# Domestic Plant Guilds: A Novel Application for Sustainable HCI

**Juliet N.P. Norton**
Department of EECS, UCF
4000 Central Florida Blvd.
Orlando, FL 32816, USA
juliet@knights.ucf.edu

**Alex J. Stringfellow**
UCF Arboretum
4000 Central Florida Blvd.
Orlando, FL 32816, USA
Alex.Stringfellow@ucf.edu

**Joseph J. LaViola Jr.**
Department of EECS, UCF
4000 Central Florida Blvd.
Orlando, FL 32816, USA
jjl@eecs.ucf.edu

## ABSTRACT
This position paper presents the challenges of designing a software application that aids in the development of a sustainable human system (i.e., an eco-friendly system established with the intent to support some human need) that can support the transition to a simple, sustainable lifestyle. It discusses the challenge of designing an application that achieves a balance of user convenience, awareness, and sustainability in the context of creating a domestic plant guild (i.e., a family of plants that sustains itself and provides for people's essential needs). Based on a field study, the authors present requirements for building a *Domestic Plant Guild Composer* as one approach for addressing the aforementioned challenge.

## Author Keywords
Plant guild; sustainability; simple living; permaculture; human-computer interaction.

## ACM Classification Keywords
H.5.2. Information interfaces and presentation (e.g., HCI): Miscellaneous.

## General Terms
Human Factors; Design

## INTRODUCTION
The CHI Simple, Sustainable Living Workshop was (in part) created to address the disjunction between sustainability and human computer interaction[3]. Past HCI research has primarily approached the problem of unsustainable practices by outlining improper resource usage and its' implications[2]. The issues associated with transitioning to a simple, sustainable lifestyle remain scarce amongst HCI publications, as it is established as a field of research in [1], and not explicitly mentioned in [2]. Conversely, this paper is not discussing slight modification of current lifestyles (e.g., reducing consumption of water); instead, we focus on fundamental deconstruction of existing behaviors detrimental to the environment.

Simple, sustainable living can be achieved by managing consumption of extraneous materials (i.e., things we replace and dispose of without regard) and increasing self-sufficiency (i.e., providing for yourself). While Pierce approaches the topic of extraneous materials by encouraging reflection of how they are used[7], we are interested in enabling people to live independently of these extraneous materials by providing themselves with materials they need. Practices like permaculture (the eco-, human-sustainable design for permanence) advocate for similar ideologies (e.g., apply self-regulation and accept feedback)[5]. Although independence is an innate step in becoming more self-sufficient, this transition poses rather intensive, short-term complications. Namely, a great time investment is required to learn these methodologies and their implementation.

In permaculture, a domestic plant guild can foster human independence from extraneous materials. A domestic plant guild is a family of plants that can sustain itself and provide people with many of their essential needs (e.g., food, building materials, etc.)[6]. It is an enabler of simple, sustainable living (i.e., reduces cost of living, ecological footprint, and the need for consumer goods).

### Example Domestic Plant Guild Scenario
Picture yourself stepping out into a quiet backyard; your property is fenced in with an assortment of sugarcane and bamboo, protecting your privacy, and your other plants from wind. This same bamboo plant was used to build the bench you just sat down on. You gently stir your morning tea with a sweet cutting of sugarcane, yet another function of your privacy fence. A brigade of bees and butterflies hover busily around your native goldenrod, gaillardia, coreopsis, milkweed, and sunflower. Where you would normally have grass, the native and hardy Gopher Apple gladly covers the ground; you even occasionally see a Gopher tortoise creep into your yard and lazily munch on his favorite snack. A large persimmon tree provides shade for your bench as well as a nice little treat for you and the local wildlife. A passionflower entangles the persimmon tree, while its flower bobs happily around in your tea. You begin to search for salad ingredients, your lunch, occasionally picking a few blackberries and sparkleberries; they taste quite like a blueberry, but half the maintenance. You pull a couple of leaves off the French Sorrel, the

Moringa, and fennel. To top it off, you snag an avocado and some rosemary. You don't have to water or prune, you just have to eat your harvest. This is an ideal domestic plant guild.

## Challenges in Plant Guild Design - A Need for HCI
The design and construction of a plant guild requires time and expert knowledge, an inconvenience that prevents many from incorporating one. Therefore, if we can provide support tools to make it easier for people to develop and establish domestic plant guilds, then the gap between the idea of sustainable environments and their realization can be reduced. We believe that utilizing HCI techniques in the development of these software tools is essential in providing easy to use yet powerful interfaces to support domestic plant guild construction.

This position paper discusses, in the context of the *Domestic Plant Guild Composer* (*DPGC*), the challenges of designing a software application with the intended use of supporting a sustainable lifestyle. Its focus is to mask the complexities of domestic plant guild creation through simple interfaces utilizing common and easily observable information about the environment. We believe our topic is suitable for the CHI Simple, Sustainable Living Workshop because it focuses on (i) the intersection between human and environmental sustainability, and (ii) the facilitation of simple, sustainable lifestyles while masking complexity.

## PLANT GUILDS
In the natural environment, plants exist in complex mutualistic communities. Within these communities, or plant guilds, each plant has a unique impact on the surrounding environment. Their impact may make one nutrient or resource more available or remove harmful constituents for neighboring plants. When considering an assessment of plant guilds, we assume that each plant has needs (i.e., inputs), products and behaviors (i.e., outputs), and intrinsic characteristics (i.e., physical traits); all are components of the plant's functional analysis. Once these plant characteristics are understood, a plant guild could be created to act as a closed system. When this plant guild is used to provide outputs for human consumers, it becomes a domestic plant guild.

A domestic plant guild is one that is designed to insert a human component into this naturally closed system. Extraneous products from the plants provide edible, medicinal, and useable parts. In short, a domestic plant guild can support primary and secondary human requirements. Plant selection is an important step in designing a domestic plant guild. The plants used in a guild are predominately perennial (living more than 2 years) or self-seeding annuals, and if at all possible, native to the region. If the plant guild is designed and established properly, the human role is reduced to harvesting what is needed.

To achieve a balanced domestic plant guild, experts initially model natural system dynamics (i.e., plant community functional analysis), then fit it to domestic constraints. The guild is designed to be convenient for humans (e.g., co-location of similar plant types and navigable paths) while still encouraging natural states of action between species (e.g., coaction, interaction, and inaction)[6], and features plants that support the humans' desired lifestyle (e.g., medicinals for an herbalist). The design of a plant guild is also dependent on implementation constraints (work, financial, and material resources). In general, the higher the human demand, the more initial energy required for the guild to reach establishment. In context of each constraint, plants are placed in the most accommodating geographic location and functional arrangement. If designed correctly, the plant guild will not require any other human support past this point. However, due to enumerate variables, success is not guaranteed. It is possible that further consultation may be required, especially for complex, high-yield guilds.

Due to the intensive process of creating domestic plant guilds, the knowledge required to properly design and establish one is only possible by experts. As such, we've conceptualized the *DPGC*, a tool to support the development of domestic plant guilds which, in turn, will empower a simple, sustainable lifestyle.

## REQUIREMENTS GATHERING IN THE FIELD
During the Fall of 2011, the first author completed a 9 week, 72 hour Permaculture Design Course (PDC) certified by the Simple Living Institute. She has firsthand experience interacting with plant guilds at the Econ Farm in Orlando, Florida. For designing the *DPGC*, she consulted the Education Director and Garden Manager at the University of Central Florida Arboretum, and community permaculture experts, all of whom are well versed in plant guilds and the cultivation of plants for food, medicine, and other materials.

From these interviews, we have come to the conclusion that the user experience design of the *DPGC* is as important as the tool's ability to effectively model and design a plant guild. Identifying and placing plants in a functional arrangement is difficult for non-experts. They also do not have the skills necessary to acquire environmental information (e.g., soil type, sun patterns, points of erosion, etc.) or the means to implement such a complex design. Due to plant guild implementation constraints (e.g., budget and time), the experience of creating it, beyond the interaction with the *DPGC*, must be considered in the tool's user experience design and how it models and simulates a domestic plant guild.

From the results of our field study, we've established the following set of requirements for the design of the *DPGC*. We have generalized these requirements because we feel future applications that aide in the construction of a sustainable human system (i.e., an eco-friendly system

established with the intent to support some human need) may encounter similar design challenges.

**Use ecocentric and anthropocentric metrics to qualify the (application designed) human system as sustainable.** These metrics will ensure that humans' needs are supported in addition to the plants'. This includes benefit and utility to the human, protection of the native ecosystems, and recovery of the environment. The application-produced designs must qualify as sustainable to alleviate the problems contributing to environmental detriment.

**Identify environmental data required to design the most efficient sustainable system.** This includes data only available to experts or acquired by professional technology. Given all the necessary environmental data, the application should produce a sustainable human system design optimized for the intended environment.

**Design to condense the time the user spends with the application relative to the entire process of creating the sustainable human system.** The user's existing knowledge of the system and receptiveness of the lifestyle change are key factors in the time they're willing to spend in the design process. Find the upper-bound by analyzing potential users who are highly motivated to make the transition and the lower-bound from those who are opposed.

**Provide the user with the information they need to implement the design and utilize the system.** The application should be incorporated into a complete system construction program, whether it is computerized or teacher-guided, so that the guild has an ecological manifestation. This includes taking into account the directly related socioeconomic concerns of the user in the application design, an implication for design established in [3].

**Determine the point where convenience renders the human system unsustainable.** This requires the evaluation of the gap of information between what the user can conveniently provide and what is required to design an optimized plant guild. The convenience metric should be dictated by the amount of work the user is willing to do. This evaluation of the upper and lower-bounds marks the point where the design criteria become too human-centric rendering the design unsustainable.

**Require users to provide easily observable environmental data, but use experts and power users to fill in information gaps.** Typical users should provide the system with easily observable information so that they become better acquainted with their environment. Experts and power users (i.e., non-expert self-motivated users) put forth more effort than average users to provide the system with detailed information. This information should be catalogued and used to optimize future designs created by the sustainable human system design application.

These generalized design requirements, intended to enable simple transitions to a more sustainable, convenient lifestyle, are geared towards small-scale sustainable human systems (i.e., families or communities).

## DOMESTIC PLANT GUILD COMPOSER - A VISION

Long before you sat down on the bamboo bench in your backyard, you faced the challenge of creating the plant guild. When you decided to transition to a simple, sustainable lifestyle you weren't sure where to start. Then you were introduced to the *Domestic Plant Guild Composer*, "The app that helps you effortlessly build Eden in your yard." The steep expense of purchasing fresh food, and the death of your late potted plants, motivated you to give this plant guild a try.

The application first asked for your address. Once entered, a diagram of your lot containing your house's location and cardinal direction was presented. It then asked you to confirm or edit the diagram. You went outside and walked around the house to make sure the *Composer* didn't miss anything, and spotted the utility connections under the Live Oak canopy in the front yard. At this time you also took note of high and low-lying areas, points of erosion, and soil properties. After you completed your property's diagram, the program asked for your priorities: food, natural medicine, building materials, household items, wildlife sightings, environmental restoration. You chose food as the primary function and decided that growing building materials and household items would also simplify your life. Then you specified cost of implementation in terms of time, money, and resources.

From there you specified your primary food requirements from a generated list of plants that grow in your climate and location. First, you investigated the fruits and noticed a native variety of persimmon, a fruit you used to buy. When you chose to include the persimmon tree, a simulation showed where it could be planted on your property. The *Composer* displayed suggestions for plants, relative to your goals, that could provide the persimmon tree with its needs. It took into account that your soil was basic (pH) and persimmon prefers a more neutral range. The *Composer* suggested perennial peanut, a low-growing legume that makes nitrogen more available for the persimmon. While you continued choosing plants based upon the *Composer*'s suggestions, the simulation continued updating in size, arrangement, and location. You realized you had wanted to include another plant. It was no longer eligible and the system told you why (too expensive, not compatible with guild optimal location), so you removed some plants that were less important to add it instead. You proceeded with this until the guild reached a closed system and your desires were met.

Once the design was finalized, the *Composer* produced the guild layout and location in your yard, the places to obtain the plants, tools, and compost within your budget, and

instructions on how to implement the guild. Two weekends later a mound with thirty young plants setting root was in your backyard. It had only taken you one morning to get the free municipal compost, a day to acquire the plants and about 2 hours to put them in the ground with your two helpers. You watered the guild a couple times a week at first, then about once a week when they started really growing, until you found they no longer needed watering. In a few weeks fresh herbs spiced your dinner, in one season the fragrance of flowers was in the air, and shortly after your first crops were harvested. Now, less than a year later, you obtain most of your food, building materials, and cleaning supplies from your backyard. You don't worry about going to the store in rush hour traffic or minimizing expenses so you can eat healthy. Life really did become simpler with the domestic plant guild.

## DISCUSSION
Our *DPGC* vision is an example of an application designed with a balance of user convenience, awareness of user role, and environmental sustainability. We believe that the *DPGC* has the potential to reduce the complexity of transitioning from our modern, complex, consumer lifestyle to one that is simple and sustainable. We described how the transition to a simple, sustainable lifestyle can be obstructed by up front complexity with the Domestic Plant Guild example. We believe there are many human sustainable systems, especially in permaculture, that also have this complexity challenge. Designing earthworks for water collection requires intimate knowledge of natural water flow through land. Building an off-the-grid house requires extensive knowledge of the many ways energy can be produced. We've suggested masking the complexity by finding the point of greatest convenience that still produces a sustainable system. We believe the HCI community should be researching how to enable people to utilize sustainable human systems without being bogged down by the complexity of learning how to get started; it is a contribution HCI can provide in the world's movement towards simple, sustainable living.

Our vision and requirements feature the idea of reducing complexities to the threshold where users still have the opportunity to learn at a higher, more leisurely level. We also believe that by removing all the complexities, the user wouldn't have the opportunity to understand, utilize, and appreciate the support the system provides (i.e., awareness of user role). We feel that the awareness challenge complements the convenience challenge and that a single solution can be found for both, although it will vary for each sustainable human system.

Accessibility to information is key in achieving the balance of convenience, awareness, and sustainability. It is essential to explore ways to gather information that can't be acquired from public resources and are too complicated for average users to acquire. Methods that should be researched include: implementing extra information produced by experts and power users into designs, using mobile technologies to aid the user in a more detailed analysis of the environment, and unconventionally utilizing common household items to indicate otherwise elusive properties of the environment.

## CONCLUSION
In this paper we described the need to develop technologies that enable people to transition into a simple, sustainable lifestyle. We introduced the concept of a domestic plant guild to show how sustainable human systems can effectively support such a lifestyle. We presented a series of requirements for building the *Domestic Plant Guild Composer*, a tool to develop plant guilds. The requirements suggest the incorporation of HCI techniques to reduce the complexities associated with its creation. Without these techniques, the *Domestic Plant Guild Composer* would only be usable by permaculture and horticulture experts. We feel that this research area needs further exploration and that our requirements could be applied to tools that support a user's journey towards a simple, sustainable lifestyle.

## ACKNOWLEDGEMENTS

## REFERENCES
1. Blevis, E., & Morse, S.C. SUSTAINABLY OURS: Food, dude. *Interactions* 16, 2 (March 2009), 58-62.

2. DiSalvo, c., Sengers, P., Brynjarsdóttir, H. Mapping the landscape of sustainable HCI. In *Proc. CHI 2010*, ACM Press (2010), 1975-1984.

3. Hakansson, M., Nathan, L., Leshed, G., Mann S., Blevis, E. Sustainability Community Workshop Proposal. *Proposal CHI 2012*.

4. Hirsch, T., Sengers, P., Blevis, E., Beckwith, R., & Parikh, T. Making food, producing sustainability. In *Proc Ext. Abstracts CHI 2010*. ACM Press (2010), 3147-3150.

5. Holmgren, D. *Permaculture: Principles & Pathways Beyond Sustainability*. Holmgren Design Services, Hepburn, Victoria, 2002.

6. Mollison, B. *Permaculture: A Designers Manual*. Tagari, Tyalgum, New South Wales, 1988.

7. Pierce, J. Material awareness: promoting reflection on everyday materiality. In *Proc Ext Abstracts CHI 2009*. ACM Press (2009), 4459-4464.