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MAPPING THE CROWD FROM WITHIN

An immersive strategy for the recording and management of visual information in the shape of people as a complement to syntactic spatial analysis.

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ABSTRACT

The study of pedestrian and crowd behaviour is central to space syntax theory, methodology and procedures. Indeed, within its theoretical corpus, it is considered to be an epiphenomenon of urban space. Yet, whereas urban configuration has received careful phenomenological treatment, people, on the other hand, have been readily reduced to abstractions from the outset, considered only as numbers derived from gate counting or agent-based simulations. As a result, the gathered evidence regarding such information has remained both methodologically and representationally weak. It has been methodologically weak in that predictions regarding people behaviour do not necessarily match actual reality; and representationally weak in that people understood as real bodies in movement through space are abstractly recorded, thus preventing a phenomenological simultaneous cross examination of these two complementary realities. The work presented here aims to complement space syntax's evidence-based stance regarding the prediction of pedestrian behaviour by providing de facto evidence regarding the patterns of people's presence and/or absence in urban space. At present, two strategies lead the way: mapping the crowd "from above" (a technique whose development is well underway) and mapping the crowd "from within". It is argued here that the lack of development of the latter option comes not from any shortage of technology but from the absence of an ad hoc immersive strategy capable of dealing with the complexity of an emergent phenomenon such as the crowd from within. The strategy presented here automatizes people detection and is capable of providing values for the amount of information in the shape of people (area of our visual field photographically abstracted populated by human bodies) thus complementing the discreet datum (number of people) provided by "from above" crowd techniques. Compatibility with a parametric space syntax platform allows simultaneous cross-examination of both integration and crowd analysis values, thus strengthening space syntax's people-related predictions. Also, the resulting interface allows for a clear communication of findings in the field to non-initiated actors involved in the process of city making.

KEYWORDS

Crowd, Phenomenology, Optical Flow, People Detection, Space Syntax.

1. INTRODUCTION

Throughout The early sixties saw the publication of two books that would change forever our understanding of the urban phenomenon. In 1960, Kevin Lynch published "The Image of the City" (Lynch, 1960) and in 1961, Jane Jacobs published "The Death and Life of Great American Cities" (Jacobs, 1961), both of them giving birth in their own particular ways, despite their evident scientific weaknesses, to the evidence-based urbanism paradigm. Two lineages of urban thought defined by their choice of core object of study. Inasmuch as it derives its knowledge from the study of the built city- whether contemporary or ruined- the former is characterized by its intrinsically archaeological nature. That is, it seeks to retrieve urban knowledge from the study of the built city. The latter in turn is characterized by its anthropological nature in that it derives its knowledge from the observation of people or, if preferred, from the study of people behaviour. Whereas the former has been able to develop and establish a highly organized methodological/analytical corpus and, in doing so, of building an impressive portfolio of evidence, the latter, in contrast, has remained analytically underdeveloped. As a direct result of this- save a few notable exceptions (Gehl 2001, 2010, 2013)- it still possesses little evidence to support its claims.

Thus when it has come to retrieve, process and communicate urban space related information, researchers in the field (notably, space syntax´s researchers) have been at their most scientifically rigorous with their own quest as well as demanding with those of others. Yet, when it has come to retrieve, process and communicate information in the shape of people (which ultimately validates space syntax analysis predictions) they have behaved rather complacently. To be sure, complacently from a phenomenological point of view. It is with the aim of overcoming this state of contentment regarding the handling of information in the shape of people in urban analysis as well as of furthering the development of the Jacobs´ lineage of urban thought that this project was conceived. This paper proposes to do this by means of furthering Whyte´s seminal immersive video photographic strategy. One that due to the inherent restrictions of the documentary format- i.e. one point of view and as a result of this, low record intensity- did not yield all its potential fruits. Today's proliferation of and easy access to video recording devices and fast data processing make possible the continuous and simultaneous mapping of vast urban areas, allowing a thorough comparative analysis between all comprised streets.

The strategy here proposed yields no predictions regarding people behaviour. Rather, it reveals ipso facto where in the city people tend to be present or absent and in what degree. This paper presents the results of a first attempt at automatically detecting and quantifying the continuous amount of people present in any given video record taken from a pedestrian point of view while at the same time suggesting ways of linking these results to space syntax related platforms. In doing so, the authors believe they are opening the path for a comprehensive immersive study of what is commonly known as the crowd, a path with the potential of including all the qualitative aspects of people perception or, if preferred, face-to-face communication down to its finest phases. The authors also believe it has all the potential to enrich and become a viable immersive complementary tool for space syntax´s so far abstract people related studies.

During the period that it was a contractors' camp, Vila Planalto was populated by workers, engineers, and businessmen of the construction of Brasília as well as politicians who sporadically passed through until the inauguration of the new capital. Currently, this neighbourhood is the result of the merged remnants of five contractors' camps: 1) Tamboril, 2) DFL (Department of Force and Light), 3) Pacheco Fernandes, 4) Rabelo, and 5) nine lots of EBE camp (Brazilian Engineering Company), plus a Sector of small farms (Figure 2).

2. DISTINGUISHING THE LYNCH FROM THE JACOBS LINEAGE

"Everything in the realm of fact is already theory"
(Goethe)

According to phenomenology´s herald Johann Wolfgang von Goethe, every "thing", every "object", properly contemplated and characterized, is already its own theory. Hence the enduring Goethean admonition: "seek nothing behind the phenomena, they themselves are the theory." (Goethe & Miller (ed.), 1988, p. 307). Seen this way, any quest for knowledge presupposes, above all, a clearly distinguished object of study. More to the point, it presupposes first hand experience of the chosen object of study. From this point of view, the foundational question for any knowledge seeker would be: Which is your object of study? Or, in more contemporary fashion: Which is your phenomenon of interest and study? Hence, the golden rule for a knowledge seeker of phenomenological extraction is- as Goethe would put it- to remain faithful to the object/phenomena/experience for therein lies his only chance of freeing himself from the grip of speculation and second hand information; indeed, his only chance of becoming a cognitively free human being. From this basal epistemological outlook, two distinct lineages of phenomenological extraction can be clearly distinguished within contemporary urban thought (Araneda, 2013a).

2.1 THE LYNCH LINEAGE

Characterized by its intrinsically archaeological nature in that it derives its knowledge from the study of the built city, this lineage can be roughly traced back to Kevin Lynch´s seminal work on the pedestrian perception of urban space while journeying through the city (Lynch, 1960). In other words, this lineage´s object of study is the city in all its material manifestations and states. Inasmuch as it retrieves its core knowledge from a study of the city´s two-dimensional morphology and topology, space syntax theory is directly linked with this lineage of urban thought. Moreover, it probably represents its most sophisticated and refined expression to date. This said, it must be borne in mind that space syntax is a phenomenology of a very specific nature: a phenomenology of city layouts, of city grids, for these are its chosen object of study. More recent development of DEM´s models took space syntax to its last ultimate methodological consequences in that it enabled a syntactic study of three-dimensional morphology of the city (Ratti and Richens 2004; Ratti, 2005; Morello and Ratti, 2007). We would argue that it is precisely its phenomenological origin that has granted space syntax with its quasi-irrefutable nature. Quasi, for it has been precisely its exclusive reliance on the axial map that has set off alarm bells regarding its effective reach. Criticism has been aimed at its intrinsically abstract nature and more precisely, at the inherently speculative nature of its predictions regarding patterns of pedestrian behaviour in urban space (Ratti, 2004; Seamon, 2007; Montello, 2007). This of course does not mean that space syntax researchers are not interested in the study of people. It simply means that they have not shown for people the same careful scientific interest they have shown for city layouts. As a result of this, its methods for retrieving people-related information do not possess the complexity, versatility and refinement that the space syntax software family exhibits. Furthermore, the platforms into which they are recorded and stored are not compatible.

2.2 THE JACOBS LINEAGE

This leads us to the consideration of another distinct lineage characterized by its anthropologically laden nature in that it seeks to retrieve knowledge not from the study of space but from the study of that other highly differentiated spatial manifestation within cities: human beings. Specifically, this involves the experience of perceiving other human beings while journeying through the city. This lineage can be roughly traced back- via William Whyte´s pioneering experiments with time-lapse photography in Manhattan (Whyte, 1980), Garretón's "Cybernetic Theory of the City" (Garretón, 1975) and also, Edward T. Hall´s studies on proxemics (Hall, 1969)- to Jane Jacob´s seminal observations on the foundational importance of co-presence as a

means of securing the self-preservation of urban communities or neighbourhoods within cities (Jacobs, 1961). Indeed, thoroughly inspired by Jacobs´ work and exercising a rapidly expanding influence on current urban practice, Jan Gehl has come to characterize the perception of other people as the "city´s attraction number one" (in Goldsmith and Elizabeth (eds.). 2010, p. 237). Furthermore, from being closely linked to technological advances in building and housing technologies, the term "sustainable urbanism" has come to be understood as synonymous with people-centred urban and architectural design, just as Gehl has advocated for decades (op.cit, 2010).

That said, while the Lynch lineage has been able to develop and consolidate a highly organized and complex methodological/analytical corpus and, in doing so, build an impressive portfolio of evidence, the Jacobs lineage has remained analytically underdeveloped and, as a result of this, with scarce and scattered evidence to support its claims. As Hillier put it, it has remained strongly prescriptive but analytically weak. Thus when it has come to retrieving, processing and communicating space related information, researchers in the field (notably, space syntax´s researchers) have been at their most scientifically rigorous. Yet when it has come to retrieving, processing and communicating people-related information they have not displayed the same phenomenological rigour. Indeed, most of the observational techniques compiled in space syntax´s observation manual belong to the anthropological tradition of recording activities by means of digital or analogue logs and therefore, do not allow for a visually eloquent mapping of people. This tradition was revised, compiled and updated by Dalton et al. in his paper "An iPad app for Recording Movement Paths and Associated Spatial Behaviours" where a number of tools such as "Pocket Observer", "Outdoor Explorer", "What I See" and his own app called "People Watcher" are explained in detail (Dalton et.al, 2012). It is to this tradition that the procedures explained in the observation manual for gathering people related information in space syntax studies belongs (Vaughan, 2001).

Another currently common procedure, also championed by Ratti and associates, consists of tracking electromagnetic signals emitted by widely used devices such as mobile telephones (Calabrese, Kloeckl and Ratti, 2008; Calabrese, F., Colonna, M., Lovisolo, P., Parata, D., Ratti, C.2011; Calabrese, Ferrari and Blondel, 2014). This kind of approach gave birth to the notion of "wikicity" and yields real time readings of certain kind of patterns, namely, those arising as a result of phone calls made during a monitored window of time. Here, the gathered information (electromagnetic pulses) is also reduced to an abstract format. People themselves- that is, human bodies in motion or stationary- are rarely, if ever seen. It is with the aim of overcoming this state of complacency regarding information in the shape of people that this project was conceived. It also seeks to further the development of the Jacobs´ lineage of urban thought by consolidating an equally consistent and encompassing analytical tool for studying the patterns of people presence and absence. Let us outline its methodological principles.

3. OUTLINE FOR A COMPREHENSIVE IMMERSIVE CROWD MAPPING STRATEGY

Time-lapse photography, the one methodological exception mentioned in the space syntax observation manual capable of directly dealing with information in the shape of people is only mentioned in passing and is not elaborated upon. Regarding Whyte´s (1980) strategy, Vaughan states: "the difficulty of time-lapse photography is finding a strategic location that provides a full picture of the space under observation and the 'irritation factors', such as trees and other people who get in the way of seeing what is occurring behind them." (Vaughan, 2001, p. 14). This paper argues that inasmuch as it yields an isolated point of view of a determined place, time-lapse photography´s real methodological shortcoming, as originally implemented by Whyte, is that it yields an anecdotic record and as such, is of questionable scientific validity. Moreover, it is here contended that the general underdevelopment of the Jacobs lineage of urban analysis is directly linked to the fact that its main object of study (people) poses difficulties inherent to all animate objects of study. However, such difficulties can now be easily overcome with the strategic use of video cameras in urban space. Therefore, despite its initial shortcomings, it is here argued that the Whyte strategy contains the seeds of a new and much needed systematic tool for recording the patterns of behaviour of people from an immersive, experiential point

of view. Put in phenomenological terms, it offers the possibility to map the behaviour of our visual field regarding the perception of people. In order for this to happen though, the video/photographic record must fulfil at least five fundamental requirements:

a. To be taken at observer level, whether from a fixed point or from the point of view of a moving subject.

b. To be taken under a comparable format (type of camera, type of lenses, type of lens aperture, etc).

c. To be taken in the middle of pedestrian areas (not in the middle of streets as it is the case with Google Street View).

d. To be continuous in time (i.e. a continuous video record).

e. To be taken simultaneously in as many points as is desirable or necessary along the streets comprised within a chosen area of study.

The implementation of these requirements yield a new pervasive kind of observational tool, a kind of Google "pavement" view capable of capturing, analysing, calculating and eloquently representing not only the state of the average citizen´s visual field in relation to the patters of presence and absence of people but also in relation to the patterns of presence and absence of the built environment and nature in all its manifestations i.e. mineral, plant and animal. (Araneda, 2013b, 2014; Araneda & Gatica, 2015).

4. CONCERNING AUTOMATIC PEOPLE DETECTION STRATEGIES

People detection remains a challenging field within computer vision, the focus being strongly placed at the moment on the refinement of quantification techniques in order to obtain the discreet number or amount of people in a given space. One of the main issues with which researchers in the field have to contend at the moment is the problem of occlusion of people by other people, which makes it difficult to obtain said number from the point of view of a walking observer (Tang et al. 2012, 2013, 2014; Dollár et al. 2010, 2012). This being the case, the most precise results in this regard have invariably been obtained from cameras situated not at observer level but at some height, such as security and vigilance cameras (Seer et al, 2012; Johansson et al, 2012). This of course comes at a price, for while the occlusion problem is overcome and the discreet number of people becomes more exact, the immersive, experiential point of view is lost.

Faithful to the immersive stance, the work here presented focuses not on the study of the discreet amount of people but rather on the detection, reading and quantification of the continuous amount of people present within our visual field photographically abstracted from the point of view of a pedestrian or if preferred, from the point of view of a moving subject or observer. In this methodological context, occlusion is not a problem to overcome. Rather, it is a variable intrinsic to the phenomenon under study. Put differently, the focus of this research is placed on what shall be called "information in the shape of people" in order to distinguish it from all other information contained within our visual field and photographically abstracted such as, for instance, information in the shape of buildings or of nature. Methodologically defined, visual information in the shape of people refers to all those points of an image (in this case, pixels) that are part of a human body. Each of these kinds of information constitutes a percentage of the total visual field, again, photographically abstracted. Together, they make up the total visual field or 100% of the photographic field. To the sum of these three kinds of information the authors call the "archetypal visual field" (Figure 1). The experiment sheds a first light upon the behaviour of this "cloud of people" that, much like clouds in the sky, constitute an emergent phenomenon characterized by being in a permanent state of change. In doing so, it begins to shed some light upon the behaviour of the average citizens´ visual field with regard to people perception in any given city.

Figure 1 - The archetypal visual field of an urban pedestrian where green corresponds to "nature", grey to "built environment" and red to "people".

5. FIELD WORK

We will now examine the results of our pilot case to implement the above-described methodological strategy in three points of one of the busiest streets in the city of Concepción, Chile, at midday, on a sunny autumn weekday (Figure 2). In order to detect and distinguish the information in the shape of people from the whole of the visual field we resort to the "optical flow" technique of movement detection, which enables the automatic detection of all moving bodies in a video record [1]. We worked with three video segments of 60 seconds each taken in three different points, each of them placed approximately in the middle of three contiguous blocks, i.e., at a distance of approximately 100 meters from each other. A fixed camera (smartphone Sony Experia) was used, set on a monopod at observer height and placed in the middle of the pedestrian available space. Two of the records were taken in the middle of the available pedestrian space, the third on a traditional pavement or sidewalk. The resolution of the record is of 1280x960 and it was processed at 680x480 pixels.

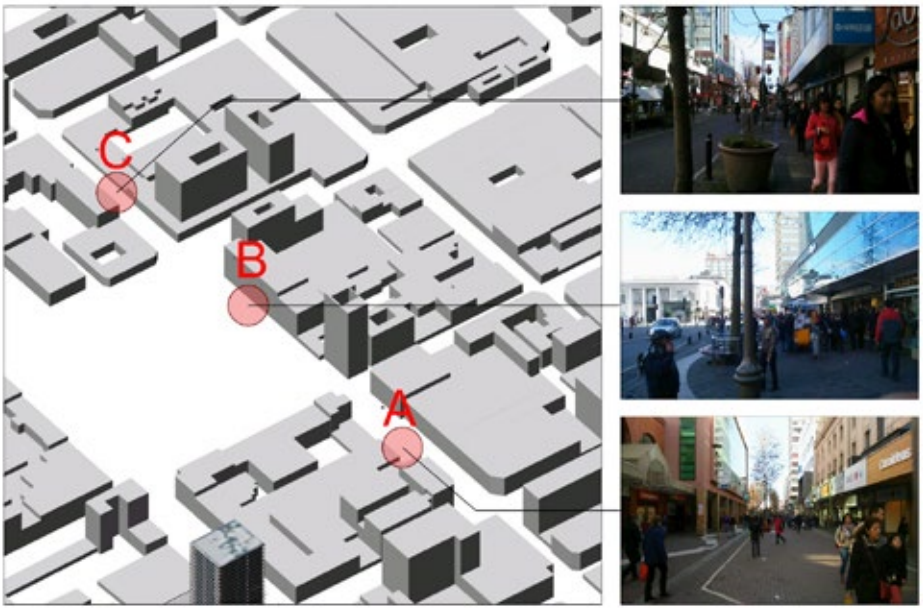

Figure 2 - Location of the three points of observation.

1 The MathWorks web page defines optical flow as follows: "Optical flow is the distribution of the apparent velocities of objects in an image. By estimating optical flow between video frames, you can measure the velocities of objects in the video. In general, moving objects that are closer to the camera will display more apparent motion than distant objects that are moving at the same speed. Optical flow estimation is used in computer vision to characterize and quantify the motion of objects in a video stream, often for motion-based object detection and tracking systems." (https://www.mathworks.com/discovery/optical-flow.html).

The record was processed in Rhinoceros platform using the Grasshopper plug-in and an object-oriented programming. The processing of artificial vision is carried out with the aid of "firefly", a software package that allows near real-time data flow between real and digital worlds. The "optical flow" algorithm enables the automatic determination, frame by frame, of the percentages of image area (pixels) belonging to people. A continuous viewing of the record offers a first visualization of the behaviour of the "people cloud" in relation to our visual field. For illustrative purposes, below we show three filmstrips made up of 6 snapshots corresponding to segments of 10 seconds of the original record and their processed equivalents (Figures 3&4).

Figure 3 - Filmstrips made of original snapshots for each point of observation.

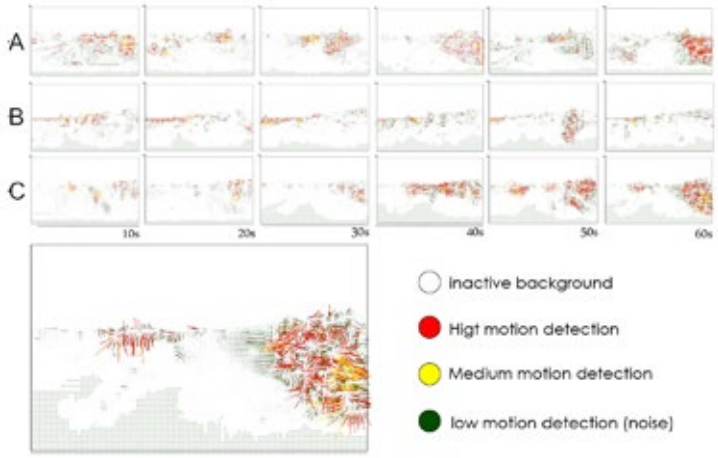

Figure 4 - Top. Filmstrips made of optical flow processed snapshots for each point of observation. Bottom. Magnified example with nomenclature.

Considering the total of the frame as 100%, the readings of information in the shape of people show a minimum of 1.8% for point C and a maximum of 24% for point A with a mean average of 4.69% and a mean median value of 9% for the three sampled points (Table 1). However, it must be borne in mind that the size of the sample here presented (three points, one per block, all contiguous) does not allow the retrieval of a standard deviation between the values of the integration map and those obtained from our observation points. Thus a regression modelling between people´s presence and integration values has yet to be carried out. We discuss this in the context of the previous pilot experiences carried out in the same city in the next section. A close look at the record shows that the maximum percentage observed corresponds to the moment people gets too close to the camera (See fig. 4, sixth frame on filmstrip A). We will tentatively call this the "close up effect". Whereas it is easy to predict that the minimum value

possible (0%) will take place in little-used streets or on any given street during night-time, due to the apparently random occurrence of close up phenomenon, only future research will reveal its recurrence as well as a possible maximum mean value[2].

	A	B	C
Latitud	-36.826.081	-36.982.592	-36.827.102
Longitud	-73.049.157	-73.050.437	-73.051.686
Ratio A	0.66 to 0.48	0.66 to 0.48	0.66 to 0.48
Ratio B	0.59 to 0.39	0.59 to 0.39	0.59 to 0.39
Op. Fl. average	9,07	3,00	1,99
Op. Fl. median	20.72	3.4	2.85
Op. Fl. %max	24,40	6,12	5,20
Op. Fl. %min	3,41	2,97	1,83
P/min.	30,20	20,25	18,32
Integration	1,13	1,12	1,14

Table 1 - Where "Ratio" is the domain of the frame sample within the immersive spherical photograph 360-180, "Op. fl. average" is the average optical flow value for the motion detected within analysed area, "Op. Fl. median" is the optical flow median value for the motion detected within analysed area, "P/min." is the amount of information in the shape of people (% area) per interval of time (min) detected via optical flow analysis and "Integration" is the integration value derived from Depthmapx analysis for the sampled point. In red, optical flow minimum and maximum readings per analysed points and integration values. In future, a bigger sample will allow the obtaining of a standard deviation between integration values and those provided by optical flow readings of people presence.

Having said this, the cumulative total for each of the three samples exposed to optical flow reading describe a well defined horizon between the area populated by information in the shape of people and what lies above the visual horizon of a walking observer which, therefore, appears to be at approximately the middle of the frame (Figure 5). This suggests that the maximum possible mean value might be around 50%, as it could be, for example, in the case of a mass gathering on a flat urban surface.

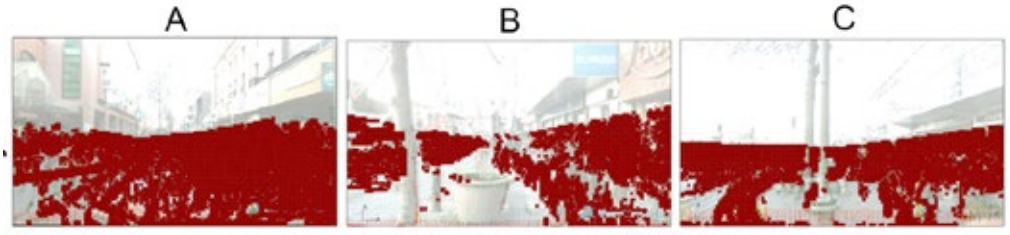

Figure 5 - Cumulative total for each of the three samples exposed to "optical flow" analysis.

2 False positives can exist in the shape of moving cars. This was corrected by means of a conditional sequence programming. False negatives, on the other hand, can exist in the shape of stationary people. Both of these cases suggest that for more accurate results, a mixed strategy should be used.

The curves described by the patterns of people presence in time are revelatory as well as eloquent in that they describe a line of behaviour of our visual field in relation to people presence within it. Concretely, they reveal the living nature of the crowd by means of sudden and considerable fluctuations that can take place in space and time (Figure 6).

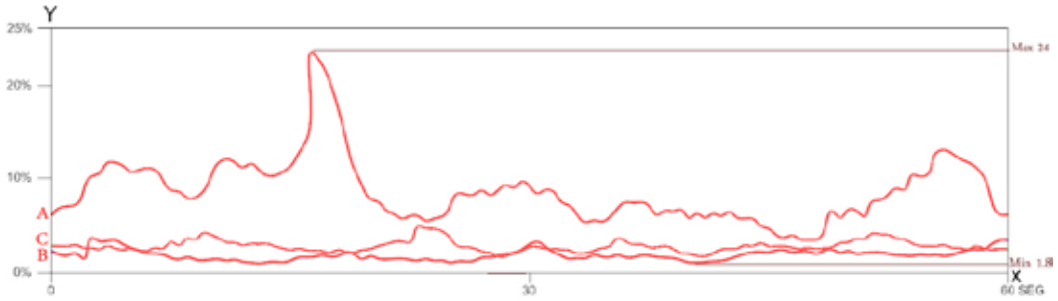

Figure 6 - Curves describing fluctuations of information in the shape of people within our visual field for each point of observation.

It is in the integration of these values into space syntax platforms that we foresee one of the most useful applications of this research, for it would bring together people behaviour related predictions derived from the integration map with the patterns of people presence derived from on site, immersive readings as suggested by this research. In order to do so, these records must be merged into compatible platforms. Of this, for the time being, we can offer no more than a target image, which is based on a previous experience carried out in the same city (Araneda & Gatica, 2015) as part of an on-going project (Fig. 7) [3]. Researchers in space syntax are already making efforts in this direction with the development of the "space syntax toolkit" (Gil et al, 2015). This toolkit, however, does not seem to be oriented towards generative design. Therefore, for the purposes of carrying out our experiment, we used the SYNTACTIC plugin (Nourian, 2013), which allowed us to merge the obtained values for people presence with a parametrically designed integration map. Finally, with the aim of allowing compatibility with Google Street View and other GIS based platforms, the photographic record was also duly formatted so that the position, orientation and scope of the captured visual field of each frame could be determined i.e. geo-referenced (Figure 8).

3 The referred exercise covered the whole of the historic centre and was based on journeys made by one person along each street of the area under study. That is, 26 streets travelled through by 26 persons. The process of discriminating information in the shape of people was done manually. Still, the correlation between the integration map and the results of our photographic mapping strategy is eloquently consistent. We believe this visual eloquence to be one of the main contributions of our proposed strategy since it would facilitate communication of findings to non-initiated actors whom, nevertheless, have a keen interest in urban matters.

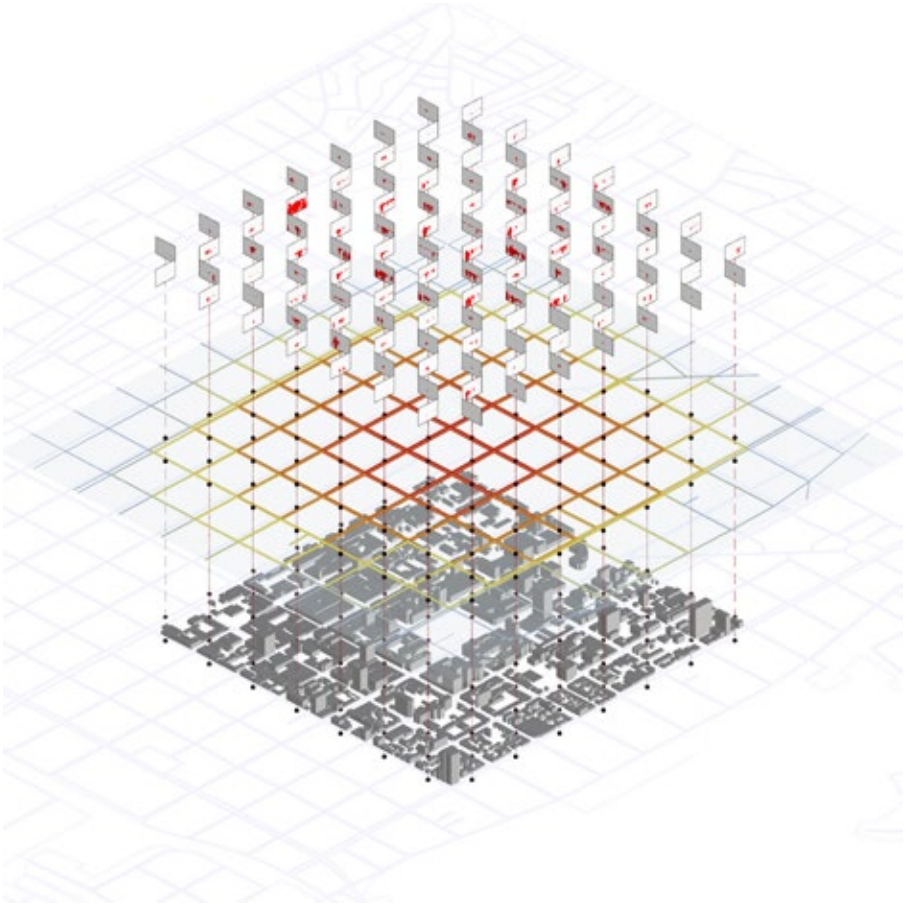

Figure 7 - Target image of how an integrative interface between the three platforms would look in a parametric environment. On top, our crowd mapping strategy showing one frame per observation point, the integration map in the middle and below, the GIS platform.

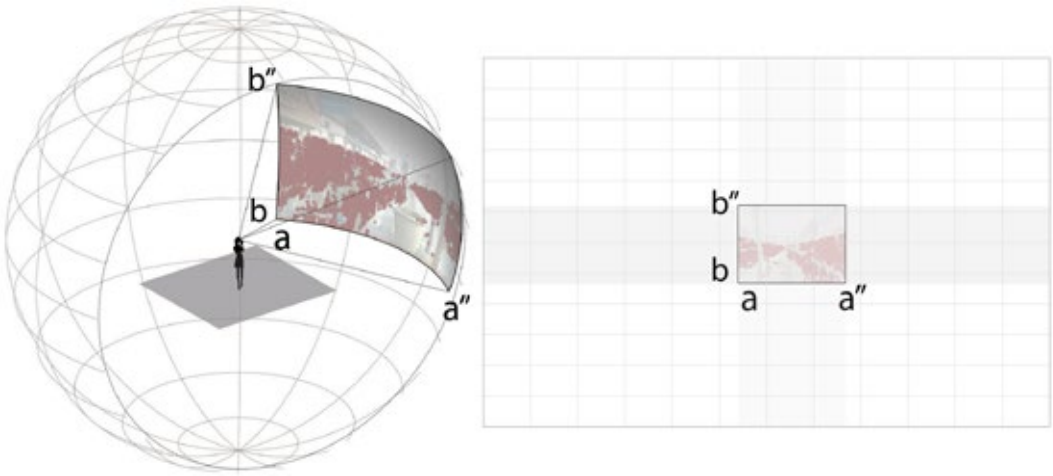

Figure 8 - Geo referencing images into Google Street View Image API (360-180 spherical photography)
Recent research (Schaffranek, R & Vasku, M, 2013) suggests that only this triple integration of CAD, Space Syntax and GIS in a parametric platform allows a versatile integration of the two worlds- space and people- that we are trying to analyse, for the records with which we are working are essentially photographic and therefore, with location and orientation in space.

7. DISCUSSION

The fundamental contribution of this strategy lies in its intrinsic phenomenological nature, which renders possible a study of people or, alternatively, of the crowd (depending on the levels of presence of people) just as they appear to our visual field. In doing so, it provides us with a more qualitative datum that complements the discreet number of people possible to obtain by counting on site or by means of video cameras placed at height [4]. We would argue that the study of people from an immersive, observer point of view, on the other hand, though much closer to the experience of the everyday citizen, has not undergone an equivalent development. As a result, its implementation has been unsystematic and does not carries the same weight as a spatial analysis of, say, space syntax pedigree. We would also argue that this is mainly due to the lack of any systematic research strategy that might allow an equally accurate study of an extremely complex object study such as a human being/body. After all, Jane Jacobs' observations on the phenomenon of co-presence are still struggling to achieve recognition and the debate on the scientific validity of her observation is still very much alive (Marshall, 2012; Dovey and Pafka, 2016). Also, apart from a few concise additions to what has already been said (Lawson 2001; Gehl 2010, 2013) very few have taken up the baton left by Hall´s ground-breaking studies on proxemics, crucially, at the far phases of face-to-face communication. Thus this is a field where much remains to be done. In this context, the strategy proposed here opens the way for a thorough study of our visual field in relation to people perception, from the perception a single person down to an outright crowd. In other words, it enables a comprehensive study of our (photographically abstracted) visual field behaviour in relation to the patterns of people presence and absence. In so doing, it carries the potential to include all the qualitative aspects of people perception or, if preferred, face-to-face communication, down to the closest, finest phases of human interaction. Its implementation entails a number of issues, some technical and some practical. Prominent among the practical issues is the problem of installing cameras in public space at observer height. If fixed permanently, they are bound to be vandalized. Besides, they would amount to an obstacle in the public space. On the other hand, if the record is the result of a journey carried out by a pedestrian along a street (in a "Google street view" fashion), the optical flow analytic strategy, as implemented by us, is of no use since the discrimination of moving bodies become impossible [5]. In the case of our current pilot case, three points in three blocks represent no major logistical problem. But were we to attempt the analysis of an area of, say, ten by ten Latin-American traditional blocks, we would need to hire a whole patrol of volunteers to ensure simultaneous records [6]. For the time being, we have ended up with a set of values corresponding to areas within frames. Each frame carries a value (percentage of the total frame) and this value indicates the quantity of information in the shape of people present. So far, we know for certain that the minimum value in a given observation point can go down to zero. The higher mean value is yet to be obtained and will depend, among other factors, on whether or not the streets under scrutiny posses acclivity. In time, each point in a street would yield a mean value at the desired time and day of any given year in any given city.

Among the technical issues within the implementation of our strategy is the incompatibility between space syntax and parametric platforms. This led us to use the "Syntactic" plug in. Yet, in order to build a database for information in the shape of people, the GIS component is mandatory. This being the case, it seems that the merging of these platforms in a parametric environment guarantees the necessary versatility to be able to systematically assess the capture and management of information in the shape of people while at the same time allowing comparison with integration values derived from axial map analysis. There are a few

4 The study of the crowd 'from above' enables the study of flows, queues and waiting time while at the same time providing an accurate discreet number of people. This way of analysing crowd behaviour in public spaces is very much established, with proven results, as is the case, for example, with "CrowdVision" (http://www.crowdvision.com/) whose analytical tools have been extensively used in airports and retail chains in many countries.

5 We have tried out this technique, its drawback being precisely that the discrimination of information in the shape of people from all other information contained in each frame had to be done manually (Araneda, op.cit, 2014; 2015).

6 We have also tested this strategy its drawback being the amount of human resources (people with cameras) needed to do the job (Araneda, op.cit, 2015).

final considerations. The "optical flow" analysis implemented by us does not take stationary people into account thus false positives do exist. In this sense, refinement of the "optical flow" programing is always possible and seems to be the most promising path ahead. Second, the absence of a regression modelling and therefore, of a standard deviation measure between the integration map values and those obtained via the implementation of our observation strategy makes any generalization impossible and therefore, the need for more fieldwork is a truism. Finally, a statistical comparison of optical flow readings with more traditional strategies such as gate count would also help in bringing more reliability to the work here presented at the same time as making it more convincing.

8. CONCLUSIONS

The crowd, pervasive and emergent phenomena that it is, has proved elusive to experiential observation. As such, its analysis poses difficulties that call for an ad hoc strategy in order to overcome them. As far as we can see, there are two are strategies that together can bring us closer to an understanding of this phenomenon. One is analysis "from above", whose development- aided by easy access to off-the-shelves automated alert cameras and drones- is well underway. The other one is from within. This latter is underdeveloped, not from lack of technology we would argue, but due to the complexity inherent in all emergent phenomena that makes it difficult to know exactly where they begin and end. In other words, we do not posses a clear-cut idea or image of what the crowd is. This is why we have resorted to the image of a cloud to provide an idea of what we are dealing with. Time-lapse photography has already taught us something about the recursive behaviour of cloud formation, and we believe that the same technique shall eventually reveal something of the nature of the crowd. So far, three pilot cases have confirmed to us that for this to be possible, the records must be taken in "all" the streets comprised within the area of analysis- much in the same way that the integration map is the result of the distance of each street to all other streets- and in as many points as needed. Of them all, automatic discrimination of the area occupied by human bodies within a video record presented by this paper is the most promising avenue of research. It offer clear glimpses into how the building and management of an ad hoc database of values for the crowd per observation points in the city might work and what it might look like. Its subsequent integration with space syntax platforms would grant the latter immediate, simultaneous, visually eloquent, evidence-based information regarding the patterns of people´s presence and absence in urban space. This in turn, would help minimize inconsistencies regarding its own people-related predictions. Lastly, inasmuch as it provides evidence where people actually look like people, it is of relevance to all social actors involved in the process of city-making, such as urban planning authorities, police and civil security, the retail sector and the building industry in general. But also, not least, it is relevant to citizens themselves, who would eventually get to know how the society of which they are part inhabits its own collective dwelling.

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