MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
NATIONAL AVIATION UNIVERSITY
FACULTY OF AERONAVIGATIONS, ELECTRONICS AND TELECOMMUNICATIONS
DEPARTMENT OF TELECOMMUNICATION AND RADIO ENGINEERING SYSTEMS

ADMIT TO DEFENCE
Head of the Department

_____ R. Odarchenko
"_____" _____2022

DIPLOMA WORK
(EXPLANATORY NOTE)

BACHELOR'S DEGREE GRADUATE
BY SPECIALITY "TELECOMMUNICATIONS AND RADIO ENGINEERING"

Topic: «Methods of artificial intelligence for analysis and management of customer experience of a telecom company»

Performer: _____ I. Voichak
(signature)
Supervisor: _____ I. Terentieva
(signature)
N-controller: _____ D. Bakhtiyarov
(signature)

Kyiv 2022

Faculty of aeronavigations, electronics and telecommunications
Department of telecommunication and radio engineering systems
Speciality: 172 "Telecommunications and radio engineering"
Educational professional program: Telecommunication systems and networks

ADMIT TO DEFENCE
Head of the Department

_____ R. Odarchenko
"_____" _____2022

TASK
for execution of bachelor diploma work

Voichak Illia
(full name)

1.Topic of diploma work: «Methods of artificial intelligence for analysis and management of customer experience of a telecom company»

approved by the order of the rector from «25» April 2022 №_433/ст.

2. The term of the work: from 23.05.2022 to 17.06.2022.

3.Initial work data: theoretical data for the use of artificial intelligence in the Ukrainian telecom company.

4. Explanatory note content:

- Telecom company - what it does and what services it provides;

- AI is the technology of the nearest future. Its types;

- Implementation of Ai technology in Ukrainian telecom market.

5. List of required illustrative material: pictures, tables

6. Work schedule

№ n/p	Task	Term implementation	Performance note
1.	Developing a detailed content of chapters of diploma work	23.05.2022- 25.05.2022	Done
2.	Introduction	25.05.2022	Done
3.	What is telecom company	26.05.2022- 29.05.2022	Done
4.	AI and its types	30.05.2022- 02.06.2022	Done
5.	Kyivstar company and AI implementation	03.06.2022- 08.06.2022	Done
6.	Elimination of shortcomings and defense of the graduated work	09.06.2022- 17.06.2022	Done

7. Date of issue of the assignment: "20" May 2022.

Supervisor _____ I.Terentieva
                                    (signature)   (full name)

Accepted task for execution _____ I.Voichak
                                                (signature)   (full name)

ABSTRACT

Graduate work on the topic «Methods of artificial intelligence for analysis and management of customer experience of a telecom company». It contains 43 pages, 10 figures, 5 tables, 12 sources.

AI TECHNOLOGY, TELECOM COMPANY, SIMATIC S7-1500 TM NPU MODULE.

Object of the study is methods of AI.

The purpose of the thesis is studying of methods of artificial intelligence for analysis and management network in telecom company.

Research of methods —to implement AI technology in Ukrainian company.

This work presents AI methods, types. How AI technology can be implemented in different branches and how to implement it especially in the Ukrainian telecom market.

Materials of diploma work are recommended to be used in the scientific research, educational process and practical activity in the teaching of undergraduate disciplines

CONTENTS

LIST OF ABBREVIATIONS

AI – Artificial Intelligence

ML – Machine Learning

GSM – Global System for Mobile Communications

CDMA – Code Division Multiple Access

LTE – Long-Term Evolution

SMS – Short Message Service

MVNO – Mobile Virtual Network Operator

SNMP – Simple Network Management Protocol

CMIP – Common Management Information Protocol

CMIS – Common Management Information Service

TMN – Telecommunication Management Network

WBEM – Web-based Enterprise Management

NLP – Natural Language Processing

OCR – Optical Character Recognition

FMC – Fixed Mobile Communications

IoT – Internet of Things

API – Application Programming Interface

OTT TV – Over the Top Television

NPU – Network Processing Unit

CPU – Central processing unit

INTRODUCTION

Artificial intelligence has been gaining more and more attention recently, and of all modern innovations, AI has the most potential to change our lives: making it more productive, efficient, and easier. Soon, people will completely change the way they think about the possibilities of technology.

In general, the subject of artificial intelligence research - any human intellectual activity subject to previously unknown laws. Artificial intelligence is a field of study at the intersection of science. Experts working in the field are trying to understand what behavior is considered reasonable (analysis) and create a working model of that behavior (synthesis). Researchers are asking questions about how to learn with the help of new theories and models understand the principles and mechanisms of intellectual activity.

Scientists still do not have a unanimous opinion about the nature of human intelligence, and have not yet defined clear requirements for machine intelligence. However, this does not prevent the successful development of AI technology in two directions:

Semiotic. Creating systems that mimic processes such as speech, thinking, expression of emotions.

Biological. Creating neural networks that are built on the biological principle.

CHAPTER 1
SERVICES PROVIDES BY TELECOM COMPANY

1.1. Introduction

Let's consider what a telecommunications company is, what it does and what methods and technologies it uses and how attracts customers.

Telecommunications operator, company - a legal entity or an individual entrepreneur providing communication services on the basis of an appropriate license. There are many different criteria by which operators are divided, by type of service and coverage area.

1.2. Telecom company and types of services

A universal communications service operator or a universal communications operator is a telecommunications company, most often a commercial one, offering subscribers a comprehensive set of communications services - wired telephone communications, Internet access in various ways (wired, mobile), cellular communications, IP-telephony (SIP-telephony), television, according to the Triple Play or Quadruple play model. TriplePlay is a telecommunications marketing term that describes a model where three services are simultaneously provided to users over a single broadband access cable - high-speed Internet access, cable TV and telephone communication.
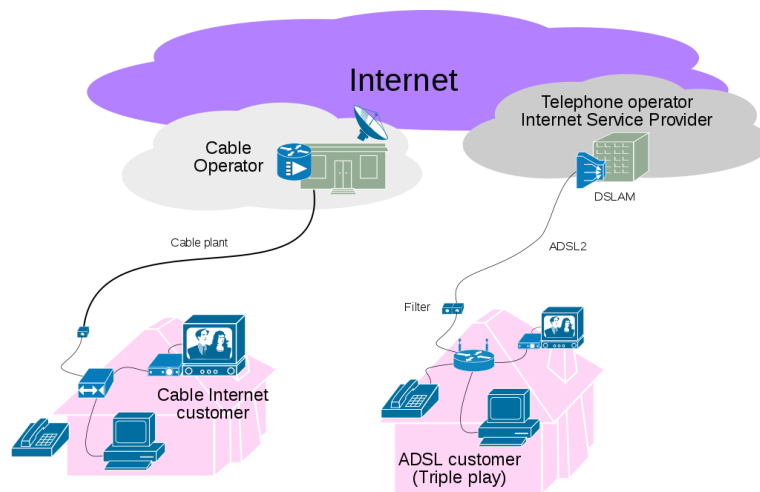
Fig.1.1. TriplePlay [1]

Quadruple play is a term that describes a model where four services are provided to cable broadband access users at once - high-speed Internet access, cable TV, fixed and mobile telephone communications. Quadruple play is an evolution of Triple Play. Another name for this term is "Fantastic Four".

This is possible, for example, through a single technological basis - a multi-service network called the Next Generation Network. With the development of the Internet and computer networks, an increasing number of telecommunications companies offer various communication services, becoming universal.

A satellite telephone operator is a telephone company that provides communication services through space radio communications. Satellite telephone subscribers have the ability to communicate with each other, as well as with other users of the global public telephone network.

To use the telephony services of a satellite operator, you need special equipment - a satellite phone, VSAT and a satellite modem or mobile satellite station. Satellite telephone communication is in demand in those parts of the globe where other methods of telephone communication are inaccessible - in space, in orbit around the planet Earth (used by astronauts), at the north and south poles, in the ocean, on islands. Depending on the telecom operator, the coverage area can be either the whole Earth, or individual regions of the world. This is due to the fact that either low-flying satellites are used, which, with a

sufficient number, cover the entire Earth with a coverage area, or satellites in geostationary orbit, where they do not move relative to the Earth and do not see it completely.

A cellular operator or mobile operator or wireless operator, is a company that provides cellular services to its subscribers' cell phones.

Operator tasks:

- obtaining permits for the use of radio frequencies and the provision of services;
- building your own cellular network and its subsequent operation;
- development of service conditions;
- collection of payments for their services;
- providing technical support.

In addition, there are a number of non-obvious tasks:

- marketing efforts to promote services on the market;
- development of a strategic plan for the development of the network;
- technological improvement of infrastructure;
- refarming of used radio frequencies.

Many operators also sell cell phones, sell digital content for phones, provide Internet access through their cellular network.

The process of forming a mobile operator in a country usually begins with obtaining a license for certain radio frequencies from the government. The frequency range for which permission must be obtained depends on the type of network that is planned to be deployed. The operator can provide access in different standards: GSM, CDMA, LTE.

Regulatory state bodies allocate the frequency range according to a scheme determined by them, including through a tender. For example, recent distributions of 3G licenses in Europe took the form of an auction, with frequencies going to the highest bidder. As a rule, the number of permits for a certain territory is limited.

The operator can provide customers with the following services:

- Voice call;

- Answering machine;

- Roaming;

- Caller ID;

- Receiving and sending short text messages (SMS);

- Reception and transmission of multimedia messages - images, melodies, videos (MMS service);

- Mobile bank (service);

- Internet access;

- Video call and video conference

Wired telephone communication, fixed communication is a kind of telephone connection between telephone users, through wires - copper or optical cables. This term, as a rule, describes the telephone services provided by telecom operators in various areas (cities, regions) of the country, providing a connection to the public telephone network with a unique telephone number that identifies the subscriber.

Mobile virtual network operator (MVNO) is a mobile operator that uses the existing infrastructure of another operator, but sells services under its own brand. A common cellular network and switches are shared with the base operator, often a common billing system. This scheme of work allows the virtual operator to eliminate the huge capital investments required to build and maintain a cellular network. Often a virtual operator manages to cover market segments that are inaccessible to large players (for example, dissatisfied former subscribers, visitors).

MVNOs are distinguished by managing the operational components of the MVNO business model, which consists of: Access to underlying network infrastructure such as base stations, transceivers, home location registers, and switching centers. Service packaging, pricing, and billing systems, including value-added services such as voicemail and missed call alerts. Consumer aspects such as sales, marketing and customer relationship management such as customer service and dispute resolution.

Since MVNOs are effectively defined by their lack of spectrum licenses, MVNOs must necessarily have agreements for at least one MNO to access the network. The type of

MVNO is determined by how "thick" or "thin" the technology layer adds the MVNO to the MNO network.

Branded reseller

It is sometimes referred to as "Skinny MVNO" as the reseller relies almost entirely on the capabilities of the MNO. They do not own any network elements, but may own and manage their own customer service, marketing, and sales operations.

Service Provider

It is sometimes referred to as "Light MVNO". The Service Provider runs its own customer service, marketing, sales and distribution activities and has the ability to set its own rates independently of the retail prices set by the MNO.

Advanced Service Provider

Sometimes referred to as "Thick MVNO". The MVNO manages a more complete technical implementation with its own infrastructure, which allows the MVNO to have more control over its offerings. These MVNOs focus more on branding, customer ownership, and differentiation through value-added services such as mobile account management apps.

Full MVNO

These MVNOs have a network implementation that operates essentially on the same technology as the mobile operator. Full MVNOs do not only have their own radio networks.

1.3. Telecom company by coverage area

Local Operators

The local operator has a transport infrastructure: physical channels between apartments, houses, offices and a communication center; ATS and a communication channel between them. Alternative operators are being added to traditional telecom operators. Alternative carriers are an Internet service provider.

Regional operators

National operators

Designed to provide communication services over a large area, have the appropriate infrastructure. They carry out transit transmission of telephone traffic, having transit automatic telephone exchanges at their disposal. These are operators for operators: their clients are local operators or large enterprises with branches and subsidiaries in various cities of the country.

Transnational operators

They have their own national networks, sometimes for several components. Cooperate with national operators.

1.4. Means of monitoring and analysis of the network of telecom operators

Constant control over the operation of the local network, necessary to maintain it in working order. Control is a necessary step that must be performed in network management. Due to the importance of this function, it is often separated from other functions of control systems and implemented by special means. This separation of control and management functions is useful for small and medium-sized networks, for which the installation of an integrated management system is not economically feasible. The use of stand-alone controls helps the network administrator to identify problem areas and network devices, and in this case he can manually disable or reconfigure them. The process of controlling the operation of the network is usually divided into two stages - monitoring and analysis.

At the monitoring stage, a simpler procedure is performed - the procedure of collecting primary data on the network: statistics on the number of frames and packets of various protocols circulating in the network, the state of the ports of hubs, switches and routers.

Then the analysis stage is performed, which means a more complex and intelligent process of understanding the information collected at the monitoring stage, comparing it with previously obtained data, and making assumptions about possible causes of slow or

unreliable network operation.

Monitoring tasks are solved by software and hardware meters, testers, network analyzers and so on. The task of analysis requires more active human participation and the use of complex tools such as expert systems that accumulate the practical experience of many network professionals**.**

All means of monitoring and analysis of networks can be divided into several major classes:

Network management systems - centralized software systems that collect data on the status of nodes and communication devices of the network, as well as data on network traffic. These systems not only monitor and analyze, but also perform automatic or semi-automatic network management mode - enable and disable device ports, change the parameters of bridges address tables of bridges, switches and routers, etc. Examples of control systems are popular systems HPOpenView, SunNetManager, IBMNetView.

System controls often perform functions similar to those of control systems, but in relation to other objects. In the first case, the object of control is the software and hardware of network computers, and in the second - communication equipment. However, some functions of these two types of management systems may be duplicated, for example, system management tools can perform the simplest analysis of network traffic. Unicenter.

Built-in diagnostic and control systems are performed in the form of software and hardware modules that are installed in communication equipment, as well as in the form of software modules built into operating systems. They perform the functions of diagnostics and control of only one device, and this is their main difference from centralized control systems. Examples of tools in this class are the hub control module Distrebuted 5000, which implements the functions of autosigmentation of ports in case of fault detection, assigning ports to internal segments of the hub and some others. Typically, embedded management modules also act as SNMP agents that deliver device status data to management systems.

Protocol analyzers are software or hardware-software systems that, unlike control systems, are limited to the functions of monitoring and analyzing traffic in networks. A

good protocol analyzer can capture and decode packets of a large number of protocols used in networks - usually dozens. Protocol analyzers allow you to set some logical conditions for capturing individual packets and perform full decoding of captured packets, ie to show in a user-friendly form the nesting of protocol packets of different levels in each other with decryption of the contents of individual fields of each packet.

Equipment for diagnostics and certification of cable systems. Conventionally, this equipment can be divided into four main groups: network monitors, devices for certification of cable systems, cable scanners and testers (multimeters). Network monitors are designed to test cables of different categories. A distinction should be made between these concepts. Network monitors collect data only on statistical indicators of traffic - the average intensity of total network traffic, the average intensity of the flow of packets with a certain type of error, etc. The purpose of devices for certification of cable systems, directly follows from their name. Certification is performed in accordance with the requirements of one of the international standards for cable systems. Cable scanners are used to diagnose copper cable systems. Testers are designed to check cables for physical rupture.

Expert systems. This type of system accumulates human knowledge to identify the causes of abnormal operation of networks and possible ways to bring the network into working order. Expert systems are often implemented in the form of separate subsystems of various means of monitoring and analysis of networks: network management systems, protocol analyzers, network analyzers. The simplest version of the expert system is a context-sensitive help system. More sophisticated expert systems are so-called knowledge bases that have elements of artificial intelligence. An example of such a system is an expert system built into Cabletron's Spectrum management system.

Multifunction analysis and diagnostic devices are low-cost portable devices that combine the functions of several devices: protocol analyzers, cable scanners, and even some network management software features. An example of this type of device is Compas MicrotestInc. or 675 LANMeter of FlukeCorp.

1.5. Management systems

Highlight the following network management features:

1) Network configuration management is the configuration of network components, including their location, network addresses, identifiers, management of network operating system settings, network schema support: these functions are also used to name objects.

2) Error handling is the detection and elimination of the consequences of network failures.

3) Performance analysis - helps to estimate the response time of the system and the amount of traffic on the basis of the accumulated statistical information, as well as to plan the development of the network.

4) Security management - includes access control and data integrity. The function includes the authentication procedure, privilege checking, support for encryption keys, rights management. The same group includes important mechanisms for managing passwords, external access, connections to other networks.

5) Network accounting - includes registration and management of used resources and devices. This feature operates on concepts such as usage time and resource charges.

The above list shows that management systems perform not only the functions of monitoring and analyzing the network, necessary to obtain initial data for network configuration, but also include the functions of active influence on the network - configuration and security management, which are needed to develop a setup and optimization plan. networks. The very stage of creating a network setup plan is usually outside the scope of the management system, although some management systems include expert subsystems to help the administrator or integrator determine the necessary network configuration measures. Network management tools should not be confused with computer management tools and their operating systems. Typical representatives of network management tools are HPOpenView, SunNetManager and IBMNetView.

System controls typically perform the following functions:

- Accounting for used hardware and software. The system automatically collects information about computers and creates records in the database of hardware and software resources. The administrator can then quickly find out what he has and where he is. For example, find out on which computers you need to update the printer drivers, which PCs have enough memory and disk space, etc.

- Software distribution and installation. After completing the survey, the administrator can create software distribution packages, which is a very effective way to reduce the cost of such a procedure. The system can also allow you to centrally install and administer programs that run from file servers, as well as allow end users to run such programs from any workstation on the network.

- Remote analysis of performance and emerging issues. The administrator can remotely manage the resources of any PC running on the network. The management system database stores detailed configuration information for all computers on the network so that remote analysis of emerging problems can be performed. Examples of such system management tools are products: Microsoft's SystemManagementServer or Intel's LANDeskManager.

Recently, in the field of control systems, there are two fairly clear trends: integration in one product of functions of management of networks and systems; distribution of the control system, in which the system has several consoles that collect information about the status of devices and systems and issue control actions.

Table 1.1

Network management standards [4]

Organization	Standards	Features
IETF	SNMP	Management should be simple, variable-oriented
ISO	CMIP, CMIS	Management must be strong, object-oriented

ITU-T	TMN	Only architecture is defined
DMTF	WBEM, CIM	Network and systems management, object-oriented
OMG	CORBA	Architecture of remote objects

Currently, the most successful family of standards is SNMP. It leads in the number of managed systems. Management systems usually support many standards, so it's hard to talk about SNMP leadership.

SNMP protocol

Creating network management systems is impossible without focusing on certain standards, because management software and network equipment are developed by hundreds of companies. Because the corporate network is probably heterogeneous, management tools cannot reflect the specifics of a single system or network. The most common network management protocol is the SNMP (Simple Network Management Protocol) protocol, which is supported by hundreds of vendors. The main advantages of the SNMP protocol are simplicity, accessibility, independence from manufacturers. To a large extent, the popularity of SNMP delayed the adoption of CMIP, a variant of the OSI control protocol. SNMP is designed to manage routers on the Internet and is part of the TCP / IP stack.

SNMP is a protocol used to obtain information from network devices about their status, performance, and characteristics, which is stored in a special database of network devices called MIB (Management Information Base). There are standards that define the structure of the MIB, including the set of types of its variables, their names, and the valid operations of these variables. The MIB, among other information, may store network and / or MAC addresses of devices, values of processed packet and error counters, numbers,

priorities, and port status information. The MIB tree structure contains mandatory (standard) subtrees, and it can contain private subtrees that allow the manufacturer of smart devices to implement any specific function based on its specific variables.

Conclusions to CHAPTER 1

In the Chapter 1 it was considered what a telecom company is, what it does, what services it provides and how network monitoring and analysis takes place. As a result, monitoring is providing mostly by computers and different protocols, programs. But analysis, mostly need active human participation. The same to the aid of the person I suggest to apply artificial intelligence about which I will tell in the following sections.

The above analysis showed that the protocols work with the help of man, the man enters everything and the program performs actions. Therefore, the task of the study is to study the methods of artificial intelligence for the analysis and management of customer experience

CHAPTER 2
ARTIFICIAL INTELLIGENSE AND ITS TYPES

2.1. AI and it's types

Artificial intelligence (AI) is a new technical science that studies and develops theories, methods, techniques, and application systems for simulating and extending human intelligence. In 1956, the concept of AI was first proposed by John McCarthy, who defined the subject as "science and engineering of making intelligent machines, especially intelligent computer program". AI is concerned with making machines work in an intelligent way, similar to the way that the human mind works. At present, AI has become an interdisciplinary course that involves various fields.

Machine learning (ML) is a set of methods in the field of artificial intelligence, a set of algorithms used to create a machine that learns from their own experience. As a learning machine processes huge arrays of input data and finds patterns in them. The concepts of Data science and Machine learning should not be confused. These tools intersect in many ways, but still they are different and each with its own tasks. Also in this article, we will once and for all understand how not to mix machine learning, artificial intelligence and neural networks.

Artificial intelligence includes many tools, algorithms and systems, including all components of Data science and Machine learning.

Machine learning is one of the sections of AI, algorithms that allow a computer to draw conclusions based on data without following strict rules. That is, the machine can find patterns in complex and multi-parameter problems (which the human brain can not solve), thus finding more accurate answers. The result is correct forecasting.

A neural network, using artificial neurons, simulates the work of the human brain (neurons) that solves a specific problem, self-learning based on previous experience. And

every time he makes fewer and fewer mistakes. Neural networks are a type of machine learning, not a separate tool.

Deep Learning is a subset of machine learning where algorithms are created and function similarly to machine learning, but there are many layers of these algorithms, each providing a different interpretation of the data it feeds. Such a network of algorithms is called artificial neural networks. In simple terms, this is reminiscent of the neural connections that are found in the human brain.

Types of AI

- *Strong AI*

The strong AI view holds that can really reason and solve problems. Such machines are considered to be conscious and self-aware, can independently think about problems and work out optimal solutions to problems, have their own system of values and world views, and have all the same instincts as living things, such as survival and security needs. It can be regarded as a new civilization in a certain sense.

- *Weak AI*

The weak AI view holds that intelligent machines cannot really reason and solve the problems. These machines only look intelligent, but do not have real intelligence and self-awareness.

What are Intelligences?

- Human intelligences can be divided into such categories:
  - Verbal/Linguistic
  - Logical/Mathematical
  - Visual/Spatial
  - Bodily/Kinesthetic
  - Musical/Rhythmic
  - Inter-personal/Social
  - Intra-personal/Introspective

The activity of the brain with intelligence, which is aimed at solving intellectual tasks, we will call thinking, or intellectual activity. Characteristic features of intelligence that are manifested in the process of solving problems are the ability to learn, generalize, gain experience, knowledge and skills and adapt to changing conditions in the process of solving problems.

Methods

- **Heuristic method** (inherent in human thinking, which is characterized by the emergence of assumptions about the solution of the problem with their subsequent verification,);

- **Algorithmic method** (interpreted as a mechanical implementation of a given sequence of steps, which deterministically leads to the correct answer.);

- **Method of resolutions** (based on proving theorems in the logic of predicates by leading to contradictions)

Basic approaches in AI modeling

In the first approach, the object of research is the structure mechanisms of the robot and the human brain, and the ultimate goal is to unravel the mysteries of thinking. Necessary stages of research in this direction are the construction of models based on psychophysiological data, conducting experiments with them, making new hypotheses about the mechanisms of intellectual activity, improving models.

The second approach considers AI as an object of study. This is about modeling intellectual activity with the help of computers. The purpose of work in this direction is to create algorithmic and software for computers, which allows you to solve intellectual problems no worse than humans.

The third approach focuses on the creation of mixed human-machine, or, as they say, interactive intelligent systems, a symbiosis of natural and artificial intelligence. The most important problems in these studies are the optimal distribution of functions between natural and artificial intelligence and the organization of dialogue between man and machine.

2.2. Distribution of AI Application Technologies in Enterprises

At present, application directions of AI technologies mainly include:

o **Computer vision:** a science of how to make computers "see"

o **Speech processing:** a general term for various processing technologies used to research the voicing process, statistical features of speech signals, speech recognition, machine-based speech synthesis, and speech perception

o **Natural language processing (NLP):** a subject that use computer technologies to understand and use natural language

Computer Vision Application Scenario (1)

- Computer vision is the most mature technology among the three AI technologies. The computer vision research include image classification, target detection, image segmentation, target tracking, optical character recognition (OCR), and facial recognition.

- In the future, computer vision is expected to enter the advanced stage of autonomous understanding, analysis, and decision-making, enabling machines to "see" and bringing greater value to scenarios such as unmanned vehicles and smart homes.

- Application scenarios:

    1. Facial recognition
    2. Comparison Gallery   **Electronic attendance**
    3. Authentication result

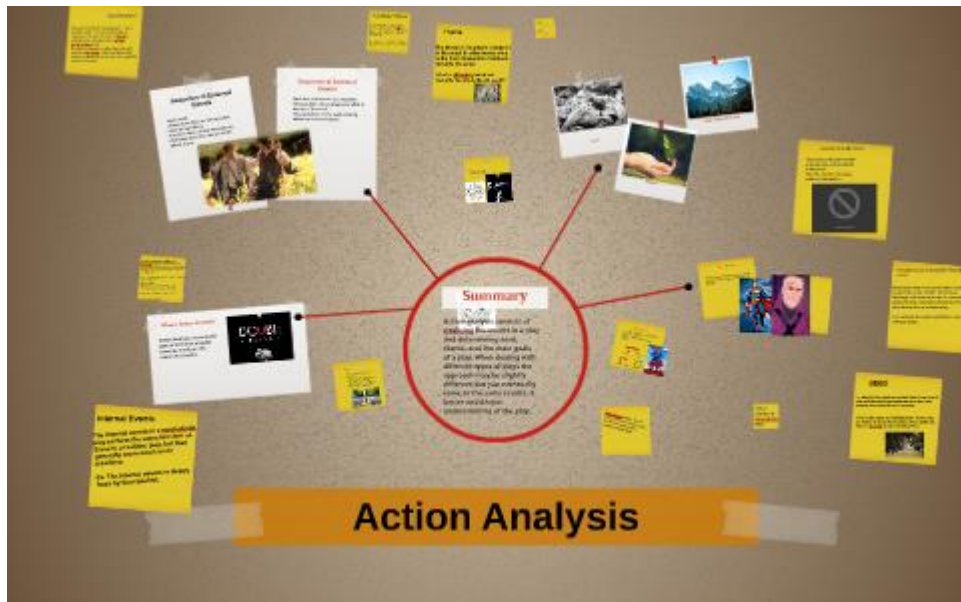**Computer Vision Application Scenario (2)**

Let's consider examples:

Fig. 2.1. Action Analysis

Artificial intelligence machine must have the following tools:

1) processing of texts in natural languages that allow you to successfully communicate with a computer, such as English language;

2) providing knowledge with which the computer can record in memory of what he learns or reads;

3) automatic formation of logical conclusions that provide the opportunity to use the information stored to find answers to questions and draw new conclusions;

4) machine learning, which allow you to adapt to new circumstances, and to find and extrapolate signs standard situations;

Fig.2.2. Smart Album

5) machine vision for the perception of objects;

6) means of robot technology to manipulate objects and move in space.

Fig.2.3. AI Authentication

Intelligent is a system that can purposefully, depending on the state of information inputs, change not only the parameters of operation, but also the behavior itself, and the behavior depends not only on the current state of information inputs, but also on previous states.

Fig.2.4. Image search

Voice Processing Application Scenario (1)

- The main topics of voice processing research include voice recognition, voice synthesis, voice wake up, voiceprint recognition, and audi-based incident detection. Among them, the most mature technology is voice recognition. As for near field recognition in a quite indoor environment, the recognition accuracy can reach 96%.
- Application scenarios:
  - ➢ Question Answering Bot (QABot)
  - ➢ Voice navigation
- Other applications:

- ➢ Spoken language evaluation
- ➢ Diagnostic robot
- ➢ Voiceprint recognition
- ➢ Smart sound bo

NLP Application Scenario (1)

- The main topics of NLP research machine translation, text mining and text analysis. NLP imposes high requirements on technologies but confronts low technology maturity. Due to high complexity of semantics, it is hard to reach the human understanding level using parallel computing based on big data and parallel computing only.

- In future, NLP will achieve more growth: understanding of shallow semantics – automatic extraction of features and understanding of deep semantics; single-purpose intelligence (ML) – hybrid intelligence (ML, DL, and RL)

- Application scenarios:
    a) Public opinion analysis (theme mining, trend analysis, emotional analysis, information distribution, hotspot event)
    b) Evaluation analysis

NLP Application Scenario (2)

- Machine translation
- Text classification
- Other applications:
    - ➢ Knowledge graph
    - ➢ Intelligent copywriting
    - ➢ Video subtitle

2.3. AI Application Field

The use of AI is effective for:

o poorly structured industries, ie industries in which the algorithm of action is unknown in advance. Such industries are characterized by ambiguity and ambiguity in the input data. However, decisions need to be made unambiguous, clear and understandable, it is also desirable to predict the effectiveness of these decisions. Such areas include: medicine, economic management, management of complex technical objects, psychology, linguistics, etc.;

o sphere of education. In a number of areas of study involves a very large number of cycles of repetition of educational information and actions in a specially designed learning situation with different variations: control of aircraft movement, learning foreign words and phrases about a certain situation, etc. Individual training skills and abilities with the help of computers much cheaper, and most importantly more efficient;

o information retrieval systems, as they are the basis for building global information repositories. One of the most striking examples is "soft search".

Intelligent Healthcare

- *Medicine mining:* quick development of personalized medicines by AI assistants

- *Health management:* nutrition, and physical/mental health management

- *Hospital management:* structured services concerning medical records

- *Assistance for medical research:* assistance for biomedical researchers in research

- *Virtual assistant:* electronic voice medical records, intelligent guidance, intelligent diagnosis and medicine recommendation

- *Medical image:* medical image recognition, image marking and 3D image reconstruction

- *Assistance for diagnosis and treatment:* diagnostic robot

- *Disease risk forecast:* disease risk forecast based on gene sequencing

Intelligent Security

- Security protection is considered the easiest field for AI implementation. AI technologies applied in this field are relatively mature. The field involves massive

data of images and videos, laying a sound foundation for training of AI algorithms and models. Currently, AI technologies are applied to two directions in the security protection field, namely, civil use and police use.

- Application scenarios:
  - Police use: suspect identification, vehicle analysis, suspect tracking, suspect search and comparison, and access control at key places
  - Civil use: facial recognition, warning against potential danger, and home protective measure deployment

Smart City

- *Social management scenarios:* AI + Security protection; AI + Transportation; AI + Energy
- *Public service scenarios:* AI + Healthcare; AI + Government; AI + Service robot
- *Industry operation scenarios:* AI + Agriculture; AI + Building; AI + Retail
- *Individual application scenarios:* AI + Life and entertainment; AI + Education

Retail

- AI will bring revolutionary changes to the retail industry. A typical symptom is unmanned supermarkets. For example, Amazon Go, unmanned supermarket of Amazon, use sensors, cameras, computer vision, and deep learning algorithms to completely cancel the checkout process, allowing customers to pick up goods and "just walk out".

- One of the biggest challenges for unmanned supermarket is how to change the right fees to the right customers. So far, Amazon Go is the only successful business case and even this case involves many controlled factors. For example, only Prime members can enter Amazon Go. Other enterprises, to follow the example of Amazon, have to build their membership system first.

Autonomous Driving

- The Society of Automotive Engineers (SAE) in the U.S. defines 6 levels of driving automation ranging from 0 (fully manual) to 5 (fully autonomous). L0 indicates that the driving of a vehicle completely depends on the driver's operation. The system

above L3 can implement the driver's hand-off operation in specific cases. L5 depends on the system when vehicles are driving in all scenarios.

- Currently, only some commercial passenger vehicle models, such as Audi A8, Tesla, and Cadillac, support L2 and L3 Advanced driver-assistance systems (ADAS). It is estimated that by 2020, more L3 vehicle models will emerge with the further improvement of sensors and vehicle-mounted processors. L4 and L5 autonomous driving is expected to be first implemented on commercial vehicles in closed campuses. A wider range of passenger vehicles require advanced autonomous driving, which requires further improvement of technologies, policies, and infrastructure. It is estimated that L4 and L5 autonomous driving will be supported by common roads in 2025-2031.

AI: Still in Its Infancy

Table 2.1

Phases of AI

		Ability	Example	Benefits
Three Phases of AI	**Computing intelligence**	Capable of storage and computing: Machines can compute and transfer information as human beings do.	Distributed computing and neural network	Help human beings store and quickly process massive data, laying a foundation for perception and cognition.

	Perceptual intelligence	Capable of listening and seeing: Machines can listen and see, make judgments, and take simple actions.	Cameras capable of facial recognition and speakers able to understand speeches.	Help human beings efficiently finish work related to listening and seeing.
	Cognitive intelligence	Capable of understanding and thinking: Machines can understand, think and make decisions like human beings.	Unmanned vehicles enabling autonomous driving and robots acting autonomously	Fully assist in or replace partial work of human beings.

Algorithmic Bias

- Algorithmic biases are mainly caused by data biases.
- When we use AI algorithms for decision-making, the algorithms may learn to discriminate an individual based on existing data including race and gender, and therefore create unfair outcomes, such as decisions that are discriminatory based on race, sex or other factors. Even if factors such as race or gender are excluded from the data, the algorithms can make discriminatory decisions based on information of names and addresses.

Privacy Issues

- The existing AI algorithms are all data-driven. In this case, we need a large amount of data to train models. We enjoy the convenience brought by AI every day while technology companies are obtaining an enormous amount of user data, which will reveal various aspects of our lives including politics, religions, and gender.

- In principle, technology companies can record each click, each page scrolling, time of viewing any content, and browsing history when users access the Internet.
- Technology companies can know our privacy including where are we, where we go, what we have done, education background, consumption capabilities and personal preferences based on our ride-hailing records and consumption records.

2.4. AI Development = Rising Unemployment

- Looking back, human beings have always been seeking ways to improve efficiency, that is, obtain more with less resources. We used sharp stones to hunt and collect food more efficiently. We used steam engines to reduce the need for horses. Every step in achieving automation will change our life and work.
- In the era of AI, what jobs will be replaced by AI:

Table 2.2

Replaced jobs by AI

Jobs most likely to be replaced by AI	Jobs most unlikely to be replaced by AI
Courier	Writer
Taxi driver	Management personnel
Soldier	Software engineers
Accounting	HR manager
Telesales personnel	Designer
Customer service	Activity planner

Problems to be solved
- Are AI-created works protected by copyright laws?
- Who gives authority to robots?
- What rights shall be authorized to robots?

Development trends of AI technologies

- **Framework**: easier-to-use development framework.
- **Algorithm:** algorithm models with better performance and smaller size.
- **Computing power:** comprehensive development of device-edge-cloud computing.
- **Data:** more comprehensive basic data service industry and more secure data sharing.
- **Scenario:** continuous breakthroughs in industry applications.

Conclusions to CHAPTER 2

The second chapter was devoted to an overview of AI technology. Here it was shown where and how artificial intelligence can be used, what are its phases. Because intelligent systems such as neural networks work with information - their use is relevant in all areas of human activity. Transportation logistics, medical services, banking, financial operations, industry optimization, autonomous driving, urban infrastructure - these are just a small part of where different neural networks can and do apply.

Yes, such systems have taken over some of the human work. Trained robotics can fly airplanes, handle legal cases, create journalistic texts and even conduct medical operations. Of course, all these are only promising areas for the full use of AI, and their activities are still strictly controlled by man.

The actual use of, say, neural networks is relevant in routine work involving information processing. Through the creation of intelligent systems, you can optimize the work of many office workers, clerks, secretaries, accountants, auditors, postal workers and more. In general, all those who are currently engaged in document management, mathematical calculations, collection and processing of information should be prepared for the fact that tomorrow their place will be taken by an ironworker who does not need rest and social package.

However, do not be afraid that the work will destroy all professions and take away people's jobs. We still need analysts, marketers, sales professionals, various ideologues,

political scientists, philosophers, teachers, lawyers - all those who can do their job better than a computer.

CHAPTER 3
ARTIFICIAL INTELLIGENCE IMPLEMENTATION
IN KYIVSTAR COMPANY

3.1. About Kyivstar

Consider the features of the use of artificial intelligence to analyze and manage the customer experience of the Ukrainian telecom company 'Kyivstar'.

Kyivstar is a Ukrainian telecommunications company, which provides communication and data transmission services based on a wide range of mobile and fixed technologies, including 4G (LTE). The leader among mobile operators in Ukraine in terms of the quality of mobile Internet.

The company's mobile network covers all cities of Ukraine, as well as more than 28 thousand rural settlements, highways. As of 2020, it is the largest mobile operator, as well as one of the largest broadband internet providers in Ukraine, serving about 26 million mobile customers and more than 1 million fixed broadband internet customers. The company owns five network codes: 67, 68, 96, 97, 98. Together with the main telecom services, the company provides FMC services (convergence of mobile and fixed communications), digital solutions - Big Data, IoT, Clouds, mobile financial services, Open API Kyivstar Open Telecom. The company implements these products both independently and in partnership with large IT companies, such as Microsoft, Huawei.

Kyivstar is also one of the leaders in OTT TV, providing access to over 250 TV channels. Also Kyivstar has created the largest communication infrastructure in Ukraine — almost 40 000 base stations. The company uses its own fiber optic network with a total length of 44 000 km and a bandwidth of more than 380 Gbps.

3.2. Indicators

Coverage and Outreach

As of 2020, Kyivstar serves about 26 million mobile customers and more than 1 million fixed broadband Internet customers in Ukraine. The Kyivstar network covers all large and small cities of Ukraine and more than 28 thousand rural settlements, all main national and regional highways, most of the sea and river coast, providing coverage for the territory where 99% of the population of Ukraine lives.

At the end of 2020:

- the number of mobile Internet users reached 17.1 million
- data traffic usage increased to 6.1 gigabits per subscriber
- Voice usage averaged 651 minutes each month

Kyivstar provides GSM communication services throughout its coverage area, as well as roaming in 189 countries on 5 continents. The company also provides services to more than 0.43 million users for access to broadband Internet based on FTTB. The Home Internet service operates in 125 cities of Ukraine. The operator is the leader in mobile Internet speed according to Ookla research. Since the introduction of 4G, the average data download speed in the Kyivstar network has almost doubled, from 17.9 Mb/s in 2018 to 33.2 Mb/s in the first half of 2021. As of August 2021, Kyivstar's 4G (LTE) network covers 88.75% of the population of Ukraine.

Table 3.1

Comparative characteristics of operators by number of subscribers

№	Operator	Technologies	Subscribers, millions
1	Kyivstar	GSM, UMTS, LTE	27
2	Vodafone	GSM, UMTS, LTE	20
3	Lifecell	GSM, UMTS, LTE	7

4	Ukrtelecom	GSM, UMTS, LTE	0,9
5	3Mob	UMTS/HSPA(own network) GSM/GPRS/EDGE(Vodafone Ukraine network)	0,25
6	Lycamobile	UMTS/HSPA (3Mob network) GSM/GPRS/EDGE(Vodafone Ukraine network)	0,1

The first three operators are whales, in the Ukrainian telecom market. I think, they will play a very important role in the development of AI in our country. Mobile operators use solutions based on artificial intelligence. They are used in the call center to interact with subscribers using a chatbot to improve customer service and combat fraud.

Artificial intelligence can optimize many processes, such as: monitoring and managing network infrastructure, predicting possible network accidents and preventing them, developing various security solutions. Operators will be able to provide the most relevant services and tariffs for subscribers, and possibly to form the most relevant individual offers. Artificial intelligence can also work with recruitment, automate various processes such as analysis and data collection.

There are to levels to control traffic, one of them it is monitoring and the second one – analyzing. If for network monitoring mostly works with the help of computers and protocols, for analyzing need more human activities.

3.3. New SIMATIC S7-1500 TM NPU module from Siemens

Artificial intelligence is used in automation on the Totally Integrated Automation platform as part of the new neural module S7-1500 TM NPU for SIMATIC S7-1500

controller and ET 200MP I / O system. This module can be transparently integrated into the SIMATIC automation system, thus ensuring the use of a simple and highly efficient combination of artificial intelligence algorithms and PLC logic.
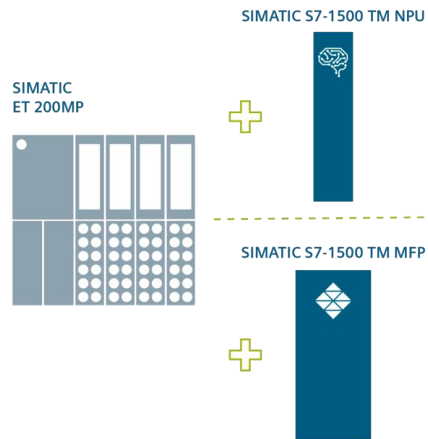

Fig.3.1. SIMATIC S7-1500 TM NPU | SIMATIC S7-1500

In this way, affordable solutions are implemented using SIMATIC technology at the machine level based on artificial intelligence. The S7-1500 TM NPU has a Myriad ™ X machine vision processor chip with support for Intel Movidius ™ artificial intelligence technology, which allows efficient calculations in neural networks. The TM NPU module can be installed both in the center, on the S7-1500 CPU, and on the periphery, on the ET 200MP interface module. By sequentially installing a number of modules, you can scale to the desired level depending on the tasks.

The S7-1500 TM NPU works with a trained neural system on the SD card. Users can connect Gigabit Ethernet and USB 3.1 compatible data collection devices, such as cameras and microphones, to the module interfaces. CPU data transmitted on the system bus can be used as input data. Further evaluation of the processing results is performed in the CPU program.

Fig.3.2. SIMATIC S7-1500 display

Advantages of using the SIMATIC S7-1500 TM NPU artificial intelligence module: increased flexibility, improved quality, increased productivity, increased economic efficiency. Thanks to artificial intelligence and machine learning algorithms, the SIMATIC S7-1500 TM NPU module simplifies the processing of even unknown objects. This does not require programming with significant resources.

Fig.3.3. SIMATIC S7-1500 display with modules TM(controllers)

Fig.3.4. TM1551 module separately [2]

Expert knowledge for fast and reliable quality control is transferred directly to the SIMATIC S7-1500 TM NPU module through neural network training at a higher level. With the SIMATIC S7-1500 TM NPU, machines can flexibly and automatically respond to situations that usually required human intervention. This reduces downtime and increases equipment availability. With the SIMATIC S7-1500 TM NPU module, you can quickly detect problems in production and avoid the costs associated with finishing or even detecting product shortages.

3.4. Implementation of module in Kyivstar network

Consider the application of the Siemens module in the leading telecom company in Ukraine. Compare how the analysis of the network took place without the use of the artificial intelligence module and how after its application, what indicators have improved.

Table 3.2

Comparative table

№	Parameter	Human	AI module
1	Information processing speed	1-3 hours, depends on the experience of the employee	Less than 30 minutes
2	Costs	Need to pay salary every month, around 50k UAH	Need to buy expensive equipment = 3 million UAH
3	Error factor	0,49 < 1	0,11 < 1
4	Workmode	8 hours with a break	24/7 – normal load

The table above shows the advantages of SIMATIC module over human. It can improve company's efficiency in 3 times. It can analyze in two times faster and more data than the engineer.

Conclusions to CHAPTER 3

In this section was introduced about big whale of Ukrainian telecom market company – Kyivstar. Here I showed technologies the operator uses, what customer base it has and why they need artificial intelligence. As with the help of artificial intelligence, namely the controller module from Siemens can improve the company's performance at times, so it has its disadvantages but much more advantages. AI is the technology of the future.

CONCLUSION

In this diploma work, my goal was to study methods of artificial intelligence for analysis and management of customer experience of a telecom company.

In the CHAPTER 1 I have considered what services telecom company-operator can provide, among them how they can be divided. They are: satellite operator, universal communication service operator, cellular operator and etc. I also searched that mostly analysis and monitoring based on different protocols, such as SNMP, CMIP, CMIS. These processes take a long time, that is, the task is to find an alternative through artificial intelligence, which will help to overcome such problem.

In the CHAPTER 2 my mission was to consider AI technology. Here it was shown where and how artificial intelligence can be used, what are its phases. Because intelligent systems such as neural networks work with information - their use is relevant in all areas of human activity.

In the CHAPTER 3 I considered how to implement AI module of Siemens company. SIMATIC S7-1500 TM NPU module can effectively improve the work of Kyivstar company. With the help of this module, the company can speed up their work on information processing and its volume. So, in my opinion, the goal has been achieved, the company's work will be improved.

REFERENCES

1. Organization scheme of the Triple Play [Electronic resource]. - Resource access mode: https://ru.wikipedia.org/wiki/Triple_Play

2. Technology modules TM 1551, SIMATIC S7-1500 series, positioning module, SIEMENS [Electronic resource]. - Resource access mode: https://eleksun.com.ua/6es7551-1ab00-0ab0-tehnologicheskie-moduli-tm-1551-seriya-simatic-s7-1500-modul-pozicionirovaniya

3. Artificial intelligence thanks to SIMATIC [Electronic resource]. - Resource access mode: https://new.siemens.com/ua/ru/products/avtomatizatsiya-promyshlennosti/sistemy-avtomatizatsii/promyshlennyye-sistemy-avtomatizatsii-simatic/io-systems/shtuchnyy-intelekt.html

4. Network monitoring and analysis tools [Electronic resource]. - Resource access mode:
https://wiki.cuspu.edu.ua/index.php/%D0%97%D0%B0%D1%81%D0%BE%D0%B1%D0%B8_%D0%BC%D0%BE%D0%BD%D1%96%D1%82%D0%BE%D1%80%D0%B8%D0%BD%D0%B3%D1%83_%D1%82%D0%B0_%D0%B0%D0%BD%D0%B0%D0%BB%D1%96%D0%B7%D1%83_%D0%BC%D0%B5%D1%80%D0%B5%D0%B6%D1%96

5. Universal communication services operator [Electronic resource]. - Resource access mode:
https://ru.wikipedia.org/wiki/%D0%9E%D0%BF%D0%B5%D1%80%D0%B0%D1%82%D0%BE%D1%80_%D1%83%D0%BD%D0%B8%D0%B2%D0%B5%D1%80%D1%81%D0%B0%D0%BB%D1%8C%D0%BD%D1%8B%D1%85_%D1%83%D1%81%D0%BB%D1%83%D0%B3_%D1%81%D0%B2%D1%8F%D0%B7%D0%B8

6. Telecommunications operator [Electronic resource]. - Resource access mode: https://ru.wikipedia.org/wiki/%D0%9E%D0%BF%D0%B5%D1%80%D0%B0%D1%82%D0%BE%D1%80_%D1%81%D0%B2%D1%8F%D0%B7%D0%B8

7. 7. About Kyivstar company [Electronic resource]. - Resource access mode: https://ru.wikipedia.org/wiki/%D0%9A%D0%B8%D0%B5%D0%B2%D1%81%D1%82%D0%B0%D1%80

8. А. С. Савченко О. О. Синельніков, AI textbook [Electronic resource]. - Resource access mode: https://er.nau.edu.ua/bitstream/NAU/40676/1/%D0%9C%D0%B5%D1%82%D0%BE%D0%B4%D0%B8%20%D1%82%D0%B0%20%D1%81%D0%B8%D1%81%D1%82%D0%B5%D0%BC%D0%B8%20%D1%88%D1%82%D1%83%D1%87%D0%BD%D0%BE%D0%B3%D0%BE%20%D1%96%D0%BD%D1%82%D0%B5%D0%BB%D0%B5%D0%BA%D1%82%D1%83%20_%D0%9D%D0%B0%D0%B2%D1%87_%D0%BF%D0%BE%D1%81%D1%96%D0%B1%D0%BD.pdf

9. How artificial intelligence works and prospects of its use [Electronic resource]. – Resource access mode: https://aiconference.com.ua/uk/news/printsipi-raboti-iskusstvennogo-intellekta-i-perspektiva-ego-ispolzovaniya-92238

10. What is artificial intelligence [Electronic resource]. – Resource access mode: https://osvita.diia.gov.ua/courses/artificial-intelligence

11. Deep learning & Machine Learning: what is the difference [Electronic resource]. – Resource access mode: https://datastart.ru/blog/read/deep-learning-machine-learning-v-chem-raznica

12. Neural networks, machine learning and artificial intelligence: what is the difference and what are they used for [Electronic resource]. – Resource access mode: https://evergreens.com.ua/ru/articles/machine-learning-overview.html