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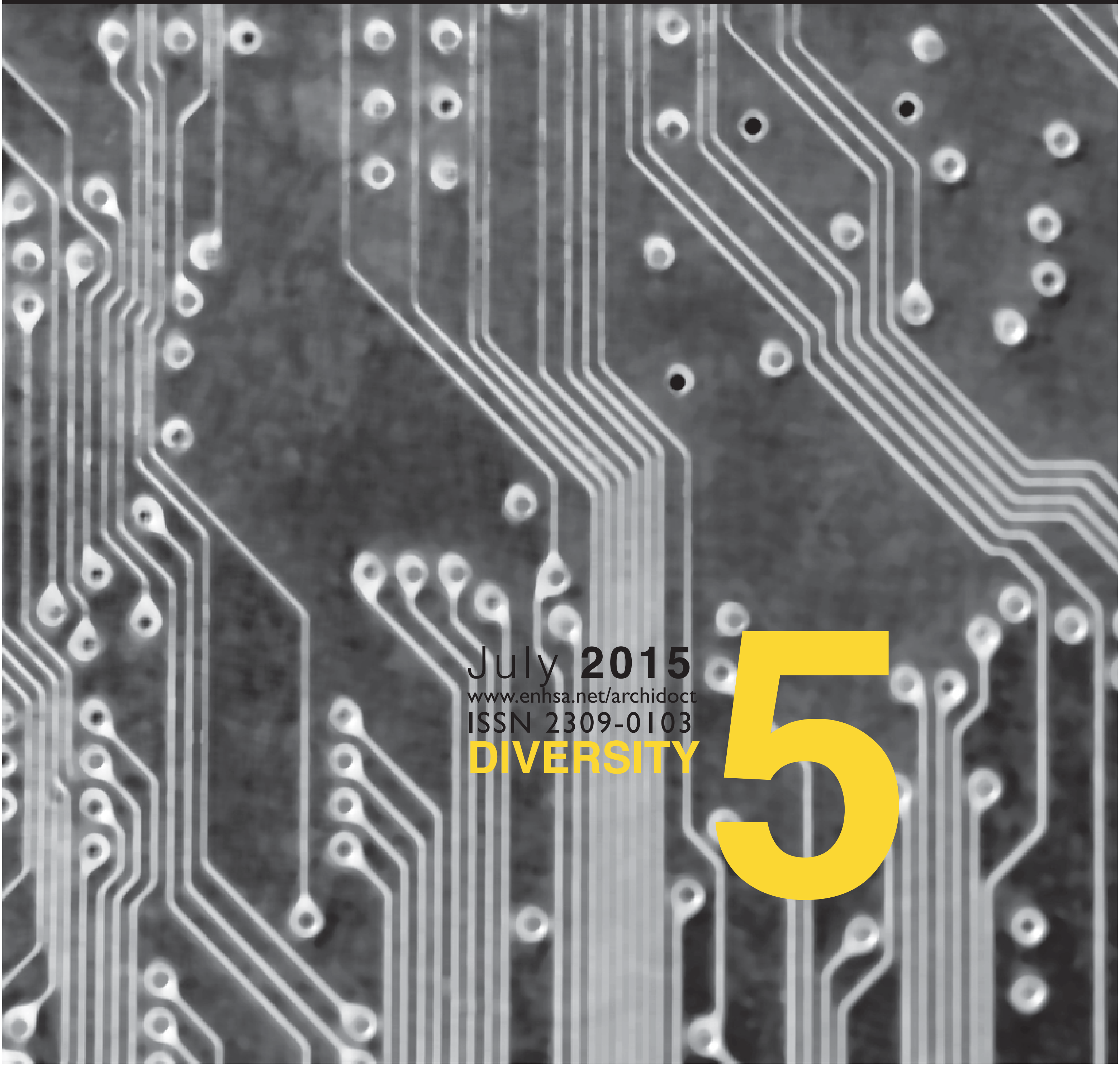

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Event Platforms: Proposing a new computational design tool for integrating spatial events into the architectural design process

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Abstract

Architectural design can be viewed as the manipulation of physical material space in relation to human events that take place inside it. Although architects have a multitude of computational design tools at their disposal, the vast majority of these applications focuses on the manipulation of physical form. This paper proposes a new experimental design tool that enables the creation of parametric components that represent potential spatial events within three-dimensional digital models. The goal is to improve the decision-making process of architectural designers by enabling them to evaluate and iterate their design revisions based not only on the building's form but also on the human spatial events that take place inside it.

Keywords

Parametric design; spatial events; design tool development; design creativity; digital modeling.

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Vol. 3 (1) / July 2015

Introduction

Supported by widespread technological progress, digital design tools have been gradually becoming commonplace among architectural studios and design practitioners. Motivated by its own body of theoretical sources and promulgated by a culture of discourse, the contemporary digital design culture is mainly focused on the algorithmic control of physical form, namely the geometric surfaces and the building components that constitute what is defined as architectural space. This paper aims at enriching the current pool of available computational design tools by exploring new algorithmic techniques for manipulating and visualizing spatial events within the physical boundaries of the designed spaces. The ability to parametrically control and maneuver potential human activities alongside the presently available topological parameters within a certain three-dimensional model could prove extremely beneficial to the productivity and the effectiveness of the designer.

This research is structured around the introduction of an experimental software plugin that provides optional, additional functionality alongside the geometric modeling process of an established commercial application. This plugin is presented as a partially functional prototype and is currently tested by being utilized in three diverse design examples. The proposed application enables its users to create parametric entities that represent potential human events inside three-dimensional digital models. By translating abstract human data into malleable interactive components, these crucial architectural parameters can be productively manipulated during the design process, bilaterally linked with geometric elements and even innovatively visualized through animations and diagrams.

Spatial Events within the architectural design process

Within the framework of architectural design, there are several theories and approaches about how the design process works. In essence, these theories examine the cognitive steps and internal machinations that the architectural designer goes through in order to arrive at a final design proposal. While it is beyond the scope of this paper to analytically examine the various architectural design methodologies, it is important to acknowledge that the design process is a complex, non-linear procedure that necessitates both rational and non-rational/creative cognitive skills and involves the manipulation of various diverse parameters that contribute to the creation of the final outcome. According to Gänshirt (2007), during this process the architectural designer is obliged to seek the assistance of design tools (both visual and verbal) in order to successfully organize as well as convey and communicate his ideas, visions and thoughts. Anything from gestures, sketches, models, videos to computer simulation programs and design criticism can all be seen as tools forwarding the design in some way or another. More specifically, the subcategory of computational design tools refers to those visual design tools that are based on algorithmic processes and that require the utilization of computational resources.

Amongst the multitude of architectural design theories and a steadily expanding number of available computational design tools, this paper focuses on the notion of spatial events. For the purposes of this research, the term spatial events is defined as the physical movements and physical interactions of human users within the physical spatial entities that are the subject of architectural design. In comparison to the decisively more broad term of human events, this definition is deliberately limited in order to ensure its operational usefulness. From the perspective of the user, spatial events encapsulate the primary sense of visual perception but do not include the secondary senses of acoustic and haptic perception. Furthermore, spatial events, within the context of this paper, are taking into account only part of the visual perception of the user. The field of architectural semiotics

ISSN 2309-0103
www.enhsa.net/archidoct
Vol. 3 (1) / July 2015

studies extensively the relationship between the physical geometric form (signifier) and the meaning or perception (signified) that is associated with architectural spaces. According to Eco (1980) this relationship has two distinct levels: at the denotative level architectural elements are mainly perceived based on their function while at the connotative level certain architectural objects can express certain ideologically defined values that are embedded in its function. A throne, for example, denotes that it can be used as a seating furniture but as the same time connotes or symbolizes a certain type of authority and power. It is important to clarify that spatial events are operating strictly at the denotative level of the visual perception of the users.

After establishing an exact definition of the spatial events, the next step is to delineate their relationship with the architectural design process. As a human cognitive process that targets the improvement of physical space, architectural design is inherently dependent on how the users of the physical space are moving, interacting and perceiving the designed space. Therefore, the spatial events are an integral part of the diverse mosaic of parameters that are guiding the architectural design process. Various computational design tools are specializing in organizing and manipulating algorithmic interpretations of these parameters in order to assist the architectural designer. Among others, parameters such as geometric form, materiality, illumination and structural rigidity have already been accurately represented in computational design tools. Their quantitative nature as well as their straightforward correlation with equations and laws of physics facilitated their algorithmic transition. On the contrary, it would be a much more challenging task to achieve a successful algorithmic translation of the general concept of human events. Based on the definition of the previous paragraph, spatial events constitute a simplified, striped-down version of human events that relies on physical movement and denotative visual perception and is therefore compatible with algorithmic processes. The goal of this research is to justify and produce a computational design tool that organizes and manipulates spatial events. Although it might not be possible to algorithmically represent the connotative level of visual perception, by controlling and evaluating (denotative) spatial events, the architectural designer will have the opportunity to subjectively create his own connotative interpretations. In that sense, spatial events aspire to become an algorithmic/quantitative proxy of certain non-quantifiable parameters of the architectural design process.

Computational precedents

The first instance of computational design tools that were loosely related with spatial events can be traced to practical implementations of the theoretical ideas of Christopher Alexander and Bill Hillier. Alexander's efforts had limited success due to insufficient technical resources as the architectural problems that he was attempting to quantify were too complex for the available hardware and software of the 1970s. On the contrary, during the early 1980s, Bill Hillier's team was more successful in creating computer applications based on the space syntax theory. Starting with Axman and Spatialist, there is a long list of spatial network analysis software that were based on space syntax and were utilized either as standalone programs or as extensions to other CAD products. These tools have been quite popular among urban planners and designers as they provide them with data analysis and simulation of road or path networks. However, their usability is limited in architecture since they only analyze potential movements and not spatial events in individual interior spaces.
Apart from software directly related with space syntax, there are various other applications that promise reliable simulation of human movements in urban contexts. Legion SpaceWorks (**Figure 1**)

ISSN 2309-0103
www.enhsa.net/archidoct
Vol. 3 (1) / July 2015

is one such tool that allows users to simulate pedestrian movement within a defined space, such as a railway station, sports stadium, airport or any place that people assemble in or move through. Another application that operates in a similar manner is MouseHaus (Huang C-J at al., 2003). By taking into account behavioral patterns as well as real people activity data, this tool provides a vague indication of how large numbers of people will move through a certain space. These tools are usually treating people as anonymous agents without any concrete functional goals and relay on statistical estimations rather than experiential qualities. Therefore, although they are dealing with the movement of people in space, are rarely geared towards spatial events at the architectural scale.

Figure 1.
Snapshot of the application Legion Spaceworks. Source: http://www.legion.com/stadium-evacuation-simulation

Figure 2.
Snapshot of the application Poser Pro. Source: http://my.smithmicro.com/poser-pro-2014.html

Outside of the realm of architectural design, there are several applications that deal with modeling and animating human figures (Poser, Character Studio). These are specialized digital tools that are working alongside conventional modeling software in order to insert and animate detailed models of human figures (**Figure 2**). They are primarily targeted for character animators and offer quite complex and specialized manipulation of every aspect of the human movement. Some of them, like Mixamo offer extensive web-based interfaces that simplify the character creation process for game developers. Nevertheless, the relative independence of these avatars from the spatial model as well as the complex user interface of these tools renders them unattractive to architects.

During the last 5 years there has been a noticeable interest in tools that address the theme of spatial events within the context of architectural visualizations. There are several, recently introduced, tools that are focused on the distribution of animated avatars within a render-ready three-dimensional model. Apart from fully integrated solutions (like the Populate toolbox within 3ds Max), there are plugins such as an(i)ma (by AXYZ Design) and RailClone (by iToo Software) that enable designers to enhance their models with characters before the visualization phase. Although these tools are undeniably useful, they are treating human avatars as simple geometric decorative accessories that are independent from the building components and that are inserted after the design process is finished.

Within the framework of the contemporary computational design tools, it is evident that there is an absence of tools that algorithmically address the presence of spatial events during the architectural design process. Although there are several visualization tools and techniques, it has not been possible to parametrically articulate spatial events during the design development of projects.

ISSN 2309-0103
www.enhsa.net/archidoct
Vol. 3 (1) / July 2015

The significance of spatial events

In response to the relative absence of spatial events from the computational design workflow, several reasonable arguments can be made in favor of their introduction. Four of these arguments will be presented in the following paragraphs.

Spatial events are important

Although architectural design is an intuitive and complex procedure that affords multiple approaches and routines, several design paradigms embrace, either consciously or subconsciously, the significance of spatial events within architectural spaces. The potential physical movements of the inhabitants of a certain space might be intangible and invisible for the architect during the design phase, yet these interactions constitute crucial decision-making parameters for the designer. Despite the presence of some available digital visualization techniques, these are certainly not enough to establish spatial events as an effective parameter within the digital design workflow. There is room, therefore, for better tools that would manipulate and analyze spatial events in a more productive and parametric manner that would be more suitable for the creative process.

Spatial events are so complex that computers might help

In general, human activity is an extremely complicated phenomenon that constitutes the main focus of multiple scientific fields. Despite this inherent complexity, designers are required to grasp and analyze these spatial interactions utilizing only their mental capacity.

On the other hand, computational processes are extraordinarily effective in manipulating complex tasks. By breaking down complex spatial events into quantifiable elements or variables, it would be possible to employ computational systems in order to handle part of their complexity. Within that framework, the exploration of computational design tools that would enable designers to productively manipulate complicated spatial events appears to be a rational pursuit.

Spatial events are missing from the computational design workflow

It is quite evident that over the last decade the architectural design process is gradually shifting into a completely computational workflow. Architectural studios as well as individual practitioners are using computational design tools from the beginning of the design process until the final delivery of the construction drawings or the equivalent BIM model.

Within this professional landscape, the form of the building, as well as its structural and mechanical integrity, can be accurately represented with digital models. However, the spatial events of its potential users and inhabitants, appear to be missing from the digital workflow. Therefore, the creation of a computational tool that would be focused on the manipulation of spatial events could ideally provide a currently-missing digital platform for a crucial aspect of architectural design. Since the architectural design process is becoming increasingly digital, it is important to maintain a computational presence for all the potential design aspects of the workflow, including the spatial events.

Digital spatial events will mesh well with digital parametric design

ISSN 2309-0103
www.enhsa.net/archidoct
Vol. 3 (1) / July 2015

The new generation of architects is becoming increasingly familiar with manipulating various algorithmic parameters during the creative process in order to reach a desirable design solution. Within this context, the potential addition of new, novel parametric options next to the existing ones could only prove beneficial to the digital workflow. The introduction of a new computational tool for representing and manipulating spatial events could add a new parametric category to the diverse network of the current algorithmic criteria.

The analysis of these four arguments leads to the realization that it is worth exploring new ways of inserting spatial events into the computational design process. Despite the failure of earlier efforts, several recent advancements and developments justify the re-examination of this research field with a fresh perspective.

The new tool

The main purpose of the proposed digital tool is to assist the designer during the architectural design process. The objective is to introduce a new design assistance mechanism that focuses on providing novel, optional digital features that could be gradually integrated to multiple and diverse architectural workflows without disrupting their routine. Within the framework of this research, these features are closely related to spatial events in architectural environments: The proposed tool attempts to complement the existing three-dimensional digital models with a mechanism of manipulating and visualizing the spatial events that might take place inside them.

At this point, it is important to clarify that the prospective tool does not simulate spatial events within digital architectural environments. A computational simulation is an accurate imitation of the operation of a real-world system over time based on a rigorous algorithmic model that describes the key characteristics, behaviors and functions of the said system. In the case of spatial events, such a task would necessitate the creation of a computational model that, given a certain space, could predict or simulate how the users will move, perceive and interact with that space. Based on the complexity of the human nature, the psychological and cultural parameters of human behavior as well as the semiotic/connotative intricacies of visual perception, it is evident that such a computational model does not exist as yet. Instead of pursuing a simulation, the proposed tool offers a mechanism for the architect to model his intentions. It does not predict what will actually happen if the designed space is realized but it enables the architect to visualize what he thinks might happen, based on his design goals and creative aspirations. The focus here is on the architect and the complicated, non-linear decision making processes that occupy his/her mind while designing spaces. Just as the three-dimensional models (physical or digital) of the building mass offer cognitive assistance in grasping and evaluating formal characteristics, the same should be possible with similar models of spatial events. Having the ability to manipulate and visualize an avatar's physical movements and inside the building structure would greatly enhance the architect's spatial understanding and would hopefully lead to better design decisions.

The Event Platform as a new component

Within the realm of architectural design, the notion of spatial events can be depicted in multiple and diverse forms. Ranging from simple functional diagrams all the way to animated avatars, all representations of spatial events seek to visualize how the end user will interact with his contextual surroundings. The crucial parameter that necessitates the existence of such a multitude of approaches is scale. A certain phenomenon requires different styles of representation depending on

ISSN 2309-0103
www.enhsa.net/archidoct
Vol. 3 (1) / July 2015

the distance from which it is being observed. When designing a large building complex, the potential spatial events are simplified into functional labels attached to the various spaces (offices, reception, restrooms, etc.). In this top-down approach, these labels offer an indication of how the users will engage and interact with those spaces but they are doing it in a straightforward and simplistic fashion that is suitable for compositional editing. On the other hand, during the process of making decisions regarding the interior design of a project the architect has to mentally grasp and manipulate the approximate positioning and movements of the people that will utilize that space. This bottom-up approach operates at a smaller, more intimate scale of human activity where the simple functional labels are insufficient to capture the temporal complexity of the potential spatial events. Instead, cinematic sequences that include animated avatars are more suitable for representing human activity at this lower level.

In order to create a practical digital tool that would be suitable for manipulating human events, both ends of the fore-mentioned activity spectrum scale need to be accounted for within its inner mechanisms. The major challenge in achieving such a feature lies in the introduction of a new computational entity that would have the innate capability to seamlessly encapsulate the notion of spatial events in all scales. More specifically, this entity should capture the physical movements and physical interactions of human users within the architectural model, as this is the definition that was given to spatial events earlier in this paper. At the same time, all modeling software are object-oriented: the designer is manipulating geometric elements within the three-dimensional environment. How is it possible to combine the complexity and uncertainty of moving avatars with the clarity and specificity of an object-oriented application? This is achieved by the introduction of a distinct geometric element that represents the delimitation of the volume that is designated to a certain group of spatial events. This novel entity is called Event Platform.
Within the framework of this research, the term Event Platform is used to describe a transparent, volumetric, digital representation of the intended spatial events of a certain space (Figure 3). The goal is to complement the familiar, widespread utilization of geometric building elements with a novel type of entity charged with the challenging task of depicting a geometric representation of spatial events. This representation has the following distinct characteristics:
- It is a separated entity from the actual physical elements of the building
- It is parametric
- It is top-down friendly, as it encapsulates an enhanced version of the functional diagrams
- It is also bottom-up friendly, as it incorporates corresponding activity at a lower scale

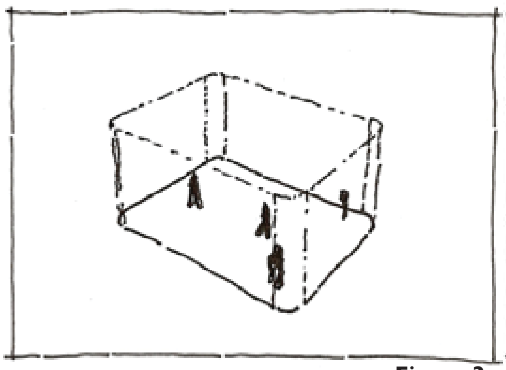


Figure 3.
A representation of an Event Platform

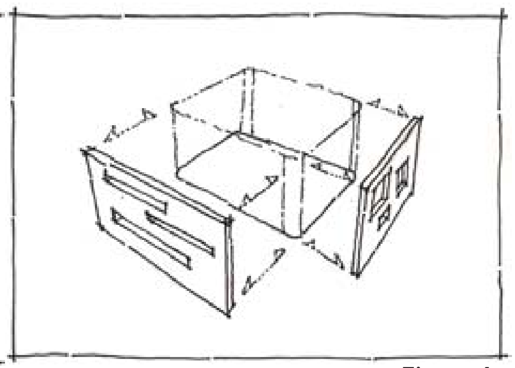


Figure 4.
Event Platforms are separated entities from the physical elements of the building.

Event Platforms are separated entities from the physical elements of the building

ISSN 2309-0103
www.enhsa.net/archidoct
Vol. 3 (1) / July 2015

The idea behind the introduction of the Event Platforms is to provide the designer with a toolbox capable of representing information regarding spatial events inside architectural spaces. The objective is that, through the proper utilization and manipulation of these elements, the architect would be able to create a separate "activity" layer that would be overlaid on geometric elements of the model. In order for this to work properly, it is crucial to maintain a clear division between the Event Platforms and the physical building components of the structure (Figure 4). This fundamental independence of the two entity typologies (activity and geometry) does not prohibit the existence of connections and articulations between them. On the contrary, the fact that Event Platforms are inserted as autonomous objects provides them with the flexibility to interact with multiple other elements in various ways.

Event Platforms are parametric

The significance of parametric control within the framework of contemporary architecture is well documented and almost universally accepted. The gradual transition towards computational design tools has brought into focus the advantages of utilizing digital modeling software. One of their most important features is the ability to maintain parametric relationships between geometric elements and numerical values. These mechanisms enable the designer to control indirectly and interactively the designed outcome through the manipulation of data. A similar level of parametric flexibility would be extremely beneficial for the Event Platforms. These new computational entities would be customizable and adjustable through a comprehensive panel of settings and values that would be always accessible (**Figure 5**).

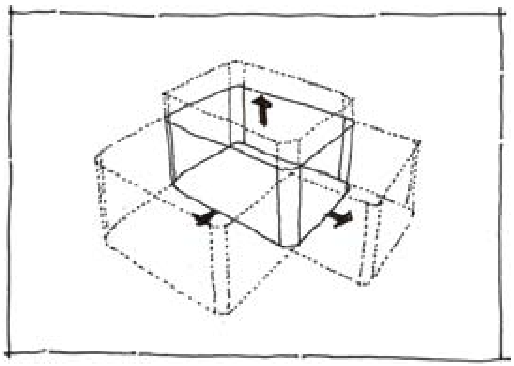


Figure 5.
Event Platforms have parametric dimensions.

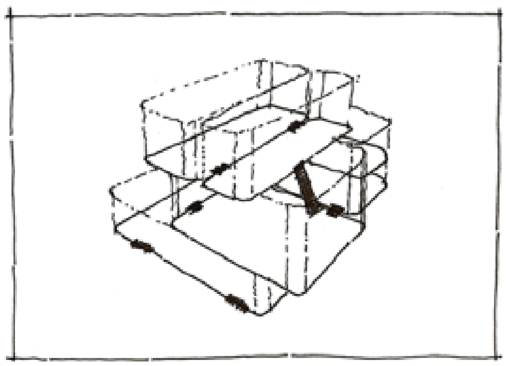


Figure 6.
A three-dimensional functional diagram as a collection of Event Platforms

Event Platforms are top-down friendly as they encapsulate an enhanced version of the simplistic information of functional diagrams

Functional diagrams have always been an integral part of the design process. Whether in the form of a sketch on trace paper or as a digital bitmap, the utilization of diagrammatic hierarchical structures has assisted the designer in optimizing the building configuration. Through the usage of abstract shapes (rectangles or boxes) and simple labels (offices, reception, restrooms, etc.), the spatial events had been transformed into simple, manageable and comprehensible entities. The Event Platforms are designed as placeholders for similar data, albeit completely integrated into the digital modeling

ISSN 2309-0103
www.enhsa.net/archidoct
Vol. 3 (1) / July 2015

environment (**Figure 6**). Moreover, their digital, parametric nature renders them far more suitable to cope with the uncertainty and ambiguity of the non-linear design process.

Event Platforms are bottom-down friendly as they incorporate human activity at a lower scale

In contrast to the widespread usage of the functional diagrams, lower-scale human activity has hardly ever been part of the design process. Analyzing and representing how people move and interact within a certain space has always been a highly complicated task that had minimal impact on the design outcome as the decision-making process was focused on a larger scale. However, recent advancements in the field of computation and digital media have rapidly increased their capacity of manipulating complex phenomena. The Event Platforms are taking advantage of contemporary algorithmic processes in order to visualize and manipulate the intricate machinations of the human activity. Although designers are still operating at a larger scale, the added benefit of maintaining a more circumstantial view of their project should not be ignored (**Figure 7**). The broadening of their understating and control over how people interact within space at a micro-scale could only lead to more educated decision-making in any design scale.

How Event Platforms are used

The Event Platforms can be utilized by architects and designers during the schematic design or the design development phase of projects. They are inserted as supplementary components within commonly used digital modeling software and appear as additional options alongside the existing tools and techniques of the programs. The most intriguing characteristic of the Event Platforms is that they are not geometric building components but parametric, transparent, volumetric placeholders for human activity. The scope of the Event Platforms is to offer a novel representation technique for capturing useful information that is currently absent from computational building models. Despite the impressive level of detail of the representation of the physical geometric elements (accurate topology, materiality, indirect illumination), modern software have not been able to capture the events that take place inside these elements. The Event Platforms attempt to bridge this gap by providing the designer with a tool for manipulating physical human activities within a spatial context. They function as a semi-autonomous parametric data layer that is developed in parallel with the actual geometric components of a project. By creating and positioning individual Event Platforms, the designer can compose an independent "event" skeleton that is separated from the building shell. Consequently, by utilizing the parametric flexibility of the software he is able to selectively link the geometric elements with the "event" skeleton. The ultimate goal is to improve the decision-making of the architect by having him successfully interact with both information structures (geometry and events) during the design process. More specifically, the Event Platforms can be used in two ways:
- As parametrically connected elements within the three-dimensional model
- As generators of innovative visual and data feedback

The Event Platforms as parametrically interconnected elements

The Event Platforms are computational components that are controlled by a diverse set of parameters (**Figure 8**). These options can be divided into three distinct groups: size, events and connections.

The first parametric cluster regulates the general dimensions of each entity and is quite straightforward, as it resembles commonly used settings of other components. The designer can control the width, the length as well as the area of each Event Platform by entering either absolute or flexible values within a

ISSN 2309-0103
www.enhsa.net/archidoct
Vol. 3 (1) / July 2015

The first parametric cluster regulates the general dimensions of each entity and is quite straightforward, as it resembles commonly used settings of other components. The designer can control

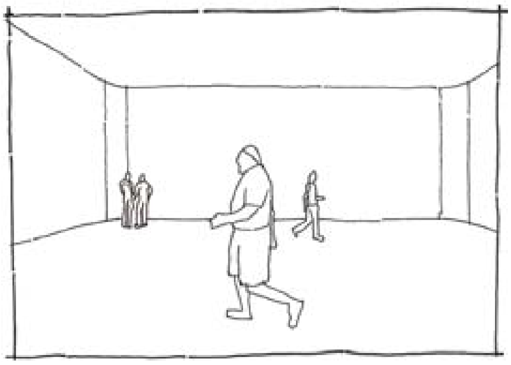


Figure 7.
Human activity is captured vividly within the Event Platforms.

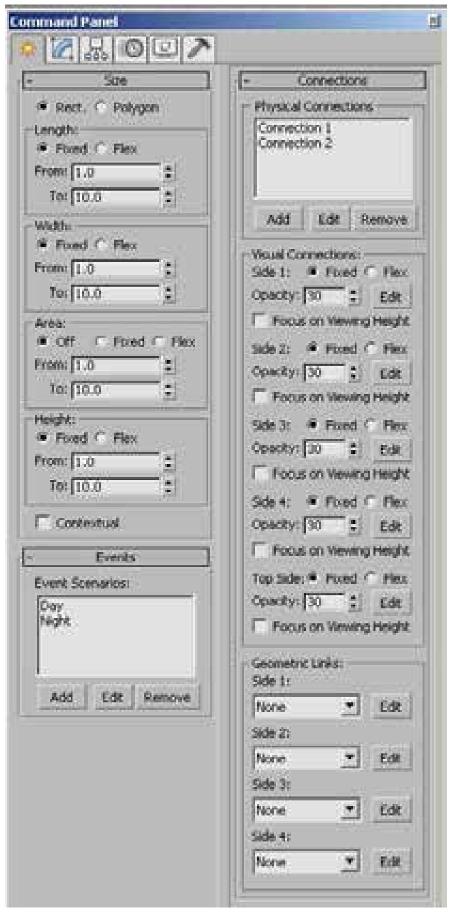


Figure 8.
Part of the user interface of the plugin within 3DS Max.

the width, the length as well as the area of each Event Platform by entering either absolute or flexible values within a certain range. Therefore, the uncertainty and ambiguity that was present in analogue media (sketches on trace paper, smudges, lack of scale) can be somehow translated into value ranges within digital media environments. Although the Event Platforms are components with geometric characteristics, it should be noted that they are not physical building components. The Event Platforms are areas of activity that have a specific volume but no physical definition of their borders. They can be described as transparent bubbles that depict how much space is assigned by the architect for certain spatial events.

The second group of parameters controls the activities that take place within the platforms. The designer has the option of assigning various event scenarios to each Event Platform. By utilizing established techniques from other digital fields (character animation), the proposed tool enables the designer to create simple avatar sequences with minimal hassle. The desired event scenario can be constructed through the insertion of the participating avatars, the control of their positioning and the selection of their activities through pre-established motion capture libraries (**Figure 9**). These complex animated sequences might appear too complicated and inconvenient to set up for

ISSN 2309-0103
www.enhsa.net/archidoct
Vol. 3 (1) / July 2015

the average architect/user of digital software. Nevertheless, recent advances in the field of character animation constitute the process effortless and almost fully automated.

The last parameter group regulates the various algorithmic connections and links of each Event Platform. There are three types of connections: physical connections, visual connections and geometric links.

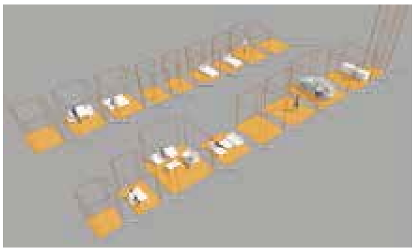
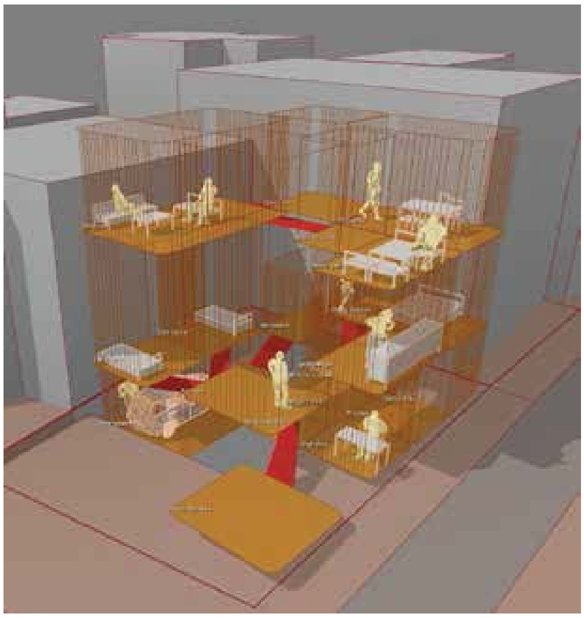


Figure 9.
Event Platforms after the creation of the various events.



(right) Figure 11.
A configuration of Event Platforms with physical and visual connections between them.

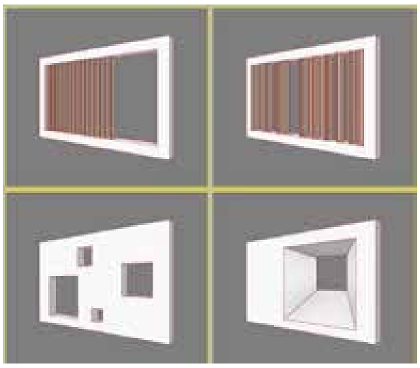


Figure 10.
Four types of parametric panels for a certain project.

The last parameter group regulates the various algorithmic connections and links of each Event Platform. There are three types of connections: physical connections, visual connections and geometric links. By assigning physical connections for each platform, the designer can establish how the human users can move between the platforms. Therefore, the passageways from each space to the neighboring ones can be positioned in a parametric manner.

The visual connections encapsulate parameters that define how much of the surrounding context is visible to the avatars of each Event Platform. Depending on the position, the configuration and the contained activity of each component, the architect can adjust the intended opacity of individual borders of each platform (**Figure 10**). Therefore, he is able to not only control the optical relationships among the different Event Platforms but also their visual connections with the environmental context. Similar to the physical connections, the presence of parametric flexibility ensures that the designer can use ranges of opacity values and selectively assign them to separate visual targets.

The last type of parametric connections controls the relationship between the Event Platforms and the other geometric components of a certain digital model. The geometric links enable the parametric data flow between the two distinct models in order to improve the decision making process. The designer can assign parametric geometric panels (**Figure 11**) to specific borders of the Event Platforms. The concept is that the embedded characteristics of the panels (type and distribution of openings, materiality, topology of their surfaces, etc.) are informed by the opacity of the visual connections and the positioning of the physical connections to algorithmically produce the final geometry. In a sense, the geometric

ISSN 2309-0103
www.enhsa.net/archidoct
Vol. 3 (1) / July 2015

"armor" of a certain building will have to conform and wrap around its activity "skeleton" (**Figure 12**). Both models would remain open to parametric tweaks and adjustments throughout the non-linear design process.

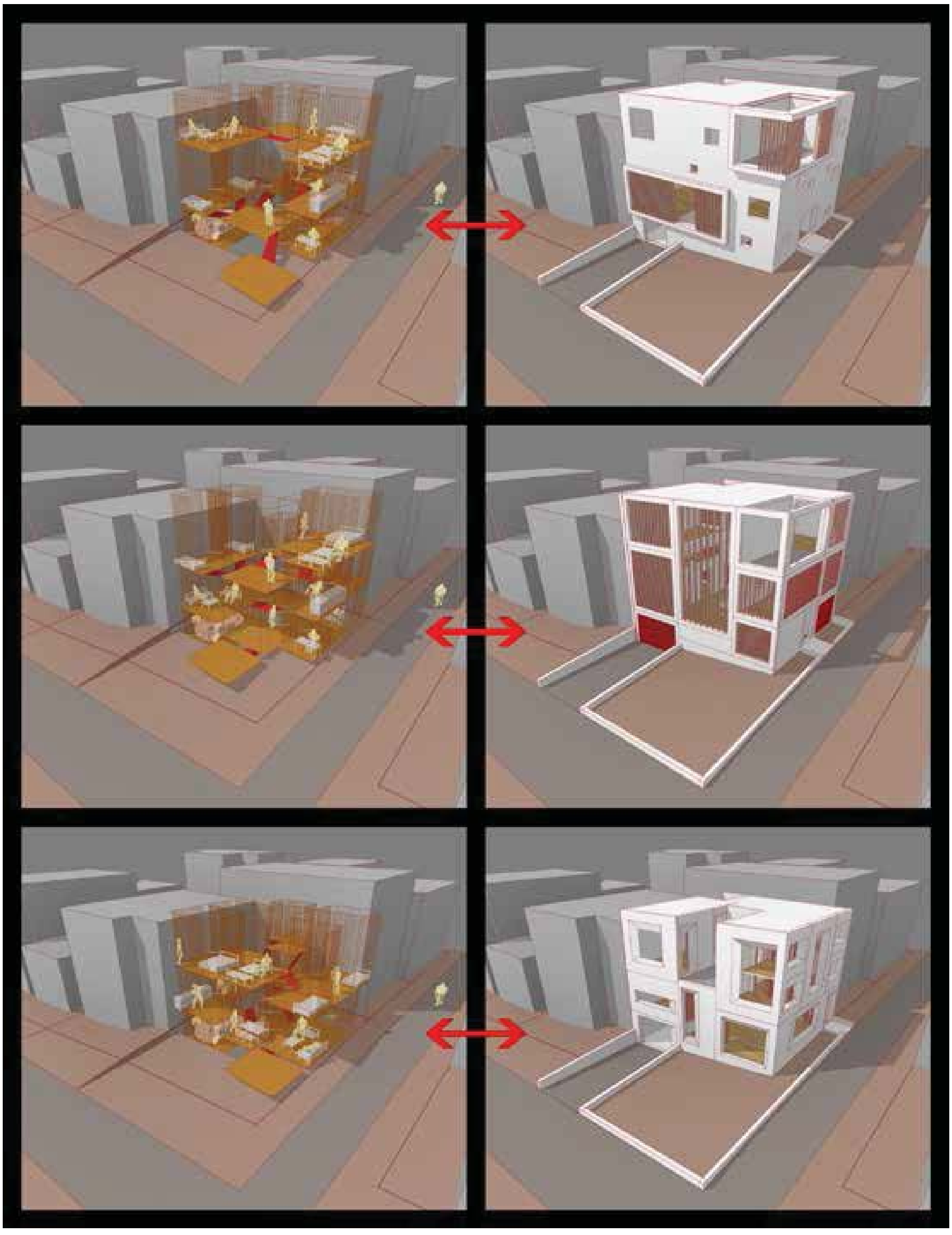


Figure 12. Three different configurations of Event Platforms with the corresponding panels that are linked based on their physical connections and visual opacities.

ISSN 2309-0103
www.enhsa.net/archidoct
Vol. 3 (1) / July 2015

The Event Platforms as generators of innovative visual and data feedback

Apart from constituting tangible modeling components during the digital design process, the Event Platforms are also capable of functioning as generators of innovative feedback for the architect. Independent of their preferred workflow, most designers are using various representation techniques in order to properly grasp and evaluate the outcome of their efforts. The emergence of the Event Platforms provides the opportunity for a fresh perspective on the existing architectural visualization techniques. The proposed software takes advantage of the parametric nature of the Event Platforms in order to produce novel visual and data representations of the design outcome.

Visual feedback

In order to adequately encapsulate the complexity of events and human activities in space, the proposed tool utilizes the positioning of the avatars of the Event Platforms and creates various digital cameras around them by adhering to established cinematic conventions. After creating a large number of cameras, a representative sample of the best shots is algorithmically compiled into an animation matrix that shows up to 25 different frames (Figure 13). This activity animation matrix constitutes a new visualization mechanism that offers a fresh representational perspective during the design process.

Figure 13.
An animation matrix consisting of nine cameras depicting various events inside and outside of the designed building.

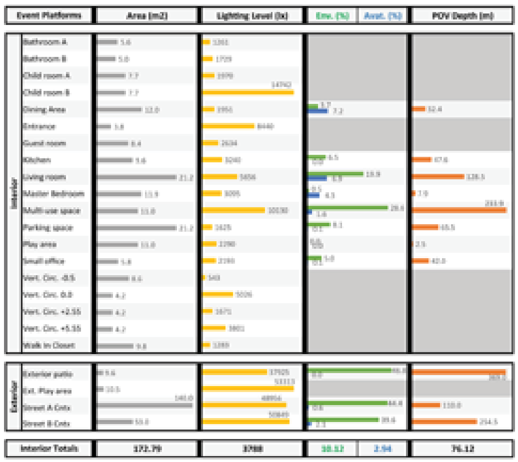


Figure 14.
A typical data diagram.

Data feedback

In addition to the animation feedback, the Event Platforms are capable of analyzing the frames of all the point-of-view cameras and extracting useful data out of them. Apart from visual imagery that they provide, the viewpoints of the avatars can provide additional information that could be translated into useful diagrams (**Figure 14**). The digital tool can currently monitor data about the contextual environment (how much environment is visible to each avatar), other avatars (how many of the other avatars are visible to each avatar) and average spaciousness (the average distance of the first obstacle in front of every avatar). In addition to that, the tool can also measure the average lighting level of each platform. The currently available types of diagrams serve as a first step towards proving the effectiveness of this approach. It is quite certain that there are more aspects of architectural projects that could be partially translated into numerical quantities by utilizing the parametric nature of digital software. The challenging aspect of morphing them into productive tools is maintaining an effective balance between qualitative

ISSN 2309-0103
www.enhsa.net/archidoct
Vol. 3 (1) / July 2015

Data feedback

In addition to the animation feedback, the Event Platforms are capable of analyzing the frames of all the point-of-view cameras and extracting useful data out of them. Apart from visual imagery that they provide, the viewpoints of the avatars can provide additional information that could be translated into useful diagrams (**Figure 14**). The digital tool can currently monitor data about the contextual environment (how much environment is visible to each avatar), other avatars (how many of the other avatars are visible to each avatar) and average spaciousness (the average distance of the first obstacle in front of every avatar). In addition to that, the tool can also measure the average lighting level of each platform.

The currently available types of diagrams serve as a first step towards proving the effectiveness of this approach. It is quite certain that there are more aspects of architectural projects that could be partially translated into numerical quantities by utilizing the parametric nature of digital software. The challenging aspect of morphing them into productive tools is maintaining an effective balance between qualitative and quantitative feedback. Although architectural decision-making cannot be totally depended on data diagrams, their limited integration into the design process could be immensely valuable.

Experimentation and evaluation

During the current stage, the proposed digital tool has the form of a plug-in software that has reached the prototype phase. All the main computational threads as well as the user interface of the software have been identified and have been partially implemented. While a significant amount of the processes have already been scripted, there are some functions that are currently executed manually in order to test the usability and practicality of the tool.

In order to examine the practical usability of the tool, it has been put into use through three diverse experimental design projects. These examples (a small residence, an office building and a bank headquarters complex) differ in scale and complexity and focus on evaluating and critiquing the usefulness of the tool workflow under a diverse range of test-cases. By engaging the new plugin into the design process of these three examples the goal is to acquire a thorough and comprehensive understanding of the proposed workflow as well as the possible shortcomings of the new design tool.

Conclusion

The realm of contemporary architecture is becoming increasingly dependent on computational tools as integral parts of the design workflow. The majority of these applications appears to revolve around the parametric articulation of physical building elements and formal attributes. This paper attempted to outline the main components of a new digital tool that enables designers to visualize and manipulate human events and interactions in spatial settings. This tool aims at augmenting the architects' perspective by providing a more spherical view of the design outcome that could hopefully improve their decision-making mechanisms.

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Vol. 3 (1) / July 2015

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Vol. 3 (1) / July 2015

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