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COMPETENCES AND BEHAVIOR OF THE LEADERS IN DIGITAL ENVIRONMENT

Ivaylo Stoyanov

Abstract*: The publication addresses key issues related to the competencies and behavior of leaders in the digital environment. Digital technologies are a part of the modern business practices of organizations and find application in all spheres of society. This requires knowing the basic requirements for leaders' work and their competencies in a digital environment.*

Keywords*: Competencies, Behavior, Leadership, Digital environment.*

ITHEA Keywords*: J.1 Administrative Data Processing: Business*

Introduction

Digital technologies are part of today's work and behavior requirements for the people in the workplace. They help companies and organizations to adapt to the new requirements of the business, to open new market niches and opportunities, to introduce new technologies for competitive advantage. On the other hand, digitalization is entering in all spheres of the society which reflects on the business strategies of the companies, the management of corporate assets and their relationships with stakeholders.

Today, a large part of social processes are digitalized, and the economy is transformed from physical to digital, ie. Information technologies and systems have in entered all spheres of the social and economic activity. The basis is the transformation of the analog information into digital, the transformation from traditional media to digital, social media and technologies have emerged and changed not only people's personal lives, but also ideas about business in digital environment [Temelkova, 2018(a), Wilen, 2018, Gutkowski, 2018].

In the nowadays business, conventional approaches for impact on people and work are rethinking attitudes and behavior, and new competencies are being imposed in the digital environment. The requirements for behavior in the organization are integrated. The reflection of the global tendencies in the economic system is used for optimization of the business processes in order to increase the efficiency of work and to achieve optimal results of business activity. A connecting element in this process is automation, new business models and technologies, as well as people's competencies to adapt to the demands of work and behavior in the digital environment. The importance of digital technologies and business models, opportunities for implementation are becoming increasingly clear in the *Web 2.0, Project Management 2.0, Business 4.0, Leadership 4.0* and others [Temelkova, 2018(b), Dimcheva, 2016, Otsetova, 2017, Kolev, 2019].

Leadership in digital environment

The digital transformation of the organizations is a complex process of adaptation to the dynamics and needs of the business environment, where large data sets and electronic forms of business determine their management policy. The leaders should have a clear vision, strategy and tactics for managing in a digital environment, which is quite difficult in practice.

Digital transformation requires contemporary leaders to support the transformation process from a hierarchical organizational structure to a flexible, team-oriented/project-based approach to achieve the goals [Wilen, 2018, Gutkowski, 2018, Lambovska, 2018]. In this way, it responds quickly and adequately to customer requirements so that the product/service is delivered at the right time, at the right price and high quality. For this purpose, leaders need to have not only competencies to work in the digital environment, but also behavioral techniques to communicate, motivate and inspire their followers, apply new digital technologies and business models. In addition, emotional and practical intelligence are required, to acquire new knowledge and skills, to adapt to the conventional and digital changes in the business environment.

Leadership 4.0 requires not only IT competencies, but also “soft” skills, which are a symbiosis of computer literacy, responsiveness and social behavior to achieve

the effect of adequate management in a digital environment. In the organizations' literature and practice there are different competencies of the leaders in the digital environment. The most important of these competences are as follows [Temelkova, 2018(a), Qualman, 2012, Brett, 2018, Wilen, 2018, Gutkowski, 2018, Angelova, 2017]:

1. Strategic e-leadership

This is a leadership that requires implementation of long-term trends for development of the organization in the context of business digitalization. This leadership requires not only to provide opportunities for competitive results, but also finding ways to innovate, conventional and digital business solutions that optimize business processes and organizational performance. Strategic e-leaders inspire people to achieve results, support them, help them learn and adapt to changes and new job requirements. They need to create an organizational culture that fosters values oriented towards digital technology and social interaction within the organization. Understanding the business environment is very important to the strategic priorities of the organization, for which e-leaders learn from mistakes, make sense of the current situation and anticipate future changes.

2. Digital Competences

The modern business requires leaders to have competencies in information technology and systems, to respond to the digitalization of business processes. The Leaders and the employees need to be computer literate, to be aware of artificial intelligence trends, to be able to process large amounts of information. In the context of the Fourth Industrial Revolution, the technology is constantly evolving and transforming jobs. This is the reason for leaders to communicate in Internet, to use social media, to discover, analyze and prepare business data, to use software products, etc.

3. Communication competences

The leaders in the digital environment not only interact virtually, but have personal contact with their followers. The digital communication is essential not only for the internal construction of information and communication infrastructure and access to

databases, but also for interaction with external audiences. The leaders need to have a well-established communication strategy for the online generation and transmission of information, use of social networks and Internet. It is important for leaders to have a constant connection with their followers, to have two-way communication, to be inspiring, to provoke sharing, and to be intelligible. In the presence of real-time digital communication, the employees are informed of current or future tasks, business priorities corporate news and so on.

4. Competences for cooperation

The leaders in the digital environment cannot make authoritarian decisions and exercise total control over the activity. Working in a digital environment, sharing corporate information, engaging professionals on-line are prerequisites for cooperation and decentralization of power. The leaders build trust among their followers, teamwork, mutual assistance, and commitment to business analysis and decision-making. Cross-functional virtual teams are skillfully used to accomplish tasks or scrum projects, work closely with clients, business partners, institutions, etc.

5. Competencies for training and mentoring

The leaders in the digital environment need to bridge the gap between employees who have a high degree of training in digital technology and those with professional knowledge but no digital competencies. This is an important part of the overall digitalization strategy of the organization, which requires a targeted training and mentoring policy. Much of the resistance of employees is due to a lack of preparation for meeting the goals and objectives, including working with digital tools. The leaders should have competencies for coaching and mentoring employees in an “online” environment and personal contact, which will enhance their skills to use new technologies. They need to develop their human resources talent and digital experience so that they can achieve long-term success.

6. Competencies for innovation and organizational change

The leaders in the digital environment are taking risks in creating new ways of working and implementing cutting-edge technologies and systems, which requires

them to respond appropriately to change and innovation. This cannot be done without creativity and improvisation, stimulating employees to make decisions about digital transformation, to offer innovative methods and mechanisms. They need to encourage creative thinking, create an environment where the followers develop their intellectual potential. The innovations leads to competitive market behavior create new business opportunities, a chance for prosperity and rapid optimization of business processes through IT technologies. The latter are at the heart of change dynamics, redesigning business processes, reducing costs and increasing business efficiency.

Conclusions

In the industrial sectors, organizations are adapting to new trends in the economy, adapting to digital changes and managing business processes. The need for digital transformation has required leaders to rethink business, product and service offerings, access to markets and customers, and their relationship with human resources. But digitalization is not only about technology and cutting-edge business solutions, it requires a strategy to create, stimulate, maintain and develop people's competencies and leadership potential for impact in the digital environment [Sheninger,2019].

The digital economy and the need for digital governance require organizations to transform, in line with cutting-edge technologies in business and designing a new organizational culture. The latter is the result of the implementation of new ways of working, automation, technology of business processes and behavior of people. The new job requirements are a prerequisite for the change of the human resources numbers, high technology and social competences, team behavior and leadership in the digital environment.

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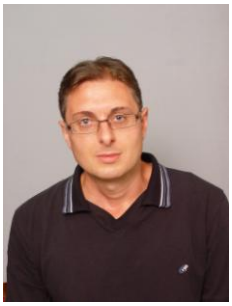

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POSTAL SECTOR TRANSFORMATION IN DIGITAL ECONOMY

Anna Otsetova

Abstract: *In today`s rapidly changing world, the essential role that postal services play in ensuring the right to communication through the exchanges of messages and goods, and sending of money is more relevant than ever. Postal services market around the world is currently undergoing rapid and significant changes. The Internet and the digital revolution are fundamentally changing the worlds of communications, business and commerce. The digital economy continues to grow at a rapid rate. Technological change, digitalization and big data have transformed customer needs, thus leading to the creation of new products and services. The boundaries of many industries have therefore become even more blurred. The postal sector is no exception in this regard. Electronic substitution of traditional postal services is accelerating as both consumers and businesses adopt electronic processes across multiple domains. In the conditions of digital economy postal services need to modernize theirs role to accommodate for the digital age. Postal operators should offer new products and services that reflect the evolving mandate to bind the nation together in a new world where people are increasingly communicating digitally. In this regard the present paper discusses the postal sector development in condition of digital economy.*

Keywords: *Postal Services Market, Digital Economy, E-commerce.*

ITHEA Keywords*: J.1 Administrative Data Processing: Business*

Introduction

Nowadays, the world is on the cusp of a new digital era. Digitalization is dramatically reducing the costs of collecting, storing and processing data, thus transforming economic activities around the world. This new digital era will require changes to existing legal and regulatory frameworks, and has tremendous implications for the transformation of postal sector.

In today`s rapidly changing world, the essential role that postal services play in ensuring the right to communication through the exchanges of messages and goods, and sending of money is more relevant than ever. Postal network are vital to e-commerce and contribute to trade facilitation. In all over the world postal networks constitute an essential infrastructure for an inclusive and effective economy.

Postal services market around the world is currently undergoing rapid and significant changes. The Internet and the digital revolution are fundamentally changing the worlds of communications, business and commerce. The digital economy continues to grow at a rapid rate. Technological change, digitalization and big data have transformed customer needs, thus leading to the creation of new products and services [Димчева, Янгънова, 2017]. The boundaries of many industries have therefore become even more blurred. The postal sector is no exception in this regard. Electronic substitution of traditional postal services is accelerating as both consumers and businesses adopt electronic processes across multiple domains. Now customers are attracted to greater convenience, faster service, and lower costs. In the conditions of digital economy postal services need to modernize theirs role to accommodate for the digital age. Postal operators should offer new products and services that reflect the evolving mandate to bind the nation together in a new world where people are increasingly communicating digitally.

The general definition of postal services include any kind of service provided by postal operators – is characterized by the varied presence of both public and private operators offering a broad range of services and products. This includes the traditional services of collecting, sorting and delivering letters, documents and parcels on national territory and abroad, as well as more recently express, courier and home delivery services, city messenger etc. The services provided by postal operators may also include communication, logistics, retail, money transmission and other financial services, and many others besides [European Foundation for the Improvement of Living and Working Conditions, 2016].

In the European Union (EU) Postal Directives the most basic division in the postal market is between universal and non-universal services. Universal postal services (UPS) are those which a government assures will be provided on a permanent basis throughout the national territory.

The UPS consists of the provision of basic postal services (essentially letters and light-weight parcels) subject to certain quality requirements: collection and delivery in the entire territory, at a stipulated frequency and at prices that are affordable and normally uniform throughout the territory. Providing this service normally also requires the existence of certain infrastructure, such as offices open to the public. The UPS is provided every working day, at least five days per week. There is at least one clearance and one delivery to the home or premises of every person.

Each country designates a postal operator (known as a designated operator (DO)) responsible for ensuring access to the postal service. In contrast to other postal operators the designated operators are obligated to cover the entirety of the national territory and to offer their services at a uniform rate. UPS are very important to many people, including older people, people living in rural and remote communities (where internet connections can also be sporadic or non-existent), and those less able to travel.

The services included in the scope of the UPS are:

- The clearance, sorting, transport and distribution of “postal packets” up to 2 kilograms in weight;
- The clearance, sorting, transport and distribution of parcels up to 20 kilograms in weight;
- A registered items service;
- An insured items service;
- Postal services, free of charge, to blind and partially-sighted persons.

The postal items that do not fall within the scope of universal service are considered to be non-universal postal items. Non-universal postal services are domestic and international postal services which are not covered by the UPS, e.g. postal services from the UPS domain, exceeding the set limits for weight. These services include all types of postal services with added value to UPS, which are developed and will develop as a consequence of the information and communication technologies (ICTs) development. Combining the various additional components can meet almost all the requirements of individual and business users of these services: from simple

letter deliveries, monthly statements, accounts and brochures to inventory management or management of distribution networks.

During the last three decades, the organization and delivery of postal services have undergone considerable change, as a result of both new consumer demands and also the restrictions imposed on public expenditure by a new economic and political environment. The transformation, which was largely facilitated by technological innovation, led to full market opening. Thus, an increasing number of private providers were able to emerge and secure a significant share of the high value-added services. At the same time, postal operators considerably expanded the range of their activities, which currently include financial, insurance, e-services and other services besides the more traditional postal facilities.

Faced with potential competition and the likely loss of market shares in the former monopoly areas, the DOs in many countries adopted internationalization and diversification strategies to maintain or increase revenues.

The postal services market has seen substantial change over the past decade. It has become more competitive. The regulatory regime has changed. So the postal services market has started to look much more like a private sector market. But in common with many other sectors that have followed the same path, regulatory intervention has been needed to ensure that wider social objectives continue to remain at the heart of the market.

Hence the aim of this paper is to analyze the postal sector development in condition of digital economy and to emphasize its most characteristic aspects that can attribute to a stable and profitable postal market.

Postal Sector Development

The aggregated real revenues of DOs all over the world have grown modestly over the past decade, at an average of nearly 2% per year (Figure 1). In 2018 the postal revenues is about 267 billion Special Drawing Rights (SDR).

Postal industry revenue is growing solidly despite ongoing traditional letter decline. Postal statistics saw year-on-year growth of 2% or more, which clearly demonstrates that postal operators continue to develop through broadening their service offerings

and improving their existing network and efficiency. E-commerce does remain the main and common growth driver and postal operators are expanding their networks and capacity to respond to the increasing demands.

The last decade has been characterized by two major opposing pressures in the postal sector:

(1) letter volume decline, and

(2) growth in e-commerce parcels volume.

These contrasting pressures underpin different challenges for all stakeholders in the postal sector.

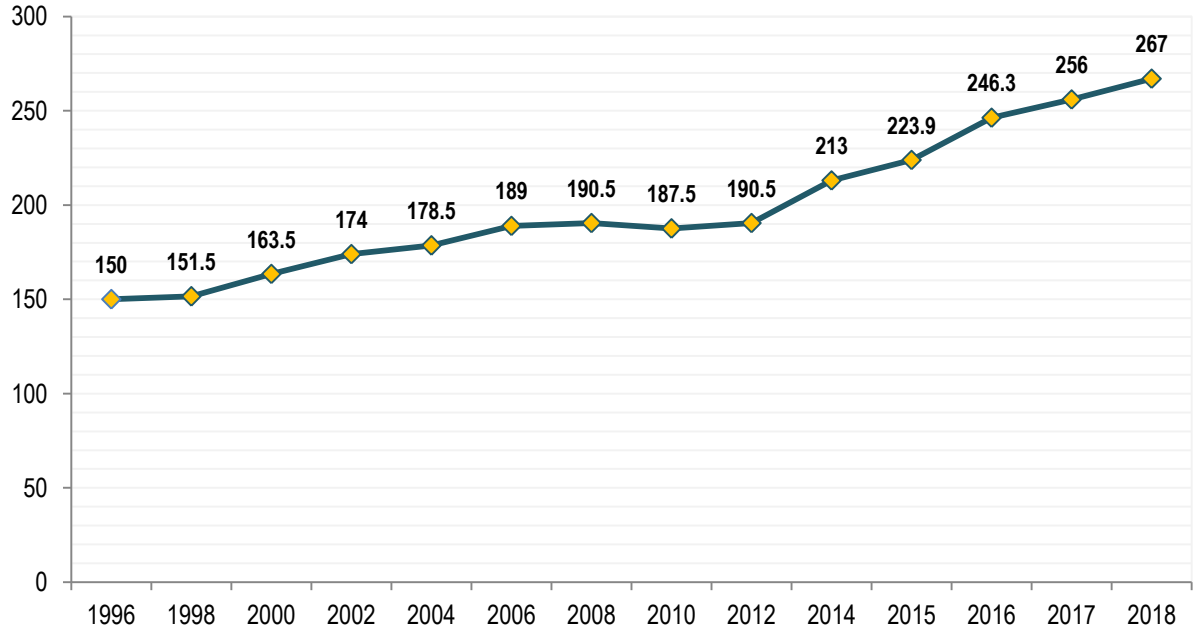

Figure 1. Postal Revenues (SDR)

Source: Universal Postal Union, Postal Economic Outlook

As a result of the complex mix of factors influencing postal revenue growth, DOs have shifted their core activities significantly in the past 12 years. Figure 2 shows that, over the past decade, the single major change has been the decreasing reliance

on letter post as the main source of revenue, dropping from 45.90% of total revenues in 2007 to 38.20% in 2018.

While the share in “other” and financial services has remained almost stable, total revenues from parcels have grown steadily every year, increasing from 14.80% in 2007 to 25.6% in 2018.

Postal operators have always been a part of the nation’s vital infrastructure. Today, the postal providers still provide infrastructure services, facilitating economic activity, improving quality of life, and benefiting society in a variety of ways.

Postal infrastructure is an infrastructure that has a capability of laying institutional, financial, economic and social foundations for a country`s broader development process [Walsh, 2002].

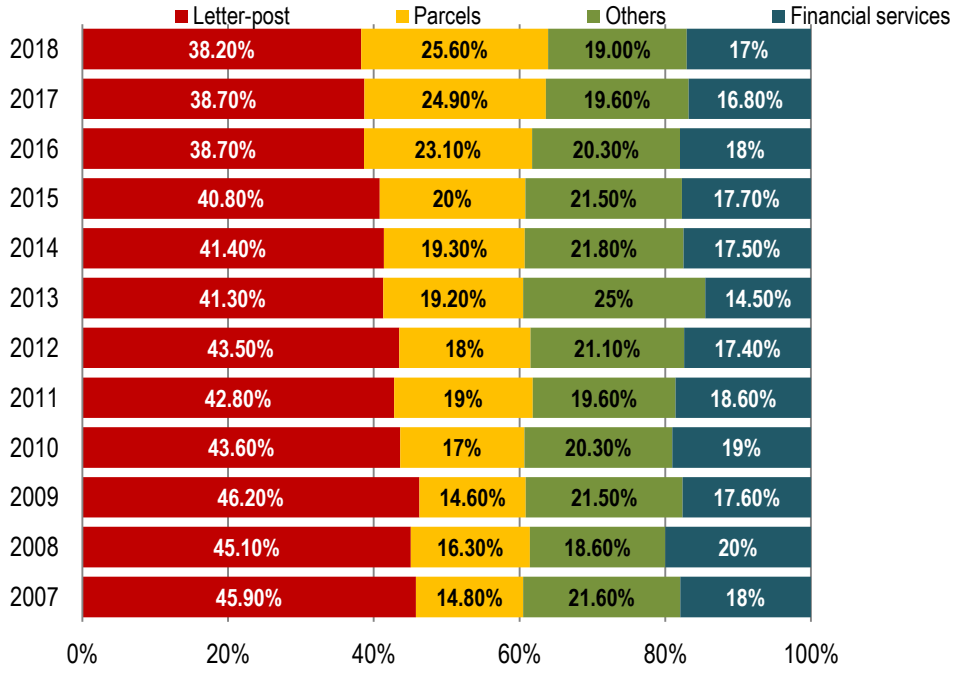

Figure 2. Breakdown of Global Postal Revenues

Source: Universal Postal Union, Postal economic outlook

The number of postal offices in the world (657 959) shrank slightly over the last decade: a decrease of 1.7% was estimated for the 2007–2018 period (Table 1).

Table 1. Distribution of Postal Offices

Types of offices	*Number (2018)*	*Change 2007–2018 (%)*
Outsourced offices	222 552	- 4,05%
Offices managed by the DOs	435 407	- 0,25%
Total number of permanent offices	657 959	- 1,7%

Source: UPU official statistics

Many DOs have re-engineered postal networks and processes to cut costs. In order to compensate for lower scale economies, postal operators have made the pursuit of economies of scope as a key target, leading to integration of activities, e.g. merging letter and parcels delivery networks, and using post office networks for financial services [European Commission, 2018].

Figure 3 summarizes access modes to postal services globally. Overall, in the world almost 85.80% of the population has postal items delivered to their homes, 9.40% of population has to collect postal items from postal offices and only 4.80% of the world population has no access to postal services. In 2018, more and more people had access to postal services. However, almost 5% did not have access to basic services.

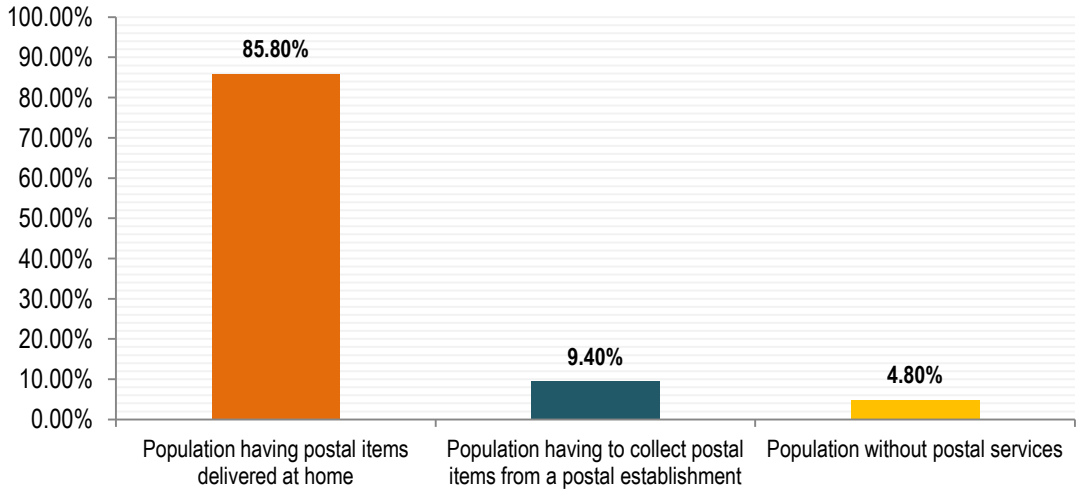

Figure 3. Delivery Modes and Access to Postal Services

Source: UPU official statistics

Delivery modes and access to postal services differ across regions. The proportion of the total population without access to postal services is negligible in the group of industrialized countries as well as in Eastern Europe and the Commonwealth of Independent States (CIS), but remains high in Africa (26.5%) (Table 2).

Table 2. Delivery Modes and Access to Postal Services by Regions

Region	***Population having postal items delivered at home***	***Population having to collect postal items from a postal establishment***	***Population without postal services***
Africa	19,20%	54,30%	26,50%
Arab region	88,40%	9,80%	2%
Asia-Pacific	94,00%	3,40%	2,60%
Europe and CIS	97,30%	2,70%	0,00%
Industrialized countries	96,60%	3,40%	0,00%
Latin America and Caribbean	89,70%	5,10%	5,20%

Source: UPU official statistics

Total employment by DOs worldwide has decreased over the past decade by almost 6%. The number of full-time employment decrease by 7.41%, at the same time the number of part-time staff increase by 4.03% (Table 3). Full-time employment continues to dominate (4.15 million or 78.9%), while part-time employment accounts for 1.11 million. There is an increase in the share of part-time staff.

Table 3. Distribution of Postal Staff

Type	***Number (2018)***	***Change 2007–2018 (%)***
Total staff	5 260 911	- 5,97%
Full-time staff	4 149 550	- 7,41%
Part-time staff	1 111 361	4,03%

Source: UPU official statistics

On the one hand there is a decrease of employment at DOs, forced by the decline in letter post volumes and growing competition in the parcel segment, majority of DOs

have decreased the number of employees. Part-time workers have shown to be more vulnerable to staff reductions than fulltime workers.

On the other hand, there is an increase of employment at other postal operators – growing e-commerce and consequent increase in parcels and packets volumes are driving growth in employment at couriers and other postal operators. This growth offsets the decline at DOs employment, increasing overall postal and courier sector employment [European Commission, 2018].

In the context of increasing competition in the postal market, one of the important issues is a question of market power and market concentration as a specific indicator of market power [Otsetova & Nedelchev, 2018].

Figure 4 presents the market shares of DOs in different postal segments. While DOs remain dominant in letter post, the picture is inverted when it comes to parcels, precisely the area that is growing fastest.

It can be summarized that the level of competition in postal market varies across market segments. The competition in letter segment is moderate; the competition in parcel and express services is intensive.

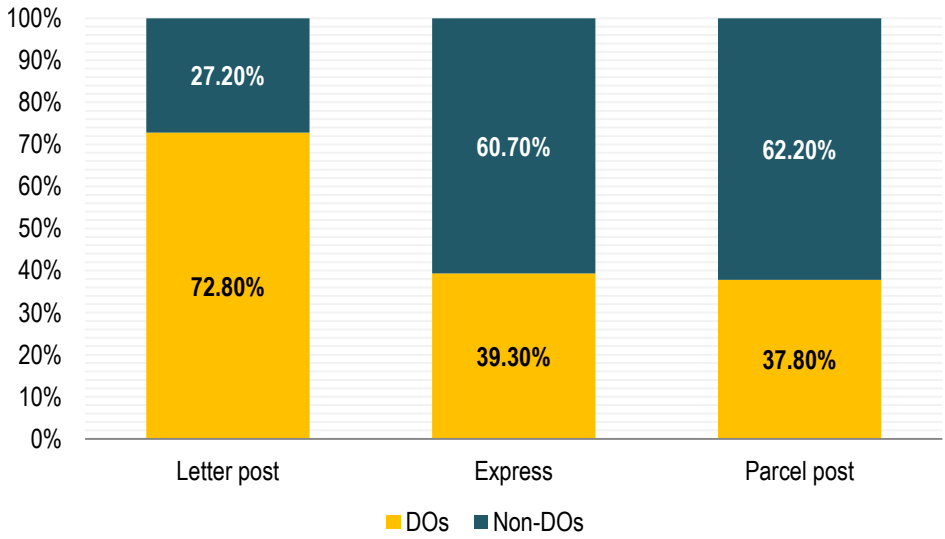

Figure 4. Competition in Postal Sector

***Source**:* UPU official statistics

National DOs experienced growth in the parcel and express segments of the market, but for the most part their revenue growth has not been commensurate with the revenue growth of the market.

Although postal operators throughout the world are faced with widely diverging economic conditions and business models, most are confronted with the same challenges of declining or low letter-post volumes and the need to enter new business areas or develop postal services according to customers' expectations.

In conclusion there are three principal trends which are likely to shape the postal sector over the next years (Figure 5).

Figure 5. Trends in Postal Sector

Digital Economy and Postal Sector

The digital economy refers to a broad range of economic activities that use digitized information and knowledge as key factors of production and delivery of services. The internet, cloud computing, big data and other new digital technologies are used to collect, store, analyze, and share information digitally and transform social

interactions. The Digital Economy is rapidly driving transformational disruption across every sector. By 2022, over 60% of global Gross Domestic Product (GDP) will be digitized. An estimated 70% of new value created in the economy over the next decade will be based on digitally enabled platforms [World Economic Forum, 2019].

In order to be successful in digital economy postal operators will need to rely on their competitive advantages and transform key aspects of their business.

ICTs have become widely available to the general public, both in terms of accessibility as well as cost. A boundary was crossed in 2007, when a majority (55%) of households in the European Union (EU-28) Member States had internet access. This proportion continued to increase, passing three quarters in 2012 and four fifths in 2014. By 2018, the share of EU-28 households with internet access had risen to 89%, 34% point higher than in 2007 (Figure 6).

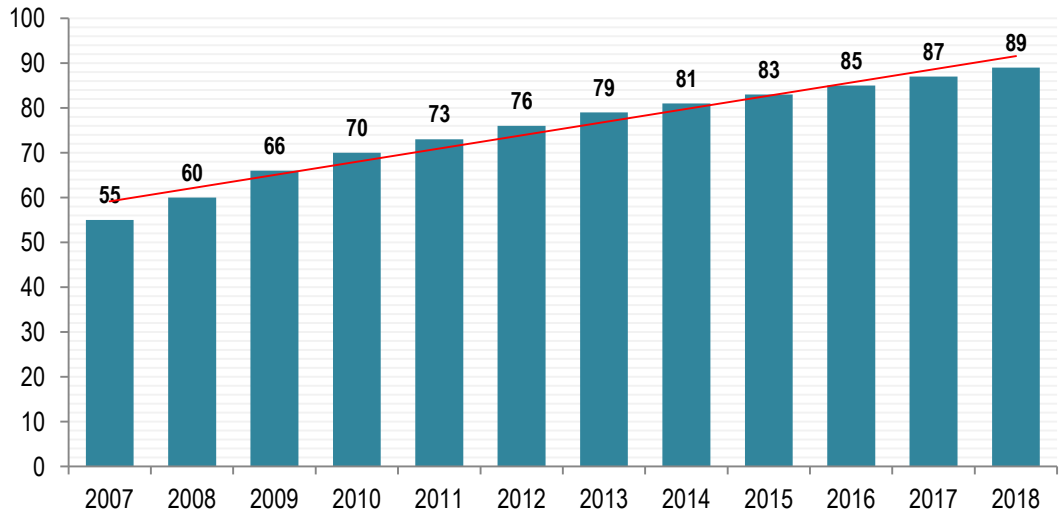

Figure 6. Internet Access of Households, 2007 and 2018 (% of all households)

Source: Eurostat

The highest proportion of households (above 90%) with internet access in 2018 was recorded in the Netherlands, United Kingdom, Germany, Finland, Denmark, Luxembourg and Sweden (Figure 7). The lowest rate of internet access among the EU Member States was observed in Bulgaria (72%). However, Bulgaria, together

with the Romania, Cyprus, Greece, Portugal, Lithuania and Croatia recorded a rapid expansion in its proportion of households with internet access, with increases within the range of 15-25% in past five years.

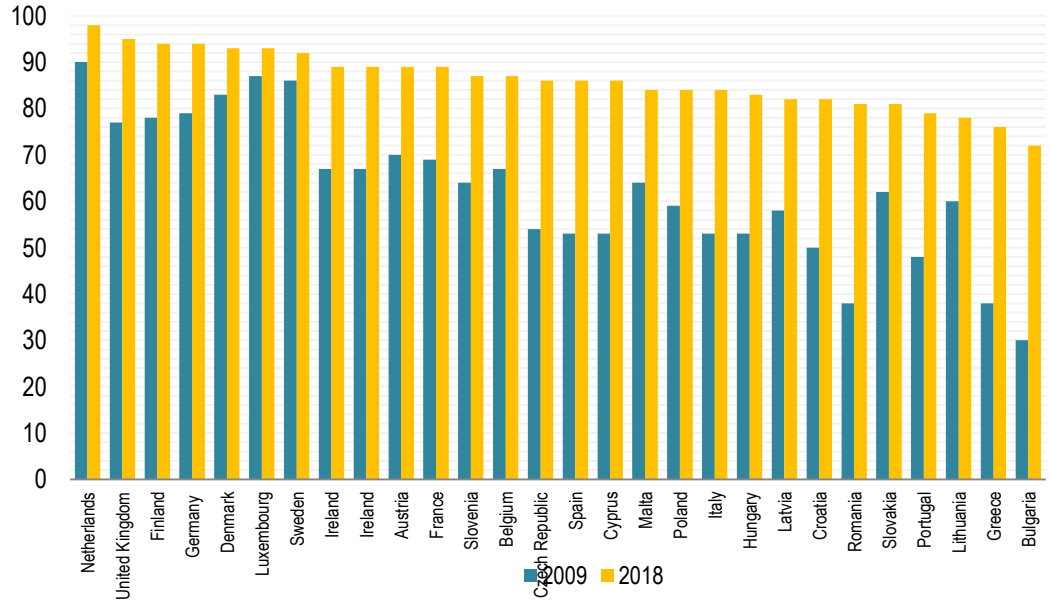

Figure 7. Internet Access of Households in EU Member States

Source: Eurostat

The proportion of individuals aged 16 to 74 in the EU who ordered or bought goods or services over the internet for private use continued to rise. In 2018, it stood at 51%, an increase of 26% when compared with 2008 (Figure 8). Three quarters or more of individuals in Germany and Sweden ordered or bought goods or services over the internet in 2018 and this share reached at least four fifths in the Netherlands (80%), the United Kingdom (83%) and Denmark (84%). By contrast, this proportion was lowest in Cyprus (32%), Bulgaria (21%) and Romania (20%) [Eurostat, 2018].

Figure 8 shows that consumers are increasingly purchasing online, domestic as well as cross-border. As a result businesses are prioritizing their online offerings. This change in consumer and business behaviour has presented a significant opportunity for the postal operators to contribute to e-commerce growth and further cross-border trade.

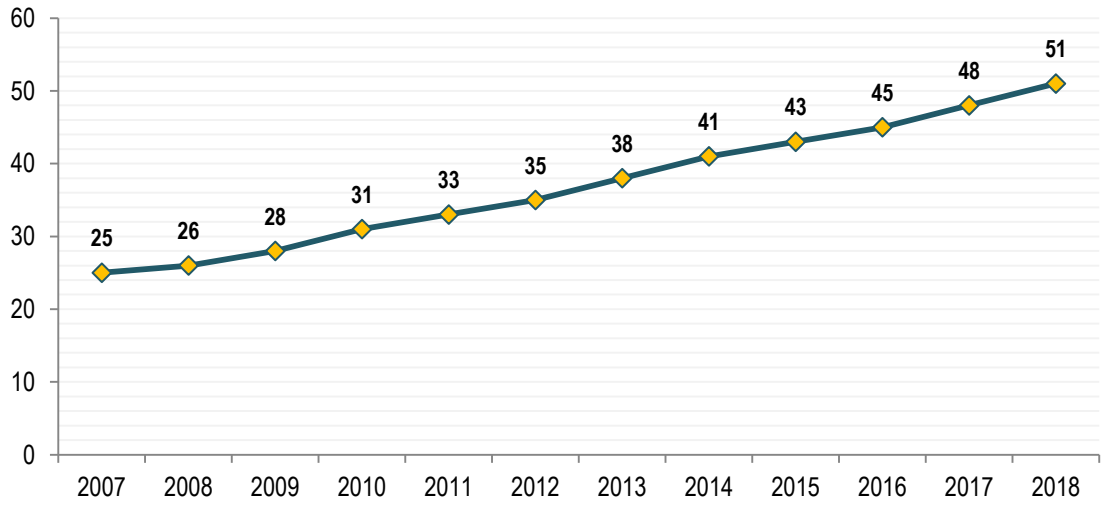

Figure 8. Individuals who ordered goods or services over the internet for private use in (% of individuals)

Source: Eurostat

E-commerce has facilitated the way by which consumers are able to purchase from abroad, and enabled enterprises to sell across borders.

Overall, e-commerce has grown significantly in all EU Member States. The e-commerce markets in the EU Member States have increased its revenues from around EUR 307 billion in 2013 to EUR 602 billion in 2018 (Figure 9). The average growth rates were 14% per year and the experts predict that this growth will continue in the future. The main drivers for this growth according to WIK Consult report include an increasing share of consumers' online purchases (domestically and across borders), more frequent online purchases, and the expansion of online purchases to new product categories like groceries and furniture.

Around 9.7 billion parcels, and at least 1.9 billion small packets, were delivered in Europe in 2018. Since 2013, total revenue increased by 4.3% per year, reaching more 65 billion Euros in 2018, and is expected to amount to around 73 billion Euros in 2020 [WIK Consult, 2019].

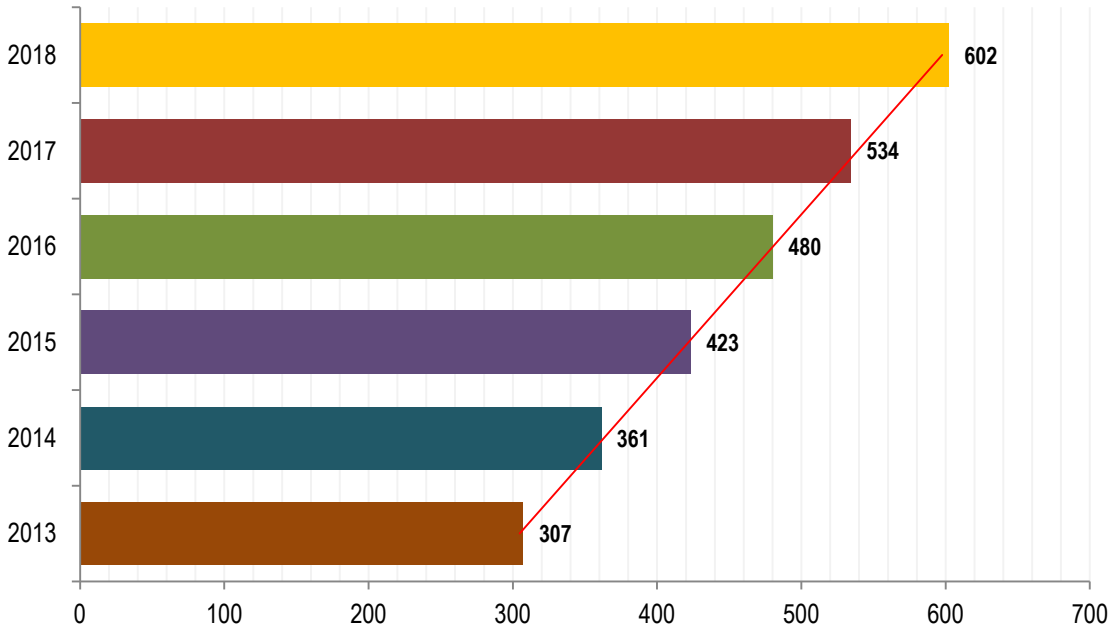

Figure 9. Revenue from E-commerce in EU Member States (2013-2018)

As the market is constantly evolving, so do the postal operators. The reality today is that both buyers and sellers expect more from postal services. Postal services are not just about delivering a letter or parcel from one point to another. The digital era of communications has enabled postal operators to develop innovative solutions to deliver efficient and high-quality services. The postal operators have fostered a range of online and mobile options for small and medium enterprises (SMEs) to quickly calculate cross-border postage prices and delivery options. They are responding to the specific rise in electronic goods ordered online by providing insurance and "signature upon delivery" options. Through creative solutions such as these, postal operators have a valuable role in ensuring a positive shopping experience for consumers [International Post Corporation & PostEurope, 2018].

As e-commerce delivery service encompasses the collection, transportation, distribution, exchange and return of products purchased on the web. Delivery is the most basic (and also most important) service the postal operators offer to the e-commerce market. E-commerce customer demand more features and information than other customers of postal services. For this reason e-commerce delivery calls for quality, agility, reliability, technology integration, and the lowest price possible.

E-commerce consumers have very high expectations in terms of quality – they want to be sure that they will receive what they order and that there will not be unexpected delays. A best practice for e-commerce is the establishment of a service-level agreement (SLA) to better organize the relationship between the postal operators and the retailer and increase the confidence. An SLA has to define deadlines, expected performance, bonuses and fines.

The e-commerce market is highly competitive, and services must be quickly adjusted to meet customer needs. This is a particular challenge for postal operators, which must contend with organizational decisions, as well as restrictions related to hiring, resource allocation, and the equitable treatment of all customers (adjusted services must serve the entire market equally).

At the same time e-commerce business greatly depends on the buyer experience.

For e-commerce, information about delivery is just as important as the actual delivery. The seller needs to have access to delivery information through an IT structure. It is therefore important to develop an application programming interface and protocols for integrating processes between postal operators and e-shops.

High competition and the attractiveness of free shipping for buyers exert pressure on delivery prices in the e-commerce market. In this regards postal operators can offer multiple shipping options with different service agreements.

Digital Postal Services

Nowadays, with the business embracing digital technology at an ever faster rate, customers are increasingly expecting to interact directly with the postal operators through digital channels. According to Universal Postal Union report 73% of postal operators indicate that they have increased their investment in digital postal services. At the same time 93% of postal operators provide digital postal services, either directly or in partnership with other companies [Universal Postal Union, 2019b].

Digital postal services are services delivered by postal operators to their end-customers (individuals, businesses or governments) through digital channels. The Internet is the main digital postal services delivery channel, while other

telecommunications channels (e.g. mobile phones, tablets, call centers or televisions) are also considered.

The digital postal services were classified into four groups: e-post and e-government, e-finance and payments solutions, e-commerce, and support services. The focus was on the digital capabilities of the services – the "physical" elements of the electronic services (for example, delivery or logistics) are excluded.

Table 4 summarizes global penetration rates for digital postal services. The e-post and e-government services are marked in green, e-finance services are marked in red, e-commerce services are marked in yellow, support services are marked in blue.

Table 4. Global Penetration Rates for Digital Postal Services

Service	*Rate*	*Service*	*Rate*
Track and trace	90%	Online management: documents / merchandise delivery	21%
Online information on services and tariffs	83%	Calculation of estimated total landed costs	21%
Online contact and customer service	74%	Performance reports and analytics	21%
Online lookup (postcodes, addresses, post offices)	73%	Digital signature	21%
Online philatelic and postal products shop	54%	Online facilitation of hybrid mail	21%
Electronic notification	49%	Digital archive	20%
Hybrid mail	49%	E-invocing	20%
Pick up service	38%	E-administration	17%
Electronic remittances	37%	Postal electronic registered mail	17%
Public internet access point in post offices	33%	Digital postage	16%
Online postal shopping portal (shopping mall)	33%	Online customs declaration	15%
Postal electronic mailbox	33%	Electronic postal certification mark	15%
Integration of postal web services with e-merchants sites	32%	Online address cleansing services	13%
Payment solutions	27%	Reverse hybrid mail	13%

E-cards	27%	Online direct mail	13%
Online bill payment	24%	Digital customized postage	11%
Electronic postal invoicing	22%	Virtual international address service	11%
Digital identity services	22%	Credentialing services	11%
Holding of mail delivery online	21%	E-health services	7%
Online change of address	21%	Online burofax	7%
Online account management	21%	Escrow services for e-commerce	5%

Source: Universal Postal Union, Measuring Postal E-service Development – A Global Perspective

Only five services have been implemented by more than half of the countries - track and trace (90%); online information on services and tariffs (83%); online contacts and customer service (74%) and online information on the postal infrastructure (73%).

In most of the countries, the portfolio of e-post and e-government services is built around a core of three products: hybrid mail, postal electronic mailbox and e-card.

Support services are the most widespread digital postal services. Seven of the top 10 digital services are support services.

E-commerce services and e-finance services widely seen as important components of modern core postal offerings are still underdeveloped.

According to the Universal Postal Union report the fastest-growing services in terms of the percentage of countries providing them are e-cards, digital identity services, online contact and customer service, digital postage and e-health services.

In accordance with new digital reality top priorities for postal operators have to be services that accompany and support the growth of e-commerce: the integration of postal web services with e-merchants' sites, payment solutions and online management of documents and merchandise delivery options.

Digital postal services enable postal operators to give customers seamless access to more than one service within the same online transaction. The main advantages of digital postal services are:

- Expanding access to mere customers;
- Improving customer experience;
- Simplifying the selling process for e-merchants.

The global trends that are expected to impact digital postal service development in the future can be summarized as follows:

- Big data and cloud computing technologies;
- New delivery technologies such as drones;
- Cyber-attack, cyber-security standards and technologies;
- New payment technologies such as mobile wallets;
- Crowd shipping.

In the digital economy the major strategic priorities of postal operators should be directed towards:

- Customer interaction - to develop more customer-centric services; meeting customer needs by innovating and launching new products and services focusing on one or more dimensions of the customer experience;
- Innovation capabilities - the ability to design new operational processes, products and services;
- Digital culture - postal operators have to encourage collaboration across teams and the acquisition of new skills, and train managers to take make data-driven decisions;
- Operational capabilities - linking physical and digital services to become a multichannel operator.

Conclusions

During the last three decades, the organization and delivery of postal services have undergone considerable change, as a result of both new consumer demands and digital economy. The transformation, which was largely facilitated by technological innovation, led to full market opening. Thus, an increasing number of private providers were able to emerge and secure a significant share of the high value-added services. At the same time, postal operators considerably expanded the range of their activities, which currently include financial, insurance, e-services and other services besides the more traditional postal facilities.

The internet revolution has transformed the economics of postal operators around the world. It has reduced the demand for letters and has boosted the demand for parcels as online shopping has taken a growing share of the retail market. Nowadays, the postal operators whether public or privatized enterprises, are facing common pressures to generate new revenues and provide more cost effective service.

Faced with potential competition and the likely loss of market shares in the former monopoly areas, the DOs in many countries adopted internationalization and diversification strategies to maintain or increase revenues. There are three principal trends which are likely to shape the postal sector over the next years: a continued decline in letter volume, electronic substitution, continued competition and growth in parcel sector.

In order to be successful in digital economy postal operators will need to rely on their competitive advantages and transform key aspects of their business.

ICTs have become widely available to the general public, both in terms of accessibility as well as cost. In 2018, 89% of households in the EU Member States had internet access. The proportion of individuals aged 16 to 74 in the EU who ordered or bought goods or services over the internet for private use continued to rise (51% in 2018). Consumers are increasingly purchasing online, domestic as well as cross-border. As a result businesses are prioritizing their online offerings.

As e-commerce market is constantly evolving, so do the postal operators. Delivery is the most basic and important service the postal operators offer to the e-commerce market.

A fundamental shift in communications behaviour is challenging the postal sector. Nowadays, the postal sector is focused on growth opportunities in the parcel by offering a wide variety of digital postal services. Postal operators are investing significantly in the development and marketing of digital postal services. These are still at the very earliest stage of market development and are perceived across the sector as highly sensitive and competitive areas.

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NEED TO BUILD A TRAINING CENTER FOR CONVENTIONAL AND DIGITAL MANAGEMENT AND ENTREPRENEURSHIP AT THE UNIVERSITY OF TELECOMMUNICATIONS AND POST

Gergana Dimcheva

Abstract*: Some theoretical statements related to the concepts of "entrepreneurship" and "digital entrepreneurship" are discussed. The consumption of information and communication technologies in Bulgaria for the period 2016 - 2018 is analyzed as part of the digitalization of the business in Bulgaria.*

Keywords*: Entrepreneurship, Digital Entrepreneurship, Information and Communication technologies.*

ITHEA Keywords*: J.1 Administrative Data Processing: Business*

Introduction

Information and communication technologies have been undergoing rapid development and continuous progress in the last 20 years. They are also the main driving force in our development and evolution. With the advent of the so-called an information society, anyone can create, access and share information and knowledge.

Each organization is an open system that operates in a dynamically changing environment that is influenced by many factors -external and internal [Стоянов, 2017]. From this point of view, it must be flexible and adaptable to these changes.

The dynamic development of technologies necessitates changes in business organizations not only in technological but also in organizational management aspect, which necessitates new ways and mechanisms for business implementation.

The speed and dynamics with which technological changes occur in the global economy require more tangible synthesis of qualitatively new concepts of leadership in the digital environment [Temelkova, 2018, p. 353].

Powered by digital technologies, the requirements related to workplaces are becoming more flexible and complex [Otsetova, Dudin, 2018].

Not only the technology of work and automation, but also the human factor [Kolev, 2017] - the entrepreneur and his role in the entrepreneurial process stand out. Educational institutions are essential precisely in the formation and preparation of knowledge and skills in management practice and entrepreneurship - the basis of the small and medium business of the national economy.

From this point of view, every educational institution, including the University of Telecommunications and Post, should take into account the new trends and patterns in business organizations and direct its efforts to change the educational product it offers. This change is related to the emergence of new management and entrepreneurial skills needs in the conventional and digital business environment.

Entrepreneurship and digital entrepreneurship

Education has a strong influence on entrepreneurial intentions and therefore on entrepreneurial behavior [Андонова, Кръстева, 2017, с. 67]. In the digital age we are in, educational institutions need to prepare successful entrepreneurs by combining the specifics of conventional and digital governance and entrepreneurship. Developing conventional and digital skills and competencies in the management and entrepreneurial process enable business organizations to be competitive and to cope with the changes and challenges of the business environment.

The etymological root of the terms "entrepreneurship" and "entrepreneur" is from the French word "entrepreneur", whose translation means an intermediary or an opportunity seeker (of some public activity) [Маринов, Велев, Гераскова, 2008, с. 18]

Management professionals define an entrepreneur as a person who not only shows initiative and skill in building a new business, but then develops it effectively, creating new customer values. His actions are seen not as a one-off act, but as a specific management style. The entrepreneur demonstrates his / her skills in formulating the goals, in planning the roads and the means for reaching them, in the organization of production and in controlling and responsibility for the activity of the enterprise [Маринов, Велев, Гераскова, 2008].

Digital entrepreneurship, defined as the practice of pursuing new venture opportunities presented by new media and internet technologies". [Davidson, Vaast, 2010 p.8; Ngoasong, Michael Zisuh, 2018, p. 2]

It is similar to traditional entrepreneurship with regard to pursuing entrepreneurial opportunities by creating new enterprises or commercializing products and services [Davidson, Vaast, 2010 p.8; Ngoasong, Michael Zisuh, 2018, p. 2]

In other words, digital entrepreneurship includes everything new and different to entrepreneurship in the digital world, including [Allen, JP, 2019]:

- ✓ New ways of finding customers for entrepreneurial ventures.
- ✓ New ways of designing and offering products, and services.
- ✓ New ways of generating revenue, and reducing cost.
- ✓ New opportunities to collaborate with platforms and partners.
- ✓ New sources of opportunity, risk, and competitive advantage.

The main difference arises because in digital entrepreneurship "some or all of the entrepreneurial venture takes place digitally instead of in more traditional formats" [Hair et al., 2012, p. 3]

A digital entrepreneur is therefore an individual who creates and delivers key business activities and functions, such as production, marketing, distribution and stakeholder management, using information and communication technologies (ICTs) [Hair et al., 2012].

According to the European Commission[1] Digital entrepreneurship embraces all new ventures and the transformation of existing businesses that drive economic and/or social value by creating and using novel digital technologies. Digital enterprises are characterized by a high intensity of utilization of novel digital technologies

[1] European Commission (2015). European Commission (EC), Digital Transformation of European Industry and Enterprises; A report of the Strategic Policy Forum on Digital Entrepreneurship, available from: http://ec.europa.eu/DocsRoom/documents/9462/attachments/1/translations/en/renditions/nativ

(particularly social, big data, mobile and cloud solutions) to improve business operations, invent new business models, sharpen business intelligence, and engage with customers and stakeholders. They create the jobs and growth opportunities of the future [Zhao, Collier, 2016].

Digital entrepreneurial competences are a combination of entrepreneurial competencies [Manolova et al., 2007; Marvel, 2011] and competencies in information and communication technologies [Ashurst et al., 2012].

Figure 1. Relationship between Entrepreneurial competencies and Digital competencies

Source: Adapted by [Ngoasong, Michael Zisuh, 2018, p. 36]

Establishment of the Training Center for Conventional and Digital Management and Entrepreneurship in the University of Telecommunications and Post will enable the trainers to acquire specialized knowledge and skills for starting, realizing, developing and refining the entrepreneur's business idea in the digital business environment.

Digitization of business in Bulgaria

According to the Digital Economy and Society Index (DESI)[1], in 2018, Bulgaria is ranked 27th out of a total of 29 participating countries in Europe in the digital economy. Denmark, Sweden, Finland and the Netherlands have the most advanced digital economies in the EU, followed by Luxembourg, Ireland, the United Kingdom and Belgium. Romania, Greece, Bulgaria and Italy have the lowest index scores[2].

In 2019, all EU countries have improved their digital performance. Finland, Sweden, the Netherlands and Denmark have achieved the highest DESI 2019 ratings and are among the global leaders in digitalization. However, some other countries still have a long way to go and the EU as a whole needs to improve in order to compete on the world stage. Bulgaria is displaced by Romania and Greece, falling from 27th place to 29th[3].

Digitization is a concept that is associated with the use of information and communication technologies. In order to track the extent of their use in Bulgaria, enterprises are grouped into three groups: use of computers and Internet by businesses; e-commerce and the use of automated data exchange (Fig. 2).

The analyzed data cover the period 2016 - 2018, with the exception of the heading "Use of automated data exchange", where the data are for the years 2015 and 2017. The reason is the lack of such data for each of the years during the studied period.

[1] The Digital Economy and Society Index (DESI) is a composite index that summarises relevant indicators on Europe's digital performance and tracks the evolution of EU member states in digital competitiveness. The five dimensions of the DESI: 1. Connectivity (Fixed Broadband, Mobile Broadband, Fast and Ultrafast Broadband and prices); 2. Human Capital (Basic Skills and Internet Use, Advanced skills and Development); 3. Use of Internet Services (Citizens' use of Content, Communication and Online Transactions); 4. Integration of Digital Technology (Business digitisation and eCommerce); 5. Digital Public Services (eGovernment and eHealth), https://ec.europa.eu/digital-single-market/en/desi

[2] Digital Economy and Society Index Report 2018 Use of Internet Services, https://ec.europa.eu/digital-single-market/en/desi, 2018.

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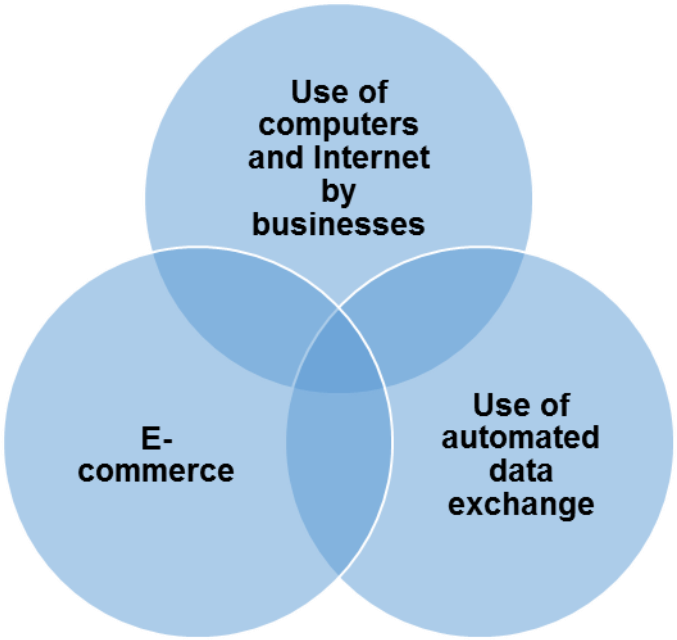

Figure 2. Use of information and communication technologies in Bulgaria

Source: According to data from the National Statistical Institute, www.nci.bg

➢ ***Use of computers and the Internet by businesses***. One of the key dimensions of advancement in the digital economy is the use of computers and the Internet by businesses, in particular: businesses with Internet access; employees of enterprises that use computers; employees of enterprises using the Internet; businesses that use electronic invoices; enterprises using cloud services (Table 1).

As observed from the data over the period considered, the number of enterprises with Internet access increased only in 2017 compared to 2016, as opposed to 2018 compared to 2017, when their number remained unchanged. The change in the number of employees using computers and, respectively, using the Internet is almost insignificant in the three surveyed years.

Businesses using cloud services have seen an increase every year. Large enterprises with more than 250 employees significantly increase their access to cloud services between 2016 and 2017, but fail to reach 30 percent in 2018. Medium-sized enterprises (50 to 249 employees) reach 15 percent in 2018, and the small ones (10-49 employed) do not exceed ten percent.

Table 1

Use of computers and the Internet by businesses

***Source*: According to data from the National Statistical Institute, www.nci.bg**

By size class	Enterprises having access to the Internet (%)			Persons employed using computers (%)			Persons employed using Internet (%)			Enterprises sending and/or receiving e-invoices (%)			Enterprises using cloud computing services (%)		
	2016	2017	2018	2016	2017	2018	2016	2017	2018	2016	2017	2018	2016	2017	2018
Total	**91,3**	**94,6**	**94,6**	**29,7**	**30,2**	**31,5**	**25,8**	**26,7**	**28,1**	**46,9**	**47,4**	**47,8**	**6,7**	**8,0**	**8,3**
10 - 49 employed	89,7	93,7	93,7	30,8	32,0	33,3	27,7	29,0	30,6	44,3	45,4	45,6	5,5	6,7	6,6
50 - 249 employed	98,4	98,5	98,5	27,8	27,5	28,0	25,3	25,3	25,8	57,6	56,3	58,5	11,1	11,7	14,8
250 + employed	99,8	100,0	100.0	30,3	30,7	32,8	24,5	25,7	27,6	67,4	59,0	58,7	17,9	28,6	29,7

➢ ***E-commerce*** - Includes: businesses that have received online orders (sales) and businesses that have purchased goods or services online (Table 2).

Table 2

E-commerce

Source: According to data from the National Statistical Institute, www.nci.bg

By size class	Enterprises having received orders on-line (%)			Enterprises having purchased on-line (%)		
	2016	2017	2018	2016	2017	2018
Total	**8,6**	**10,5**	**8,1**	**10,7**	**13,0**	**17,0**
10 - 49 employed	7,9	9,5	7,2	9,5	12,3	15,7
50 - 249 employed	11,2	14,6	11,5	15,7	15,4	22,8
250 + employed	17,4	18,5	15,4	22,1	22,0	28,5

An interesting fact seen in the table is the increase in businesses that received online orders (sales) in 2017 compared to 2016 and about the same percentage decrease in 2018 compared to 2017 (22%). For businesses that have purchased goods or services online, the upward trend is continuing over the three surveyed years.

➢ ***Use of automated data exchange*** - this includes businesses that have used a resource management system (ERP), customer information management (CRM) software applications, and businesses whose business processes are automatically linked to those of their suppliers or customers.

Table 3

Use of Automated Data Exchange

Source: According to data from the National Statistical Institute, www.nci.bg

By size class	Enterprises using ERP software package (%)		Enterprises using software application for managing information about clients (CRM) (%)		Enterprises sharing electronically information on the supply chain management (%)	
	2015	2017	2015	2017	2015	2017
Total	**24,9**	**23,3**	**17,2**	**18,6**	**17,6**	**17,3**
10 - 49 employed	20,7	20,0	15,6	16,9	16,1	15,9
50 - 249 employed	41,4	35,5	22,8	25,7	23,0	22,3
250 + employed	60,8	59,2	33,6	32,9	34,0	34,7

It can be seen from the table that the change in the use of different information systems by the enterprises, although in the course of the year, is hardly observed. On the contrary, some of them show a decline.

The above data on the degree of use of information and communication technologies as the main criterion for digitalization of business in Bulgaria are confirmed by the latest positions of our country according to the DESI index in Europe.

One of the main reasons for this is the lack of sufficiently competent digital entrepreneurs in Bulgaria.

Even the most successful entrepreneurs need to develop digital skills in this modern business environment. Unfortunately, few organizations still invest in this type of training.

Digital platforms are enabling collaboration, communication, document management, scheduling, resourcing, talent management, troubleshooting, training and everything else in project management. This is reducing the lag time between communications

and task updates, providing real-time and relevant information directly to the people that need it most [Alexander, 2018].

Established companies recognize that digital technologies can help them operate their businesses with greater speed and lower costs and, in many cases, offer their customers opportunities to co-design and co-produce products and services [Sambamurthy et al. 2003; Snow, Fjeldstad, Langer, 2017]

The rapid development of information technologies and systems has led to new requirements in the management mechanisms as well as the ways of organizing entrepreneurial activity. There is an awareness of the need for intelligent solutions to various problems in management practice and business in order to increase competitiveness in the context of complex organizational processes and trends.

Technology is a way of getting work done [Perrow, 1967]. New technologies are seldom “invented” but rather are developed by combining technologies that already exist. Unlike older technologies, which mostly produce fixed physical outputs, digital technologies are generative [Zittrain, 2006] -- they can be combined and recombined endlessly for fresh purposes [Arthur, 2009] [Snow, Fjeldstad, Langer, 2017]

Managers in many organizations leverage new technologies to create new or refine existing business processes, to do business analytics, to make decisions, to improve communication with customers, suppliers, partners, and other stakeholders. This is achieved through good preparation, in combination with conventional and digital governance and entrepreneurship.

According to research, it has been found that Bulgarians have understood that entrepreneurship is a complex and demanding endeavor that needs both a specific way of thinking and specific skills [Bosma, Kelley, 2018, p. 70][1].

[1] Global Entrepreneurship Monitor (GEM) is a consortium of national country teams, primarily associated with top academic institutions, that carries out survey-based research on entrepreneurship around the world. GEM is the only global research source that collects data on entrepreneurship directly from individual entrepreneurs. https://www.gemconsortium.org/about/gem/5

According to the National Report on Entrepreneurship in Bulgaria in the survey of national experts, Bulgaria has many significant weaknesses. The most important ones concern entrepreneurship education, both at school level and beyond.

Education has a strong influence on entrepreneurial intentions and therefore on entrepreneurial behavior. The negative assessment of the quality of entrepreneurship education at school level clearly shows that the school system in Bulgaria fails to adequately prepare students for successful participation in the economy [Андонова, Кръстева, 2017, с. 60].

As the figure 3 shows, although there is a growing trend, Bulgaria still has a low score on entrepreneurship education, both at school and post-school levels.

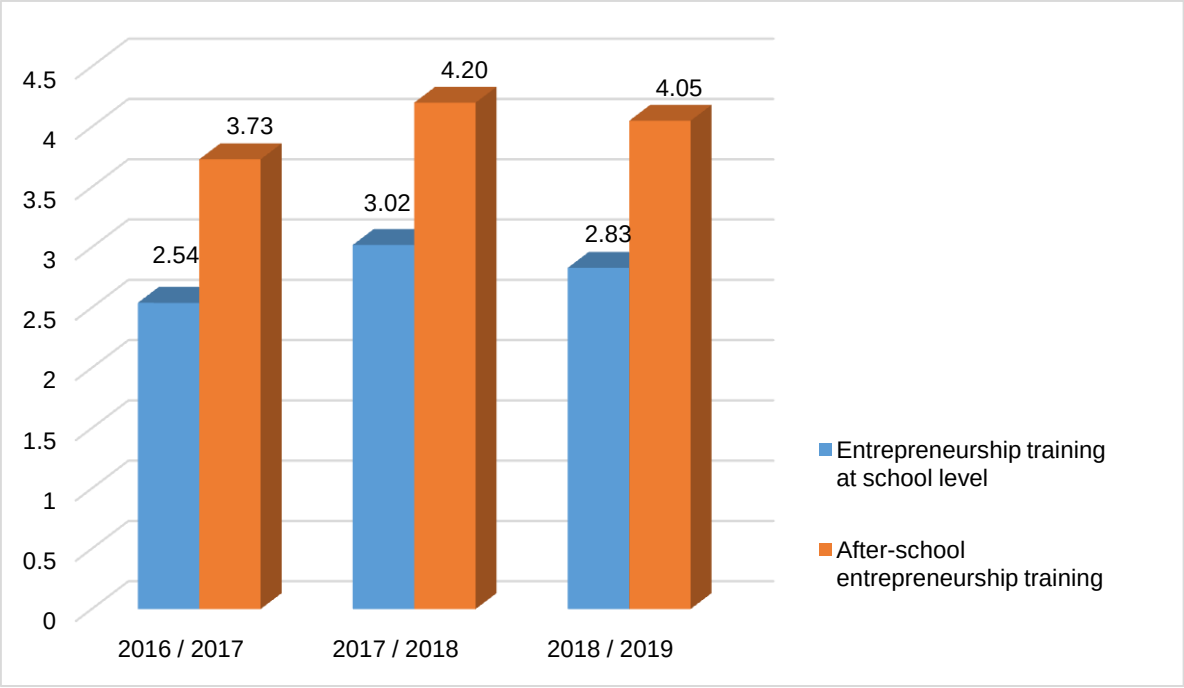

Figure 3. Average assessment of entrepreneurship training

Source: According to data from [Bosma, Kelley, 2017/2018; Bosma, Kelley 2018/2019]

Provision of training and further evaluation of high school and university graduates for soft skills, including entrepreneurial awareness, emotional and social skills. It is

likely that the emphasis on good practices and role models will be an advantage for such efforts. In particular, to allow universities to participate in the equity of commercial enterprises using on-site technologies. Creating educational opportunities at the intersection between entrepreneurship and science [Андонова, Кръстева, 2017].

These results indicate that there is a need to establish a Training Center for Conventional and Digital Management and Entrepreneurship at the University of Telecommunications and Post. Its construction will lead to:

- Creating opportunities for starting your own business;
- Opening entrepreneurial workshops;
- Continuous improvement of new knowledge and skills of both current and future entrepreneurs;
- Solving practical cases in a real work environment by combining conventional and digital tools in the field of entrepreneurship.

Conclusions

In a digital economy, more and more organizations are developing and delivering products, services and solutions and interacting with their stakeholders digitally. With the help of new technologies, organizations offer their customers reliable services at flexible prices.

The development and refinement of management's conventional and digital skills is becoming a must for all entrepreneurs in Bulgaria in all sectors of the economy.

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STRATEGIES FOR INTERNATIONAL BUSINESS AND ENTREPRENEURSHIPS

Dimitar Kolev

Abstract*: This research paper is dedicated to small business and entrepreneurship. A theoretical framework about multi-level marketing and its similarities with franchise has been drown. In order to determine the new wave of entrepreneurial ideas and models, some examples of successful business startups have been described. On that basis, some key conclusions and recommendations about entrepreneurship and small business in Eastern European countries have been outlined.*

Keywords*: entrepreneurship, international business, multi-level marketing.*

ITHEA Keywords*: J.1 Administrative Data Processing: Business*

Introduction

Small business is the basis of any economy, the relative share of small and medium-sized enterprises in the total number of organizations in developed countries ranges from about 70% in the UK to over 95% in the USA, Japan, Germany and France. They create about 2/3 of new jobs, and their share in the public product (GDP) is in the range of 40-60%. In all countries, small organizations are the bearers of technical progress and innovative entrepreneurship. The important role of small business in business life is proven by the state that small organizations in one country are a kind of indicator of the general situation of the economy.

The expansion of the small business sector in the western countries is estimated as a signal for the transition from managerial to entrepreneurial economy. In Bulgaria and other Eastern European countries, it is indicated by the willingness of not only the managers of the old enterprises but also the thousands of other people to achieve the material basis of their independence (small business ownership) and take advantage of the opportunities offered by economic freedom.

There are varied opinions for the causes of small business and self-employment growth in recent years. Some experts see the growth of small businesses as a short-term response to the restructuring of large companies; others see them as the result of long-term changes in the economic structure, which is expected to produce positive outcomes. A large number of macroeconomic factors are cited as an explanation for the increasing number of new small business enterprises – the growth of services sector in comparison to industry production, the unemployment rate, the progress in electronics and technology and so on.

The main purpose of this research paper is to present some of the strategies for startups of small and medium enterprises and entrepreneurship in correspondence to the economy conditions of Eastern European countries.

The goals are:

- To make a theoretical review of multi-level marketing as an opportunity for small business;
- To examine the similarities and differences between franchise and multi-level marketing;
- To highlight some of the modern entrepreneurship business models.

I. Multilevel marketing and franchise

One of the most popular modern strategies for entrepreneurship and international business is multi-level or network marketing. In 2013, it reached a turnover of $ 179 billion with 96 million representatives worldwide [Makni, 2015]. On the one hand, this type of activity can be considered as entrepreneurial because it requires initiative, risk taking, and allows generation of income directly dependent on the entrepreneur himself. On the other hand, the risk here is minimized because the business does not start from zero, but you join an existing business network and develop it depending on the scope of your social contacts and activity.

According to the European Union Consumer Commission [Makni, 2015], network or multi-level marketing involves suppliers / manufacturers who set up a distribution network by attracting consumers to sell their products to their acquaintances.

The US Federal Trade Commission defines this type of activity as direct sales of products in which distributors profit not only from their sales, but also from the sales of other parties involved in the business network [Makni, 2015].

This activity is based on three main pillars [Makni, 2015]:

- **Personal consumption** of the products / services of the company by the distributors (direct business partners), which makes them their long-term loyal customers. Therefore, it is advisable for distributors to partner with a company whose products they like and would like to promote;
- **Recommendation of products** from business partners to other users / end customers. This process is most effective only if the aforementioned condition is met, because only then the distributors are aware of the qualities of what they offer; the professional approach in this process, which increases reliability and confidence in it, requires the acquisition of more knowledge and competence about the products and the company they represent.
- **Sponsorship (networking)** - seeking, supporting and training by business partners to new business collaborates on a ready-made system that gives knowledge of how products are offered and the business opportunity. Usually the system is developed by the first distributors of the company (its leaders) and if it is effective, the organization can grow to tens of thousands of distributors in different countries.

The characteristics discussed here from entrepreneurial logic are very much like a franchise, which is a license that allows one **(franchisee)** to sell and market the other's (**franchisor)** products in a specific location under specific conditions, using the trademark. Some of the main similarities and differences between the two models can be seen in Table 1.

From all the features in the table, attention should be payed to the low cost of starting a multi-level marketing business, and quite often it includes a bundle of products that are distributed through the network. Other important feature is the ability to create an international network and the fact that in this type of business the distributor creates its own network with unlimited profit opportunities. In both cases, however, the biggest winner is the organization whose products are distributed either through franchise or through multi-level marketing.

Table 1. Comparison between franchise and multi-level marketing

Indicators	Franchise	Multi-level marketing
Startup fee	40 000 USD on average	200 USD on average
Royalty	Yes - Franchisee pays 3-10 % of its income	No – the business partner (distributor) receives 3-28% on its network turnover
Expenses for employees	Yes	No
overhead costs	They increase with the business growth(rent, office expenses, cars and so on)	Self-employment
Territorial coverage	Limited	Potential for international business network
Network	the franchisee builds a foreign network	Distributor makes its own network
Income	Lineal growth	Exponential growth

II. New entrepreneurship business models

The aforementioned models enable the development of entrepreneurial activities and small business. At the same time, new concepts are emerging, such as internal entrepreneurship, which is an opportunity for initiative employees in an organization to develop according to their vision in the company structure [Narlev, 2007]. Such developments may apply to individuals as well as to a particular team, enabling organizations to retain their employees and obtain alternative research and development opportunities. However, it is more common practice for individuals who have gained experience in an organization to decide to establish their own businesses. This is typical for people working in the field of construction and repairs, personal services and so on.

The other main modern entrepreneurship strategies are [Bulgarian Ministry of Youth and Sports, 2018]:

– **Digital Entrepreneurship** - represents the unification of traditional entrepreneurship with a focus on new technologies, the opportunities created by these technologies and new business forms. Digital startups are

characterized by the use of many new technologies, social media, big data analytics, mobile cloud services, predictive analytics, etc. that improve business processes, create new business models and develop relationships with customers and stakeholders. These companies create jobs and opportunities for growth. Digital businesses have been recognized by the European Commission as an extremely important impetus for the economic development of countries in the European Union due to the generation of jobs and high incomes for people engaged in the digital sector.

- **Social entrepreneurship** - this is a different way of economic activity (doing business) that mixes the ingenuity of business with a social mission, skillfully combining and balancing social and economic goals. Social entrepreneurship is an activity aimed at solving important social problems, but generating income for the entrepreneur. It is related to the "non-profit" sector, as well as to the concept of "social economy", which emphasizes on benefiting the community and society as a whole, and not entirely aimed at the profit of the company. Not all social service providers are social enterprises. For example, an enterprise providing luxury rehabilitation services works in the social sector but is not a social enterprise if its workers do not benefit from its activity or if the enterprise needs funding from the state to work. To clarify it some examples are given below.

Green entrepreneurship or **"eco"** entrepreneurship is an economic activity which deliberately addresses an environmental problem and / or need by realizing an entrepreneurial idea that has a positive environmental impact and is financially sustainable at the same time. Green entrepreneurship is directly linked to social entrepreneurship because it works for a social cause in the environmental field.

- Entrepreneurship in the field of **education** is the launching and development of a business related to the educational process of children, young people or adults. Well-known examples of this type of entrepreneurship are the learning centers where a trainer works with a small group of students. Recently, many innovative companies and associations based on non-formal learning methods have emerged.
- **Creative or art** entrepreneurship is in the fields of music, theater, art, dance, animation, cinema and other creative sectors. For example, Grozen

Entertainment is a Bulgarian cultural organization, a production company for 2D & 3D animation and comics, a publishing and educational center whose activity is focused on promoting worldwide the quality of contemporary art, created in Bulgaria and abroad by the best Bulgarian comic book authors, illustrators, designers and animators.

- Entrepreneurship in **healthcare** - can be related to the opening or renovation of a health establishment, the creation of a new device or treatment method, or the clinical trial of new medicines. It is an industry that simultaneously encourages innovation and drives companies within it to operate in a risky environment. For example, the DivaCare platform is a telemedicine application that allows doctors and therapists to connect with their patients and clients via a mobile smart phone or tablet. It consists of 2 parts - a mobile application for patients and a desktop web application for doctors. The platform allows for a two-way relationship between therapist and client - sharing information, scheduling appointments and exercises, collecting biometric data and other treatment-relevant information. All this in real time and without the need for personal meetings.

From all the given examples of modern entrepreneurship models, the most popular in Bulgaria is the social type. There are many entrepreneurship businesses currently working in this field, such as [Open mind project, 2018]:

Bulgarian food bank: saves unnecessary but still worthy food that would otherwise be wasted. The food is sorted, fresh and of good quality. Most often, it has lost its market price because it is not in perfect commercial condition or because of various logistical, technological or marketing reasons it cannot be sold. This bank relies on its network of collaborators from civic organizations across the country who work with socially disadvantaged families and individuals, orphanages and retirement homes.

- **Hope Soap** is a workshop for soap for underprivileged young people. Their main goal is to give job and social inclusion opportunity for young people from orphanage homes. The soap is made from ready-to-use preparations, fragrances and colors, the required operations and manipulations from people are very easy to follow.
- **Bread house network** aims to inspire people and communities around the world to discover and develop their creative potential and to collaborate

through collective bread bakery and the accompanying arts and sustainable environmental education. The Bread House Programs include various initiatives: the **Bread Therapy** Program, made for small groups of people with different special needs; **Bread Breaking Boundaries** Lifelong Learning Programs; **Bread Building** team building program; **HedgeHope** children's program; environmental and nutritional education program.

- **Listen Up App** was originally developed by top students from Samsung Tech Institute in Bulgaria, participants in a mentoring program that allows them to work with a team of professional developers. With the exclusive support of Samsung Bulgaria, the mobile app was recognized by the **Listen Up Foundation** and launched in the country to help 8,000 hearing-impaired children and students gain access to previously unavailable educational resources.

These are just a few samples of Social entrepreneurship done in Bulgaria, which seems to be very attractive field. On the one hand, in recent years, social responsibility has become an integral part of doing business and instead of having it as an addition to your main business, it is your main purpose. On the other hand, employing underprivileged people has not only social effect but also benefits the organization with government funding and low taxes. The only considerable downfall is the supposed low income from the social activity.

Conclusion

In the context of the fourth industrial revolution, starting small business or entrepreneurship is very difficult especially in Eastern European countries, which are considered to be relatively small markets. One of the most common ways to do it is via entering an existing business network, such as franchise or multi-level marketing. Both models have their advantages/disadvantages and the one point outlining the others is that you enter an already working business with well-known branding.

There are some new approaches for stating small business correlated to the modern society - digital, green, education, art, social, healthcare and so on. All of them give ideas and inspiration for entrepreneurship, which is very important economy asset. One of the most popular in Bulgaria is social entrepreneurship, which inclines on combination of meaningful social goal and profit orientated organization.

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TOWARDS A PREDICTIVE MODELING OF SELF-CONTROL MOBILE NETWORKS

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Abstract*: Abstract: The problems of investigations of routing algorithms and data transfer algorithms in mobile self-controlled networks by simulation methods are considered. This class of networks has specific properties: dynamically moving nodes, "limited distance" between nodes, and the absence of a centralized node. The mathematical model of such a network is a dynamic graph. It is important to predict the conditions when the connection failure of nodes occurs during the execution of various routing algorithms. Simulation experiments are performed in the AnyLogic environment.*

Keywords*: ad hoc networks, simulation modeling, simulation systems, dynamic geometric graph, routing algorithm*

ACM Classification Keywords*: I.6 SIMULATION AND MODELING I.6.8 Types of Simulation - Distributed : I.2 ARTIFICIAL INTELLIGENCE I.2.5 Programming Languages and Software - Expert system tools and techniques*

Introduction

Nowadays a class of computer networks (wireless decentralized) is widely used, for which mobility is characteristic: nodes can move in space, join a network, or be excluded from it.

In addition, such networks are characterized by limiting the distance between nodes. Each node is characterized by the power of the signal source and the sensitivity of the signal receiver. If the nodes are separated from each other by less than a certain distance r, then we can say that between them there is a connection for transmitting signals. If the distance between the nodes exceeds the specified distance r, then the connection between the nodes can be interrupted, since there is no direct connection.

The mathematical model of such a network is a graph. Since the network is mobile, the graph is also dynamic, in this graph the number of vertices randomly changes, edges appear and disappear. The operability and qualitative characteristics of the network in this case can be described through such characteristics of the geometric graph as connectivity, number of components, length of routes, etc. A graph at some points can be connected, at some moments - non-connected.

For a certain pair of nodes at different points in time, there may be no routes at all, there may be a single route, or there may be several routes.

An opportunistic mobile system can ensure the transmission of a message even if there is no route between two nodes of network at some time periods, one of which is the source, the second is the receiver. This can be achieved due to the fact that the message moves from the source first to the intermediate node (to which there is a route), waits in it (buffered), and then moves on when the opportunity arises due to the movement of nodes .

The routing algorithm must dynamically find a route consisting of partial routes for each message. A knowledge accumulated about the system and its environment may be used for this purposes. The behavior of nodes is difficult to predict. For this reason, it is necessary to use the apparatus of graph theory and probability theory (random graphs) [Mikov A.]. For the analysis of information flows in computer networks, in addition to the methods presented by graph theory, analytic methods of queuing theory and simulation methods are used.

Simulation models are one of the most important tools for the investigations of routing algorithms for the reason that mobile networks and the behavior of objects of mobile networks are quite complex and do not always make it possible to use analytical methods. Since the mathematical model is a dynamic graph, the tools for simulation should be flexible and efficient.

The AnyLogic simulation system was chosen [Grigoriev I.] as a software tool for simulation.

Currently, there are a large number of different classes of mobile networks: MANET, VANET, FANET, etc.

At first, we'll focus on networks of the FANET class, give an overview of these networks and their research methods.

Routing algorithms in FANET

FANET is a type of peer-to-peer VANET network (Vehicle Ad-hoc Network - a self-organizing network of vehicles), the nodes of which are UAVs [Leonov A.] (unmanned aerial vehicles). The movement of UAVs in FANET is controlled exclusively by algorithms without any human interference, so UAVs can easily be re-deployed to an ad-hoc network [Sami O.]. The nodes of this network are connected via wireless technologies: WiFi, LTE, WiMAX, etc.

Although FANET is very similar to VANET and MANET (Mobile Ad-hoc Network - a self-organizing network of mobile devices), but FANET also has some specific characteristics.

FANET Mobility Models and their practical application

There are two types of communication that can be established in FANET [Sami O.]:

- Wireless air-to-air connection: UAVs can communicate with each other using only ad-hoc architecture to avoid the restrictions associated with the transmission range imposed by the communication between UAVs and ground base stations. In addition, the aforementioned type of wireless communication can be used in multi-hop communications, in which nodes can transmit a data package to another node that is out of range.
- Wireless air-to-ground connection: in FANET, not all UAVs can communicate with different infrastructures (infra-structure hereinafter refers to the combination of software and hardware complexes of telecommunication) such as ground base stations or satellites. However, only some of the FANET nodes communicate with infrastructures to improve connectivity.

As noted earlier, the movement of nodes in FANET is usually predetermined, i.e. it is defined by means of some algorithm. However, in a real environment, the movement of nodes can be changed due to some external factors: due to weather conditions, the nature of the mission which network performed, etc. [Sami R.]. In accordance with this, there are several mobility models (from the English Mobility models) of the

nodes that make up the FANET. FANET node mobility models can be classified into five categories [Bujari A.]:

- Random model of mobility (Randomized mobility model), - the simplest model of movement, which is used in the study of networks. The behavior of an individual network node (its movement) in this type of mobility model is absolutely independent of the behavior of other nodes included in this network, as well as of the node's previous actions. Examples of random mobility models are RW (Random Walk), RWP (from the English Random Way-Point) and RD (Random Direction). In these models of mobility, each node selects an arbitrary direction of movement and speed with which it will move in a certain period of time. Another example of this type of mobility model is the MG model (Manhattan Grid), which uses the topology of a real transport network. At the same time, the movement of nodes is accompanied by some difficulties, since the nodes must change the trajectory of their movement, either horizontally or vertically, taking into account the peculiarities of the map of the area (city).
- Mobility models that depend on spatio-temporal characteristics (Time / space dependent mobility models) - mobility models belonging to this category are based on eliminating sharp changes in the speed and trajectory of nodes. For this, various mathematical equations are used. The following mobility models can serve as examples: BSA (Boundless Simulation Area), GM (Gauss-Markov). In similar mobility models, the current speed and path of the nodes are selected based on the relationship with the path and speed of the nodes in the previous step. The ST mobility model (Smooth Turn) allows network nodes to move along curved paths. At the same time, a certain point is chosen in space, which will be the final point of the trajectory of the node.
- A mobility model with a predefined path (Path-planned mobility models) - mobility models belonging to this category define a path of a certain shape for nodes. The nodes follow a specific path until they reach the end point of this path, then the nodes randomly select a new path or repeat the movement along the same path. The SRCM mobility model (Semi-Random Circular Movement) also belongs to this category, since the model is intended for cases when network nodes move along curved paths. The PPRZM mobility

model (Paparazzi mobility model) is a good example of a stochastic mobility model. Stochastic mobility models are based on a state machine, each of the states in which is one of the possible trajectories of the node: Stay-At, Oval, Eight, Scan, Way-Point. Each of the network nodes selects a specific trajectory and random speed of its movement.

- Group mobility models (Group mobility models) - these models impose certain spatial restrictions on all network nodes. The RPGM mobility model (Reference Point Group mobility) simulates random node movements near the starting point, using a simple RWP mobility model. Special cases of RPGM are also distinguished: in the NC mobility model (Nomade Community) each of the nodes moves near the starting point, which in turn also moves randomly in space. The PRS mobility model (Pursue) is similar to NC, but at the same time the network nodes try to follow a specific goal without resorting to random movements near it.
- Mobility models based on the control of network topology (Topology-control based mobility models) - used in cases where it is necessary to constantly monitor the network topology in real time. A classic example for this category of mobility models is the DPR model (Distributed Pheromone Repel), which is used in networks designed for reconnaissance or implementation of search missions. In this model, each node has its own map of pheromones (pheromone map). The Mobility Model SDPC (Self-Deploy Point Coverage) is designed for networks that are designed to solve problems associated with natural disasters. This model deploys a UAV network at the scene in order to create a communications infrastructure that can be used by the injured. The goal of each of the nodes in this network is to reach as many people as possible and to maintain communication with other nodes of the network.

Although FANET is a kind of subclass of MANET and VANET networks, FANET has its own data routing techniques. These techniques have their advantages and disadvantages. Next, we will consider the most popular techniques currently used for routing data in FANET, and we will also classify the existing routing protocols.

FANET Package Routing Techniques

Routing technique Store-carry and forward

At a certain point, when periodic communication disruptions occur in the network, the sending node may not find the node to which it could transmit a data package. As a result, the sending node cannot send a data package to a specific node that would be within the radius of its transmission (transmission range). In this case, the sending node must physically move in space itself until it reaches any node to which it could transmit this data package (or the node to which this data package is destined) [Sami O., Nadeem A.].

LCDR Routing Protocol

The most popular routing protocol in terms of use and reliability, which is based on this principle, is called LCDR (Load, Carry and Deliver Routing). The principle of operation of this routing protocol is described in detail in [Yassein M.]: this model is designed to transmit data from one ground-based base station to another. For this, UAVs and single-hop communication are used.

This model is suitable for transferring images and videos. First, the data is downloaded from the access point to one of the UAVs, and then the data UAV moves to the recipient's access point in order to transmit a package of data to it. From a security point of view, the considered routing protocol is quite reliable: the data package does not carry out additional “jumps” (from the English hops) during transmission. The time required to deliver a data package from one base station to another depends on the speed of the UAV and the distance between access points. One of the options for reducing the time for delivery of data packages is to increase the number of UAVs that would receive and transmit data.

In addition, you can increase the speed of UAV movement or divide the entire network into subnets, inside which LCDR routing will also be used.

Greedy forwarding routing technique [Sami O.]

This technique is recommended to be used if FANET has a high density (contains a sufficiently large number of nodes). The main task of the “greedy” routing is to

minimize the number of “jumps” of the package of data during its transmission from node to node.

The principle of operation of the technique is quite simple: at each step it is necessary to choose the node that, from the geographical point of view (using the geographical coordinates of the nodes), is closest to the receiving node as a relay node. The package forwarding process ends when the package reaches the receiver.

However, there are some drawbacks to this technique. The process of transmitting a data package can be blocked if the node to which the data is transmitted is recognized as the closest to the receiving node, but there will not be a single node (including the receiving node) within its radius of operation it could potentially transmit a data package to continue the routing process.

To ensure the reliability of data transmission, it is necessary to use the proposed approach in combination with other approaches.

RGR Routing Protocol

Significant improvements in the technique of "greedy" routing can bring the RGR method (Reactive-Greedy-Reactive routing), proposed by Rostam Shirani in [Shirani R.]. This protocol is a typical representative of reactive routing protocols. The principle of reactive routing is to find all possible paths (from the English path discovery) from the source of the package to the destination node. However, do not confuse this type of routing with proactive routing: in proactive protocols, all possible paths between each pair of nodes in the network are calculated, therefore this technique is not entirely suitable for FANET, due to the high dynamism of the nodes of this type of network.

In reactive routing protocols, the calculation of paths from the source to the destination node occurs “on demand”, when it is not possible to make a path between two nodes because the sending node does not know the geographic location of the receiver [Sami O.].

The path search process is based on the distribution of route creation requests (RREQ). The RGR routing protocol uses a mixed technique: the package is delivered using the reactive routing technique, but if for some reason the package transmission

process is interrupted, the alternative branch of the algorithm, GGF routing, will be used.

The paper [10] presents the results of modeling taking into account changes in UAV speeds. Reactive routing protocols include the AODV and OLSR protocols. A.V. Leonov and G.A. Litvinov [11] gives a characterization of these protocols and also demonstrates the results of modeling in the NS-2 environment.

Routing Techniques Single-path and Multi-path

The name of the Single-path routing technique speaks for itself - it searches for one path from the source of the data package to its recipient. However, it is worth noting the main drawback of this approach: if for some reason the network connection is broken (the connection between the UAV or one of the nodes through which the found path passes will be lost), then the package will not have an alternative sending channel. This situation may lead to serious loss of data on the network. The solution to this problem can be the use of the Multi-path technique: it searches for several alternative paths for package delivery from source to destination. This method is effective, because in the event of a failure in FANET, this error will be quickly detected and the data package will be routed to an alternative delivery path. However, this method also has its drawbacks: it is rather difficult to configure this type of routing, because even minor errors can lead to the appearance of a "loop" (from the English loops), which can block the delivery process.

Prediction Routing Technique

The principle of operation of this method of routing consists in predicting the position of a network node at a particular time, based on its current geographical location, speed of its movement, direction of its movement, etc.

Swarm Intelligent Technology

The routing approach, based on the concept of “swarm intelligence”, became very popular. The term was proposed in 1989 by Gerardo Beni and Jing Wang [Beni G.,1989]. The algorithm describes the collective behavior of a decentralized self-organizing system [Beni G.,2004]. The approach is based on modeling the behavior of animals or insects that adhere to a pack or swarm lifestyle.

Author in [Leonov A.] suggested to use the “bee colony” algorithm for modeling mobile networks. The algorithm of the bee colony is widely known; however, we will describe it in more detail. The algorithm imitates the behavior of a bee swarm, which searches for pollen and nectar in a certain area

The main goal of the bee swarm is to determine the largest source of nectar (from a mathematical point of view, this is the task of optimizing some objective function) [Leonov A. and Litvinov G.].

All the routing techniques discussed above are widely used in real FANETs. However, each routing technique has its advantages and disadvantages. The study of the advantages and disadvantages of the certain routing protocols when using real FANET networks is not only labor-intensive and quite time-consuming, but also quite expensive.

Thus, it is necessary to find a method that could give the opportunity to carry out research experiments on a process constantly changing its parameters, without resorting to working with a real system. Moreover, it is necessary that this method allows one to take into account a significant number of parameters, changes of which can lead to changes in the results of the algorithm. It is this method that is simulation. This is confirmed by a large number of publications exploring mobile computer networks with the use of various tools of simulation [Gudov A.].

Let us consider one of the routing algorithms (GGF) and the results of a simulation experiment performed using AnyLogic tools [Grigoriev I., Borshchov A., Anylogic]. AnyLogic is a domestic development and there is a version available to all users.

Description of the GGF Algorithm

The greedy geographical routing algorithm is as follows: the node that is currently holding the package must transmit this package to its neighbor node, which has the following properties:

- it must fall within the range of the transmission of the carrier node;
- it should be closer to the recipient of the package than the current host node and its other neighboring nodes.

Thus, the node selected at each step of the algorithm should minimize the number of data package transfers from node to node. Routing will be considered completed successfully if the package is delivered to the recipient in a time less than (or equal to) the package "lifetime".

Network simulation using AnyLogic

There are a lot of simulation tools for designing and analyzing computer networks, these simulation systems may be divided into specialized ([COMNET, 2019], [OMNet++,2019], [OPNET,2019], [NS-2,2019] and etc.) and general purpose one ([ANYLOGIC,2019], for example). Some of them allow analyzing networks; others are focused on solving network design problems. Let us briefly discuss the advantages and disadvantages of these simulation tools.

- ***COMNET:*** Advantages: (a) an ability to enter traffic data in real time; (b) a simplicity of entering traffic hypotheses; (c) an ability to fine-tune network parameters;(d) a presence of additional modules for various tasks. Disadvantages: (a) a complexity of implementation; (b) a difficulty in perceiving network circuits; (c) a high cost.
- ***OMNet ++ :*** Advantages: (a) a presence of discrete event simulator.
- Disadvantages: (a) a complexity of user training.
- ***OPNET :*** Advantages: (a) a convenience of network objects designing; (b) a flexibility of the resulting models. Disadvantages: (a) a high cost; (b) an insufficient ability to import and configure existing product components.
- ***NS-2 :*** Advantages: (a) an ability to use two-level programming (C++ and OTcl) and an object-oriented approach (provides flexible configuration of models and scenarios). Disadvantages: (a) a poor visualization; (b) a limitations of the component library; (a) a complexity of the models and analysis of the results.
- ***Anylogic :*** Advantages: (a) a presence a high-level programming language (Java) (provides flexible configuration of models); (b) a convenient visualization; (c) an ability to collect various statistics and display graphs. Disadvantages: (a) a restriction on the maximum number of agents in the free educational version.

To study the GGF algorithm, a simulation model was constructed using the AnyLogic tool. The development language is Java.

It is well known that routing algorithms must be correct, so the algorithm must deliver every package that arrives in the network, exactly as intended ((to the designated recipient).

The model allows to build data package transmission routes inside FANET. Nodes can move at a certain speed in a certain limited area. In the simulation, the RWP mobility model was used. The constructed model does not take into account some characteristics: it happens that in real FANET there are technical problems that can interfere with the package transfer process, in addition, external environmental influences, etc. are not taken into account.

Test No. 1: determining the dependence of the functioning of the algorithm on the number of nodes in FANET.

Test № 1.1:

- Number of nodes in the network: 50.
- Type of arrangement of nodes: Random.
- Communication distribution range: 81.125 cu
- Package lifetime: 4483.3 ms.
- Package source node index: 34.
- Package Receiver Node Index: 24.

The results of the GGF routing algorithm for given parameters are presented in Fig. 1. The number of relay nodes: 3. The package was not delivered to the recipient. The package remained with the drone with the No.17.

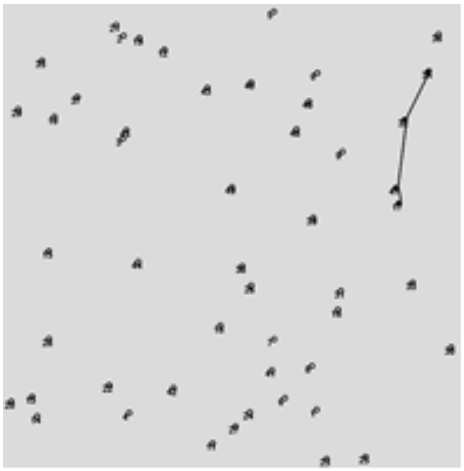

Fig. 1. Test No. 1.1

Test No. 1.2

- Number of nodes in the network: 100.
- Type of arrangement of nodes: Random.
- Communication distribution range: 81.125 cu
- Package lifetime: 4483.3 ms.
- Package source node index: 9.
- Package Receiver Node Index: 3.

The results of the GGF routing algorithm for given parameters are presented in Fig. 2.

Number of relay nodes: 5.

The package was delivered to the recipient.

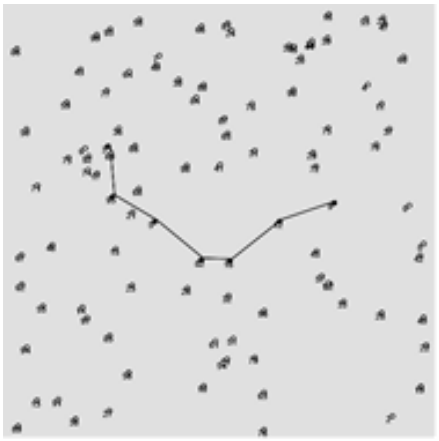

Fig. 2. Test No. 1.2

Test number 1.3:

- Number of nodes in the network: 200.
- Type of arrangement of nodes: Random.
- Communication distribution range: 81.125 cu
- Package lifetime: 4483.3 ms.
- Package Source Node Index: 93.
- Package Receiver Node Index: 58.

The results of the GGF routing algorithm for given parameters are presented in Fig. 3. The number of relay nodes: 4. The package was delivered to the recipient.

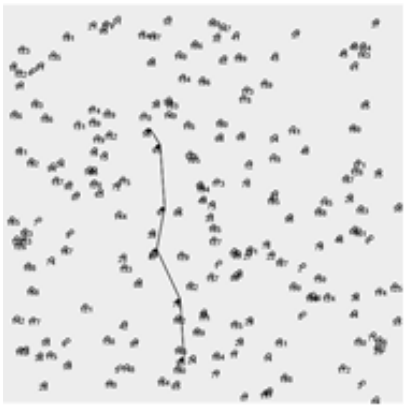

Fig. 3. Test No. 1.3

Test No. 1.4:

- Number of nodes in the network: 400.
- Type of arrangement of nodes: Random.
- Communication distribution range: 81.125 cu
- Package lifetime: 4483.3 ms.
- Package source node index: 4.
- Package Receiver Node Index: 60.

The results of the GGF routing algorithm for given parameters are presented in Fig. 4. The number of relay nodes: 5. The package was delivered to the recipient.

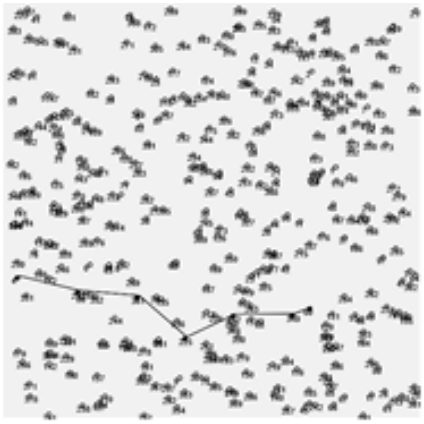

Fig. 4. Test No. 3.4

On tests 1.2, 1.3 and 1.4, the model gave good results. The paths laid between the nodes can be considered acceptable, because there are no loops in this paths, and the package was delivered to the destination in each of these cases. However, in test No. 1.1, a problem is discovered: the package did not reach the recipient and remained with drone No. 17 for the reason that there were no drones in the communication radius of drone No. 17 to which it could transmit the package so that the process continued.

From this we can conclude that the algorithm considered above shows good results only in networks with a high density of nodes. The more nodes in the network, the better the algorithm works.

Conclusion

The paper presents a comparative description of such types of ad-hoc networks as FANET, MANET and VANET. The most popular data routing techniques in FANET were reviewed. The paper presents the possibilities of using simulation methods and AnyLogic tools. Moreover, FANET networks are considered. A simulation model of the greedy geographic data routing algorithm in FANET was built. A drawback was identified related to the applicability of this algorithm to FANET networks with a low density of nodes. It is established that the algorithm shows good results for networks with a high density of nodes.

Thus, the algorithm needs refinement and optimization. One of the solutions to this problem may be the implementation of the RGR algorithm, which combines two alternative paths: reactive routing and the GGF algorithm.

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РАЗРАБОТКА АРХИТЕКТУРЫ ИНТЕЛЛЕКТУАЛЬНОГО ЧАТ-БОТА

Анна Литвин, Виталий Величко, Владислав Каверинский

***Аннотация**: В статье рассмотрена общая концепция приложений типа чат-ботов, развитие идеи чат-бота и их практического значения. Проведен анализ существующих на данный момент современных чат-ботов и платформ для их построения. Проведена классификация чат-ботов по способу создания, по архитектуре и по принципу выдачи ответа. Предложена концепция интеллектуального чат-бота, совмещающего в себе возможность интеграции с популярными месседжерами и обновляемую на основании потребностей пользователей базу знаний.*

***Ключевые слова**: чат-бот, анализ естественно-языкового текста, генерация осмысленного текста, база знаний.*

***ITHEA Keywords**: D.2.11 Software Architectures*

Введение

Идея чат-бота – виртуального собеседника в целом не нова. История чат-ботов восходит к 1966 году, когда Вейзенбаум написал компьютерную программу под названием ELIZA. Она имела всего 200 строк кода [Weizenbaum, 1976]. На сегодняшний день чат-боты прошли эволюцию от достаточно примитивных программ с минимальной функциональностью, основанных исключительно на заложенных в них шаблонах и ограниченном малом наборе правил, до продвинутых программ, не только общающихся с пользователем, но и автоматизирующих выполнение рутинных задач.

Для внешней оболочки чат-бота многие системы обмена сообщениями (меседжеры) предоставляют готовые решения и API (Application Programming Interface) для работы с ними. Создание внутреннего логического содержания чат-бота является задачей более сложной. В любом случае, перед разработчиком чат-бота (особенно интеллектуального чат-бота) стоит задача

построения системы, работающей с естественным языком (в нашем случае – со славянскими флективными языками) и базой знаний, способной адекватно анализировать поступающие сообщения и генерировать ответы. Фактически, чат-бот должен в той или иной мере реализовывать идею «Текст → Смысл → Текст» [Melchuk, 1995]. То есть, программа должна из поступающего текста выделить смысл сообщения и в соответствии с этим смыслом предоставить адекватный ответ. Но несмотря на то, что компьютерные системы достигли немалых успехов в задачах распознания, проблемы понимания смысла всё ещё остаются не до конца решёнными. Одним из перспективных вариантов средства работы со смыслом текста является онтология.

Постановка задачи

Основными целями данной работы является обзор принципов работы и архитектуры известных чат-ботов и платформ для их создания, проведение классификации чат-ботов, построение архитектуры интеллектуального чат-бота, работающего с пополняемой (обучаемой) базой знаний, основанной на онтологии.

Обзор систем и подходов разработки чат-ботов

Чат-бот – это программный продукт на основе искусственного интеллекта, действующий в устройстве, приложении или веб-сайте, который пытается оценить потребности пользователей, а затем помочь им выполнить определенную задачу, например, коммерческую транзакцию, бронирование гостиницы, получение информации о продукции и многое другое. На данный момент существуют множество чат-ботов, построенных на основе парадигмы обработки текста пользователя и возвращения релевантного ответа.

Все чат-боты можно принципиально разделить на те, которые основаны на чётко установленных правилах и на обучаемые. В первом случае чат-бот отвечает на вопросы, основываясь на некоторых, заложенных в него правилах. Это вовсе не означает примитивность такого бота. Заложенные правила могут быть как очень простыми, так и очень сложными. Он просто статичен, не способен к сбору новой информации и её интерпретации [SiteActive]. Обучаемый чат-бот использует в своей работе подходы, основанные на

машинном обучении. По принципу выдачи ответа чат-боты можно разделить на два класса: основанные на поиске и на генерации [Melnichuk, 2018].

В моделях, основанных на поиске, чат-бот осуществляет выбор ответа из библиотеки предопределенных ответов основываясь на анализе контекста. Не следует полагать, что в данном подходе предполагается только набор полностью заранее заготовленных фраз. Шаблоны могут иметь некоторую гибкость в плане подстановки понятий, на основе анализа конкретного контекста. Контекст может включать в себя текущую позицию в дереве диалога, все предыдущие сообщения в диалоге, ранее сохраненные переменные (например, имя пользователя). Опираясь на анализ оперативно полученных в ходе диалога данных, в имеющиеся шаблоны встраивается необходимая информация. Боты, основанные на генерации способны генерировать оригинальные ответы без использования заготовленных шаблонов [Glek, 2018].

Следует отметить, что в последнее время приобретают популярность чат-боты, работа которых основана на нейронных сетях с применением Deep Learning [Tarasov, 2015]. Такие боты с первого взгляда могут произвести хорошее впечатление. Но детальный анализ и работа с ними позволяет выделить некоторые их существенные недостатки. В первую очередь – это медленная скорость обучения. Чтобы обучить чат-бота, основанного на нейронных сетях, требуется много времени и большие объёмы данных. Это не всегда возможно и рационально [Levin, 2016].

Интересной особенностью чат-ботов, работающих на основе нейронных сетей это то, что они испытывают трудности с тем, чтобы просто сказать «не знаю». В случае недостатка или отсутствия релевантной информации по заданному вопросу генерируется странный ответ, не содержащий полезной информации, а то и вовсе лишённый смысла.

Третий недостаток, часто отмечаемый у всех систем, работающих на нейронных сетях – это то, что не ясно каким образом, руководствуясь чем был дан тот или иной ответ, а тем более совет. А, следовательно, и проверить адекватность такого ответа сложно [Levin, 2016].

Примером известного современного чат-бота может служить разработанный Стивом Уорсвиком чат-бот Mitsuku [Mitsuku]. Для разработки данного бота

использован язык AIML (Artificial Intelligence Markup Language) [AIML]. Его называют одним из лучших чат-ботов, он является 4-х кратным лауреатом премии Лобнера. Однако тестирование Mitsuku позволило определить важный недостаток: бот плохо удерживается в контексте диалога. То есть, проще говоря, забывает, о чём только что шла речь. Это может приводить к неадекватным ответам. Например, бот спрашивает пользователя: «What is your favourite film?» («Какой твой любимый фильм?»). Пользователь отвечает: «Tell me a story», имея в виду название некоторого фильма. Бот же, в свою очередь, воспринимает эту фразу как обращение к нему с просьбой рассказать историю и рассказывает некоторую историю. Кроме того, Mitsuku рассчитан на общение на неспециализированные темы. Если беседа переходит в узкую предметную область, возможны неадекватные, лишённые смысла ответы.

Одним из примеров современных платформ (фреймворков) для создания чат-ботов, использующих в том числе и подходы, базирующиеся на рекуррентных нейронных сетях, является DeepPavlov [DeepPavlov]. Более подробно речь о ней пойдёт ниже.

Альтернативой можно считать парадигму базы знаний, строящуюся на онтологии. Онтологией называется иерархический способ представления набора понятий и их отношений. Такая база может быть обучаемой – онтология может строиться на основе естественно-языковых текстов. Кроме того, следует отметить, что онтологии могут быть перенесены для работы с другим естественным языком. Необходим лишь перевод терминов.

Также существует множество конструкторов чат-ботов, которые позволяют создавать простые чат-боты. Большинство таких ботов реализуют модель архитектуры, основанную на поиске. Это означает, что чат-бот осуществляет выбор ответа из библиотеки предопределенных ответов основываясь на анализе контекста. Контекст может включать в себя текущую позицию в дереве диалога, все предыдущие сообщения в диалоге, ранее сохраненные переменные (например, имя пользователя).

Появилось немало платформ, позволяющих создать чат-бота даже без написания программного кода [Cristina Krestu, 2019]. Можно привести следующие примеры: Aimylogic, Bot Kits, Botmother, Botsify, Chatfuel**.** Мы не

будем останавливаться на подробном описании каждой из перечисленных платформ, они в целом подобны. Но следует отметить, что такие системы обладают рядом существенных недостатков. Во-первых, они не являются свободными приложениями с открытым исходным кодом, что усложняет анализ их работы, модификацию и возможность расширения функционала на усмотрение разработчика. Второй важный недостаток – это ограниченность перечня сервисов обмена сообщениями, с которыми они могут взаимодействовать. Например, только с Face Book-ом или Telegram-ом. И основной, важный для нас недостаток – они в основном не интеллектуальные. То есть используют готовые шаблоны ответов, максимум некоторые могут реализовывать простую аналитику или подключаться к RSS-каналу (например, для регулярного сообщения свежих новостей).

Часто можно встретить упоминания использования при построении продвинутых интеллектуальных чат-ботов сервисов лингвистического анализа. Наиболее известные из них – это IBM Watson Conversation, Dialogflow, LUIS.

IBM Watson – это суперкомпьютер фирмы IBM, оснащённый системой искусственного интеллекта, созданный группой исследователей под руководством Дэвида Феруччи. Его создание – часть проекта DeepQA. Основная его задача – понимать вопросы, сформулированные на естественном языке, и находить на них ответы с помощью ИИ [IBM Watson].

IBM Watson Conversation представляет собой платформу с дружественным интерфейсом, которая позволяет быстро создавать и разворачивать чат-боты и виртуальные агенты для различных каналов, включая платформы обмена сообщениями, мобильные устройства и даже роботов. IBM Watson Conversation позволяет пользователю создать приложение, которое понимает естественный язык и способно давать ответы в ходе диалога. Виртуальный агент Watson может быть настроен для специфической предметной области [Watson Conversation].

Dialogflow — это сервис, позволяющий создавать чат-ботов для разных платформ и языков на разных устройствах. Это платформа для понимания естественного языка, которая позволяет легко проектировать и интегрировать диалоговый пользовательский интерфейс в мобильное

приложение, веб-приложение, устройство, бот, интерактивную систему голосового ответа и т. д. Dialogflow может анализировать различные типы ввода пользователя, включая текстовые или аудиовходы (например, с телефона или записи голоса). Он также может отвечать несколькими способами: с помощью текста или с помощью искусственной речи [Dialogflow].

LUIS – это технология, которая позволяет разработчикам создавать интеллектуальные приложения, понимающие естественный язык и взаимодействующие с пользователями. Например, помогает приложению анализировать высказывание «Забронируй мне билет в Лондон», и распознавать намерение клиента «Забронировать» и направление «Лондон». LUIS активно обучается и совершенствуется в процессе работы приложения под руководством разработчика. LUIS отмечает те случаи, когда он не может однозначно оценить высказывания, и даёт возможность указать, как анализировать подобный случай в следующий раз. LUIS поддерживает английский, французский, итальянский, немецкий и китайский языки. Он предлагает набор REST API, которые используется для автоматизации процесса создания приложений и их публикации. LUIS также работает с сервисом распознавания речи Microsoft Cognitive Service [LUIS].

Но закрытость исходного кода и ориентированность в большей степени на английский язык готовых решений в данной области лингвистического и смыслового анализа существенно ограничивает возможность их применения для наших задач.

Далее рассмотрим примеры сервисов для создания чат-ботов.

Сервис Ana [Ana] позволяет создавать ботов для различных сфер деятельности: электронная коммерция, автомобили, недвижимость. Данный сервис поддерживает интеграцию с Android и iOS SDK **(**software development kit), содержит интерфейс для администратора, где можно производить аналитику и управлять сервисом. Фактически – это фреймворк с открытым исходным кодом, снабжённый конструктором для автоматизации создания и администрирования ботов. Интерфейс Ana предоставляет для работы четыре основных компонента: платформа (platform); студия (studio); симулятор (simulator); SDK.

Основные компоненты представлены в платформе. Это API, который обслуживает запросы, приходящие из чата. Этот компонент отвечает за объединение шаблона диалогового потока с текущим содержимым чата и возврат позиции диалогового потока по запросу клиентов.

Студия служит для моделирования шаблонов разговоров (диалоговых потоков). В ней конструируется смысловые потоки диалогов. В конструкторе смысловых потоков предусмотрена возможность поддержки нескольких языков в одном потоке. Имеется поддержка расширенного текста (задание стилей тексту), смайликов, HTML и медиа-контентов (голосовой чат). Студия позволяет людям, не являющимися разработчиками редактировать смысловой поток и его содержимое в любом участке диалога. Внесённые изменения отражаются мгновенно.

Симулятор используется для тестирования и проверки разрабатываемых диалоговых потоков.

SDK для iOS и Android помогают интегрировать чат-бота с приложениями, работающими на мобильных устройствах.

Созданный при помощи Ana готовый чат-бот разделяется на две основные компоненты: Ana Chat Server и интерфейсный модуль бота. Последний может быть представлен в 3-х вариантах: Web Chat, Android Chat и iOS Chat. Ana Chat Server требуется для публикации смысловых потоков и обслуживания опубликованного контента по разным каналам, включая Интернет (в том числе Facebook и многие другие сервисы обмена сообщениями), Android, iOS. Ana Chat Server состоит из микросервисов, обслуживающие определенные предметные домены. Всего имеется 12 микросервисов, из которых 7 основных и 5 дополнительных. Имеются следующие микросервисы.

Основные: 1. регистратор (service-registry); 2. сервер конфигурации (config-server); 3. точка доступа к управлению программными функциями (api-gateway); 4. ws-customers; 5. сервис, выполняющий рутинные задачи (business-service); 6. регистратор пользователей (user-service); 7. ядро (core).

Опциональные: 1. сервис хранения истории (history service); 2. плагин для работы с облачным сервисом сообщений и уведомлений для Android, iOS и

веб-приложений (fcm-plugin); 3. сервис агентов (agents-service); 4. сервис работы с файлами (file-service); 5. функции аналитики (analytics).

Микросервисы доступны на одном хосте, но на разных портах.

В целом Ana – платформа для чат-ботов основанная на шаблонном подходе. При этом шаблоны не совсем примитивны. А именно, платформа предоставляет возможность отправки запросов к некоторым (в том числе и сторонним) API для получения или отправки данных, возможность встраивания функциональных кнопок, добавление изображений, видео или аудио компонентов и даже возможность перехода к другому боту или другому смысловому потоку. Таким образом, Ana подходит для достаточно простых функциональных чат-ботов, не претендующих на интеллектуальность, но способных ответить на типичные простые вопросы пользователя, предоставить пользователю необходимые ссылки, файлы, вызвать программные процедуры в режиме дружественного интерфейса. К некоторым примечательным особенностям Ana можно отнести архитектуру, основанную на микросервисах.

Также существует платформа Rasa [Rasa], которая работает в связке с инструментом NLU (Natural-language understanding), который подразумевает «понимание естественного языка». Под понятием NLU понимается пост-обработка текста после использования алгоритмов NLP (Natural-language processing – идентификация частей речи и т. д.). Это означает превращение пользовательских сообщений в структурированные данные [Semaan, 2012].

Стек технологий Rasa и NLP позволяют осуществлять обработку текста на естественном языке и на основе этого формировать общее понимание этого текста. Генерация ответа пользователю происходит на основании шаблонов, которые задаются создателем (администратором) чат-бота с применением NLP и NLU алгоритмов. Чем больше таких шаблонов будет задано, тем точнее и полнее будут ответы.

На рисунке 1 приведена архитектура типичного чат-бота, созданного на основе платформы Rasa.

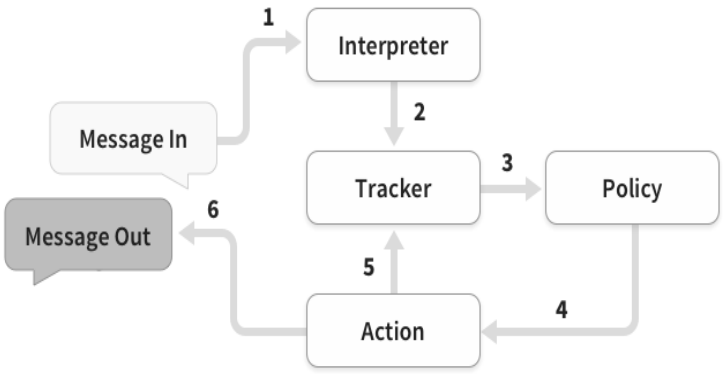

Рисунок 1. Архитектура чат-бота, созданного на основе платформы Rasa

Сообщение принимается и передается объекту Interpreter, который преобразует его в словарь, включающий исходный текст, намерение, а также любые найденные объекты. Эта структура обрабатывается NLU. Схему работы системы можно описать следующим образом:

1. Объект `Tracker` отслеживает состояние диалога. Он получает информацию о том, что пришло новое сообщение.
2. Объект Policy получает текущее состояние объекта `Tracker`.
3. Объект Policy выбирает, какое действие предпринять дальше.
4. Выбранное действие регистрируется объектом `Tracker`.
5. Ответ отправляется пользователю.

Недостаток подобной архитектуры заключается в том, что такая модель медленно обучается и существует необходимость увеличения количества шаблонов для ведения адекватного диалога. Такая модель не является генеративной, а корректность ответа бота зависит от заданных текстовых шаблонов. Она несколько более продвинутая, чем описанная выше Ana, в том отношении, что может осуществлять анализ смысла сообщений пользователя, это даёт большую свободу ведения диалогов, а бот может выступать в некоторой степени как виртуальный собеседник, а не только как интерактивный интерфейс. В то же время чисто шаблонные ответы снижают гибкость подобной

системы, в том смысле, что в ней не может быть получено новой информации (пускай и являющейся логическим следствием из имеющихся данных), а только один из множества шаблонов. В то же время в имеющихся описаниях нет упоминаний об архитектуре, основанной на микросервисах, которая является одним из немногих плюсов Ana, также сильно ограничены возможности относительно управления при помощи чат-бота некоторым дополнительным программным функционалом и поддержка сторонних API.

Платформа DeepPavlov – это библиотека искусственного интеллекта с открытым исходным кодом, построенная на Tensor Flow и Keras [DeepPavlov]. Это платформа, обладающая рядом возможностей, среди которых можно выделить следующие основные: ответы на вопросы по тексту (текст QA); ответы на вопросы, в частности модель ODQA; распознавание именованных сущностей (NER); анализ тональности.

Ответы на вопросы по тексту (текст QA) – это задача поиска ответов на вопросы в заранее заданном фрагменте текста (например, в параграфе из Википедии).

Например, если имеется следующий текст:

«*Урбанизация (от лат. Urbanus — городской) – процесс повышения роли городов, городской культуры и «городских отношений» в развитии общества, увеличение численности городского населения по сравнению с сельским и «трансляция» сформировавшихся в городах высших культурных образцов за пределы городов*».

Вопрос может быть таким:

«*Что делает урбанизация?*»

В свою очередь ответ будет таким:

«*увеличивает численность городского населения по сравнению с сельским*»

Практическим применением данного функционала может быть, например, поиск ответов на вопросы по документации.

Кратко рассмотрим подходы, лежащие в основе поиска ответа на вопрос в естественно-языковом тексте. В DeepPavlov для данной задачи имеются две модели: BERT и R-Net. Обе модели предсказывают начальную и конечную позицию ответа в данном контексте.

BERT (Bidirectional Encoder Representations from Transformers) представляет собой преобразователь, предварительно обученный работе с моделью «маскированного языка» и задачам прогнозирования следующего предложения [Devlin, 2019]. В структуре работы модели BERT выделяются два этапа: предварительная подготовка и точная настройка. Во время предварительного обучения модель обучается на немаркированных данных. Для тонкой настройки модель BERT сначала инициализируется предварительно подготовленными параметрами, и все параметры настраиваются с использованием маркированных данных из последующих задач. Отличительной особенностью модели BERT является её унифицированная архитектура для решения различных задач. Архитектура модели BERT представляет собой многослойный двунаправленный преобразователь, основанный на оригинальном алгоритме, описанном в работе [Vaswani, 2017], программно реализованном в библиотеке tenor2tensor. В BERT не используются традиционные языковые модели слева направо или справа налево для предварительной подготовки. Вместо этого используются две неконтролируемые процедуры, называемые Masked Language Model (далее «Masked LM» или MLM) и «Предсказание следующего предложения» (Next Sentence Prediction или NSP). Для создания двунаправленного представления в модели BERT просто случайным образом маскируют некоторый процент входных токенов (токеном может выступать слово или последовательность слов), а затем прогнозируют эти замаскированные токены. Эта процедура лежит в основе «Masked LM». Обычно случайным образом маскируют 15 % от всех токенов в каждом обрабатываемом участке текста. Предсказывают только замаскированные слова, не стремясь полностью восстановить всю входную информацию. Хотя указанный подход и позволяет получить двунаправленную предварительно обученную модель, его недостатком является то, что создаётся несоответствие между предварительным обучением и последующей тонкой настройкой, поскольку токен [MASK] (который ставился на место

маскируемых токенов) не виден во время тонкой настройки. Чтобы смягчить этот эффект, «замаскированные» слова не всегда заменяются фактическим токеном [MASK]. Генератор обучающих данных выбирает 15% позиций токенов случайным образом для прогнозирования. Если i-й токен (слово) выбран для маскировки, мы заменяем его на токен [MASK], но только в 80 % случаев. В остальных 20 % случаев случаях поступаем одним их двух способов: в 10 % производится замена текущего токена на случайный токен, в оставшихся 10 % токен остаётся неизменным.

Следующей задачей является предсказание следующего предложения. Многие важные задачи, такие как «Ответ на вопрос» (QA) и «Вывод» сообщения на естественном языке (NLI), основаны на понимании взаимосвязи между двумя предложениями, которая непосредственно не отражается в языковой модели. Чтобы обучить модель, которая понимает отношения между предложениями, в рамках модели BERT производится предварительное обучение задаче прогнозирования следующего предложения, которая может быть сгенерирована из любого одноязычного корпуса. Например, в проанализированном корпусе в 50 % случаев B является предложением, следующим за предложением A (помечено как IsNext), а в других 50 % случаев это случайное предложение из корпуса (помечено как NotNext).

Точная настройка (следующий этап) не является сложным процессом, поскольку механизм самодостаточности в преобразователе позволяет BERT моделировать многие последующие задачи путем замены соответствующих входов и выходов. По сравнению с предварительным обучением, точная настройка является относительно малозатратной процедурой. Все результаты тестирования, приведенные в документации [BERT, 2018], могут быть воспроизведены не более чем за 1 час на одном облачном TPU (Tensor Processing Unit) или за несколько часов на графическом процессоре.

Предварительно обученный BERT можно использовать для ответов на вопросы в наборе данных SQuAD (Stanford Question Answering Dataset), просто применив два линейных преобразования к выходным данным. Первое и второе линейное преобразование используются для прогнозирования вероятности того, что текущий подтекст является начальной или конечной позицией ответа.

В DeepPavlov помимо BERT также используется другая модель ответов на вопросы, которая основана на R-Net, предложенной Microsoft Research Asia [R-Net, 2018]. Описание данной модели приведено в работе [Wei, 2017].

R-NET по своей сути – это прямая модель, основанная на нейронных сетях, предназначенная для ответов на вопросы в стиле понимания, целью которой является ответить на вопросы по данному отрывку текста. Данная сеть была протестирована на больших наборах данных, таких как набор данных для ответов на вопросы Стэнфорда (SQuAD) и Microsoft MAchine (MS-MARCO). Схема модели R-NET приведена на рисунке 2.

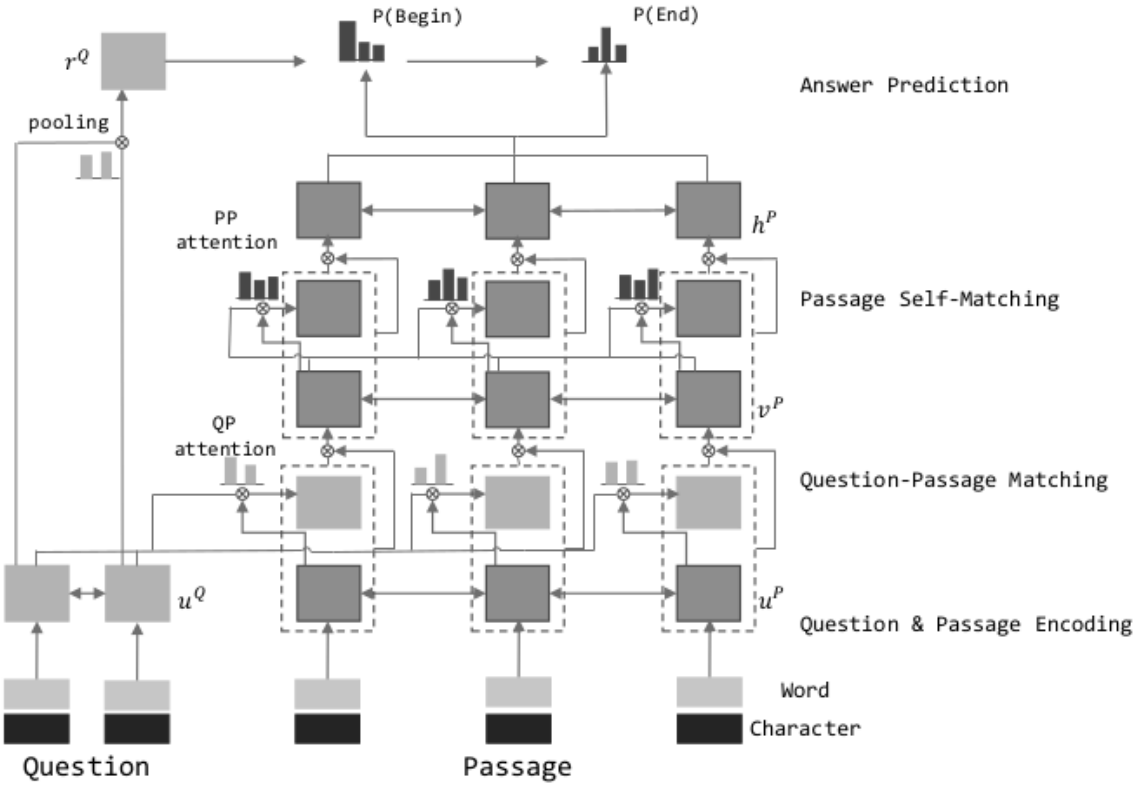

Рисунок 2. Архитектура R-NET

Для формирования ответа на вопрос в стиле понимания прочитанного задаются некий отрывок текста P и вопрос Q. Задача состоит в том, чтобы предсказать ответ A на вопрос Q на основе информации, извлеченной из P. Архитектура R-NET сопоставляет вопрос и отрывок, затем переходит к

рекуррентным сетям, чтобы получить схему текстовой последовательности (в которой ищется ответ) с учетом вопроса. Затем механизм самосогласованной обработки уточняет полученную ранее схему, сопоставляя текстовую последовательность с самой собой, что позволяет кодировать информацию из всей данной последовательности. На последнем этапе сети указателей используются для определения местоположения ответов в заданном текстовом отрывке.

Подробности реализации модели R-NET раскрыты в работе [R-Net].

Многие чат-боты реализуют подход называемый «открытая доменная система ответов на вопросы» (англ. Open-domain question answering или ODQA) [Harabagiu, 2006], [Sun, 2018]. ODQA – это задача поиска ответа на любой вопрос внутри коллекции документов, например, в Википедии. Решение задачи идет в два шага: сначала выбираются релевантные документы; затем в них ищутся ответы. Бизнес-решения на основе ODQA – это, например, диалоговые ассистенты, отвечающие на вопросы по корпоративным базам знаний, справочной и технической документации.

Задача ODQA сочетает в себе реализацию задачи поиска документов (поиск соответствующих статей) с задачей машинного понимания текста (определение диапазона ответов из этих статей). Система ODQA может использоваться во многих приложениях. Чат-боты применяют ODQA для ответа на запросы пользователей, в то время как бизнес-ориентированные решения Natural Language Processing (NLP) используют ODQA для ответа на вопросы, основанные на внутренней корпоративной документации. Ниже на рисунке 3 показан типичный диалог с системой ODQA.

Q: What’s the name of Anakin Skywalker?

A: Darth Vader.

Q: Who destroyed the Death Star?

A: Luke Skywalker.

Рисунок 3. Типичный диалог с системой ODQA [Konovalov, 2019]

Существенной частью любой диалоговой системы, которая необходима для извлечения информации из текста является распознавание именованных сущностей (англ. Named Entity Recognition или NER). NER в составе системы – это компонент для распознавания именованных сущностей. Задача заключается в классификации токенов текста по известным категориям – имена людей, количество, локации, организации, время и дата, цена и валюта, и т. п. Например, с помощью платформы DeepPavlov можно распознать до 19 сущностей [NER].

Ещё одной методикой, получившей распространение при создании чат-ботов является анализ тональности. Это задача, заключающаяся в автоматизированном представлении текстовых и эмоциональных оценок авторов (мнений) по отношению к объектам, речь о которых идёт в тексте. Подобный компонент, если он присутствует в системе, позволяет, например, проводить оценку комментариев [Text QA].

В сущности, DeepPavlov представляет собой достаточно большой фреймворк для работы с естественным языком для построения чат-ботов. В частности, он предоставляет следующие пакеты: набор предварительно обученных NLP моделей, компонентов диалоговой системы и шаблонов; фреймворк для реализации и тестирования своих собственных диалоговых моделей; инструменты для интеграции приложений со смежной инфраструктурой (месседжеры, службы поддержки и т. д.); инструменты для доступа и работы с соответствующим наборам данных. Согласно официальной документации [DeepPavlov Doc] общая структура системы, построенной при помощи DeepPavlov выглядит как показано на рисунке 4.

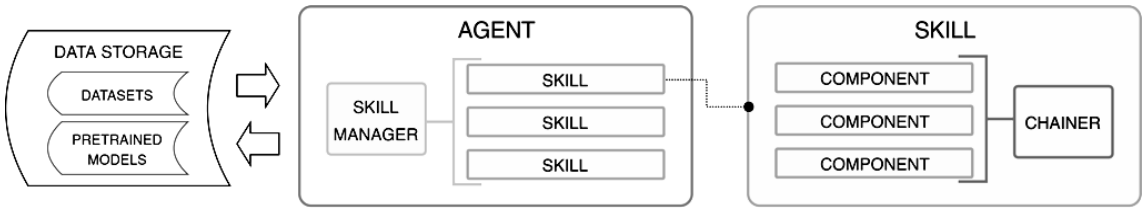

Рисунок 4. Концептуальная схема архитектуры платформы DeepPavlov

Представленная структура имеет в своём составе следующие базовые составляющие:

- агент (AGENT) – диалоговый агент, общающийся с пользователями на естественном языке (в текстовом режиме);

- «навык» (SKILL) – выполняет задачи, необходимые пользователю. Как правило, это предоставление информации или реализация транзакции (например, ответ на вопрос, бронирование билетов и т. д.).

- хранилище данных (DATA SORTAGE) – сервис, хранящий базы данных и предварительно обученные модели и предоставляющий API для работы с ними;

- менеджер «навыков» (SKILL MANAGER) – компонент, выполняющий выбор «навыка», необходимого для корректной для генерации ответа в конкретном случае;

- объединитель (CAINER) – строит связи между агентом и моделями из разнородных компонентов. Это позволяет обучать и работать с несколькими моделями как с единой сущностью;

- компонент (COMPONENT) – функциональная оболочка модели или «навыка»;

- модель (MODEL) – любая NLP модель. В платформе DeepPavlov выделяются 3 основных типа моделей: основанные на правилах (необучаемые), основанные на простом машинном обучении (обучаются вначале один раз), основанные на глубоком обучении (могут обучаться самостоятельно, без учителя в процессе работы).

Наименьшим строительным блоком такой системы является Компонент (COMPONENT). Компонент отвечает за одну определённую функцию. Он может быть реализован в виде нейронной сети, или другой модели машинного обучения или представлять собой систему, основанную на правилах. Компоненты могут быть объединены в Модель (MODEL) или Навык (SKILL). Модель решает несколько большую задачу по сравнению с отдельным Компонентом. Тем не менее, с точки зрения реализации Модели не отличаются от Компонентов. Отличие Навыка от Модели заключается в том, что вход и

выход Навыка должны быть строками. Поэтому Навыки обычно предназначены для задач ведения диалога. Предполагается, что Агент – это многоцелевая диалоговая система, которая включает в себя несколько Навыков и может переключаться между ними. Это может быть диалоговая система, которая содержит Навыки, ориентированные на достижение текущей цели чат-бота, и выбирает, какой из Навыков использовать для генерации ответа, в зависимости от данного пользовательского ввода.

DeepPavlov можно подключать к своему проекту на Python как внешнюю библиотеку, и использовать в приложении необходимый функционал. Также предусмотрена возможность интеграции собственных моделей в систему, построенную на DeepPavlov. Это является её важным преимуществом.

Как недостаток DeepPavlov можно выделить то, что эта платформа ориентирована в первую очередь на использование моделей, основанных на нейронных сетях, следовательно, она имеет и характерные для нейронных сетей проблемы.

У рассмотренных выше платформ для создания чат-ботов алгоритмы формирования ответов пользователям, в основном, основаны на простых или сложных шаблонах, которые, опираясь на содержание контекста, пытаются сформулировать осмысленный ответ. Другим вариантом является применение генеративных алгоритмов, базирующихся на машинном обучении (обычно рекуррентных нейронных сетях). Методы формирования ответа пользователю у различных чат-ботов весьма схожи. Их основной недостатком является то, что они не обладают достаточной гибкостью, ориентированы, в основном, на ограниченное количество предметных областей, это приводит к дополнительным временным затратам на обучение выбранной модели для множества предметных областей. Поэтому нами был рассмотрен подход генеративного способа предоставления ответа на основе онтологии и самонаполняемой базы знаний, которая не привязана к конкретной предметной области.

Существует множество информационных систем, использующих онтологии для реализации отдельных компонентов программы, например, Ontology-Driven Automation of IoT-Based Human-Machine Interfaces Development [Ryabinin, 2019],

[Chuprina, 2019]. Указанная система позволяет проводить визуальную аналитику вариативности речевого поведения пользователей социальных сетей в зависимости от психологических черт личности. В статье [Ryabinin, 2018] рассматривается создание фундаментальной концепции личности, которая бы позволила описывать, объяснять и прогнозировать речевое и неречевое поведение человека и социальных групп, включая группы пользователей социальных интернет-сервисов (англ. Social Network Services, SNS). Несмотря на то, что эти приложения не являются чат-ботами, подходы разработанные при их создании могут быть эффективно использованы при разработке интеллектуальных чат-ботов.

Принцип обучения интеллектуального агента на основе онтологии описан в работе [Smirnova, 2012]. Выделяются следующие этапы:

1. Выявление основных ключевых слов, связанных с предметной областью. Составление глоссария.

2. Системно-онтологический анализ предметной области, в результате которого строится интерпретационная модель предметных знаний. В процессе анализа эти знания разделяются на инвариантные и прагматические знания.

3. Создание необходимых шаблонов на базе онтологии, обучение интеллектуального агента в соответствии с построенной онтологией. На данном этапе в основном используются инвариантные знания.

4. Проработка связей реплик с предысторией разговора с пользователем, установление «якорей», позволяющих агенту вести связный диалог. Такие цепочки в диалоге разрабатываются с учетом связей между различными понятиями в составленной онтологии.

5. Дополнение базы знаний более точными формулировками в соответствии с предметной областью.

6. Дополнительная разработка шаблонов, содержащие все основные определения предметной области.

7. Часто складываются ситуации, когда интеллектуальный агент «не понимает» реплику пользователя, тогда он должен задать пользователю уточняющий вопрос.

8. Проработка реплик агента после продолжительного ожидания (паузы в беседе).

9. Проработка ситуаций дублирования ключевых слов в качестве сигналов для вызова шаблонов. Так, если ключевое слово встречается несколько раз, это может служить веским аргументом для вызова некоторой функции или выбора специфической шаблона для ответа.

10. Анализ разговоров агента с пользователями, выявление нелогичных ответов и корректировка его реакции, т. е. последовательное обучение агента. Данный этап может продолжаться в течение всего времени существования агента.

Преимущество подхода, основанного на онтологии, в сравнении с подходом, использующим для генерации ответов нейронные сети – это в первую очередь возможность интерпретации, понимания и описания результата работы чат-бота при выдаче ответа. Это же облегчает при необходимости ручную корректировку ответов путём внесения изменений в онтологию или в программную систему, работающую с ней. Мы можем сколь угодно расширять и масштабировать онтологию. Кроме того, существует возможность автоматического построения онтологий на основе набора текстов некоторого предметного домена. Такое обучение происходит значительно быстрее, чем обучение нейронной сети, а вероятность ошибочного обучения значительно ниже. Более того, как указывалось выше, при желании, некорректности, возникшие в ходе автоматического построения онтологии можно исправить вручную, чего так просто не сделаешь с неверно обученной нейронной сетью. Кроме того, онтология лишена многих других присущих нейронным сетям проблем, таких как переобучение, «забывание» старых обучающих наборов, локальных минимумов ошибки.

Подытожив, можно провести некоторую классификацию чат-ботов. Классификация для наглядности представлена в виде схем на рисунках 5 – 7.

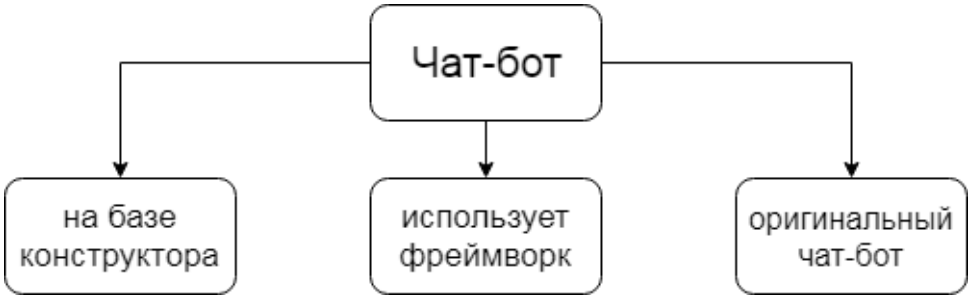

Рисунок 5. Классификация чат-ботов по способу создания

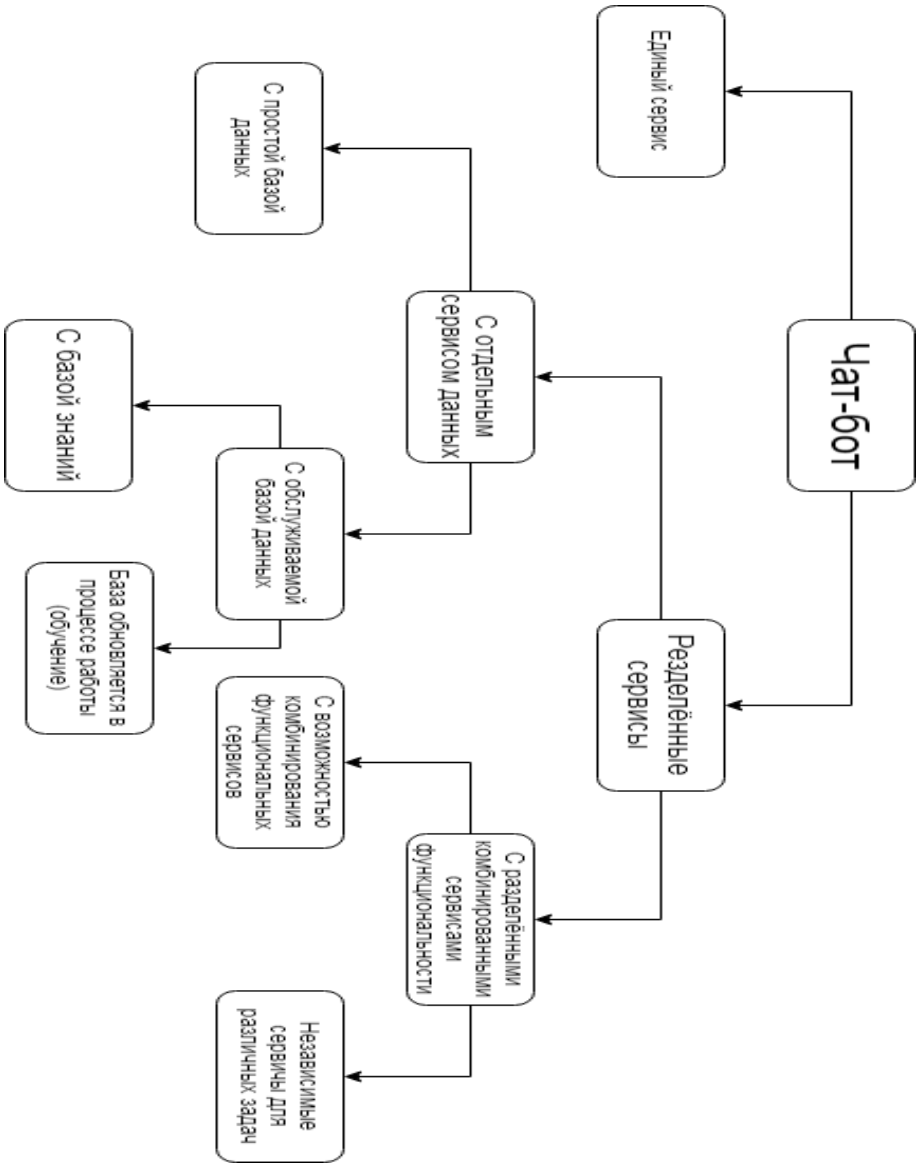

Рисунок 6. Классификация чат ботов по архитектурной схеме

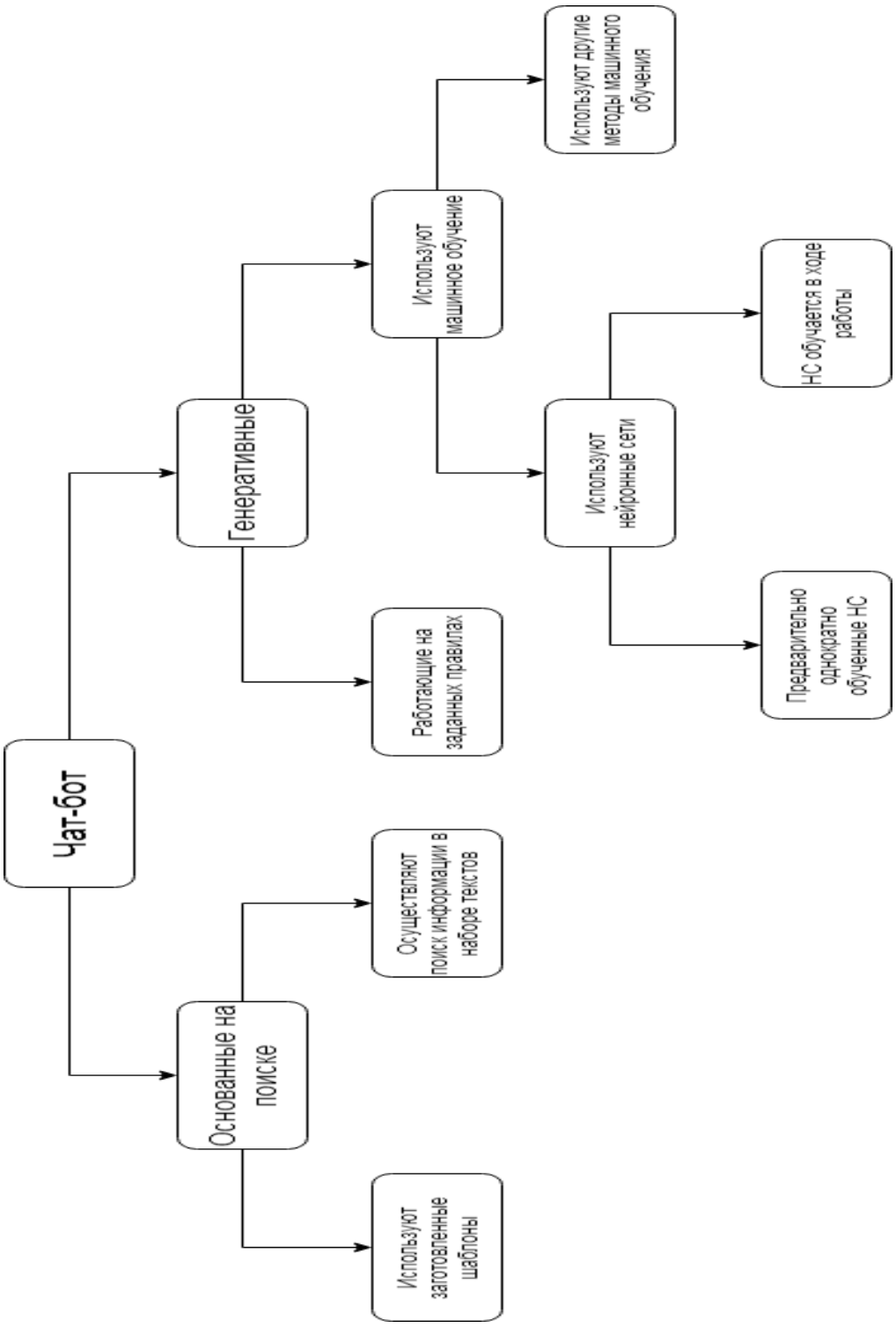

Рисунок 7. Классификация чат ботов по принципу выдачи ответа

В первую очередь чат-бот можно классифицировать по тому, каким образом он был создан. Так он может быть сделан при помощи специального конструктора даже без написания кода. В основном это достаточно примитивные чат-боты

для типичных тривиальных задач. Более продвинутые чат-боты создают с применением соответствующих фреймворков. Но даже этого может быть недостаточно. Функционал любого фреймворка ограничен. Для сложных экспериментальных и нетривиальных задач пишутся полностью оригинальные чат-боты. Это не означает, что код такого бота пишется абсолютно с нуля. Это может быть переработка или дополнение некоторого фреймворка, могут применяться программные библиотеки для решения специфических задач.

Чат-бот в виде единого сервиса в наше время встречается достаточно редко. Это скорее устаревшая концепция, применявшаяся в ранних и примитивных версиях ботов. Большинство современных чат-ботов используют разделённую и даже мультиагентную архитектуру. При этом часто отдельно выделяется сервис работы с данными. В простейших случаях – это просто база данных с СУБД. В более продвинутых вариантах база данных может содержать набор процедур, автоматизирующих её обслуживание. Это может быть сервис пополняющий её в ходе обучения бота, другой вариант – это превращение базы данных в базу знаний, в которой её структура организована так, что обслуживающие процедуры могут выделить из неё информацию, не содержащуюся в базе напрямую, а являющуюся следствием из имеющихся логических посылок. Дальнейшим развитием является более специализированное разделение функциональности в виде микросервисов. При этом возможны варианты, при которых эти сервисы гибко комбинируются между собой или же являются независимыми, но при этом, как правило, не столь узко специализированными.

Важным вариантом классификации чат-ботов является классификация по принципу выдачи ответа. Тут все чат-боты можно глобально разделить на те, которые основаны на поиске и на генеративные. Чат-боты, основанные на поиске, существуют в двух вариантах. В первом случае поиск производится среди имеющихся заранее заготовленных шаблонов, это более примитивный подход. Более продвинутая концепция состоит в поиске информации, являющейся ответом на вопрос в имеющейся базе текстов, которые подвергаются в свою очередь семантическому анализу. Но, к сожалению, такой подход подходит в основном для достаточно примитивных немногословных ответов. Генеративные чат-боты осуществляют синтез ответа на естественном

языке. Такие системы могут работать на заранее заданных правилах. При корректно разработанной большой системе правил можно получить достаточно качественный диалог. Но разработка правил долгая и скрупулёзная задача. Такая система получается очень сложной. Поэтому при разработке чат-ботов распространение получило машинное обучение. В основном применяются нейронные сети. Хотя не исключены и другие варианты машинного обучения (например, построение деревьев принятия решений). В случае использования нейронных сетей также возможны два варианта. В первом случае это может быть статичная предварительно обученная нейронная сеть. Другой вариант – это динамические (обычно рекуррентные) нейронные сети, обучающиеся без учителя в ходе работы чат-бота.

Следует отдельно упомянуть место в данной классификации интеллектуальных чат-ботов, база знаний которых построена на онтологии. Согласно первой классификации (по способу создания) это будет скорее всего оригинальный чат-бот. В принципе, не исключено использование и фреймворков для чат-ботов, но лишь как вспомогательных средств. По архитектурной схеме – это чат-бот на распределённых сервисах, с отдельным сервисом данных, с базой знаний, не обновляемой на основании непосредственно реплик, но обновляемой в ходе сбора данных, в том числе и на основании плохо распознанных реплик пользователей. По способу выдачи ответа такой чат-бот можно отнести к генеративным чат-ботам, выдача ответов которых основана на наборе правил.

Концепция интеллектуального чат-бота

Следует отметить, что большинство обычных чат-ботов не являются интеллектуальными приложениями. Они используют для выдачи ответа лишь заранее заложенные шаблоны, не адаптируются сами под текущие потребности пользователей, редко автоматически выполняют аналитику, не являются обучаемыми, не реализуют автоматическое пополнение базы знаний, или вовсе не содержат базы знаний, а ограничены просто базой данных. Всё что они могут, это определить намерение в сообщении пользователя и вернуть ему наиболее релевантный из имеющихся в базе ответов.

На рисунке 8 схематически представлена типичная архитектура простого не интеллектуального чат-бота. Данная схема является некоторым обобщением, составленным на основе анализа различных чат-ботов.

Чат-бот должен быть построен так, чтобы быть способным взаимодействовать с популярными месседжерами, такими как Telegram, Face Book, Viber. Это повышает внедряемость, а, следовательно, и потенциальную полезность, и востребованность такого приложения. Многие месседжеры предоставляют готовый веб-сервис, который обеспечивает работу с API месседжера. Из этого следует важный вывод, что перед нами не стоит задачи построения пользовательского интерфейса чат-бота и веб-сервиса обеспечивающего работу приложения э этим интерфейсом. Эти задачи высококачественно решены и реализованы популярными сервисами обмена сообщениями ввиду понимания ими важности и актуальности применения чат-ботов. Существует большое количество чат-ботов, работающих по такому принципу.

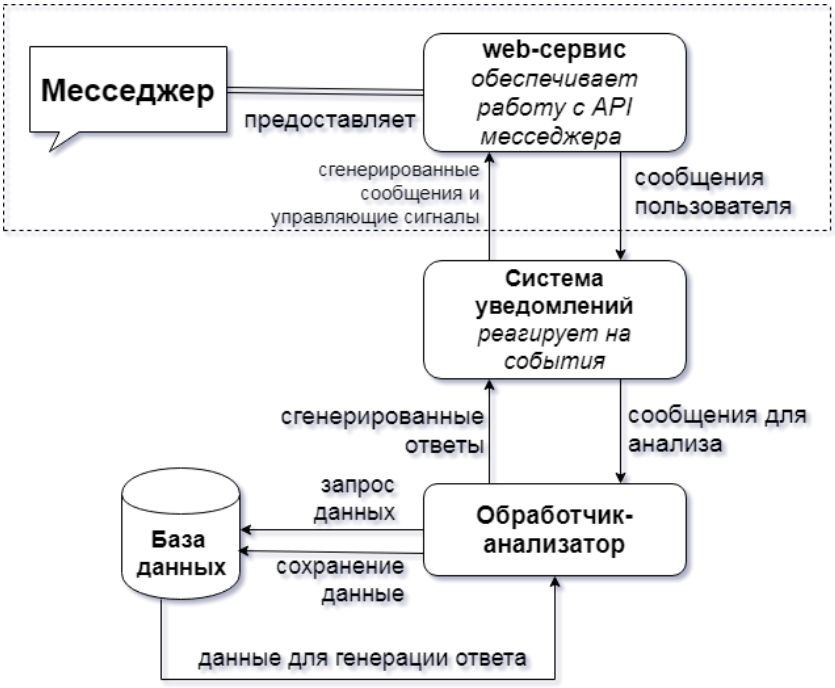

Рисунок 8. Типичная архитектура чат-бота

Предлагаемая архитектура интеллектуального чат-бота приведена на рисунке 9.

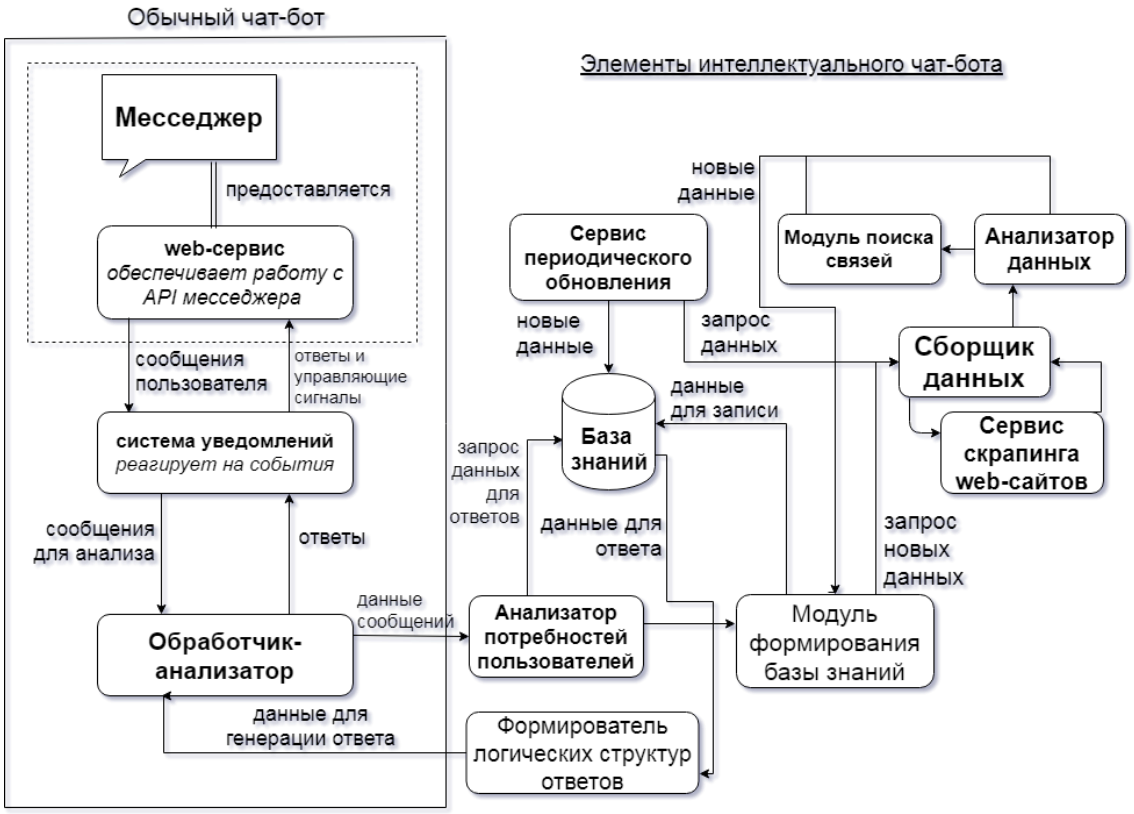

Рисунок 9. Предлагаемая архитектура интеллектуального чат-бота

В своей технической основе (левая часть схемы) предлагаемая архитектура соответствует архитектуре обычного чат-бота. Это сделано для того, чтобы не нарушать стандартность внешней парадигмы его работы и обеспечить возможность встраивания бота в популярные месседжеры и использования готовых работающих web-hook-ов (систем уведомлений).

Главной отличительной чертой является использование не просто базы данных, а базы знаний и построения системы, обеспечивающей её работу. Сама база знаний может содержать в своей основе онтологию.

Так, в данном случае, данные сообщений, подготовленные обработчиком-анализатором, поступают на анализатор потребностей и намерений пользователя. Он, в свою очередь, не только направляет запрос к базе знаний, которая может, как содержать, так и не содержать готовый ответ на поставленный вопрос. Но база знаний тем и отличается от просто базы данных, что она производит интеллектуальный анализ при помощи встроенных в неё хранимых процедур, и пытается получить новые данные, которые не

содержатся в ней непосредственно, но являются следствием из имеющихся в ней данных. Но даже этого может быть недостаточно для получения релевантного ответа. Допустим данные по данной теме или по состоянию на запрашиваемую дату напрочь отсутствуют. Поэтому другой сигнал анализатор потребностей пользователя отправляет модулю формирования базы знаний. Модуль формирования базы знаний управляет сборщиком данных, который использует сервис скраппинга веб-сайтов для поиска новой недостающей информации в сети интернет и во внешних хранилищах данных. Собранные таким образом сырые данные поступают на анализатор, который взаимодействует со специальными дополнительным модулем, предназначенным для поиска и установления связей в полученных сырых данных. Сформированные таким образом новые данные возвращаются модулю формирования базы знаний. После этого он производит обновление базы знаний за счёт пополнения её новой внешней информацией. Так как мир не стоит на месте и новые знания и данные появляются постоянно, в архитектуре предусмотрен сервис периодического обновления базы знаний. Он с установленной периодичностью выполняет по средствам сборщика данных и их анализатора обновление имеющейся базы знаний. Этот процесс можно сделать самонастраивающимся. То есть если какие-то данные обновляются редко, можно увеличить период их обновления, и наоборот, если какая-то информация очень изменчива во времени, система может уменьшить период её обновления. В ответ на поступающий запрос база знаний предаёт данные для ответа модулю формирования логических структур ответа, который формирует данные для генерации ответа в форме, удобной для обработки обработчиком анализатором, в котором происходит синтез ответа на естественном языке. Этот ответ через систему уведомлений постукает на веб-сервис месседжера, а он уже обеспечивает, то, чтобы интерфейс месседжера вывел этот ответ пользователю.

Выводы

При создании интеллектуальных чат-ботов основное внимание исследовательской деятельности следует сосредоточить на модуле генерации ответов.

При реализации веб-сервиса чат-бота следует воспользоваться одной из платформ поддерживающей работу с конкретным месседжером или социальной сетью. Это повысит эффективность использования и практическую ценность бота.

Для работы с флективными языками необходимо разработать лингвистический анализатор для представления входящей информации в виде синтаксических и семантических графов и модуль для синтеза ответов на естественном языке на основании базы знаний.

Для обеспечения интеллектуальности и обновляемости следует снабдить чат-бот сервисами сбора и анализа данных в сети интернет их анализа, и обновления информационной базы. Кроме того, такой чат-бот требует наличия модуля интеллектуального синтеза логических структур ответа.

Использование онтологии в качестве базы знаний для чат-бота является надёжным и гибким способом получения в ходе диалога информации, в том числе и не содержащейся в явном виде, но являющейся следствием имеющихся данных и связей между ними. Чат-бот, база знаний которого основана на онтологии является быстро обучаемым и не даёт нерелевантных ответов в случае недостатка или отсутствия информации по заданному вопросу.

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Основные направления научных исследований: обработка естественного языка для анализа и синтеза текста на флективных языках, интеллектуальные системы, чат-боты

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Основные направления научных исследований: компьютерные онтологии и их использование в учебном процессе; информационные системы с обработкой объектов естественного языка

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Основные направления научных исследований: теория и математическое моделирование процессов фазовых и структурных превращений, эволюция функции распределения дисперсных систем, модифицирование литого метала, обработка естественного языка для анализа и синтеза текста на флективных языках.

DEVELOPMENT OF AN INTELLECTUAL CHAT-BOT ARCHITECTURE

Anna Litvin, Vitalii Velychko, Vladislav Kaverinsky

Abstract*: The article discusses the general concept of chat-bots applications, the development of a chat-bots idea and their practical significance. The analysis is carried out of the currently existing modern chat-bots and platforms for their construction. A special attention was given to the chat-bot platforms Ana, Rasa and PeepPavlov. Conclusions were made on their functionality and usability. Ana is suitable for rather primitive chat-bots able to answer typical questions, provide the user with the necessary links, and invoke program procedures. RASA can analyze the meaning of user messages at the same time, purely template answers reduce the flexibility of such a system. PeepPavlov is a platform with a number of features: answers to questions on the text; answers to questions, in particular the ODQA model; Named Entity Recognition; tonality analysis. A brief review of BERT and R-NET used in PeepPavlov technologies is presented. A review on the most popular and powerful linguistic analysis services is given, namely on IBM Watson Conversation, Dialogflow, and LUIS. The article also describes the principle of training an intellectual agent based on ontology. Basic concepts of this process are listed. The chat-bots were classified by the method of creation, by their architecture and by the principle of a response making. The classification defines a place for intelligent chat-bots based on ontology. It could be a chat-bot on distributed services, with a separate data service, with a knowledge base that is not updated on the basis of replicas directly, by the method of issuing an answer, such chat-bot can be attributed to generative ones which is based on a set of rules. The concept of an intelligent chat-bot is proposed, which combines the ability to integrate with popular messengers and update the knowledge base in accordance with the needs of the user. It is declared that to ensure intelligence and updatability, the chat-bot should be provided with services for collecting and analyzing data on the Internet for their analysis, and updating the information base. Additionally, such chat-bot requires intelligent module for the synthesis of the response logical structure. Using the ontology as a knowledge base for a chat-bot is a reliable and flexible way to obtain information during the dialogue, including information that is not explicitly contained there. A chat-bot which knowledge base is based on an ontology could be quickly trained and does not give irrelevant answers in case of lack or absence of information on a given question.*

Keywords*: chat-bot, analysis of natural language text, generation of meaningful text, knowledge base*.

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