaimed hardware
- Stepping stones are made from wool bricks, a greener alternative to regular bricks
- Simple construction allows for easy repairs/upgrades

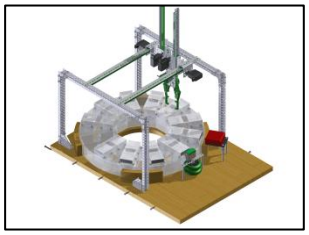
Mobile Robot:



The main component of the R-CROP is a mobile robot that moves throughout the garden on a raised monorail track. This robot plants seeds using a special seed module with one compartment for seeds, and another for vermiculite.

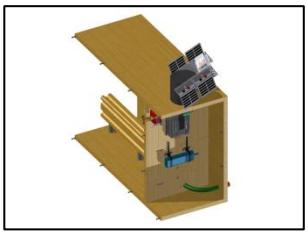
Seed Changer:

The seed module changer consists of a robotic claw that provides the mobile robot with seed modules based on the R-CROP's planting schedule. It pulls the seed modules from a rotating carousel and lowers them into the mobile robot's socket. A barcode scanner is used to find the proper seed module. The barcode provides planting and watering information for that seed type. A section of the monorail track inside the seed module changer rotates to allow the robot to swing its arm into the proper position for seed loading. This also allows the robot to move its arm from one side of the track to the other.



Charging Garage:

The charging garage recharges the robot using a two axis solar panel. It houses a second microcontroller that controls the solar tracking, seed changer, and water valves. The water valves are daisy chained together to deliver water as instructed by the controller.



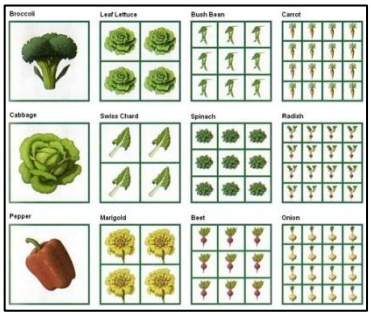
The base microcontroller also connects to an interactive web page. This web page is updated by the R-CROP, sending the user status notifications and allowing the user to "order" produce. Using this web page, the user can monitor the robot from anywhere.

Installation:

Installation is as simple as connecting the monorail sections together, inserting them into the ground, and attaching a seed module changer and charging garage. Different seed modules can be inserted into the carousel as desired. The modular design of the R-CROP allows it to cover gardens of any size by simply adding/reconfiguring track.

Method:

The robot uses the Square Foot Gardening method. This method is very space efficient, growing more produce than an equivalent conventional garden, and requires almost no weeding/thinning. Based on data from the barcode on the seed modules, the R-CROP knows how and when to plant each type of seed.



Design Process:

- Understood challenge requirements
- Researched sustainability
- Brainstormed robot ideas
- Decided on best fit for challenge based on sustainability of the robot's function
- Brainstormed/sketched various robot designs to achieve the function
- Prototyped ideas in Inventor
- Finalized design

Conclusion:

Growing your own food is an excellent way to start moving towards a more sustainable lifestyle. The R-CROP is the ideal tool to assist you in achieving that goal.

Credits:

This project was created by Team Automata (2114a). The gardening method is based off of the book *Square Foot Gardening* by Mel Bartholomew.

The CAD model was constructed and rendered using Autodesk Inventor 2013. I found the hole tool/content center screws very helpful when constructing the bamboo garages. The spring creator was helpful for creating some of the sensors. The Vex components are taken from the Inventor 2013 Kit of Parts[1], Vex CAD Wiki[2], and Vex Inventor Standard Library.

R-CROP makes use of several techniques discussed in the Autodesk Sustainability Workshop, including lightweighting, green materials selection, and extending product lifetime. One way to increase its sustainability would be to connect the water supply to a rain collection system.

The video and images were compiled using Inventor Publisher, CorelDRAW, Audacity, and Windows Movie Maker.

1 – www.students.autodesk.com/?html=vex_resources *2 – www.vexforum.com/wiki/VEXCAD*