

The Use of Internet of Things Technologies Within The Frames of The Cultural Industry: Opportunities, Restrictions, Prospects.

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Abstract. The article presents an analysis of the possibilities and limitations of the use of information and communication technologies, in particular the Internet of things as an effective tool for artistic and sociocultural practices in the context of transformations of cultural industries. It is revealed that such radical transformations lead to a change in the formats of cultural objects, their content and form. The prospects of technological development are analyzed and the framework of interdisciplinary research is set.

Considering two main trends in the field of culture - the fusion of art with science and the high demand for viewers' participation in art-projects, we emphasize the role of technology in the development of media and focus on the prospects that can provide the Internet of things. In addition, analyzing the perspectives of contemporary technological tools as creative tools, we argue that the Internet of things and derivative technologies can have a strong influence on design, education and culture: today the society faces exponential innovative growth in all areas, but the most promising among them are those which provide the user with an active position, ability to provide feedback and an option to become co-author of the responsive, recipient-oriented projects that engage complex technical excellence in order to meet the expectations of a contemporary adaptive user, viewer or student.

Keywords: Internet of things, IoT, the culture industry, cyber-physical systems. RFID, NFC, iBeacon, communication society, creative production, design, creative industry, trends, contemporary art, theater, interactivity, participation, immersion, media art.

Introduction

Intensive technological development of the society contributed to the activation of the processes of introducing digital technologies both in the sphere of production and of cultural industry. In the cultural industry, this has led to a radical transformation at all levels: organizational, marketing, technological, substantive, personnel etc. The very

structure and form of the cultural product, which today has a hybrid character and combines classical artistic mediums and the latest information and communication technologies, has changed [1].

In this regard, the problem of application of certain technologies in the cultural industry, taking into account their opportunities and limitations in use, and indicating the possible prospects for their development, becomes particularly urgent for a research. One of the key technologies today we consider an information-communication technology of the Internet of things.

In recent years, the flow of scientific publications on the issue of digital technologies in such areas as economics, medicine, education and other industries has been increasing [2, 3, 4, 5, 6, 7, 8, 9, 10], we also focus on their application in the field of cultural industry. In our article, we point a scientific niche in which we consider information and communication technologies – the Internet of things (IoT) in particular – as an effective tool of artistic and socio-cultural practices in the context of the development of cultural industries that require understanding of the possibilities of their practical use in a communication society.

Cultural industries today have become an important part of the national economy of many countries, creating an environment for the implementation of creative work, the introduction of information and communication technologies at all levels of human life [1]. The leading role in this process today is played by Internet technologies, which not only accelerate the production and distribution of goods and information and images, but also create a feedback effect which may not be compared to anything from the past experience of consumption.

Considering the impact of information and communication technologies in the cultural industry (including wireless sensor networks, the IoT technology and etc.) we deliberately avoid extrapolating the problems of their linear development. Our key idea is that the intense technological development at each phase involves a new plan of connecting technology with cultural queries of the industry and to rearrange elements between scientists, engineers, designers and artists. That, in turn, will lead to the emergence of brand new combined products.

Basing on this, we will focus on the current state of the Internet of things technology itself, its communicative and aesthetic opportunities in the field of culture, will determine its capabilities and limitations, and describe the range of tasks that need to be addressed in the nearest future.

1 Internet of Things in The Cultural Industry

The Internet of Things (IoT, Internet of Things) is a system of integrated computer networks and connected physical objects (things) with embedded sensors and software for data collection and reporting, with capability of remote monitoring and control in the automated mode without human intervention [10, 11, 12, 13, 14, 15]. The technology of wireless sensor networks, consisting of wireless sensors and control devices is capable of self-organization with the help of intelligent algorithms,

shows large-scale prospects in the cultural industries. We see them as leading technologies in this field.

In this paper, IoT is understood more specifically as a multilevel system that includes sensors and controllers associated with specific exhibits, works of art or elements of a theatre stage, means for transmitting collected data and their visualization, powerful analytical tools of interpretation of the received information with the capability of remote monitoring and control in the automated mode, without human intervention.

These technological features make it possible to use the Internet of things as an effective technology of communication with the consumer in a space of diverse cultural objects. Nowadays, the production of cultural industries is focused not only on making objects, but also on the events that enhance our vision, convey vivid impressions and memorable images, make viewers' understanding of the world more profound and form new perceptual habits. This is achieved primarily through multimedia – images, sounds, tactile sensations and the transmitted texts (narratives) are intertwined to create new hybrid forms of art.

Due to the unprecedented extension of discursive networks and the accessibility of content created by the cultural industry, as well as by amateurs, the central place in the system no longer belongs to an Author but is grasped by a Viewer who independently makes his "curatorial" choice in the vast field of texts, images and sounds, makes high demands for the content, and therefore, becomes a driver of creative production [16]. Today these expectations are primarily bound up with interactivity and the immersive effect of a project, the involvement and engagement of a viewer becomes a quality mark in the fields of education, art and entertainment.

In this work we distinguish the following forms of cultural objects, each of which synthesizes an artistic, media and technological component:

1. museums and exhibition spaces;
2. interactive installations (including total ones) in combination with interactive art objects;
3. theatres and show-programs;
4. interactive audio guides (except museums and exhibitions).

In order to enhance the participation and immersive effect of the communication process associated with the experience of the cultural object space and immersion in its content in museums, exhibition projects, theaters, show programs, the Internet of things technology gets associated with the management of light, sound, stage, impressions and experiences of the viewer.

Communication with the audience takes on a synthetic character which allows to broadcast the main content of the cultural product with the greatest accuracy and efficiency. A person receives information through five sensory organs: eyes (vision), ears (hearing), tongue (taste), nose (sense of smell), skin (touch, tactile sensations, etc.). Today it is partially possible to carry it out by the means of the Internet of things.

Light control takes place through lighting electrical systems, automated laser systems and led technologies with program control and wireless communication.

Sound management takes place through analog and digital amplifiers, sound recording and broadcasting, modern audio systems capable of synchronizing with on-premises or cloud services.

The stage in the theater is a set of controlled stage elements, such as curtains, scenery, created manually or with the help of digital technologies, mechanized stage space, etc.

Impressions and experiences of the viewer are associated with the ability to participate, change and even create the development of the plot of any play. Depending on the physical abilities of the viewer, theatre venues can radically change the classical idea of the theater itself.

During a visit to a museum or exhibition space the sequence the viewer's visual range, which includes works of classical and modern art (paintings, sculptures, art-objects, installations) is of particular importance. In some cases, visual impact can be complemented by tactile sensations, the impact on the olfaction, vestibular system, etc.

Thus, with the help of the listed systems and processes, it is possible to design a new reality and form a space with specified characteristics and properties. This will help to attract the audience, increase the number of visits to cultural sites and develop the cultural industry in the direction of the art of the latest media.

2 Opportunities and Limitations of Internet of Things Technology Application in Cultural Objects

Owing to this accelerating trend of interdisciplinarity, cultural industries attract an increasing number of diverse specialists, including experts in the field of high technology, scientists, engineers, the merging of cultural strategies and scientific methods is clearly illustrated in such a striking phenomenon of the present, as media art.

Every day we are being struck by streams of images, but if in the information society it was in the mode of one-way broadcast, in the modern communication society social patterns have developed in such a way that the individual requires reaction, feedback in various forms, from "likes" and votes to participate in serious discussions. In the 20th century, the cultural industry has taken such a form, that main objective was a creation of the immediate effect of ecstasy, but today the developers of product faces new challenges: to arouse the viewer to a dialogue. The combination of these two goals requires investments in high technology, with which it is possible to create impressive media projects in formats never seen before. It is noteworthy that for the first time these tasks were set by artists who in the 1960s focused their attention on creating interactive environments and communicative situations (actions and happenings), where it was important to bring the viewer out of the state of passive absorption of images, to invite them to become co-authors in the creative process. Media art and the art of the latest technologies in 1970-1990s also as one of the key artistic strategies placed the emphasis on interactivity [17]. Today, this method of communication with the audience integrated into projects in the field of mass culture,

and it should be noted that the speed with which the industry of entertainment combines formal findings and methods of contemporary artistic practices is getting higher every day. The innovations presented at major international exhibitions such as Documenta or Arts Electronica, are almost instantly included in the toolkit of the cultural industry.

Within the diversity of institutions, museums and art galleries occupy a special place; today, they have a new, more flexible structure than before and their role goes far beyond the classical understanding of museum as a guardian of national heritage, nowadays a "new museology" is developed [18]. Participation sets one of the most important trends in the evolution of not only museums, but also cultural institutions in general: all institutions – from film clubs to libraries and archives – seek to engage the viewer in a dialogue and active exploration, to offer one the role of a partner and even co-author of cultural events [19].

Elements of the IoT technology are already quite actively used for the organization of exhibitions. In this vein, such technologies as iBeacon, RFID and NFC are the most widely used at the moment.

The technology of placing Bluetooth beacons (iBeacon etc.) around the perimeter of the exhibition space and close with the exhibits allows to organize visitors' local positioning as well as their indoor navigation. The tracking of users allows to not only effectively organize an exhibition space (identify the most popular routes around the exhibition space, total time of visit), but also to obtain data on the amount of time spent in front of certain exhibits, and accordingly, to track the level of interest in specific types of exhibits. The collection and analysis of the listed data may contribute to decision-making aimed at improving the efficiency of the exhibition space and in some cases increase incomes. A combination of technologies based on Bluetooth beacons and Wi-Fi positioning is used quite often to improve the efficiency of local positioning. This technology is widely used to increase the level of sales in shopping centers and malls.

In museums, such beacons automatically deliver the content depending on the zone the visitor is in. Sensors, placed in different parts of the exhibition space, interact with mobile devices (audio guides and smartphones with established museum applications) and activate specific content when approaching the desired location in space. The application of Bluetooth beacons can be found in the Metropolitan Museum [20], the Guggenheim [21] in New York, the Museum of Rubens [22] in Antwerp and in Russian Multimedia Art Museum Moscow (MAMM) where a successful implementation took place in 2015 [23].

RFID (Radio Frequency Identification) is a method of automatic identification of objects by radio signals which are read, recorded and stored in so-called transponders or RFID-tags. In fact, the emergence of RFID technology was the starting point for the development of the Internet of Things. In museums, visitors are given cards (similar to transport cards) or bracelets with RFID tags. They allow you to control the number of viewers, time of visit, to rank items on the basis of marks; it means that if the visitors like the object, it is possible to attach your bracelet to the scanner next to it, and your "voice" will be taken into account. This technology is used in the collection and analysis of users' behavior and adoption of appropriate solutions to

improve the efficiency of the organization of the exhibition space. RFID is used at the Cleveland Museum of Art [24], Science Museum The Exploratorium (San Francisco) [25], and in Russia the technology in this role was implemented at the exhibition of high technologies SMIT [26] in Moscow.

Near field communication, NFC (Near-Field Contactless Communication) is a technology for wireless data transfer of small radius of action which enables the exchange of data between devices over a distance of about 10 centimeters. In Russian museums, the NFC technology is not as widespread as abroad. In the world, NFC is used along with QR codes, for example, in the Australian Museum, Sydney [27] or the Museum of London [28]. NFC tags are placed next to the objects and paintings, and a mobile device with a special chip (a smartphone or a dedicated audio guide), reads the label, gives users access to the content in the form of images, videos, texts and links.

The abundance of recipients and consumers of cultural industries makes special demands to the formation and design of such facilities. Working on a concept, designers and artists are now modelling a behavioral situation with a person in a particular semantic field. Everything that happens in «the project» one strongly feels, he lives it through plunging into the exhibition venue where the set affects all senses and enhances the immersion. It is worth considering that in addition to educational and informational influence, visiting a museum or exhibition intends to optimize the emotional state of a person. In fact, one's state at the beginning of the visit can be easily changed at the "exit" by means of the appropriately organized space [28]. The exhibition itself and exposed objects are the effective tools for such changing, tuning. The emerging recipient's condition is influenced by various factors: perception of works in classical forms of visual and plastic art, as well as visual content, time, the use of light (light installation), sound (sound installation), fragrances, touches and etc. The overlay of technology and blend of different mediums on the visual content in accordance with the given scenario forms a special atmosphere of immersion and participation at all levels of perception.

3 Participation and Immersion: The Communication Process in Various Forms of The Cultural Projects

In order to present the "landscape" of interactive cultural products with the greatest completeness, we will follow below as the task of enhancing immersion and participation was solved in the previous period of the cultural development (based on the material of contemporary art of the 1960s-2000s) and what role technologies played in this process, and then turn to the examples of recent years.

The problem of participation holds a central place in the discourse of contemporary art in the 1960s due to the development of Neo-Dadaism and Fluxus, the philosophy of which presupposes blurring of the boundaries between art and life. Artists criticized rigid forms of art establishment, creating works not for sale on the art market, but for immediate impact on a viewer that no longer was separated from the artist by insurmountable border. The work of art ceases to be autonomous and distracted, it

goes “off the pedestal”, becomes open to the viewer, and interactive [30, 31]. Minimalist, postminimalist and neodada objects have become the first striking phenomenon of this kind, that influenced the viewer not like a traditional sculpture which has to be understood on the level of its subject (narrative), but as material bodies present in the same space as the body of the viewer and thereby forcing him to pay attention to his own presence and also to abolish habitual schemes of behavior, to deconstruct patterns of perception [32]. The degree of participation was drastically raised by Allan Kaprow in the invented format of happening, which was in fact not the inspection of art objects, but adventure of spectators in a specially arranged exhibition space (A. Kaprow, “18 happenings in 6 parts”, 1959; “Yard”, 1961).

Soon the interactive component of an art work became closely related to the use of modern technologies. In the early 1970s, video was the most up-to-date one and artists made use of its main innovation – the effect of feedback – to create installations, key elements of which were a camera-screen closed circuit on which the captured objects were projected. A viewer standing before the lens was literally facing himself in such an estranged reflection, seeing, however, not a mirrored, but a converted reflection, and it made him feel the aesthetic distance from his image and at the same time experience his own here-and-now presence. Such works were created by Peter Campus, Bruce Nauman, Dan Graham and other artists, they sought to maximize the use of a viewer’s body and therefore organized extended space around the camera-screen system in which a viewer could move then receiving both visual and motor impressions. A contemporary art researcher François Parfait emphasizes that an interactive installation is always “a construction in space and of space” [33].

The next step in the development of interactive works has become the use of the computer and the Internet in such projects as “Zapping Zone” (1990-1994) and “Immemory” (1996) by Chris Marker, where in the gallery space the artist placed dozens of monitors, creating a polyphono-chaotic flow of information, where the viewer is already occupied not with contemplation, but with search-oriented activity, attempting to pave their way in this saturated audiovisual field. The metaphor of the way is made play by Jeffrey Shaw in his interactive installation “The Legible City” (1988-1991), where the viewer was asked to ride a real bike, the movements of which were recorded by special sensors and transformed into a journey through the virtual city, which was shown on the screen.

The 2000s are characterized by the creation of responsive interactive environments through the use of motion sensing technologies. Focusing on the behavior and bodily reactions of a viewer, the artists create interactive works the aesthetics of which is based on contact and figuratively given feedback (“Probe” by B. Debacker, 2008; enactive cinema by P. Tikka, 2005, virtual reality video).

The next step taken by artists and designers is creation of virtual environments where a viewer may experience a state of maximum immersion and influence the world designed by the author (“Bjork Digital”, 2017) as well as create interactive environments in real exhibition space with the help of wireless technology. Single works, as well as environments are responsive to the presence of the viewer, consisting of a series of elements that interact by the principle of Internet of Things and will form a new stage of aesthetic development of the feedback phenomenon as a

way to strengthen participation, likewise, awareness of the viewers, their sense of themselves as elements in a living system of the world.

The development of information and communication technologies in this regard is the driver of the transition to participation projects and immersive artistic solutions, allowing to transfer the aesthetic experience to a new level. No doubt the cultural industry supplies products of different quality and purpose, and all of the above-described technology and artistic techniques are often used as a banal theme, however, we set ourselves the task to show that these same technologies and techniques in the hands of an artist can be a tool to create such "art", which will require the active intellectual and spiritual work of the viewer, his/her inner transformation. In particular the Internet of things, as will be shown further, is the technology allowing to solve one of the most actual problems of both modern art, and culture: the problem of art creation not "for all", but "for everyone", or, in P. Virno's terminology, for «masses» [34].

Modern theatrical performances and other show programs also abound in a variety of devices and sensors that can be organized online. The most striking example is light costumes, combining modern light technology, Internet of things technology and theater, a variety of optical effects. Modern virtuoso juggling and twisting of neon props, combined with bright space suits creates a futuristic atmosphere. The technology of "cold neon" is used to create such an effect: an electro-luminescent wire covered with a phosphor that shines in an electromagnetic field. Each suit is a complex multi-channel light system handmade. Costumes depending on the requirements can be controlled wirelessly transmit Bluetooth data [35], ZigBee [36], Wi-Fi [37] or even to organize a body network standard (Body Area Network, IEEE 802.15.6 [38]). The microcontroller costume program can be loaded both written for each dancer, implying the performance of certain synchronized with lighting effects costume dancer movements and dynamic software system that analyzes the position of the dancers relative to the scene and each other, as well as having the ability to dynamically adjust to the style of dance (for example, freestyle). In the first case the choreographer thinks over not only movements for each participant, but also sequence of when what detail of a suit has to be lit. A separate application on the PC synchronizes the operation of all controllers with music — all this is calculated to milliseconds. The second case is more suitable for improvised performances and dances, but has a high complexity of implementation [39, 40].

An example of the use of light costumes is the theater of light performance "Svetlitsa" [41], which arranges not just dance numbers, but dance and theatrical performances. Light performance theatre "Bright faces" uses its own technological developments, including programmable micro-controllers that allow you to control the led costumes with neon elements and inflatable constructions, creating a complex, self-organizing network with the ability to control different elements of the systems depending on the specific situation. In this case, specialists program lighting effects for each costume and art object individually. The program is transmitted to them in real time synchronously with music and video installations in accordance with the Director's idea.

Another example of the use of light costume is the Prague Black theatre or the Theatre of light and shadows [42] - a new unusual kind of theatre art, based on the play of light and shadows, with the addition of bright color effects. Black scene, actors in black costumes, "reviving" stage props. There are no words, there is only music, pantomime and acting plastic. This theater embodies the idea of harmonious synthesis of shadow theater, music, dance, pantomime and modern information technologies in order to give the audience aesthetic pleasure. Perhaps because there is no language barrier characteristic of drama or Opera, the IMAGE theatre has become surprisingly popular among tourists from all over the world, and tickets for its performances are booked in advance. More than 7000 performances played and almost one and a half million spectators within twenty years, this is not the only scale of the success of the theater.

Today, classical stage scenery is traditionally associated with theatrical, circus or cinema decorations that imitate reality or create a new one — depending on the artist's idea. But over the past couple of decades the technology of video removal penetrates in stage scenery more and more. Modern video technologies can create great entertainment, but at the same time they are on the way to simplify the technical component of the use of scenery in the theater or show. In this regard, the market of today's theater follows two main trends that directly affect the scenography of the play: the first – the use of multimedia technologies; the second – the use of complex mechanized/robotic structures together with lighting effects. In other words, many performances undergo fundamental changes aimed at the "wow-effect" on the part of the viewer, which is easier to achieve with the help of scenography than through an intricate plot. An example is such a technology of creating stage space as Black box theater [42], which is a mobile and flexible system not only for organizing stage and working space, but a rather complex mechanized system with a huge number of sensors and actuators connected to each other with the help of Internet of things technologies.

Internet of things technologies in combination with virtual and augmented reality technologies in the cultural industry solve the actual problem of finding and revealing new ways of communication between the audience and the theater.

Two years ago, the Parisian Comedy theatre (Théâtre Le Comedia [44]) held the opening of the next season under the slogan "Breaking language barriers!". A pair of augmented reality glasses, connected to the Internet, helps spectators who want to enjoy the French theater, but do not speak the language. Thanks to this device, everyone can see the English or native translation of the phrases spoken by the actors.

In addition to the augmented reality (AR) [45], the theatre uses virtual reality (VR). In the traditional sense it is, of course, rather a film, because there is no direct contact with the actors, but the new genre to the theater is very close. First of all, due to the effect of presence, when the viewer is inside the action. In addition, if in the cinema our mind is manipulated by the operator and the editor, while in the theater the viewers decide what to pay their attention to: to the actors, to the scenery or to the neighbor. The same freedom is given to the viewer in the VR-production: the viewer can at least ignore the whole performance of the characters and look at the sky above his head. In more complex productions, the audience is not even limited to a static

position in the chair, but allows you to navigate the virtual world — which is already close to the now popular immersive performances. A serious problem for the development of VR theaters and productions is the imperfection of communication and data transmission technologies for VR helmets and virtual reality glasses. Due to the low speed of streaming data transmission at the network level, it becomes impossible to organize collective interaction in VR-theater space or staging, which from the point of view of the network architecture is the inability to create a wireless network within the concept of the Internet of things, the nodes of which are VR-helmets. These restrictions are currently being solved by many leading companies, such as TPCast [46].

The theatre is in itself an art, the art of the real and rich, and, therefore, the virtual reality of the sometimes to anything. However, thousands of people around the world have limited physical capabilities, which often prevents them from touching the beautiful. It is obvious that in this case, the development of technology works exclusively for the benefit of physically challenged people, helping everyone to hear and see the play as it is perceived by a healthy person. Today, the development of personal screens with subtitles, augmented reality glasses, personal audio headphones and even remote broadcasting in virtual reality serve people with disabilities, breaking the boundaries between art and disease of each of us.

The IoT is used not only for the organization of the exhibition space but also for improvement of the effect of immersion due to the total automation of the exhibits and staging during the whole visit to the exhibition space. The main task is to collect and analyze data coming from both the interactive exhibits at the exhibition, and visitors. The analysis of extensive data from exhibits is connected to the network and operates within the framework of the concept of the Internet of Things solving the following problems: the detection of faults or partial failure of equipment used at the exhibition; remote monitoring of equipment status in real time on a PC or mobile device; predicting and foretelling of a malfunction or partial failure of the equipment; automation of power systems, the procurement process, scheduling, logistics optimization, control and maintenance by predicting results. The solution of these tasks leads to a change in an employee (from an agent to analyst-controller intervening in the process in exceptional cases) and a significant reduction of economic losses due to untimely identified and/or predicted situations of failure or accident.

4 Prospects for The Development of New Technologies in The Cultural Industry

Having considered the application of the IoT technologies in the cultural industry, we finally arrived at the conclusion that the inferences we draw, lie in different planes of its functioning.

It is obvious that the Internet of Things is currently effectively used not only to improve the performance of the global digital economy and cultural industry as an independent region. It is an effective technology, the use of which results in

increasing immersion of exhibition spaces and museums, as well as strengthening the communication "dialogue" component, which in turn affects the achievement of a qualitatively new level of development of commercialization models in the field of art that can be interpreted as an absolute trend. In this regard, we can identify a number of trends that will determine its development in the near future.

Owing to the growing trend of interdisciplinarity, cultural industries attract an increasing number of diverse specialists, including experts in the field of high technology, which can be seen on the example of such a bright phenomenon of our time as media art.

It opens up prospects and the fact that the artist, the designer and the curator know the possibilities and limitations in the use of information and communication technologies, including the Internet of things. It is well known that artists and designers were among the first to react to technological breakthroughs. Experiments with the digital medium were carried out by them for decades before the official digital revolution [17].

Obviously, the possibility of their use has great potential and exceeds existing limitations. At the same time, we take into account that in due course any technology shows its limitations in use when new challenges arise. The emergence of new tasks is associated with the emergence of new cultural practices, scenarios of interaction with the environment and communication with the audience.

We assume that possible applications of the IoT technology in the cultural industries lie in the way to use them as an effective means of communication with the audience. Here we distinguish two strategies:

- 1) an institution collects data about the activity of visitors using the latest technologies, and this information is used to improve the efficiency of the project;
- 2) with the help of the latest technology, the viewer gets the opportunity to get engaged in a dialogue with the authors of the project, to set up the exhibition space upon one's needs or share his opinion about the exhibition.

If the first strategy is an elaboration of the classic methods of cultural institutions working with the audience (mandatory option), then the second trend is part of a general movement towards democratization of culture. Exhibition space or a separate exhibit "responds" to the appearance of the viewer and through this engages him in a dialogue, in intellectual work, in a game, the result of which will be a valuable experience, unique to each viewer. In other words, the Internet of Things can be used as a monitoring system or as a tool to shape out single (depending on specific qualities of the viewer) "texts", addressed not to the crowd, but to everyone personally. It seems that in the framework of the development of communication society this type of cultural products will have great value.

As the communication society develops, the future acquires the characteristic of invariance, presenting to the person more changeable than in previous years [47]. And this, in turn, leads to a new understanding of the communication process, which should become plastic, that will contribute to the evolution of traditional processes of interaction with the audience. From the point of view of the art theory this example leads culture to function in "the death of the Author" mode: a monologue is replaced by a dialogue with the audience. It is through dialogue, through the recognition of the

uniqueness of each personality that cultural industry can make a major and long-awaited turn from the formulaic mass production to producing multi-faceted art for the multitude [34].

The presence of a variety of branches in the development of both technologies and cultural practices enhances the trend of nonlinear development in these areas. High probability to face a situation, when tested starting from socio-cultural practices of the artist, designer and curator will order a technology before the current one will put a limit and it sets an independent vector of technological development.

At the same time, there are a number of problems at the level of collaboration in the field of technological development and production of cultural products, innovation management: the lack of a common established terminology understandable to representatives from different industries, the minimum number of common projects, insufficient understanding of the end result in joint activities, the fragmentation of professional interests and goals.

Worldwide, there is an acute shortage of qualified professionals with comprehensive training in the field of the Internet of Things and cyber-physical systems, as well as specialists, programmers and engineers capable of working at the interface of technologies in various fields of activity. In liberal education designers and curators of exhibitions must be also provided with structured knowledge about the possibilities of new technologies to expand the semantic field and enhance the emotional impact of the exhibits.

Obviously, it is needed to expand the possible applications of wireless technologies and sensor networks to create full-functional and actual objects of the cultural industry. There is a number of barriers to widespread the technology of the Internet of Things, including considerable financial and time expenditures in order to implement it in museums, there is also a lack of the amount of energy converted from the external environment which is essential for monitoring complex equipment and periodically send the information to the data center. Active development and practical application of the concept of the Internet of Things inside the cultural industry with the aim of commercialization of the objects become the leading driver of this process and will contribute to its rapid implementation.

5 Conclusion

Radical transformations of the cultural industry have influenced both the structure and form of the modern cultural product, in which today traditional and innovative approaches are organically combined. The spread of information and communication technologies has led to the need to change the traditional patterns of creating a cultural product, taking into account the peculiarities of the communication space in the cultural industries.

The instruments of enhancing participation and immersion become technologically more advanced and accessible, so it is natural that the space of socio-cultural practices will become more personalized and interactive.

The diversity of technological solutions increases the competitiveness of contemporary cultural objects in the market of cultural industries. Both entertainment and psychological aspects of the cultural object are becoming increasingly important regardless of its format.

Thus, we may conclude that the fundamental change in communication processes in cultural facilities has resulted in a substantial transformation that needs to be further integrated and interdisciplinary analysis.

In an attempt to frame the future of the research field, we identify a number of tasks that need to be addressed in the nearest future on the interdisciplinary basis.

1. Foresight - research of prospects of cultural industry development and transformation of its objects with the use of information and communication technologies in the digital economy;
2. Carrying out systematic research on the integration of new technologies in the cultural industry;
3. Comprehensive analysis of requests and visionary projects that humanitarian professionals can submit to scientists, engineers and programmers;
4. The creation of laboratories and research groups which will develop the collaboration of scientists, technicians, curators, artists, etc.;
5. Harmonization of terminology and lexical correspondences in order to improve professional and scientific communication;
6. Preparation and implementation of joint research in the field of digital Humanities (DIGITAL HUMANITY) and breakthrough interdisciplinary projects based on research data;
7. Development of classification of projects that can be implemented in the field of culture with the help of Internet of things technology, technological monitoring of this area;
8. Analysis of psychological and social impact of such projects, processing of feedback;
9. Quantitative evaluation of the IoT projects emerging in cultural industry;
10. Qualitative evaluation of the impact such projects have.

Together, these tasks become part of a unified communication process at the level of determining the directions of development of the cultural industry, education, science, art and design for the coming years. It seems to us that the use of the latest technologies in the sphere of both mass culture and contemporary art can go far beyond the simple "attraction" (which is the case today) and open up the possibility of creating new forms of communication and relations in the system of "artist-piece-viewer". We believe that the introduction of the Internet of things technology, used to expand art mediums, can be the key to the creation of impressive art projects, not only spectacular and entertaining, but also those that will strengthen the democratic component in contemporary art. The latest technologies may open the way not only to new messages, as we can assume recalling M. McLuhan, but also to new kind of experience. As we have argued, it can be the experience of understanding an audience as a "multitude", and each viewer – as an individual with its own creative initiative. In today's economy, where mechanical work is less needed and a creative approach to

solving problems at all levels is more and more appreciated, the experience of transferring cultural industry projects to the tracks of co-creation and participation can become a way of radical transformation of society in the direction of more relevant life strategies. Solving this problem, of course, will require systematic work, including both relevant interdisciplinary re-search and the formation of creative laboratories where artists and technicians will be able to take the contemporary challenges together. We invite all interested parties to perspective interdisciplinary cooperation in the field of understanding the processes of practical application of information and communication technologies in the cultural industry.

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