

Sensor Narratives

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Sensor Narratives

1. Introduction

As sensing and recording information about the urban environment is becoming ubiquitous practice, we witness an emerging era of representations and information models that form the basis of a new urbanism interrogating the everyday.

Real-time noise, air, water pollution, energy consumption and activity visualizations, produced either by individuals, institutions or governments increasingly contribute to the production of common knowledge that bring new kinds and levels of awareness about cities through their datasets.

For a generation of data-voyeurs like us, different cities emerge, implicitly or explicitly, from different datasets and form the basis of the new narratives of the city.

Like all narratives, on the other hand, these representations introduce their own social, political and technical agenda and not only provide alternative views to inform the experience of the lived environment, but also become tools that allow their producers to construct arguments that can directly shape the public opinion.

In fact today, it is possible to capture sulfur dioxide levels in different neighborhoods of Ankara in real-time with mobile sensors and overlay them on a map that shows the boot-leg coal distribution facilitated by the city officials and prepare the ground to make speculative arguments about a political party's intentions behind investing underdeveloped neighborhoods in a city to earn extra votes before the coming election.

In this paper, I articulate on the kinds of politics (of representation) that emerge from such practices. Tying it closely to the scopic regimes of our times, I investigate the culture and experience of data-voyeurism that is shaped by this emerging genre of 'sensor narratives.'

Being both a designer and user of such systems, I present arguments on the implications of sensing, recording and representation systems and discuss the way they establish new norms and values about cities. From cities that experience data-facilitated segregation due to their less-desirable zones rendered by sensors, to citizen-science, grassroots knowledge that help inhabitants fight against governmental politics, I address a variety of scenarios how data, information, its real-time and archival representation transform the way we construct our sensor narratives and shape our experiences of the cities of today and near future.

2. City and its Image

2.1 Scopic Regimes of the City

Like all imagery, the image of the city, is a negotiation between the technique of representation and the cultural meaning of that technique, which shapes the interpretation of the image within values and norms of a given time period.

The French film theorist Christian Metz uses the term “scopic regime” to address the process that constructs the image aesthetically, socially, and politically, namely in a broader cultural discourse in relation to its technical means of production, it being painting, photography, film, and now more recently computation (Jay 1988).

As the scopic regimes of a given era shape the way we respond to visual representation, the concepts of the city became inherently coupled to a “mode of seeing” and a “structure of visibility” that configures the city before us (Donald 1995).

“The Man with the Movie Camera” that documents the urban landscape of Odessa is both the eye of the director, Vertov, and his cinematographic technique, which is expressed through double exposures, jump cuts, freezes and split screens that renders the dawn of modernism at work and play at 1920s Soviet Union (Figure 1).



Figure 1: Still from “The Man with the Movie Camera” (Chelovek s kinoapparotom)
From: <http://hcl.harvard.edu/hfa/films/2000sepoct/nonfiction.html>

The images of “London in 2066” painted by Zaha Hadid for Vogue magazine, likewise, illustrates a graphical metamorphosis of the city, where this time the medium becomes Hadid’s brush, disintegrating the urban form into her pure style as of 1991 (Figure 2).



Figure 2: Zaha's Hadid vision of London 2066.
From: <http://teamhelsinki.blogspot.com/2007/05/london-2066.html>

2.2 Data-scopic City

Today, with computational image making, we witness a different cinematography shaped by the data-scopic regimes of representation. The internal dynamics of cities, their relationship with the environment, and the activities of their inhabitants are increasingly quantified, visualized and archived as datasets. While computational techniques that treat data may not

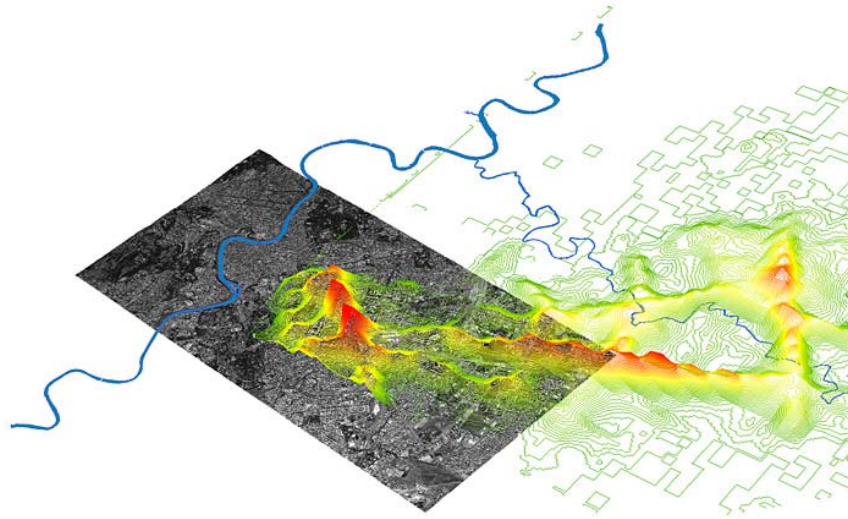


Figure 4: Real-time Rome, MIT SENSEable City Lab

From: <http://senseable.mit.edu/realtimerome/>

2.3 The Urban Document

As certain familiarity with representation technique prevails within visual culture, it tends to become easier to see beyond its analytics and experience further from what has been inscribed by a technocratic agenda.

The first image produced by a photochemical process, Niépce's "View from the Window at Le Gras", also happens to be the first "successful" photo-realistic depiction of a city (Wikipedia 2009). However, what the view from the window at Le Gras negotiates with the history of representation and discourse of visual culture today is already beyond what it technically 'viewed' and how that image was constructed in 1820s.

Long time has passed from the scientific-minded Niépce's technical experiments to today's digital camera culture which almost desensitized us from the technical agenda concerned with the production of the image. The photographic image of the city has gone through many levels of technical innovation, but more importantly, has been a subject of many years of cultural interrogation that now allow us to see the view from the city not only as a technical imprint, an interplay between the light and chemistry of its sensitive surface, but also as a

cultural product that is aesthetically, socially and culturally framed within its urban context.

However, when the image of the city is compiled from a set of data points that consist of Carbon monoxide levels associated with a given longitude and latitude within the city, the cinematographic play behind the image does not strike us so immediately as it would, if we were to look at a more 'traditional' image. The view of the sensed city is still regarded merely as a technical recording that 'documents' the city, while its interpretations are often stripped from the narrative agendas that shape it from its technical inception until its interpretation.

The different kinds of styles of thinking behind the selection of the sensing apparatus, its configuration, calibration, usage, the sampling of the data, the frequency of sampling, the techniques for storing the data, its formatting, processing, analysis and finally its presentation to the user are complex processes that are still evaluated primarily based on their technical merit and not for their cultural consequences.

Today, the sensory recording of the urban landscape is still left to be studied by the "visual analytics," (Therón 2008) and have not find its place as urban narratives that will make it to film departments' regular screening events.

However, what is visible, what is forgotten, what is accentuated, what is omitted, what is suspended, what is underrepresented, who is shown with whom in urban datasets will certainly find its way into urban-noirs, data-thrillers, new waves, comedies or 'mocumentaries,' as sensor narratives form new genres for understanding tomorrow's "sensory urbanism (Lucas 2008)."

2.4 Data Literacy

Nowadays, temperature, air, water and noise pollution, traffic, congestion, public transportation and many other environmental and urban phenomena are sensed, recorded, visualized and provided as services for inhabitants of cities. This increasingly data-driven urban culture not only brings a new kind of awareness and a culture of interaction with the

city but also calls for a different level sensitivity and responsibility towards how this sensory information is produced, processed and presented for us and by whom.

However this would not be a call to extend our graph reading skills to be able to penetrate into the complexity of urban systems and comprehend their dynamic nature but to develop a different kind of literacy towards the thinking behind the new technologies of representation as they narrate the everyday of cities as maps, information mesh-ups, simulations and real-time interactive visualizations (Figure 5).

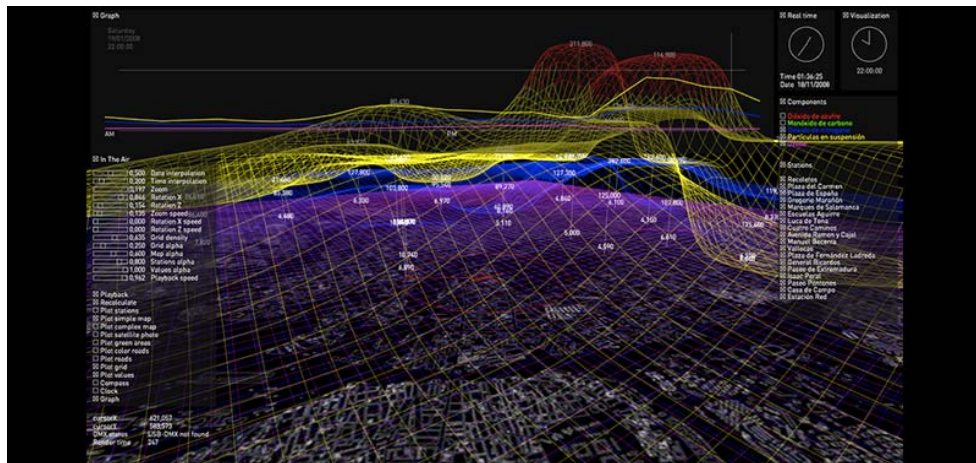


Figure 5: Screen capture from “In the Air,” a visualization project which aims to make visible the microscopic and invisible agents of Madrid’s air (gases, particles, pollen, diseases, etc), to see how they perform, react and interact with the rest of the city. From: <http://intheair.es/>

3. The Politics of Sensing the City

Before the eyes of the data-voyeur, the city not always unfold the same expected way.

3.1 The Sensor’s Narrative

Imagine waking up one morning to a cloudy, gray, thick sky. You open your windows to find the extremely bad quality air, which seems more polluted than yesterday. Remembering the website where your city provides air monitoring ‘service,’ your immediate response is to go online and check if there is anything unusual reported by the website that publishes real-time sensor readings from these city-wide air quality measurement stations. Nope, everything seems alright. While you are not very sure what the numbers exactly mean, the status labels

summarize all this technical information into a status message and assure that everything is 'normal.' While not being entirely convinced, you decide to forget about the issue. After all it is 8:00, rush hour. If you can effort to spend an extra hour at home, things may get better. You decide to watch the morning news instead. Strangely and luckily enough, you 'spot' the one channel that has some news about the air pollution.

Apparently, it looks like you are not the only one who is concerned about the unbreathable air. There is a live interview with the city officials in front of one of the larger public displays that report the real-time pollution values from one of the densest part of the downtown.

The officer simply claims that everything is normal as it goes with air pollution as he repeats the numbers you have already seen on the web site. There is nothing to worry about, nor the mentioning of any precautions about closing schools for the day to mitigate congestion by reducing student transportation traffic or more importantly to protect them from the current conditions.

The weather looks much darker and thicker on TV and the reporter also does not seem very convinced about the city official's explanations as the numbers on the display lose their importance before their presence of an 'official' person who is in charge of interpreting them.

The topic of the conversation now focuses on the sensors. To everyone's surprise, the official admits that the information on the displays is not communicating the real information. A pump on the particle reading unit is to be found broken that day, the technicians have already being called for maintenance, and the new pump is already being ordered by the company that is in charge of servicing the station. The official is calm: "Like all machines, these sensors also break every once in a while, and get replaced under the service agreement with the company."

Being partially relieved by discovery that you are not the only one who thinks that there is a problem with the air right now, you learn even more astonishing details as the conversation switches to the process of publishing the air pollution data from the web site.

It is reported that the measurement stations are designed to publish 'raw' sensor data as it gets collected in real-time, and as the published data gets 'verified' by laboratory technicians (by being compared to previous readings), it eventually gets registered as 'official' information and archived for future records.

The reporter asks what the officer thinks about the interpretations of today's data (published on the web site) by a group of 'third' party experts, such as engineers and academicians who expressed opinion based on the same readings. You implicitly sense that there is a disagreement in her tone of voice. To your surprise, the city official blames their own data. As the sensors immediately publish the data to the web site, there is not enough time for the 'official review,' would have checked its reliability by comparing to the data from the previous day. The mayhem caused by the third party expert is simply due to an analysis is based on this 'unverified data,' which is probably due to a 'calculation error' by these sensors.

Otherwise, everything is under control and the quality of the air is within the expected 'thresholds.'

This story is neither a sketch nor a made-up narrative. It based on news from a variety of media coverage around the 18th and 19th of December, 2008 when the air pollution in Ankara has reportedly reached fatal values and therefore created media attention (NTV-MSNBC 2008, Haberset 2008).

A careful reading of the story exposes many subtleties about the nature of urban sensing practices and perhaps shed more light on the process that transforms the sensory practice into the form of urban narratives.

What immediately may stuck you could be an inherent 'unreliability' in such systems. Given the complexity of the process, which I will elude further in the paper, the system can always produce errors or completely break down and produce no information at all, while you observe previous reading assuming that they are updated in real-time. As spectators, or

consumers of data, if one becomes tuned to 'working' system, and develops subscribes to a sense of trust, it often becomes quite difficult to evaluate if the quantified results support what one is experiencing in the very moment.

But in this case, what lies at the core of this can be even much deeper. There are a series of design decisions that allow the system to be used against itself. So, here, what is at stake is not a wish for better reliability, but a desire for manipulability. The real-time data produced and published by the stations and those that are officially registered by the institutions are not the same data. In the city official's words, the data that goes into the records is the one that is analyzed, processed, verified by the laboratory technicians. The 'official' air measurements of Ankara in December 18th 2008 are not what the sensory device reads, but what the officials write for us.

It is not hard to envision, a graphical movie based on a series of montages of such datasets, a contrast between the official view and the sensory view juxtaposed next to each other. On the one side, you see the numerical representation of what you should be seeing, given your experience of the air, and on the other side, the numbers that have been officially to you, showing how nicely they stay under the thresholds approved by the World Health Organization's safety legislations. You will still not breathe well, but at least the numbers will make you feel better.

It worth taking a deeper look at the inner workings of this air sensing system and observe the machinery of this narrative.

3.2 The Sensor and its Data

The reliability of air-quality measurements is technically conditioned by a number of factors: Sensors that work with chemical processes (e.g., measuring the amount of gas in air), so they have limited lives, six months to one year based on usage. Such sensors require regular maintenance and need periodic replacements. Secondly, sensing systems need regular calibrations for minimizing the deviations in their readings as the imprecision that happen during the different stages of the conversion process, from electrical conversion, to sampling

algorithm, accumulate over time and yield errors. The accuracy of the dataset further depends how often the data has been sampled and in what precision, thus, the techniques that are used for building collections of data, their formatting and archival techniques play important roles.

On the other hand, the reliability of the measurements and the perception of their results are also 'conceptually' conditioned by certain factors. The metrics the readings are compared against and how these standards are calculated under which assumptions and environmental factors determine if your current reading is 'normal' or 'fatal.'

Secondly, if the source of the information is a student-run media art project vs. an institutionalized one, regardless of any systematic evaluation, one can easily get biased towards the official way of doing it. While the technical diligence of sensor readings can be better maintained under a regularized institutional control, as the example we have seen, it never guarantees that what you see will match with what really is happening in the city.

While the process of translating the raw material of the city into representation is similar for the optics of Vertov's lens and a chemical sensor, such as SO₂ sensor used for measuring the sulfur dioxide levels outputted from burning of coal), the representation techniques differ in the way they create an image out of the recorded reality.

Vertov's camera imprints what it is in its visual field onto celluloid, where the sensory apparatus yields an abstract representation which starts as chemical process, turns into a voltage value, and ultimately a numerical representation that can then be mapped onto any visual form by computational means. As Vertov's image manipulates perception with a stylistic maneuver in the realm of photorealistic imagery, the sensory data utilizes different layers of abstraction, manipulation and interpretation and maps the sensed phenomena to an arbitrary representation that is otherwise unobservable to its human spectator.

3.3 Mesh-ups

The narrative of the sensory apparatus for sure doesn't begin or end in its technical means of

recording and representation. Data-scopic regimes provide also 'interaction' techniques for constructing new kinds of narratives. The culture of mesh-ups, for example, introduces a new cinematography of data by allowing users to combine seemingly unrelated datasets with others, exposing new meanings and richer interpretations. A quick mesh-up of religious places on Google maps, for example, will allow you to plot all the churches or cathedrals in Florence. As the map gets rendered in your favorite browser, you will not only see the religious hot spots for your desired spiritual or touristic intentions, but also realize what is not there, who is underrepresented in which areas, as a broader political agenda unfolds the minority before your eyes.

While Google may or may not argue behind the intentionality of such combinations, and for sure claim no responsibility for its interpretations, the same techniques can be used by user generated mesh-ups, where the same style of thinking can serve as a tool to make explicit political statements or building consensus.

One of the main speculations about Ankara's poor air quality during the winter of 2008 was to blame the burning of large amounts bootleg coal within the underdeveloped neighborhoods of the city (Tumgazeteler 2009). It is reported that the coal was 'officially' distributed by the city officials to support low-income inhabitants who cannot afford the high price of natural gas or fuel-oil during the heavy winter season. As the story goes, this 'support' was interpreted as an implicit bribery before the coming elections in March 2009 where as the officials defended themselves for their good intentions, as the distribution of high quality coal was due excessive production.

Another interesting narrative emerges, this time from a visualization of three different datasets; the coal distribution data, air quality measurements and 2009 election results overlaid on different neighborhoods of Ankara.

As said, Sulfur dioxide, a known pollutant of air, is released with the burning of coal. A visualization that would allow the data-voyeur to see the relation between the amounts of coal distribution (e.g., how many kilos of oil is given to which neighborhood in which period,

the averaged Sulfur dioxide readings and the distribution of votes over the geographical map of Ankara (comparing the election and the old election results) will definitely make a statement that will call beyond data analytics or other means of objective interpretations.

The story and its interpretation are constructed from a deliberate combination of three seemingly unrelated datasets that are collected by different techniques. Apart from all the issues concerns around the production of reliable data for individual sets, the way they are represented together in time and space gives hints of a thrilling data movie, that would not only stir the speculations, but also provide the basis of 'facts' that can be used for taking legal action. Being at the very thin borderline between fact, fiction and speculation; such narratives express a city that is perhaps far complex then what we used to know.

3.4 Grass-roots Sensing

One important caveat in making a visualization to make an argument against city officials, on the other hand lies in the usage of "official" data provided by the city's monitoring stations. As it became apparent in the discussion of the first narrative (see section 3.1), the 'institutionalized' data has the risk of being highly manipulated to meet a certain political agenda.

Moreover, taking measurements from fixed locations may not provide enough spatial resolution. Stations can be spaced too sparsely or one may realize that there are not any stations at the locations which are known to be low-income neighborhoods. The location selection criteria of air-quality monitoring stations may also serve to different agenda that prioritize political wills, which are more concerned with providing services to supporting voters rather than embracing more scientific criteria such as uniform distribution over the city based on geography and population density.

One quite popular solution, which is also utilized in Barcelona (Figure 5), is to use a grass-root approach to sensing, collecting and presenting data by a volunteer network which can place remote sensors around the city, maintain and monitor them to provide an alternative views to what is published as 'official' data. As this approach will also bring its own

challenges, such as logistics, technical reliability, etc. it would highlight the importance of democratizing the sources of information to be able to construct alternative arguments. If a new grass-roots narrative about the air pollution Ankara is desired to serve a counter-view against the official agenda, it can also be designed to 'prove its point' with 'scientific' evidence and factual information to 'expose' the presence of a government-oriented pollution given their political objectives.

However, regardless of whose information is right or wrong, accurate or proximate, for making a better or worse argument against each other, it is inherently important to not dismiss the subjectivity that is built into the system, which is inevitably manipulated with different representation techniques. In this respect, it is quite important to remind ourselves against a blind optimism towards the use of technology and a submission towards its misleading objectivity, which could inherently dismiss the subtle politics behind representation and making meaning, regardless of whose story's been told through sensor narratives.

4. Sensor Scenarios of the Future

As this emerging genre find its place within visual culture, the archival and real-time usage of sensor data fuels our imaginations with even more with future scenarios.

4.1 Real-time Segregation

As the data from real-time sensing become immediately available to one's favorite handheld or mobile device, the perception of the city also gets updated in real-time informing where one should be or not be at a given moment. If the particle counts in the air in a given location exceed 'safety' limits, people traveling with young kids or those with asthma can be warned in real-time and advised to change their paths or to avoid certain areas of the city. As travel choices within the city gets informed not only by traffic congestion, but also pollution, cell-phone activity, energy usage and many other factors, it would not be hard to imagine a real-time segregation of the urban landscape, and the implicit or explicit regulation of its accessibility. As the inhabitants of the city increasingly allow themselves to be informed

about their potential experiences of the city, they will need to remember the ways the information gets narrated with its underlying social and political agendas.

4.2 Data Narratives

The archival of past real-time will also find its niche market not only for institutions but also among young experimental movie makers. Imagine a narrative of Heiligendamm, the city hosted the G8 in Germany during summer of 2007. Overlaid on top of the footage of demonstrations, you see a distribution gases in the air. What were these people breathing? Did the police use pepper gas against the protestors? Is there a hint of use of gunpowder? This could be presented as a 'documentary' that not only captures the richer spirit of the protests, but also contribute to grass-roots data inspections that can expose signs of excessive use of power, if they are exercised by armed forces. As the culture of sensing cities prevail even more to our visual imagination, the representation of events and their relation to the city and their meaning will also change over time. As the everyday lives of cities of cities get captured, recorded and archived over time, looking them back through a data voyage would probably yield many more stories that will shape our understanding of the history of events and the cities that shape them.

4.3 Event Signatures

Either for witnessing the moments of protests or inspecting further details about criminal events, being informed by past data will not only allow us see what was not known at that time, but also allow us to imagine fictions that will speculate about what could have known if we were to look at data at the right time. Looking back at a combination of energy consumption, noise and cell phone activity in one neighborhood, perhaps one could have identified the 'unusual' activity around the museum, hinting perhaps the planning of the most important art robbery of 20th century which shocked not only Paris, but the entire art world the next morning. Could the event be avoided given the availability of data seeks for further discussion, but there will certainly be a study of conditions that can be cross-correlated to find similarities in data recorded before similar happenings. As such events get classified with their data signatures; it would be also much easier for authorities to justify preemptive actions (e.g., raiding suspect's homes) once similar data patterns get observed under similar

circumstances.

5. Conclusion

In this paper, I have addressed the emergent culture of sensor-driven urban practices and reflected on their social, cultural, artistic and political agendas to discuss what lies beyond their measurement duties. By looking at specifically on the impact of real-time sensing, being it for noise, air/water pollution, energy consumption and activity, produced either by individuals, institutions or governments, I intended to bring attention the process that turn sensor datasets into an emerging genre of sensor narratives that express a particular view of their creators.

Christian Metz's notion "scopic regimes" is used to explain the processes that allow us to understand the urban representations technique in a broader visual discourse where we can consider both the technique and the social, cultural and artistic interpretations of the technique in relation to each other. So that the design of the sensory apparatus, the production of the data, it's interpretation and visualization identify similar responsibilities for the making of a narrative that not only expose their creator's will but call for further interpretations of their meaning beyond the immediate (seemingly objective or factual) information that is claimed to document the everyday of cities.

In relation to the history of urban representation techniques, the paper intended to bring into attention the cinematography of data-driven image making practices that are not only shaped by today's computational representation technologies but also reflect the data-scopic regimes of our times, which turn us into data-voyeurs who continuously seek for more pleasure from quantified and visualized interpretations of the environment.

As the production of datasets establishes the urban visual Zeitgeist that brings new kinds and levels of awareness about cities, the paper calls for a data literacy to seek more about how this information is produced, processed and presented for us and by whom and how it can get manipulated for different purposes. As datasets often do not reveal what is

forgotten, what is accentuated, what is omitted from their agenda, the potential for further genres such as urban-noirs, data-thrillers, data-mangas, comedies or 'mocumentaries,' are expected to happen as sensor narratives gain more interrogative responsibilities within the popular visual discourse.

By providing examples from recent events that took place in Ankara, the paper also emphasizes the kind of politics that emerge from sensory practices used for manipulating public opinion and building consensus. Extended by three more possible scenarios for the immediate future, the political dimension is explored further in situations like real-time information based urban segregation, or the potential use of the technology for justifying preemptive actions based on relating data patterns recorded during similar happenings with each other.

As spectators of such narratives, it becomes important for us not only to acknowledge the potential uses or limits of the technical imperative, as its offers a wide range of affordances serving for implicit regulatory practices to improving the awareness towards the urban landscape, but also see them as new forms of cultural expression that can find much creative uses as we gain much experiences in using them to communicate alternative experiences of the lived environments.

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