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INFLUENCE OF INTERNET OF THINGS ON PUBLIC SPACES CREATION PRINCIPALS AND FURNISHING

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ABSTRACT

The paper reviews the influence of modern technology – Internet of things (IOT) on the public environment. Different aspects of this influence on the principals of how the spaces function, how they are designed and furnished are studied. The leading trends in these principals, initiated by the penetration of IOT technology are shown, as human centric lighting and heating, smart furniture etc. All these are leading to energy saving, increased security, productivity and comfort enhancement.

Key words: internet of things, public furnishing, public spaces.

INTRODUCTION

The rapid pace and intensity with which technology enters the everyday life of people inevitably alters the environment in which they live. In modern housing, technological innovations are a reality and a necessity, facilitating the everyday life and ensuring the safety of the occupants. Introduction of the Internet of things technologies into the real life turns everything being “smart”: smart cities, smart buildings, smart health etc. The concept of "smart home" is no longer a novelty, but quite a debated issue in both popular and scientific circles. New technologically integrated furniture is being offered nowadays, "robot furniture" is being talked about. However, a person spends almost as much time out as he does at home. The public environment is varied, multifunctional and rich in its diverse activities, which implies the integration of its furnishings with modern technologies. The implementation of Internet-of-things technologies in the public environment obviously changes its style, functionality and vision. Due to the applied Internet-of- things technologies these public spaces, as office buildings, hospitals, schools, commercial centers etc. become smart. Access control systems, product marking, contactless payment, self-service terminals are just a small part of the real examples that can be mentioned. This penetration of the Internet-of-things technologies inevitably changes the design principals of the public environment and the way of their integration in it. This article examines the changes in the social environment, interior and furnishings that this integration brings about. The different aspects of the impact of "Internet of Things" technology on the principles of organizing public spaces are also discussed.

Internet of things definition and objectives

The Internet of things, also known as the Internet of objects, refers to the networked interconnection of everyday objects. Another definition is: A network of interconnected computers to a network of interconnected objects, from books to cars, from electrical appliances to food, and thus creates an ‘Internet of things’. “Internet of Things” refers to the general idea of things, especially everyday objects that are readable, recognizable, locatable, addressable, and/or controllable via Internet.

The main objective of the Internet of things technologies implementation is to connect everything, everywhere and every time. In this way the outcomes of Internet of things implementation are:

1. Reducing energy cost by integration of infrastructures (Heating, Ventilation and Air Conditioning – HVAC, Lighting, …etc.)
2. Increased safety and security by integrated presence detection through information fusion
3. Productivity, capacity and management enhancement through asset tracking
4. Comfort enhancement through human centric lighting, heating and smart furnitures

How these principals are applied in public environmental creations and how they influence and change the design principals of this environment?

1. Internet of things technologies in office buildings

1.1. Personalized lighting, heating and humidifying of the workplace with sensors which via internet-based systems control temperature, lighting etc.. For the redesign of Agnelli Foundation headquarters, Carlo Ratti Associati has developed a personalized heating, cooling and lighting system which follows occupants as they move around the building, like an individually-tailored environmental bubble. The system gives shape to a workplace that naturally learns and is synchronized to its users' needs, thus optimizing space usage and limiting energy waste (Figure 1 and Figure 2).

Figure 1: Personalized heating, cooling and lighting system

Figure 2: Personalized heating, cooling and lighting system

1.2. Movable walls for dynamic space remodelling – a flexible solution for multifunctional and more efficient distribution of large spaces. This innovation provides an easy and fast way to modify the dimensions and functions of the premises, and its field of application can be in offices, conference halls, exhibition halls, etc. (Figure 3 and 4).

Figure 3: Movable walls for dynamic space remodelling

Figure 4: Movable walls for dynamic space remodelling

1.3. Ergonomics are an important aspect of furniture design. Ergonomic chairs "should allow each partof the body to be in its most comfortable position, but it should also encourage movement and be easily adjustable to different seating positions". Chairs are now available which automatically respond to movement of the body (Figure 5 and 6).

Figure 5: Ergonomic seating

Figure 6: Ergonomic office chairs

2. Internet of things technologies in commercial sites, public catering establishments and bank offices

2.1. Self-service terminals in shops, banks etc. – this implies excluding the human factor (cashier), which allows for a greater number of cash desks and hence a larger capacity of the unit (Figure 7 and Figure 8).

Figure 7: Self-service terminals in a bank

Figure 8: Self-service terminal in stores

2.2. Self-service terminals in fast food restaurants – the lack of service staff reduces salary costs and eliminates the likelihood of human billing errors. From the user's point of view the unlimited choice-making time and reduced customer concentration can be considered as an advantage. But above all the self-service option reflects on the space zoning – the service area is decreased and the cashier area is shifted to the entrance-exit zone (Figure 9).

Figure 9: Self-service terminal in restaurant

2.3. "Touch screen" tables in restaurants – replacing the menu, they save time for taking the orders from a waiter and give more freedom in terms of choice-making time (Figure 10 and Figure 11).

Figure 10: Touch menu

Figure 11: Smart table in a restaurant

2.4. Designed by Carlo Ratti Associati, the bar's mechanical arm prepares cocktails ordered by tablet. Clients will start the Bionic Bar experience by tapping their RFID bracelet on one of the tablets on display. Besides choosing from standard and signature recipes, guests will be able to entirely customize their drink with an almost limitless number of combinations. Guests will have the possibility to name their own creation, access their order history and reorder their favorite cocktails, while rating and commenting on them (Figure 12).

Figure 12: Barman-robot

2.5. Supermarket of the future – a large grocery store featuring pioneering digital solutions developed by Carlo Ratti Associati. It incorporates facilities such as interactive food tables, smart shelves and real time data visualizations, which will inform shoppers about the origins and characteristics of particular food stuffs, promoting more informed consumption habits. At the Supermarket of the Future, more than 6,000 products are displayed on large interactive tables. As the shopper puts his hand close to a product, extra information about the food appears on a suspended digital mirror above – as in seamless augmented reality. Through these "augmented

labels", each product can communicate its nutritional properties, its origin, the presence of allergens, waste disposal instructions, correlated products and promotions and other data, potentially encouraging a stronger use of fresh, local products, and even new social links among people (Figure 13).

Figure 13: Smart supermarket

2.6. A uniform disposition of sensors develops a new way of communicating the products' data and their location within the store. This information may be shared with the profile of the customer and must be processed as an input into algorithms that formulate proposals for cross-selling (Figure 14).

Figure 14: Smart clothes store

3. Internet of things in Smart Hospitals

Introduction of the novel hospital bed transportation system using multiple cooperative service robots (using principals of IOT) will change the design of the beds and will change the structure of the hospital interior as the maintenance and cleaning of the beds will be localized in a separate place in the hospital and the logistic of the beds will be based on the service corridors (Figure 15).

Figure 15: Hospital bed transportation

4. Internet of things in Smart Schools

With e-learning applications, students can work at their own pace, which allows the teacher to provide one-to-one instruction to those who need it most. Additionally, assessments can become more seamless, less manual and time-intensive. Educators no longer have to grade every exam. Instead, they can spend time focusing on the learning activities that have the biggest impact on students. The laboratories become virtual, so that the students will be able to experiment from home. Finally, when connected to the cloud, the see-learning technologies can collect data on student performance, which can then be used to improve lesson plans in future school years.

The IOT stands to dramatically change the way institutions operate, protecting valuable assets and enhancing student learning at every level. In addition to the immediate benefits outlined above, educational institution scan harness long-term value from these technologies by analyzing the resulting data to better plan resource allocation, curricula and safety procedures in the years to come.

5. Internet of things and Product security

5.1. Anti-theft marking the goods in shops (Figure 16).

Figure 16: Anti-theft label

5.2. Parcel marking – shipment quality information (Figure 17).

Figure 17: Shock tag

5.3. Drugs marking (temperature tags) – information about their storing temperature (Figure 18).

Figure 18: Temperature tag

6. Internet of things and People safety and security

6.1. Access control at the working place – information about the time of entry, working time and exit (Figure 19).

Figure 19: Card access control

6.2. Access control in residential buildings, hotels etc. (Figure 20 and Figure 21).

Figure 20: Tag access control

Figure 21: Smart phone access control

7. Internet of things technologies for On-line sales and contactless payment

From the consumer's point of view, it saves time to go shopping, and from the owner's point of view–it saves space, equipment and staff.

CONCLUSION

Furniture integrated with some kind of IOT technology is a fact, but not very common, which could be due to their high cost. The same applies to technological innovations providing comfort and coziness in the workplace.

Changes in the public environment concern mainly the different approaches to space organization and functional zoning. Self-service penetration is widely observed as a mass approach, and this is a major factor in determining the trends in the public space changes. On the whole a trend to excluding the human factor can be observed in the field of services, as a result of which the customer service area has been limited or entirely missing, at the expense of diverse, technological and saturated with new features self-service areas.

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