

Moving Pots: Rhythmic and Smart Plant Pots
Research Topics in HCI, Spring '21
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Abstract

According to the USDA 54.4 million people in the United States live in a food desert[1] where they have limited access to fresh produce. There are many initiatives to combat this form of food injustice from community gardens to food access programs in elementary schools in the United States. However, none of these solutions account for the culture of house plants in the United States and the ability of growing vegetables and produce indoors would revolutionize how we combat food insecurity in food deserts. Moving pots uses multi-robot systems to flock and group houseplants to make them interactive and help the user grow their plants. Moving pots use flashing lights and raspberry pi sensors to help provide the important information to take care of the plants.

Introduction

The United States Department of Agriculture's [1] Economic Research Service defines a food desert as an area "with limited access to affordable and nutritious food, and particularly such an area composed of predominantly lower income neighborhoods and communities," [2]. Food deserts are not unique to the United States and there have been many attempts to define and identify food deserts in Australia, UK, and Canada. The consensus is that in the United States, food deserts disproportionately impact marginalized communities of color [3] [4]. There are many studies that have plotted the spatial or statistical correlations of race and the absence of supermarkets [5] [6]. Researchers have even found that small corner stores and ethnic groceries or bodegas are abundant in food deserts in the United States, but their produce tends to be of poorer quality and less healthy, high in sugars and saturated fats [7] [8]. One way communities combat this is by growing

house plants that communities can consume; this may take the form of justice for these communities.

According to the National Gardening Association growing a consumable garden can save a person \$600 with just an investment of \$70 [13]. This could help communities out of food deserts by providing their own source of food. However, low-income is tied to having smaller living spaces or even an interior courtyard that may not receive the same amount of sunlight as other places of living[14]. House plants are not the easiest to maintain and they require care and attention. Not every person can regularly maintain their plants and not every living space makes that accessible. For example some spots in a living space may get more sun than others and not all plants are meant to be in the sun for very long. Or even physical barriers are presented in moving heavy pots around to sustain a plant.

Considering the question of how we can make growing produce accessible we present Moving Pots. By using a multi-system of robots that carry the pots we can provide better care for the plants and allow for some of the logistical burden and understanding of taking care of plants indoors. By using different LED lights we can show when a plant is under watered, overwatered, getting too much sun, getting too little sunlight, or even if they should be repotted. By using flocking algorithms we can get pots to group by blinking light and make it easier for their caretakers to identify issues and take care of their plants. As shown in the cartoon above the plants make formations to support each other. It also helps the plant pots themselves make formations to take care of one another by placing plants that can take more sunlight than others in front of plants that need very little sunlight.

Related Work

There have been many efforts to ease this from urban community gardens to growing kits for plants [9] [10][11]. We first review prior work that explores popular solutions to food deserts and food insecurity like community and urban gardens. We further summarize various plant growing kits and plant sensors that are popular with this solution.

Community Gardens and Urban Gardens

To fully understand the concept of Community Gardens we have to look at the brief history of why they exist and what they have come to be in our times. Community gardens in the United States during World

War I and World War II these gardens came to be known as *Victory gardens*. They were planted on public land to help citizens make gardening and self-community sustainability patriotic. As noted in *Rethinking Urban Poverty: A Look at Community Gardens*, “During times of hardship, gardens proved to be a sufficient way to unify people and feed a community, but their significance declined with the easing of general scarcity.” [20] These gardens soon became known as community gardens and have kept the same values of sustaining low-income communities, but less and less associated with patriotism in the United States. [20]

Scholarship in food justice states that success of a community garden is based on the values set here which is that people *growing produce, provide satisfying labor, value formation through gardening, neighborhood improvement, and developing a sense of community*[21, 20]. With this in mind most of the innovation in regards to community gardening and empowering communities to grow their own produce is centered around maintaining community, providing efficiency, and education on community gardens.

Ludwig et al. focuses on designing an ICT system that is made up of a solar-powered radio that allows for communication and data to be transferred to a server and a mobile app.[10] This solution for community gardens was meant to tackle communication and coordination of the garden to establish a sense of community and make it easier to garden by providing data to the community. Although ideal for community gardens this isn’t practical to use

in a community, because of cost as well as maintaining the ICT system long term.

Community gardens have several benefits, but ultimately fall prey to vandalism and a long waitlist to even begin to partake in the garden[12]. This doesn't address the fact that underfunding in community gardens and even the lack of education on how to maintain and grow plants makes them difficult to gather as a community garden[12]. Furthermore, this doesn't even begin to dive into the communication and coordination issues community gardens may face [10]. But to enable food justice is to empower citizens to grow and maintain plants regardless of perceived limitations the alternative is to just enable people to grow their own plants.

Plant Kits and Plant education

Now taking the burden and focus on the community we can consider individual supported plant kits. There are many variations of the plant growing kits. Many of these implement different ways to achieve different forms of education and maintenance of a plant.

Carrozzo, et al. used arduinos to teach children to garden through gamifying gardening. They also created an avatar to express the plant's need to the children and was meant to inspire children into gardening[16].

There is also *Growkit* [17] and *We-Sense* [19] that are systems meant for gardens in an urban setting focused on education on how to take care of a plant. Both *Growkit* and *We-sense* use sensors to

provide information of the plant's current state like moisture, light, temperature, and visual display that provides that information. The objective of these is to educate on basic plant care.

All of these are great motivation and provide novel ways to educate and help citizens take care of their plants. These solutions step away from empowering lower income communities through gardening to making it harder to financially sustain community garden through the addition of technology. They might even lower the barrier of entry in terms of education into gardening as an individual; their implementation still requires the user to have the ideal set up for growing plants like the environment, lighting in the setting, or access to resources to take care of the plant.

While all this work shows the potential of plant kits, and gardening in community we are unaware of any existing research that has explored the opportunities of using multi-robot systems and plant sensors to aid the everyday citizen to grow their own produce. We see an immense potential to explore the opportunity of alleviating the physical barriers of growing a plant in a small space, with little or limited lighting, and a community of people who are in low-income food desert areas.

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