# Plant-Computer Interaction, Beauty and Dissemination

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## ABSTRACT
We inquire into ways of understanding plant interaction through a triangulation of four approaches: a multispecies ethnography of people's ordinary practices and doings in relation to sakura trees during their short blossoming season; readings of theoretical works on human-plant relations and plants' urge to spread; a systematic review of how plants are involved in computing and computer systems; and finally a review study on how cherry blossoms are used in design and architecture. We bring these together and propose to discuss the involvement of florae in computer systems and design items through the lens of understanding plant interaction as temporally extended dissemination and agency to spread. The design intent within Animal-Computer Interaction (ACI) has been to develop systems where non-human species are seen as "users". If such an approach is applied to plants, then we need to frame research in a direction that aims to give us an understanding of what these sorts of users are doing. Since the most successful forms of dissemination are hedonic, we argue that researchers should focus more specifically on system design that supports aesthetic interaction, rather than supporting abstract contemplation, as has been common within Human-Computer Interaction (HCI).

### Author Keywords
Multispecies-Computer Interaction; Nature; Trees; Plants; Dissemination; Beauty; Human-Plant Interaction.

### ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI).

## INTRODUCTION
Individual members of species from the plant kingdom constantly surround us, but the way in which we relate to them and they relate to us are largely unknown. Plants are important to us in many ways, ranging from shear biological necessities to experiential demands for relaxation and aesthetics. We use them to decorate our homes and parks. We eat some of them and use others for perfume. Some are considered weeds, while others are aesthetically cherished. Japanese cherry blossom trees are representative of the latter. Like other visually appreciated flowers, such as roses or tulips, the fruitless cherry trees are embedded in the lives of humans for primarily aesthetic reasons. Their ornamental value has long been recognized [8]. They blossom for a short time in early spring, which provides opportunities for remembering and longing for their blossoming, and they also are a symbol of life itself, as well as of love, beauty, and rebirth [29]. Between blossomings, they are perceived as just one tree among others, discreetly experienced as background elements in the periphery of human lives.

In this paper, cherry trees are investigated in order to unpack how plants can be conceptualized as interacting with technology. This is of interest for Animal-Computer Interaction (ACI) because of its stated ambition to re-think nonhuman species as "users". The topic is briefly discussed in McGrath's [25] early piece on species-appropriate computer-mediated interaction. Recent advances in plant science [e.g. 22] argue for focusing on plants and their many senses and ways of expressing "intelligence" in dealing with their own kinds of problems. Such research can increase the potential for plants to be users of digital technology. It is also relevant because plants might reveal characteristics of non-human interaction extending beyond vegetation that otherwise remain hidden due to ACI's tendency to study user-computer interaction involving "human-like" companion animals. Hence, despite ACI's ambition to treat animals as the "new humans" to design for and with, we still discriminate in the selection of animals as users by focusing on species that are useful, often in very specific ways. Species from the plant kingdom, which lie even farther toward the extreme end of the human-nonhuman continuum, have been neglected as users, and including them takes this idea to an extreme. In that sense, plants can be seen as the "new animals", and the suggested focus on multispecies interaction within ACI needs to consider florae as well.

In a similar fashion, botanist Francis Hallé [10] investigates the hierarchical asymmetry in the perception of animals and plants. Species from the plant kingdom silently live their "immobile" lives on entirely different time-scales than humans are used to. They are ubiquitous and are very often unreflectively intertwined with human life, treated as barely

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living objects in the background of the human and animal world. Just as with animals, we use and interact with plants in many ways and for various reasons. In that sense, the relation between humans and plants is similar to that between humans and animals. Nevertheless, if animals are different from humans, then plants are radically different from both humans and animals. Focusing on plants' beings and relations in the world puts both human and animal life in a different perspective.

We investigate this topic through a triangulation of four different approaches: ethnographic observations in a park, theories on plants and human-plant interaction, an analysis of plant interactive systems in HCI-related fields, and a study of how cherry blossoming is used in interior design and architecture. A triangulation approach goes beyond limitations of a single method by combining several methods and giving them equal relevance [9]. In the field of HCI, a broad set of methods has been used to study and learn from humans' interaction with computers, and some of these methods have also been useful within ACI. Methods used include experiments of various sorts and observational studies, such as ethnography. All of them take for granted that turns in interaction are rather fast, i.e. on the order of milliseconds to minutes. We thus learn from ethnographic observations that people engage with cherry trees. Their walking pace slows when approaching a blossoming tree. They look at it and touch the fallen petals. They smell, photograph and socialize in public spaces. In all, the study reveals people's appreciation of the blossoming trees, but fails to address how the interaction should be understood from the point of view of the trees. Even if we study the blossoming event, which is temporally bounded, we will face activities or "interactions" which are extremely extended in time. Plants do change and vary, but slowly.

We employ a triangular approach in order partly to overcome the problem of only being able to empirically capture interactions with plants asymmetrically. Combining methods gives us the opportunity to articulate an ACI-approach to florae. That said, the result of a triangulation depends on the selection of cases, here studies of both cherry trees in particular and plant systems in general. It needs to be recognized that a particular selection will give a particular viewpoint on a topic.

The first thing added to the ethnographic observation was a theoretical discussion based on available literature. Posthumanist thought and studies on animal cognition have paved the way for taking nonhuman beings into account in a more serious way in our anthropocentric world. According to plant philosopher Mikael Marder, "non-animal living beings, such as plants, have populated the margin of the margin, the zone of absolute obscurity undetectable on the radars of our conceptualities" [26, p. 2]. Theoretical accounts inspired by biology suggest that we can understand plants as oriented toward, or interacting through "dissemination" [31]. Through trial and error, plants develop ways for their species to multiply. The beauty of the blossoming and the praise it receives from humans are not then coincidental, but are a result of that orientation. Since ACI is concerned with the design of computational systems, we then take the ethnography and the theoretical study and juxtapose them with systematic reviews of two different design fields. In doing so, we take a broad look at the occurrence of plants in the design of interactive systems in HCI-related fields. Finally, we review how the cherry blossoming is used in interior design and in architecture. The study shows that this is done through indexical and iconic approaches. In the discussion section, we are then able to juxtapose the individual studies with each other to reveal shortcomings in previous HCI research and give recommendations about how to pursue plant-computer interaction research in ACI.

In sum, the different sorts of events or behaviors, or whatever we should call them, that we face when dealing with florae put us in a methodologically challenging position. It seems that we need to move out of ACI's methodological "comfort zone". When it comes to plant interaction, we need to take an exploratory approach that initially works with weak empirical material, in order to at least establish a research question.

## PEOPLE UNDER THE CHERRY BLOSSOMING

In the following we account for our ethnographic observation of the cherry blossoming in *Kungsträdgården* ("King's Garden"), a park in central Stockholm, Sweden. The ethnography consists of field notes and detailed observations of peoples' ordinary doings in relation to the cherry trees during their short blossoming season, which lasts for about a month in early spring. Their colorful presence has constructed them as an appreciated attraction for both tourists and locals, and the blossoming is one of the most photographed events in the city during this period. The trees have stood there since 1998.

In total, the material consists of video-recorded observations (about 190 minutes in total), mostly captured from the same location (at the end of one of two parallel corridors of sixty-three sakura trees separated by a large basin). The material was gathered on several occasions. A pre-study took place in 2014, with two visits. The main part of the study took place in 2015 with thirteen visits covering the entire blossoming season, from the emergence of the first buds, through their full bloom, and until the very end when the petals fall down (see Fig. 1). The park was also revisited


**Figure 1: Sequential extracts of the cherry blossoming from the fieldwork in 2015**

on six occasions during the 2016 blossoming season. The material was initially analyzed in joint sessions where preliminary themes were identified and discussed. It was then coded in detail by one of the authors, with screen captures to exemplify the identified themes. Even if there is a lot to say about the analyzed material, we have contented ourselves with presenting only four broader themes related to these practices.

**Figure 2: Inspecting the buds.**

*Looking*

In the early phase of the cherry blossoming season, when the first buds begin to show, many passers by tend to slow down to check the status of the budding (Fig. 2A). Others engage in a closer inspection by stopping and walking around under the trees in search of the first buds (Fig. 2B). This type of interest can be seen as an expression of people's interest and longing for the blossoming season. There were also occasions where strangers began talking to each other about the trees and the flowering, which resembles how dog walking can lead to increased sociability. The human gaze is of course present throughout the entire blossoming season. When one is in the vicinity of the trees they are constantly visible, even in one's peripheral vision, especially at the time of year when they are clad in their pink attire.

**Figure 3: Smelling (A), touching (B-C) and collecting petals (D).**

*Touching and smelling*

Even if enjoying the blooming seems primarily to be a visual activity, there were several occasions when the people engaged with the trees through tactile interaction. This could for example be by bending down a branch (Fig. 3C) and touching (Fig. 3B) and smelling the petals (Fig. 3A). Physical interaction with the trees could also manifest in different ways of taking photographs. People might, for example, pick up fallen petals from the ground and take close-up shots, or release the petals and let them gently fall down in front of the lens, or throw the petals up in the air

**Figure 4: Kid playing with fallen petals.**

and shoot a portrait with the petals falling like pink rain in the image. In other cases, they might just bend down and take up a handful of petals to observe them in their hands and then leave them on the ground. There was even one occasion when an elderly man collected petals in a small transparent plastic bag (Fig. 3D). Touching could also take the form of children playing with fallen petals, picking them up and throwing them in the air (Fig. 4).

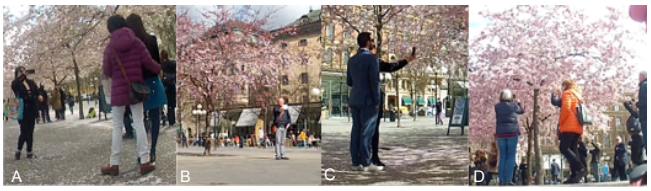

**Figure 5: Examples of photographing practices - groupie (A), reversed selfie (B), reversed groupie (C), and tree portrait (D).**

*Photographic practices and online blooming*

Taking photographs was a very common, and almost ubiquitous practice. This increased in intensity as the blossoming progressed. The many different ways of posing and photographing (e.g. selfies (Fig. 5A), reversed selfies (Fig. 5B), groupies (Fig. 5C), portraits with the blossoming trees in the background, portraits of the trees (Fig. 5D) and close-ups of the petals) lead to the same conclusion. In an almost ritualized manner people visually "worship" the blossoming trees and are fascinated by their collectively perceived beauty.

**Figure 6: Excerpts from the blossoming on Instagram.**

This is also evident when observing the images posted on Instagram during the blossoming season. Exploring geotags and hashtags related to "*Kungsträdgården*" amounts to experiencing an explosion of pink. Hence, the cherry trees also bloom online. Just as in the park, they fascinate people online, who post comments praising the trees and expressing their longing to be there and participate.

In all, we learned that humans relate to the cherry blossoming in ways that visibly reveal an interest in experiencing the trees with many of our senses (vision, touch, smell). We could go so far as to read a positive experience of adoration into the interaction. However, our ethnographic fieldwork came to highlight the method's inadequacy for providing a symmetric understanding of what was going on between the humans and the plants. From the bench beneath the trees, we were close to the plants but still could not capture their interaction with the human passers by. The problem is that we do not learn about symmetric interaction, only one-way interaction. In this sense, we consider our ethnography to have failed. We need other approaches to consider the interaction from both species' perspectives, and we begin

this inquiry by considering theoretical perspectives on the topic.

## THEORIES ON HUMAN-PLANT INTERACTION

In the following, we turn to research outside HCI and ACI to gain a better understanding of plants' ways of being in the world and their relationship to humans (as well as humans' relationship to them). In particular, we turn to botany, philosophy, anthropology, and geography. Recent research within these fields concerns how to conceive of plants' intelligence, senses and agency.

There is growing interest within non-ACI disciplines in seriously accounting for multifaceted interspecies interdependencies, and understanding plants as active beings and subjects rather than overlooked objects (e.g. [7, 10, 16, 18, 26, 27, 31]). The way we nurture and take care of animals, and recognize them as being dependent on us, can also be seen in our domestication of plants in our homes and gardens. In that sense plants can be perceived as pets [37, 38] comparable to animals, and consequently as a part of nature under human control. Geographer Yi-Fu Tuan states that human domestication of other species is clearly an act of power, but when this power is exercised in combination with affection, a pet is created instead of a victim [37]. We care for domestic plants almost as much as we care for companion animals.

The asymmetrical and hierarchical structure of species relations, with humans at the top exploiting other species for their own needs, can also be symmetrically considered from the perspective of the other party. Animals, and their ways of being and relating in the world, have for quite some time been seriously studied, especially in research influenced by posthumanist thinking. Plants and their way of being in the world are on the other hand excluded from ontological consideration. Hence, there is "a human bias towards animals and a relative indifference to plants", as stated by renowned botanist Francis Hallé [10]. If animals have been marginalized, plants have been perceived as "the margin of the margin" [26, p. 2], as pointed out by philosopher Michael Marder [26, 27], who instead puts plant beings at the center of philosophical attention.

The view of plants as complex beings, rather than just merely living matter, is a line of thinking that goes all the way back to Darwin [7]. Recent advancements in plant science show that plants are more intricate and sophisticated than previously known. Researchers in this field examine plants' sensory and communicative abilities and their ways of being "intelligent". Stefano Mancuso [22] argues that plants have the same senses as humans (sight, hearing, taste, smell, touch) even if manifested differently, and even have several more (e.g. the ability to measure soil humidity, identify water sources from a distance, sense gravity, and measure chemical gradients in air and soil). Cognitive tests and experiments on plants, similar to those conducted with animals, have revealed that "plants are sentient (and thus endowed with senses), that they communicate (with each other and with animals), sleep, remember, and can even manipulate other species" [22, p. 156]. This kind of research reveals that plants have rich sensory and communicative abilities and even memory and the ability to learn, despite lacking a brain and neurons. Such research contests conventional ways of perceiving plants, and for that reason is often met with skepticism [e.g. 1], especially when characteristics usually attributed to humans are applied to plants. Even if the latter anthropomorphizes plants, in a similar manner as we do to animals when ascribing human-like qualities to them, the experiments and cognitive tests done within this field show that plant species are more complex beings than previously shown. This perhaps amounts to taking a step away from treating plants solely as automata, i.e. as mindless machines. This shift toward including the plants' perspectives reconstructs the species hierarchy and begins to remedy the asymmetrical notion of plants.

Human geographers have recently begun to study human-plant relations. One example is Jones and Cloke's [16] Actor-Network Theory (ANT) inspired account of trees and their different ways of having agency. This can be seen as a continuation of previous work done on human-animal relations within the field of animal geography [e.g. 41]. They discuss four forms of agency that trees possess: *routine* actions (natural processes of growing, reproducing, and spreading); *transformative* actions (how they grow, and self seeding); *purposive* action ("the way trees are able to influence future courses of action; their DNA clearly entertains a plan which purposes particular forms of being and becoming"); and *non-reflexive* action ("a capacity to engender affective and emotional responses from humans who dwell amongst them"). In other words, plants, in this case trees, act upon others as well as being acted upon. These kinds of theoretical accounts ascribe agency to the trees, even if they do not emphasize the well-developed sensory life suggested by Mancuso [22] and other plant scientists.

Jones and Cloke's [16] advocacy for plants' agency in routine actions such as growing and spreading, and in transformative actions, is further emphasized by Pollan [31]. He understands agency in relation to individual plants' lack of means to move from one place to another. The immobility of plants "has led to a remarkable diversification in their biochemistry, partly to entice animals to do their work for them" as highlighted by Hallé [10, p. 15]. Pollan further develops this notion in his co-evolutionary account of how plants, through trial and error, also use non-plant species for the sake of spreading by playing on "their desires, consciousness and otherwise"; the ones that do so most effectively are "the ones that get to be fruitful and multiply" [31]. Sweetness, beauty, intoxication, and control are four human desires that Pollan exemplifies with the cases of the apple, the tulip, cannabis and the potato. These species have been successful in playing along with human desires in order to spread and multiply.

Just as with Pollan's tulips, the cherry blossom trees disseminate by purely aesthetic means. These arguments imply that plants' agency consists of a wish to spread, and that plants use other species to do so. In this idea of co-evolutionary relationships between humans and plants, "every subject is also an object, every object is a subject" [31]. In conceiving of plant as users, it is this notion of agency as dissemination that we will explore further.

## PLANTS IN COMPUTING AND COMPUTER SYSTEMS

In the following we present different types of plant involvement in computing and computer systems, as they can be found in the ACM digital library, in HCI and in other related fields. The systematic review provides an opportunity to discuss and compare these approaches with the theory presented above. We focus both on how they are incorporated as living plants and how they influence biomimetic interfaces. In some cases, design projects outside academia are mentioned. In reading these texts, particular attention has been given to the intended role and function of the plant in the system, as well as to how the inclusion of plants has been motivated. In the following, the categories and themes identified when reading these papers will be presented in separate sections.

### *Plants as output devices*

When including plants in computing systems within HCI, the most prevalent category is that of plants as output systems. This is primarily done to increase human concern for environmental health [5] or to strengthen our relationship with nature [11]. In these systems, plants typically serve as displays for visualizing information; for example by artificially manipulating the plants' color [5] or by affecting their growth, which is stimulated or controlled by water and light [11, 20,12]. As a design resource, this way of involving plants primarily exploits the plants' aliveness and their different and slower temporality, and engages human vision.

An early attempt to use plants as visual information displays is *Babbage Cabbage* [5], where the plant (in this case a cabbage) is used as a pixel in a living screen able to display different types of information by changing color. This system does not involve the plants' natural abilities. It is manipulated to provide interaction by changing the cabbage's PH-level to change the color of the plant. Even if they make use of the fact that the species is alive, they only use the plant's aliveness as a design resource that adds a new dimension to the interaction, rather then treating plants as living beings with their own perspectives. The motivational argument is that including living beings in the system can give human users a more immediate and tangible experience of interacting with environmental health issues.

Other ways of using plants as displays play more on natural characteristics of plants, such as growth [11, 20, 12]. *Rafigh* [11], for example, was designed to encourage primary school children with speech disorders to use their speech in a game that involves supplying a living mushroom colony with water. The growth of the mushrooms is controlled by changing the level of watering, which is connected to the amount of communication. The inclusion of living mushrooms is motivated by the need to convince children to learn by "taking care" of other living beings, and by the fact that this also would have therapeutic values for humans. *PlantDisplay* [20] functions in a similar manner. The system controls the growth of the plant by manipulation, in this case by adjusting the rate of photosynthesis. The quantity of mediated communication in dyadic relationships (e.g. number of phone calls) is used as input data, and the status of the plant's well-being symbolizes the strength of the social ties and the level of communication between the humans. This type of system uses the plant and its aliveness solely as a design resource, and does not see the plant as a living being in its own right. Another system that uses plants' aliveness (expressed by growing) as a design resource is *Infotropism* [12]. In this case it is the direction of growth that is manipulated by altering the position and degree of access to a light source. It is argued that the plant's aliveness adds an emotionally engaging and compelling form of interaction, in this case with the ambition to affect people's recycling behavior.

There are also examples where the plants support audio presentations. *ListenTree* [32] is an example of the latter. It uses a real tree as an audio-haptic display where different kinds of sounds can be heard through bone conduction, transforming the tree into a living speaker. The motivation is to create calming technology [40] in the form of an ambient display that is naturally embedded in the environment.

### *Plants as input devices*

There are also systems that explore the use of plants as part of an input interface, or as biosensors. *Botanicus Interacticus* [33] is such a system, where any plant can be transformed into a touch-sensitive control device. The plant acts an electrical circuit and supports different kinds of touch gestures. The diversity of shapes and sizes of florae constructs manifold variations of such interfaces. The project is motivated by possible experiential, entertainment and aesthetic uses. It is described as leading to increased engagement with the physical surroundings, as well as supporting a new environmental computational platform for both education and entertainment. The former is often done in combination with human touch. The diversity of shapes and sizes of florae constructs manifold variations of such interfaces. Similar to the output category, it is primarily motivated by its promoting increased engagement with nature, as with the output category, but also by its having therapeutic paybacks and recreational benefits. *Flora Touch* [14] is another example where human touching of plants is translated into audio-visual output. Different kinds of touch trigger the projection of visual graphics on the table next to the flowerpot. Household plants of various sizes, with diverse tastes, scents, colors and textures, are explored. The project especially targets as users children with autism and elderly adults in an assisted-living facility, and is

envisioned as serving therapeutic and meditative purposes. People's emotional attachment to nature and nature's therapeutic value are central to this idea. It is suggested that plants, like animal pets, trigger feelings of relaxation and attachment. Being close to nature, especially by touching it, triggers a sense of relief.

Another category of using plants as input devices comprises systems where the plants rather than the humans generate the input. These systems are centered on the plants' abilities and interactions with the environment. The *Pleased* project [23] uses the sensing capabilities of plants as biosensors, with plant root systems detecting chemicals in the ground. In the project *BiooLite* [4], the ability of plants to absorb sunlight is harnessed to create electricity. In a sense the plant can also be seen as outputting electricity.

#### *Biomimetic systems*

Plants are also included in systems in a more indirect way. Florae are used as inspiration in creating forms of interaction similar to those involving real plants. Like how material science has been inspired by plants in developing new materials, HCI researchers have begun observing nature to create novel and authentic forms of interaction. An example of the former can be taking inspiration from how we physically interact with plants. Such systems are also motivated by the ability of plants to generate emotional attachment and meditative moods.

An example is *LightBundle* [14], which artificially mimics the way we hold a bundle of strands, such as a bouquet of flowers, the way we peel a piece of fruit, or how grapevines intertwine and become entangled in each other. Both the plant behavior (such as growing and becoming entangled) and the different ways of physically engaging with plants (holding, peeling) are transferred to the design of an interactive bundle of optical fibers. The way of holding the bundle, peeling off layers, pointing the strands in a specific direction, or twisting two strands together manifests different way of linking and dealing with diverse sources of information. Hence, this system can be seen as both an input system and an output system, but with the difference that only artificial plants are involved. *Grass* [14] is a similar project where more than 2000 strands of green optical fiber emulate a field of green grass. The artificial grass is sensitive to hand gestures such as touching, stroking and caressing, and is supposed to trigger a multisensory experience, as different nature sounds (such as water, wind, birds, and crickets) and LED light patterns are projected on the tips of the fibers when users gently caress them.

This project, together with *Flora Touch* (also found under input devices), is described as having the main purpose of generating tranquility in the user, as well as emotional attachment, by harnessing the meditative and therapeutic values of nature. The systems are intended for users with mental and physical disabilities, who have limited access to nature. *LaughingLilly* [2] is an artificial plant that is used to display information on graphic petals, and it is also intended to create calm using ambient technology [40].

Another area of biomimetic systems is that of biorobotics and biomechanics [24, 36], where animals have been the predominant source of inspiration. Recently there has also been increased interest in plants and their abilities and sensory capabilities. Different parts of vegetation, such as the roots and leaves, are used as a source of inspiration for novel robotics and pioneering engineering solutions [24].

#### *Nurturing systems*

There are also types of systems designed to support the well-being of a domesticated plant itself. Such systems assist humans with routine tasks such as watering. Some of these systems measure soil conditions and inform the human users when it is time to water a potted plant. These systems include interactive pots, such as *EmotioPot* [30], which displays facial expressions on the pot to inform users about whether the plants are satisfied. *PotPet* [17] is another example; it does the same thing but also moves the potted plant, which is equipped with wheels and sensors, to sunny locations. The potted plant also circles around people when it needs to be watered and spins in joy when receiving water. The authors argue that enabling plants to autonomously move physically, amounts to making them imitate pets. These systems depend on anthropomorphic elements, as they attribute movements and emotional expressions to the plants. This is also present in *MyGreenPet* [13], where plants are ascribed human emotions with the aim of increasing children's interests in pets and preventing them from damaging plants. *Plantio* [21] is another system which explicitly aims at increasing humans' bond with nature by augmenting plants' expressivity. It builds on the *I/O plant* [19], where the levels of light and water are controlled by actuators which in turn are controlled by environmental stimulation of the plant (touch, light, talk, nutrition, vibrations and water). In this sense it can also be seen as using the plant as a sensing device, but it is meant to create a more intimate relationship between humans and plants, and defines the plant as a "communication partner".

Taken together, the entire area of plant systems copies and augments biological characteristics, and/or uses vegetation as a part of an interface to stimulate human thinking. How these approaches can be used to support symmetrical interaction, as favored in ACI, remains to be discussed.

## CHERRY BLOSSOMS IN DESIGN

In the following we take a different approach to understanding the interaction with plants, namely analyzing how cherry blossoms have been used in design. We attempt to bring together different areas of knowledge in order to shed light on plant interaction. We propose to account for the sakura trees by unpacking design works involving cherry blossoms and the making of them as objects. The field of design has a long tradition of using nature as a source of inspiration, in order to make things beautiful and desirable. Cherry trees have spread throughout our visual

culture because of their beauty. Their occurrence in contemporary design offers a channel for broadly understanding how species spreads through aesthetic appeal.

This is reflected in established design magazines, which promote and critique leading works of design and are influential trendsetters in contemporary design globally. We reviewed designs incorporating cherry blossoms in 11 magazines (*Dezeen, Design Milk, Fast Co. Design, Design Taxi, Core77, Colossal, Abduzeedo, Dwell, Wallpaper, Contemporist* and *Design Observer*). These were selected because they are representative of the design literature and provide a comprehensive overview of the use of cherry blossoms in contemporary design. Some magazines present dozens of works related to cherry blossoms, while others have only a few or even none. In total we found 44 design works from the years 2000 to 2016 covering a broad range of design fields including architecture, interior design, furniture, fashion, packaging and digital design. Instead of focusing on a few design disciplines, we look at design more broadly in order to reflect on the occurrence of cherry blossoms. We analyze how florae are used, and categorize the works accordingly. The aggregation was conducted following an inductive approach; two design categories emerged when studying individual design items: indexical and iconic use of cherry blossoms.

*Indexical use of cherry blossoms*

Architecture and landscape design often use cherry trees in the formation of physical spaces. We use the term "indexical" to highlight when design is used to point directly to a physical tree. For example, the 63.02° House, designed by a Tokyo-based architecture firm, has windows positioned to frame a blossoming cherry tree [34]. Architects and designers also experiment with various means to enhance the aesthetic experience of the cherry blossoms. For example, the architect design piece "mirror", by Japanese firm Bandesign, has a mirror installed on the outside wall of a house to reflect the cherry trees. In this way the blossoming and falling of the flowers are visually deconstructed and recomposed to create new aesthetic experiences [3].

**Figure 7: Patient Gardener by Visiondivision**

Another example is the project "patient gardener" by Swedish architecture studio Visiondivision, who built a garden house out of cherry trees by planting a circle of 10 trees with a temporary wooden structure in the middle to guide their growth (Fig. 7). The design accounts for the timescale of the growth. The cherry trees were planted in 2011 and the garden house will be completed in 60 years when all the vegetation is fully-grown. Such design cases motivate the appreciation of cherry blossoms and enhance our relationships with the plants. In all, indexical design uses cherry blossoms as design material for the direct aesthetic experience they provide [39].

*Iconic use of cherry blossoms*

While architects and landscape designers use physical cherry trees as design materials, other domains of design mostly use graphical representations of cherry blossoms as design elements. We refer to this as iconic design. They use representations to connect design with cherry blossoms. Although there are hundreds of species of cherry trees that vary in many different ways, the dominant visual representation of them takes the form of pale pink cherry flowers with five petals evenly arranged around the center. This rather distinctive representation makes possible diverse designs influenced both by shapes and patterns of the actual flowers. In furniture and product designs, for example, some designers use iconic shapes of cherry blossoms to lend a unique and unconventional spin to ordinary objects, such as flower-shaped lamps or benches. The most recent example is the home collection, "Pause for Harmony", designed and produced in collaboration between the Finnish tableware and home interior design firm Iittala and the Japanese fashion house Issey Miyake [15]. This collection includes 30 items inspired by springtime and cherry blossoms. The plates and table imitate the shape of a blossoming cherry flower (Fig. 8).

**Figure 8: Porcelain tableware and table flower from "Ittala X Issey Miyake Collection"**

**Figure 9: Nike shoes. Image from Soletopia**

In packaging, fashion, and textile design, cherry blossoms are often utilized as graphic patterns to enhance the visual expression and variation of products, without changing their basic form. A recent example is the Nike sports shoes featuring cherry blossom prints, which gives the ordinary sports shoes a more fashionable look (Fig. 9).

The other key feature of cherry blossoms is their pale pink color, which is visible in most designs (e.g. Fig. 8 and 9). This color is also balanced with cold colors, such as blue and grey, to create a sense of calm and freshness, which can evoke early spring weather and Japanese Zen culture. The form and color of cherry blossoms are often used to together to convey the idea in design. This sometimes also extends to other properties than visual qualities, such as smells, tastes and textures. The award-winning design Cherry Blossom Soap (Fig. 11) looks and feels like cherry

**Figure 10. Cherry Blossom Soap by Mayumi Kondo**

blossom petals that are gently absorbed in the hand, expressing a sense of "delicate beauty", according to the designer Mayumi Kondo [28].

Various mobile and desktop applications make use of the graphic form and color of cherry blossoms with a focus on their decorative value; one example is a website with a cherry-blossom design theme [6]. This type of usage is still iconic. However, important aspects of design in digital format include representations involving movement and interaction. For example, the project "Sakura Dream" [34] plants virtual cherry trees in Google Maps street views, transforming any location into a cherry orchard in full bloom, where you can walk and look around. The virtual trees mimic the form and color of blossoming cherry trees, as well as depicting the falling of the petals. Fig. 11A shows the same location and view as Fig. 11B, only adding the blossoming cherry trees and falling petals.

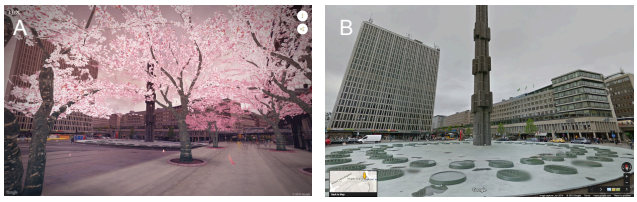


**Figure 11. Screenshots of the same street view in Sakura**

In all, various design disciplines use cherry blossoms in an iconic sense, often for the sake of the aesthetic experience they generate. Such usage may not directly benefit cherry trees, but it stimulates a culture of appreciation which in turn may benefit them.

## ANALYSIS AND DISCUSSION

Pollan's notion of dissemination concerns the fact that plants use different strategies and characteristics to spread. These strategies include ways of pleasing other species, e.g. being beautiful in the eyes of other species, and having a pleasant and sweet taste. In the following, we discuss how our results fit with plants' strategies for dissemination. We do this by aligning activities, designs and systems with their motivations, which allows us to discuss whether they support the spread of florae and vegetation.

We have sorted the discussed systems, designs and activities into three different categories of motivations. These categories emerged from the triangulation of different materials. The hedonic motivation is included from Pollan's work, as it is the most rewarding dissemination strategy by plants. The category of utility emerges in theoretical discussions on plant interaction. It also emerges from studying the motivation behind research and design of particular systems, as did the contemplative category.

Mapping out how individual approaches are motivated does not tell us how the mechanisms fit with plants orientation to dissemination directly. A specific system, designed with a particular motivation, might or might not lead to plant dissemination. Trying to understand how all these approaches map to plant strategies is not a straightforward task. For a system to support dissemination, its use must lead to activities favoring that species. In order to fully understand these effects, we must include design-oriented research on computers within ecological analysis. This particular triangulation approach would not support such an analysis fully, but it points to general design paths that are interesting to investigate.

### Input and output systems as supporting dissemination

As shown in Table 1, a number of research projects within HCI and related areas combine computing with plants in order to stimulate human thinking and contemplation. The question, then, is whether such a normative approach would support plants' dissemination, as suggested by Pollan [31]. Interestingly, none of the systems seem to be directed towards hedonic functionality. The systems designed in HCI that incorporate plants as input or output devices are explicitly motivated by a wish to care for plants, but not in the ways that plants most need to be cared for according to Pollan. Instead, they are designed to stimulate an

| | | Motivation | | |
|---|---|---|---|---|
| | | **Contemplation/Normative** | **Hedonic** | **Utility** |
| Computer Systems | **Input systems** | Botanicus Interacticus; FloraTouch | Botanicus Interacticus | Botanicus Interacticus; FloraTouch; Pleased; BiooLite |
| | **Output systems** | Babbage Cabbage; Rafigh; Infotropism (Living Plant Display) | | PlantDisplay; ListenTree; |
| | **Biomimetic systems** | Grass; LightBundle | | LightBundle; Grass; LaughingLilly |
| | **Nurturing systems** | Plantio | | EmotioPot; PotPet |
| Design | **Indexical** | Patient Gardener | 63.02° House; Mirror | |
| | **Iconic** | | Pause for Harmony; Nike Shoes; Cherry Blossoms Soap; Sakura Dream | |
| Real life | **Ordinary park activities** | | Walking, Looking, Smelling Touching Socializing, Photographing | |

**Table 1: Categories of motivation for plants in computer systems, design and real life.**

appreciation of nature as such. The *Babbage Cabbage* [5] project is a good example of this. It is justified as a showcase for disseminating the idea of caring for plants, which does not make it a strategy for increased cabbage production. It is not intended to support active interactions, be they for hedonic or practical purposes. It nevertheless can be seen as research that supports a dissemination strategy. For example, if cabbages are used as pixels, we will need to grow more of them, and the species will spread.

### Mimicking plants as supporting dissemination

Many systems and design items copy or mimic plants and cherry blossoming. The computer systems are designed to duplicate the behavior of vegetation. It is common in decoration and fashion design (as seen in Table 1) to copy the shape and color of a flower, to mimic its visual expression in order to enhance the aesthetic experience of the design. Similarly, when computer systems are designed to copy plant behavior, it is also a form of mimicry, though for utilitarian purposes. In all, this orientation does not directly support plants' dissemination. These systems and design items include plants, but not physically. Hence they either are neutral in relation to plants' dissemination strategies or, in the worst case, replace plants.

### Beauty and hedonic motivations as supporting dissemination

One aspect of how plants interact with the human world is that they also use us (e.g. 31), and the most successful plant methods are those that please other species. Drawing on ethnographic observation of peoples' practices during the cherry blossom season and analysis of the photos of the trees posted on Instagram, we have studied how people appreciate the beauty of the flowers when they appear. The adoration of these plants and fascination with their beauty are visible in the doings of people under the trees (e.g. looking, changing rate and direction of movement, touching, smelling, photographing and sharing images online for others to enjoy). Even if the trees do not explicitly use technology, the people use it, and by using it they also indirectly serve the trees' need and desire to reproduce.

Using technology to appreciate aesthetic qualities of plants can, however, support dissemination in more or less direct ways, as we learn from the study of cherry blossoms in architecture and other design areas. The indexical approach, which is common in architecture, relates directly to the dissemination of a cherry tree. A tree needs to be planted and nurtured to allow a window to reveal it. The same goes for mediatization through social media such as Instagram. There need to be trees for them to be photographed. The iconic graphic design in interior design, porcelain, etc. has a more indirect relation to the dissemination of plants. It shows that sakura trees provide aesthetic pleasure, and in this sense the mode of design meshes with the plants' interaction strategy. But it is also possible that design pieces will simply replace the plants.

### Utility versus aesthetic motivations supporting dissemination

A large number of computer systems are designed to use plants for utilitarian purposes (see Table 1). For example, *BiooLite* [6] uses plants to create electricity. In the *Pleased* project [23], the plants are used as biosensors. Another example is *ListenTree* [32], in which trees are used as an ambient audio display embedded in the environment. Systems designed for human utility can at the same time be compatible with plants' dissemination strategies. When we need plants, we also see to it that they spread. The utility motivation is also of interest because it has a narrow focus that could guide design. However, the focus on utility, which is visible in the large number of computer systems in this category (see Table 1), is not in line with the most successful dissemination strategy, as argued by Pollan. The orientation toward utility may therefore reflect not how the researchers think about the plants, but how the research system works. Again, ACI may be needed in order to balance how researchers reflect on what it means to be useful, and what such a motivation would be from a more theoretical plant perspective.

## CONCLUSION

We have shown that previous research within HCI has tended to design systems that support a generalized admiration of nature. In ACI, the design intention has more specifically been to develop systems where non-human species are seen as users. If such an approach is adapted to plants, then we need to frame research in a way that helps us understand what these sorts of users are doing. In this paper, we view plant interaction in terms of strategies for dissemination. We show how Pollan's idea of pleasing animals and being used by them is easily combined with how cherry trees blossom in a way that is appreciated by people visiting parks and in design. We therefore argue that if ACI researchers engage with plant interaction, they should focus more specifically on aesthetic interaction than supporting abstract contemplation. In particular, they should focus on developing new systems and services that support indexical mediatization of actual plants.

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