RESEARCH

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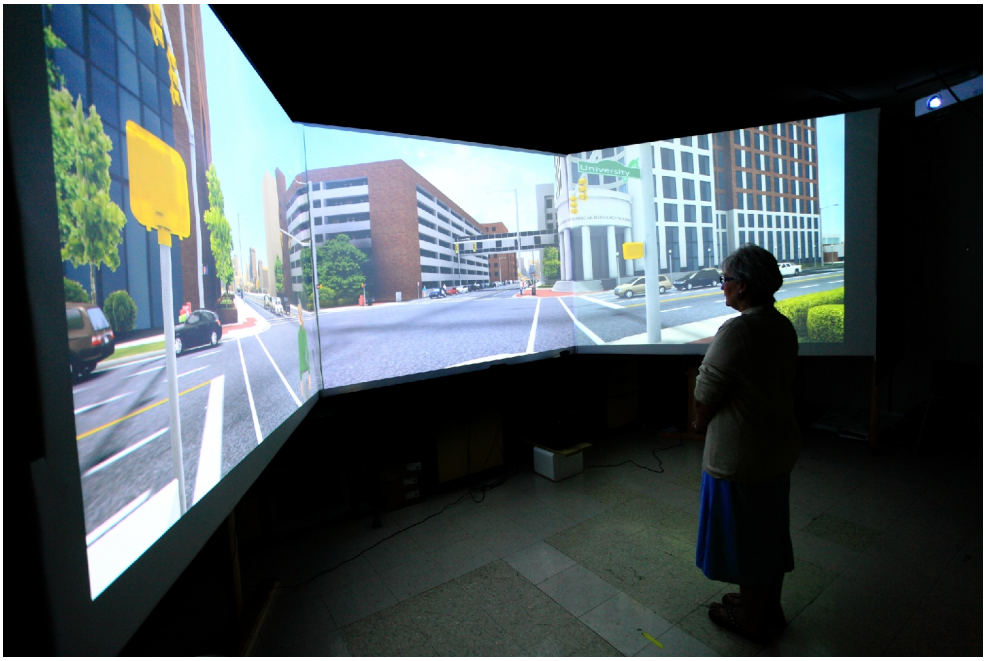
The following text is an overview of some of my research; emphasizing on examples taken from my projects that I produced. I have chosen to introduce these topics – with examples I would present to students.

INTERACTIVE DESIGN

As an interactive designer, I specialize in the dynamic visualization of urban environments, the 3D mapping of cities and the creation of a simulator where various components of the street life are interactive and dynamic.



Top image: CROSSWALK 2011 – 2012
Jean-Marc Gauthier designed and produced “Crosswalk”, a virtual 3D environment that recreates the spatial experience of a pedestrian crossing a street intersection. The client is Lei Liu, Phd, UAB- Vision Science Research Center, University of Alabama in Birmingham (USA). Viewers stand in front of a 180-degree screen with projections of interactive 3D animations of pedestrians, street traffic and environments filled with dynamic sound. The locations of the street intersections, car traffic, sounds from car engines and pedestrians can change in real time. Data about urban design, architecture, traffic patterns, and weather can be uploaded and scenes can be saved. The parameters for car traffic, timing of traffic signals and number of pedestrians can be changed during the simulation. The synchronicity between animated visuals and associated sound is less than 15ms. Sounds of traffic and of moving cars are rendered by a 3D sound engine designed for this project.

Crosswalk https://vimeo.com/user6568702/videos
Project description

I published a textbook called Building Interactive Worlds in 3D, Focal Press publisher (author) which is an introduction to visualization techniques for the web, games and for immersive displays.

INTERDISCIPLINARY COLLABORATIONS

An interdisciplinary approach is a key element of my research. The collaborative work starts by learning from the interests and expertise of other people from various backgrounds and understanding their priorities in any given project.

My visualization research is highly collaborative. The list of collaborations includes:

- *Crosswalk*, a training urban environment for the visually impaired with Dr. Lei Liu, UAB- Vision Science Research Center, University of Alabama in Birmingham , USA

  Project description
  Video link for Crosswalk https://vimeo.com/user6568702/videos

- 3D modeling of cities and participatory 3D sensing of the city streets in a collaboration with a leading expert in the automotive industry
  Geospatial World Forum 2014, Geneva, Switzerland.2013 (conference paper)
  Asia Geospatial Forum 2013, Kuala Lumpur, Malaysia (paper in preparation)

- *Virtual Archeology in Aphrodisias*, virtual reconstitution of the agora, a joint project with Christopher Ratte, Institute of Fine Arts, Classics Department, NYU, NYC, USA

  Project description

- *Genetic diversity of the World's 10,000 Bird species, a* 3-D interactive tool, with Mark Stoeckle, researcher of birds' DNA at Rockefeller University, NY, USA

  Project description

- The *Brain Project*, an interactive navigation inside the brain with Patrick Kelly, Chairman of the Department of Neurosurgery, NYU Medical Center, NYC, USA
  New Software Allows Scientists to Navigate in 3-D, NYU Research, Vol. 3, #1, USA.

  Project description

- The *Dynamic Virtual Patient Simulator*, in collaboration with Martin Nachbar, AES School of Medicine, NYU, NYC, USA.
  Nachbar, M., et al. *ENTERTAINING LESSONS: APPLYING GAMING TECHNOLOGY TO THE VIRTUAL PATIENT* , paper accepted for *Slice of Life 2005*, Portland, OR. (Conference paper)
  Virtual Patient Technology to Help Students Recreate Rare Disorders and Perform Complex Procedures , NYU Research, USA.

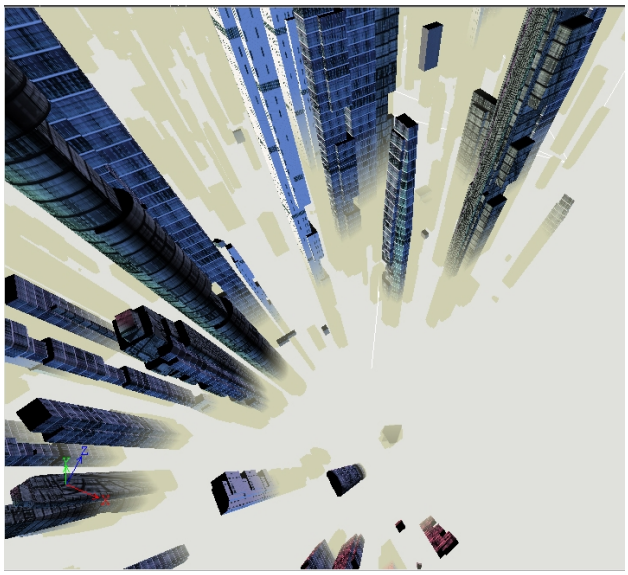
  Project description
  Video link for the projects mentioned above, *Dynamic Virtual Patient and Genetic diversity*
  https://vimeo.com/78137146

- Numerous collaborations with designers, architects, animators, game designers and artists. Some of the projects are:
  Nighthawks, an urban 3D game installation, exhibition at Festival 1ier Contact, Issy, France.
  Nighthawks, Filip Lipinski, Phd dissertation, Department of Art History, Adam Mickiewicz University, Poznan, Poland. Nicebots and Dust.

  Project description for Nighthawks

  Project description for Nicebots (Connected objects)
  Video link for *Nicebots* project https://vimeo.com/62355210

  Project description for Dust
  Video link for *Dust* project https://vimeo.com/62392719



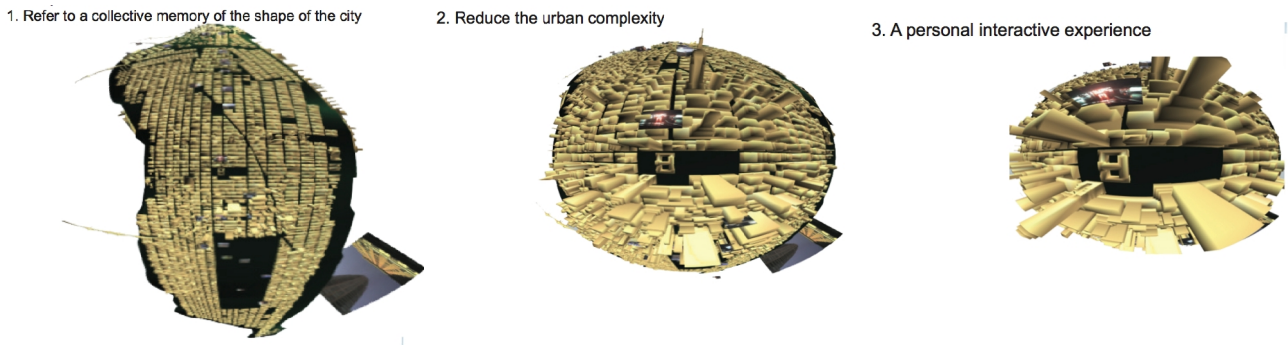
Above image: *Virtual Manhattan*, an interactive installation presented at IMC Exposition, IMC Studio, NYC, USA and DaeGu Culture and Art Center, Korea.

DESIGN OF A USER INTERFACE OR OF A HUMAN MACHINE INTERFACE
User interface design is a critical element of interactive design. In the case of an interactive map, the challenge is to fit together the requirements of people, technology and content. A digital mapping project will be successful if people can use the user interface based on their content needs. The main qualities of a user interface are efficiency, precision, certainty and clarity.

The following example shows a project of interactive 3D map of Manhattan designed for smart phones. The design constraints are using a small screen and tapping with only one finger in order to find a location in Manhattan. The innovation of the design is a 3D spherical interface that allows navigation without the need to scroll the map.

Above image: *3D Map of Manhattan for Smart Phones*, 2006, Jean-Marc Gauthier. 3D spherical display enables users navigation inside a 3D map of Manhattan (NY, USA).

The response to a request by a user such as "Show me Bryant Park" is displayed by the phone in 3 steps:
1- Reference to a collective memory of the shape of the city
2- Reduced complexity of the navigation in the city by using a constant point of view
3- Offering an interactive experience of Bryant Park



Video for 3D map of Manhattan for smart phones https://vimeo.com/78144659

ADVANCED DESIGN METHODOLOGIES
The following examples show advanced design methodologies used for the creation of dynamic virtual worlds.

Behavioral engine:
I designed *Crosswalk, a t*raffic simulator project, for Lei Liu and his team from University of Alabama in Birmingham for a research on people with low vision inside an urban environment. The research is funded by a grant from the National Eye Institute. This innovative project helps them to evaluate why someone with a low vision will decide to cross the street when immersed in a virtual world.

In this example, the motion of each car is controlled by a behavioral engine. The audio and visuals of the car traffic needs to provide a relatively satisfactory approximation of reality for the user. The design methodology is to create a stack of behaviors made by the addition or layering of simple behaviors.

At the street level, cars are moving according to a complex set of behaviors that can be divided into several layers including individual behaviors, driving laws, traffic regulations and response to ambient conditions.

In this case, the stack of behaviors includes:
- Individual behaviors: The simulation of car traffic is based on building blocks of simple behaviors: acceleration, slowing down, following a lane, collision detection, changing lane, waiting, parking.

- Car traffic in the downtown area: Driving behaviors evolve with the constraints of driving in a city. These additional behaviors are added on top the previous simulation of car traffic.

The research showed that the layering of behaviors or stack of behaviors for each car rendered a simulation of the car traffic in the downtown area at that was satisfactory for the training of low vision patients inside the simulator.

Virtual cameras:
The sample chapter about virtual cameras attached with this application is from my book, *Building Interactive Worlds in 3D: Virtual Sets and Pre-visualization for Games, Film & the Web.* It is the development of the conference paper *Gauthier Jean-Marc, CONCEPTUAL DESIGN OF VIRTUAL CAMERAS: How to design self-determined virtual cameras, paper accepted for Design Computing and Cognition' 04, MIT, Cambridge, MA.*
It shows how virtual cameras can follow the scale of urban design and move from "10 000 feet" above the whole downtown area to eye level at a street crossing. The camera path transitions from a wide angle shot of the whole city to a close-up shot of a street intersection. The path of this real time camera can be changed on the fly by the user to show any street intersection of their choosing.

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There are obvious limitations of current design methodologies facing the problems of growth of Asian cities. The above examples "mimic" methods of description of the urban space and replicate the evolutions observed in the real world of leading cities in the USA and Europe. As we witness the major transformations of Asian cities in the next decades, new urban leaders and new problems will emerge. The growth will

require the testing and validation of solutions that may be different from the ones implemented in the USA and Europe.

The challenges of urban growth are multiple and complex.
Disruptive innovations bring solutions to urban problems that have a global impact on cities all over the planet. This can be the case in the domains of energy, water and transportation. For example, new modes of hybrid transportation between bus and subway are becoming increasingly successful in Los Angeles, Bogota, Brazil and developing countries. The infrastructure of the new hybrid transportation systems are not anymore part of the infrastructure of the urban fabric. To the contrary, the transportation network can adapt and change following the evolution of the centers of the city.

There is an urgent need to go back to the basics to shift the mindset that will enable new methodologies – since what exists is no longer sufficient to work with the new patterns of growth that we now witness. For example in Bangkok or Jakarta. This calls for new approaches to design that may even be inspired by elements deriving from product design, game design, social networks, interactive media and participatory media. For example, fast prototyping and “scrum”. The research and teaching of these methodologies are crucial for innovation because they allow fast cycles of product implementation, product research, testing and innovation.

Description of an iterative process regarding the design of virtual worlds
The following diagram shows a typical cycle of innovations taking place in the design of a networked virtual urban environment. The three poles; collaboration, immersive experience and interaction, are dynamically connected with a clockwise rotation. If we begin with 'collaboration' with a group of users, we aggregate ideas and content in order to create a new kind of immersive experience. The renewed viewer’s experience calls for new types of interactions and new ways to tell stories. The possibilities offered by new interactions triggers the interest from a different group of users looking for collaboration.

3D MODELING OF CITIES AND PARTICIPATORY SENSING
My current research is the creation of a simulator and a visualization system of cities using participatory sensing.
The topic of the research was presented under the title *3D Interactive Stories for the City,* Asia Geospatial Forum 2013, Kuala Lumpur, Malaysia (conference paper). The research on *3D modeling and participatory sensing* will be presented during my key address to the 3D modeling forum at Geospatial World Forum 2014, Geneva, Switzerland.

ARCHITECTURAL DESIGN AND URBAN SPACES
Jean-Marc Gauthier (JMG) is the architect of several award winning hospital projects for the aging population in France. These projects were commissioned by large hospital corporations and by local governments. JMG created digital tools in order to promote a participatory decision making process that involved hospital corporations, governmental agencies, medical staff, patients and the city representatives. The goal was to bring realistic and innovative solutions that could help the elderly at home, in the street and in their neighborhood.

Publication: Gauthier, Jean-Marc, Designing a Room as a Social Unit, in Hospitable Design for Healthcare and Senior Communities, Van Nostrand Reinhold: New York. p. 230-233

Left view: Hopital Joffre, Draveil, France - Jean-Marc Gauthier Architect
Right view: Hopital Local, Chagny, France - Jean-Marc Gauthier Architect