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SOME ASPECTS OF MODERN DEVELOPMENT FOR SIGN LANGUAGE RECOGNITION SYSTEMS

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Today, video communication is gaining momentum, it is becoming available in different countries around the world, allowing you to talk and see employees. However, this technology is not available to a large percentage of people with hearing and speech impairments. Gesture recognition and sign language features in video communication systems can overcome this barrier and view video communication at a new modern level.

There is a lot of research on image recognition techniques [1-5], some of them allow you to interact with a computer using hand gestures, including sign language recognition.

Recognition and classification of images [6-10], in particular gestures, is not a new task, but active research in this area has been carried out in the last decade, which is associated with the rapid development of artificial intelligence methods [9-14]. Gesture recognition from video sequences requires the separation of both spatial and temporal features, which, in turn, requires the development of new or improvement of existing recognition methods [15].

The main task of sign language recognition is to obtain the translation of gestures in the form of text for communication between ordinary people and people with hearing impairments. Areas of application of this direction – systems of contactless human-machine interaction [9, 10].

A sign language recognition video communication system can become really important in the lives of people with hearing impairments and in the lives of those around them. Thus, it is possible not only to give the opportunity to communicate with people with hearing impairments at a distance in cases where text messages are not enough, but to communicate with people who speak and do not speak sign language. Video communication is a sign language to text or voice translator.

Gestures – are various body movements that are a non-verbal way of conveying information.

Movement of fingers, hands, head, shoulders, facial expressions: all of the above are gestures. With the help of gestures you can convey an independent information unit, supplement the verbal series, convey feelings, etc. Movements are divided into static (perceived simultaneously) and dynamic (perceived in a certain period of time),

they have a certain interpretation in manual alphabets and contactless human-machine interfaces.

A hand gesture recognition system – is a set of computer technologies and mathematical algorithms that allows you to solve the problem of recognizing a certain group of hand gestures.

Gesture recognition can be used, for example, in the following areas of human activity:

– Control of computer and household devices:

1) In a computer application, each hand configuration is mapped to a specific command. The person shows a gesture, the system recognizes the configuration of the hand and sends the necessary command to the computer;

2) The position of the palm is compared with the position of the mouse cursor on the screen. Hand movements lead to cursor movements. Commands to click the mouse buttons are compared with different hand configurations;

3) Recognized fingertip positions can be used to control a computer or home devices with a few fingers at the same time;

– Creation of natural human-machine interfaces for the deafblind people:

1) Gesture recognition can be used to enter text into a computer using hand gestures, which is easier and more natural for deafblind people than entering text using a computer keyboard;

2) Gesture recognition can be used to create online communication applications when network bandwidth is low and video communication is not possible. Having recognized hand gestures at one end of the network, you can show the animation of the same gestures at the other end, transmitting over the network only the characteristics of the displayed gestures;

– Manipulation of three-dimensional models of objects. To work with three-dimensional models [16], usually use a computer mouse, which is not very convenient for this task. Having three-dimensional coordinates of a hand and fingertips, it is possible to create the Human-Computer Interaction system which will allow to operate models in all directions of three-dimensional space;

– Virtual reality applications. By supplementing the gesture recognition system with devices such as stereoscopic glasses, you can create virtual reality software applications where the user can “touch” imaginary objects.

Nowadays, in order to learn a language, it is enough to have access to the network from any device. Every day, a large number of sites appear on the Internet, through which you can find many methods and lessons of learning foreign languages, including video lessons.

The created mobile applications are aimed at learning in an exciting way any language, but sign language is a unique language that differs from others by a non-verbal way of transmitting information. Words and sentences in sign language are shown through hand gestures, fingers and facial expressions. One gesture of sign language can mean a letter, a word and even express feelings.

The handwritten alphabet or the dactyl alphabet – is an alphabet used in dactylology that reproduces the spelling of a word with the help of the fingers. Communication with a dactyl is considered verbal. To indicate a letter, change the position of the fingers.

Most letters of the dactyl alphabet are similar to the printed ones, which makes it easier to learn. Possessing a manual alphabet, there is communication between a deaf person and a hearing person. However, difficulties may arise during such communication when the person does not speak sign language. To solve these problems, research is being conducted to create automatic sign language translation systems and systems equipped with a more natural human-machine interface for deaf people.

Given that the handwriting alphabet has only a fraction of the gestures used in deaf-mute language, automatic handwriting recognition opens the way for more natural human-machine interfaces, removes the communication limitations faced by deaf people in everyday life.

Unlike people who become deaf as a result of an accident or illness, people who are deaf from birth prefer sign language instead of plain text. They find it easier to accept and display gestures than to read or type on a computer or phone keyboard.

There are various sign languages in the world, American deaf culture is one of the most developed, American Sign Language (ASL) is the basis for the development of recognition systems for other sign languages.

According to the World Health Organization, there are 360 million people with hearing impairments and deaf people in the world. Given the rapid development of communication technologies, the problem of communication of people with hearing impairments continues to be relevant. There are more and more studies to solve this problem every day. Consider the current developments in the field of simultaneous translation from sign language.

One of the areas of sign language translation is related to the development of robotics. Machine translation from sign language has been possible since 1977, when a robotic arm was created. Later, the use of cyber-gloves with motion sensors became the main one, such projects as CyberGlove and VPL Data Glove appeared. Using cyber gloves is one way that allows a computer to track a person's movements and translate them into spoken or written language.

In 2002, Ryan Patterson, in the United States, developed a simplified glove. The device allows you to track the gestures of the deaf alphabet, and then wirelessly transfer data to a portable device that displays text on the screen. The glove had to be taught to feel the hand of a particular person. More useful are gloves that can capture entire characters. For example, CyberGlove has 18-22 sensors and connects to a host computer via a serial cable (CyberGlove, n.d.); while VPL Data Glove has sensors that are fiber-optic transducers that measure finger bending angles.

A practical example of the use of these technologies is the SignAloud project implemented by a group of students from the University of Washington. With the help of two gloves equipped with sensors that monitor movement and transmit data to a computer system via Bluetooth, the developers were able to translate into English American Sign Language (ASL).

Despite the high accuracy, these technologies impose certain restrictions on users: the need to use special technical devices, the inability to take into account the articulation.

Kinect Sign Language Translator – is a translator developed in 2012 by a Chinese team in collaboration with the Microsoft Research Asian team. The translator consists of two modes: translation mode and communication mode. Translation mode is able to translate individual gestures into written text (words) and vice versa. Translator mode can also determine hand postures and shapes, as well as trajectory, using machine learning, pattern recognition, and computer vision technologies. Communication mode can translate complete sentences, and the conversation can be automatically translated using a 3D avatar. The Kinect peripheral to the Microsoft Xbox360 gaming console is used to read gestures.

SignAll – is an automatic system of the Hungarian company Dolphio Technologies for the translation of American Sign Language (ASL). The works have been underway since 2015. This study is based on computer vision and natural language processing (NLP), uses Microsoft's Kinect and webcams with depth sensors (depth sensor and 3 webcams) connected to a computer. Computer vision technology reads the gestures and facial expressions of a deaf person, and the natural language processing system converts the collected data into a simple English phrase. The disadvantage is that a complex structure of three cameras, a sensor and a computer must be installed to read the sign language.

MotionSavvy – is a device for sounding American Sign Language and vice versa. Developed in 2012 by a team from the Rochester Institute of Technology (National Technical Institute for the Deaf). The team used a tablet with a Leap Motion sensor. The Leap Motion 3D controller recognizes hand movements performed by the user over the surface of the tablet. As a result, the image of the gesture is displayed on the screen and it is translated into text or voiced.

The Sign2 Conversion System was designed to convert American Sign Language (ASL) to English (written and spoken). The current system only includes finger gestures in a controlled environment using computer vision, but the long-term goal is to translate complete offerings in natural environments, including integration with personal digital assistants (PDAs) and smartphones.

Not only large companies make efforts to make better and more comfortable communication of people with hearing impairments with the external environment. Deaf programmer Oleksiy Prykhodko presented a prototype of a system that is able to translate sign language into the text of his native language.

Oleksiy Prykhodko is the only deaf programmer in the world who is working on creating an automatic gesture translator into audio language. According to him, today there are many companies that claim to have been able to create a ready-made translator for the deaf, but there is no “perfect” among them.

The program that Prykhodko is working on works by analogy with the human brain. With the help of the camera, it recognizes the picture and captures the gestures, which it then converts into images. Then they are translated into a model and processed by a system that compares them with the data in the neural network. After the complete processing process, the computer displays a text translation that already corresponds to the gestures.

The method of randomized decision forests is a machine learning algorithm used in classification, regression and clustering problems. In gesture recognition problems,

this method is used to recognize the positions of key characteristics of the human body and to classify the configuration of the hand. It is on this technology that the human gesture recognition system released by Microsoft in 2010 is based. This method allows you to recognize the positions of 20 parts of the body, including the positions of the palms of both hands, receiving at the entrance one far-sighted image of a person. Positioning of the desired points of the body is carried out with the help of random forests of solutions, which are learned by sampling images from 100,000 different poses of the human body.

So, it is established that the practical significance of gesture recognition on video is not limited to sign language translation; gesture recognizer can be integrated into other systems, such as virtual or augmented reality technology, interfaces for entering information using gestures, game development.

Because of this, research, development and implementation of gesture recognition tools on video sequences using artificial intelligence apparatus [17-19] are important and urgent tasks not only for the development of information technology, but also for the development of society as a whole.

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