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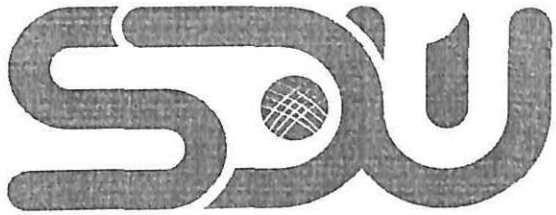

Bakdaulet Kynabay

Development of Artificial Intelligence algorithm for deaf-and-dumb students to enhance education equity in Kazakhstan.

THESIS

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Supervisor: **Azamat Zhamanov**

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Abstract

This research work proposes the solution of academic inequity problems of students with specific disabilities like deafness. The main task is to construct a system that will ease the communication between deaf and dumb students and the environment by integrating an algorithm that transforms hand gestures into text, speech into text and etc. Proposed system converts multilingual speech into text. The novelty and originality of the work is that this system works for Kazakh language, realized on Telegram bot and it is free of charge. Conversion is realized by extracting information from speech signals. The system is developed in Python language by using AI techniques and Machine Learning (ML) algorithms. The main focus of the work is to implement it in educational sphere, specifically in lectures of universities and colleges what plays a significant role in achieving inclusion and education equity in the country.

Аңдатпа

Бұл зерттеу жұмысы саңырау сияқты ерекше мүгедектігі бар студенттердің академиялық теңсіздік мәселелерін шешуді ұсынады. Негізгі міндет - қол қимылдарын мәтінге, сөйлеуді мәтінге және т.б. айналдыратын алгоритмді енгізу арқылы саңырау және мылқау оқушылар мен қоршаған орта арасындағы байланысты жеңілдететін жүйені құру. Ұсынылған жүйе әр-түрлі тілдегі сөйлеуді мәтінге айналдырады. Жұмыстың жаңалығы мен ерекшелігі - бұл жүйе қазақ тілінде жұмыс істейді, Telegram ботында жүзеге асырылады және ол ақысыз. Түрлендіру сөйлеу сигналдарынан ақпарат алу арқылы жүзеге асырылады. Жүйе жасанды интелект әдістері мен машиналық оқыту алгоритмдерін қолдану арқылы Python тілінде жасалған. Жұмыстың негізгі бағыты оны білім беру саласында, атап айтқанда университеттер мен колледждердің дәрістерінде енгізу, бұл елдегі білім мен білімнің алудың теңдігіне қол жеткізуде маңызды рөл атқарады.

Аннотация

Эта исследовательская работа предлагает решение проблем академического неравенства студентов с особыми нарушениями, такими как глухота. Основная задача состоит в том, чтобы создать систему, которая облегчит общение между глухонемыми студентами и окружающей средой путем интеграции алгоритма, который преобразует жесты рук в текст, речь в текст и т.д. Предлагаемая система преобразует речи на нескольких из языках в текст. Новизна и оригинальность работы заключается в том, что эта система работает на казахском языке, реализована на боте Telegram и является бесплатной. Преобразование осуществляется путем извлечения информации из речевых сигналов. Система разработана на языке Python с использованием методов искусственного интеллекта и алгоритмов машинного обучения. Основное внимание в работе уделяется ее внедрению в образовательную сферу, в частности, в лекциях университетов и колледжей, что играет важную роль в достижении инклюзии и равенство в образовании в стране.

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Contents

1. Introduction

1.1 Motivation

Communication between people is an integral part of our life. It's even difficult to imagine what would happen to a social society if people could not be able to convey their thoughts, show emotions, express what they want. The problem with a lack of communication is often found in people with disabilities namely in the deaf-and-dumb, and which lead to loneliness and isolation from the social society [1]. According to the World Health Organization - WHO, about 466 million people in the world suffer from hearing loss where 34 million of them are kids. It is also estimated that till 2050 around 900 million people will suffer from this disease [2]. Most people who have difficulty hearing, use the language of gesture for the concept of thoughts or actions of the interlocutor and to convey their opinions. However, at the moment in connection with globalization, the latest technologies are gradually switching to automation and control of objects with the help of vocal cords. According to the fact that people with disabilities find it difficult to use advanced technologies, scientists are introducing the recognition of hand gestures and transforming the speech into hand gestures or texts. he new methodology that can be implemented in the process of giving and gaining an education for disabled students. It can be realized by the help of artificial intelligence algorithms that include image processing techniques, natural language processing[3] implementations and etc. For instance, this research work introduces an abrupt, easily understandable and uncomplicated implementation of text summarization. The technique is constructed for the Kazakh language. The primary focus is to implement it for deaf-and-dumb students to use it on lectures at universities, schools and etc. Efficient and quick performance is necessary for the first step of converting natural language speech into gestures after summarizing it. It lets to

extract only the main information from the whole speech and ease the process of text to gesture converting. One of the fields of NLP that deals with the recovery of summaries from large texts is text summarization. It is time-efficient, makes the process of selection easier, refines efficiency of indexing, compared to human summarization they will be biased less, can be useful by providing personalized data for question answering systems etc[4]. This work proposes an NLP based technique that can be implemented by using Natural Language ToolKit (NLTK) library on Python programming language.

Automatic text summarization is the technique that compresses a large text by leaving only the most important information in the context [3][4]. Despite the fact that these kinds of systems have been developed for more than the last five decades there is still necessity for secure and implementable text summarization techniques, as in most cases they are constructed for only the most famous languages of the globe.

Novelty is that the technique is applied for Kazakh language and extractive type of summarization uses new, keywords focused, approach. Contribution of the work is manually created stop words used for text summarization specifically for Kazakh language and data-set. State-of-the-art results of the work show that it is possible to implement automatic text summarization for Kazakh language. The primary focus is to implement it for deaf-and-dumb students to use it on lectures at universities, schools and etc. Efficient and quick performance is necessary in the first step of converting natural language speech into gestures after summarizing it. It lets to extract only the main information from the whole speech and ease the process of text to gesture converting. [5] One of the most important and natural form of communication is speech. It's even difficult to imagine what would happen to a society if people could not be able to convey their thoughts, show emotions, express what they want. The problem with a lack of communication is often found in people with disabilities namely in the deaf-and-dumb, and which lead to loneliness and isolation from the social society. In Kazakhstan, lectures are held in the traditional format. In this regard, situations arise periodically when students cannot hear the teacher or when it is hard to reach lecture video recording. It is very logical that real-time speech to text conversion can help to overcome these problems. Furthermore, according to WHO, worldwide, more than 5% of people suffer from hearing loss. In Kazakhstan, there are about 150 thousand people

[4]. If to implement such a system in education this kind of people will be able to participate in any lectures they want as normal people. Therefore there is a need for such a system in the field of education. In this regard, situations can arise periodically when students with limited abilities have significant academic problems according to the fact that it is not always possible for them to have special helps and opportunities. [6] Parhat Yusupzhanov, president of the Youth Organization of People with Disabilities "Zhiger" states that in Kazakhstan, when it comes to getting higher education, people with disabilities are not taken seriously. He states that: "Students need to ensure equitable access to the learning process, and not to cultivate dependency in them". In many universities, there are no centers for students with special needs. Some universities want to help, but there is no support from academic side, support is provided in the form of material means, once a semester they can be given money, food stamps. All this leads to the fact that a person, having graduated from a university, is not competitive, compared to other students. He can not compete in the labor market and, accordingly, can not get a job. He cannot get a job because the universities do not have adequate conditions for obtaining high-quality knowledge, taking into account his disability. In Kazakhstan, there are about 150 thousand people suffering from this disease [6]. If to implement a system which will solve this problem in education this kind of people will be able to enter any universities they want and participate in any lectures they want. [7] Knowing in practice what it is like to study physically limited in opportunities at a Kazakhstani university, he, together with friends and colleagues, helps to ensure that higher education is accessible to people with special needs. For the second year, a center for supporting students with disabilities has been working on the basis of the Kazakh National Pedagogical University. This is the author's project of Parhat, which he launched with the participation of the Soros Kazakhstan Foundation. The creation of the support center was preceded by research conducted by Parhat. He studied the mechanism for the implementation of the right to higher education for people with disabilities in the Republic of Kazakhstan. The results are sad: higher education in Kazakhstan is not accessible to many people with disabilities. The situation can be corrected, and with minimal cost. About how to do this, Parhat told Forbes.kz. He states that it is obvious to everyone that people with disabilities are discriminated against in the form of a lack of infrastructure, but few people think about

the employment, access to information, education and knowledge of these people. In order to ensure the realization of the rights of people with disabilities in various spheres of human activity, in 2006 the UN adopted the Convention on the Rights of Persons with Disabilities. The Republic of Kazakhstan undertook to fulfill all the requirements of the international treaty by ratifying it in 2015. Thus, article 24 (education) guarantees that the state will provide inclusive education at all levels. [8] Inclusive education is not only about co-education for people with and without disabilities. This means that an individual approach to a child with a disability, a student and an adult should be ensured in the process of receiving him or her education in educational institutions. Such an approach is to provide reasonable devices for training people with disabilities in the inclusive education system, which allows people with disabilities to receive full and equal education in one institution, classroom, environment with people without disabilities.

It is very important. There is often a debate about the positive and negative aspects of inclusive education. It is an important component of both the right to education for people with disabilities and their right to non-discrimination in education. The fact is that the provision of education for people with disabilities in closed educational institutions, where only people with disabilities of a certain category study, by itself leads to segregation in the field of education and, consequently, to a violation of the right of a person with special educational needs . In an inclusive environment, a child, gradually growing up, according to the so-called cumulative effect, develops its potential to communicate with different people and to be in different situations. Thus, the chances of getting a higher education, and then a decent job for him increase, and he becomes more competitive compared to his peers studying in closed educational institutions. [9] First, the legislation of our country in the field of disability is not comprehensive in terms of guaranteeing the right to higher education to persons with disabilities. There is no protection against discrimination in obtaining higher education - universities are not ready to accept persons with disabilities of any category and provide them with appropriate conditions and do not bear any responsibility for this. Legislation does not spell out the provision of reasonable facilities for access to the learning process. The time of admission to college, studies, passing tests, exams and internships is not always regulated.

Secondly, there is no infrastructure for people with disabilities. There are no

programs to access information for people with visual or hearing problems. Only a few try to match the trends of support for people with disabilities.

Thirdly, the state or universities themselves do not introduce special training grants for persons with disabilities. But even after receiving a grant, a student does not receive the opportunity to fully master educational programs within his specialization. [10] Fourthly, the discriminatory norm is practiced when universities are exempted from physical education, regardless of the student's desire. from work experience. Underestimate the requirements for passing an exam of a particular subject.

In addition to all the facts tat are mentioned above, there is also one fact that is not less important. According to Organisation for Economic Co-operation and Development this problem, problem of equity in education in Kazakhstan is included in the strategy of the country and it has to be overcome [7]. The Organisation for Economic Co-operation and Development (OECD) works worldwide, has status of international organisation and aims to create more efficient policies and thus to improve the lives of whole nation. Their purpose is to make the world better by building such policies that favor welfare, equity, potentials and possibilities for all humanity. The organisation has over sixty years of experience is. Organization works together with the country's government, townsman and policymakers to establish fact-based standards that have international status and solve different number of environmental, social and economic problems. Organization not only works on developing economic state and create jobs for encouraging qualified education, but also ensure number of forums, knowledge hubs that can be used for data analysis, experience exchange, sharing with practices in a best way and etc. It can be stated that OECD plays a big role in international co-operation and it is at the heart of it.

According to their report prepared especially for Kazakhstan, in section "Strengthening higher education, employment and social inclusion", Kazakhstan has some gaps in the field of education, namely it needs to establish more equal access to education [11]. It states that for Kazakhstan it is necessary to realize number of special enterprises to improve and ease access to education for all people. As our country purposes to become one of the thirty most developed countries by 2050, it set a number of very big and ambitious goals. Reaching these targets will obviously demand some reforms that are substantial that will help to develop

public governance, to have competitive and open economy and to provide with more equal access to education. [12]

According to the Organisation for Economic Co-operation and Development (OECD) report Kazakhstan needs to improve aspects to become among 30 most advanced country in the world by 2050 below:

- to promote more equal access to the education;
- to enhance public governance;
- to make the economy more competitive;
- to make the economy more open;

The use of ICT in teaching children with disabilities has several advantages. One of the main advantages of using computer-based teaching aids in the education of children with disabilities is their great ability to visualize the educational material provided. The use of TSOR in pedagogical activity helps the teacher to significantly reduce the time for broadcasting educational material, increasing the volume of productive activities in the lesson; to create interesting educational and didactic materials, handouts, assessment and testing materials, necessary for the implementation of the set correctional and educational tasks, to quickly find the main and additional educational materials on the topic of the lesson or for elective courses. The introduction of information technology in all areas of special education is subordinated to the task of the maximum possible development of the child, overcoming existing ones and preventing new deviations in development. Lessons using ICTs have great potential for corrective work aimed at focusing attention, developing thinking, imagination. At the same time, it becomes possible to individualize correctional education in a classroom environment, to provide each child with a pace and method of mastering knowledge that is personally adequate for him, and provide an opportunity for independent productive activity and graduated assistance. An important task of the teacher is the socialization of students in society. ICT allows you to solve this problem:

- develop a new information culture of activity for students with disabilities;
- increase student motivation;

- expand the area of individual activity of the child;
- find sources of additional information on the subject;
- increase the dynamics and imagery of the proposed educational material;
- check the volume and accuracy of knowledge, their depth, awareness, flexibility and efficiency;
- apply various ways of enhancing students' mental activity;
- systematize new knowledge for students;
- to activate the maximum creative participation of children in the educational process.

With any training, it is necessary to create motivation and enhance the cognitive activity of students. This condition becomes crucial for success in remedial education. Improving the effectiveness of cognitive activities of children with disabilities through the use of new information technologies in the correction process largely depends on the teacher's initiative at each stage of training. An important factor is the selection of material, the preparation of tasks, the construction of pedagogical and correctional tasks, taking into account the individual psychological and age characteristics of children. In modern conditions, when new requirements are imposed on textbooks (the availability of an electronic version), the teacher receives a very good tool. E-learning tools can be used:

- in the form of presentations;
- as a textbook and workbook;
- as an explanatory dictionary;
- as a reference to instructional videos;
- as a simulator to consolidate new knowledge;
- as a practical guide.

However, it becomes necessary to correct the proposed information for students with disabilities and include adapted fragments in the lesson. In the development of assignments and the preparation of texts for students with disabilities, the general laws and specifics of the development of such children, the logic of building special education and the basic principles of correctional pedagogy are taken into account.[13] Thus, when introducing ICT in teaching children with disabilities, a large role is given to the teacher, and special requirements for the qualification of the teacher appear. The teacher must know the psychological and pedagogical features of working with children with disabilities and the methodology for working with this category of children and take them into account in their work; have the skills of an advanced user in information and communication technologies; possess key professional competencies, such as information competence; use special software, electronic textbooks, simulators, workshops, center, encyclopedias, the Internet; to know the composition and features of educational and methodological complexes and didactic materials, including on electronic media; must be able to create their own electronic educational resources; constantly learn new information technologies. The teacher must take into account the general laws and developmental features of children with various disorders. Moreover, he can be guided by one of the advantages of computer training tools, namely the fact that the computer can be equipped taking into account the needs and needs of people with disabilities. So, for children with disorders of the musculoskeletal system, a keyboard configuration can be changed, a membrane keyboard with increased sensitivity is used, and a keyboard with enlarged keys. Special finger sensors can be used.[14] For people with visual impairments, a special keyboard with notches on the keys is used, programs with which information is read out - the so-called "Screen reader". The variety of defects, their clinical and psychological-pedagogical manifestations involves the use of various correction techniques, and, consequently, the use of a variety of computer technologies. This helps to increase the effectiveness of the educational process.[15] Organization of training and extracurricular activities for children with disabilities using information and communication technologies can be different:

- traditional lesson system using ICT;
- distance education;

- elements of distance education in temporary disabilities (long illness, not able to attend school)
- participation in network projects;
- distance olympiads, contests, WEB quests.

The use of computers in the educational and extracurricular activities of the school looks very natural from the point of view of the child and is one of the effective ways to increase the motivation and individualization of his education, the development of creative abilities and the creation of a favorable emotional background[16]. Thus, we can conclude that the implementation of the capabilities of modern information technologies expands the range of types of educational activities, allows you to improve existing ones and generates new organizational forms and teaching methods. A lesson using modern information technologies for children with disabilities helps to solve one of the main tasks of correctional education - the development of the student's individuality, his ability to navigate and adapt in modern society. Therefore there is a need for such a system. First of all, in order to recognize speech it is necessary to extract information from speech signals that is sent as an input for the system. Afterwards an accurate decision will be made through analysing these signals. It is widely used by people on a daily basis, as human computer interaction (HCI) is an undeniable fact of current time. However, for instance, in Kazakhstan's education it is not so popular. However, it could be used to improve the quality of education. According to the research results, the problem with disabled students was arisen a lot of times by some of the Deputies of Parliament of RK [17]. According to their reasons the main cause for education inequality in Kazakhstan is the lack of specialists in sign language, which limits access to secondary and higher education. It will be much cheaper and quicker to develop a system that will replace those specialists rather than preparing them. Possible solution for that problem is integrating AI in the sphere of education, namely a service system for disabled students that will ease and faster way of information gain for them. The next step is to develop that system and test whether our universities and schools are ready for such novelty and will it be effective.

1.2 Problem statement

The main problem that is being discussed is about obtaining equal access to education in Kazakhstan. One of the factors that affect negatively the education equity is the fact that there are no special opportunities and conditions for children and students with some kind of disabilities like deafness. So goal of the study is to develop an AI algorithm for deaf-and-dumb students to enhance education equity in Kazakhstan. Exact task focuses on constructing it properly and embed it in a way that it will be very easy to use.

1.3 Aims and Objectives

The main goal of this work is to solve the problem of education inequity in Kazakhstan and make a good contribution to the development of the sphere of education with the use of AI techniques. There are four main objectives that have to be reached first:

- Look for statistical data about deaf and dump students of Kazakhstan and their current condition;
- Find out the main causes of education inequality problem among school and university students;
- To construct possible solutions for removing these causes;
- To evaluate the effectiveness of the solution by integrating it and trying it on students.

Possible solution will be realized by implementation of artificial intelligence, machine learning tools and techniques. According to the system that should be developed as a possible solution for this problem, exact task is about conversation multilingual speech to text. It includes speech recognition and information extraction from signals, conversion of the recognized speech into text in real-time and text summarization. Accordingly, main objectives that must be fulfilled are:

- Find, analyze, and identify the shortcomings of existing algorithms

- Find out what kind of functionalities are necessary in reality, draw the structure of ideal algorithm
- Find out the pros and cons of existing algorithms
- Develop own algorithm which covers the needs of students with disabilities
- Implement the constructed algorithm

1.4 Thesis Outline

The first chapter is Introduction chapter. It includes brief introduction of the general subject and focus area of expertise. It gives insight into the work done. The next chapter, Literature review, is the part which introduces previously done works on this topic briefly. It shows done background research and can be used for evaluation of other works and current work: what is different on this work, what is the problem in other works and etc. The next section is Materials and Methods which describes the methods and materials used to conduct research. It allows you to understand how the research was conducted and to judge if the methods were good. It is detailed enough in order to make it available for other researchers to replicate the study. It can be divided into two main parts:

- Description of methods (algorithms that are used)
- Description of how they are implemented in my work

The next chapter is called "Experiments and Results". This chapter describes the implementation process of listed methods and their results. It helps in discriminating between different hypotheses, reproducing the achieved results. The main point is to properly construct the experiment, proper control of variables, pay attention on methods of measurements like accuracy and precision. Discussions chapter tells what all the results from the experiment can mean: do they approve our hypothesis or not. It provides an explanation and interpretation of the findings to readers and researchers. Provide answers to the questions of my subject of study. Provide some proof that held experiments and used approach is relevant and of course critical evaluation of conducted research. Eventually, the "Conclusion" chapter, it generally covers our findings, contributions from whole

work and includes further works that are possible to be done on this topic. It covers what is the strongest and most important statement that can be made from the work done. It refers back to problem proposed and describes the conclusions that are reached from carrying out this investigation. It summarizes new observations, new interpretations, and new insights that have resulted from the present work.

2. Literature review

2.0.1 Significant prior research: Globally

In the last decade speech technology has reached its peak in development.The reason for that is the fact of necessity on the improvement of the quality of HCI. The process of development shows that such kind of research brought noticeable advantages to not only human community, but also to the modern technology. Furthermore, it is continuously being developed. Nowadays, speech recognition is one of the most researched topics in the sphere of machine learning and specifically in the area of speech technology [3]. Deputy of the Parliament of the Republic of Kazakhstan, Irina Smirnova, pointed out the absence of specialists in sign language at universities: "Currently, not a single university, as well as colleges in the Republic of Kazakhstan, have a specialist in sign language, which limits access to secondary and higher education" [4]. In order to solve the problem of shortage of sign language specialists scientists propose computer aided approaches. There are a number of research works and projects done on current topic.

UNESCO Institute on information technology in education has given a short report on topic: "ICT in education for people with disabilities - policies and innovative practices". Here they state that one of the IITE's priority areas of activity is the creation of an enabling environment for people with disabilities (HIA). It is important for us to create conditions under which people with disabilities can receive a quality and competitive education, which will expand their opportunities for participation in the economic, cultural and social life of society. Providing access to modern technologies and innovative tools will allow people with special needs to increase integration into the social and educational environment. It will also bring significant benefits to states, as it will reduce the financial burden of custody of people with special needs, while promoting investment in education for people with disabilities instead of providing passive support. We strive to advance

the idea of creating an inclusive society [5].

What are their challenges?

- Raising awareness of the educational community, representatives of the private sector and officials about the potential of information technology in ensuring social integration and reducing poverty among people with disabilities;

- Developing the competencies of teachers / teachers and other specialists involved in the education and social rehabilitation of people with disabilities, as well as the competencies of officials on issues of electronic accessibility and use of information technologies for people with visual, hearing and motor impairments;

- Promoting greater independence and full participation in social life for people with disabilities by adapting the electronic environment for their communication, training and access to information. Developing computer literacy and skills among people with special needs through the use of digital technologies and resources.

What are they doing?

- Conduct face-to-face and correspondence trainings for teachers and specialists, which are included in the training of people with special needs, and also develop educational and methodological materials to familiarize teachers with best practices and encourage them to use digital technologies in their practice.

- Creating resource centers equipped with standard and specialized software and hardware that provides people with disabilities with access to information and knowledge, and is also used as supporting material for teaching teachers.

- Launching an online platform on which the database with best practices and experience in implementing digital solutions in the training of people with special needs will be concentrated.

Another work done on this problem, called "Education for people with disabilities health opportunities through implementation information technologies", due

to the increase in the number of children and adolescents with various developmental issues are becoming increasingly relevant issue use of of modern technology for solutions tasks vocational training and socialization of people with disabilities health opportunities. At the same time, the use of information and communication technologies significantly increases the effectiveness of the learning process, helps perform tasks whose solution by traditional methods is not productive enough, allows you to make operational changes to social or labor functions of the learner, individualizes correction process, takes into account the educational needs of each baby, which ultimately helps to increase efficiency general educational process [6]. Education of persons with disabilities and disabled people is one of the priority areas of the educational system of the Russian Federation. The Constitution of the Russian Federation and the Law "On Education in the Russian Federation" say that children with developmental problems have equal rights to education with all. Education for children with disabilities and children with disabilities is one of the basic and inalienable conditions for their successful socialization, ensuring their full participation in society, effective self-realization in various types of professional and social activities. The efforts of the Ministry of Education and Science of Russia are focused on creating an educational environment within the framework of modernizing Russian education, ensuring the availability of quality education for all persons with disabilities and disabled people, taking into account the peculiarities of their psychophysical development and health status. Thus, the most important tasks of modernization are:

- ensuring the availability of quality education;
- individualization of education;
- differentiation of education;
- systematic increase in the level of professional competence of teachers;
- creating conditions for achieving a new modern quality of general education.

And one of the priority strategic directions of modernization of education, solving these problems is the introduction of information and communication technologies in the educational process. This area is of particular importance in the case of education of children with disabilities and the disabled. Children with

disabilities are "special" children whose health conditions impede the development of educational programs outside the special learning environment. Modern information and communication technologies provide fundamentally new opportunities for training. They can be used at all stages of training:

- when explaining new material,
- in the control of knowledge,
- when securing,
- in the generalization and systematization of the material.

What didactic tasks allow solving ICT? In relation to the traditional educational process, the following methodological goals for using educational software can be distinguished:

- individualize and differentiate the learning process;
- carry out self-control and self-correction of educational activities;
- visualize training information;
- model and simulate the studied processes or phenomena (which cannot be seen in nature);
- monitor with error diagnosis and feedback;
- to form the ability to make the best decision in various situations;
- develop a certain type of thinking (for example, visual-figurative, abstract);
- Strengthen the motivation for learning (for example, through the visual means of the program or interspersing game situations);
- to form a culture of cognitive activity, etc.

To achieve these goals, various hardware (computer, printer, scanner, copier, projector, photo and video equipment, sound recorders, multimedia, etc.) and software (virtual designers, simulators, comprehensive training packages, search engines, the Internet) are used facilities. The use of new information technologies in training allows you to create special skills in children with various cognitive

abilities, allows you to make lessons more visual and dynamic, more effective from the point of view of learning and development of students, and contributes to the formation of key competencies of students. The use of ICT allows the teacher to bring the effect of visualization into the lessons and helps the child in need of corrective education to absorb the material in full. Visual display of information helps to increase the effectiveness of any human activity. But in special (inclusive) education, it becomes especially important.[7] Computer technology provides great opportunities for the development of the creative potential of the student. Thanks to the use of information technologies in children with disabilities, visual perception and auditory attention are aggravated, which leads to a positive result of the education and development of this category of children. The use of ICT in various lessons with children with complex defects allows us to develop students' ability to navigate the information flows of the world around them; master the practical ways of working with information; develop skills that allow the exchange of information using modern technical means. In addition, the use of ICT allows you to make the lesson attractive, modern, to individualize and differentiate learning. The organization of education for people with disabilities based on the introduction of new information technologies is associated with the implementation of the following basic principles of training: 1. Enhancing the independent cognitive activity of students, increasing its effectiveness and quality. The basis for the implementation of this principle is the use of innovative teaching methods. They allow you to create an open learning system, in which the student is given the opportunity to choose the appropriate program and training technology. This feature is due to the need to increase the adaptability of the learning system to the individual psychophysical characteristics of a child with disabilities. With such an organization of the educational process, training becomes flexible, not associated with a rigid curriculum and mandatory classroom activities. 2. The interactivity of the computer-based learning system using new information technologies. The use of computer-based learning tools allows the student to receive information regardless of spatial and temporal limitations, to be in constant consultation with various sources of information, to carry out various forms of self-monitoring. This greatly contributes to the creation of conditions for the social rehabilitation of people with disabilities. 3. The multimedia nature of computer training systems. The organization of training for people with disabilities based on ICT allows you

to activate the compensatory mechanisms of students on the basis of preserved types of perception, taking into account the principle of a polysensory approach to overcoming developmental disorders. In other words, the application of the principle of multimedia not only activates attention, spatial orientation, observation in students with disabilities, but also corrects their logical thinking, visual perception, visual memory, color perception.[8] At the same time, one should not forget about the other principles of teaching children with disabilities using ICT: The principle of developing and differentiated teaching of children. Computer technologies provide for the possibility of objective determination of areas of actual and immediate development of children. The principle of consistency and sequence of training. Computer technology allows you to use previously acquired knowledge in the process of mastering new ones, moving from simple to complex. The principle of access to training. Computer technologies and methods for presenting them correspond to the age characteristics of schoolchildren. Assignments are presented to children in a playful or entertaining way. The principle of individual learning. Computer technologies are designed for individual and subgroup classes and allows you to build corrective work taking into account their individual educational needs and capabilities. The principle of an objective assessment of the results of the child. In computer programs, the results of the child's activities are presented visually on the screen in the form of animated images and characters that exclude subjective assessment, in the form of digital rating scales or orally. The principle of a game strategy and introducing a child into a problem situation. The game principle of training with the presentation of a specific task to the user, which varies depending on individual capabilities and correctional and educational needs, allows you to effectively solve the set correctional problems and put into practice the didactic requirements for the availability of computer training tools. The principle of educational training. The use of computer technology allows to educate children with disabilities strong-willed and moral qualities. This is facilitated by the activities of the child, aimed at solving a problem situation, the desire to achieve the desired result on increased motivation of activity. The principle of interactivity of computer training tools. The use of computer programs occurs simultaneously with the implementation of feedback in the form of animation of images and symbols, as well as with the provision of an objective assessment of the results of activities.

Parhat Yusupzhanov, a human rights activist, an expert in the field of the rights of people with disabilities, and will soon become a social entrepreneur gave an interview to Forbes.kz. He says that: I think, subjectively, I would give the first place to Indiana University. It has a center of assistive technologies, in which I was provided with services of translating the text of educational materials into Braille, special equipment, computers with screen access programs. I was provided with special loops to enlarge the text. There was another service there, by analogy with which we created a support center for students with disabilities in Kazakhstan. This service provided me with individual assistants. If the teacher showed some diagram, the assistant drew it to me with a thermal pen on special paper. At Indiana University, when I studied there, 900 out of 120 thousand students are disabled. Moreover, the majority had mental disorders. Second place I would give to the University of Minnesota. There is a huge support center for people with disabilities. In 2016, he served 4,434 students, 65 employees work in it, half of which have disabilities. At that time 40 thousand students were studying at the university, and 11% had a disability. Graduates of this university were able to take their rightful place in the society of their country. One graduate works at NASA, the other won the national music competition. Many graduates work both in government and in local administration. Having received a decent education, they were able to adequately realize themselves in the labor market. Now think about how many of our students with disabilities have this opportunity.[9]

Third place can be given to Hiroshima University. There is also a very good support center, many volunteers. If in America the support centers mainly work under the contract, in Japan the volunteering system is very developed. Japanese society is collective. Volunteer students read materials to their fellow students, print texts in Braille. Collective responsibility helps students gain access to higher education. I think the Japanese experience could be introduced with us. I am sure that then the situation with access to education would improve significantly. The experience of Malaysia would also be suitable for us - there, universities themselves take responsibility for providing students with disabilities with access to education. Universities in Malaysia develop and apply internal practical guidelines for inclusive education at the university [7].

Now we have moved to another level - we are opening a network of support centers for students with disabilities across Kazakhstan. In addition, we work

with deputies and the Ministry of Education to promote the right of people with disabilities to education. We are preparing practical recommendations for universities.

If we do not solve this problem, we will lose a generation of students with disabilities. It just goes away. After all, there is also the problem of dependency. Due to the fact that teachers make concessions so that they do not lose a scholarship, a person stops trying. This is unacceptable when a person goes to university just to receive a scholarship. There are such cases when a person just somehow studies for four years, then goes to a magistracy, there still receives a scholarship. The money is not bad, you can not work. Then these people will present to the state - why don't you want to pay us, did you pay at the university? This will not work, I am against it, no matter how they treat me after that.

The approach to give money only because you are disabled is long outdated. People with disabilities need to ensure adequate access to education and demand from them as well as from other students, and not just pay a scholarship so that they sit quietly and do nothing.

I note that this is the first such center in Kazakhstan, the creation of which was supported by the Soros Kazakhstan Foundation. We proposed the idea to the rector of the university, many thanks to him for agreeing. The center served 37 students with disabilities of various categories - by hearing, vision, musculoskeletal disorders, with common diseases from different universities. Firstly, we were the coordinators who defended the interests of the student, defended his rights. For example, about providing additional time for passing tests, materials in Braille. The coordinators were negotiating with the university administration that, for example, toilets should be equipped for people with musculoskeletal disorders. We have purchased special equipment. This is a machine that photographs a text and reads it in three languages - Kazakh, Russian and English. These are hearing-impaired webcams for students with whom they can communicate with their sign language interpreters. Unfortunately, universities still do not pay for sign language interpreters. Moreover, we united students, organized leisure - went to the mountains, theaters, exhibitions, karaoke.

From the history, the term of deaf was referred to the ones that used sign language as a means of communication. Nowadays this term is still used for unable to speak and hearing impaired people. According to sources, nowadays

the term deaf is used in two ways: one for deaf people that hear the sounds with the help of audiology and they are not associated with other hearing impaired community members, while the other meaning indicates deaf people that use sign language for communication.

Actually there are other means of communication or hearing impaired people, like: books, messages, helper pages, notes, gestures, reading from the lips and so on. However, despite this fact actually there are a lot of difficulties for hearing impaired people, mostly while communicating with normal people. However the issue is not only about the people that are unable to hear and speak but also deaf culture lack of awareness among normal people. The reason for that is the lack of knowledge of sign language, because there are over three hundred sign languages and obviously it is had for other people to learn all these languages. However, the problem can be solved by developing a program that can distinguish these sign languages and transfer them into spoken language words and thus ease the process of communication between deaf and hearing people. Also the systems that distinguish the speeches can also assist as technologies for translation the speech of people into sign languages. For example, one of the examples of such technologies is automatic speech recognition [13]. It is about the recognition of speech and transforming them into spoken language words by using specially developed algorithm. According to the description of the system speech recognition process includes three phases: feature extraction, generation of acoustic models and phase of recognition.

The purpose of the work[14] is to invent a way of deaf people communication speech development with the help of modern technology, it is simple and effective according to the cost. It proposes a system that uses speech recognizer based on HTK in order to distinguish the language of hearing impaired people in order to provide communication.

Sign modeling is a problem that is considered both independently and as part of the problem of modeling and recognition of gestures and thus as a technology learning and evaluating sign language. One of the systems to display the sign language is American Sign Language Online Dictionary[11], which consists of a video database of words and phrases displayed via sign language. These developments were involved in a number of commercial agencies[12], but the systems they propose are configured to predetermined number of gestures, and therefore do not

solve the problem of modeling sign language. Also all of them lack functionality of gestures recognition, thus not allowing to evaluate the quality of sign language performed by a user.

Creating a model hand is the first step in the task of sign language modeling. In their work[13], authors analyze existing approaches of hand modeling, which are divided into two main groups: spatial and temporal. Former consider the characteristics of different positions for the hand gestures, while the latter refer to the description of the dynamics of gestures. Modeling hands in the spatial area can be completed in two and three dimensions.

One of the examples of sign language recognition is the interface used in information desk of the hospital. The system works in the following way: first it asks questions by broadcasting sign videos and afterwards suggests answers on the screen thus the application helps deaf people to tell their problems. The system tries to find the answer for each group of people by looking at possible answers, not looking to all the data-set of signs. Eventually, the application shows the summary answer on the screen then they are assisted according to these answers. In [14] proposed system by authors is able to simulate sign animations for a given text. As a part of this system a statistical model is used to analyze input text and generative algorithm is used when creating the appropriate simulated kinematics of sign animations. Within the article, the authors have provided ANVIL tools for input text annotation, gesture generator NOVA, and DANCE library developed in [15] is used for gesture animation. The system is built on the Microsoft Windows platform and x86 processor. In [16] authors discuss the modeling of virtual character for spatial reproduction of sign language on the platform of Microsoft Windows. The training system is based on Microsoft Windows platform and x86 processor. Gesture recognition for mobile platforms is developed in [17], but gesture modeling on mobile devices is not performed.

The proposed technology should perform modeling of sign units [16][17][18] of sign language, and reproduce animation of gestures structures (words, sentences) via state transitions between shown units using spatial virtual model hand. The proposed technology should perform recognition of sign language based on camera input from the device in order to evaluate sign language performed by user. The technology should be a combined solution for learning sign language via gesture modeling and recognition. Technology should solve the problem of running on

existing platforms using cross platform development without implementing the functionality for each platform separately.

The process of development of speech technology shows that it brought noticeable advantages to not only the human community, but also to modern technology. Furthermore, it is continuously being developed. Nowadays, speech recognition is one of the most researched topics in the sphere of machine learning and specifically in the area of speech technology [5]. Deputy of the Parliament of the Republic of Kazakhstan, Irina Smirnova, pointed out the absence of specialists in sign language at universities: "Currently, not a single university, as well as colleges in the Republic of Kazakhstan, have a specialist in sign language, which limits access to secondary and higher education" [6]. In order to solve the problem of shortage of sign language specialists scientists proposes computer-aided approaches.

Indeed there are a lot of works done on this topic.For instance, author of the work called " Unsupervised Text Summarization using Sentence Embedding " proposes an approach of text summarization for short texts [6]. The process includes a number of operations for data preparation and then for data processing for summarization. The approach is structured very well and results show good performance. However, its limitation is that this approach works for English, French, Danish language texts and implementation of the method is complicated. As it uses skip-thought vectors the process of training the model takes a long time (from 2 to 7 days). Another example for text summarization is TensorFlow Summarization method which uses Recurrent Neural Networks and TextTeaser algorithm [7]. It uses the traditional Seq2Seq model that refers to a deep-learning approach. Implementation is not from the easiest ones and the structure is also. From the research done on relative works on this task, it can be stated that most of the approaches have differences by means of complexity and time consumption.

Indeed there are a lot of works done on this topic as the problem of education of disabled people is one of the most severe ones. Deputy of the Parliament of the Republic of Kazakhstan, Irina Smirnova, pointed out the absence of specialists in sign language at universities: "Currently, not a single university, as well as colleges in the Republic of Kazakhstan, have a specialist in sign language, which limits access to secondary and higher education" [6]. In order to solve the problem of shortage of sign language specialists scientists propose computer aided approaches.

One of them is Netherlands-based start-up which worked out an AI powered

application for deaf and dumb people. It translates sign language into text and speech in real time [7]. "Google translator for the deaf and mute" application works by putting a phone in front of the user, application starts translating hand gestures / sign language into text. Application uses artificial neural networks and CV to identify gestures from the video of sign language speaker. Afterwards, constructed algorithm translates all the information into text and speech. It has three main features: Voice (convert text into voice), Electronic Assist for Sign Interpretation (convert voice into text) and Vision (detect objects). To my point of view, this project is very good and suitable, but can be helpful with only its EASI feature, in case of deaf and dumb people.

The second example is camera-based project Cyber Gloves that has virtual reality sensors that capture continuous and isolated signs. It is also one of the very popular projects developed for disabled people [9]. It uses patented resistive bend-sensing sensors in order to transform hand / finger motions into real-time digital data as accurate as possible. However, it is not available for everyone and expensive.

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task is Finger - spelling hands - "Ralph". It is a Japanese sign language robot that was developed for deaf people. The robot takes a text as an input and transforms it into hand gestures [8]. It is very useful but expensive, as it is a robot.

One another field that is very strongly related to this topic is sign language and its recognition problem. Many of the research works on the topic of sign language recognition approached the problem through gesture recognition task, supposed that there are 1 to 1 mapping between the words of sign and spoken language. One of the works propose the translation of these two languages by using seq2seq algorithm, which is one of the basic deep learning algorithms. The idea is very basic, the algorithm tries to map the signs with spoken language words [10].

There are a number of other different works on sign language recognition and translation that have shown great progress. For instance, there is a work that is constructed for this task and it recognizes only isolated separate signs and creates sentences [11]. Till today there is no work that is able to recognize and translate directly from video stream. Another problem is that there is a very limited linguistic work that deal with text translation, because the dataset of available words itself is very limited: only about 3000 words [11].

One of the problems also is about data collection for sign language, cause it needs to be collected and annotated. However, for now, there are datasets on linguistic sources, interpretations of sign language broadcasts.

In order to inhibit the goal of sign language recognition number of researchers worked on the collecting sign language datasets under limited conditions like in controlled environments. Because of the fact that there is a lack of dataset for sign language the process of collecting it made good progress. For example, there are some algorithms that are developed for recognition and learning from the data according to the pose estimations and facial expressions. According to these developments, for instance, the group of researchers lead by Forster released RWTH-PHOENIX-Weather 2012 developed an application from the broadcasts of weather interpretations and this dataset became one of the most used datasets for sign language recognition [12].

In the work called "A system for converting english text into speech" made by W. Ainsworth, researcher of the Keele university, the system is developed by investigating not so large amount of data and by using a simple, not expensive computer. Firstly the input data, text, is segmented into several small groups,

while the orthography is also formatted into a phonemic partrayal. Also, lexical stress is assigned to appropriate syllables, then the resulting string of symbols is converted by synthesis-by-rule into the parameter values for controlling an analogue speech synthesizer [3].

Research work done by A. Kain, W. Macon: "Spectral voice conversion for text-to-speech synthesis", presents novel algorithms that converts voice and modifies an input data into sound, to make it sound like it is proxy by a speaker. It is realized by applying to a residual-excited linear predictive coding diphone synthesizer. By using locally linear transformation spectral parameters have been charted, by using Gaussian models. By joint density estimation the model's parameters are trained. The linear predictive coding residuals are adjusted to match the target speakers average pitch [4].

It is also known that people can have problem of poor eyesight or even an eyes disability. A mobile wireless communication device represented in research work "Mobile wireless communications device with speech to text conversion and related methods" is a system that can cooperate with one audio transducer as minimum , in order to transform input speech to converted text and then proposed edition for the converted text is retrieved as an output transducer [5].

If to talk about the special schools and educational centres for disabled people all around the worl. it can be seen that there are not so many of them. For example, In Austria, as elsewhere, there are a lot of people with disabilities. But they live here much better than anywhere else. All sidewalks and lifts are equipped with ramps, on each subway platform there are elevators, there are special low-level trams for wheelchair users, etc. Here they lead an absolutely normal full life.

- Conditions created in universities in Austria On the territory of any Austrian university there are many buildings, parks, cafes, shops. And everywhere you can meet people in wheelchairs or visually impaired. The entire infrastructure is adapted for their comfortable life and movement without outside help. In any hostel, some of the rooms are equipped for the needs of people with disabilities. These rooms have special kitchens and bathrooms. A wheelchair can be absolutely in any room. And even the inscriptions in the elevators are duplicated in Braille.

- A chance for the future for everyone Unfortunately, in none of the CIS

countries people with disabilities can lead such a full life. Only in single schools and only as an experiment disabled wheelchairs attend classes with healthy children. In higher education institutions, however, people with disabilities cannot study in full-time. For those whose loved ones can afford to study and live in Austria, this is a chance for a full life and a well-paid job in the future. For example, Vienna Technical University has a special program of support and adaptation at the university for people in wheelchairs, hard of hearing and visually impaired.

- Technical University of Vienna - projects for students with disabilities The director of the Researchers Service Center (MFE), which has been operating since 1997, Magdalena Furmann-En, states that the center works so that all students have equal rights and opportunities to participate in university research projects. Every Monday from 14:00 to 16:00 and Thursday from 10:00 to 12:00, you can approach MFE without an appointment and express a desire to participate in university projects. Especially for students with disabilities, the group "Technical University without Barriers" was created. University specialists provide support and try to remove the barriers that arise in the way of learning for people with disabilities. The office is located in the library at 1040, Resselgasse 4, 4th floor.

- WHO data on people with disabilities According to WHO (World Health Organization), there are more than 1 billion people with disabilities in the world, which is 15% of the total world population. Significant difficulties in functioning are experienced by 110 (2.2%) of the population, and a severe form is observed in 190 (3.8%) millions of adults.

Unfortunately, the statistics is inexorable and indicates that the probability of finding a job for people with disabilities is lower. Thus, according to the WHO, employment among men with disabilities is lower by 35%, and women by 20% than in healthy people. Studying in Austria can change the fate of the person who needs it. There are all conditions created for the education and life of people with disabilities.

2.0.2 Significant prior research: Kazakhstan

Unfortunately, not all people with disabilities in Kazakhstan today can boast of comfortable living conditions. A lot of difficulties await them in the field of employment.

According to a survey conducted by the Association for the Development of Civil Society (ARGO), in 2017, about 630 thousand disabled people were registered in Kazakhstan. Out of 40 thousand people living with disabilities living in Almaty, only 3.5 thousand people work, and 25 thousand people of working age with higher education and professional qualifications cannot get a job.

In 2015, First president of the Republic of Kazakhstan N. Nazarbayev signed the Law on Ratification of the Convention on the Rights of Persons with Disabilities, which aims to eliminate discrimination against people with disabilities, to ensure their right to work, health care, education and full participation in society, access to justice, personal integrity, freedom from exploitation and abuse, freedom of movement, individual mobility. Particular attention is paid to protecting the rights of women with disabilities and children with disabilities as the most vulnerable and in need of social support categories of the population.

How are the rights of citizens with special needs being realized, including the right to work? What difficulties do they encounter when moving around Kazakhstan? These questions are answered by the chairman of the Union of Disabled Organizations of Kazakhstan Ali Amanbaev, the president of the NGO "Youth Organization of People with Disabilities" Zhiger "Parhat Yusupdzhanov and the director of the Public Foundation" Center for the Support of Deaf Persons with Disabilities "Umit" Amanbike Ergalieva.

Parkhat Yusupdzhanov, president of the public organization "Youth organization of people with disabilities" Zhiger ":

- If we talk about the right of people with disabilities to work, then we need to recall the statutory rules for quoting jobs for people with disabilities, according to which employers must provide work to people with disabilities. The quota for the employment of persons with disabilities is established by local executive bodies in the amount of two to four percent of the number of jobs determined by the authorized body for employment.

Often people with disabilities of groups I and II cannot get jobs on quotas, because it is easier for employers and even government agencies to employ people

with disabilities of group III, who, in principle, are able-bodied in many respects. And people who do not see or move in wheelchairs practically remain overboard. Cases of discrimination of people with disabilities also occur when such a person sends a resume to the employer, and during an interview they are denied employment. For example, abroad, in the USA, people with visual impairments are given the right to own automatic machines for selling soda and ordinary water, which are installed in government agencies. This can be called "positive discrimination", we, unfortunately, do not have such preferences if the issue concerns an ordinary citizen with a disability and not counting special enterprises.

With regard to higher education for people with disabilities, there are also a number of problems. For example, in Kazakhstan, when it comes to higher education, people with disabilities are not taken seriously. Firstly, such people immediately upon admission encounter problems associated with the submission of documents. If this is a person with visual impairment, then they should provide him with a person who would read him examination materials. Moreover, additional time for passing tests is not always provided. If the total time for passing the tests is three hours, then the blind person needs extra time for him to understand the essence of the test, digest the questions and be able to answer them. Secondly, in the learning process, the situation is also deplorable, because there is no barrier-free access to universities even in Almaty, there are no special elevators for people with special needs, except for teachers, for whom for some reason separate elevators with keys are reserved. I'm not talking about toilets for people with disabilities, which are locked, and they are also used by the teachers themselves. A person who has disorders of the musculoskeletal system, chooses a university not by the principle of specialty, but by the principle of access to toilets, elevators and ramps. Many universities also lack special support centers for students with special needs.

Some universities are moving towards them, but there is no support in terms of education. Support is provided in material support, once a semester they can give money, food stamps. All this leads to the fact that a person who graduated from a university is not competitive in comparison with other students. He cannot compete in the labor market and, accordingly, cannot get a job. But he cannot get a job because universities do not have adequate conditions for obtaining quality knowledge, taking into account his disability. Here is such a vicious circle. In

2015, together with KazNPU named after Abay, we opened one such center where coordinators provided special support to students with disabilities. Now we are working with KazNU. al-Farabi and TarSU im. Dulati, as well as with Almaty Management University and other universities. Most universities cite the fact that they do not have the means to create all the necessary conditions for people with special needs, explain that the equipment is very expensive, etc. In this regard, we have to attract public workers through employment centers: they help young students with disabilities read books, record audio and accompany them on exams. I would like such people to always be present in universities on an ongoing basis, and then people with disabilities, especially I and II groups, will not have big problems.

Ali Amanbaev, Chairman of the Union of Disabled Organizations of Kazakhstan:

- Unfortunately, successes in this area are observed only in the legislative plan. In my opinion, we have no performing discipline. If everything is done well somewhere, for example, in cities of republican significance - in Almaty and Astana, then in other regions there are still problems. As for employment, I note that we can build hundreds of factories, but if a person with special needs doesn't leave his house, doesn't go along normal sidewalks, and there will be no appropriate transport for him, why do he need these plants? Unfortunately, we still have a medical model for understanding disability, because if you are in a wheelchair, you are called a patient or patient. What makes us disabled is not leg amputation or paralysis, but the inability to take care of ourselves and the infrastructure that is not adapted around, that is, an inaccessible environment. Now, if we took into account all these features, this issue could be resolved. When many people assume that people with special needs are sick people and they receive medical and material support from potatoes and sugar, this does not solve the problem itself. It must be done as in the West, so that people can move freely, so that jobs are created for them, etc.

They used to say that the law established a three-percent quota for employing people with special needs, now this quota is from two to four percent. Even the legislation itself, in my opinion, worsened the whole process. After all, when it was enough three percent, it was possible to force a person with special needs to enter enterprises where 30 people work. Even large enterprises, unfortunately, do not

agree to employ people of this category, although the state must strictly control the process by which the quota is carried out. We proposed to resolve the issue at the legislative level, so that at least one person was employed at enterprises. It is much more pleasant when a person earns himself. To find a job, a person with special needs needs to get a higher education. But what about education, if most universities are inaccessible to such people? In this regard, we also have problems. Here we have in Almaty appeared the services of "Invataxi", which are financed by the state. Now we take people of a special category to work and study, and thanks to this they have full access to both work and study. As for benefits, in our group I invalids receive somewhere around 54,300 tenge per month, and this is an increased allowance. Do you think a person in a city can live on that kind of money? I am not talking about people receiving disability benefits of groups II and III. I think that all these issues can be resolved effectively, because according to official statistics there are not so many people with special needs in our country. People with special needs should be given the opportunity to find a job and get higher education, but not to live on benefits alone, they should not feel disadvantaged.

Amanbike Ergalieva, director of the Public Foundation "Umit Support Center for the Deaf":

- Given the specifics of our activities, aimed at a specific target audience, that is, people with disabilities from childhood, according to the rumors of group III, we can clearly indicate that the exercise of their rights is discriminated against when defining disability groups. They are disabled since childhood, some from birth, but upon reaching adulthood they are assigned the III group of disability, which ultimately deprives them of all benefits.

For example: they are not declared in housing preferential programs, they are also deprived of notarial, legal, lawyer and some medical preferential services. After receiving pre-school education in specialized kindergartens, children with hearing impairment go to (zero) classes, as they are absolutely not ready for school. The process of incomplete secondary education does not meet international standards, as a result of which graduates of special schools for children with hearing impairment have a small vocabulary, poor written literacy, and understanding of the written text is only 20-40 percent.

After graduating from special schools, graduates are forced to receive sec-

ondary specialized education and go to colleges and universities, as schools provide incomplete secondary education. Currently, in the Republic of Kazakhstan there are 24 special boarding schools for deaf and hard of hearing children, in which from 150 to 300 children receive knowledge. At the end of special schools, graduates, to continue their further education, enter secondary specialized educational institutions. And the educational institutions of some cities do not have grants for students with hearing impairment, and where there are grant programs for deaf and hard of hearing people, there are no experts accompanying the learning process - sign language translators. With regard to universities, I note that in none of the universities of the Republic of Kazakhstan there is a single sign language interpreter, despite the fact that all existing universities have been accredited for the availability of conditions for training for people with disabilities in general[18].

The issue of employment of hearing-impaired people also remained an outsider according to the results of various programs and normative legislative acts. For example, a three percent quota for job creation has remained inactive. The prevailing stereotype of the Soviet past in society that deaf and hard of hearing people should work as janitors, shoemakers, cleaners and seamstresses is also untrue, because even in these positions people of a special category cannot find jobs. The main obstacle to the employment of people with hearing disabilities is the language barrier, and their literacy and knowledge are low. Regarding the issue of moving around the country, there are also unresolved problems in this aspect. For example, the main difficulty in traveling around the country by air and rail is the lack of benefits. The benefits established by the state in accordance with the third group of disabilities are the lowest in comparison with people with disabilities of groups I and II, although most people with hearing disabilities create families, raise children, and contribute to the development of Kazakhstan's demography. I think we should not forget that the meager disability allowance and the lack of stable work with decent earnings leads people of a special category to disadvantage and need.

3. Methods and Materials

This chapter, Materials and Methods, describes the methods and materials used to conduct research. It allows you to understand how the research was conducted and to judge if the methods were good. It is detailed enough in order to make it available for other researchers to replicate the study. It can be divided into two main parts:

- Description of methods (algorithms that are used)
- Description of how they are implemented in my work

This thesis project will depend upon the following research methods for garnering results:

- Finding out the needs Attend the schools for deaf and dump students, for more information about technologies and methodologies that they use for teaching and learning processes. Have a discussion with the staff, administration of that schools about possible problem causes and solutions and implementing new algorithm.
- Collecting the data Collect a lot photos and videos of Kazakh sign language alphabet with their spelling and text version together. Take statistics of deaf-and-dump people by region and, if possible, study their financial condition, opportunities, etc.
- Development of an algorithm The technologies like CNN, LSTM will be used.
- Implementation School for deaf-and-dump students which placed in Kazakhstan, Almaty, Auezov region will be used for testing the algorithm.

3.1 Speech-To-Text

3.1.1 Dataset

Huge scope profound learning frameworks require a bounty of named information. This system needs many recorded expressions and comparing English translations, however there are barely any open datasets of adequate scale. Broad dataset comprising of 5000 hours of read discourse from 9600 speakers was gathered.

3.1.2 Algorithm

There is a system that is developed by using deep learning stages of end to end processing called deep speech. This method is efficient and shows high performance because of the fact that it connects natural language processing and deep learning. Used model is Recurrent Neural Network which was trained by KAGGLE dataset and took very long time to be trained as it was required to extract the training features from the given input data and there is no adaptation to speakers voice or some other audio filtering tools were implemented. Therefore, mostly because of this kind of problems like noise the model is keen to have an error and nonrccognition.[12]

Speech recognition systems that are existing nowadays are developed by hard-coded stages of processing and they were given specific features as an input data and preprocessed data, eg. acoustic speech. In order to make the model better by overcoming the drawbacks listed above, new model must be fine tunned and use a new approach for feature data. Most of the speech systems were developed by giving deep learning algorithms preprocessed audio or acoustic ones. In the time where overcoming these pipelines has been critical, profound learning despite everything assumes just a restricted job in customary discourse pipelines. Accordingly, to improve execution on an assignment, for example, perceiving discourse in an uproarious situation, one should difficultly design the remainder of the framework for strength. Interestingly, our framework applies profound learning start to finish utilizing intermittent neural systems[13]. We exploit the limit gave by profound taking in frameworks to gain from huge datasets to improve our general execution. Our model is prepared start to finish to create translations and hence, with adequate information and registering power, can learn heartiness

to commotion or speaker minor departure by itself.

Puncturing the advantages of start to finish deep learning can come up with some kind of problems like:

- necessity of finding large scale and captioned dataset
- necessity of training big networks

Firs of the problems that can be faced while constructing a neural network model is about text alignment transcripts of the speech that is recieved as an input. This challenge was faced by Graves et al., and they proposed a method that simply come up with using neural networks which are able to work with not aligned speech. This also can be improved by implementing several GPU processing. It is expected to use these experiences to satisfy the vision of a conventional learning framework, in light of enormous discourse datasets and adaptable RNN preparing, that can outperform progressively confounded customary techniques. This vision is propelled somewhat by crafted by Lee et. al.[14] who applied early solo component learning strategies to supplant hand-assembled discourse highlights. We have picked our RNN model explicitly to delineate to GPUs and we utilize a novel model parcel plan to improve parallelization. Moreover, we propose a procedure for amassing enormous amounts of marked discourse information showing the mutilations that our framework ought to figure out how to deal with. Utilizing a mix of gathered and integrated information, our framework learns power to practical commotion and speaker variety (counting Lombard Effect [20]). Taken together, these thoughts get the job done to manufacture a start to finish discourse framework that is without a moment's delay less complex than conventional pipelines yet additionally performs better on troublesome discourse assignments

3.1.3 Model training

The main thing in the system is RNN that is trained to recognize speeches and construct text in English language. Let a solitary expression x and mark y be examined from a preparing set $X = (x^1, y^1), (x^2, y^2), ...$ Every articulation, x^i , is a period arrangement of length T^i where each time-cut is a vector of sound highlights, $x_t, t = 1, ..., T^i$. Spectrograms are used as highlights, so x_t) means

the intensity of the p'th recurrence canister in the sound edge at time t. The objective of our model is to change over an info arrangement x into a succession of character probabilities for the interpretation.

Model is made out of 5 hidden layers. For an information x, the concealed units at layer l are indicated h^l show that h^0 is the given data as input. The initial three layers are not repetitive.

For the primary layer, at every t, the yield relies upon the spectrogram outline x^t alongside a setting of C outlines on every. The remaining non-repetitive layers work on free information for every step. In this manner, for each time t, the initial 3 layers are registered by:

$$h_t^l = g(W^l h_t^l + b^l)$$

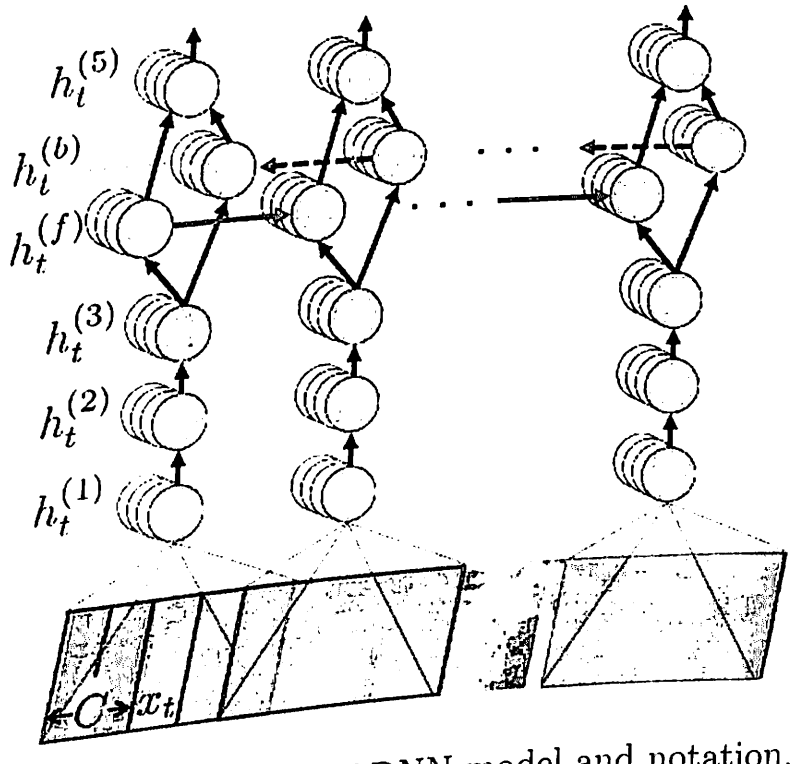

Figure 3.1: Structure of RNN model and notation.

The constructed neural network model is depicted on Figure 3.1 above. As it can be seen from the picture the model is very simple as there is only one recurrent layer and there is no long short term memory, as long short term memory cell needs its data to be computed at each time step. Since the forward and in reverse repeats are successive, this little extra expense can turn into a computational neck of bottle. By utilizing a model we have made the calculation of the intermittent enactments as proficient as could reasonably be expected: registering the ReLu yields includes just a couple profoundly improved BLAS procedure on the GPU.

3.2 Hand-Sign-To-Text

3.2.1 Dataset

Gesture language is an independent language consisting of gestures, each of which consists in combination with facial expressions, shape or movement of the mouth and lips, as well as in combination with the positive body of the body. These languages are mainly used in the culture of the deaf and hard of hearing for the purpose of communication. The use of hard languages without hearing impairment is secondary, but quite common: often there is a need to communicate with people with hearing impairments who are users of sign language.

This means that linguistic and sound and linguistic connections have nothing in common. In addition, gestures in speech are used as gestures, as well as gestures in speech [1] or gesture articulation used by audible voices. to transmit information by gestures is grammatically identical to the verbal language. There are new gestures, old ones die off - and most often this has little to do with the development of verbal languages. The number of sign languages in a country is not related to the number of verbal languages in it. Even in one country where several language languages are present, there can only be one common language.

The use of gestures, voice communication can occur in many situations. However, such gesture systems cannot be obtained due to their primitiveness. However, if it is possible to use sound language, a person instinctively begins to use for this gesture.

The data that are used for training of the model consists of pictures of American Sign Language alphabet.Where the number of classes is twenty nine, where 3 of them are classes of nothing, delete and space which are very useful while classifying at real time. There are around 90 000 images in training set with size of 210 to 220 px. American Sign Language (ASL) is a natural language[6] that serves as the predominant sign language of Deaf communities in the United States and most of Anglophone Canada. Besides North America, dialects of ASL and ASL-based creoles are used in many countries around the world, including much of West Africa and parts of Southeast Asia. ASL is also widely learned as a second language, serving as a lingua franca. ASL is most closely related to French Sign Language (LSF). It has been proposed that ASL is a creole language of LSF,

although ASL shows features atypical of creole languages, such as agglutinative morphology.

ASL originated in the early 19th century in the American School for the Deaf (ASD) in West Hartford, Connecticut, from a situation of language contact. Since then. ASL use has propagated widely by schools for the deaf and Deaf community organizations. Despite its wide use, no accurate count of ASL users has been taken. Reliable estimates for American ASL users range from 250,000 to 500,000 persons, including a number of children of deaf adults. ASL users face stigma due to beliefs in the superiority of oral language to sign language.

ASL signs have a number of phonemic components, such as movement of the face, the torso, and the hands. ASL is not a form of pantomime although iconicity plays a larger role in ASL than in spoken languages.[15] English loan words are often borrowed through fingerspelling, although ASL grammar is unrelated to that of English. ASL has verbal agreement and aspectual marking and has a productive system of forming agglutinative classifiers. Many linguists believe ASL to be a subject–verb–object (SVO) language. However, there are several alternative proposals to account for ASL word order.

3.2.2 Algorithms

3.2.2.1 VGG

There is a CNN model that consists of 16 layers constructed by K. Simonyan and A. Zisserman called VGG16. Model is very popular as its accuracy is about 93%, which is among the top five algorithms trained with ImageNet dataset. There are more than 14 million pictures clustered into thousand classes.

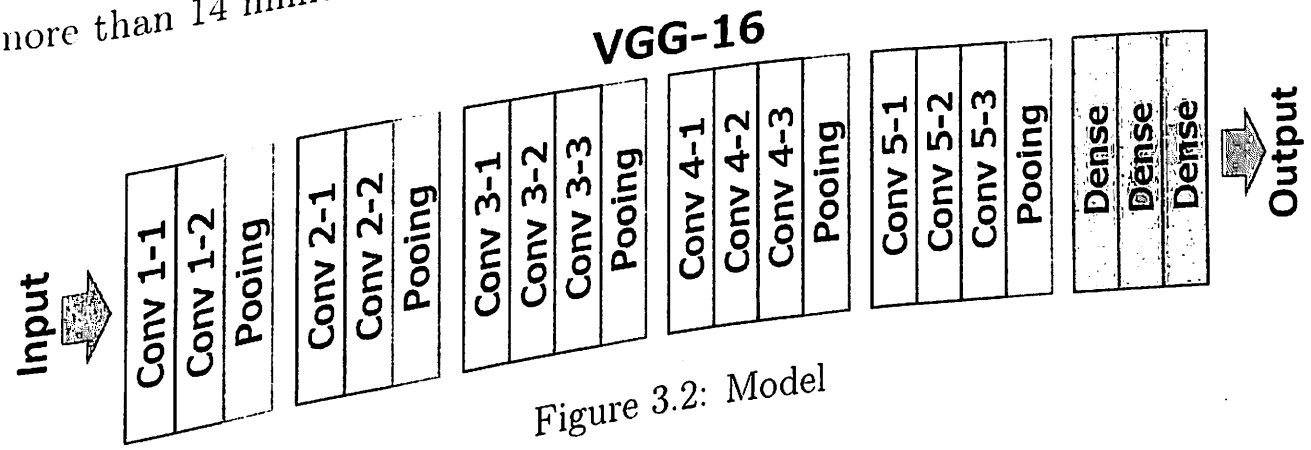

Figure 3.2: Model

The Architecture

The architecture illustrated below is VGG16 (Refer to figure3.3).

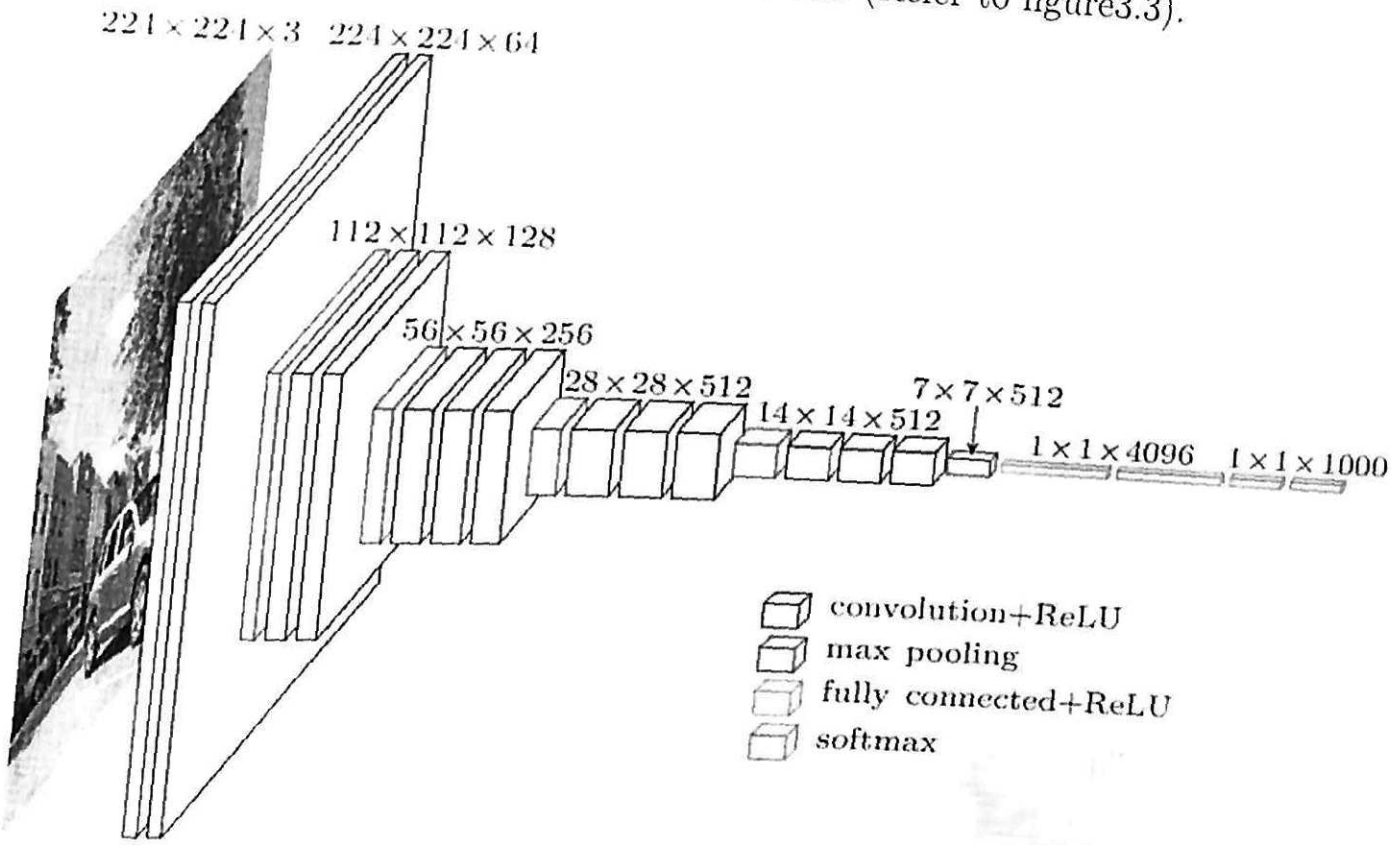

Figure 3.3: VGG16 Architecture.

As it can be seen from the picture above the input image must have size 224 x 224 RGB image. There are 16 layer from which the image passes through. There are also several filter which utilizes and look like linear transformation. There are 3 fully connected layers with differnt architecture: initial and the second fully connected layers have 8192 channels overall and the third one has 1000, while the eventual layer is soft-max.

Every single concealed layer are furnished with the correction (ReLU). It is likewise noticed that none of the systems (aside from 1) contain Local Respose Nrmalization, this kind standardization doesn't refine the exhibition on the ILSVRC dataset, however prompts expanded memory utilization and calculation time.

Configurations

There are variety of convolutional neural network types.All the given arrangements follow the conventional structure present in design and contrast just in the profundity. Convolutional layer's width can be small, starts from 64 initially and

then after each and every max pool. layer rising by power of 2, till 512.

ConvNet Configuration					
A	A-LRN	B	C	D	E
11 weight layers	11 weight layers	13 weight layers	16 weight layers	16 weight layers	19 weight layers
input (224 × 224 RGB image)					
conv3-64	conv3-64 **LRN**	conv3-64 **conv3-64**	conv3-64 conv3-64	conv3-64 conv3-64	conv3-64 conv3-64
maxpool					
conv3-128	conv3-128	conv3-128 **conv3-128**	conv3-128 conv3-128	conv3-128 conv3-128	conv3-128 conv3-128
maxpool					
conv3-256 conv3-256	conv3-256 conv3-256	conv3-256 conv3-256	conv3-256 conv3-256 **conv1-256**	conv3-256 conv3-256 **conv3-256**	conv3-256 conv3-256 conv3-256 **conv3-256**
maxpool					
conv3-512 conv3-512	conv3-512 conv3-512	conv3-512 conv3-512	conv3-512 conv3-512 **conv1-512**	conv3-512 conv3-512 **conv3-512**	conv3-512 conv3-512 conv3-512 **conv3-512**
maxpool					
conv3-512 conv3-512	conv3-512 conv3-512	conv3-512 conv3-512	conv3-512 conv3-512 **conv1-512**	conv3-512 conv3-512 **conv3-512**	conv3-512 conv3-512 conv3-512 **conv3-512**
maxpool					
FC-4096					
FC-4096					
FC-1000					
soft-max					

Figure 3.4: The ConvNet configuration.

3.2.2.2 ResNet

ResNet is an abbreviation for residual network (literally, "residual network"). Deep convolutional neural networks exceeded the human level of image classification in 2015. Deep networks extract low-, medium-, and high-level attributes of the end-to-end multilayer method, and the number of layers laid can enrich the "levels" of attributes. When a deeper network begins to fold, a problem arises: with increasing network depth, accuracy first increases and then deteriorates rapidly. A

decrease in training accuracy indicates that not all networks are easy to optimize. To overcome this problem, Microsoft has introduced a deep "residual" learning structure. Instead of hoping that every few stacked layers directly correspond to the desired main view, they explicitly allow these layers to correspond to a "residual". The formulation F (x) + x can be implemented using neural networks with connections for quick access[16]. Shortcut connections skip one or more layers and perform identifier matching. Their outputs are added to the outputs of stacked layers. Using ResNet, you can solve many problems, such as:

- ResNet is relatively easy to optimize: "simple" networks (which simply stack layers) show a large learning error when the depth increases.
- ResNet makes it relatively easy to increase accuracy by increasing depth, which is more difficult to achieve with other networks.

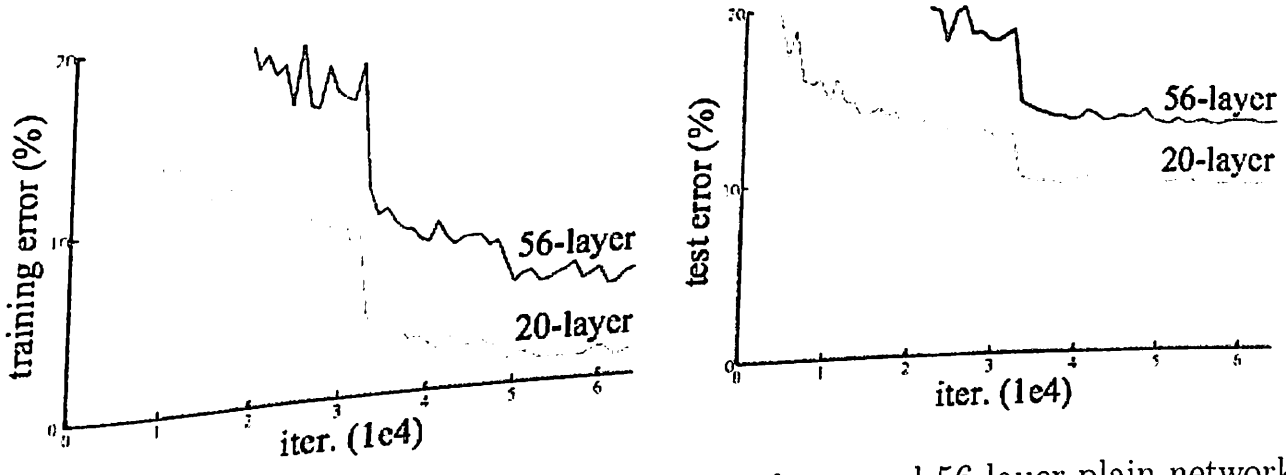

Figure 3.5: The training and testing rate of 20-layer and 56-lauer plain network.

There is a work that compares 2 kind of models, differing by their number of layers: 20 and 56[9].This plot opposes the conviction that including more layers would make a progressively mind boggling capacity, accordingly the disappointment would be ascribed to overfitting. On the off chance that this was the situation, extra parameters for regularization and calculations, for example, dropout or L2-standards would be a fruitful methodology for fixing these systems. In any case, the plot shows that the preparation blunder of the 56-layer arrange is higher than the 20-layer organize featuring an alternate wonder clarifying it's disappointment. The work shows that the highest accuracy and the best result have shown the models with number of layers more than 16 and less than 30.

The disappointment of the fifty six layered neural network model could be accused on the enhancement work, instatement of the system, or the celebrated evaporating/detonating slope issue. Evaporating angles are particularly simple to fault for this, be that as it may, the creators contend that the utilization of Batch Normalization guarantees that the slopes have sound standards. Among the numerous hypotheses clarifying why Deeper Networks neglect to perform superior to their Shallow partners, it is once in a while better to search for experimental outcomes for clarification and work in reverse from that point. The issue of preparing profound systems has been reduced with the presentation of another neural system layer — The Residual Block.

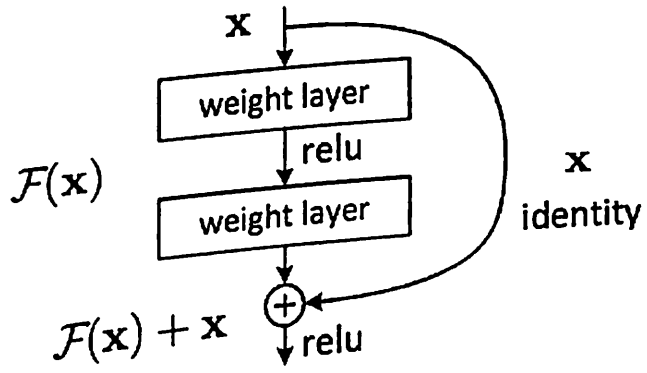

Figure 3.6: Residual block

There is no parameter in character mapping , it is only responsible for including the yield from the past layer to the layer ahead. Nonetheless, some of the time x and F(x) won't have a similar measurement. Review that a convolution activity normally contracts the spatial goals of a picture, for example a 3x3 convolution on a 32 x 32 picture brings about a 30 x 30 picture. The character mapping is increased by a straight projection W to extend the channels of easy route to coordinate the lingering. This takes into account the information x and F(x) to be joined as contribution to the following layer.

$$\mathbf{y} = \mathcal{F}(\mathbf{x}, \{W_i\}) + W_s\mathbf{x}.$$

Figure 3.7: Formula for additional parameter

```
def _shortcut(input, residual):
    """Adds a shortcut between input and residual block and merges them with "sum"
    """
    # Expand channels of shortcut to match residual.
    # Stride appropriately to match residual (width, height)
    # Should be int if network architecture is correctly configured.
    input_shape = K.int_shape(input)
    residual_shape = K.int_shape(residual)
    stride_width = int(round(input_shape[ROW_AXIS] / residual_shape[ROW_AXIS]))
    stride_height = int(round(input_shape[COL_AXIS] / residual_shape[COL_AXIS]))
    equal_channels = input_shape[CHANNEL_AXIS] == residual_shape[CHANNEL_AXIS]

    shortcut = input
    # 1 X 1 conv if shape is different. Else identity.
    if stride_width > 1 or stride_height > 1 or not equal_channels:
        shortcut = Conv2D(filters=residual_shape[CHANNEL_AXIS],
                          kernel_size=(1, 1),
                          strides=(stride_width, stride_height),
                          padding="valid",
                          kernel_initializer="he_normal",
                          kernel_regularizer=l2(0.0001))(input)

    return add([shortcut, residual])
```

Figure 3.8: Keras implementation of the block

The yields from past layers to the yields of stacked ones are kept in Skip connectnos between layers. This outcomes in the capacity to prepare a lot further systems than what was already conceivable. The creators of the ResNet design test their system with 100 and 1,000 layers on the CIFAR-10 dataset. They test on the ImageNet dataset with 152 layers, which despite everything has less parameters than the VGG[4], another exceptionally well known Deep CNN engineering. A troupe of profound lingering systems accomplished a 3.57% blunder rate on ImageNet which accomplished first spot in the ILSVRC 2015 grouping rivalry.

A comparable way to deal with ResNets is known as "expressway systems". These systems likewise actualize a skip association, be that as it may, like a long short term memory cells these skip associations are gone through parametric entryways. These entryways decide how much data goes through the skip association. The creators note that when the gates approach being shut, the layers speak to non-remaining capacities while the ResNet's character capacities are rarely shut. Observationally, the creators note that the creators of the parkway systems have not indicated exactness gains with systems as profound as they have appeared with ResNets. On the off chance that the yield highlight maps

have a similar goals for example 32 x 32 - 32 x 32, at that point the channel map profundity continues as before. The structure is shown in Fig. 3.9:

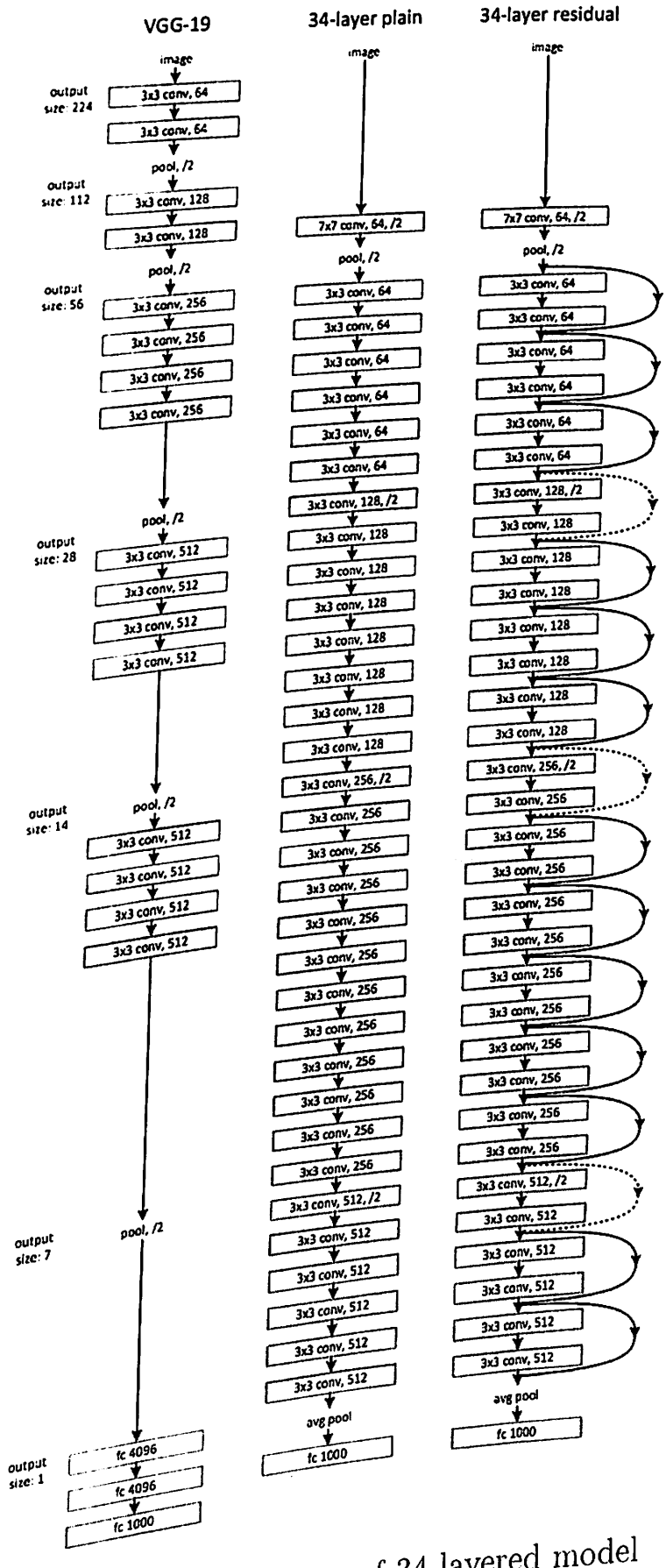

Figure 3.9: Architecture of 34 layered model

3.3 Summarization

There are a lot of works done on text summarization as problem of big data and summarization of data is now one of the significant questions of modern research. For instance, author of the work called " Unsupervised Text Summarization using Sentence Embedding " proposes an approach of text summarization for short texts [4]. The process includes a number of operations for data preparation and then for data processing for summarization. The approach is structured very well and results show good performance. However, its limitation is that this approach works for English, French, Danish language texts and implementation of the method is complicated. As it uses skip-thought vectors the process of training the model takes a long time (from 2 to 7 days).

Another example for text summarization is TensorFlow Summarization method which uses Recurrent Neural Networks and TextTeaser algorithm[5]. It uses traditional Seq2Seq model that refers to deep-learning approach. Implementation is not from the easiest ones and the structure is also.

There is another one which is proposed by Prateek Joshi, member of the community of Analytic and Data Science Processionals community: a method for extractive text summarization by using TextRank algorithm [6]. It includes concatenation of all source texts and splitting the text into sentences, implementing word embedding for every sentence and calculation similarities of those vectors, converting the matrix into graph in order to calculate ranks for sentences and eventually the selection of top ranked sentences.

From the research done on relative works on this task, it can be stated that most of the approaches have differences by means of complexity and time consumption.

3.3.1 Dataset

Dataset for text summarization task is constructed by scraping news from one of the most famous international news agencies of Kazakhstan - www.inform.kz. For web scraping task Selenium, framework designed for automation of testing web applications, is used. This framework lets control interactions of browser and

PC, available on Python, easy to implement and quick. Dataset contains 1422 news in Kazakh language with their title, main text(body), date of publication and keywords (Refer to 3.10).

	title	body	date	keywords
0	Ақтауда «Масат» базарының тең жарты аумағы өрт...	Ақтауда бүгін 18:32-де 23-шағынауданда орналас...	2017 жылғы 1 қаңтар 23:11	Маңғыстау облысы, Оқиға
1	Вашингтоннан ресейлік дипломаттар мінген ұшақ...	Вашингтоннан американдық әкімшілік АҚШ-тан шетт...	2017 жылғы 1 қаңтар 22:46	Оқиға, Америка
2	Еліміздің бірнеше облысында жолдар жабылды	Қазақстанның бірнеше облысында ауа райына байл...	2017 жылғы 1 қаңтар 22:24	Ауа райы, ҚР ІІМ, Көлік
3	Air Arabia авиакомпаниясының Астана-Шарджа ре...	Air Arabia авиакомпаниясының Астана-Шарджа рей...	2017 жылғы 1 қаңтар 21:31	Нұр-Сұлтан, Қоғам
4	Белгісіз адам Ыстанбұлда мешіт жамағатына оқ ...	Белгісіз адам Ыстанбұлда мешіт жамағатына оқ ж...	2017 жылғы 1 қаңтар 20:53	Әлем

Figure 3.10: Dataset of news from inform.kz

3.3.2 Algorithm

Algorithm workflow contains the following steps:

Convert Paragraphs to Sentences

Source text needs to be separated into sentences. One of the most widespread ways of doing it is splitting the source text by period symbol.

Preprocessing the text

Secondly it is necessary to delete unnecessary characters like numbers, punctuation marks, stop words from generated sentences.

Sentence tokenization

In the next step preprocessed sentences need to be tokenized into words.

Calculating weighted frequencies for each word

Further task is to calculate weighted frequency of occurrences for each and every word. Weighted frequency of the word is calculated by dividing its frequency to most occurring word's frequency.

Words replacement by their weighted frequencies

The next step is about plugging the frequencies in place of their words respectively with their weights together and summing them. All the removed symbols and words during preprocessing step will have 0 weights.

Sentence sorting

Eventually, algorithm needs to sort the sentences according to their sum of weights. As the summarization of the sources text sentences with the highest frequencies are taken.

4. Experiments and Results

4.1 Speech-To-Text

Speech to Text model has shown good performance, its accuracy is about 73%. The reason for that is that the model is very keen do depend on trained data, so it is overfitted and in order to solve this problem and increase its accuracy more data should be collected and model should be trained with more data.

1	hello world	low world
2	how are you	how are you
3	my name is	my name is
4	please	please
5	potential oucomes	outcome
6	I am very hungry	a very hungry

Figure 4.1: Testing results of the model

4.2 Hand-Sign-To-Text

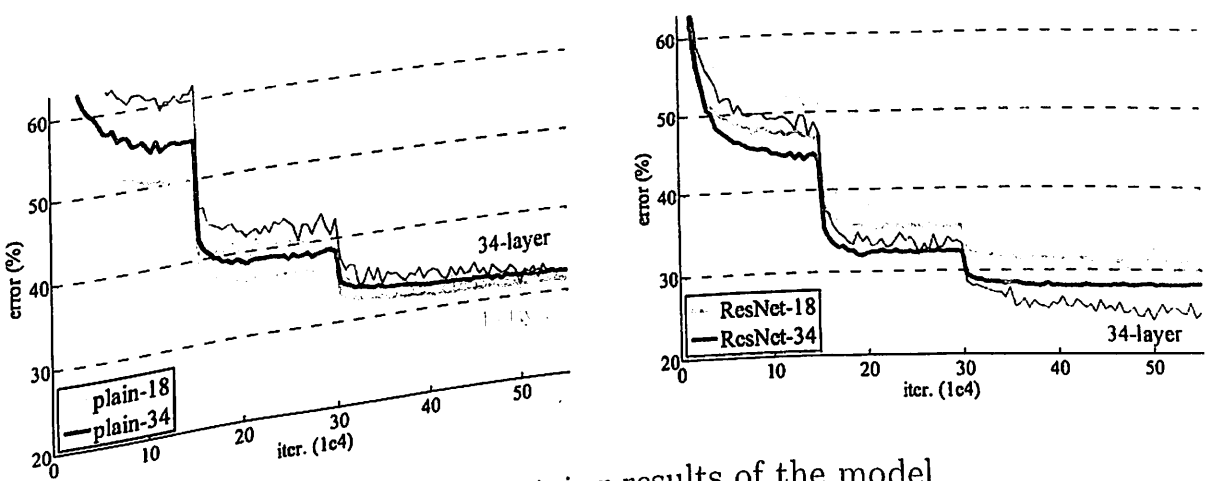

Figure 4.2: Training results of the model

In the picture over, the spotted skip associations speak to duplicating the character mapping by the Ws straight term talked about before to adjust the components of the data sources. Training results graph explanation: The straight line delineates training mistake and the static line portrays testing mistake. The 34-layer ResNet accomplishes sub 30% blunder rate, in contrast to the Plain Network on the left plot.34-Layer ResNet outflanks the 18-Layer ResNet by 2.8

Table Showing Testing Error of the various profundities and the utilization of Residual Connections.

	plain	ResNet
18 layers	27.94	27.88
34 layers	28.54	**25.03**

Figure 4.3: Testing Error

Finally it can be stated that Skip Connection is an exceptionally fascinating expansion to Convolutional Neural Networks that have experimentally appeared to expand execution in ImageNet characterization. These models can be utilized in different assignments requiring Deep systems too, for example, Semantic Segmentation, Localization and others. Lingering Networks are not quite the same as Long Shor Term Memory cells which entryway past data with the end goal that not all data goes through. Also, the Skip Connections appeared in this article are basically masterminded in 2-layer squares, they are not utilize the contribution from same layer 3 to layer 8. Remaining Networks are increasingly like Attention Mechanisms in that they model the interior condition of the system contradicted to the information sources.

4.3 Summarization

One instance from the data-set is taken as an example of paragraph that is going to be preprocessed and summarized.

Convert Paragraphs to Sentences

The first thing is to divide the paragraph into sentences as in Fig. 4.4.

1	Белгісіз адам Ыстанбұлда мешіт жамағатына оқ жаудырды, деп хабарлайды Лайф.ру.
2	Жергілікті БАҚ 2 адамның жарақат алғаны туралы хабар таратқан.
3	Олар қазіргі сәтте ауруханаға жеткізілді.
4	Оқиға орнында полиция жұмыс істеп жатыр.
5	Қаскөй ізін жасырып үлгерген.
6	Еске сала кетейік, өткен түні Ыстанбұлда түнгі клубтағы қонақтарды ер адам көліктен оқ жаудырып, қырып салған болатын.
7	Соңғы деректер бойынша, ол 39 адамды өлтіріп, 69-ын жаралаған екен.
8	Әзірге ешбір лаңкестік ұйым бұл әрекетті өз мойнына алған жоқ.

Figure 4.4: News text from the data-set

Preprocessing the text

All unnecessary characters and words were removed from all sentences of the paragraph. (Refer to Fig. 4.5)

Word	Frequency	Weighted Frequency
белгісіз	1	0.50
адам	2	1.00
ыстанбұлда	2	1.00
мешіт	1	0.5
жамағатына	1	0.5
оқ	2	1.00
жаудырды	1	0.50

Figure 4.5: Converted paragraph

Sentence tokenization

Preprocessed sentences were divided into words in order to assign weight and ranks further.

Calculating weighted frequencies for each word

Each and every word of the paragraph which are not stop words were given their weighted frequencies (Refer to Fig. 4.6)

Word	Frequency	Weighted Frequency
белгісіз	1	0.50
адам	2	1.00
ыстанбұлда	2	1.00
мешіт	1	0.5
жамағатына	1	0.5
оқ	2	1.00
жаудырды	1	0.50
лайфру	1	0.50
жергілікті	1	0.50
бақ	1	0.50

Figure 4.6: Calculated weighted frequencies

Words replacement by their weighted frequencies

All frequencies were plugged instead of their assigned words (Refer to Fig. 4.7)

1	белгісіз адам ыстанбұлда мешіт жамағатына оқ жаудырды лайф ру	0.5+1+1+0.5+0.5+1+0.5+0.5+0.5=6.0
2	жергілікті адамның жарақат алғаны таратқан	0.5+0.5+0.5+0.5+0.5=2.5
3	қазіргі сәтте ауруханаға жеткізілді	0.5+0.5+0.5+0.5=2.0
4	оқиға орнында полиция жұмыс істеп жатры	0.5+0.5+0.5+0.5+0.5+0.5=3.0
5	қаскөй ізін жасырып үлгерген	0.5+0.5+0.5+0.5=2.0
6	еске сала кетейік өткен түні ыстанбұлда түнгі клубтағы қонақтарды ер адам көліктен оқ жаудырып қырып салған	0.5+0.5+0.5+0.5+0.5+1+0.5+0.5+0.5+0.5+1+0.5+1+0.5+0.5+0.5=9.5
7	соңғы деректер бойынша адамды өлтіріп жаралаған	0.5+0.5+0.5+0.5+0.5+0.5+0.5=3.0
8	әзірге лаңкестік ұйым әрекетті мойнына алған	0.5+0.5+0.5+0.5+0.5+0.5+0.5 = 3.0

Figure 4.7: Words replacement

Sentence sorting

Sentences are sorted and the ones with highest ranks were chosen for the summary of the source text (Refer to Fig. 4.8) .

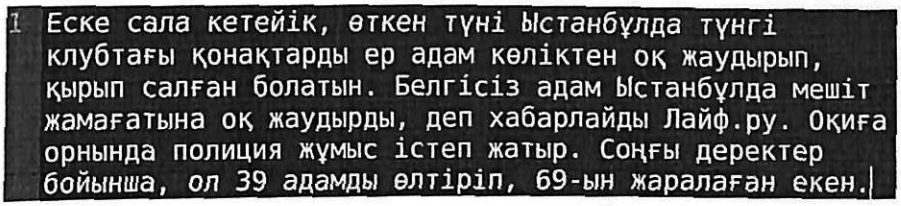

Figure 4.8: Summary

It can be seen that chosen texts could summarize the initial paragraph very well without loosing important information. The paragraph's summary can be judged easily. In order to have more instructive and meaningful summary several top ranked sentences can be included in output.

5. Discussions

Deep learning algorithms are very cool and effective things to use in a modern computer science field. However, it can come up with several problems as it works with very large scale of data. During the work I have faced with number of problems that affected the overall time, efficiency and performance. The first problem is about the power of my computer. As the data that should be used to train my model is very large (eg. hand sign to text model) it required big RAM size and GPU to process it. As a solution for this problem I have used Google Colaboratory that provides with 12GB NVIDIA Tesla K80 GPU, 12.72 GB of RAM, 62.40 GB of free space as a memory that can be used during the process. It was much more effective and faster. However here the second problem appeared, the internet connection. If the internet connection is weak, Google Colaboratory may through you away from the process, while training the model it is a big problem. Because if the process is cut in a middle, the model has to be trained from the start. In order to solve this issue after making some research on the internet I found one way of saving it and even if the connection is lost the last changes will be saved. This piece of code that run in console of browser is shown below:

```
function ClickConnect(){
console.log("Working");
document.querySelector("colab-toolbar-button#connect").click()
}

setInterval(ClickConnect,60000)
```

Figure 5.1: Preventing data loss in case of connection interruption

There is also one more trick for preventing the trained data loss - checkpoint. Checkpoints - saved parameters of trained model to that time. It is very useful

when your model is very deep and it take a lot of time to train it. I save the checkpoints on the middle of training process. In pytorch is very easy to save and load pretrained models. So, in my opinion it is the good solution for data scientists who have same issues.

6. Conclusion

This research work proposes the solution of academic inequity problems of students with specific disabilities like deafness. The main task was to construct a system that will ease the communication between deaf and dumb students and the environment by integrating an algorithm that transforms hand gestures into text, speech into text and etc. Proposed system converts multilingual speech into text. Conversion is realized by extracting information from speech signals. Two models ResNet and VGG16 were trained and compared. Results of research work have shown that it is possible to build an algorithm for deaf and dumb peoples. According to the fact that there is no comfortable conditions provided nowadays at universities, it is vital to implement this kind of system / algorithm. It is possible to reach equity in education and society in general, see potentials of disabled people and give them the opportunity to gain knowledge and get a job only by equalizing the chances of getting knowledge first. By reaching the equity in education, we can help both government and disabled people by means of reducing unemployment, increasing work power and save such people from isolation and loneliness. Further research will include implementation of it in educational sphere, specifically in lectures of universities and colleges. Also for text summarization implementation of abstractive text summarization for Kazakh texts as a new method. In addition to that it will involve its implementation in the main system for converting texts into gesture. In addition to this, dataset of audios in Kazakh language must be collected in order to train Speech-To-Text model for Kazakh language. Dataset may contain audio-books, audio versions of popular Kazakh dictionaries and most frequent audio messages on messengers.

References

[1] C. Z. Davi Hirafuji Neiva, *Gesture recognition: A review focusing on sign language in a mobile context, Expert Systems with Applications.* 2018.

[2] WHO, *Deafness and hearing loss, World Health Organization WHO.* web. article, 20 March 2019.

[3] M. Stampar and K. Fertalj, *Artificial intelligence in network intrusion detection.* 2015 38th International Convention on Information, Communication Technology, Electronics, and Microelectronics (MIPRO), 2015.

[4] B. Tohtahunov, *Kak realizuetsya prava lyudei s ogranichennymi vozmozhnostyami?* web. article, 2018.

[5] S. Shamiluulu, M. M. Boukar, and Z. Yussupova., *Medical tool for assisting patients in Kazakhstan polyclinics.* 2017 13th International Conference on Electronics, Computer and Computation (ICECCO), 2017.

[6] *available at https://obk.kz/news/social/education/item/122554-v-kazakhstane-net-ni-odnogo-spetsialnogo-ili-vysshego-uchebnogo-zavedeniya-gde-by-velos-obuc surdoperevodchikov.* V Kazakhstane net ni odnogo uchebnogo zavedeniya gde by velos obucheniye surdoperevodchikov, web article, 17 January 2019.

[7] B. Students Develop Practikality App for Deaf and N. V. P. to Communicate, *https://coolblindtech.com/students-develop-practikality-app-for-deaf-blind and-non-verbal-peopl e-to-communicate/.* web article, 29 January 2019.

[8] B. S. Parton, *Sign Language Recognition and Translation: A Multidisciplined Approach From the Field of Artificial Intelligence.* Journal of Deaf Studies and Deaf Education, February 2016.

[9] CyberGlove, *Cyberglove ii wireless data glove", metamotion, web article, available at.* [Online]. Available: `https://metamotion.com/hardware/motion-capture-hardware-gloves`.

[10] A. G. System, *Apple touchless gesture system for idevices, metamotion, web article, available at.* [Online]. Available: http://www.patentlyapple.com/patently-apple/2014/12/apple-invents-a-highly-advanced-air-gest%20uring-system-for-future-idevices-and-beyond.html%20(access%2010/08/2019).

[11] Z. K. Rafiqul, A. I. Noor, M. Natarajan, and et al, *Comparative study of hand gesture recognition system: SIPM, FCST, ITCA, WSE, ACSIT, CS IT.* June 2012.

[12] M. Neff, M. Kipp, I. Albrecht, and H.-P. Seidel, *Gesture Modeling and Animation by Imitation.* MPI–I–2006–4-008.

[13] A. Shapiro, D. Chu, B. Allen, and P. Faloutsos, *http://www.arishapiro.com/Sand* Controller Toolkit, 2019.

[14] I. Kryvonos, I. Krak, O. Barmak, and D. Shkilniuk, *Construction and identification of elements of sign communication.* Cybernetics and Systems Analysis. Vol. 49, N. 2. P. 163-172., 2013.

[15] I. Krak, I. Kryvonos, O. Barmak, and A. Ternov, *An approach to the determination of efficient features and synthesis of an optimal band-separating classifier of dactyl elements of sign language.* Cybernetics and Systems Analysis. Vol. 52, N. 2. P. 173-180., 2016.

[16] Y. Krak, A. Golik, and V. Kasianiuk, *Recognition of dactylemes of Ukrainian sign language based on the geometric characteristics of hand contours defects.* Journal of Automation and Information Sciences. Vol. 48, N. 4. P. 90-98., 2016.

[17] J. I. Raheja, A. Sadab, and A. Chaudhary, *Android based portable hand sign recognition system, Science Gate Publishing.* P. 1-18. doi: 10.15579/gcsr.vol3.ch1, 2015.

[18] E.-J. Ong and et al., *Sign language recognition using sequential pattern trees.* IEEE Conference on Computer Vision and Pattern Recognition, Providence, pp. 2200-2207 (2012) doi:10.1109/CVPR.2012.6247928, 16-21 June 2012,