RESEARCH ARTICLE

People as place-making coordinate:
A methodology for visualizing personal spaces

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Abstract
The present research introduces the Activity Counter Maps (ACM) as a methodology for visualizing people's social spaces, arguing that accurate representations of these spaces are crucial for understanding the role of human activity as a place-making coordinate. The ACM were tested in two case studies conducted in Ueno Park (Tokyo). The first case study is focused on the visualization of the intensity of activity in the totality of the park. The second case study is focused in two sub-places of the park, generating representations of people's personal spaces combined into a three-dimensional "Common social space". The research concludes with the analysis of the generated visualizations and their potential for incorporating place-variables into the digital design process.

Keywords
Digital visualization; Patterns of occupation; Social spaces; Place theory

1. Introduction
The relationship between human activity and space is a complex one. The built environment can be understood as the scenario in which social and individual life takes place, yet is not easy to identify the clear edge between when our activities dictate how our environment should - or could - be designed, and when our environment defines how our activities occur. Built space and activity permeate each other constantly. Understanding the way in which built space and activity affect each other is essential for architecture, and while clear patterns and classifications can be observed in this space-activity relationship, - from more flexible to more rigid correlations - there is always a degree of randomness in it (Hillier and Hanson, 1988) turning the study of these correlations into a challenge.

If place can be defined as human experienced space (Casey, 1997), the correlation between space and activity is crucial for understanding places. Place-theories are usually focused on issues like history, function, character and space, but there is a lack of methodologies for studying the concrete spatial impact that we might have in a place by just being in it. Whyte (1980) already observed that applying minor changes...
to the layout and elements of a given public space can create major modifications in how people behave while being in them. In other words, one concrete space could become many different places depending on the way in which people stay in them. For instance, we could think that, if we are standing in a square which is crowded with people and suddenly the people move elsewhere, leaving the square almost empty, the square changes. What changes is neither the space of the square nor the personal spaces of the people that moved elsewhere, but what changes is the space of the place that the square is in, explained by the fact that people generate spaces when interacting with others. Hall (1966) defines different degrees of individual distances for human beings, an “anthropological space” that is generated by us being in the space and in contact with others. These distances are invisible areas around us and they represent different degrees of contact with others. Hall describes four different distances: intimate distance, personal distance, social distance and public distance. When studying these distances the main difficulty is that they are observed to exist, yet they are invisible to the human eye. These distances are rather a sense of space than a clear boundary. Can these sensed spaces be visualized as a clear boundary? This paper introduces the Activity Counter Maps (Fuji, 1972) as a methodology for visualizing people’s personal spaces interacting in public places.

2. Visualization as a design tool

Today, architecture makes use of all sorts of visualization tools for improving or modifying the design process. We can visualize how a building will behave in terms of thermal performance, aerodynamic performance or acoustic performance, so we can modify our designs accordingly. The fact that we can turn this information into images is what makes this information meaningful for the design process: suddenly we can see how the wind “looks like”, and moreover, how it looks when encountering a projected building. Digital tools can be crucial for achieving these visualizations, yet they can also be used not only for creating new approaches and possibilities to the design process, but also for revisiting old problems from a new perspective. Digital representation and visualization can generate new ways of perceiving and understanding old yet valid and relevant concepts (Ware, 2004). However, the reliability and value of a given digital visualization is always linked to the type of information which is visually represented. In Architecture, 3D modelling and image rendering is widely used for visualizing projects before they are built, yet the impact that these images and animations might have in the quality of a completed project is still a matter of debate (Day, 2002). In the pursuit of reducing the gap between projected building and built building, virtual reality promises the possibility of not only visualizing a project, but actually experiencing it in an immersive virtual environment in which even the design process could be carried out (Ye et al., 2006). Nevertheless, is important to notice that virtual environments are essentially replicating real environments, and regardless of how sophisticated some of these models and images can be they are still based on the most essential form of architectural representation: the interaction between solid and void. This raises the question if there are other essential interactions or concepts worth representation. Urban and cartographic visualization has been very effective in translating varied types and amounts of information into geographical representations. Mapping issues like migration, globalization, ethnicity and energy usage demand new approaches and abstractions in order to be accurately visualized (Bhagat and Mogel, 2008). But here we find levels of abstraction that, while being meaningful on an urban or global scale, can be quite general and incomplete on an architectural scale. For example, when looking at Flow maps, which are some of the most used types of urban visualization (Guo, 2009), we find that the core information which these maps convey - origin and destination - may not be so relevant on an architectonic scale, where a concept like journey could be more compelling and important to visualize. Evidently, depending on the kind of information which we want to visualize, different approaches are needed. When discussing the role of cartography, Chrisman (1978) argues that cartography is the science of representation, not measurement, and physicists have emphasized the space as a structure that needs to be measured, when the important issue lies in the efforts to identify distinctions that will allow better measurements. For instance, natural phenomena like wind or temperature are perceived by all of us, and we have developed tools that allow us to measure them and turn them into very accurate information. The sequence is quite clear; the phenomena is first perceived and measured, then translated into a visual representation that allow us to identify patterns and create models that can lead to a better understanding and use of the perceived phenomena. However, this research states that for visualizing people’s personal spaces we encounter a different problem which requires, perhaps, a different sequence. A concept like personal spaces has been overlooked by most visualization methodologies, since personal space is not entirely a physical phenomenon, but an anthropological one, so we could propose the following sequence; a concept is first theoretically understood, then, based on that understanding, a visual representation is created, and only then is it possible to actually perceive the concept. In the case of this research, we propose a methodology for identifying and measuring distinctions which, combined with the ACM, can be used not only for visualizing information, but also for generating form based on the people’s personal space.

3. Introduction to the activity counter maps

In order to study these personal spaces and use them as a design coordinate, first we need to find a methodology for translating them into architectonic language: a clear figure-ground relationship showing the interactions between solid, boundary and void. The Activity Counter Maps (ACM) is a digital tool that allows representation and visualization of different kinds of data in a geographical context; combined with GIS, any database containing geographical locations could be translated into ACM. For instance, a database of all the tourist attractions in Tokyo, when translated into ACM, allowed an easy visualization of clusters of tourist activity (Kubota, 2006). What the ACM does is to assign an area of influence to an object or location in the space. The radius and height of the area of influence can be assigned
accordingly to the specific needs of varied researches (Figure 1). When \( x \) areas of influence meet, the highest point where they are intersected is multiplied by \( x \), generating a new common area of influence. The process goes on until every area of influence is combined with the others into a resultant common area, allowing visualization of both the shape of the combined personal spaces and the intensity of activity, since the combined spaces grow vertically. Therefore, the intensity of activity can be expressed three-dimensionally, just like topographic contour lines. Especially for this research, here is where it lays the potential of this tool; it can be used not only for generating graphics, but also to generate form and, therefore, space.

4. Case studies: Introduction to Ueno Park

For the first case study, we decided to test the form-generation capabilities of the ACM in Ueno Park (Ueno Onshi Kōen, 上野恩賜公園). Ueno Park is located in Taitō ward, to the northeast of the Imperial palace. It is the first public park in Tokyo and the most popular one in terms of number of visitors. The main reason why we decided to carry out the case study in a park was because it allowed us to study people interacting with an undemanding and flexible environment, in which the location, duration and range of activities carried out by the visitors were more related to personal choice and not partially dictated by the constraints and limitation of a fully shaped urban environment.

Among Tokyo's parks, Ueno stands out due to its location, history and character. It has been related to leisure activities since the Kanbun era (1661-73), it was the site for one of the most important battles of the Boshin war (Battle of Ueno, 1868) and it has served as evacuation area during natural disasters and WWII bombings. Today, Ueno Park is a cultural landmark in Tokyo, containing temples, museums, and theatres. Despite the dramatic and numerous changes occurring in the city since the Meiji period, the outline of Ueno Park has barely changed. Instead, the park is composed by areas and places which belong to different historical periods and events. This gives the impression of a park made up from different patches, apparently disconnected from each other, yet the park has managed to retain integrity as a place, and this integrity is greatly given by the visitors and the way in which they occupy the park. Therefore, for the first case study, we wanted to visualize the intensity and patterns of this occupation.

4.1. First case study: Intensity of activity in Ueno Park

For this research, we defined intensity of occupation as the spatial relationship between density of occupation and the boundaries of the occupied places: a spatial visualization of density. The first requirement for this visualization was quantitative information about the number of people visiting the park. Regarding people's flow in Ueno Park, up-to-date data was not available, so we were in need to collect our own. First, we focused on finding available data from many public facilities of the park (Museums, Zoo, theatres). We compared the monthly number of visitors per facility during two years (2006–2007). These facilities combined received more than twelve million visitors per year. We could observe that there was a clear correlation between years in terms of the total number of visitors per month. However, there was no such correlation when doing the same comparison for each individual facility; their monthly numbers of visitors varied drastically from one year to another. The only facility in which we could observe a correlation between years was Ueno zoo, which is also the only open-air facility in the park. Interestingly, there was a clear monthly correlation between the sum of all the visitors and the visitors of the Zoo. This suggested that most of the people coming to the museums were also considering spending some time in the park. Nevertheless, this did not clarify the amount or flow of people in the open area of the park.

4.2. First case study: The issue of the boundaries

In order to visualize the intensity of activity in the park, we needed to perform our own counting of people. For doing so, the first step was to divide the park into parts in which to perform the counting. It is necessary to emphasize on the fact that, since we are studying the role of personal spaces as a place-making coordinate, these parts should not be considered only as partitions in the space, but as a network of sub-places. This required a consistent methodology for identifying each sub-place. There are several difficulties
when defining the boundaries of a given place. One of the problems is the complexity and openness of the concept, which can be equally used for referring to the moon or under a table: They are both places. All places can eventually be subdivided into smaller places, but they cannot be smaller than a human body. If we consider the human body as the basic unit for measuring a place, then we could agree that Ueno Park is made off as many places as people being in it. Since it will be impossible to know every sub-place that manifests in the mind of each person who visits the park, we needed to focus on finding a methodology for identifying a common network of sub-places. This network may not be specific to an individual, but every individual would agree with it. For defining this common network of sub-places, we decided to use Lynch’s “image of the city” methodology (Lynch, 1960). Ueno Park has a strong “urban character”; it appears as a portion of the city where the buildings have been replaced by trees, so regardless of the fact that Lynch’s methodology was first intended to be used in fully urban environments, it adapted to Ueno Park with ease, providing a starting point for identifying the sub-places. However, we realized that this methodology by itself was not enough, because it does not consider the concept of boundary, and to distinguish a boundary is perhaps the most essential operation for place definition. The identification and creation of boundaries is crucial for establishing a figure-ground relationship with the extension, and equally essential for identifying paths, nodes, districts or anything else in our environment. The presence of a boundary is what allows us to realize that we are here instead of there. In Ueno Park, the notion of leaving a sub-place and entering another one is given by subtle, yet perceivable changes in the space, allowing us to make distinctions and divisions to the park even if we are not fully acquainted with its totality. In the city, the interaction between solids and voids are an unmistakable distinction between spaces, while in the park the natural elements have a degree of permeability of light, sounds and smells, so that the level of enclosure that the trees produce is not as severe as those produced by the solid man-made elements. Moreover, the man-made elements encountered in the park are not radical interventions to the space like walls, buildings and streets, but they are mostly a guide, a suggestion to the space that provides a level of flexibility in the way we move and stay. Therefore, we cannot identify the boundaries of the places in Ueno only by using space defining elements, since the edges and divisions produced by these elements do not always match the boundaries that we can perceive as place-defining ones. We investigated all the elements and instances capable of creating a boundary, classifying then into the following three categories: Strong boundaries, Intermediate boundaries and weak boundaries (Figure 2). Strong boundaries are generated by elements or spatial features which do not allow going through them, or demand great effort in order to do so. Examples of these boundaries are walls, high fences or a building. Natural features like a hill or a shore are also strong boundaries. In Ueno Park, natural boundaries are usually reinforced by man-made elements, like curbs or fences. Intermediate boundaries are those which create a clear division in the space, yet can be easily trespassed.

![Fig. 2 Categories of boundaries; a few examples.](image-url)
A simple example is a sidewalk: A small change of level indicates the division between two different spaces. Weak boundaries are the ones that suggest divisions in the spaces by creating distinctions in it, rather than becoming an obstacle. A simple change of pavement, or different elements arranged along an axis can become reference for differentiating one area from another.

We realized that the defined boundaries for identifying the sub-places did not allow performing the subdivision directly on CAD files or GIS maps of the park. Information like changes of pavements or garden fences were not contained in the available maps for Ueno Park, so first we had to identify and map every boundary in situ, while being in the park. This was actually beneficial for the research, since it allowed us to perform the subdivision by experiencing the boundaries in the same way in which a regular visitor in the park would do it. We started the subdivision of the park with only one rule: no sub-places could be fully contained by another one. This resulted in a network of 33 sub-places of similar size and manageable for a person to count the people inside them (Figure 3).

4.3. First case study: Counting of people

The counting was performed during one single day, simultaneously in each one of the 33 sub-places. We decided that the counting would be done from 10:00 AM to 05:00 PM, since in previous research we registered that before 10:00 AM the level of activity was not significant, and after 05:00 PM, the level of activity decreases notoriously, in accordance with the same period of time in which most of the facilities in the park are open to the public. Another requirement was that the day in which the counting would be executed had to be a weekday, because during weekends the park is visited by great numbers of people, making the counting more difficult and potentially less accurate.

The counting was carried out as planned. We collected samples of ten minutes per every hour. These time periods for counting people occupying public spaces have been proven consistent in providing reliable samples, especially for data extrapolation (Gehl et al., 2006). During the ten minutes samples we counted everybody who was inside the boundaries of a given sub-place, regardless of their age, gender or activity. The volunteers who performed the counting were encouraged to do their best not to recount an individual during a single sample, but if an individual could be found staying in a place during more than one sample, he had to be included in it. In other words, everybody being in a place during the counting time was included in the sample.

4.4. First case study: Graphic’s generation and results

Prior to the generation of the ACM, we needed to place the counted people in each one of the 33 sub-places of the park. Using a simple script, the numbers of people were randomly yet evenly distributed in each sub-place, and each individual was represented by a dot (Figure 4). The randomness of the individual locations is consistent with the research,
since what we want to visualize is intensity of occupation, not precise traffic flow.

Once the people were distributed we assigned them different areas of influence and tested different parameters searching for a single shape in the visualization results. The criterion for visualization was based on obtaining a clear distinction of the intensity of activity for each sub-place and, at the same time, a unified shape for the total of the park. The resulting images were obtained by assigning a radius of 30 m to the area of influence of each individual. Using these parameters we obtained a total, unified contour in which it was also possible to distinguish the particular activity for each sub-place (Figure 3), showing how the occupation for each sub-place merged with the others into a continuous, coherent shape.

Based on the obtained maps, it was also possible to generate color-gradation graphics (Figure 3). When looking at the resultant ACM, sometimes it could be difficult to visualize the boundaries of the sub-places in relation to their intensity of occupation. This was quite notorious when sub-places showed the combination of having a small size yet high levels of activity. In those cases, the graduation graphics allowed better visualization, showing the intensity of activity in a more general way, in which the sub-places where clearly identifiable.

The ACM made it easy to visualize patterns regarding the intensity of occupation in the park. During the studied day, it was possible to see a clear axis of activity made by sub-places 12, 15 and 16. The places with less activity were also the ones which were independent from the network of the park (sub-places 8 and 12), but the people visiting these places had the aim of doing so, since they are not part of any route. Most of the places shared the tendency showed by the main nodes (when the nodes increased or decreased their intensity of activity, the same happened in most places of the park).

However, this changed during the fifth time span (14:00-13:00), when the places around Shinobazu pond started to show different tendencies from the rest of the park, especially by the end of the day. This shows an interesting correlation between special features and occupation: the clear spatial
differences between the pond and the rest of the park also exist in terms of activity.

5. Second case study: Visualizing personal spaces

For the second case study, we decided to use the ACM for visualizing people's personal spaces while being in a public place. The research was focused in two of the sub-places of Ueno Park. They were chosen because of their similarities in terms of size, shape and the amount and nature of the activities happening in them, which allowed us to record their activities using the same methodology. At the same time, their differences in term of location, surroundings and arrangement of elements offered the potential for interesting comparisons in the resulting maps. We decided to record one of the most essential and basic place-making activity: to stay. The act of staying in a place voluntarily involves a conscious decision, and it offers a starting point for a wide range of various optional and social activities to appear.

For the data collection we filmed a series of videos on both sub-places. We filmed two days per place, one day on a weekend and another during the week, making sure that the weather conditions were similar in every filming session, and no extraordinary events (parades, flea markets, etc.) were happening in the park during filming time. For each place, we filmed five minute videos every thirty minutes, from 10:00 AM to 07:00 PM, giving a total of 16 videos per day. Two days per place resulted in thirty-two videos per place, sixty-four in total.

5.1. Second case study: Graphic's generation and results

After the video recordings, the next step was to translate the videos into digital drawings. While watching the footage we marked the location of every individual who decided to stay or were staying in the studied places during the filming times. The result of this process was sixty-four DWG files, each one containing the number and location of the visitors. Based on the information in the DWG files, we could generate the ACM. While in the first case study the radius of the areas of influence assigned to the visitors was fixed to 30 m for visualization purposes, for this case study the aim was to visualize the public distances of the visitors interacting with each other. Therefore, we assigned an area

![Sample results of people's personal spaces in the studied places](image)

Fig. 5 Sample results of people's personal spaces in the studied places: the dots represent the location where people stayed during the studied times, from which the ACM (contour graphics) were generated, creating a unified "common social space".
of influence according to the public distance of 7.6 m, as described by Hall (1966), resulting in 64 images showing “snapshots” of combined personal spaces (Figure 5).

Once the personal spaces became visible, interesting observations could be made in terms of patterns of occupation. For instance, in place one a continuous curb alongside the trees was the only element where people decided to stay, and when the number of visitors was high, it was possible to observe an interesting coherency between the layout of the place and the personal spaces. A different situation occurred when only a few people decided to stay. The locations where people chose to stay were neither too close nor too far from other people: most of the time they chose a location inside the public distance of another person and we rarely observed someone isolated from the rest of the people staying in the place. The combination of these personal spaces generated very symmetrical shapes, which could be seen repeatedly during early morning and late afternoon. In place one, the shapes of the combined personal spaces were very regular. We could observe a different situation in place two, where most of the elements that shaped the place seemed randomly scattered along the place with no apparent consistency and some of the spots where people decided to stay rarely repeated during the day. This created irregular and unpredictable combinations of personal spaces: people stayed in random spots, sometimes seated on a curb, or sometimes under a tree. This generated a separation between the shape of the place and the shapes generated by the personal spaces, giving the impression of being independent from each other, evincing a separation between place and activity.

6. Conclusions and future development

By comparing the two studied places, it could be observed that the correlation between personal spaces and the space defining elements was an indicator of the level of integrity between a place and its inhabitants. This tells us about the deep integration between places and the way we occupy them. Especially in public spaces, activity becomes an important component in the overall perception of how a place finally is. In other words, spaces could be studied separated from the activity which occurs in them, but when we study the places in which those very same spaces are, the activity has to be considered in relation to both space and character of that place. Both case studies showed that the ACM is a consistent tool for representing, visualizing and characterizing personal spaces as design parameter.

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