Decision Support System Design For Low-Voice Emergency Medical Calls At Smart City Based On Chatbot Management In Social Networks

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Abstract
People value today's life more than ever. We have one in a million people who need listening or editing, and they need a silent emergency call. The digital technologies we use now, we see more and more and more popular in this field of health, also represent new unique tools, which allow being convinced of the interests and be fresh in other branches of medicine. With these new solutions, which are reviewing their own, available in a medical consultation, or following only possible actions, you can use these difficulties to use digital technology. An analysis of literature and Internet sources was conducted, the main approaches to the
development of this problem were explored, and a number of their advantages and disadvantages were identified. It was proposed to design information systems to make wooden targets that transform the main targets. In addition, they chose the type of information system that uses the methodology of hierarchies. The analysis of many technical means for sending chatbots was confirmed. After analyzing the control example, it was almost known that the software product is working and fulfills the tasks, offering the opportunity to team members who have unknown expressed medical care in Smart City. The expediency of the development of a new software product is substantiated.

**Keywords**
Chatbot; Telegram; Decision Support System; Information Technology; Social Networks; Dialogflow; Python Django; PostgreSQL; Smart City; Emergency Medical Calls

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**Introduction**

Today, human life is more valuable than ever. Modern digital technologies are becoming more and more popular in the healthcare sector and represent specific unique tools that can accelerate and create new innovative processes in the field of Medicine in Smart City (Xu et al., 2018; Ramaprasad et al., 2017; Rassia et al., 2017; Allam et al., 2020; Kirimtat et al., 2020; Lau et al., 2019; Matseliukh et al., 2021). With these latest solutions, being in an environment where getting timely medical advice or help is impossible or difficult, a person can get around all these difficulties using digital technologies (Shakhovska et al., 2019; Kubinska et al., 2021; Central103, 2021). Thus, a person who does not have the necessary conditions to obtain the required information or service about his life and health can use tools that will give him a convenient solution to get answers to their questions, or even save someone's life in circumstances in which without these technologies it would have a tragic end. Many processes require automation and optimization in the modern field of healthcare and life-saving (Shakhovska et al., 2019; Kryvenchuk et al., 2018; Shakhovska et al., 2015). General-use technologies in this area are vital, and solutions are created to solve problems set only by specific segments of society in Smart City. For example, people with disabilities should receive differentiated services through specially designed information systems created to provide better services to this segment.

Thus, the result of this work was the creation of an information system based chatbot (Ni et al., 2017; Sheth et al., 2019; Kolesnichenko et al., 2021; Dharwadkar et al., 2018; Mohasses et al., 2019; Hochreutener et al., 2020; Edwards et al., 2016; Ouerhani et al., 2020) that creates such digital processes that allow the patient to receive the necessary service in such conditions that receiving timely and high-quality medical care would be impossible or very difficult for reasons that cannot be eliminated or minimized without the use of information technologies in these processes. Recently, a significant number of such tools have already been implemented worldwide, which solve problems and which it is time to solve by digitizing processes based on world experience. The information system is designed to increase service differentiation for a specific segment of patients significantly. The available service method and, for example, receiving emergency medical care is far from optimal for
people with hearing or speech disorders. A system has been created for people with such
disabilities that minimizes or eliminates the negative impact of those factors that made it
impossible or difficult to obtain medical advice or call for emergency medical care. There are
currently about one million people in Ukraine for whom this information system will be
relevant due to the lack of optimal channels to obtain the necessary technologies. Having
considered these factors, the task of implementing such a digital service channel for a specific
segment of patients, namely, receiving consultations and calling emergency medical care
without voice contact, is more relevant than ever (Pereira et al., 2019; Badawy et al., 2020;
Wang et al., 2020; Yadav et al., 2019; Lai et al., 2020; Tran et al., 2019). The purpose of this
work is to solve this problem, that is, to create an information system that will make the
necessary tool for people with disabilities, namely, to provide an opportunity to receive the
essential medical services without voice contact, for people with hearing or speech disabilities.
To achieve this goal, you need to solve the following tasks:

1. Analyze the subject area by researching and testing existing solutions to this problem
   and determine the functional requirements to comply with them, and create an
   information system that will meet the needs of the industry in which it is going to be
   used;
2. Perform a systematic analysis of the research object by constructing a goal tree, data
   flow diagram, and task hierarchy;
3. Choose tools for solving this problem by studying and comparing their technical
   characteristics;
4. Implement the information system, test it, and describe the main modules.

The object of research is providing a voiceless emergency medical call. The subject of study
is methods and means of providing a mute call to emergency medical care.

The developed information system is designed as a system that will be used to give a
voiceless call for emergency medical care. This system will make a significant contribution to
society and the sphere of health care. The developed system contains:

**Related works**

Now society is trying to digitize, literally, all branches of the life of the community in Smart
House (Risteiu et al., 2016; Jalali et al., 2015; Filho et al., 2010; Teslyuk et al., 2018; Lytvyn
et al., 2019; Lytvyn et al., 2020; Dokhnyak et al., 2021) and Smart City (Chen et al., 2017;
Eckhoff et al., 2017; Zdraveski et al., 2017; Khan et al., 2012; Boreiko et al., 2016; Boreiko
et al., 2017; Wieclaw et al., 2017; Duda et al., 2018; Duda et al., 2019; Duda et al., 2020;
Katrekno et al., 2020; Podlesna et al., 2020; Nataliia et al., 2019; Matseliukh et al., 2020;
Matseliukh et al., 2021; Krislata et al., 2020; Bublyk et al., 2020), and it is not surprising that
it is the provision of high-quality and timely medical care, even individually for a specific
segment of patients, that has become relevant. The new solution offers the use of modern and
appropriate communication channels and technologies for this period, which will create the
necessary conditions to speed up the processes for providing emergency medical care for the
segment of people for whom the available communication channels (Modrzyk, 2018;
IT_everyday, 2021; Telegram, 2021; Dialogflow, 2021; Google, 2021; Baumgartner et al.,
2021)
2015) and solution methods are far from optimal (Modrzyk, 2016; Kravets, 2016; Basyuk, 2015; Demchuk et al., 2019; Makara et al., 2020; Bodnar et al., 2020; Khomyskha et al., 2020), for example, big analysis (Berko et al., 2018; Berko et al., 2019; Shakhovska et al., 2017; Shakhovska et al., 2018; Shakhovska et al., 2019; Shakhovska et al., 2015). People with hearing and speech impairments are the segment for which the newly created system is intended. The available communication channels with patients are not sufficiently differentiated for this segment. Since voice communication channels are not suitable, it was decided to switch to non-voice contact with the patient. In addition, the presence in our society of the Central 103 system, which online monitors the work of regional emergency medical centers and receives all the necessary information about the treatment and the results of their processing, and is also a so-called “bridge” for the exchange of information between regional dispatchers 103 and other services, provides all the conditions for such a system of voiceless call for emergency medical care to be implemented for these patients (World Health, 2020; Hauser-Urlich et al., 2020; Androustoupolou et al., 2019; Souflye et al., 2021; Smaida et al., 2020; Lytvyn et al., 2020). But in reality, this information system performs the functions of optimizing the process of calling emergency medical care for a specific segment and asking the patient about his condition, and analyzing his condition according to his answers according to the algorithm provided by the algorithm Centar103 (Central103, 2021).

So, this information system performs three main goals: making an emergency medical call without voice contact with dispatchers (Sheth et al., 2019; Dharwadkar et al., 2018; Aksonov et al., 2021; Bisikalo et al., 2016; Ivanov et al., 2020) collecting and analyzing information about the patient's condition based NLP methods (Intyaswati et al., 2022; Senthil et al., 2022; Sonika et al., 2022; Bisikalo et al., 2017; Zhezhnych et al., 2018; Khomyskha et al., 2020; Semotiuk et al., 2003; Davydov et al., 2017; Chyrun et al., 2019), and providing chatbot advice (Chandel et al., 2018; Landis et al., 2014; Marino et al., 2014; Minhas et al., 2021; Park et al., 2019; Nayak et al., 2021; Nuruzzaman et al., 2020; Tu, 2020), if relevant, to the patient before the arrival of the emergency medical team. For example, a person with hearing or speech disorders will not experience any inconvenience when calling an emergency medical service via a mobile call. Or, for example, the patient will not be able to provide basic information about the sick person. Or it won't be able to hear the recommendations and respond accordingly. You will not need to use an inconvenient and ineffective communication method for this segment, which will use a new communication channel – a chatbot-to correct this situation. According to this solution, it will be enough to make the necessary communications in the chatbot via a smartphone. In addition, for the development of this information system, we specifically selected technologies that coincide with the technologies used by Tsentral103. all this makes it possible to maintain, expand and scale the project with the Central103 system. All these solutions create conditions for further development and improvement of this system. The ability to further support and scale is relevant and reliable for many Information Systems. The reasons for the use of Information Systems in medicine were the global problems of the modern world, including the aging of the population and the growth of medical costs. The dynamics of increasing healthcare costs are growing faster than the dynamics of the economy are growing. In addition, the number of medical specialists is decreasing relative to the number of patients, and the number of insurance premium payers is
also decreasing compared with the number of users of medical services. In the same chat, patients’ demands for the quality of healthcare services will not stop growing. One possible way to address this problem is to change how health services are provided. In 2005, the European Union proposed an initiative for each EU member state to create its national strategy for integrating information technology (IT) in medicine. Further, a pan-European program was built on this basis. The introduction of Information Systems in medicine faces many challenges. So, the system must meet all legal requirements. Also, the main problems in implementing projects may be the increased complexity of standardization and unification of medical documentation in various medical organizations. In addition, it may be resistance or passive attitude of medical workers. The creation of medical information systems in the world requires a focus on standardizing and sharing medical data between different health systems and accelerating processes in this area. Standardization increases the efficiency of medical institutions, reduces the risk of doctors making common mistakes, helps save time for medical workers, and generally improves the economic results of the healthcare system.

One of the trends in the development of Information Systems in medicine is the broader introduction of Medicine in smartphones. Because it's easier and more convenient, systems and devices must be connected to the internet to do this. Over the past decade, smartphones have significantly changed many aspects of our daily lives – from banking to shopping and entertainment. Now Medicine is next in line. Smartphones with medical apps have the revolutionary potential for medicine. As a result of this revolution, the patient can become its central figure instead of the doctor for the first time in history.

The next trend is the introduction of artificial intelligence. Artificial intelligence is now used in many areas of life. So, in the future, due to the widespread use of artificial intelligence, the number of erroneous diagnoses and, indeed, errors in the healthcare sector, in general, should be significantly reduced. This information system will use cloud technologies. In a short time, cloud technologies have become a crucial step for digital technologies for both companies and government agencies, and ordinary users. In addition, they created a general change in our perception that software should be combined with specific hardware and resources, which have significant flexibility compared to a historically compiled model. Cloud technologies have made substantial changes and changed our understanding of the development and use of computing resources. They changed the strong relationship between the purchase of software components and their use. Cloud technology is a Distributed Data Processing Technology in which the user leases computer resources and capacities through an internet service. Cloud technologies have made the IT infrastructure even more modular, dynamic, and independent than ever before. These changes impact all aspects of the data processing process. They allowed people to launch new services quickly or reallocate computing resources depending on business tasks. "Clouds" make it easier to maintain software by making it much easier to install updates and additional modules. So, this information system has many advantages, but it is not an easy task. Suppose you pay attention to how this tool performs a very responsible mission and when implementing this system. In that case, you will have to face many challenges in the form of large requirements for the standards of digital tools in healthcare. In Ukraine, such projects were developed jointly with Tsentral103 and are already helping to
save people's lives using chatbots. After getting acquainted with ready-made solutions and systems already working successfully, it is worth saying that such information systems that can be used to solve the problem set in the work already exist, and this area should continue to be developed.

Such solutions will be implemented and will be used in smartphones, which are already a separate part of people's lives, which significantly positively affects the effectiveness of this solution for society, which is already ready to integrate this product. After reviewing these properties, it is possible to say that the task of developing this information system for voiceless emergency medical care is relevant. This technology allows you to partially automate the processes of calling emergency medical care without making voice contact with the dispatcher, which is a big problem for people with hearing and speech disorders. Its main feature is the combination of the subsystem with dispatching Central103, which will process incoming calls. Since the network of control rooms has already covered almost all of Ukraine, this system can be launched in a significant number of regions. In the future, when dispatching Centers 103 will be distributed to all regions, this will cover the entire country. This necessary database usually consists of four technologies: databases, instant messengers, smartphones, programming languages, and cloud technologies.

If we look at them in more detail, database technology is integral to any information system. Without it, there will be nowhere to store information, without which systems cannot function. In general, the quality of database implementation affects and largely determines the effectiveness of the information system as a whole (Soufyane et al., 2021; Shakhovska et al., 2018). When developing a modern Information System, designing data storage and processing becomes the most important. Given that business processes are automated (Dewobroto et al., 2022; Kuzmin et al., 2020; Bublyk et al., 2020), the database is considered an integral part of it (Edwards et al., 2016; Shakhovska et al., 2018). So, the database review is based on the need to transmit information in business processes and the need to work with documents.

Moreover, many information systems work based on document management and structural review of documents. Their presentation storage on a storage medium requires a database, and therefore its design with development. For this system, to adhere to the Central104 technology stack and support and extend this project in the future, PostgreSQL was chosen. PostgreSQL is a freely distributed object-relational database management system, the most advanced open DBMS globally, and is a natural alternative to commercial databases. There is a need for an object-relational database because relational and object databases have individual advantages and disadvantages. The isomorphism of a relational database system with a mathematical relationship makes using many valuable methods and theorems from set theory. At the same time, these types of databases are not effective for data complexity and inconsistencies between the application and the DBMS. The object-oriented database model works effectively with containers such as sets and lists, randomly defined data types, and nested objects. It provides standard features between application and database-type systems that eliminate any nonconformity issues. But, despite everything, object databases, unlike relational ones, cannot provide a mathematical basis for their in-depth analysis.
messengers now play no less important role than browsers. They are popular and widespread now, more than ever before, and a significant number of the population uses them, and if necessary, almost every citizen can switch to the messenger. They are now the best channel for communicating with users, so it was chosen for this information system. A fundamental reason for using instant messengers is their frontend part, which is available for use in chatbots and eliminates the need to develop and use your frontend technologies. Telegram was chosen for this system.

Today, this messenger is viral, rapidly developing, and massively distributed. Although it is not the most popular in Ukraine, it has its technical features before Viber. That is why it was chosen for this digital system. As of 2020, smartphones have become an integral part of human life. They are widespread, which means that they should be chosen as a device from which it will be convenient to log in to the digital information system and use its services. So, for example, every modern smartphone has a built-in GPS, which allows you to share in the messenger the location where the person who needs help is currently located, where the emergency medical team can then go.

Python was chosen as the programming language. The main reason for selecting this programming language was complying with the Central103 technology stack. This information system will be supported and expanded in the future. Django, a high-level open-source Python framework for creating web systems, developed the software part. The Django program is designed from one or more components recommended to be made modular. It is one of the critical architectural distinguishing features of this framework from others. After working with this framework, you can personally see its comfort and simplicity. For example, my project was started with an SQLite database when I had already written a significant part of the program code. Thanks to the modularity of Django, it was enough to change the database Settings from SQLite to PostgreSQL and start migrating again. After that, the project continued its work, already with a new database without any difficulties and complications.

Nginx - there are Main and backup web servers. This structure ensures reliable operation and load distribution. The use of these technologies allows the architecture to be designed and built in such a way as to ensure non-failure and continuous operation of the system 24/7. For this purpose, all the system's main components will be placed in "clusters" and duplicated. This structure ensures that the load is distributed over the details. And the physical distribution of elements in a single cluster provides the system with additional protection against possible accidents. GitLab-a repository that stores the source code. Dialogflow-Google service for building dialogues and machine learning communication. Paying attention to the tasks of the thesis, one of the methods of adding products to the information system can be considered the process of creating an emergency medical call in the messenger via a chatbot. The chatbot can collect information about the patient's location, which is regarded as the most critical parameter using messenger and smartphone technologies. The emergency medical team will not respond in time. In addition, the chatbot can get additional location information from the user while communicating with the user. Ask different questions about symptoms and conditions that the chatbot will be able to analyze and advise the user and assess the criticality of the situation. The system will store all information in a database. After
the required amount of data is collected for the call and it turns out that the situation in which the user finds himself falls under the requirements, a request for an API call will be issued and sent. You can also use a specially designed mobile app to perform the non-voice call function. This solution has its advantages and disadvantages. So, the benefit of this application will be its narrow specialization, which allows you to focus as much as possible on the problem that this software product solves. It is much easier to analyze the area to serve and create a solution that will perform its function as efficiently as possible when developing such programs. In addition to the advantages, this solution also has its drawbacks. So, the distribution of such an application becomes more complicated because users must find out about its existence and download and install it on their mobile devices.

In contrast, almost everyone already has a messenger solution, and it is much easier to initialize user communication with a chatbot. The second disadvantage is developing the application itself and its further support, which creates additional difficulties and costs in money and time. For example, you will not have to face when developing a chatbot in messenger. The third possible scenario could be a website with a form filled out by people who need medical advice or help. Form B analyzes the data that the user fills out and determines the patient's condition and responds accordingly, provides recommendations, and, if necessary, sends a call to the control Center103. It is an excellent and well-tested option that society is already used. But it has the worst interactivity parameter and its distribution and ease of working with it.

For a non-voice call to emergency medical care, it was possible to make a separate device that would perform its assigned task, but unfortunately, this is expensive. In addition, now, creating a narrow profile device in multifunctional gadget technologies is not the best idea.

These approaches are used in well-known systems that deal with the medical industry. For example, manufacturers of smartphones and smartwatches already produce their gadgets that implement this functionality or can programmatically add new functionality to the gadget without modifying the physical part of the device, but only programmatically. Individual systems or devices are not patented, but there are many studies. For example, Tsentral103 has already launched a chatbot for volunteers who will go to the rescue and arrive at the patient earlier than the emergency medical team without a voice call. Unfortunately, there are not enough digital solutions to call emergency medical care for every segment of people and their needs. That is why the problem of creating a system without voice calling for emergency medical care is still relevant.

The topic of digitizing all business processes is more relevant today than ever before, so it is not surprising that there are attempts to digitize this particular industry. Technological progress in digitizing various activities has reached incredible heights in recent years. Therefore, it is not surprising that such information solutions are growing every day. The medical industry is no exception, as it is a type of activity that, like no other, requires the optimization and acceleration that people have to face in their lives. Its main task is to preserve human life by accelerating the processes in the medical industry on which the fate of a person depends. After analyzing the world's heritage, it became possible to find several
information solutions that already perform the same or similar function as the information system that will be developed. So, the iBeat Heart Watch entered the market, which today you can buy for 250 dollars. The device's purpose is that this invention looks like a simple watch, but it can save your life in an emergency. It collects information about your heartbeat 100 times a second to achieve this goal. Artificial intelligence processes this information. As soon as the watch detects something abnormal, it will alert its user. If the Watch owner confirms that they have health problems or do not answer within 10 seconds, the Watch will start calling the ambulance service and warn your loved ones. The watch has an SOS button. You need to press it in situations where you need emergency help, have fallen, cannot move, or are in danger. The Watch has GPS and is connected to the network. In addition, the watch connects to your smartphone via Bluetooth. In the software application on your smartphone, you can specify your medical history and other crucial necessary information that paramedics receive if essential. The cost of this service is 20 per month, and it includes a subscription fee for cellular communication. Previously, it was proposed to create the ability to integrate this platform on the Apple Watch, but since the sensors in the Apple Watch are too focused on fitness. The Watch must always be ready for action. For this reason, the iBeat Heart Watch can work on a single charge for as long as four days and can fully charge in just an hour without removing them from your hand (Fig. 1).

The system operation algorithm is as follows:

1. They constantly check their heart rate and blood circulation to identify life-threatening emergencies and ensure that everything is in order with the host.
2. In real-time, data coming from the clock is analyzed to detect emergencies.
3. If something turns out to be disabled, then the question follows: «Are you all right?».
4. If you receive a response that not everything is in order or within ten seconds, there is no response at all. Then the watch informs the control room that "trouble has occurred" in the ambulance or to the phone number of a person close to you that you specified earlier.
5. There is also an SOS button for emergency care.

![iBeat Heart Watch](image1)

**Figure 1. Device image iBeat Heart Watch**

![DAYTECH Care Alert SOS Call System](image2)

**Figure 2. DAYTECH Care Alert SOS Call System**

**Table 1** List of advantages and disadvantages of the device «iBeat Heart Watch»
A person carries this device next to them and, if necessary, presses the emergency call button. It triggers a call about a critical situation to your loved ones or the emergency medical service. This solution helps care for disabled people, children, the elderly, and pregnant women. When they need help, they can get timely and attentive help without shouting, just by pressing a button. The wrist pager is wearable and portable, and it's small enough to fit in your pocket. The device has a waterproof call button so that it is not damaged in any case. A large SOS key is convenient for the elderly if it is hung around the neck. The system operation algorithm is as follows:

1. After purchasing the system (Fig. 3), you need to configure it and place it at home.
2. Give the device to the person who may need help and inform them about the use rules.
3. If necessary, the patient makes a call using a wireless button in an emergency.
4. The system responds to the call and makes the necessary notifications to the patient's relatives or the emergency medical service immediately.

### Table 2 List of advantages and disadvantages of the mobile app «DAYTECH Care Alert SOS Call System»

<table>
<thead>
<tr>
<th>Advantages:</th>
<th>Disadvantages:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Affordable price.</td>
<td>1. Mobile tariffs are required for its operation.</td>
</tr>
<tr>
<td>2. Lightweight and easy to use.</td>
<td>2. Narrow specialization. The device is sharpened to perform only one function.</td>
</tr>
<tr>
<td>3. Stylish design.</td>
<td>3. There are not enough settings to use the device effectively.</td>
</tr>
<tr>
<td>4. Once you buy this device, you get all the functionality.</td>
<td>4. The device analyses only the heartbeat.</td>
</tr>
<tr>
<td>5. Effectively performs its functionality.</td>
<td>5. The device is relevant for a narrow segment of consumers.</td>
</tr>
<tr>
<td>6. High level of reliability.</td>
<td>6. The device is difficult to scale to other countries.</td>
</tr>
</tbody>
</table>

Special applications are also being developed for smartphones to call for help in emergencies. For example, SOS Mobile is an app almost like a lifeline if you find yourself in a critical
situation. An alarm button appears on your phone, after clicking which all your loved ones will be able to find out that something has happened to you. You just need to create a list of contacts that will be notified at the right time. They can be reported in any way: via SMS or the mobile internet. You can even pay a little extra, and SOS Mobile will monitor your security even more closely. The app will notify your loved ones and call the necessary specialized services. According to statistics, SOS Mobile has already helped more than 2000 users (Fig. 3). The system operation algorithm is as follows:

1. When registering for the app, you need to fill out a list of contacts to send notifications if something happens to you.
2. Also, after you start working with the app, you must select the service type in the app. There is an accessible model and a paid subscription. A paid subscription extends the app's functionality. So in case of an emergency, in addition to loved ones, a call for emergency medical care will also be created.
3. If a critical situation occurs, you click the call for help button.
4. The system notifies all your loved ones that you have previously added to the list of people who need to be informed.
5. If you have a paid subscription to the app, in addition to notifying your loved ones, the app also automatically calls for emergency medical care.
6. The app can be downloaded to multiple devices and can be exchanged between them.

In addition, there are fewer technological and no less effective tools on the market. So there are wireless devices of the «SOS» button. Consider, for example, DAYTECH Care Alert SOS Call System.

Figure 3. Screenshots from the app «SOS Mobile»

Table 3 List of advantages and disadvantages of the mobile app «SOS Mobile»

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The app is available on Android and IOS.</td>
<td>1. High price of a paid subscription.</td>
</tr>
<tr>
<td>2. Quick start to work.</td>
<td>2. A significant amount of functionality is not available in the free version.</td>
</tr>
<tr>
<td>3. There is a free version of the functionality.</td>
<td>3. There are not enough settings to use</td>
</tr>
</tbody>
</table>
4. The app effectively performs its functionality.
5. The app is supported and works on both new and old versions of mobile phone operating systems.
6. Intuitive interface.

The analysis of literature and internet sources is carried out, the main approaches to solving this problem are investigated, and a number of their advantages and disadvantages are highlighted. As a result, it can be argued that developing an information system for calling emergency medical care is an urgent task, so there is a need to conduct research in this area and conduct a systematic analysis of the object of research and development of the information system.

Methods and materials

System analysis is a set of methods and tools for application in the study of a complex object of research, at the end of providing it as a system and analyzing these systems. So, almost the main part of System Analysis belongs to the system approach, which makes it possible to consider any system as a system formed from separate, interconnected elements that work with the environment and are constantly being improved (Zhezhnych et al., 2007; Mykich et al., 2016; Zhezhnych et al., 2017; Burov et al., 2020; Zhezhnych et al., 2018; Babichev et al., 2020; Golovko et al., 2000; Sachenko et al., 1999). The main part of creating a methodology for analyzing systems under certain conditions is formed by the so-called principles of system analysis, which are general methods of working with complex systems based ontologies, cauterization, machine learning, neural networks, and decision-making (Wang et al., 2019; Tsmots et al., 2015; Babichev et al., 2018; Babichev et al., 2020; Lytvynenko et al., 2020; Okrenets et al., 2017; Komar et al., 2013; Safonyk et al., 2021; Semenova et al., 2019; Klymovych et al., 2020; Voloshynskyi et al., 2021; Mykich et al., 2016). It is also necessary to consider the methods of big data processing. These include the principle of ultimate goal, connectivity, modularity, functionality, development, decentralization, and uncertainty. At the end of studying the system of the soft call of emergency medical care, we can state: the principle of the final (unified) goal is to create a system of non-voice call of emergency medical care, which will have the necessary tools and integration tools to analyze the user's request and, if necessary, provide him with advice and make an emergency call in the external system Central103, the principle of connectivity makes it possible to find connections between the elements of this system and connections with the external environment. Therefore, you can link analyzing the user's request and create a call. Since before creating a call, it must first be analyzed in our system, the modularity principle indicates the possibility of evaluating the system as a set of modules. The non-voice call of emergency medical care is formed from four main modules that can be applied separately or with each other. The principle of functionality is a technique in which, in the mutual revision of functionality and structure, the function is taken and given more important importance. The creation and
implementation of the system structure should be carried out only after receiving the final and complete list of system functions. The development principle assesses possible changes in the system and its ability to develop, expand, and accumulate information. The non-voice emergency medical call system can be updated with functional parts and databases. Building a system in modules and adhering to a clear stack of technologies will allow you to develop the system with minimal costs. The principle of decentralization focuses on finding a common solution between the ability of the system to function under certain actions of parts of the system and complete centralization. In non-voice emergency medical call systems, decentralization will be built so that certain modules can work and process calls received separately from the entire system. So, for example, after creating a call in the Central Information System, the non-voice emergency medical call system no longer needs to respond to further operations with this call. The uncertainty principle estimates the probabilities of uncertainty and randomness of the system. In our system, uncertainty should be avoided because this system deals with human life, and those accidents that may be should be processed so that the system can perform its function. So, for example, the algorithm for assessing a chatbot user's situation has when making an emergency medical call knows how to respond to cases when a patient or user cannot provide reliable information due to their incompetence. System analysis was used to build a goal tree – a structured hierarchy of sub-goals, which is necessary to identify the main direction of action. The result is shown in Fig. 4. The created tree has four levels: the main goal, its goals, sub-goals, and criteria for the quality of system functioning. As a result of creating the goal tree, the following three main aspects of obtaining the main goal were identified and formed: subject area analysis, system design, and system implementation. The first aspect should be investigated – «Subject area analysis.» Domain analysis is one of the most important parts of System Analysis. It always includes an analysis of requirements and explaining the relationships between information elements. Actually, because of this, sub-aspects were taken into account: collecting data on the human condition. Depending on the patient's condition, the information system will respond according to the criticality of the situation. So if there are no health problems after collecting information from a person, the system will refuse to call. On the contrary, when the patient's condition meets the call requirements, it will be issued, collecting data about the patient's location. It is important information for the emergency medical call team. The user must provide the necessary information about their location using the messenger and text form tools and analyze existing solutions. There are many options for solving the problem mentioned above, but since this is still relevant, these options contain some disadvantages. Because of this, we still need to study the solutions that all exist to fix our problem. It is necessary to highlight the disadvantages and advantages and think through the correct functional model. The following quality parameters were selected for the first aspect: quality and relevance. Therefore, it is considered that these properties are the most necessary and have a high level of importance for working with information during the subject area analysis.

Next aspect – «System design.» Before creating an information system, you should decide on its primary functions, processes, and tasks and finally think it through. That is why you need to think through the following sub-goals for this stage: creating a hierarchy of functions. Determine the essential functions that this information system will solve, the system's
procedures, and the system's processes in the future. It is probably the most important thing when designing it. So, these three criteria will decide in the end the means and methods of building our system, drawing a contextual diagram. A data flow diagram (sometimes called DFD) is a specific notation that is used to design an information system from the side of storing, processing, and transmitting data and designing the architecture of system modules. It was decided to take performance and flexibility as the basic properties for evaluating the quality of this step because these properties will be the reason for the efficiency and success of the system. The last aspect of achieving the most important goal is "implementation of the designed system." The sub-goals of this is generally accepted steps to implement this information system: selecting programming technologies, writing program code to implement the plan, creating tests for the software product and correcting system shortcomings, and providing technical support and maintenance. The properties that will be used to evaluate quality for this stage will be efficiency, ease of use, and cost-effectiveness. According to automation, information systems are usually divided into the following types of systems: information search, information reference, information management, and intelligent information systems, and Decision Support Systems (Demchuk et al. 1, 2019; Makara et al. 1, 2020). To select the type of our information system in the future, you need to choose the hierarchy analysis method. It was decided to choose four types of information systems for alternatives: information and search (A1), information and reference (A2), calculation and logic (A3), and information and control (A4). Determining the type of Information System will be evaluated about six quality characteristics: use of quality information (K1), relevance (K2), performance (K3), flexibility (K4), cost-effectiveness (K5) and ease of use (K6).

Figure 4. Information system goal tree

The goal tree has been constructed, it is necessary to create a matrix of pairwise comparisons
of the quality characteristics of the Information System, a matrix of pairwise comparisons of alternatives, and calculate eigenvalues (EV) and vectors (VV) for subsequent analysis. A scale of the relative importance of priorities was used (Table 4-5). The characteristics comparison matrix shows the relative importance of one criterion compared to others.

Table 4 Priority importance scale table

<table>
<thead>
<tr>
<th>Quality characteristics</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equivalent elements</td>
<td>1</td>
</tr>
<tr>
<td>Non-essential priority</td>
<td>2</td>
</tr>
<tr>
<td>Weak priority</td>
<td>3</td>
</tr>
<tr>
<td>Moderate priority</td>
<td>4</td>
</tr>
<tr>
<td>Significant priority</td>
<td>5</td>
</tr>
<tr>
<td>Essential priority</td>
<td>6</td>
</tr>
<tr>
<td>Strong priority</td>
<td>7</td>
</tr>
<tr>
<td>Extreme priority</td>
<td>8</td>
</tr>
<tr>
<td>Absolute priority</td>
<td>9</td>
</tr>
</tbody>
</table>

Table 5 The characteristics comparison matrix

<table>
<thead>
<tr>
<th></th>
<th>K1</th>
<th>K2</th>
<th>K3</th>
<th>K4</th>
<th>K5</th>
<th>K6</th>
<th>EV</th>
<th>VV</th>
</tr>
</thead>
<tbody>
<tr>
<td>K1</td>
<td>2,00</td>
<td>1,50</td>
<td>1,17</td>
<td>1,20</td>
<td>1,33</td>
<td>1,25</td>
<td>1,33</td>
<td>0.10</td>
</tr>
<tr>
<td>K2</td>
<td>3,00</td>
<td>2,00</td>
<td>1,20</td>
<td>1,25</td>
<td>1,50</td>
<td>1,33</td>
<td>1,50</td>
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</tr>
<tr>
<td>K3</td>
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<td>2,00</td>
<td>3,00</td>
<td>5,00</td>
<td>4,00</td>
<td>3,99</td>
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<tr>
<td>K4</td>
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</tr>
<tr>
<td>K5</td>
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<td>1,33</td>
<td>2,00</td>
<td>1,50</td>
<td>1,79</td>
<td>0.13</td>
</tr>
<tr>
<td>K6</td>
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<td>4,03</td>
<td>1,33</td>
<td>1,50</td>
<td>3,00</td>
<td>2,00</td>
<td>2,26</td>
<td>0.16</td>
</tr>
</tbody>
</table>

Eigenvalues are calculated using the following formula, and eigenvectors can be calculated using the formula 2:

\[
EV = \sqrt[n]{\prod_{j=1}^{n} a_{ij}^{w_i}}
\]

\[
VV = \frac{w_i}{\sum_{i=1}^{n} w_i}
\]

Table 6 The matrices of paired comparisons of alternatives A1, A2, A3, A4 for each criterion and relative to the main goal:

<table>
<thead>
<tr>
<th>use of high-quality information</th>
<th>A1</th>
<th>A2</th>
<th>A3</th>
<th>A4</th>
<th>EV</th>
<th>VV</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>2,00</td>
<td>1,50</td>
<td>3,00</td>
<td>5,00</td>
<td>2,41</td>
<td>0,27</td>
</tr>
<tr>
<td>A2</td>
<td>3,00</td>
<td>2,00</td>
<td>5,00</td>
<td>6,00</td>
<td>3,51</td>
<td>0,39</td>
</tr>
<tr>
<td>A3</td>
<td>1,50</td>
<td>1,25</td>
<td>2,00</td>
<td>3,00</td>
<td>1,71</td>
<td>0,19</td>
</tr>
</tbody>
</table>
After calculating the eigenvalues, you need to create a matrix of alternative comparisons and identify the type of Information System for creating a low-voice emergency medical call system. The alternative comparison matrix is shown in Table 7.

**Table 7** Alternative comparison matrix

<table>
<thead>
<tr>
<th></th>
<th>A4</th>
<th>1.25</th>
<th>1.20</th>
<th>1.50</th>
<th>2.00</th>
<th>1.40</th>
<th>0.16</th>
</tr>
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<td>3.00</td>
<td>1.71</td>
<td>0.19</td>
</tr>
<tr>
<td></td>
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<td>2.00</td>
<td>1.50</td>
<td>5.00</td>
<td>2.41</td>
<td>0.27</td>
</tr>
<tr>
<td></td>
<td>A3</td>
<td>5.00</td>
<td>3.00</td>
<td>2.00</td>
<td>6.00</td>
<td>3.51</td>
<td>0.39</td>
</tr>
<tr>
<td></td>
<td>A4</td>
<td>1.50</td>
<td>1.25</td>
<td>1.20</td>
<td>2.00</td>
<td>1.40</td>
<td>0.16</td>
</tr>
<tr>
<td>performance</td>
<td>A1</td>
<td>2.00</td>
<td>1.50</td>
<td>1.25</td>
<td>3.00</td>
<td>1.71</td>
<td>0.19</td>
</tr>
<tr>
<td></td>
<td>A2</td>
<td>3.00</td>
<td>2.00</td>
<td>1.50</td>
<td>5.00</td>
<td>2.41</td>
<td>0.27</td>
</tr>
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<td></td>
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<td>3.00</td>
<td>2.00</td>
<td>6.00</td>
<td>3.51</td>
<td>0.39</td>
</tr>
<tr>
<td></td>
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<td>1.20</td>
<td>2.00</td>
<td>1.40</td>
<td>0.16</td>
</tr>
<tr>
<td>flexibility</td>
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<td>3.00</td>
<td>5.00</td>
<td>1.71</td>
<td>0.19</td>
</tr>
<tr>
<td></td>
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<td>2.00</td>
<td>5.00</td>
<td>6.00</td>
<td>2.41</td>
<td>0.27</td>
</tr>
<tr>
<td></td>
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<td>3.00</td>
<td>3.51</td>
<td>0.39</td>
</tr>
<tr>
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<td>1.50</td>
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<td>1.40</td>
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<tr>
<td>effectiveness</td>
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<tr>
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<tr>
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<td>2.00</td>
<td>1.40</td>
<td>0.15</td>
</tr>
<tr>
<td>easy to use</td>
<td>A1</td>
<td>2.00</td>
<td>3.00</td>
<td>5.00</td>
<td>6.00</td>
<td>3.51</td>
<td>0.39</td>
</tr>
<tr>
<td></td>
<td>A2</td>
<td>1.50</td>
<td>2.00</td>
<td>3.00</td>
<td>5.00</td>
<td>2.41</td>
<td>0.27</td>
</tr>
<tr>
<td></td>
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<td>1.71</td>
<td>0.19</td>
</tr>
<tr>
<td></td>
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<td>1.50</td>
<td>2.00</td>
<td>1.40</td>
<td>0.16</td>
</tr>
<tr>
<td>relative to</td>
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<td>1.50</td>
<td>1.25</td>
<td>1.20</td>
<td>1.40</td>
<td>0.16</td>
</tr>
<tr>
<td>the main</td>
<td>A2</td>
<td>3.00</td>
<td>2.00</td>
<td>1.50</td>
<td>5.00</td>
<td>2.41</td>
<td>0.27</td>
</tr>
<tr>
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<td>2.00</td>
<td>6.00</td>
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<td>0.39</td>
</tr>
<tr>
<td></td>
<td>A4</td>
<td>6.00</td>
<td>1.25</td>
<td>1.20</td>
<td>2.00</td>
<td>1.71</td>
<td>0.19</td>
</tr>
</tbody>
</table>
Performing the hierarchy analysis method was the ability to correctly select the type of Information System with the highest priority, 0.35, which most corresponds to the calculation and logical subtype intelligent information systems and decision support systems.

**Specification of the system's functioning**

The context diagram shows the basic system operation process. It contains external entities User and Central103 and the primary process of making a soft call for emergency medical care in a chatbot. A person logs in to the Telegram messenger, where they dialogue with the chatbot. The chatbot information system provides instructions on how to use the chatbot. In the future, if necessary, the user presses the call button. The machine begins to communicate with the person and ask the questions required to assess the situation that has developed for his interlocutor. After the user has answered all the questions about him or the person he is trying to call, the health machine analyses the status during the dialogue and responds according to the algorithm. So, suppose the call to the emergency medical team is relevant. In that case, the chatbot will collect other necessary information, after which a call will be created in their system from all the information received using the Central103 API. This call will already be processed in their control room. Suppose the current situation does not fall under the conditions for making a call. In that case, the chatbot refuses and provides advice to the user according to the algorithm to its developed situation.

![Figure 5. Context diagram](http://www.webology.org)
After the context diagram has been built, it is worth performing a detailed decomposition of the first level (Fig. 6). In our situation, the most critical process is «Make a non-voice call for emergency medical care.» This process will consist of four main subprocesses (modules):

- user registration in the system;
- collecting patient status data;
- analyse data on a person's condition and symptoms;
- the appropriate response, if you need to make a call in the Central103 system.

Process «User registration in the system» is responsible for adding new users and updating information about them in the system. When the user logs in to the chatbot, starting communication and subscribing to the chatbot, they submit the necessary data about themselves to log in, which allows us to maintain and constantly have an updated database.

Process «Collecting data on the patient's condition» responsible for collecting information about the patient's condition. The chatbot uses dialogue and precise questions to collect the necessary information from the user. And it saves it to the database for later transmission along with the call. Process «Analysis of data on a person's condition and symptoms» is necessary for assessing the current situation's criticality and classifying the request. The result of this process will be a decision by the information system whether this request is subject to the conditions for making an emergency medical call or not. If, after analyzing the responses, the system does not assess the patient's condition appropriately for making a call. The system will block the implementation of the last process but only notify the user about it and give them the advice provided by the algorithm. Process «Appropriate response, if necessary, making a call in the Central103 system» is required if the system's algorithm evaluates the user's current situation to determine that they fall under conditions that need the help of an emergency medical team. Under these conditions, the call will be processed. All helpful information that was collected in advance will be processed and processed to create a call. After that, by applying the Central103 API, the market will be issued in their information.
system and sent to their control room. The process of registering a user in the system is considered in two ways. Strictly according to the list, so that the functionality of our system can only be used by a limited circle of people who exactly need this functionality. And the second option is that anyone who has registered in a chatbot can utilize the system's functionality. The system will be designed so that you can switch between these modes.

The user will register by subscribing to the chatbot and starting a dialogue. Or, in another case, when a list is created, people will submit applications, where they will be entered into the database via the admin panel. Communication with the user takes place in the Telegram messenger. People from the Central103 organization provided the algorithm for evaluating the request and conducting a dialogue. This process is implemented, described, and monitored in Dialogflow (Fig. 7). All user responses and actions are saved as a history to transmit this information further. In addition, this information will be used for analytics in the future. The result of detailing the second level of the process, collecting data on the patient's condition, is shown in Fig. 8. The system collects this information via a chatbot through a dialogue. The dialogue implementation algorithm will be built by integrating with a special system designed for this purpose - Dialogflow.

![Image of DFD diagram](http://www.webology.org)

**Figure 7.** Detailed (level 2 decomposition) DFD for the process «Process user interaction»
Building a task hierarchy

Building a hierarchy of tasks is also a significant step in system design. It allows you to structure the system implementation process and depict exactly what essential functions and procedures should be implemented in our program. The main task is «Create an information system for non-voice emergency medical calls». The main task is destructured into four subtasks, which can be distinguished as four main elements of the program: user registration in the system, collecting data on the patient's condition, analysing data on the situation and symptoms of a person, appropriate response, if necessary, making a call in the Central103 system. These modules contain certain functions that are necessary for the effective operation of the system. The first module, «User Registration in the system», includes adding, updating, and deleting user information. The second module, «Collecting data on the patient's condition», contains a collection of information about the condition of a person who needs medical attention. The third module, «Analysis of data on a person's condition and symptoms», describes and analyses the information received in advance and decides how to respond further. The fourth module is used to implement the received data and create a call, which is the system's ultimate goal.
Figure 9. Hierarchy of tasks for the information system

An information system was designed by constructing a goal tree depicting the step-by-step achievement of the primary goal. In addition, the type of information system was selected by applying the hierarchy analysis method. The designed system is a subtype of a computational and logical system such as intelligent systems and decision support systems. A context diagram was created that reflects the relationships in the method mentioned above, and a breakdown of processes was performed. The task tree was built. It shows the basic modules and functions that should be implemented in the information system for a low-voice emergency medical call. The result of this section was the ability to start selecting software tools for solving the problem.

Software tools for solving the problem

Selection and justification of means of solving the problem

The analysis of available tools (Modrzyk, 2018; IT_everyday, 2021; Telegram, 2021; Dialogflow, 2021; Google, 2021; Baumgartner et al., 2015) has shown that it is worth implementing the projected system in the mobile device channel in the messenger. It is primarily due to trends in creating automated communications with people, the availability of information, and the procedure for end-users. When creating a chatbot, you need to perform the following preparatory operations: select a messenger, analyze development environments, select a programming language, select and integrate the necessary external services, select and create a database. To achieve your goals, you can use various tools described below. Viber messenger is a VoIP application for smartphones running on BlackBerry OS, Android, iOS, Symbian, Windows Phone, Bada platforms, and computers running Windows, OS X, or Linux operating systems. It can integrate with the address book, and authorization takes place by phone number. It can make free calls (payment is made only at the expense of internet traffic) of high quality between smartphones with Viber installed and transfer text messages, images, video, and audio messages. As one of the most well-known and popular messaging
apps globally, Viber has many of its tools to offer bot developers. It allows you to create a Viber bot using the official app libraries, integrate a bot built on other platforms, or use the platform's REST API. Rakuten, based in Tokyo, owns Viber, and its product is one of the most widely used and popular instant messengers globally. Viber has about 260 million monthly active users worldwide, so many major brands use the platform to attract new and existing customers. And they use chats for this purpose. In addition, this messenger is the most popular in Ukraine, so the chatbot that will be created on this platform will reach the largest audience. Since this channel is already fully used by the business and can meet all its needs, its set of tools will be sufficient. This makes Viber unique and allows it to offer a lot to chatbot creators. Creating a Viber bot will make sense, even when other messengers may have more users and more probability of entering the global market.

You can find out by reviewing these and other questions and exploring the world of Viber chatbots. For example, although WhatsApp is now the dominant messaging platform globally, developing a bot takes longer and will be more expensive due to the application process. If your system is looking for a popular messaging platform in many of the same markets as WhatsApp but doesn't require the same waiting period for approval and expensive development and support, consider creating a Viber bot. Viber is particularly popular in Eastern Europe and Central Asia. Because of this, it makes sense to develop a bot in Viber. An essential reason for creating a bot for Viber is security - one of the most significant and most critical points in Viber for users. All chats are fully encrypted, so Viber can't see what users are talking about. For bot development, this culture of trust gives users confidence that their conversations with the bot remain private. The incentives for creating a Viber bot are its extensive developer tools for a developer. There are also APIs for Python and REST that can speed up development. Despite all Viber's advantages, it also has disadvantages because this messenger will not be the best candidate for development. For example, the Viber REST API offers a tool for getting the user's location, which does not provide fast and accurate transmission of the necessary data. Facebook Messenger is an instant messaging information system created by Facebook. It is integrated with the leading Facebook site and is implemented based on the open MQTT protocol. As of April 2017, the messenger's monthly audience was 1 billion persons. Facebook Messenger is a free mobile messaging app used for instant messaging, photo sharing, video sharing, audio recording, and group chats. With the unprecedented increase in the number of people using messaging apps today and the development of artificial intelligence, machine learning, and natural language processing (NLP) technologies, the growth of chatbots seems inevitable. Studies have shown that the number of people who use chat apps exceeds those who use social media apps.

Facebook's F8 developer conference showed support for bots on the Messenger platform. And since then, developers from all over the world have been working on using the next-generation technology. Today, more than 100,000 bots are available for use in Messenger. The number of messages sent between businesses and customers has reached 2 billion per month. The above data provides an idea of what the future will look like in the absence of hundreds of apps, and chatbots will be everywhere. Unfortunately, Facebook made it impossible to get the user's location in the bot, making it impossible to use it for the
information system for a low-voice emergency medical call.

Telegram messenger, a software for smartphones, tablets, and PCs that allows you to exchange text messages, image and video files, and make free calls to other program users. Third-party developers can create "bots", special accounts managed by applications using a particular API. JavaScript's dynamic capabilities include building runtime objects, lists of property variables, function variables, creating a dynamic script, introspecting a thing, and restoring source code. Node.js is a packaged compilation of Google's V8 JavaScript engine, a Platform Abstraction Layer, and a core library that itself is mainly written in JavaScript. Node.js provides developers with a tool to work in a non-blocking, event-driven I / O paradigm. Node.js works in real-time web applications using push technology over web sockets. It can be argued that this has been used for years in the form of Flash and Java applications, but in reality, it was just sand environments that used the Internet as a transport protocol that was delivered to the client. In addition, they worked in isolation and often worked on non-standard ports, which may have required additional permissions, etc. Having all its advantages, Node.js now plays a crucial role in the technology suite of many well-known companies that depend on its unique benefits. Foundation Node.js brought together the best of everything, thinking about why businesses should consider Node.js in a summary that can be found on the page Foundation's case studies Node.js. An Event Loop allows Node.js to perform non-blocking I / O operations, even though JavaScript is single-threaded, by offloading operations to the system kernel whenever possible. Since most modern cores are multi-core, they can handle multiple operations in the background. When one of these operations is completed, the kernel notifies Node.js that the callback function corresponding to this operation can be added to the polling queue to be executed eventually.

Python is a high-level programming language that remains universal and modern today. Its advantages include the high performance of software solutions and structured, well-understood code. The syntax of Python is as simple as possible, which allows you to learn it in a short time. The core of the language has a very convenient structure, and a comprehensive list of built-in libraries will enable you to use a significant set of useful functions and features. The programming language can be used for developing application programs and developing WEB services. Python can support various application development styles, including being very convenient for working with OOP and functional programming. One of the most popular language interpreters is CPython, created in Ci. This development environment is distributed free of charge under a free license. The interpreter supports more popular platforms. Python continues to evolve intensively. Approximately every two years, updates for this language are released.

A significant difference between this programming language is that it does not have coding standards, such as ANSI, ISO, etc. It works using a code interpreter. The programming language has a well-structured semantic core and a relatively simple syntax. Everything written in this language will always be easy to read. If you need to pass arguments, the language uses the call-by-sharing function. The set of operators in the language is relatively standard. A convenient and essential feature of the syntax is formatting the code text using splitting them into blocks using indents created using the "Space" and "Tab" keys. There are

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no curly brackets or operator brackets in the syntax that indicate the beginning and end of blocks. This solution significantly reduces the program body's number and teaches the programmer to good style and accuracy when writing code. In 2018, some key terms were changed in Python, but this made it easier to understand. Therefore, developers do not have any problems studying the documentation. Do not forget that Python is a high-level language that can create application programs and WEB development. The platform's performance is very high, and the code is readable and straightforward. Sometimes Python is compared to such popular languages as Ruby, but unlike IT, Python requires less RAM and runs faster with the processor. Django is a general, well-known, and full-featured server-side web framework written in Python.

MySQL is a freely available open-source relational database administration system (RDBMS) that uses a structured query language (SQL). SQL is the most widely used language for adding, accessing and managing a database. It is most marked by fast processing, proven reliability, simplicity, and flexibility of use. MySQL is an integral part of almost every open-source PHP application. Good examples for PHP and MySQL-based scripts are WordPress, Joomla, Magento, and Drupal. One of the essential things about MySQL is having a dedicated MySQL host. PostgreSQL is a freely distributed object-relational database management system, the most well-known and developed of the available DBMS globally, and is a natural alternative to commercial databases.

PostgreSQL is not just relational but combines both relational and orientation, making it an object-relational DBMS. It allows it to have some advantages over other open-source SQL databases, such as MySQL, MariaDB, and Firebird. The main property of an object-relational database is the ability to provide workers with objects and their behavior. It contains data types, functions, operations, domains, and indexes. It allows PostgreSQL to be highly reliable and flexible. In addition, this database provides support for creating, storing, and publishing complex data structures. In some instances, you can see that there are nested and composite constructs that cannot support standard DBMS. There is an impressive list of data types that are kept in PostgreSQL. In addition to numeric, floating-point, text, Boolean, and other expected data types (as well as many variations of them), PostgreSQL can also support UUIDs, money, enumerated, geometric, binary types, network addresses, bit strings, text search, XML, JSON, arrays, Composite types, and ranges, as well as certain internal types for identifying objects and placing beams. MySQL, MariaDB, and Firebird also support some of these data types, but only PostgreSQL supports them all. If initially PostgreSQL was used mainly in academic projects for studying database algorithms, in universities, as an excellent base for learning, now PostgreSQL is used almost everywhere.

For example, the .org and .info zones are fully served by PostgreSQL, and many terabyte astronomical data warehouses, Lycos, and BASF are known. PostgreSQL has many features. It was created using an object-relational model. It offers support for complex structures and a wide range of embedded and user-defined data Types. It supports extended data capacity and is trustworthy in its attitude to data integrity. PostgreSQL and most other DBMS use SQL as a query language. SQL is well portable and easy to learn. However, each SQL statement was executed separately on the database server. It means that the client application must send each
request to the server, wait until it is processed, get the result, perform specific calculations, and then make new requests. All this requires interaction between processes and carries a large network load if the database client and server are located on different computers. PostgreSQL allows you to Group a block of calculations and a sequence of queries inside the database server. The developer gets the power of procedural language and ease of SQL development while saving a lot of overhead for client-server interaction. Additional requests between the client and server are excluded. Intermediate unnecessary results are not transmitted between the server and client. You can avoid multiple analyses of a single request. As a result, all this leads to a significant increase in performance compared to an application that does not use stored functions.

Dialogflow is a Google service that runs on the Google Cloud Platform and allows you to scale hundreds of millions of users optimized for Google Assistant. Dialogflow (previously Api.ai) is a product for communications, among which there are tools for creating bots for various platforms. For example, for Google Assistant, Amazon Alexa, Facebook Messenger, etc. The final product can be made without programming skills. A step-by-step form is available to select bot functions, context binding, and behavior logic processing. Creating a bot takes place in three stages. The user projects the main points, connect the bot to the web service and launches the bot. The service runs on Google machine learning and uses Google Cloud Speech-to-Text to recognize and understand speech. The platform SDK allows developers to integrate chatbots into devices, phones, cars, etc. The project supports more than 20 languages. Dialogflow is a comprehensive development suite for fully deploying and developing conversational interfaces for websites, mobile apps, popular messaging platforms, and devices. A developer can create interfaces that provide a natural and rich interaction between your users and your business. Dialogflow Enterprise Edition users access Google Cloud support and service level agreement (SLA) for production deployments. Editors like Sublime and TextMate offer convenience but only limited extensibility. Emacs and Vim, on the other hand, provide extreme flexibility, but they are not very accessible and can only be configured using custom scripting languages. Atom is trying to do better. This goal combines ZERO Compromise of hacking and usability: an editor that will welcome an elementary school student on the first day of code learning and a tool that they won't outgrow, turning into experienced hackers.

### Technical characteristics of the selected development software tools

Telegram offers two API options for developers. The Bot API makes it easy to create apps that use Telegram messages for the interface. The Telegram API and TDLib allow you to create your customized Telegram clients. Developers can use both API for free.

The Telegram API provides all the necessary tools for developing a chatbot. Telegram has created a convenient and intuitive API, which can be easily viewed thanks to the documentation from the official website. So, for example, it has a set webhook method for listening to the program that will manage the chatbot. A basic sendMessage and many other techniques provide unique opportunities for the chatbot to interact with its users. Developers
can also add Telegram Widgets to their site. Designers can create animated stickers or custom themes for Telegram.

This API allows you to connect bots to the Telegram system. Telegram Bots are special accounts that don't require an additional phone number to set up. These accounts serve as an interface for code executed somewhere on the server. To use this, the developer does not need to know how the Telegram MTProto encryption protocol works - their intermediate server will handle all encryption and communication with the Telegram API. The program communicates with this server via a simple HTTPS interface that offers a simplified version of the Telegram API. The Telegram API can be defined by spambots and search robots - service spambots. They can be personally created by anyone who wants to. The Telegram bot has many unique abilities that are performed by various default commands. Users can start a conversation at any time from the chat inputs field. To do this, type a bot and query mode for the required search. After receiving the request, the Robot returns any results. As soon as a person clicks on the bot, they immediately get into the chat.

The Telegram Bot API is a functioning interface that allows you to create your robot's program. It includes various command codes and Telegram API documentation intended to install robot functions. If you use the program interface, any user will create individual programs with codes that will function as bots when launched in the id telegram api.

In the system, all control elements are called methods that are set according to their specified conditions. It can allow you to easily share data across the entire service and at no extra cost. A vast number of controls are designed to build the chatbot's operation. Keywords extend the chatbot's extensive capabilities. You can exchange texts between other clients in the form of corresponding requests. Here are some examples: sendMessage - for receiving a message, send video - for sending videos, send audio - for sending audio recordings. All controls are divided into groups to receive updates and informational announcements, chat, send various messages, function with stickers, update text messages, payment functionality, games, and entertainment portals.

You can organize team texts in the appropriate system. To search for a chatbot, you need to use the search engine in the middle of Telegram. To create chatbots, there is a @Botfather service system. If you go there, you can see an extensive command set, thanks to which you can create a new chatbot. To build a new chatbot in Telegram, call a command called-new bot. Next, enter the name for the chatbot, which must necessarily end with "bot." After that, an identification token is sent, and a new account is created. You can only authorize it using a token. Next, the program mode starts in the portal. The client finds its chatbot and clicks on the start button, launching a specific command line. Next, the corresponding command lines will be reserved under the name settings and / help.

Python has significant advantages in WEB development. Among its main benefits, it is worth mentioning these: a clean syntax, which is achieved by using indentation to select blocks, what is allowed by the program and which is a mandatory property of most interpreted languages, the standard distribution provides access and the ability to use a large number of
functional modules, even, including a module for developing a graphical interface, the ability to use Python in dialogue mode does not cease to be very useful and significant for experimenting and solving trivial problems, the standardness of the distribution provides a simple, but with a developed and robust development environment called IDLE, it was created in Python, convenient for solving mathematical problems, also has tools for working with complex numbers, can operate with integers of any size, in dialogue, the model can be used as a powerful calculator, open source provides the ability to modify it by other developers.

Python has efficient high-level data structures and a simple yet productive approach to Object-Oriented Programming. Python's elegant syntax, dynamic type processing, and the fact that it is an interpreted language make it suitable for developing scripts and quickly creating applications in many industries on the most well-known platforms. The Python interpreter can be extended with functions and data types developed based on C or C++ or in another language that can be run from C. Python is also convenient as an extension language for further configuration applications. Django is a free and free web application framework developed in Python. A framework is a set of components that help you create websites quickly and easily. Each time you build web applications, you need similar details that must be generated repeatedly: user authentication, login, logout, registration, site Administration panel, forms, tools for uploading files, etc. It is worth paying attention to the fact that there is a solution to eliminate the same type of problems in web development. Therefore, the developers decided to team up and create the Django framework and others that offer developers ready-made templates.

Frameworks exist to make the development process faster and easier and allow developers not to reinvent the wheel every time they create a new application.

The port on which the webserver is running is checked for requests. When a request arrives, the server reads it and sends a response. However, to send something, you need to generate a response. Django just helps you quickly and easily create the necessary content that will be sent in the response.

When requests are received on the server, they are forwarded to Django, which processes them. First, it takes out the Web page's address and tries to understand what needs to be done. This part of the process in Django is performed by URL resolver (the website address is URL-Uniform Resource Locator - a single resource pointer, so the name URL resolver, resolver == recognizer, makes some sense). It just takes a list of templates and maps them to the URL. Django compares templates from top to bottom and, if something matches, redirects the request to the desired function called view. Django is an adult framework that, by default, makes many decisions independently without intervention, so the developer has at his disposal a ready-made tool for implementing typical web applications. Django is starting to differentiate itself by providing a wide range of additional base classes that allow you to modify the base implementations of several simple patterns that a developer can find in web applications when it comes to class views.
Django has its template engine with similar syntax and features set to Jinja2. In general, if you have had experience before and prefer to use Jinja2, switching to Django will not be difficult.

Django provides convenient solutions for tracking static files and understanding how to link to them using code and templates to support different development environments is not a difficult task.

To solve the problem, the framework provides utilities for sending to static files (such as CSS, js, jpg, png, etc.), thanks to which, according to the settings, URLs that refer to static files will be correctly generated. In addition, Django offers an administration command to collect static files from a particular application, saving files in the places that specify the settings. It can simplify your work when deploying an application in production. Thanks to its declarative syntax, Django provides an easy way to define a form object, allowing you to display and process data in a single form. Forms are implemented using built-in templates that can be redefined for a custom appearance. Django forms provide handling of data validation and security mechanisms, such as CSRF protection, without storing this aspect in memory.

Django has several form classes (ModelForm) that integrate with Django ORM Models to simplify the definition of forms from data models. Django contains an ORM. Some people like Django ORM for its simplicity, some don't, for its shortcomings, and for managing the database instead of the user. However, it allows you to get started very quickly, not to mention the features that its simplicity guarantees. ORM has a tool for the automatic generation and administration of database migrations. Using the provided management commands, you can make significant progress by changing the definition of the Django Model, and most database migrations are managed: there are several situations in which automatically generated migrations can help significantly. Django ORM can be called a self-confident tool that has certain limitations. Still, it can be customized, extensible, and ultimately get pure SQL if you need to get around these limitations. It is difficult to overestimate the convenience and speed of developing a web application using Django.

Dialogflow-chatbot constructor. Supported platforms: Google Assistant, Facebook Messenger, Slack, Telegram, Skype, Viber, and other media. It runs on Google machine learning and uses Google Cloud Speech-to-Text to recognize and understand speech. The platform's SDK allows developers to integrate chatbots into devices, phones, cars, etc. With its easy-to-create and easy-to-configure Intents, bot platforms make it easy to recognize similar words for entities. There is compatibility with Firebase compatibility with webhooks, which allows you to make the product more extensive and more efficient. Easy deployment on platforms for Microsoft bot framework, web, Facebook, etc. Google offers an easy-to-use and accessible user interface. Anyone who doesn't work in it will develop their regular chatbot after any tutorials. In addition, it offers many one-click integrations for major messaging platforms, allowing the user to deploy their chats across multiple platforms in minutes quickly. Excellent integration with other Google software, such as Google Assistant, has an easy-to-use API and offers a variety of programming language options, such as Python and NodeJs. The interface is intuitive and easy to learn. It doesn't take long to set up NLP and integrate it into another project. Visual Studio Code is a lightweight yet influential source code editor that runs on the desktop and is implemented for Windows, macOS, and Linux. It has built-in support for
JavaScript, TypeScript, and Node.js and is equipped with a rich ecosystem of extensions for other languages (such as C++, C#, Java, Python, PHP, Go) and runtimes (such as .NET and Unity).

Visual Studio Code is a source code editor used with various programming languages. This list includes Java, JavaScript, Go, Node.js, and C++. It is developed based on Electron, which creates Node web applications.js that work in the Blink layout engine. Although it uses the Electron framework, the software does not use Atom. Instead, it uses the same editor element (codenamed "Monaco") found in Azure DevOps (formerly called Visual Studio Online and Visual Studio Team Services). Instead of a project system, it allows users to open one or more directories, which can then be saved to workspaces for later reuse. It will enable it to work as a language-independent code editor for any language, unlike Microsoft Visual Studio, which uses a proprietary solution file .sln and project files customized for the project. It provides support for several programming languages and a selection of different functions for each language. You can hide unnecessary files and folders from the project tree using Settings. Visual Studio's Code features don't open through the menu or user interface, but they can be used through the command palette. Visual Studio Code can be extended using applications available through the central repository. It includes editor add-ons and language support. A notable feature is creating extensions that add support for new languages, themes, and settings, perform static code analysis and add code bindings using the Language Server Protocol. Visual Studio Code includes several extensions for FTP, which allows you to use the software as a free alternative for web development. The code can be synced between the editor and the server without downloading additional software. Visual Studio Code prompts users to set a code page that stores the active document, the new line symbol, and the programming language of the active form. It allows you to use it on any platform, in any area, and for any programming language. A set of technical tools for developing chatbots was analyzed. After analyzing this set, we selected the necessary technologies for implementing the designed system, namely: Telegram Messenger as a client for hosting the chatbot, the Python programming language and its Django framework for developing the system backend, integration with Google Dialogflow service, for convenient and easy training of the chatbot, the integrated Visual Studio development environment, as well as the PostgreSQL database.

**Experiments, results, and discussion**

The software product "NG Chatbot" is designed for making a soft call to emergency medical care using a chatbot in Telegram. It is written using the Telegram API using Python Django and a PostgreSQL database. The chatbot was also integrated with the Google Dialogflow service. This service has a simple interface and helps you build a dialogue with a chatbot without professional programming skills. A Dialogflow interaction handler was implemented in the program code. As a result, convenient bot management and training tool was obtained, which can be used by a person without special technical skills. Usually, in Dialogflow, it is based on text messages when creating a chatbot path. This project decided to place JSON objects in the string format instead of plain text, which are then converted into an object in the program code that the program code knows how to process and based on what to generate a response to the user. This particular method of project implementation aimed to conveniently
further manage and improve the chatbot without interfering with the program code and without professional programming skills. For example, people from the medical field better understand how a chatbot should work but do not have the skills needed to develop chatbots and other web software products. They received a convenient tool for managing and configuring the chatbot in the Dialogflow system with this implementation.

First, a telegram chatbot was created using the @BotFather bot. After creating a chatbot, you get a token that you can work with using the Telegram API. To begin with, using Python Django, the project is initialized in a deployable virtual environment. It was necessary to add the following main external packages: Django, python-telegram-bot, Dialogflow. The latter is a library for easy use of Dialogflow in a project [5]. To start using this service, you first had to go to this service to create an agent and build a chatbot path using the above messages in JSON format based on the user survey algorithm proposed by Central103. To use this service, then you had to go to Google Cloud to create a project for Dialogflow, create a service account inside this project, grant it the necessary permissions, download the key to work with this account, and use it in integration when using the Dialogflow library that needs it. It is worth noting that creating a project in Google Cloud requires the developer to provide its payment data in the form of a bank card for further payments if the developer exceeds the free limit or decides to change the tariff for using the services. After all the necessary actions we have been performed to integrate with Dialogflow. The design of the database and its creation began. It was decided to identify three main entities necessary for the correct operation of the system.

- profiles for storing all the necessary information about the user:
  - id - unique key for the user;
  - messenger_id - unique user key in the Telegram system;
  - name - user name in the Telegram system;
  - external_id - unique user key in the Central103 system;
  - phone - phone number for which the Telegram account is registered;
  - previous_state - the user's previous state is required to manage the bot;
  - state - the user's current state is required to handle the bot.

- messages to store all notes and user interactions:
  - id - unique key inside the system;
  - text - the text of the sent message, or the payload of user responses;
  - profile_id - user id, to identify the user's affiliation.

- emergency_calls for storing all initialized calls and information provided by the user about it:
  - id - unique identifier inside the system;
  - profile_id - user id, to identify the user's affiliation;
  - info - a field in JSON format to save all the necessary information provided by the user;
  - status - to protect the level of the call.

Using a ready-made tool that provides Django, models for the database were described, based
on which the necessary migrations were created. To run the database in the development environment, the following parameters were selected: elephantsql.com as a free host. Later, the project and its database can be moved to the central103 servers. If the user's case meets the call requirements, the call will start. It is implemented using the API offered by Central103. Sending a call to the Central103 test environment was executed by requesting their API using the instructions posted on their website. It would be best to get the developer's account and API keys in their system to do this. The chatbot uses a PostgreSQL database that contains general information about the user and information about the user's calls. It consists of three tables: profiles, emergency_calls, and messages. The profiles table contains general information about chatbot users, emergency_calls includes information on emergency calls that the user initializes, notes that the user sends for their further processing sending to the Central103 API. The names of Table Fields and their types are shown in Fig. 10. The functional purpose of this software product is to provide the user with the opportunity to call emergency medical care using a chatbot in the messenger, which is necessary for people with hearing and speech disorders. A unique feature of the system is the ability of a person to make a call without voice contact, which is required by a significant segment of society. Functional restrictions of the chatbot occur if the user does not grant access to contacts and location. The main parts of the created system are:

- The system core is the leading software module that coordinates the work of other system parts and is directly used in communication with the user to generate responses.
- A database containing information about users, their calls, and their messages;
- Module for analyzing the health status of a person who has applied for help;
- Module for making a call from the collected data about the user

![PostgreSQL database schema](image)

**Figure 10. PostgreSQL database schema**

The call registration module is linked to the database because after analyzing the user's current situation, this module will collect all the necessary data for call registration. The user's health and symptom analysis module, the database, and the user interaction processing module interact to communicate with the user and collect the necessary information. This
software product has the following minimum requirements for the technical means used:

- installed Telegram messenger, version no earlier than 2016;
- Internet connection;
- smartphone with GPS tracker.

![Diagram of system modules]

**Figure 11. Scheme of the interaction of system modules**

For the chatbot to work correctly, you need to connect it to the PostgreSQL database. Next, you need to purchase hosting space and put a web server there. All the necessary modules for the Django web server must be installed for the hosting service to work correctly. To start working with a chatbot, find it in the Telegram messenger. Product information is provided as input to the system:

- phone number (CHAR);
- width (DECIMAL);
- length (DECIMAL);
- message: text format (CHAR).

This software product is designed for making a soft call to emergency medical care. It should only be used for individual purposes and, if necessary, by people who need this differentiated calling method. The NG Chatbot software product is written using Python Django and a PostgreSQL database. It is designed for smartphones in the middle of the Telegram app. Older versions of Telegram or smartphones with a missing GPS tracker will have problems that will make the chatbot functionality unavailable. The software product is designed to solve one main class, creating a non-voice call to emergency medical care. The user can get instructions on using the chatbot, and most importantly, the ability to make a call if something prevents them from doing so via a call. Information about a person’s condition and symptoms is collected by communicating with them in Messenger via a chatbot. All responses are analyzed in Dialogflow, where the algorithm provided by Central103 is implemented using Intents.
This product is designed for emergencies that threaten the chatbot user or others. It doesn’t require any updates or downloads. This software product is always available inside the Telegram messenger. Technical limitations of the program include dependence on the internet. In other words, the call can only be made if the user is connected to the internet. For the system to work correctly, you need a new Telegram version, and smartphones need a GPS tracker. To confirm the operability of the information system, the results of the implementation of the created software product were presented. An initial window appears in front of the user, offering to register. Under the Register button, there is a button to share the phone number, which will be the base contact that will be used to communicate with the person if they do not offer another connection (Fig. 13). After registration, the user is taken to the main menu, with instructions for use and a call button. When you click on the "call" button, the call initialization will begin. In addition, the call button contains a request for the user’s location, which will help Central103 determine the most optimal team to go to the call. After pressing the call button, the process of collecting information about the condition and symptom of the person who needs help will begin, as well as analyzing and evaluating the current situation (Fig. 14). If it turns out that the current situation is not subject to the call requirements, then it will not take place. If the case is subject to conditions, the user will receive additional location information and generate a call using the CENTRAL103 API (Fig. 15).

As a result of the analysis of the control example, it was determined that the software product is working and corresponds to the task, allowing the user to make a soft call for emergency medical care. A description of the created software product was made by the standard GOST 19.402-78 "program description," according to which, as a result, general information about the software product, its functional purpose, logical structure, technical means used, calling and loading, input and output data as described. The user manual was written by the IEEE STD 1063-2001 “Standard for Software User Documentation,” which described the classes of tasks to be solved, the main characteristics and features of the program, and information about its functional limitations.
This work aims to develop a chatbot on the Telegram client for making a non-voice call to emergency medical care. The main functionality of the developed system is to provide users
with hearing or speech disorders with the ability to make an emergency medical call without voice contact. Secondary functions include providing the chatbot with advice on the user's current situation. The economic feasibility of developing a software product lies in need for differentiated services for a specific country segment. More than one million residents of the country have hearing or speech disorders and cannot call emergency medical care using a mobile call. In addition, this option is the most appropriate since it is one of the most popular, most effective, and most accessible in terms of availability. Chatbots are one of the most straightforward software products and are the most understandable for the user. In addition, this option is the cheapest and fastest in terms of development, and unlike its analogs, it is free for users. All this suggests that a well-developed product will significantly contribute to society.

The introduction of information technologies in medicine deserves the direct attention of industry leaders, interested departments, and society. One of the priority areas for developing the healthcare system is creating a single medical information space that ensures the adoption of effective management decisions at all levels. It will enable medical institutions to establish practical accounting of the organization's activities, carry out Management at the current status, receive timely information about calls, and use all medical information about the patient accumulated at all levels of medical care to achieve high-quality service. At this stage of society's development and with the capabilities of modern technologies, medicine can serve patients as narrowly focused as ever before. The non-voice calling of emergency medical care is only one way to differentiate a specific segment of society. In the future, systems should continue to evolve and improve so that the level of service is the same for everyone, regardless of the patient's health status, location, or affluence.

Conclusions

Because today a person's life is more valuable than ever before. More than one million people have hearing or speech disorders in our country and need a non-voice call for emergency medical care. The digital technologies that we now have are becoming more and more popular in the healthcare sector and represent specific unique tools that can accelerate and create new innovative processes in medicine. With these latest solutions, being in an environment where getting timely medical advice or help is impossible or difficult, a person can get around all these difficulties with the help of digital technologies. Thus, a person who does not have the necessary conditions to get the required information or service about their life and health can use tools to give them a convenient solution to answer their questions. The analysis of literature and internet sources was carried out, the main approaches to solving the problem were investigated, and a number of their advantages and disadvantages were identified. An information system was designed by constructing a goal tree depicting the systematic achievement of the primary goal. In addition, the type of Information System was selected by applying the hierarchy analysis method. A set of technical tools for developing chatbots was analyzed. After analyzing this set, the necessary technologies were chosen to implement the designed system. After analyzing the control example, it was determined that the software product is working and corresponds to the task at hand, allowing the user to make a soft call for emergency medical care. In the economic part of the diploma project, the practicality of
developing a new software product is justified, and all its economic characteristics are calculated.

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