A survey on the awareness on Virtual Reality, Internet of Things and Blockchain in the 4th IR era

Konstantinos Sakkas*, Niki Eleni Ntagka*, Panagiota Vinni*, Paraskevi Artemi*, Aristidis Anagnostakis††, Nikolaos Giannakeas*, Katerina D. Tzimourta*†, Alexandros T. Tzallas*, Euripidis Glavas*

* Department of Informatics and Telecommunication, University of Ioannina, Arta, Greece
†Dept. of Electrical & Computer Engineering, University of Western Macedonia, Kozani, Greece
††Department of Accounting & Finance, University of Ioannina, Preveza, Greece

ksakkas@uoi.gr, niki.el.daga@gmail.com, penyvinni@gmail.com, vivian-artemi@hotmail.gr, arian@uoi.gr, giannakeas@uoi.gr, ktzimourta@uoi.gr, tzallas@uoi.gr, eglavas@uoi.gr

Abstract— **The Fourth Industrial Revolution (4th IR) is hastily reshaping the global industry. The term is often used as a semantical umbrella to describe state-of-art technological advances that improve the quality, the productivity and the efficiency of the industrial and societal processes. It combines developments in the disciplines of Artificial Intelligence, Virtual Reality, Robotics, Internet of Things, Genetic Engineering, Quantum Computing and Blockchain. Metaverse itself, in the form of AI-fueled 4D virtual reality space is redefining the way humans and machines are interacting with themselves and with each other. To maximize the positive impact of the 4th IR, it is essential that the underlying mechanisms are conceivable and assimilated by everyone. In this paper we investigate the awareness of the general population on Virtual Reality, Internet of Things and Blockchain technologies under the framework of the 4th Industrial Revolution. A literature review on the core 4th IR technologies, supplemented with a combined questionnaire survey is presented. The work aims to quantify the awareness of the general population on the technologies that contribute the most to the 4th industrial revolution.**

Keywords— *4th Industrial Revolution, Virtual Reality, Blockchain, Internet of Things.*

I. INTRODUCTION

Midway through the 1980s, the phrase "virtual reality" was first used by the American author and pioneer of virtual reality, Jaron Lanier, who defined it as an "interactive, three-dimensional environment, made by a computer, in which one can immerse oneself". However, over time, as well as with the exceeding evolution of the technologies, this definition turned more into "the simulation of a real or imaginary environment by a computer" which is delivered through the appropriate equipment - a VR Headset [1]. The immersion into the virtual world is achieved through the use of specific devices through which the computer - processing the data it has collected and utilizing 3D graphics processing algorithms- creates the virtual world and allows for free movement and interaction within this virtual environment. Figure 1 depicts a representative sample of immersive equipment, the Oculus Quest 2.

Fig. 1. Oculus Quest 2 [2]

Virtual Reality is renowned and being used in a variety of commercial fields, including robotics, pharmaceuticals, multimedia, computer animation, gaming, etc. The pioneer in this field is Matsushita Electric Works, which, since 1990, has designed a variety of Virtual Reality application solutions for use in industry. Many businesses have launched items that the ability to create Virtual Reality Application systems [3].

The impact of VR in the world of technology has completely reshaped the lifestyle of people and the modern society itself.

Alongside with the introducing of the alleged Internet of Things (IoT) technologies designates an overall upgrade to a higher technological level to a society full of smart devices [4]. Kevin Ashton coined the term "things" in the 1990s to refer to a collection of tangible items interconnected in some way and data exchange with other systems and devices over the internet. IoT technologies enable small devices to exchange data and information with one another to give users more functionality, comfort, and control. The principle is illustrated in Figure 2.

There are now tens of billions of connected IoT devices worldwide, and this number is anticipated to increase as Internet connectivity becomes increasingly common in electronic equipment [6]. Examples of IoT applications that have enhanced people's lives include smart homes, smart cities, and smart transportation. With continued growth, these applications will fundamentally alter the current technological era [7].

Fig. 2. Internet of Things Network [5]

Technological innovations, such as the invention of electrical appliances and the introduction of the Internet, have so far served as driving forces for business and economic transformations [8].

Blockchain technology is one of these most recent technological advancements, It constitutes an immune chain of records, organized in a cryptographically linked list of Blocks. Each such block contains the cryptographic thumbnail of the previous. A simplified block structure is presented in Figure 3. Blockchain allows for secure and reliable peer-to-peer transactions, as well as the formation of disrtibuted networks and systems without the necessity of third-party intermediation [10]. Hence, the applications of the Blockchain technology extends in almost every field of the economy, while more and more companies, organizations and public authorities are investing significant funds to apply this new technology on pilot level.
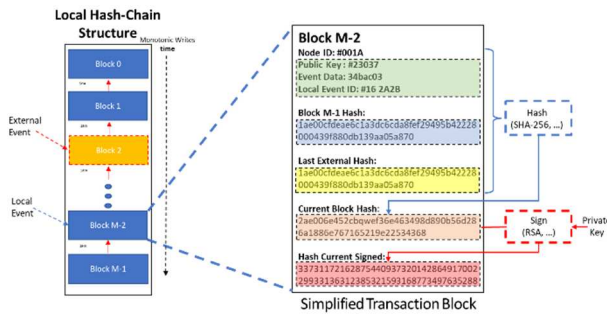

Fig. 3. Simplified micro-Blockchain Transaction Block structure

Domains of application include:

- **Financial / Insurance services:** The confirmationand the clearance of the financial transactions is done without the need of third-trusted parties regardless of the geographical location of the transacting parties.

- **Governance:** Smart Contracts advance digital governance and allow for much more effective, secure fast, automated and transparent processes.

- **Internet of Things (IoT):** Devices that are connected to the internet, interacting with their owner and with each other, continuously providing and receiving data are characterized as smart. Blockchainified operation

provides a supreme level of recordkeeping and transactional immunity operation.

- **Virtual currencies / cryptocurrencies:** For the first time in the digitized world, they deliver peer-to-peer reliable financial transactions among non-trusted peers.

- **Personal data:** Modern technology, as a new way of recording and storing data, must be viewed in the light of the law of personal data protection [11].

It is usefull to emphasize that apart from being the underlying technological infrastructure of cryptocurrencies, Blockchain technology revolutionizes every aspect of the activity. Even while being at an early stage and still evolving, it is capable of helping to address the challenges faced in many fields of the 4th Industrial Revolution and to provide solutions in many issues plaguing society [12].

The technologies mentioned so far are part of the evolving 4th Industrial Revolution, Internet of Things, Artificial Intelligence, Virtual Reality, Robotics, Cloud Computing, Sensors and 3D Printing are the technologies of the 4th Industrial Revolution [13].

The 4th Industrial Revolution as a semantical umbrella was originally conceived in 2008 by academic institutions and private enterprises. It is inclusive of advanced technologies and ideas utilized to bring industrial manufacturing on to a new stage, i.e. smart manufacturing. Through Artificial Intelligence and the Internet IoT the distinctions between digital virtual space and real space are analyzed creating a system of mutual interaction [14]. Its role is variable from manufacturing to satisfying customers by providing value according to demand. Industrialists like the idea, and a high acceptance rate has been seen. One of its main advantages is that it gives businesses access to a new capability of digital technologies that does more than just businesses by improving optimum output but also gives clients what they want in today's citizen environment. Additionally, it advances industrial development and contains a system that offers the best possible environmental protection. Unlike the previous industrial revolutions, in 4th IR sustainability is a highly treasured trait in the. [15]. The fourth industrial revolution opens the door for a technological and social revolution that will fundamentally alter how the world is perceived [16].

II. STATE OF THE ART

The Literature Research carried out was based on queries – key words of the research topic. However due to the fact that the results of the queries to the for a combination of all of the invoked technologies were few, the literature review was divided into three categories of relevant research according to the following combination of keywords [17] – [28]:
- Blockchain AND 4th Industrial Revolution
- 4th Industrial Revolution AND Internet of Things
- Virtual Reality AND 4th Industrial Revolution

The conclusion induced was that even though there is an immense volume of research articles on each of the core technologies (i.e., Virtual Reality, Internet of Things AI and Blockchain) very few deals with their integral role to the 4th Industrial Revolution. Based on this, we developed and

distributed a combinatorial questionnaire, with the initial aim of recording the responders' acquaintance to each of the invoked technologies individually, as well as to the integral role of these technologies to the 4th Industrial Revolution.

III. QUESTIONAIRE METHODOLOGY

A. Questionnaire implementation

The contribution of technology to the 4th Industrial Revolution is often taken for granted, still this does not always hold. The questionnaire developed in this research was based on this observation. The questionnaire was based on an offer-and-demand methodology, thus, for us to collect the information from the participants and for the participants to obtain useful feedback on these technologies.

In more detail, in each module of the questionnaire, the participants in the 1st phase were asked to answer a series of questions related to the module, while in the 2nd part, the participants were briefed on the concepts of the module as well as information on the questions they were asked to answer. At the end of the modules, the participants were asked to evaluate the questionnaire as well as the method applied.

B. Experimental procedure

The experimental process involved 50 participants, 30 women and 20 men with an age range from 18 to 50, where they were invited to take part in the research through the questionnaire. People with different educational backgrounds of various domains including but not limited to Informatics, Economics, Chemistry, Foreign Languages, Healthcare, participated in the survey, such as shown in Figure 4 and 5.
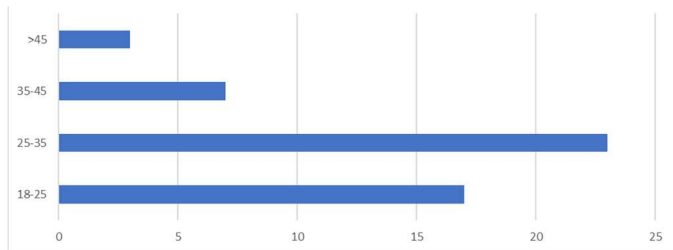

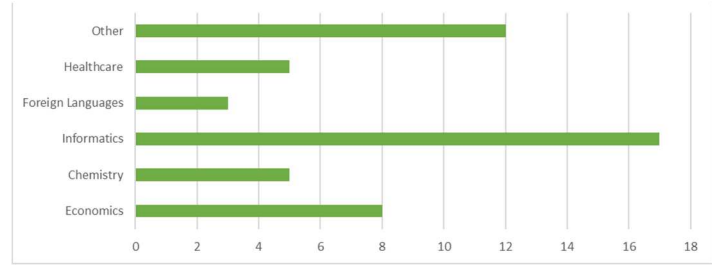Fig. 4. Responders' age distribution

Fig. 5. Responders' domain of expertise

The sample was unbiased and representative. The participants, after having been informed about the topic of the research and the methodology, they filled in the questionnaire under thematic sections as follows:

- 4th Industrial Revolution
- Blockchain technology
- Internet of Things
- Virtual Reality
- The contribution of Virtual Reality, Internet of Things and Blockchain to the 4th Industrial Revolution
- Evaluation of Research

In each of the thematic units there was a series of questions related to the thematic concepts while at the end of each one, information about the concepts and technologies encountered in the thematic unit was given to the reader. At the end of these units there was evaluation of the research by the participants.

IV. RESULTS AND DISCUSSION

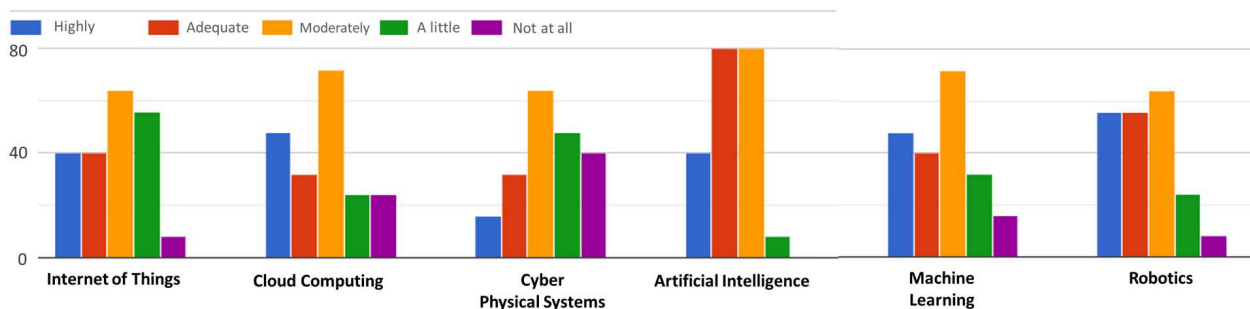The results of the survey are shown in Figures 6 - 16 in the form of statistical graphs.

Fig. 6. Familiarity to the core 4th IR technologies

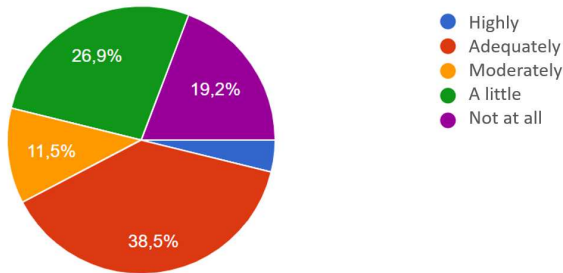**How familiar are you to the term 4th Industrial Revolution?**

Legend:
- Highly
- Adequately
- Moderately
- A little
- Not at all

26,9% • 19,2% • 11,5% • 38,5%

Fig. 7. Awareness on the term 4th IR

Do you know the term Internet of Things?

Legend:
- Highly
- Adequately
- Moderately
- A little
- Not at all

34,6% • 19,2% • 26,9% • 15,4%
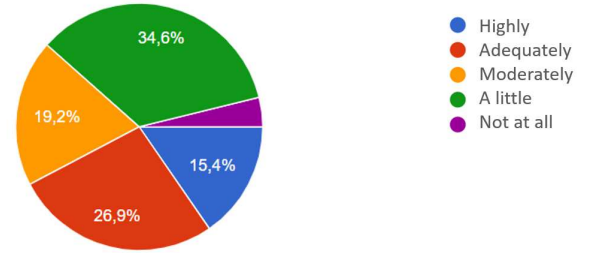
Fig. 10. Awareness on the term IoT

Do you know the term Blockchain?

Legend:
- Highly
- Adequately
- Moderately
- A little
- Not at all

34,6% • 23,1% • 23,1% • 11,5%
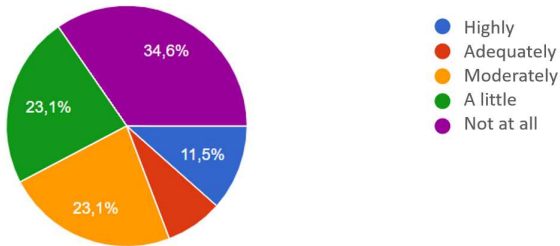
Fig. 8. Awareness on the term Blockchain

Do you know any of the following Internet of Things applications?

- Smart House — 25 (100%)
- Elderly care — 14 (56%)
- Medical and health care — 14 (56%)
- IoT transports — 6 (24%)
- Manufacturing with IoT — 6 (24%)
- Agriculture with IoT sensors — 9 (36%)
- Maritime with IoT methods — 3 (12%)
- Energy management — 9 (36%)
- Environmental monitoring — 10 (40%)
- IoT in the military sector — 7 (28%)
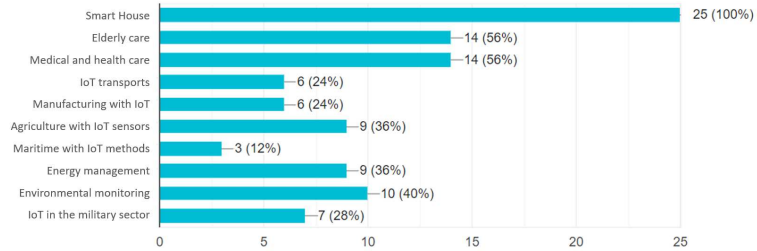
Fig. 11. Awareness on the main IoT applications

Do you know any of the uses of Blockchain?

- Cryptocurrencies — 20 (83,3%)
- Financial services — 15 (62,5%)
- Smart contracts — 6 (25%)
- Supply chain — 4 (16,7%)
- Domain names — 1 (4,2%)
- Games — 8 (33,3%)
- Other uses — 3 (12,5%)
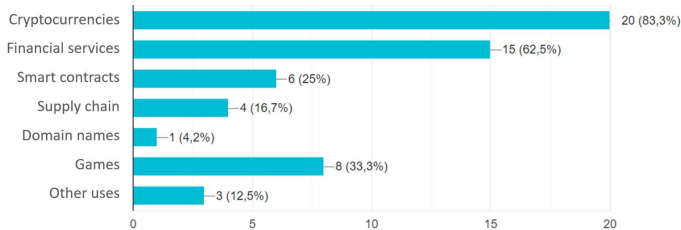
Fig. 9. Awareness on the main Blockchain use-cases

Do you know the term Virtual Reality (VR)?

Legend:
- Highly
- Adequately
- Moderately
- A little
- Not at all

23,1% • 34,6% • 34,6%
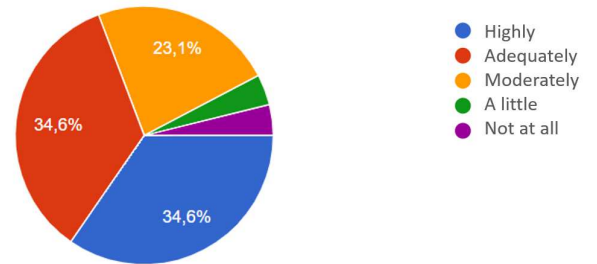
Fig. 12. Awareness on the term Virtual Reality

How familiar are you with the following 4th industrial revolution trends?

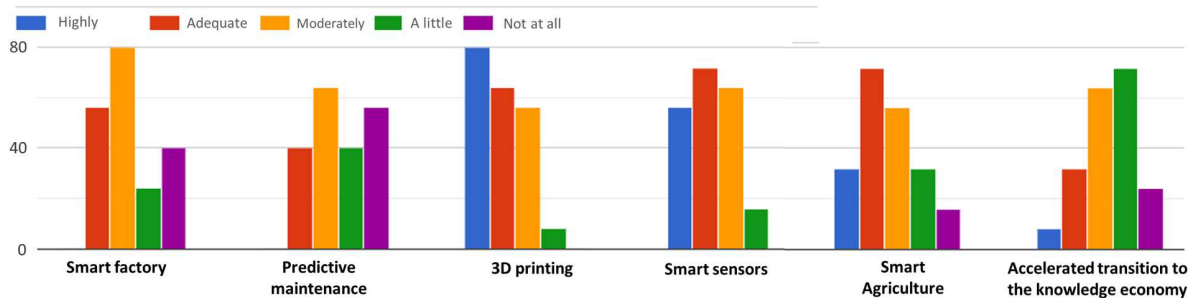Legend: Highly, Adequate, Moderately, A little, Not at all

Categories: Smart factory, Predictive maintenance, 3D printing, Smart sensors, Smart Agriculture, Accelerated transition to the knowledge economy

Fig. 13. Familiarity to some of the main 4th IR trends

Fig. 14. Awareness on the main VR applications

From the answers of the participants it follows that:

4th Industrial Revolution

- A moderate 38.5% of the responders are highly aware of the term 4th Industrial Revolution, while a vast 46% tend to know little or nothing about this concept.

- Regarding the technologies that combine the 4th Industrial Revolution such as Cloud Computing, Artificial Intelligence, Cyber Physical Systems, Internet of Things, Machine Learning and Robotics most of the participants stated that they are familiar with these technologies to a moderate extent.

Regarding the trends of the 4th Industrial Revolution such as Predictive maintenance, Agriculture & food industries, 3D printing, Smart factory, Smart sensors, and Accelerated transition to the knowledge economy, the majority presented increased familiarity with these concepts to a substantial degree. ***Blockchain tecnology***

- 57.7% of the participants stated that they know little or nothing about this technology, while there was also 23.1% who stated that they know about this technology.

- Regarding the uses of Blockchain such as Cryptocurrencies, Financial Services, Smart Contracts, Supply Chain, Domain Names, Gaming and Other uses, the first and foremost known use-case with a vast 83.3% was Cryptocurrencies followed by Financial Services with 62.5%, while the rest of the concepts presented lower scores, revealing an increased need for education intensification on the field.

Internet of Things

- There is a notable deviation in the responses of the participants: 42.3% stated that they are highly familiar to the term to a very good degree, while the rest of them presented ranged from "fair" to "slight" awareness.

- In terms of IoT applications, 100% of the participants stated that they are aware of the Smart Home, while 56% are aware of Medical, Healthcare and Elderly care applications.

Virtual Reality

- 69.2% of the population is sufficiently familiar with the term Virtual Reality, while 23.1% were partially familiar with this term.

- Regarding Virtual Reality applications 88% are aware of VR applications for entertainment and education.

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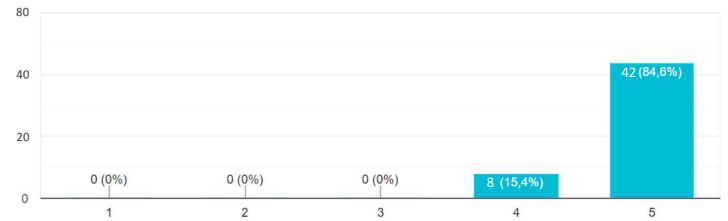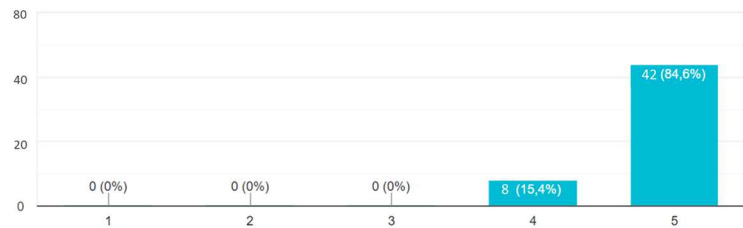Fig. 15. Questionnaire Answers about Rate research

Fig. 16. Questionnaire Answers about Methodology

Questionnaire

- 84.6% evaluated the research with the maximum grade (5), considering it as "excellent", while the remaining 15.4% evaluated the research with grade 4, considering it "quite good".

- Regarding the combined method of the questionnaire, i.e., questions and briefings, the method was again evaluated by 84.6% of the participants with 5 (excellent) while 15.4% granted it 4 (fairly good).

The results indicate that the term "4th Industrial Revolution" is rather disperse and poorly demarked. Still, with the exception of Blockchain applications, increased familiarity is recorded to the individual technologies it stands for. Increased familiarity to its core trends is also recorded. IoT and cloud computing are the more familiar terms, and Virtual Reality holds a substantial awareness degree. The answers reveal an elevated need for wider information diffusion regarding the integration of the technologies that shape the 4th industrial revolution. Even though a considerable part of the population were familiar to some of terms (i.e., the cloud computing, Internet of Things and Virtual Reality), they have not used or in any case they are still unaware of the fact that they actually use applications related to these technologies in their everyday lives.

V. CONCLUSIONS

The 4th Industrial Revolution is shaping the future brings great changes to people's daily lives. Still, the lack of a standard definition on the term prevents its assimilation by a significant

part of the general population. Towards this, in this survey, a semantical delimitation of the term is attempted: some of the core technologies it is constituted of such as the Internet of Things, Virtual Reality, Cloud Computing and Blockchain are identified, and the awareness of the general population on them is investigated. Alongside with emerging AI advances, they are believed to be at the cutting edge of the current R&D activity, while an increasing number of researchers are dealing with each one of them every day. The next step is their semantical aggregation under the inclusive term "4th IR", which will foster wider awareness on their seamless integration in applications.

The rising new reality calls for the rapid development of semantical integration frameworks - such as the "metaverse" and the "4th Industrial Revolution"- that combine ever-emerging technologies. They will lead to a more intuitive understanding and stand as a practical proof of the fact that it is the evolution on the combination of the technologies - rather than the evolution of every single one of them individually- that leads the vast advancement in everyday life.

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