

# Development of digital technologies for interpersonal communication

Ivaylo Iliev<sup>1</sup>

**Abstract:** This article examines the development of basic Internet communication technologies over the past decades and the changes that have come about as a result. The development from Web 1.0 to Web 3.0, characteristics of 5G technology, applications of artificial intelligence in business organizations, as well as capabilities of virtual reality sets are tracked. The results of an empirical study related to the attitudes and popularity of digital devices for interpersonal communication are presented, and conclusions based on the results are formulated.

**Keywords:** Digital Communication, Web3, Virtual Reality, Artificial Intelligence

JEL: M10, O30

## I. INTRODUCTION

New technologies are all around us and most people would probably have a hard time imagining a world without them. Over time, they develop from Web 1.0 to Web 3.0, 5G technologies, virtual reality, artificial intelligence, etc. Digital devices are used as an invariable part of every person's daily life, and with their development, a number of daily activities also change. Such are the activities related to interpersonal communications, both personally and professionally, business processes and human-machine interaction.

## II. LITERATURE OVERVIEW

The World Wide Web is the primary tool used by billions of people to exchange, read and write information and communicate with other people via the Internet. The web has changed dramatically over the years and its current applications are almost unrecognizable from the first ones. The evolution of the web is often divided into three stages: Web 1.0, Web 2.0, and Web 3.0.

The earliest version of the Internet is known as Web 1.0, where users can only read information on the Web without interacting with each other. They were content consumers, while creators were primarily web developers who created websites with material delivered primarily in text or graphic format. Web 1.0 existed from approximately 1991 to 2004 (Cormode & Krishnamurthy, 2008).

The web is most widely known in its current version, known as Web 2.0, which is known as an interactive web for reading and writing, as well as having social networks. No deep knowledge is needed to participate in the information

creation process, even many of the digital applications in use are designed in such a way that anyone can participate in this process (Susarla et al., 2012). Web 2.0 makes it possible, for example, to share thoughts with users from all over the world, and also to publish videos available to millions of people who can watch and comment on them. Platforms like YouTube, Facebook, Instagram, Twitter, Tik Tok and other social networks are just a few examples of Web 2.0 applications.

Developments in software products allow companies to develop new ideas that allow users to participate more and more in social networks. As a result, it is only necessary to design a mechanism to activate and engage users. The popular platforms that were mentioned were quite different in their early days compared to what they are now. Usually, the process goes through the steps of launching an app, promoting it to as many people as possible, and then the company monetizes its user base. In this regard, we may again refer to the artificial intelligence algorithms described in this point that govern the social media platforms.

Another important feature that should be mentioned is that users rarely have control over their personal data or how it is stored in Web 2.0. In fact, organizations responsible for mobile and web applications often track and retain user data without permission, then use, manage, and even sell the data they hold. Moreover, those with government power can easily intervene, control or shut down applications using centralized servers, even in the banking sector, as they are also digital and under centralized control. Examples of this in recent years, given the international situation, are not an exception at all. Many of these shortcomings will be addressed by Web 3.0, which attempts to radically rethink the way we build and interact with applications from the ground up.

The next stage in the development of Web 3.0, also known as Web3, is the period after 2010, which hints at the future of the web and is described as the Semantic Web. Artificial intelligence and machine learning enable computers to analyze data in the same way that humans do, which supports the intelligent generation and distribution of valuable content according to the specific needs of the user (Gottinger, 2017). Several key differences can be distinguished between Web 2.0 and Web 3.0, but decentralization is at the core. In the Web 3.0 era, it is rare to create and deploy applications that run on a single server or store data in a single database (often hosted and managed in the cloud by a single provider). Instead, Web 3.0

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<sup>1</sup> Dr. Ivaylo Iliev is a chief assistant professor at the Department of Management at the University of National and World Economy.



applications are built on blockchain technology, decentralized networks of multiple peer-to-peer nodes (servers), or a hybrid of the two (Potts&Rennie, 2019). Such programs are known as decentralized applications (DApps), and this term will become increasingly popular in the Web 3.0 community. in creating a stable and secure decentralized network.

### **Fifth generation wireless communication technologies (5G)**

The fifth generation of cellular technology, 5G, provides a big leap in the speed of wireless devices. This is a significant change for both individual consumers and businesses. Speeds that aim to be 10 to 100 times faster (Elayoubi, et al.) than 4G can present many more possibilities to users, and the delay for users to be less than one millisecond. Such high data transfer rates can enable changes in communication, for example, using virtual reality applications or to control autonomous robots or vehicles, such as ships, trucks and even cars. All this requires the implementation of new technologies and infrastructure, which is currently happening in many places around the world.

With processes like the above, the high requirements for the fifth generation of technologies are also determined. First of all, the need for significantly higher speed has already been mentioned. According to a Cisco study, from 2017 to 2021, the use of wireless networks will increase at a compound annual growth rate of 47% (Cisco, 2019). Reducing network latency is also particularly important. The inclusion of various devices with remote control will lead to the need for a highly reliable wireless communication channel, with an extremely low level of signal time delay. The continuous increase, at a rapid pace, of users and the number of connected devices leads to a multifold increase in the amount of data to be transferred over the mobile network. Emerging technology must be prepared for such massive connectivity. Another requirement, caused by the mass and the new services offered, is related to the reliability that must be provided to the users. Last, but not least, in terms of requirements is efficiency and productivity at the technological level. Small cells with high energy efficiency are one of the key factors for high performance of the distributed infrastructure.

Another aspect to consider that the introduction of the new technology has caused is related to the impact of the necessary infrastructure on the life and health of the population. Although according to Jeffrey Shuren (2018), the body of available scientific evidence continues to not support adverse human health effects from exposure at current RF energy limits. Research in this direction as well as discussions on various occasions continue to explore and consider the various possible aspects to ensure the necessary peace of mind for the society.

### **Impact of artificial intelligence in communication**

New technologies are all around us and most people would probably have a hard time imagining a world without them. As an invariable part of every person's daily life,

computers, smart phones, ATMs, post terminals, automated systems are used to support all kinds of activities, in the surrounding environment and in business. This use is associated with the development of artificial intelligence (AI). The definition of artificial intelligence characterizes it as a branch of computer science that deals with the automation of intelligent behavior or which focuses on creating intelligent machines that function and react like humans. Among the frequently used applications of AI in everyday life are the voice assistant, setting the right parameters when shooting with a mobile camera, following music or video suggestions made by algorithms to identify user trends, navigation and route optimization applications, spam filters, the video surveillance, the function to check the grammar and spelling of the text and much more.

Business organizations also benefit from the possibilities of AI. Among the main applications according to Invest Northern Ireland are:

- improving customer service through the use of virtual assistant programs;
- Automating workloads by collecting and analyzing data or using algorithms to categorize work, automatically route service requests, etc.;
- Optimization of logistics - planning of transport routes;
- Increasing productivity and production efficiency through production automation, integration of industrial robots in the work process, etc.;
- Prevent outages by using techniques to detect anomalies or identify prerequisites that are likely to disrupt the workflow;
- Performance forecasting to determine when performance goals, such as response time to help desk calls, can be met;
- Implementing data management and analytics systems – for example, AI can help you interpret and mine your data more efficiently than ever before and provide meaningful insight into your assets, your brand, staff or customers;
- Improving marketing and advertising by effectively tracking user behavior and delivering much more focused and targeted messages.

The applications can be many and varied depending on the field of activity. Of interest is the use of AI in customer relationship management and communication, something common to all business organizations. The popular CRM (Customer relationship management) systems support this process. The goal is to improve business relations and grow the business, and the CRM system helps companies maintain a relationship with customers, streamline processes and improve profitability.

Chatbots are increasingly used in customer service. These assistants recognize keywords that the customer might say and respond according to their assigned value. Depending on the use, this assistant can be more or less complex.

Beyond the sphere of individual and interpersonal relationships brought about by digitalization, the next level is emerging that will affect the life and communication of the population – various types of humanoid robots. They are

expected to play an increasingly important role in the organization of societies, and can be used in a number of different roles - to serve clients, as personal trainers, to help lonely or isolated people, to care for the sick or elderly etc.. Before The Economic Times (2021) CEO David Hanson, of Hong Kong-based Hanson Robotics, claims that "The world of Covid-19 will need more and more automation to keep people safe." This belief is also the reason for the company to announce in June 2021 that they are launching a new prototype (after Sophia, 2016), under the name Grase, which will be aimed at the healthcare sector with the idea of helping the elderly and those who are isolated due to the pandemic. Popular is the fascination with cutting-edge artificial intelligence (AI) technology from companies such as Google 's DeepMind and Japan's SoftBank Robotics, maker of the Pepper robot.

Such cutting-edge developments in humanoid robotics, combined with advances in artificial intelligence, whereby robots can learn and develop autonomously, are causing strong affect and discussion of the potentially apocalyptic threats to humanity engendered and provoked by science fiction (Brundage, 2015). More sober, although not without an emotional dimension, are the discussions and concerns related to the mass automation of multiple processes, which would lead the so-called working class to mass unemployment. If popular interest focuses mainly on the futuristic specter of "superintelligent" digitization, more mundane and even insidious forms of artificial intelligence have already established themselves as significant aspects of the social infrastructure. The algorithms that drive social media platforms and their recommendation engines have real advances in personalization and user convenience, and promote both content and people (contacts) that they can predict are likely to be interesting. In reality, of course, this seemingly benign process has come under increasing scrutiny in recent years. Increasing awareness of the information-gathering capabilities of social networks is prompting deeper scrutiny of both the automated and human processes shaping our information flows, as well as the various structural biases embedded in them. The very specific kind of intelligence embedded in social media algorithms has come under particular scrutiny following major world events such as the US presidential election and the UK 's Brexit referendum campaign. There is also growing awareness of the ability of social media platforms and third parties to build complex user profiles based on likes and shares to optimize receptivity to different types of messages (most commonly advertisements - commercial or political). A little more than a decade since social media became mainstream, debates have turned to whether it is for the benefit of users or a new and powerful platform for propaganda.

### Smart environment

Digital technologies have dramatically changed the types and spaces in which we live, work, play and communicate. There are two quite different kinds of spatiality to consider here: purely digital (or virtual) environments on the one hand, and hybrid spaces that reflect

how digital and physical processes and structures are increasingly intertwined.

The idea of a fully digitized environment is technically wrong. Digital signals depend on material infrastructure, on production, on energy consumption and have environmental consequences (the virtual currency BitCoin, for example, is currently estimated to consume about 110 terawatt hours per year, as much as countries such as Malaysia and Sweden (Carter, 2021). Thus that the idea of an immaterial digital realm could be defined as unreal. However, the closing years of the 20th century saw a wave of excitement about the emerging possibilities of "virtual reality" (VR) environments, but as a technology this process was difficult to happen - devices (headsets and gloves) were too expensive and cumbersome, and the processing power too limited to provide a seamless experience. But the expected improvement came later as technology developed. The fascination of virtual experience promoted by more accessible technologies such as World Wide Web and computer video games, immersed users in the virtual and even offered convincing interactive experiences. Today, there is something of a renaissance in the pursuit of fully immersive simulation technologies. Gaming environments enjoy dramatically increased visual and audio realism thanks to enhanced data processing power combined with intricately constructed virtual worlds produced within the world's largest creative industry today. Virtual reality sets are also gaining popularity, becoming increasingly mainstream consumer devices and entering homes and schools as their costs decrease and functionality, including communication, increases. VR sets using mobile phones are already an outdated technology, a new generation of mobile VR devices may become a common sight, just as the smartphone has become ubiquitous in recent years. Heather Bellini of Goldman Sachs Research (2020) expects the virtual and augmented reality market to surpass desktop computing in size in the next few years. More and more businesses are turning to the use of such technology because of the possibilities it offers:

- Virtual reality can be used in training personnel, including medical, related to operations;
- VR can be used to simulate working with expensive equipment in a range of hazardous environments;
- Enables the "experience" of a sporting event or tourist destination without leaving home;
- Real estate, architecture and construction businesses can use VR to show what the finished environment would look like;
- The technology allows automotive designers and manufacturers to: perform real-time 3D visualization;
- It can also help treat patients with anxiety disorders by gaining a better understanding of how they respond to stressful situations while remaining safe;
- It also supports the diagnosis of patients with visual or cognitive impairments through eye tracking;
- Of course, the most basic remains the gaming industry.

Amidst the Covid pandemic, augmented and virtual reality technologies are seeing a surge in interest mainly due to their ability to reduce training time and enable remote



assistance. Almost any process that can be carried out in the physical world and in business, such as customer service, marketing, finance, HR and manufacturing, can be simulated in a virtual environment. Tasks can be broadly divided into one of two categories - training or practical application. For training purposes, VR offers the potential to immerse ourselves in any situation that can be simulated on a computer. Increasingly, photorealistic visual effects "trick" our brains into believing to varying degrees that what we see is real, allowing us to observe and learn from our interactions. A great example is public speaking training systems that have been developed using the technology, such as Oculus's VirtualSpeech.

As for practical applications, they are virtually limitless - key factors here are the potential to enable people to perform tasks without being physically present and the ability to model and interact with simulations of real-world objects that would not be real feasible.

Tech industry analysts are divided on whether the growing interest in fully virtual environments will persist, but if so, such technologies could raise new concerns and controversies about people (and especially young people) increasingly interested in fabricated realities and increasingly forget the real. Such concerns are already acutely observed in a different and more everyday context in relation to filter bubbles, fake news, conspiracy theories and online extremism.

Perhaps more significant is the rise of Internet connectivity of objects that we use in everyday life - cars, household appliances, even farm animals are increasingly connected to digital networks. The home environment is becoming increasingly populated with networked devices that allow household members to enjoy increasingly flexible and personalized ways of communicating within the household. The idea of the "smart home" promises to transform it into an integrated and intelligent ecosystem (including lighting, security, energy efficiency, etc.) that can be finely tuned to personal wants and needs. Additionally, and perhaps most importantly, it promises to enable consumer voice control, using voice-activated digital assistants such as Amazon's Alexa or Apple's Siri. From a marketing point of view, the smart home promises a unified and interoperable network of devices built into the design of the home itself. This would provide consumers with a supposedly seamless experience while locking them into new relationships of dependence on technology firms, but perhaps in the future smart technologies will become standard aspects of household infrastructure.

### An empirical study

Research related to digitization and modern technologies has been constant since its inception, increasing in recent years. Diverse aspects gain deserved popularity and attract many researchers. Among the reasons for this popularity are the trends for continued exponential development of technologies and their deep penetration into daily personal and business processes. The data presented in the development are part of a more extensive study, from which the elements related to the discussed topics were

derived. The object of the research was everyone who managed to fill out the provided survey correctly, the object being the attitudes towards digital communication devices. Empirical data in the study were collected using questionnaires. Software and statistical tools were used to analyze the data obtained, such as Microsoft Excel with its built-in functions, two-dimensional empirical distribution, etc.. The answers to the included statements were collected in a 5-point Likert scale with values from 1 - strongly agree to 5 - strongly disagree. The claims in the study related to the development of digital communication technologies:

- Most of my personal communication is via social media and mobile applications.
- My work is impossible without digital devices.
- I like that the organization I work for uses digital devices.
- I believe that modern society is highly dependent on digital devices.
- I don't think young people are addicted to their mobile phones.
- I like the idea of being able to control everything in my home through my phone.

### Empirical results

The first of the statements is aimed at relationships through communication. The trend towards using mobile technologies for communication has been around for quite some time and the results here confirm it. Nearly 70% of respondents strongly and rather agree with the statement (table 1).

Table 1. Most of my personnel communication is through social media and mobile apps.

Strongly agree	Rather agree	Cannot judge	Rather disagree	Strongly disagree
34%	35%	7%	2%	1%

The entry of digital technologies is also considered by the next statement, but not specifically about communication, but the impossibility of carrying out work without digital devices. The percentage of agreement and strong agreement with the statement "My work is impossible without digital devices" is high (table 2). The results by gender and place of residence are also close to those shown.

Table 2. My work is impossible without digital devices

Age group	19-25	26-34	35-44	45+	Total
1 Strongly agree	50%	67%	49%	36%	<b>55%</b>
2 Rather agree	9%	20%	37%	55%	<b>26%</b>
3 Cannot judge	13%	7%	7%	9%	<b>8%</b>
4 Rather disagree	13%	4%	7%	0%	<b>7%</b>
5 Strongly disagree	16%	2%	0%	0%	<b>5%</b>

A breakdown of the respondents by age groups shows a greater degree of agreement among younger people. Considering that the computer is part of the digital devices, such a result should not be particularly surprising, but it confirms the strong dependence of people on technology.

The next statement in this group is a kind of personal assessment of the entry of more and more digital devices into people's personal and professional worlds. It reads " *I like that the organization I work for uses digital devices* ". The assessment obtained from the empirical data is categorically positive, with strongly agreeing (31%) and rather agreeing (45%) totaling 76%. It is interesting that, divided by age groups, only the 19-25 year olds have lower percentages of agreement compared to the general population (table 3).

Table 3. *I like that the organization I work for uses digital devices*

Age group	19-25	26-34	35-44	45+	Total
1 Strongly agree	19%	37%	37%	18%	<b>31%</b>
2 Rather agree	38%	46%	42%	82%	<b>45%</b>
3 Cannot judge	28%	13%	14%	0%	<b>16%</b>
4 Rather disagree	3%	2%	7%	0%	<b>4%</b>
5 Strongly disagree	13%	2%	0%	0%	<b>4%</b>

Here, the trend seems to be towards greater liking by older respondents. It is undeniable that technology facilitates many activities, and an objective assessment of this can be given by people who can compare what work processes looked like before and after the mass adoption of digital devices.

A serious issue addressed by the research is related to the dependence of the modern population on digital devices. This is a question that is increasingly being asked on various occasions - from the upbringing of children to the impact on the psychological health of consumers. The dependence of modern society on digital devices is also confirmed by the empirical data obtained. According to them, a total of 94% of respondents strongly agree (66%) and rather agree (30%) (Figure 1). These results make it unnecessary to consider the responses separated by any criteria.

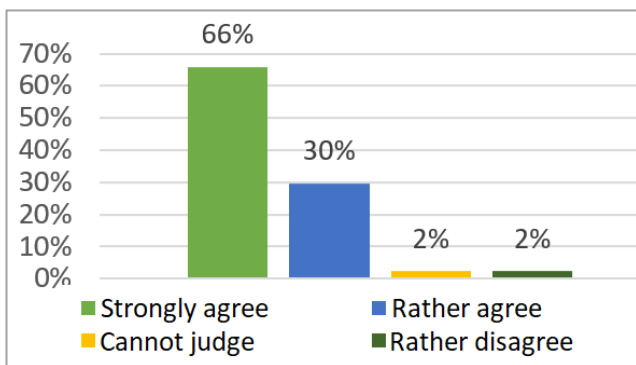


Fig. 1. *I believe that modern society is highly dependent on digital devices.*

The results are similar for the other statement related to addiction, namely " *I don't think that young people are addicted to their mobile phones* ". Formulated as a negation, disagreement actually confirms the presence of dependence. On table 4, a predominantly strong disagreement is noticeable, and the percentage of respondents who do not

think that young people are addicted to their mobile phones is only 7 of all respondents (table 4).

Table 4. *I don't think young people are dependent on their mobile phones*

Age group	19-25	26-34	35-44	45+	Total
1 Strongly agree	0%	2%	7%	9%	<b>4%</b>
2 Rather agree	9%	0%	2%	0%	<b>3%</b>
3 Cannot judge	13%	7%	12%	9%	<b>10%</b>
4 Rather disagree	28%	24%	23%	36%	<b>26%</b>
5 Strongly disagree	50%	67%	56%	45%	<b>58%</b>

The dependencies that are examined by the last statement are also a consequence of the changes imposed by the incoming technologies in people's daily lives and their frequent use on various occasions. Looking at the intelligent environment that is beginning to take hold, the "smart" cities and homes that use the novelties in the development of technology, the established dependence is substantiated. The question remains to what extent people like this, and for this the last of the first group of statements is formulated as " *I like the idea of being able to control everything in my home via my phone* ". In the results here, the closest percentages are observed and there is an unequivocal answer (table 5).

Table 5. *I like the idea of being able that manage everything in my home through my phone*

Strongly agree	Rather agree	Cannot judge	Rather disagree	Strongly disagree
23%	23%	21%	19%	14%

Differences compared to the average values for questions are mainly found in the two extreme age groups. The youngest respondents liked the idea of the statement significantly more than the oldest. In this question, the percentage of people who cannot judge is also high. This is probably due to the fact that the technologies in question for "smart" homes and its remote control by means of a mobile phone are still relatively expensive and not so widely entered into the everyday life of the mass consumer. Not knowing the technology in turn leads to many questions being left unanswered and this clarifies the lack of judgment on the part of the respondents.

CONCLUSION

Data from the conducted research confirms the increased use of mobile devices everywhere with 82% of respondents. The percentage of mobile technology overusers between the ages of 26 and 34 is the same. The prevailing opinion is that almost all age groups cannot live without a mobile phone in their daily life. Given the nature of their work and their need for constant communication, the mobile phone is probably seen as a necessary tool to carry out daily tasks. A stronger attachment to digital devices is seen than generations where they were available from an early age. The ability to use digital devices for all kinds of activities is loved to over 70% of respondents, and among younger



people there is a trend for using electronic devices to monitor daily physical activity.

Personal communication is changing with the advent of various mobile applications and according to the study, it is mostly done through social networks and mobile applications. Dependence on digital devices is also strong in modern society, with almost all respondents (96%) feeling this way. The mobile smartphone is the most widely used product among the younger generations and is also dependent on it according to 84% of respondents. The popularity of the mobile phone leads to the possibility, through various applications, to be used for all kinds of things, including controlling high-tech home appliances from a distance. This possibility is also liked, although not with high definiteness.

Today's reality is technologically advanced and people are highly dependent on various devices, both in their daily lives and at work. This dependence, however, cannot be viewed in a negative way, since the influence of digital devices is perceived by society as bringing benefits and facilities.

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