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DESIGNING FOR THE FUTURE OF THE CITY

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ABSTRACT

A rapid acceleration in urbanization has appeared as an important by-product of the world's globalization process, with the result that cities have now become man's primary habitat. This development is both forcing urban environments to embrace increasing numbers of inhabitants, despite their often limited resources, and requiring 21st century architects and urban planners to quickly develop new ideas and new forms on how to direct the futures of global cities. Faced as they are by the challenges of sustainability, these architects and planners are exploring ways both to rehabilitate existing urban centers and come up with new modes of space production. This study concentrates on the concept of the smart city and explores these new approaches by considering the findings achieved by the IAAC Global Summer School, which was conducted at the ITU Faculty of Architecture in 2013. This summer school was conducted as a means in the investigation of new strategies for urban development and city production by focusing on such different aspects as the production of knowledge, production of food, production of objects, and the production of energy. In order to enhance the discussion of this development, this work looks at the method of exploration utilized and the ideas set forth by the architectural student participants and considers their suggestions for adaptive and reactive spatial infrastructures. The aim of this study is to the enable architects to enhance their spatial awareness while generating new ideas for the future of the city.

Key words: productive city, smart city, architectural design

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Introduction

Today, globalization is both stimulating the urbanization process and transforming our cities into man's primary habitat. Between the years of 1900 and 2000, the global urban population expanded from 225 million to 2.9 billion [1]. While 15% of the total world population of 1.5 billion resided in cities in 1900, by the year 2000, 47% of the total world population of 6.2 billion resided in cities. By 2030 global population is expected to rise by 60% with approximately 4.9 billion people living in urban settings [2]. Such enormous and complex congregations of people will cause new kinds of problems in mega cities, problems that will include a scarcity of resources, issues relative to waste disposal, air pollution, inadequate infrastructure, health concerns, etc. [3]. These developments, hand-in-hand with ever new advanced technologies, are forcing architects and urban planners to generate new design ideas for more sustainable, self-sufficient, livable, efficient, responsive, and in-formed architecture of cities and buildings [4]. New technologies are encouraging designers to create new design logics and new ways of designing and constructing for the future of the cities. “Smart city," “intelligent city," “digital city," “information city,” and/or “self-sufficient city” are emerging concepts that describe this new 21st century urban phenomenon.

Most approaches dealing with the concept of the smart city focus on issues related to technology. Washburn *et al* address the concept of the smart city by looking at the use of smart computing technologies [5]. Harrison *et al* envision the smart city by listing three main necessary characteristics: instrumented, interconnected and intelligent. “Instrumentation” enables the capture and integration of real-time, real-world data from both physical and virtual sensors. The combination of instrumented and interconnected systems effectively connects the physical world to the virtual world. “Interconnected” means the integration of those data into a computing platform and the communication of such information among the various city services. “Intelligent” refers to the inclusion complex analytics, modeling, optimization and visualization in the operational processes [6]. Besides these, other approaches used to conceptualize the smart city also present a growing demand for more efficient, sustainable and “livable” models for cities [7].

The concept of smartness in architecture cannot be understood merely as being an injection of new technologies into old strategies. The term requires innovation both in design thinking, making, and manufacturing. Here architectural approaches mostly consider new type of infrastructures that effectuate the transport of data or information that allow cities to perform as living organisms and influence behavior [4]. These approaches aim at ways of advancing cities that are responsive to environmental or social data and user needs, and promoting the participation of residents in the collection and sharing of neighborhood data. According to Markopoulou *et al*, we are moving towards different forms of habitats, forms in which we do not simply inhabit our architecture but also integrate, interact and evolve with them. The fundamental shift in paradigm is thus in understanding cities and architecture not as efficiently designed machines, but as dynamic ever-changing ecosystems [4].

By utilizing information and communication technologies in spatial planning, these new architectural forms aim to construct intelligent entities that continuously interact and interchange resources with their environment, with the context, with the medium, with the user, the citizen [8]. These informational, interactive and relational structures render architectural space more sustainable, more sensitive, and more conducive to individual involvement. Thus the trend becomes moving from old, static, definite and finished icons towards more open, fluctuated, changing, and responsive spatial entities. Today cities are no longer a collection of passive infrastructures, but active and complex environments able to produce real-time feedback on our activities, to communicate, to generate innovation [9].

This study aims to explore the new modes of production under the effect of computational advances. The discussion is developed by focusing on the following questions: Is the citizen of the new era a consumer of architecture or is s/he its real constructor? Does this citizen perform as a consumer of its information or is s/he its real creator? Do the enabling and encouraging of citizens to perform as participating members of the community result in more sustainable built environments? Can information technologies assist in providing real-time data that can shape our urban environments?

These questions are explored by investigating the results of the IAAC (Institute for Advanced Architecture of Catalonia) Global Summer School (GSS), which was conducted at the ITU Faculty of Architecture in 2013. In the scope of the work a discussion of these concepts is advanced by considering the ideas developed and presented by the participant architecture students relative to the creation of adaptive and reactive spatial infrastructures. It is our hope that this study will enable architects to enhance their spatial awareness and lead to the generating of new ideas for the future of the city.

IAAC Global Summer School: Productive City

The theme of the IAAC GSS '13 was defined as the "Productive City," and had the participation of institutes from Istanbul, Mumbai, New York, Mexico and Tehran. The aim of these synchronized efforts was to investigate the current agenda on new urbanization by concentrating on local responses, research and implementations. IAAC GSS also sought to investigate multi-scale strategies that would lead to the (re)construction of our habitats. This topic was selected in recognition of the fact that recent technological, social, political, economical and cultural changes are influencing dramatic changes in space and its utilizations and this, in turn, is forcing us to re-think the kinds of habitats humanity will live in the coming decades. It was also recognized that the world's major interest in climate change control, the incorporation of the green agenda in urban development, the local development of energy production techniques, the incorporation of information technology to physical space and other relevant situations, require a new vision regarding the development of the city and architecture [10].

The concept of the Productive City addresses the production of energy, alimentation, and other entities that are key to the establishment of self-sufficient habitats. The world's population now largely resides in urban environments and is disconnected from the sites of energy, alimentation, and object production and manufacture. One aim of the IAAC GSS '13 was to refer to this disconnect and to investigate the opportunities existing in urban environments for the production of these key elements [10].

IAAC 2013 Istanbul Sessions

The agenda of the Istanbul sessions was based on the themes of "infrastructures" and "networked city." These concepts concentrated on the notions of system and network on an environmental/regional scale and on formal material systems on a tectonic scale [11]. In such densely populated, dynamic, and growing cities like Istanbul, the idea of productivity highlights the production of knowledge. In the production processes carried out in smart cities, the dissemination and transmission of knowledge becomes essential. The project thus aimed to create spatial-temporal urban installations that could interact with local environmental conditions. Urban "smartness" was thus created through the multiplication of different formations of these responsive installations in a specific region [11].

The method for the design process involves experimenting with materials and systems that are artifacts of the urban. The smart city agenda for Istanbul sessions was formulated in a synthetic manner: take the technological (escalators, pistons) biological and chemical (moss, plants, minerals), electronic (processors, sensors), industrial products (hoses, plywood, clamps) as ingredients of the equation and approach them as the cavemen treat the woods, media to explore and make. Today advent of the personal computer with the immensity of the industrial production is a derivative resource for the urban dweller to handle, and reshape, to make and personalize the goods, turn the role of the consumer to an individual maker. Smart city therefore is translated into the individual, the group and the network of groups into the production and sharing of goods, knowledge and energy and (Figure 1).

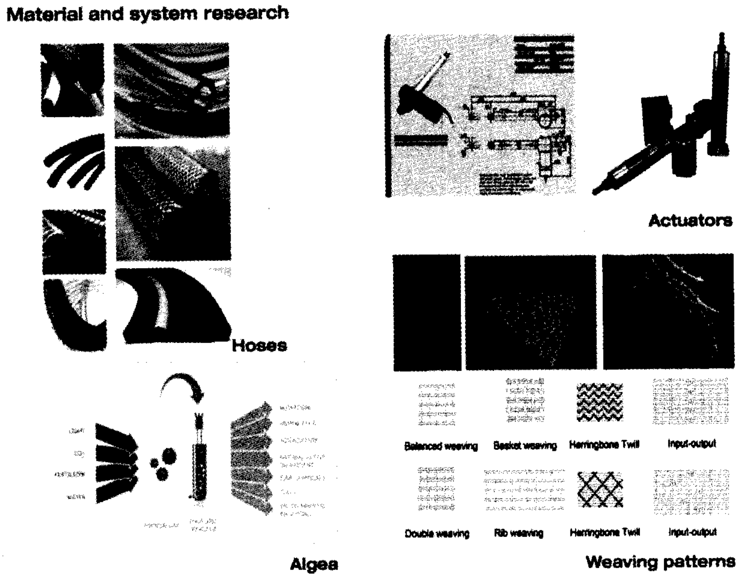

Figure 1 : Material and System Research

The project site corresponds to the network emphasis of the local brief. The main campus of the Istanbul Technical University, *Ayazaga*, was thus duly selected as a research area. Five campuses of the Istanbul Technical University both form a spatial network and also constitute important components of the social and educational infrastructures of the city. Of these five campuses, Ayazaga Campus, located in a major commercial zone of the city, is the largest, most diverse campus in ecological, topographical, administrative, and climatic aspects.

Preliminary workshops aimed for data collection and preparation for digital and physical toolsets. Arduino sensor boxes placed at the campus served to map micro-climatic data. Analyses on the pedestrian flow and movement patterns in the existing spatial layout helped to decode the key features of the spatial network. So that design proposals could be formed with the use of real time data. To this end, site specificity denoted that design ideas incorporating new interfaces could be shaped by the exploration of the interactions between space and body.

In this case, space syntax was used to explore, understand, and evaluate architectural space. This constitutes a kind of mapping in which the built environment is accepted as a spatial and social network and one that aims to depict the living culture by focusing on organization of spaces, movement patterns and their social meanings.

Figure 2 : Spatial Analysis of the Ayazaga Campus (Workshop Team: M. Gencer, I. Kalkan, A. Inal, E. Yetim)

A workshop team first identified eleven key points on the campus and observed the pedestrian movement flow, while recording the data at specific time periods including the main pedestrian entrance gates and the surrounding key spaces that link the campus to the city (Figure 2). Also included were those zones along the main axis of the campus where the social, cultural and educational buildings are located. Then, spatial configuration of the campus was analyzed by the help of space syntax software. Here, the most integrated spaces of the spatial complex were depicted with the color red, and the degree of relative integration was represented by the density of tone ranging from red to blue, with dark blue indicating the most segregated areas. The most integrated spaces produce the highest levels of movement flow and represent the key spaces for social encounters as they host the campus' main activities. The most segregated spaces produce the lowest movement flow and tend to be separated from the rest. The analysis demonstrated that this spatial mapping correlates well with the observational records.

Design Proposals at IAAC 2013 Istanbul Sessions

Two design proposals, titled *Mutua-supra* and *Act-in*, were developed in the course of the workshop studies. These were designed as responsive and intelligent infrastructural installations linked to bicycle paths in the campus.

The first design proposal, *Mutua-supra*, was established in a way that it could create a reciprocal relationship between the infrastructure and the superstructure [11]. Its aim was to catalyze use of underused or wasted space areas on the campus by introducing a bicycle utilization system and a green superstructure that promotes environmental awareness. The aim here was to develop this mutual relationship that would transform these inactive and underused areas into active spaces that could be utilized for a variety of social activities (Figure 3).

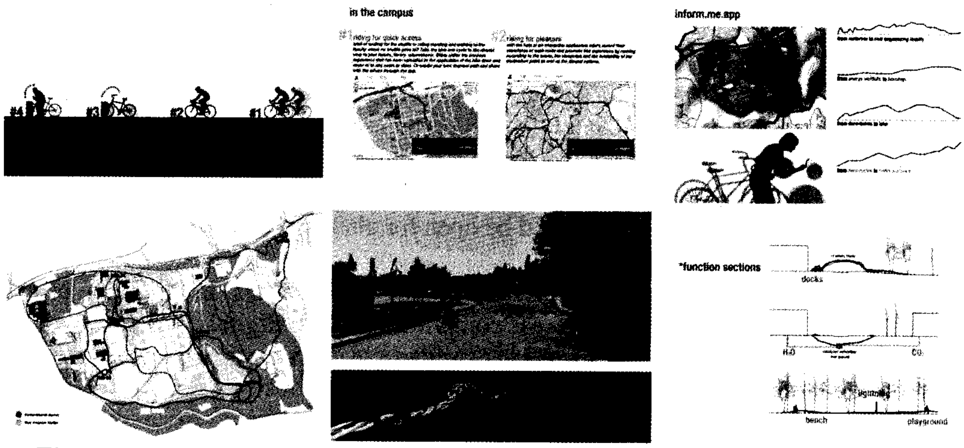

Figure 3 : Mutua-supra (Design Team: I. Kalkan, S. Josceline with B. Biçer, M. Kokkinos, C.K. Bingöl)

This proposal includes an in-campus bicycle sharing that will provide an alternative for the primarily automobile-based existing transport infrastructure. Thus the eco-friendly network of cycling routes would both lessen fossil fuel driven vehicles and increase accessibility. When interfaced with the web, this transportation system could also be transformed into a social network in which users can interact and play active roles. The proposed smart system also includes a solar energy collection component that would charge bicycle batteries, thus lowering user energy footprints.
Mutua-supra project is based on pervasive algae farms that would establish a self-sufficient spatial system. The design scenario called for the feeding of algae farms by the users. These farms would also benefit from the existing energy resources of the campus recycling process. The idea was to use these farms as bicycle sharing stations with the assistance of four main system supplements: electricity, water, carbon dioxide, and bioluminescence algae.
According to the proposal, waste carbon dioxide and water would be collected from the ventilation systems of extant buildings then used to feed the bioluminescence algae. By creating a connection to the existing system of electricity, the energy provided from smart phone applications was also fed back to the system so that H2O, CO2 and algae move.
The proposal suggests that users could change the shape and pattern of algae farms via pistons used as urban furniture for different activities such as sitting, resting, playing etc. At night, the resultant bioluminescence algae provides light for the campus spaces for social activities.
The second design proposal, *Act-in* aims to create interactive meeting points in the campus [11]. Rather than imposing specific functions to particular spaces on the campus, it explores more flexible and adaptable spaces that would be shaped by the contribution of their users. The idea was that the relation between body and space

would define the needs and the function of the area; that would lead more open, incomplete and dynamic spatial systems (Figure 4).

The design proposal attempts to generate a multi-centric spatial network in the campus. Each center allows intercommunication by a digital interface. This allows the system to act as a knowledge transmitter. The centers allocated for such diverse functions as riding, meeting, waiting, eating, playing, and reading, etc. would both motivate the user to be active and would be open for alternative functions.

The current location of each center affects the behavior of others. In the scope of the project, this physical interaction was complimented by digital interaction. The proposed mobile application allows its users to participate in the space and share their experiences creating new spaces for social interaction.

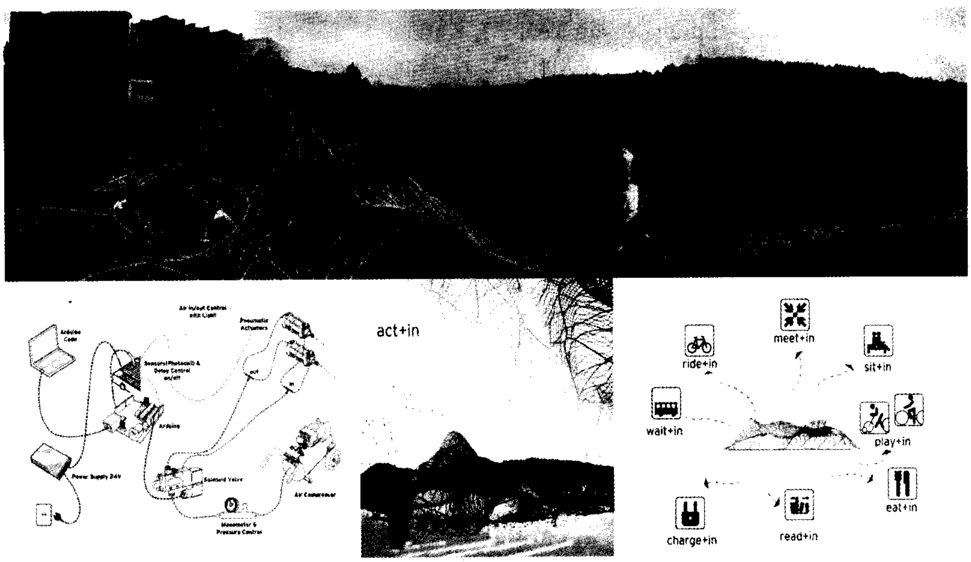

Figure 4 : Act-in (Design Team: M. Gencer, K. Kallavi, B. O. Turan with G. Gündüz, D. Tümerdem, C.K. Bingöl)

The location of the each center was defined by the help of syntactic analysis of the existing spatial layout of the campus and the observed pedestrian movement flow. By implementing integrated digital sensors, the outer facades of the each center were designed as mechanical, smart surfaces that can be responsive to such environmental factors as rain, sun or wind. Flexible architectonic systems were investigated in order to create these interactive surfaces as living organisms.

Installations that represented the ideas explored during the summer school with sensors, pistons, algae and woven industrial materials were exhibited at the Architectural Biennale in Antalya, as Post-productions.

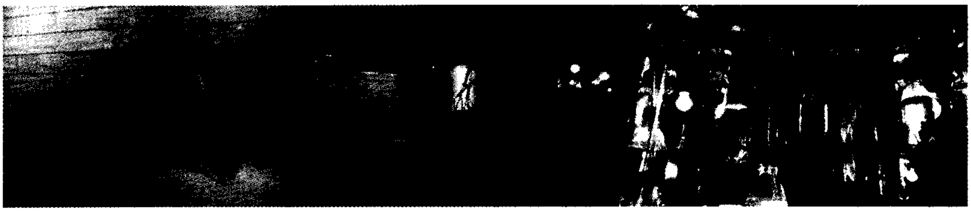

Figure 5 : Post Productions of IAAC Summer School

Conclusion

Design is an experimental process that includes both exploration and discovery. The architect learns by doing and experimenting [12]. Today architectural design education crosses borders of design studios and expands and moves into cities, and then even beyond cities and individual countries.

The IAAC GSS is a rewarding educational program that provides opportunities for architecture students to work, think, and learn together in an international platform. By focusing on the theme of the "Productive City," the GSS '13 revealed an informative process that enhances our spatial awareness by presenting alternative ways of engaging with the theme, and the possible ways that they can be transformed into different design proposals in a networked environment.

The city is transformed from being only a form and becomes a rather complex system of relationships and events that are engaged in a process in which simultaneous processes of action and reaction are triggered [8]. According to Gausa, the city of the new era is defined and redefined dynamically, continuously, and relationally by combining diverse and simultaneous layers of information and infrastructural networks of exchange. The city thus becomes characterized by information that can be classified as topographic, biological, economic, cultural, environmental, socio-political, etc. On the other hand, the city is organized by such infrastructural networks as transport, energy, diffusion, communication and by relative demographic and financial movements [8]. Here, it must be noted that today each city produces its own informational structure, which it exhibits both spatially and architecturally. This information structure generates responsive environments, configured by the interaction of people, objects, spaces, boundaries, networks, interfaces and content [13].

Design proposals developed during Istanbul sessions were aimed at creating social and spatial networks on the Ayazaga Campus. The nodes of these networked structures that host diverse activities were shaped by the interaction of their users. These units have been organized in a way that promotes strong interrelationships that form and transform each other. Here inactive, static forms of space give way to more dynamic, organic, flexible and active forms that have the capabilities of communicating with its users and responding to environmental conditions.

Experimenting with electronic, biological and material systems with hands on and synthetic manner, the projects evolved with a systemic and multilayered composition. It allowed the projects to be focused on effects, processes and interaction, rather than a fixed outcome; they served a temporal approach that included behaviors, phases, versions and loops (Figure 6).

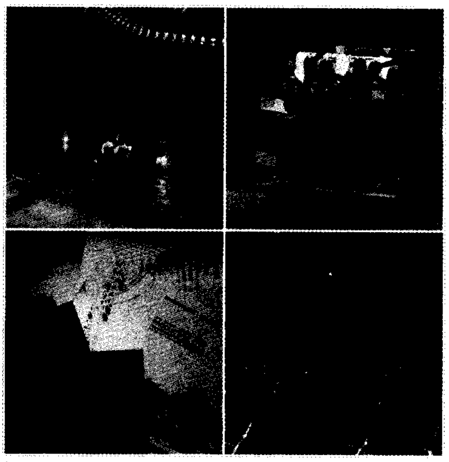

Figure 6 : Experiments with Electronic, Biological and Material Systems

Site specificity and responsiveness are achieved by utilization of sensors and mapping. Real-time data provides substantial feed-back for the architects to both utilize in the design process and as means in developing and evaluating their proposals. Sustainability is acquired by the efficient use of campus resources and reducing consumption. In both proposals bicycle sharing system creates an eco-friendly alternative to existing transportation system in the campus by minimizing air pollution and fuel consumption. The on-campus underused or wasted resources are activated and incorporated in the designed scenarios as a means of generating new spaces and promoting new social interaction. These proposals inject new lives and functions into existing campus spaces and stimulate their utilization, as well as providing alternative solutions such as the use of waste carbon dioxide and water to feed green infrastructure.

Smart spaces are shaped with real time data, feedback, and information technologies. The proposed ideas are remarkable in terms of their fabrication techniques, selection and use of materials, tectonic characteristics. Designed spaces appear as algae farms, smart surfaces, canopies, shells, and/or urban furniture emerging socializing catalysts. The process is an indicator that ITU Ayazaga Campus has significant potential to model for a smart campus in Istanbul. Proposed design ideas demonstrate GSS '13 program serve as an important architectural research tool relative to the production of spatial knowledge and architectural space. Efficient use of existing energy resources becomes recognized as a way to create self-sufficient and sustainable architectural space, while the project also underscores that the contribution of information and communication technologies in the process of design techniques and the novel experiential characteristics of these new architectural spaces.

The primary result of the process demonstrates designed spaces that are unfixed, organic, self-sufficient and sustainable in terms of their tectonic characteristics and materials, information technologies and living scenarios exhibited. The projects reveal a new design culture that stimulates production, action and interaction. The users of these new spaces are no longer simply passive consumers, but are now active procedural participants who assist in the creation, construction, and development of an architectural space or spaces.

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