LOCATIVE MEDIA INTERVENTIONISM: A CONCEPTUAL FRAMEWORK FOR CRITICAL REVIEW OF AUGMENTED REALITY APPLICATIONS IN THE PARTICIPATORY SPATIAL DESIGN CONTEXT

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Abstract
This paper offers an analytical framework for a critical review of augmented reality visualisations in the domain of participatory spatial design in general and Participatory Architecture in particular. By offering this framework the paper aims to respond to the concern in published discourse that augmented reality visualisations are insufficient on their own to accomplish participation's ultimate objective of social inclusion. To derive this framework the paper turns to augmented reality itself, that is, the realm of locative media practice as a whole. Illustrative examples have been reviewed to identify an overarching commonality of purpose, namely proactive spatial intervention for social inclusion. This common underpinning concept has been labelled as Locative Media Interventionism, or LMI. Finally, this compact framework has been used to evaluate augmented reality applications in participatory spatial design. A cursory evaluation of micro as well as macro scale examples indicates that the usage of this visualisation technology has yet to undergo the process of maturation that locative media in general has undergone. It has yet to evolve out from being a mere novelty to becoming a politically charged platform for delivering social inclusion.

Keywords: *Architecture; participatory spatial design; augmented reality; locative media.*

INTRODUCTION
This paper is in response to a published concern that visualisations alone are insufficient for achieving the ultimate aim of social inclusion in participatory spatial design (e.g. Jasanoff, 2003; McGrath, Hsueh, & Shan, 2016; Selinger, 2005). Is this concern true for augmented reality visualisations as well, and if so, then how may it be dispelled? These two questions are significant because augmented reality technology is a much-celebrated recent advancement, and it is important to determine whether the expectations associated with this invention are actually deliverable or not.

Augmented reality is now known fairly commonly as geo-located augmented reality, or G-AR, or also as geo-situated augmented reality (e.g. Bohøj, Borchorst, Bødker, Korn, & Zander, 2011; Cameron, 2010a; Reinwald, Berger, Stoik, Platzer, & Damyanovic, 2014). It first appeared in 2009 and was investigated in 2011 by the author for its potential appropriation in participatory spatial decision-making (see Khan & Dong, 2011a, 2011b), albeit only with regards to its experiential aspect in general, not its potential to deliver social inclusion specifically.

To evaluate the social inclusion effectiveness of G-AR visualisations however, it is first necessary to define an analytical framework that can be suitable for the task. An optimum source to turn towards can be the domain of locative media practice as a whole, because of two reasons. Firstly, this field has a track record for innovative interventions in spatial politics to affect social inclusion (e.g. Amat & Brantner, 2016), and therefore can offer insights on how to achieve similar results via G-AR in the field of PSD as well. Secondly, it also happens to be G-AR's principal domain of origin (e.g. Layar, 2016; Wikitude, 2016), and as such its evolution may hold insights

on how G-AR may be developed to suit participatory spatial design. Locative media is taken to mean here a political-artistic movement, whose gradual developments have contributed to the impetus for a corresponding evolution of locative technologies, which G-AR is the logical outcome of (e.g. Azuma, 1997; Carmigniani & Furht, 2014). Therefore drawing strategic lessons from tracing the development of this source holds promise to be readily applicable for the development of G-AR's applications in the context of participatory spatial design.

Hence the first part of this paper comprises a review of key stages in the evolution of locative media practice. Care has been taken however, to minimise repetition of exhaustive literature surveys already published on this subject in general by others (e.g. Bilandzic & Foth, 2012; de Souza e Silva & Sheller, 2014), by highlighting only the interventionist aspect (e.g. Crang & Graham, 2007; Kitchin, Lauriault, & Wilson, 2016). Selected examples show a gradual progression of the locative media platform coming into its own, from merely a charismatic invention to a politically charged mass medium. A key commonality of spatial disruption has been highlighted to acknowledge its contribution as a distinct – and successful – paradigm of practice, under the label, *locative media interventionism*, or LMI. This label holds the benefit of articulating the interventionist aspect of the paradigm into a portable framework for G-AR's analysis.

In the rest of the paper the LMI approach has been demonstrated as a critical framework, by way of using it to conduct an indicative critique of G-AR's appropriation in the participatory spatial design domain, or PSD. As this is not an exhaustive but illustrative review, only a selection of prominent examples have been used, to reflect on whether the published concern for the ineffectiveness of using visualisations alone applies to this technology as well or not. Finally, a simple parallel has been drawn between the evolution of the locative media platform in general and the particular case of appropriation of G-AR in PSD. This comparison highlights one of the causes for G-AR's as yet ineffective usage, namely that its appropriation in the PSD context has yet to undergo a process of maturation, from a glamorous novelty to a purposeful instrument. Whereas such a process of evolution has been completed somewhat spontaneously for the locative media platform as a whole, it can be consciously instigated in the specific case of G-AR. This idea has been used to offer recommendations at the end on how to fully harness G-AR's political potential to affect social inclusion by applying the LMI approach to plan interventions.

LOCATIVE MEDIA – *from wide-eyed playfulness to purposeful political interventions*

Following is a brief review of key stages in the evolution of locative media, from initial installations to ubiquitous mass spatial infiltration. Unlike other reviews already available this is aimed at two specific purposes: to trace the process of maturation of the domain in general, to in turn serve as a parallel for the particular case of G-AR's usage in PSD; and, to highlight the common thread of spatial interventionism as a distinct conceptual framework of the domain of locative media practice.

Advent of digital global-positioning systems – *impact of the GPS*

Locative media is taken to mean here a mash-up of geo-location data with mobile communication channels to create a fresh overlay of meaningful exchange, as brought about through convergence with crowdsourcing and graphic visualization concepts (e.g. de Waal & de Lange, 2008; Kingston & Smith, 2007; Kitchin et al., 2016; Lemos, 2008). This field's emergence can be traced back to the use of digital location technologies in military applications and gaming (Crang & Graham, 2007), and then more pertinently for the purpose of the present discussion, in arts and internet-based social communities, as documented in detail by Hemment (2006). Initial usage of real-time location tracking data began soon after it became accessible via release of unscrambled GPS satellite signals, first developed in USA for military targeting purposes in 1978 (Saad-Sulonen, 2008). It was permitted for wider public use by the US Department of Defence in 1997, and then improved in accuracy to within 10m in 2000 (Ngo, 2010; RadioShack, 2004).

Pioneering artistic installations were based mainly on the idea of exploration of fresh meanings through its juxtaposition with already available information in the everyday environment, 'by asking what can be experienced now that could not be experienced before' (Hemment, 2006). Examples of initial ideas given below show that in the beginning this medium served more as a charismatic invention rather than any serious or deeper purpose.

Technology Behind the First Ideas – *trying out a new invention*

Inspirations for early artistic applications in the context of everyday environmental experience partly emanated from the first popular usage of locative data via stand-alone GPS sensors in gaming, as manifest in 'Geocaching' (GPSGaming, 2010). This gaming concept was in turn inspired by a simple non-GPS based system of proximal location detection that had already begun to be used for WAP/WML-based games such as 'Botfighters' (Sotamaa, 2002). It was also used for commercial purposes, such as 'ZagMe' in UK (Unni & Harmon, 2007), which operated via the GSM/GPRS method, based on known signal-tower location data (Roussos, 2002). This method gained popularity after it was made a mandatory feature for all mobile operators to cater for in the USA from 1996 onwards, as a measure to automatically determine the approximate origin of emergency calls, for the purpose of consistency with landlines in terms of insurance coverage (FCC, 1996). This measure inspired wider usage and eventually led to artistic installations that exploited the juxtaposition of location sensing with wireless connectivity that it offered, including ones specifically aimed at exposing its imbued connotations of surveillance (Townsend, 2006).

Initial Installations – *not quite there…*

Pioneering artistic concepts became publicized through various installation works that were collated through a key event, the Karosta Locative Workshop in Latvia in 2003, which showcased initiatory usage of locative information in artistic interventions (Hemment, 2006). Based on the detailed review by Hemment (2006), the projects presented at this workshop can be sorted under four main categories: use of human movement as a graphic generative tool; the documentary approach, such as tracing the journey of commodities from points of origin to consumption; geo-located social content interfaces; and, meshing of geo-data in real-time with other forms of data, such as live video, galvanic skin response, and musical scores. Overall this body of work has been observed by Hemment at that time to have 'not yet reached the point at which the technology disappears - all too often the tendency is to focus on the technology and tools rather than the art or content' (2006). He nevertheless observed these initiatives to resonate 'with Deleuze's and Guattari's sense of territory (as cited in Hemment, 2006), in which there is a blurring of the distinction between real estate and intellectual property…in the sense that birds use song to map their domain', with 'an understanding of context as something open and constantly shifting rather than static' (Hemment, 2006).

Precedents and Theoretical Contemplations – *past inspirations for the way forward*

Conceptually these early ideas have been placed by Hemment in a number of closely related contexts of prior art works, including: Richard Long's annotative placement of objects while traversing through landscapes, as first exhibited in 1967; Masaki Fujihata's Field Works, initiated in 1992, in which the video recording of a camera was juxtaposed with a mapping of its own movement in the process, to capture the intimate narrative of a gaze; and, Lev Manovich's elucidation of radar as an abstraction of real-time tracking of objects and spaces (as cited in Hemment, 2006). Crang and Graham (2007) on the other hand cite Pinder (2001) with regards specially to audio projects, to in turn refer these to Janet Cardiff's (1999) walking soundtracks (as cited in Pinder, 2001). They place the re-emergence of the public authorship aspect of these works further in the context of the ideas of de Certeau (1984), in particular his notion of 'accumulated times that can be unfolded but like stories held in reserve, remaining in an

enigmatic state....a different mode of territorial unity, of socioeconomic distribution, of political conflicts and of identifying symbolism' (p.108 and 201).

Spatial Connotations – *the experiential realm*

With reference to the spatial connotations imbued in these founding artistic concepts, it is pertinent to note the suggestion of Tuters and Varnelis (2006), that the serendipitous and spontaneous exploratory characteristics of interactivity with locative data manifestations reminds of the 'dérive' concept popularized in the 1960s by Situationalists (Debord, 1956; Tuters & Varnelis, 2006). For the finer aesthetic aspects of this physical interaction an apt context appears to be the ideas and works of Richard Serra on experiential beauty, as collated by Bois in the concept of the 'sublime picturesque' (Bois & Shepley, 1984). He attributes these ideas to descriptions given by Kant and Smithson (also quoted in Kant & Bernard, 2012, p.67), for an object that induces an emotionally moved state when imagination makes an exasperating effort to stabilize its comprehension of the object yet returns unsuccessful simply because of the very nature of the object to become incomprehensible when detached from movement itself (Kant and Smithson, as cited in Bois & Shepley, 1984, p.59). A core aspect of locative installations is of intervention, which has been correlated by Toft (2011) to Soja's and Thielman's definitions of 'spatial turn' as, respectively: a fresh relationship between geo-spatial understandings and temporal-historical meanings (Soja, 2008, p.12); and, beginning of the study of social and physical built environment concepts as interconnected entities (Thielmann, 2010, p.1; Toft, 2011). All three of these spatial connotations are directly relevant to PSD practice.

Applications in Spatial Design – *links with crowdsourcing*

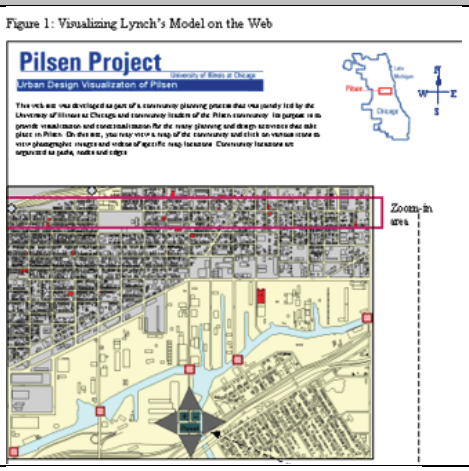
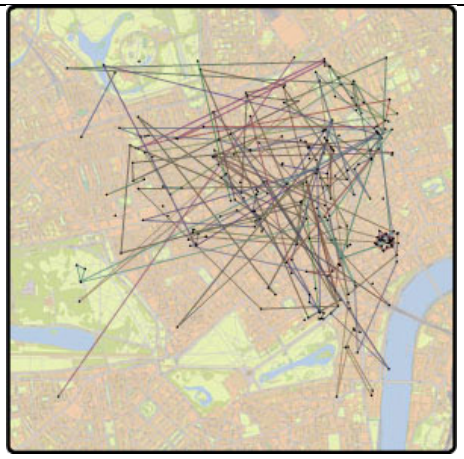
Deployment of locative media in spatial decision-making practice was preceded by the use of crowdsourcing and social media platforms (e.g. Brabham, 2008; Howe, 2006), that marked the advent of 'e-participation' (e.g. Cindio & Peraboni, 2009; Macintosh, 2004). This shift towards online manifestations of participatory spatial decision-making was triggered by the 2004 invention of Web-2.0 interactive interfaces (OReilly, 2007), and accompanying availability of mapping APIs, such as ArcGIS in 1999 and GoogleMaps in 2006 (Lane, 2011; Smith, 2004). As such, locative data began to be used in this context mainly in three forms: as an intra-communication enhancement tool for governance (Tuters & Varnelis, 2006); as a tool for macro level urban planning analysis and related cartographic visualizations (IAPAD, 2016a); and, for mapping the location of subscribers in public consultation interfaces (IAPAD, 2016b).

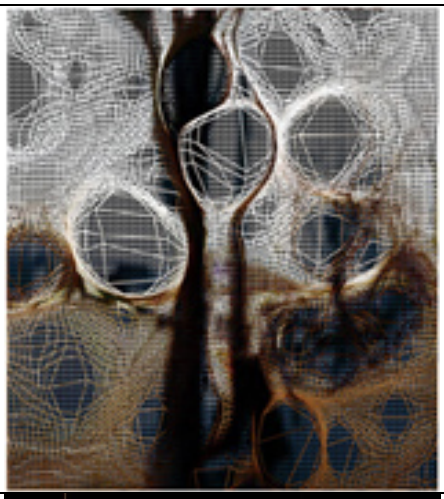
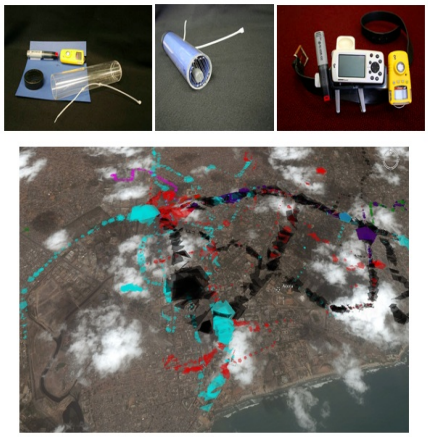
Spatial Politics – *proactive intervention directed at social inclusion*

Applications of location information in spatial planning as a concept has been traced back by Iveson (2011) to Chapin's activity pattern studies (1974). Hence the availability of locative information happens to have satisfied the need for digital data in urban and especially transport planning as sought since the 1970s (e.g. Kitamura, 1988). This overlap has produced two broad concepts of practice, namely, mapping of available knowledge about users by tracking their interactions in a given context, and collection of user feedback in sync with their time-location coordinates. An epitomic example that has combined both these ideas is Nold's Biomapping project (2004), in which variations in Galvanic Skin Response (GSR) have been enmeshed in real-time with location data to produce and record a perspectival graphical representation of the level of safety felt by users at any given point while walking through a designated locality. Similarly the 'Nomadic Milk' installation has contributed to increasing the importance of walking patterns by plotting locative data on to the movements of a remote control vehicle. It has thus transformed an otherwise verbally or textually discussed entity into a visible or tangible form, hence making it negotiable competitively in the arena of spatial politics. Four other projects based on data plotting and feedback collation concepts listed in Table-1 below, form an illustrative sample of numerous past and existing applications. These examples are presented in tabular

form to highlight political implications, as evident in the way they affect the dynamics of spatial decision-making. They strive to reverse the bias embedded in graphic communications to position those stakeholders at a disadvantage who do not have access to prior exposure in comparison to those who happen to be well resourced. This aspect is most pertinent to the subsequent discussion of the potential of G-AR beyond that of a simple visualisation tool.

Table 1: Location awareness concepts relevant to spatial politics (Source: Authors).

Name	Producer	Significance (political)	Website (publicly displayed images)
Pilsen Project 2002 http://www.uic.edu/cuppa/udv/research/pilsen.htm	UIC – Urban Data Visualization Laboratory	Collaboration with community to develop a readable GIS interface, in order to establish a facility for participation. It places information in the hands of end-users, namely cartographic data, which has conventionally been part of the privileges that have placed resourced stakeholders at an advantage over end-users.	
Biomapping 2004 http://biomapping.net/ 	Christian Nold	Meshes empirical/vital-signs with location info to create a graphical representation of wellness value (and implications for urban design). Places empirical evidence in the hands of the end-user, creating leverage for their feelings and wellbeing in the stakeholder arena.	
Urban Tapestries 2004 http://research.urbantapestries.net/ 	Soma/Proboscis in collaboration with London School of Economics, Birkbeck College, Orange, HP Research labs, France Telecom R&D UK, Ordnance Survey	Based on a GIS platform, enmeshes PDA/mobile networking with locative technology to record and access spontaneous notes jotted/tagged down by users of public space. Capitalizes on the concept of 'a fundamental human desire to 'map' and 'mark' territory as part of belonging and of feeling a sense of [re-]ownership of our environment' (Proboscis 2004).	

Impossible Geographies 2006 http://www.csl.sony.fr/downloads/papers/2006/gemeinboeck-06a.pdf	Univ. of Sydney SONY Corp.	Use of mobile phones to create interactive maps in real-time, comprising mash-up of social media content with locative information. An alternative concept for reclaiming value for everyday narratives, that may be devalued in conventional approaches to urban planning and design.	
Nomadic MILK 2009 http://nomadicmilk.net/blog/	Esther Polak	A mapping concept par innovation, creating a spatial awareness of the nomadic shepherd life in rural African communities with global governance implications for disadvantaged rural communities. Use of GPS data from mobile phones to plot the nomadic paths of shepherds in a scaled down size through a small radio-controlled vehicle. Reflective comments of the shepherds provide insights about the central importance of that path in their values and culture.	
Urban Atmos-pheres /Ergo 2012 http://www.urban-atmospheres.net/ParticipatoryUrbanism/index.html	Eric Paulos (Intel Research Berkeley) Ian Smith (Intel Research Seattle) RJ Honicky (UC Berkeley)	A future vision for using sensors attached to mobile phones which 'radically alters the current models of civic government as sole data gatherer and decision maker by empowering everyday citizens to collectively participate in super-sampling their life, city, and environment'.	

A Common Intent

Above given developments in practice and related theoretical work portray the evolution of a distinct intent in locative media practice to affect the dynamics of spatial politics in favour of the disadvantaged (e.g. Bilandzic & Foth, 2012; de Souza e Silva & Sheller, 2014). This development

coincides with the shift in the locative media platform from a specialised technology to a mass medium. This shift was marked by the incorporation of real-time locative functionality as afforded by hand-held devices, or through webGIS toolkits enmeshed with public crowdsourcing and social media platforms (LEA, 2016). It was made possible by technological developments in mobile phone or smartphone and tablet devices that occurred at the same time, as listed below separately in Box-1. Correlation of this development with the context of spatial design and planning is included within the definition of locative media described by Lemos (2008), as the second of the four components the term is considered to stand for (emphasis applied): poetics, or installation of alternate narratives via geo-notation techniques; *perceptions, or creation of alternate sense of place, through alternative geo-information enriched visualization techniques, including interactive mixed reality interfaces and transformation of mapping through geo-tagged audio-visual content*; alternative entertainment via geo-located and mixed reality gaming platforms; and, direct political action, such as flash mobs.

Box 1: Development of locative media in conjunction with advancements in handheld devices (Source: Authors).

Development of Locative Media into an Ubiquitous Mass Medium Platform Incorporation of real-time locative functionality as afforded by hand-held devices, or through webGIS toolkits enmeshed with public crowdsourcing and social media platforms (LEA, 2016), marks the shift in locative technologies to a mass medium mode. Correlation of this development with the context of spatial design and planning corresponds to the second out of the four main categories of open source interactivity that Lemos (2008) considers the term locative media to stand for, namely (emphasis applied on the second one): poetics, or installation of alternate narratives via geo-notation techniques; *perceptions, or creation of alternate sense of place, through alternative geo-information enriched visualization techniques, including interactive mixed reality interfaces and transformation of mapping through geo-tagged audio-visual content*; alternative entertainment via geo-located and mixed reality gaming platforms; and, direct political action, such as in the form of flash mobs. Applications of location sensing technology would have remained confined to one-off ventures or custom-built equipment however, if not for the ubiquity brought to this field by the introduction in the retail market of PDAs and Smartphones that offered the required hardware configurations (internet/LBS/GPRS/GPS), in hand-held devices (Apple, 2012; Eurotechnology, 2011; Garmin, 2012; Mio, 2012; van Diggelen, 2009; WebDesignerDepot, 2009). This key development took place from 1999 onwards, as tabulated below, propelling location awareness from a novelty item to a mass medium by opening the way for public scale applications, such as in gaming, tourism, archaeology, navigation, and in spatial decision-making and participatory governance practices. Full-fledged reviews are already available or in progress by various authors, including, to name a few: Iveson (USyd, 2012); Foth, Klaebe, and Hearn (2008); Lemos (2008); Pope (2005); McCullough (2006); Tuters (2004); and, Saad-Sulonen (2008).

Year	Device	Make	Category	Built-in Hardware Configurations
[1993 – 1998]	[various/100s]	[various]	PDA	Data Processor (DP)/internet access only
1996	Nokia9000	Nokia	Smartphone	DP only
1999	Palm VII	Palm/3Com	PDA	DP, PQA (zip code information)
1999	Benefon Esc!	Benefon	Mobile	DP, GPS (acclaimed)
2001	R520m	Ericsson	Mobile	DP, MPS (Ericsson Mobile Positioning Syst.)
2001	KDDI	KDDI	Mobile	DP, LBS (Location Based Services)
2002 – 2003	[various]	[incl.Motorolla]	Mobile	DP, GPRS
2003	DigiWalker 168	Mio	PDA	DP, GPS
2003	iQue 3600	Garmin	PDA	DP, GPS
2006	Mio A701	Mio	SmartPhone	DP, GPS
2007	E90	Nokia	SmartPhone	DP, GPS
2008	iPhone3G	Apple	SmartPhone	DP, Accelerometer (Acc), A-GPS
2009 – to date	[various/200+]	[incl.Samsung]	SmartPhone	GPS in 39% of all devices in use worldwide
	iPhone3GS iPhone4/4S	Apple	SmartPhone	DP (~1.0GHz), Acc, A-GPS, Digital Compass (required for G-AR)
by 2014	[numerous]	[numerous]	SmartPhone / Tablet	GPS expected penetration: 80% of all devices

(Apple, 2012; Eurotechnology, 2011; Garmin, 2012; Mio, 2012; van Diggelen, 2009; WebDesignerDepot, 2009)

Encapsulation as Locative Media Interventionism - *LMI*

To recap, the interventionist approach as manifest in a number of spatial applications of locative media stands for harnessing the key aspect of enabling disadvantaged stakeholders, or end-users of the built environment to gain access to information that has been conventionally only

available to privileged stakeholders of public space, such as government, landowners and their immediate clique, including commissioned urban planners and designers. Harnessing here means not to just tap into this facility but to use it in a way that leverages the interests of the disadvantaged into a competitive position in the arena of spatial politics, as vividly visible in the examples discussed above. Due to the breath as well as depth of the sensitivity, responsibility and enterprise embedded in this approach of practice, it has merit to serve as an analytic framework for conducting a critical review of subsequent locative media applications, including the deployment of G-AR in the formal sector of spatial planning and design. Townsend has aptly acknowledged this merit in the following words:

> *The rapid deployment of top-down context-aware systems and the lack of holistic, sustainable, human-centred visions for aware cities has created an enormous intellectual vacuum. Into this breach have stepped artists who are co- opting this new "locative media" to highlight the flaws of these visions but also to raise fundamental questions about the nature of public space and surveillance. These artists are pioneering a backlash against the command-and-control motivations of the designers and financiers of top-down context-aware systems. While powerful interests are likely to use context awareness to tighten control and increase influence over individuals, at the same time people are going to be more empowered to work around those systems using their own aware devices. (Townsend, 2006)*

Thus an evaluation can be launched for locative media applications, including G-AR applications, in the formal sector of spatial planning and design by using the concept of locative media interventionism, or LMI, as an analytical framework for drawing inferences. It may be mentioned that the review of applications presented in the rest of this paper is pre-limited for the present purpose of exposing the gap in accomplishment of social inclusion, and is therefore an illustrative rather than an exhaustive review. This is not to discount the myriad other aspects of locative media and spatial politics as a subject that have already been dealt with or are earmarked for contemplation in the near future by a number of authors, including: a full-fledged review of theory and practice related to a comprehensive research project by Iveson (USyd, 2012); along with past works by (to name a few), Foth et al. (2008), Lemos (2008), Pope (2005), McCullough (2006), Tuters (2004), and, Saad-Sulonen (2008). A tabular summary is given below to fully differentiate the separate chronological ordering at work in the paper: till this point the evolution of locative media's interventionist approach has been discussed; while in the next section a backdrop for discussing G-AR has been created by first tracing the overall use of locative technologies within the PSD domain, followed by a review of the use of G-AR technology specifically in the PSD domain.

Table 2: Key argument elements and their implications (Source: Authors).

	Key argument elements	Examples	Political Implications	Social Inclusion Implications	Relevant Recommendations
1.	Evolution of locative media as a whole – from an artistic novelty to a politically charged mass medium [2002 – 2012]	- Pilsen Project - Biomapping - Urban Tapestries - Impossible Geographies - Nomadic MILK - Urban Atmospheres/Ergo	Advent of the LMI approach.	Effective interventions for social inclusion.	This process of evolution can be tapped as a source for gaining insights on the possibilities for transforming G-AR's adoption. Such insights can lead to conceptual rigor in the basic approach to G-AR's adoption.
2.	G-AR's introduction, and background to G-AR's application in the PSD domain – initial usage of locative technologies	Macro level examples: - Mapping London - PIT – Marmo-Platano Melandro - Real-time site/studio link-up - Taiwan - Nabi Korea	Absence of the LMI approach initially and then visible in later applications.	Non-effective interventions for social inclusion.	There is a need for Institutionalization of the presentation of information in general, to encourage professionalism in adoption of G-AR in the PSD domain. This can lead to increased

	(as a cartographic tool vs. later applications with an LMI approach) Examples of locative technology and media applications.	- Urban Mediator Micro level examples: - Yellow Arrows - Trodn - Land-Share - CONTSENS - PPS – Project for Public Space			rigor, resulting in drawing from other disciplines. This can also encourage the cultivation of a direct approach to the pursuit of social Inclusion via an application of the LMI approach.
3.	G-AR's application in the PSD domain – essentially following the same non-LMI approach as the use of locative technologies in general	Macro level examples: - ILCO Cities - OnSitePlayer - thumper - *ways2gether* Micro level examples: - BuildMyKitchen - VizLab	Absence of the LMI approach.	Non-effective interventions for social inclusion.	There is a need for the documentation of G-AR's visceral appeal, so that it can be harnessed more effectively once fully understood. This can discourage the notion of technological fidelity being used as a surrogate for conceptual rigor
4.	Application of the LMI approach	Example: - streetARt	Initiation of application of the LMI approach	Beginning of effective interventions for social inclusion.	There is a need for re-conceptualization of the role of visualizations in the PSD context

G-AR IN THE PSD CONTEXT – *affecting social inclusion, or still a glamorous novelty?*

This part of the paper is devoted to a critical evaluation of G-AR applications within the PSD context, using the LMI approach as a framework for critiquing and analysing effectiveness. First a brief introduction to G-AR is given, including its significance, visceral aspect, and value in the PSD context. This is followed by a brief review of locative media in general in the spatial planning and design domain, to provide a backdrop for discussing G-AR applications. Selected instances of research and practice applications in the PSD context have been used as illustrative examples of deployment of high-fidelity visualisations. Next these examples are discussed in terms of their effectiveness, in response to the published concern mentioned at the outset, regarding marginal fulfilment of the ultimate objective of advancing social inclusion. After this there is a brief contemplation of the cause for the gap between aims and achievements, with reference to one factor in particular, namely the extent to which the LMI approach has been applied in the design of locative media and G-AR deployments. At the end a set of recommendations for future research and practice are listed, as the potential way forward for achieving a higher level of social inclusion via G-AR applications in the PSD domain.

G-AR – *a brief introduction*

Since introductory research has already been published earlier by the author (Khan & Dong, 2011a, 2011b), it suffices here to provide a brief description separately below in Box-2, in order to focus on the key aspect of effectiveness. Results have indicated that G-AR does offer a bridge across the expert non-expert divide, but more in terms of communicating 3D information in an easily comprehensible, intuitive manner, with questions remaining as to whether this feature may or may not directly contribute significantly to social inclusion.

Box 2: Introduction to G-AR (Source: Authors).

What is G-AR?
After the interactive 3D simulations for spatial design communication offered by virtual worlds and game engine technologies, the next major invention in visualisation technologies was that of geo-located augmented reality (G-AR) visualisations. Both versions of G-AR, the marker-based and the global positioning systems or GPS-based technology, offer in-situ visualisation of life-sized virtual 3D models at the actual location of a given spatial design proposal. It operates by overlaying images of 3D virtual models on the live video display of handheld devices at the physical site of the proposal. This overlay is scaled and rotated in real-time as per the position and movements of the viewer, in accordance to the rules of perspective (e.g. Bimber & Raskar, 2005, pp. 93-206; Hull, 2012), in rapid successive response to the viewer's movement in terms of distance, bearing, and vertical angle of view, creating a close to real feeling of the full physical size and shape of the proposed design – as if it were actually there. It thus adds an experiential walk-around dimension to spatial simulation. It registers in perception as a 3D experience (Azuma, 1997, p.2), and hence embodies a significant reduction in the conventional encumbrance of decoding 3D spatial understandings from 2D representational systems of spatial information (shown below in Figures 1-3). In this way it reduces the primary gap of deciphering design intent from graphic representations during negotiation processes amongst stakeholders in the arena of spatial politics (Bates-Brkljac & Counsell, 2007; Hajer, 2005; Zeisel, 1984).

Early Custom-Built Versions of G-AR
In early publications on augmented reality this concept and term are mentioned in relation to virtual and mixed reality (Azuma, 1997; Caruso, Fassone, Salvador, & Ferri, 2011; Hollerer, Feiner, Terauchi, Rashid, & Hallaway, 1999; Milgram, Takemura, Utsumi, & Kishino, 1994). It began first in the form of a head-mounted display system, termed by Sutherland (1965) as 'the ultimate display', with applications of marker-based systems eventually appearing in numerous contexts, including: manufacturing (Azuma, 1997); military equipment (Cameron, 2010b); medicine (Cameron, 2010a); sports (Lester, 2009); gaming (Wagner, Pintaric, Ledermann, & Schmalstieg, 2005), accompanied by GPS-based versions (Caruso et al., 2011); and archaeology (Noh, Sunar, & Pan, 2009). One of the first outdoor applications was MARS in 1998 (Hollerer et al., 1999).

Geo-physically Anchored Versions of G-AR
Eventually G-AR entered the realm of in-situ applications, in the form of both marker-based and subsequently GPS-based systems. A GPS-based version was first introduced in architectural pedagogy through a handheld interface, albeit with custom-configured hardware, in an attempt to reconcile the inherently 3D character of spatial ideas with the predominantly 2D format of visualization technologies (Hii Jun Chung, Zhiying, Karlekar, Schneider, & Lu, 2009). In this pedagogical application a PDA-based configuration was used, retrofitted with GPS and gyroscope sensors (Hii Jun Chung et al., 2009). Authors reported successful results based on a two-stage system: first the GPS and gyroscope data was used to ascertain the ballpark position of the viewer and device; and then, a silhouette tracking software was used to position the programmed 3D model in a precise manner with minimised CPU load (Hii Jun Chung et al., 2009). As this system was intended for students or professionals of architectural design, its targeted use was limited in scope quantitatively as well as qualitatively, in terms of the training background that could be expected from this cohort. Public scale applications of this technology however, such as for e-participation, demanded the hardware configuration required should be more compact and stream-lined as well as freely available in the market. This was made possible by the introduction of devices in the open market that had an in-built array of compatible sensors, thus opening the window for myriad applications, such as the currently popular Pokemon game (Serino, Cordrey, McLaughlin, & Milanaik, 2016), and more importantly, in spatial governance.

Evolution and Ubiquity
A fortuitous convergence between the inventions of wireless internet connectivity, GPS sensors, digital compass plus accelerometer technologies, and smartphones with high speed processing capabilities (as already mentioned earlier in **Error! Reference source not found.**), has led to the advent in 2009 of ubiquitous geo-located and geo-situated augmented reality visualisations (e.g. Santos, Acri, Gierlinger, Schmedt, & Stork, 2010). A number of third party solutions began placing customisable G-AR visualisations literally in the hands of everyday users (e.g. Layar, 2016; Vuforia, 2016; Wikitude, 2016). This ubiquitous form imbues powerful connotations of accessibility to spatial authorship, albeit in the virtual realm, by becoming available on outdoor devices – smart phones and tablets. It thus marks a step beyond using locative technology as the latest novelty in social media, towards accessing the lived spatial experience of end-users (Bohøj et al., 2011). Initial prototype development by the author has been in the form of a web-app based on the iOS G-AR interface offered by the LAYAR browser (Layar, 2016), including a scaled down user evaluation study. Testing of the 3D rendering performance of the setup has already been reported in CAADFutures2011 (Authors, 2011b), while a live demo was shared at Communities & Technology 2011 (Authors, 2011a).

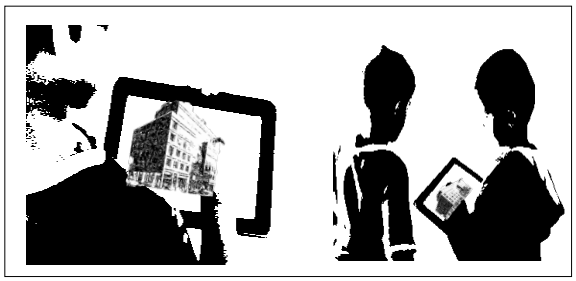


Figure 2-a: iPad UI using a conventional 2D non-experiential format (Source: Authors).

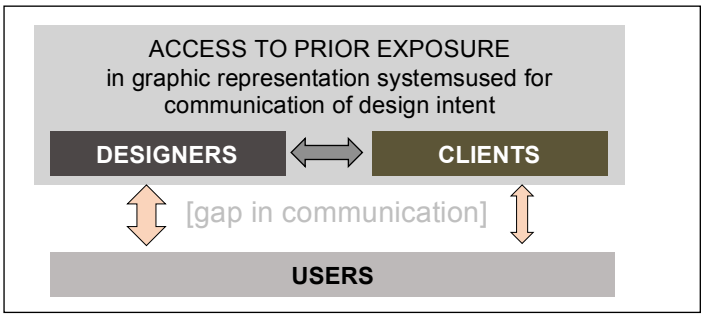


Figure 2-b: Spatial communication gap (Zeisel, 1984, p.35).

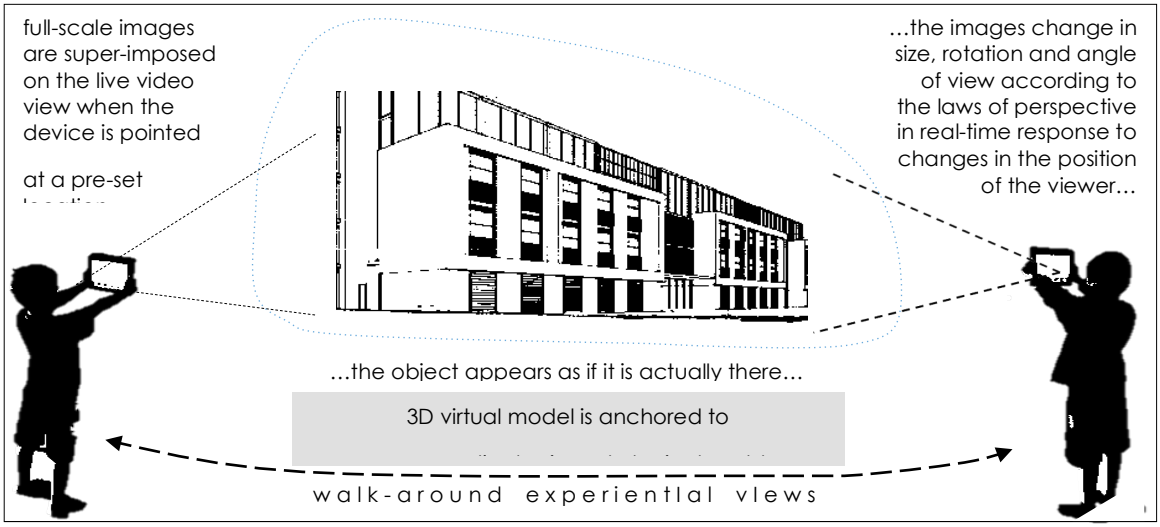


Figure 1: Movement-driven 3D experiential format of G-AR visualisations (Source: Authors).

Significance – *design iterations at a fraction of the cost*

Most design fields test full-scale prototypes and then conduct multiple iterations to arrive at optimum solutions. In Architecture however, due to the larger scale of the objects, in terms of both space and time, and hence cost as well, full-scale iterations are impractical. There has always been a latent need to somehow overcome this limitation. Ratti has succinctly summarised the irony of this long held dilemmatic yearning of the profession: 'project iteration happens on such an extended timescale that, in most cases, insights have already lost their relevance by the time they are implemented' (Ratti & Claudel, 2016). Since architectural design operates on the paradigm that 'reality itself is the framework for planning and design', it follows that 'augmented reality can make a decisive contribution to examining intended and unintended effects in advance' (Reinwald et al., 2014). This is the demand against which the close-to-real visualizations that G-AR offers acquire significance for all stakeholders alike. It is therefore considered as a facility for: reducing 'uncertainty' by allowing designs to be understood easily; imparting a feeling of 'real' engagement; increasing the comprehension of 'impacts'; and, enabling those stakeholders to participate who rarely did, and 'at any time of the day' that is convenient (Oksman, Väätänen, & Ylikauppila, 2014). These characteristics indicate its potential to create a 'digital vernacular' (Ratti & Claudel, 2016).

Visceral Aspect – *the feeling of authorship*

Further to the above features the most significant aspect is the visceral feeling of closeness of the proposed ideas to the lived experience of the users. They can walk around and feel the size and scale, height and width, and combined variations, as a situated experience. Plus they can share this experience with fellow users also just as they might in reality. This adds on a deeper sociological meaning to end-user feedback. Although it is not a new idea to turn post-occupation evaluation on its head by enabling modifications to be made in design intent prior to physical implementation (e.g. Ratti & Claudel, 2016, p.45), in spatial decision-making the prospect of end-users contributing in the same format as the communication of designers marks a significant impact on the basic methodology of this field. It remains to be examined though whether these features actually do impact on social inclusion or not. For this it will be necessary at some future stage to fully understand the visceral aspect through a detailed experiential phenomenological study.

Implied Value for PSD – *intuitive visualizations for non-expert end-users*

It is evident from the above brief introduction to G-AR and its key features that the innovation potential of this technology lies in changing how citizens engage in spatial planning deliberation. Besides the commonplace feature of collection of geo-tagged comments, which may require measures for prevention of 'astroturfing' (Monboit, 2011), participating citizens can also propose alternative designs. With further advancements they may even have the opportunity to offer their suggestions in the form of 3D sketches, as proposed for an upcoming study by the author as well. This technology has the potential to mark a significant shift in the level of accessibility to spatial cognition of design intent by end-users. It has the potential to overturn the convention of lay citizens' opinions being undervalued because of lack of graphic literacy, or where this lack of knowledge poses risks for misinformation and a disadvantaged position (Dong, 2008). With G-AR end-users can even use their own devices, moving their smartphones or tablets nearer or further, or rotating them horizontally and vertically, to interact with the full size and height of the proposed object. This is an intuitive, accessible, and comprehensible format for them, as compared to decoding spatial information from 2D representations, or even 3D simulations that are detached from the actual location of future proposals. To appreciate G-AR's appropriation it can be useful to briefly trace the preceding trend in the use of locative technology in general in PSD.

Background – *a general history of locative technologies in the PSD domain: a cartographic approach instead of the LMI approach*

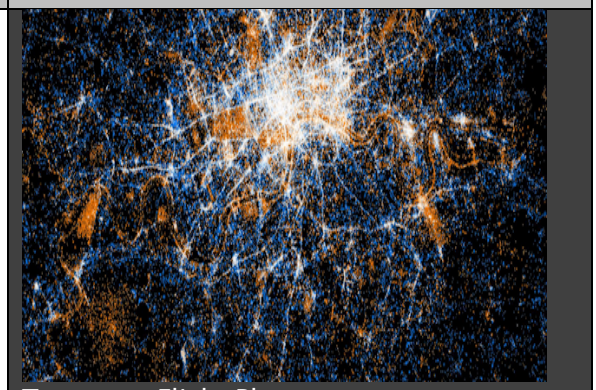
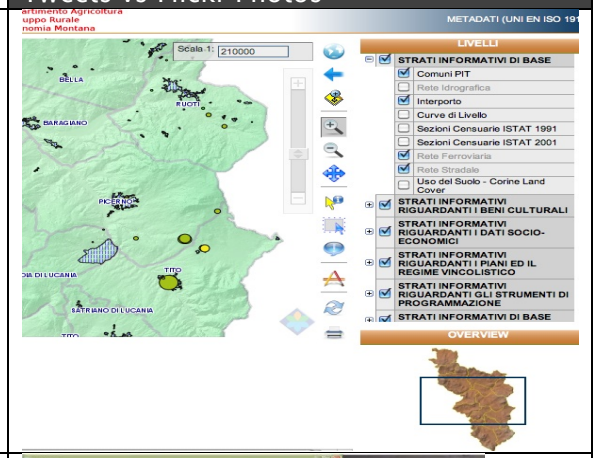
Usage of locative media technologies in the PSD domain bespeaks a predominantly cartographic emphasis rather than the interventionist character of the LMI approach visible in mainstream locative media artistic installations. In other words, locative media technologies have been imported detached from the convention of practice of the locative media domain. This anomaly is further noticeable when it is recalled that the PSD domain shares the same ultimate goal of advancing social inclusion, with an increasing concern within the planning discipline in general for an ethical responsibility to address stakeholder inequalities (Carlos Nunes Silva, 2007). A brief review of selected projects is presented below to illustrate this discrepancy in basic approach, followed by an analysis of the resulting issues.

Macro-scale applications of locative technologies in general

At the macro level locative media applications have mainly consisted of integration of mobile GPS information with web-based GIS software such as ArcGIS, Mapquest and the Google Map API (Table-2). These applications are characterized by the intention to enhance interaction with 2D representation systems of spatial information via usage of data-mined location information enmeshed with high quality audio-visuals and graphics, including photos and videos. This approach is also referred to as PGIS, that is, participatory GIS (Kingston & Smith, 2007).

Interaction consists of opinions and comments, supported by audio-visuals, and also polling. Included in this selection of examples is the case of an open-source software called 'Urban Mediator' (Saad-Sulonen & Botero Cabrera, 2008).

Table 2: Locative media-based participation:
Macro planning/governance/spatial design (Source: Authors).

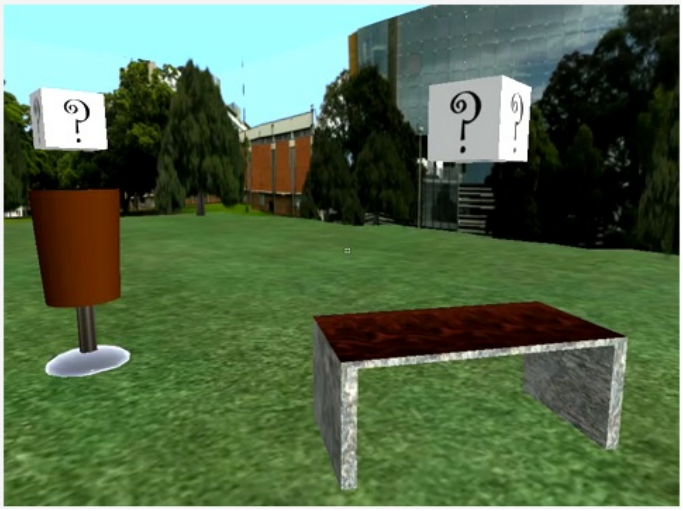
Title	Producer	Significance	Website / (publicly displayed images)
Mapping London	2011 UCL – Bartlett School/CASA http://mappinglondon.co.uk/	Although this GIS-based display includes deprivation and poverty analysis data but the strategy is passive awareness-generation (utilizing tweets as well).	
PIT – Marmo-Platano Melandro	2011 University of Basilicata, Italy http://blogpit.wordpress.com/blog-pit/	An elaborate strategy grounded in related theory to engage citizens via combination of locative social media and GIS software, using multiple interfaces: WebGIS/Blog. However, compared to the LMI approach it is still a passive display.	
Real-time site /studio link-up - Taiwan	2008 http://jazzliang.files.wordpress.com/2008/09/liang-locativemedia.pdf	AR-based urban design studio collaboration combined with real-time updates from the actual sites under consideration. A paradigm for 'spontaneous' planning. Although there is an attempt to increase the importance of in-situ conditions, still absence of LMI-based direct targeting of exclusion.	

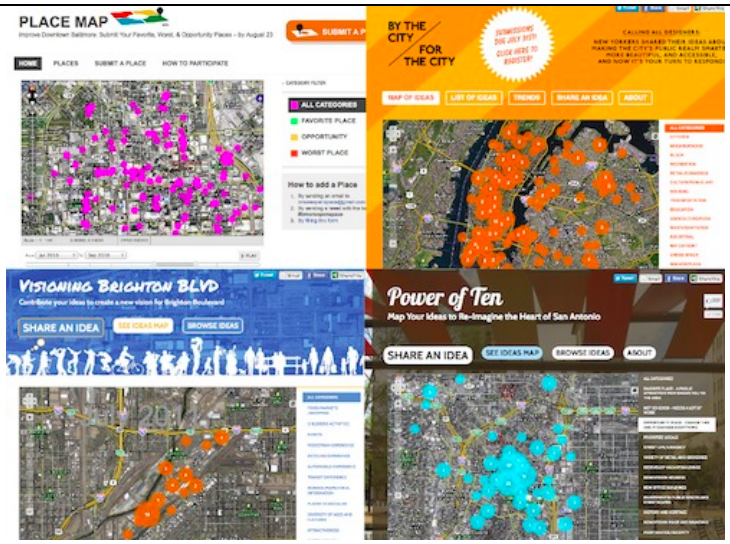
Nabi Korea	2006 Korea (artists) http://test.nabi.or.kr/site/project/2006/connected/index.html#every	Strong concept of using mobile locative media for city revitalisation, a government initiative similar to Nold's biomapping concept but not as proactive [limited information available].	
Urban Mediator	2008 ARKI research group - University of Art and Design Helsinki (Finland) http://mlab.taik.fi/urbanmediator/	A participatory design open source software for developing interface for location-aware social media targeting urban design issues. Again, application of LMI may have led to a more involved, political interaction with the issues in question.	

Micro-level applications of locative technologies in general

At the micro-design level the utility of locative media has appeared in applications with a focus on visualization of, or interaction with, more tactile objectives. Among the most universal examples of this is Google Streetview (Boardman, 2011), it enables user-submitted traffic conditions data and 360° navigable street-imagery tagged to the map or satellite views of all major urban areas of participating countries (Google, 2012). Other smaller scale projects undertaken by various groups are concerned with place-making (Lemos, 2008), in which interaction comprises sharing of insights and comments. Included in this category are research projects that deal with decision-making on specific street furniture issues in public space, with advanced interaction options such as enabling participants to even submit graphic alternative ideas, and then having an option for polling on the options (Table-3). A few illustrative examples from amongst the myriad available are given below in Table-3.

Table 3: Locative media-based participation: Micro-design/engagement (Source: Authors).

Title /Prodr.	Significance	Website / (publicly displayed images)
Yellow Arrows 2004 Counts Media Inc. http://yellowarrow.net/v3/	Offers alternative narratives to be written (Lemos 2008) in a virtual layer over the participating urban area (indicators in physical space overlayed with detailed information in the corresponding virtual layer), at times bringing back into collective memory places lost to commercial construction.	
Trodn 2010 M. Sarrof and D. Bartollo Design Lab, Univ. of Sydney http://trodn.wordpress.com/author/trodn/	Shifts the basic method of urban design practice from expert speculation to real-time involvement of collective end-user opinions, via mobile-based manipulation of objects in a virtual model (SecondLife) of a given space.	
Land-Share 2009 UK (private) http://www.landshare.net/	Rural concept of connecting growers with people who have land to share, using locative information on map and social media.	

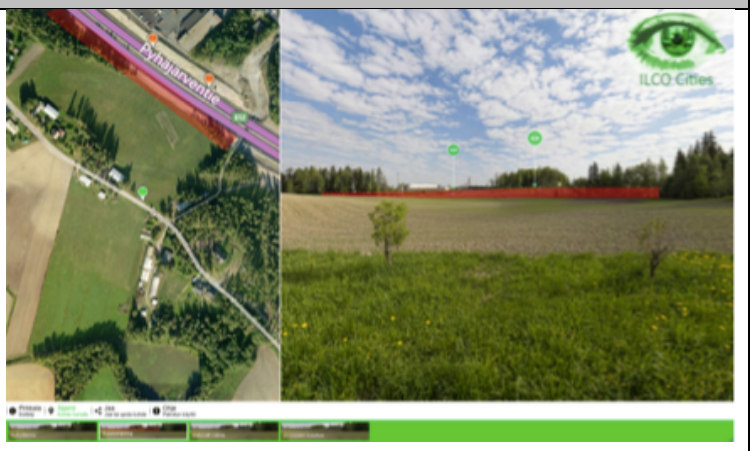
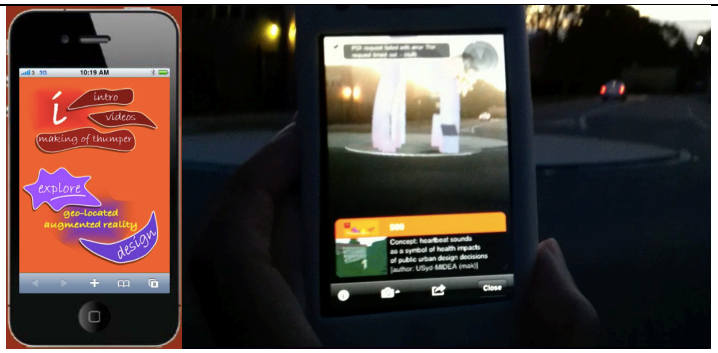
CONT-SENS 2010 - London Metrop. Univ. http://www.slideshare.net/johnnigelcook/urban-planning-education-in-context-with-mobile-phones	A diagonally opposite concept, namely to bring urban planners also into the physical experience of the citizens, thus making them use the same access point for knowledge as available to ordinary/lay end-users. Application of technology to instigate a conceptual shift in the approach to urban design from a top-down to a bottom-up method. However, could have been further strengthened with a corresponding innovation directly at the conceptual level, such as arranging a legal agreement between the residents and the designers to shift the accountability of the experts into the hands of the end-users.	
PPS – Project for Public Space (USA) http://www.pps.org/blog/digital-placemaking-authentic-civic-engagement/	GIS used by an NGO for PlaceMaking projects at neighbourhood level. Close to the LMI approach, tapping in to the emotive social capital of citizens by slogans such as PowerOf10 (10 means items to work for). Can be further extended to tap into more deeper emotive themes of the socio-cultural milieu that are threatened by the politics of space, such as conflicts in value systems (e.g. are there spaces for festivals? …of the right size, quality?)	

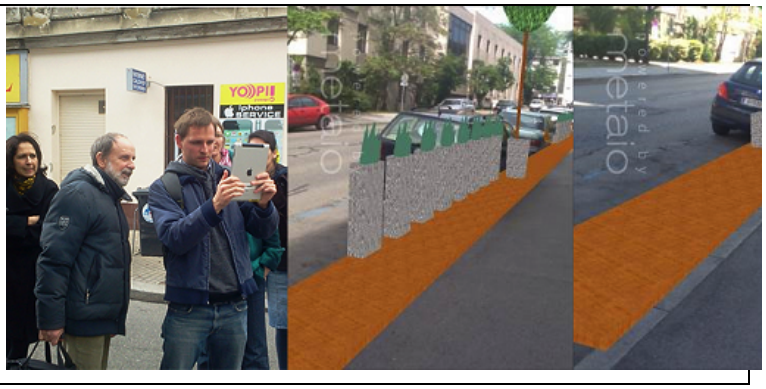
These precedents of non-LMI based locative media deployment in general in the PSD context can be expected to influence the particular case of G-AR's adoption as well. A sample of illustrative examples is presented below followed by a discussion of whether the LMI approach could have been utilised to a greater or lesser extent.

G-AR in the PSD context – *illustrative examples: macro-level*

Except for gaming applications, all examples of G-AR's appropriation, including in PSD research and practice that are visible in the public domain (e.g. Allen, Regenbrecht, & Abbott, 2011; Cameron, 2010a; Caruso et al., 2011; Ganapathy, 2013), indicate a predominantly visualisation approach (Marner & Thomas, 2014). Below are a few indicative examples (Table-4).

Table 4: Indicative macro-level examples of G-AR applications in the PSD domain (Source: Authors).

Title / Producers	Significance	Website / (publicly displayed images)
ILCO Cities VTT Technology Centre of Finland (Oksman et al., 2014)	Usage of G-AR as a visualisation tool only, User feedback included the comment: "…despite of positive attitude, a common concern related to new participatory methods used in urban planning was, how the results will be used and will there be a real impact." [LMI approach absent]	
OnSitePlayer VTT Technical Research Centre of Finland (Woodward & Hakkarainen, 2011)	Highly accurate rendering client developed with care and sensitivity for optimum user experience. However, usage of G-AR as a visualisation tool only, to access socio-cultural aspects via visual comprehension, instead of creating a direct pathway [LMI approach absent].	
Thumper Design Lab, Univ. of Sydney (Khan & Dong, 2011b)	[by the author] An effort to capture the visceral *authorship* aspect of G-AR visualisations as the first step to apply the LMI approach, but not yet fully accomplished to a notable extent.	

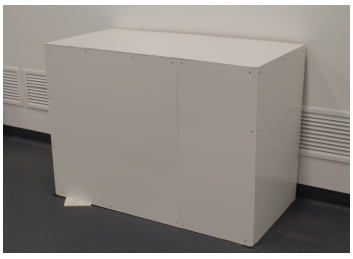
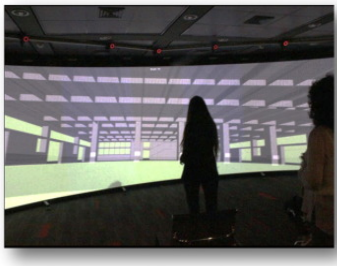
ways2gether Austria (Reinwald et al., 2014)	Usage of G-AR as a visualisation tool only, without LMI approach.	

It is evident that there are attempts to harness the affective potential of G-AR but the quality of accomplishment has yet to reach the level observable in art installations.

G-AR in the PSD context – *illustrative examples: micro-level*

Although the concern for social inclusiveness applies mostly in larger scale public space design practice, it can be noted that even in the context of interior and furniture design G-AR has been incorporated as a visualisation tool only. Illustrative examples given below show the absence of the LMI approach at the micro-level PSD domain as well (Table-5).

Table 5: Indicative micro-level examples of G-AR applications in the PSD domain (Source: Authors).

Title / Producers	Significance	Website / (publicly shared image)
BuildMyKitchen (Australia) (Marner & Thomas, 2014)	Usage of G-AR as a visualisation tool only. [LMI approach absent]	 
VizLab (Israel) (Portman, Natapov, & Fisher-Gewirtzman, 2015)	Usage of G-AR as a visualisation tool only. [LMI approach absent]	 

Published Concern – *does augmented reality really matter?*

Alarms began to be raised in published discourse at the outset of the entry of digital technologies in the PSD domain, to draw attention towards the minimal effect on the ultimate objective of advancing social inclusion (e.g. Bendix & Bendix, 1991; Cooke & Kothari, 2001; Dake & Wildavsky, 1991; Forester, 1982; Jasanoff, 2003; Mahjabeen, Shrestha, & Dee, 2009; McCall,

2004; Medaglia, 2011; Mulder & Wilke, 1970; Roberts, 2004; Selinger, 2005; Serageldin, 1997; C.N. Silva & Syrett, 2006; Tomkova, 2009). This discourse primarily stresses the need to scaffold stakeholders towards informed decisions (e.g. Ratti & Claudel, 2016). Its secondary concern is that advancements in technological fidelity are often taken to be a surrogate for conceptual rigor, similar to the way academic research may quote quantity of publications in place of extent of citations as the indicator of quality (e.g. Payne & Roberts, 2010). Examples listed in the above table show that social inclusiveness has yet to be targeted directly, despite the whole purpose of participatory processes to achieve socially inclusive production of space (e.g. C.N. Silva, 2010). This push for inclusion in process, as distinct from inclusive design itself (e.g. Langdon, Clarkson, Robinson, Lazar, & Heylighen, 2012), is in turn fuelled by the demand for socially inclusive built environment that numerous authors have been advocating for in various segments of published discourse, including critical regionalism, vernacular architecture, indigenous architecture, environment behaviour studies, and socially responsive approaches to architecture and planning (e.g. Birkeland, 2012; Carmona, Heath, Oc, & Tiesdell, 2010; Corburn & Bhatia, 2007; Correa, 2010; Earley, 1977; Evans, 2003; Frampton, 1985; Hillier & Hanson, 1989; Jackson, 2003; Memmott & Davidson, 2006; Oliver, 2006; Renalds, Smith, & Hale, 2010; Schulz & Northridge, 2004).

APPLYING THE LMI APPROACH – *what is the cause for the anomaly and how to fix it?*

From the viewpoint of the LMI approach the marginal achievement of social inclusion via G-AR's PSD applications, can be confronted by asking the question: has sufficient rigor been expended to target social inclusion directly? This question holds the key to the issue of under-informed input of lay citizens during participatory processes as well as that of technology posing as a replacement for conceptual rigor. To answer this question however, it can be useful to first briefly define both the terms rigor and directly as pertinent to the present context.

Targeting Social Inclusion Directly versus Indirectly – *problem of the designerly approach*

During participatory sessions it is important for all participants to comprehend the social inclusion implications of proposals. It is an obvious pre-requirement for informed input. However, discerning socio-cultural aspects from graphic representations of the intent can only be possible after extensive prior exposure to latest research and knowledge of the field and also training in how to extract such information from visualisations (e.g. DSL-NUS, 2010; Suwa & Tversky, 1996). Experts have access to such exposure and can therefore discern these aspects of a project, and also assess whether the design solution fulfils them or not (e.g. Corburn & Bhatia, 2007). Drawings thus serve as an indirect means to information on social implications. End-users on the other hand are non-experts and are disadvantaged in having limited prior exposure, hence cannot readily comprehend graphic drawings in the same way as experts. To expect them to extract this information from drawings is hence a designerly approach to the problem. In order to institute fairness in the process it needs to instead be approached as a challenge of communicating social implications directly.

Rigor in Addressing the Problem – *conceptual vs. technological innovation*

Effect of progress in visualisations technology on the politics of space can be observed to follow the effect of growth of science and technology in general, it 'inevitably outstrips the development of political expertise…' (BT.com, 2016). It appears that as technology used for participatory decisions progresses towards access and transparency, it exposes the lack of a corresponding progress in the concept of participation itself. Silva has traced this lack of rigor to gaps in the evolution of the use of technology within the realm of spatial decision-making in general (2010, pp. 1-6). He recounts the designer perspective of spatial decision-making during the pre-1960 urban design movements, such as the Garden City movement and the International Congresses

of Modern Architecture or CIAM, as a background to highlight the communicative approach of the recent collaborative paradigms (pp. 1-6). Whereas technology now offers participative and inclusive decision-making platforms, the conceptual underpinnings of spatial decision-making have yet to catch-up with the democratic values embedded in these advancements on one hand and the gravity of the agenda of social inclusion on the other (Meneklis & Douligeris, 2010). This conceptual gap has resulted in a situation in which 'different urban planning paradigms….are interrelated in apparently contradictory theoretical perspectives' (C.N. Silva, 2010, pp. 1-6). It is evident that a search for 'new concepts' is needed to resolve the discord between the objectives, methods and technologies of participatory spatial decision-making processes (C.N. Silva, 2010, pp. 1-6), and a lag in response to this need from the theory of spatial design therefore amounts to a lack of conceptual rigor (e.g. Cho & McLeod, 2007).

Concise Frame of the LMI Approach – *for critiquing G-AR applications*

A brief reflective critique of G-AR's applications in the PSD domain can now be conducted, followed by a set of recommendations for future possibilities. This critique is presented here in emulation of a similar analysis of the deployment of communication technologies in the field of science dissemination conducted by Horst and Michael (2011). In their analysis they have deployed the concept of 'event' as a framework for critiquing the lack of effectiveness of the paternalistic underpinnings of conventional approaches used in the dissemination of discoveries to the public, and have instead suggested a proactive engagement with the knowledge level of lay citizens (Horst & Michael, 2011). Applying the LMI framework, three discrepancies become visible as soon as G-AR applications in the PSD domain are viewed from a critical standpoint: overall, G-AR has been deployed with a mindset that is visibly detached from the way technology is deployed in the locative media domain in general; absence of conceptual rigor; and, an indirect passive strategy for the pursuit of social inclusion rather than a direct proactive one.

Visible Detachment from the LMI Approach – *a comparison of evolution processes*

Examples given earlier in Table-1 show that the deployment of technology in locative media, especially in artistic installations, has evolved from simplistic demonstrations to sophisticated exploitations of the political potential afforded by locative tools, via deployment of the LMI approach. In comparison to this evolutionary process, G-AR's deployment as a locative media advancement in general (shown in Tables 2-3), and in the PSD domain in particular (shown in Tables 4-5), indicates that a similar evolution has yet to take place in the case of this technology. It is still being deployed for its face value as a charismatic experiential format, rather than for its political potential.

Gap in Conceptual Rigor – *result of the absence of the LMI approach*

Due to the detachment from the LMI approach a lack of rigor is evident in resolving the apparent clash between the political potential of G-AR visualisations as a locative media technology and the relatively apolitical manner it has been applied with to date. This topic has been already introduced in published discourse from a number of different viewpoints (Estrin, 2010; Neto, 2006), but has yet to be made the subject of a sustained inquiry from the PSD standpoint.

Indirect Pursuit of Social Inclusion – *wide-eyed approach to the use of G-AR*

To date G-AR is deployed with an attitude of fascination with its experiential walk-around format, as if this feature alone could influence social inclusion. An awareness remains to be cultivated that the effects of advancements in technological fidelity eventually flatten out at the plateau of comprehension of immediate visual aspects of a given proposal. In order for non-expert citizens to comprehend the long-term socio-cultural wellbeing implications G-AR has to be supplemented with additional content dedicated to address that objective. For instance, the lay public may need to be informed, just as experts already are, about the generic relationship between certain spatial

decisions and their expected impacts. Only then could they possible discern what to expect from the spatial design proposal under scrutiny.

CONCLUSION AND FUTURE RECOMMENDATIONS – *the way forward*

If in future the LMI approach was applied to G-AR's deployment in the PSD domain then this could potentially resolve the above listed discrepancies. Corresponding to this potential the following recommendations can be listed as the way forward on this subject:

- *Documentation of G-AR's Visceral Appeal* – Fully understanding the visceral dimension can enable sensitive and effective interface designs for G-AR's deployment on hand-held devices, increasing the likelihood of its political potential to be harnessed fully for influencing social inclusion. For instance, if were to be known what exactly is the most captivating factor in the charismatic appeal of G-AR visualizations (Null, 2010), then interface designs can be formulated to accentuate that quality and direct it towards the aim of influencing social inclusion. Resulting images and videos could be shared on social media, eventually leading to a substantive lobby group.
- *Example* – An example of an artistic participatory installation, although now rolled back, that was based on ubiquitous G-AR and demonstrated characteristics of the adoption of an approach that is close to LMI was streetARt (Table-6).

Table 6: Artistic participatory installation that demonstrates the adoption of LMI (Source: Authors).

Title / Producers	Significance	Website / (publicly shared image)
StreetARt MOB/Rob Manson Australia [Based on LAYAR Browser, Holland] (design100, 2011)	Concept of setting up a virtual graphics layer over physical space as a venue for graffiti. A win-win idea for legitimisation of street art cravings (albeit via smartphones that are still at the high-end side of retail market prices).	

- *Need for Re-conceptualization* – After the visceral aspect of G-AR is documented however, for its deployment to the end of achieving social inclusion will be possible only when a framework for translating the LMI approach into a practical protocol of deployment is prepared. A similar concept corresponding to the particular long-term and high stakes ethos of the PSD domain can be institutionalized under the tentative label of Information. Published discourse on this subject has already identified potential pathways for addressing this need for conceptual rigor, along with examples of implementation in other domains:
    - Various authors have suggested possible strategies for exploration and standardization of alternative concepts for e-participation that are equally

applicable for the PSD context, such as: a master template on how to generate an action plan for establishing participatory decision-making in different contexts with varying requirements (Scherer & Wimmer, 2011); a framework for setting scope (Tambouris, Liotas, Kaliviotis, & Tarabanis, 2007); a model of 'participatory sensing' (Estrin, 2010); and, a sustainability-based model for designing participatory processes (Islam, 2008).

- An illustrative table of parallel concepts and their evolution in other disciplines is given below (Table-7).

Table 7: Illustrative examples of parallel concepts of intervention for social inclusion (Source: Authors).

Domain	Concept / Evolution / Description
Medicine	*from* Public Health *to* **Health Promotion** **1920 – 1986 :** Emergence of global epidemiological concerns, need felt for institutionalized pursuit of Public Health targets (Kickbusch, 2003; WHO, 2009) **Ottawa Charter 1986 :** overarching mandate for intervention in critical public health issues, such as tobacco-consumption, obesity, and inequality of health outcomes amongst disadvantaged communities (UN, 1948; WHO, 1986) **Post-Ottawa Charter :** relocation of public health issues into the para-legal umbrella of recognized basic human rights, based on concerns for taxpayers' burden and revised definitions of wellness and democracy (WHO, 2000) **'Health Promotion' :** Creation of a fresh sub-specialization, formal recognition of agency for professionals to plan, design and execute proactive interventions for pursuit of critical wellness targets (IUHPE, 2000)
Science	*from* Dissemination *to* '**event**' **2011** : Conscious awareness of the need for application of communications research to engage the public in the field of dissemination of scientific discoveries (Horst & Michael, 2011)
Locative Media	*from* Apolitical Art Installations *to* the **LMI** Approach **1996 – 2014** : Maturation in the mindset for using locative technology, from initial explorations to sophisticated deployment for achieving social inclusion [as discussed in this write-up]
Spatial Design	*from* Advocacy/Activism for Participation [Architecture/Planning] *to* ***Inform*ation** *[tentative]* **2000 – 2020 :** Proposed acknowledgement of a sub-specialization as formal recognition of the concept.

- *Implementation and Institutionalization* – Implementing this suggestion could institutionalize rigor in interface design for PSD processes. At the core of this idea is the formal recognition of professional agency, or the authority of professionals to design and execute interventions as part of a commissioned or even entrepreneurial capacity (Khan, 2009). Though in the case of Health Promotion, a formal status for professional agency has evolved spontaneously over the past few decades (Kreps 1998; Tetsuya 2004), its proven benefit nevertheless suggests the need to explore the possibility of a conscious installation in the PSD domain. This could enable optimum utilization of the potential of G-AR, or for that matter all future technological innovations.
- *Direct Approach to the Pursuit of Social Inclusion* – Once an appropriate conceptual framework for proactive intervention is in place then it will provide the basis for a higher level of rigor for the pursuit of social inclusion. It will open up research in this field to draw on cutting edge innovations in the discipline of communications and decision-making tools. Essentially the challenge of social inclusion means to scaffold the decision-making process of non-experts to arrive at informed forecasts for the socio-cultural outcomes of a given spatial decision. To date a number of research strategies have been explored to address this challenge, including: exploring the concept of 'socio-technical constituencies' (Molina, 1995); framing the problem as a need to 'balance the agency of all groups in socio-technical change' (Wessels, 2010);

attempting to reduce 'uncertainties' (Oksman et al., 2014); as a need to balance 'image' with 'content' (Neto, 2006); and, identifying the problem as an issue of 'design capability', which in spite of being a 'widespread human capacity…must be cultivated' (Manzini & Coad, 2015).

- *Drawing from other disciplines* – Compared to these existing approaches, a rigorous approach to address this challenge directly could perhaps focus on harnessing latest concepts and principles of behaviour economics and social marketing, and related forecasting tools, such as reference class forecasting (e.g. Flyvbjerg, 2007, 2008; Kahneman, 2011; Kahneman & Tversky, 2000). Published research could be explored to identify the ones that may be best suited for adaptation in the particular context of PSD processes in disadvantaged communities.
- *Technological fidelity should not be a surrogate for conceptual rigor* – A direct, rigorous and holistic or comprehensive approach would also enable the ironing out of present deficiencies of practice, such as reliance on technological fidelity as the sole solution to the issue of engagement (e.g. Gorard, Selwyn, & Madden, 2003). It could instead usher in the exploration of deeper underlying causes and alternatives. An explicit notion embedded in the LMI approach, if adopted, is not only to appropriate technological advancements for influencing spatial politics but by way of a number of outstanding examples it even offers practical models on how to execute such interventions, as already discussed in Table-1. If G-AR was to be deployed in a locative media installation then it would likely be harnessed using the LMI approach to influence social inclusion. Then what is stopping it from such an achievement in the PSD domain? What if it was deployed from the more proactive viewpoint of an LMI-inspired approach, rather than the present comparatively passive spatial design approach?

This paper has endeavoured to document a comprehensive review of augmented reality visualisations in participatory spatial design to highlight the deficiencies of practice. As such this is a response to the published concern that developments in visualisation technologies have been serving as a surrogate for commensurate developments in the conceptualisation of participatory spatial design itself. To undertake this critique a dedicated framework of analysis was formulated, namely the Locative Media Interventionism, or LMI approach. Recommendations given at the end are for advancing research on the theory of this subject, especially with relevance to applications in Architectural practice. A key proposition is that the public authorship connotations of augmented reality visualisations are prompting a sustained interrogation of the nature of these connotations on one hand and their implications for the whole spectrum of spatial design practices on the other. This paper contributes the groundwork for such research.

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