TOWARDS A NEW (MAPPING OF THE) CITY: INTERACTIVE, DATA RICH MODES OF URBAN LEGIBILITY

Abstract. The modern metropolis is a vast environment replete with physical elements and complex overlays of information. The city historically has been represented as a discrete limited physical object; this allocentric view has become less and less useful as a method of meaningfully orientation and navigation. Today, the city has more than just a physical aspect; it has technologies and flows of information that constantly change our perceptions. While it has always been true that symbolic and religious dimensions have had a place in our understanding of the city, the complex and transitory nature of the contemporary city requires a representation that is interactive rather than static.

The Urban Visualization Group's previous work has shown how to incorporate data and geospatial information in a common interface (Chang, 2007), and has studied the development of urban design theories related to urban visualization chronologically from Aldo Rossi to Kevin Lynch to Bill Hillier (Wessel, 2008). This paper presents specific proposals for new interactive modes of urban legibility based upon four aspects of contemporary urban theories that deal with the problems and opportunities of widespread data and communication: ***data space***, based on the work of Bill Mitchell and Robert Venturi; ***virtual and physical city***, established from the work of Christine Boyer and Bill Mitchell; ***multi-nodal***, derived from the work of Tarik Fathy and Thomas Sieverts; and ***information flows***, founded on the work of Melvin Webber. Each approach is introduced with a conceptual overview, nascent examples and a schematic proposal for a computer based urban visualization.

Based on this study, we conclude that two necessary aspects of any urban visualization are interactivity and the combination of data and geospatial information. Interactivity is necessary because of the fluid nature of our experience and the diversity of individual intentions in the contemporary city. The combination of data and geospatial information is necessary because the geometry of the city had become less important as a reliable indicator of meaning.

Future initiatives grow from our ongoing work in urban visualization. First, we will extend our work investigating cognition patterns of the image of the city. Our next collaboration will be with cognitive scientists, focusing on cognition not as a verification measure, but as a search for design principles useful in furthering the design of interactive modes. Secondly, we will be continuing to work with computer scientist in the visualization field to understand how these interactive modes can be understood and implemented not as unique semantic structures uncovered individually, but rather connecting to the deeper structure of the data and the geo-spatial fields.

Keywords. Visualization, information, urbanism, mapping.

1.0 Introduction

This paper is based on urban design theory and its possible applicability to alternative conceptions of urban visualization. Urban theories can contribute to urban visualizations by uncovering implicit elements and relationships. The theories addressed in this discourse are explored for a reading of the city as a geometric form influenced by modern technology and information.

2.0 Data Space Approach

How can the plethora of information about the city be combined with our position in space?

In the contemporary city, we can extend this approach to a use of symbols and text as a communicative language applied to two-dimensional surfaces in the urban environment. This combination of information and spatial location we call data space.

Bill Mitchell's book *Placing Words: Symbols, Space and the City* (2005) specifically identifies urban space and place as a setting for communication, focusing on the manner in which flows of information are conducted in the city. Robert Venturi has similar ideas to Mitchell's on information in the city expressed in his book *Iconography and Electronics upon a Generic Architecture* (1996). This collection of articles explores ways iconography of surfaces (i.e. the pictorial information relating a subject) communicates messages and influences human perceptions of the city.

Mitchell first offers a unique understanding of the city based on the communicative power of text and information. He explains that words written on an object are able to provide insight to the spatial characteristics of form, place, and meaning. The use of symbols, text, and discourse is capable of carrying associations and evoking memories contributing to our reading of the city. For instance, a symbolic element may serve as a link to memories of past events and distant places, to narratives one has heard, and to facts one has learned (Mitchell, 2005).

As a continuum of Venturi's Las Vegas investigation, he explored architecture and iconographic representations. Rather than focusing on the roadside architecture of the commercial strip, he began to investigate electronic imagery, which he states, "celebrates the beginning of an age of virtually universal literacy embracing meaning over expression" (Venturi, 1996). The introduction in *Iconography and Electronics upon a Generic Architecture* provides his most direct analogies of the electronic revolution and the city. His dialogue, "Our iconography will not be etched in stone," is relevant to how perceptions of electronic communication adjust to temporal changes (Venturi, 1996). Although Venturi does not provide an explicit way to investigate human perceptions of electronic information, he does note the impacts of frenetic change on urban perceptions of space.

The data space approach offers a reading of the city through text, providing a method to display information in two or three-dimensional space. Graphics by Jennifer Beorkrem at Ork Posters (Fig 1) uses a map of a city, arranging each name within a two dimensional frame to produce a concurrent understanding of geography and text. Within computer visualization, this technique is similar to texture mapping, in which a two dimensional projection is applied to the surface of a shape or polygon.

Figure 1. Ork Posters develop a series of neighborhood posters that apply text within spatial boundaries.

This proposal to implement the data space approach envisions an urban visualization that allows a user to gain a spatial understanding through the mapping of text. Figure 2 shows a two-dimensional environment that allows the user to seamlessly adjust to various levels of the environment and includes city areas, streets and place of interest as text elements. We will propose that the text mapping be automated. Figure 3 shows a proposal for a three-dimensional environment that merges users need for certain data (i.e. desire for restaurants in certain price range with an interactive 3D model using text mapping).

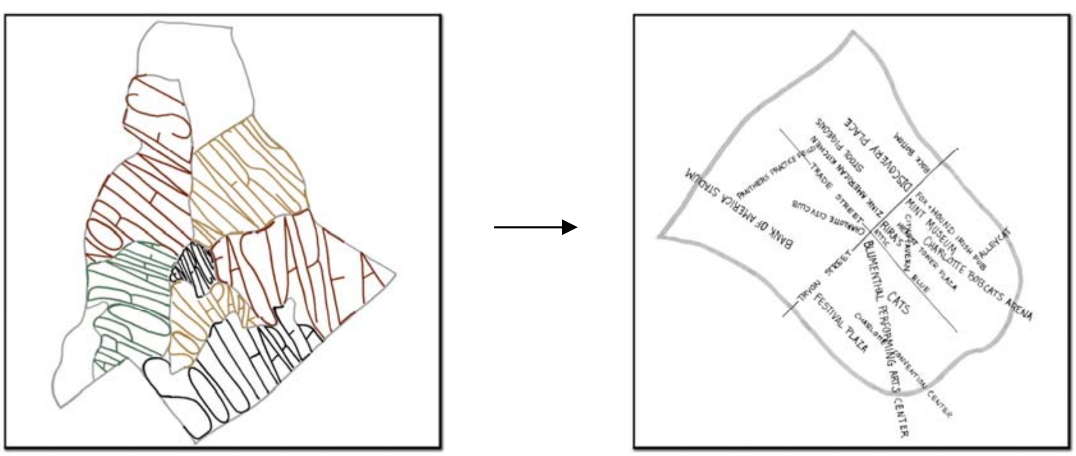

Figure 2. Implementation of the data space approach into a two-dimensional urban visualization using multiple levels of resolution.

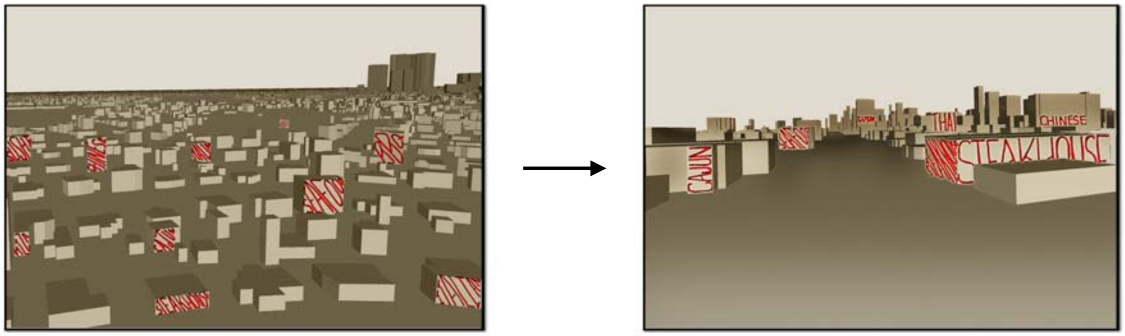

Figure 3. Implementation of the data space approach into a three-dimensional urban visualization.

3.0 Virtual and Physical City

What is the mediated presence of virtual and physical cities?

Virtual cyberspace and physical urban space are often expressed by a similarity between their physical and non-physical characteristics. For instance, a virtual network can be referred to as a city when it generates a sense of community involving human communication. Commonly, authors formulate analogies about the two realms to relate human lives that encompass both virtual and physical ideals.

Christine Boyer offers insight into the physical city and virtual on-line world in her work titled *Cybercities* (1996). Boyer focuses not only on metaphors that link physical and virtual worlds, but on the way we organize objects or information in each setting. Her metaphorical analysis of cities can be directly linked to Bill Mitchell's *City of Bits* (1995) which concentrates on telecommunication activities integrated with architecture and urbanism. Both authors use metaphors to link the city and digital communications to offer a view of the city that differs from the traditional.

Boyer conceptualizes the city in two realms: the material space of the city and the virtual space of the computer matrix (Boyer, 2000). She believes the common element between the two realms involves how users of each environment organize space and build cognitive maps in their minds. Although she specifies major differences between the two realms, she says cyberspace has no way of addressing spatial boundaries, and there is no way for the user to cross over the threshold separating virtual form actual reality.

Bill Mitchell examines the clear parallels about the functionalities of cyberspace and the physical city. From his chapter “Soft Cities,” Mitchell describes physical components of the city as enclosure, private space, and street networks, which have barriers and thresholds that play roles in both physical and virtual worlds. Similar to walls, floors, roofs, ceilings, and doors that offer privacy, one's email in-box offers privacy through access controls such as asking for identification and a password. Just as Internet users instantaneously jump from virtual place to virtual place by following hyperlinks, a path can be traced from station to station through the London Underground (Mitchell, 1995). Mitchell's metaphors allow one to recognize functional similarities between the computer space and material space.

We can see emerging evidence of this approach in Photosynth (Fig 4). This image processing application can organize a large collection of photos of a place or an object, analyze them for similarities, and display then in a reconstructed three-dimensional space.

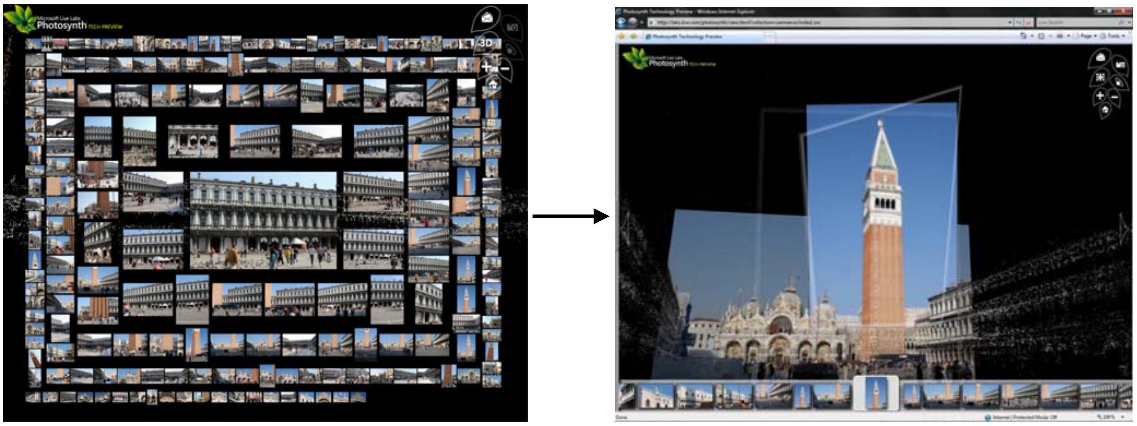

Figure 4. Photosynth developed by Microsoft Live Labs reconstructs two-dimensional images in three-dimensional space.

To implement the virtual and physical city approach I developed a visualization based upon similar ideas of the Photosynth application. This visualization provides users a way to navigate the city by projecting certain areas of interest upon selection through a touch screen (Fig 5). Users are able to zoom or walk through the environment and see a collage of photos from any angle. The seamless navigation of the urban context also allows the user to maintain their spatial surroundings. The integration of physical space (photographs) and virtual navigation directly reflect the physical and virtual city approach discussed.

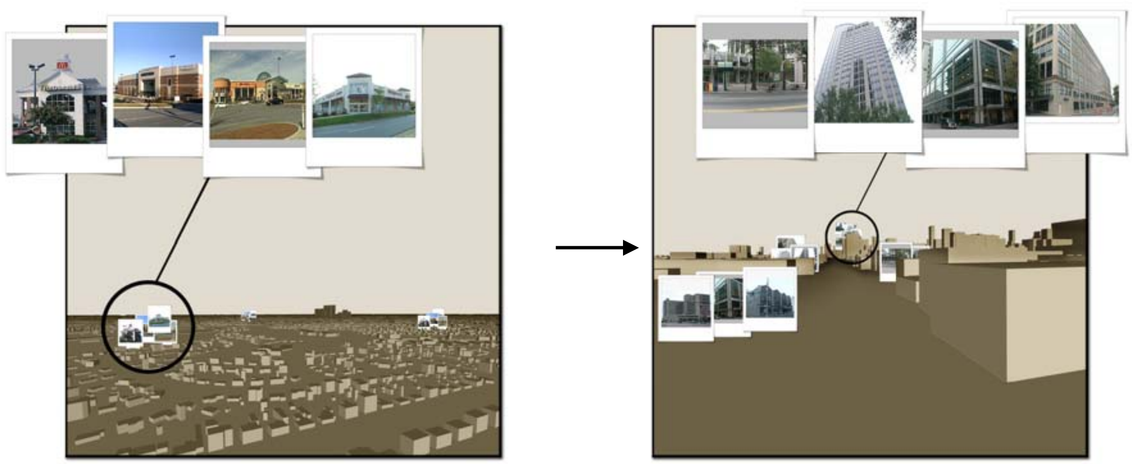

Figure 5. A diagram of the physical and virtual city approach.

4.0 Multi-Nodal Approach

How do diffuse patterns of human activities influence the physical form of the city?

Many urban theorists construct a reading of the city based on diffuse patterns of human activity. People once purchased food at the grocery store, but can now purchase food through a touch screen on their refrigerator, having the food delivered minutes later. A road map is no longer needed to navigate through a city, when a GPS device can read directions to us. Urban theorists have been studying the effects of these transitional activities in order to see their impacts on spatial form.

Tarik Fathy's ideas published in the work *Telecity* (1991) focus upon the existing physical form of the city and concentrations of virtual communication and information in the city. Similar ideas of concentrated urban activities are noticeable in the work *Cities Without Cities: An Interpretation of the Zwischenstadt* (2003) by Thomas Sieverts, which notes urban form no longer has one center, but numerous functional diverse nodes.

Fathy introduces a theory of the city based on teleactivities which came from an interest in the spatial arrangement of activities and their structural patterns. He says teleactivities are socioeconomic activities based on interactive, individualized, and asynchronous telecommunication systems to connect people, tasks, and information regardless of distance (Fathy, 1991). Fathy categorizes these activities in three forms: online activities, teleworking and telecommuting activities, and psychological neighborhood activities (cognitive schema in one's mind to link one's own activities interactively in non-locational relationships). The aggregation of these forms of activities make up the image of the city.

Fathy's concept of the Telecity is based on communication among information active places referred to as nodes. These places integrate personal, work, leisure, and recreational activities and are central locations where teleactivities occur. He develops a schema for the city described as a multi-nodal and non-hierarchical system based on overlays of communication and transportation networks that accommodate the physical mobility and interaction needed in people's lives.

Technology's introduction of telecommunication networks impacting city form is the working distinction between concepts proposed by Fathy and Sieverts. Sieverts does not focus on the changes technology has upon locations of the urban environment as much as the settlement patterns of "centers" which he says are located by social, economic, and environmental changes. Instead of the city as the old system of a well balanced hierarchical order, it is now becoming a network of development clusters linked by transportation routes and encompasses different kinds of centers, such as places of employment, leisure, and living markets.

Evidence of the mutli-nodal approach is seen in the Google Mapping application (Fig 6). Here, the display uses a series of pins to locate places such as restaurants, entertainment venues, or hotels. These information active places are denoted by using color coded pins which begin to densely cluster indicating locations that people can associate an activity. Although, this method is it does not use signifiers that are immediately recognizable to the user.

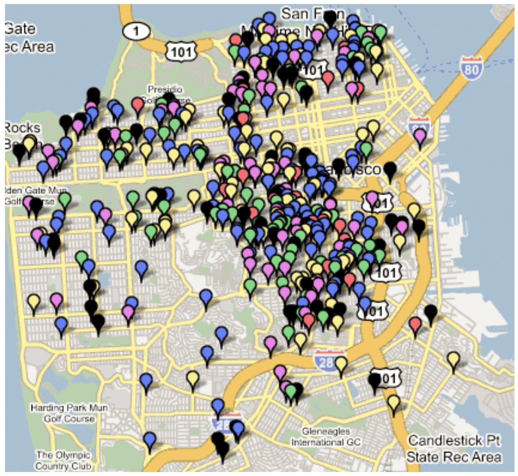

Figure 6. Google Maps showing places of interest using "pins."

The proposal for integrating the multi-nodal approach allows a user to easily recognize central locations they commonly use along a route by projecting symbols and signs (Fig 7). Elements not located at "nodes" are black in color to lessen the users cognitive work load. This method provides the user with a familiar sense of placement to assist them in the navigating the environment.

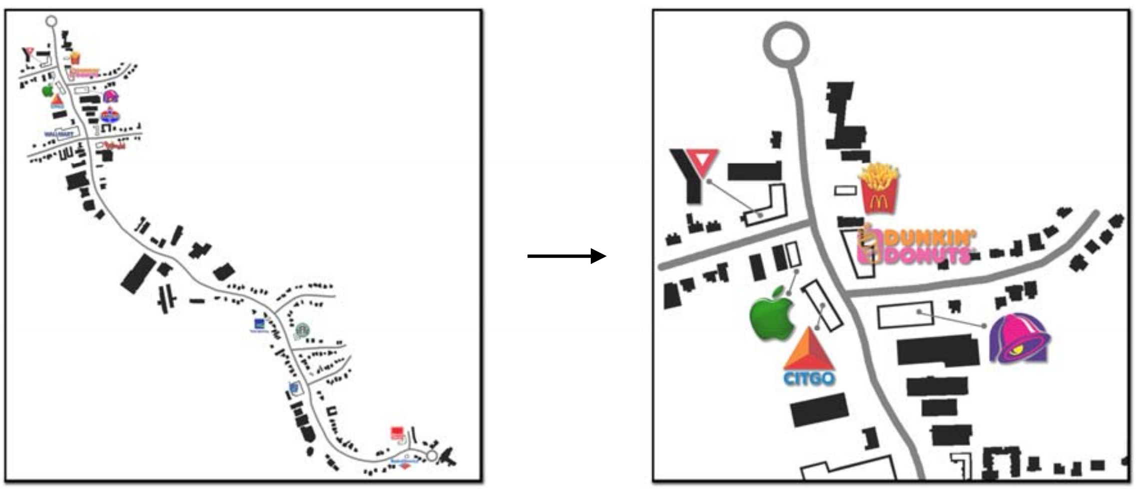

Figure 7. The visualization incorporating the multi-nodal approach displays symbols and icons along a route that people commonly use at nodes or decision points. Integrating these salient features assists the user as they navigate the environment.

6.0 Information Flows

How do we visualize information flows in the city?

With advances in technology also came an ease in human interaction and an increase in accessibility, which permitted the spatial arrangement of the city to depend on communication and transportation networks. As the city began to expand and grow, flows of information (the flow of goods, money, and people) increased and expanded outward away from the city creating overlaping networks and flows of information.

Melvin Webber was one of the first theorists who published work on the changing structure of the city titled *Explorations into Urban Structure* (1964). The section "Urban Place and Non-Urban Realm" describes the outlook for the future city integrated with telecommunications and the automobile. He says one of the most important links in the physical location of the environment is the influence that communications and spatial arrangements have on the city (Webber, 1964).

Webber saw the city in terms of three components: spatial flows of information, money, people, and goods; locations of the physical channels and the spaces that house activities; and locations of activity places. The first component shows the most relevance to our discussion of technology and city form. It is based on human interactions by which communication occurs through physical movement referred to as physical channels. He felt that by recording spatial flows through origins, destinations, and routes, we could better understand how linkages are maintained through space. He proposes this documentation could provide clues to alternative urban spatial arrangements. It could also provide indicators of levels of cultural productivity, which may lead to a device to measure urban spatial structure. Webber suggests a useful spatial measurement is comparing the effectiveness of the communication systems in permitting messages to be substituted for people's movements (Webber, 1964). While Webber does not discuss the resulting urban form as a clear structure, he does pose ideas of tracing communication channels.

Evidence of the information flows approach can be seen when multiple people interact with GPS technology (Fig 8). The TomTom Buddy, connects two users and guides each of them through the city to a meeting point, not at a fixed point, but rather at the real time intersection of their flow through the city. This meeting point is recalculated as the conditions of each individual driver (fast driver or cautious) and ambient conditions (traffic, isolated thunderstorms) affect the relative position of the users.

Figure 8. TomTom navigation system directs people to same desired locations.

In order to implement the information flows approach I propose a visualization that incorporates spatially located information (for example about restaurants) as well as way finding information (Fig 9). A user can visualize the wait times of restaurants in the surrounding area as well as driving route and time. The critical aspects of this proposal are the incorporation of user intentions with dynamic, ambient information.

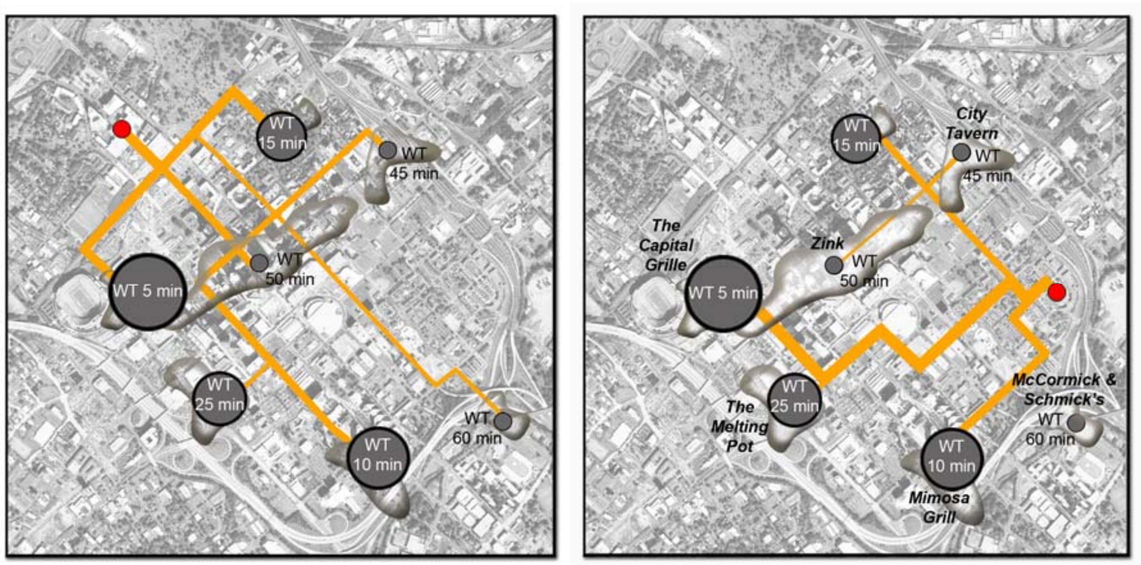

Figure 9. Visualization incorporating the information flows approach by allowing the user to see restaurant information on waiting times in order to choose best location. It also projects the areas that are most populated with pedestrian and traffic.

7.0 Conclusions and Future Work

None of the studies of contemporary urban theory leads directly to a new mode of urban visualization, but they do suggest two critical factors.

The Information Flow and Physical/Virtual approaches both suggest that our relation to the city will no longer be defined by one stable representation that abstracts only one facet of the city. Interactivity is necessary because of the fluid nature of our experience and the diversity of individual intentions in the contemporary city.

The Data Space and Multi Nodal approaches both suggest that our reading of the city has changed significantly as the city has become more diffuse and less easily recognizable as a single form. The combination of data and geospatial information is necessary because the geometry of the city has become less important as a reliable indicator of meaning.

We are collaborating with the Cognitive Science Program at UNC Charlotte to analyze urban structures using semantic networks. We are in the process of designing experiments to uncover cognition processes with human subjects. One focus will be studies of navigation and cognition using GPS.

Another initiative aims to produce visualization algorithms based upon urban theories that extend the work begun by Chang. Based on the work in this paper, we are collaborating with the Charlotte Visualization Center to combine geometric form, interactivity and flows of information in a single model.

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