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## VIDEO TRANSCRIPTION SYSTEM

**Abstract:** The system for transcribing video files into text created by the authors using Yandex SpeechKit. This system will provide significant assistance to both teachers and students.

**Key words:** Transcribing audio and video into text, Yandex SpeechKit, text processing in Russian.

**Language:** English

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### Introduction

Creating a system for transcribing audio and video into text is currently a very urgent task for SPbPU. Since the beginning of the coronavirus pandemic (spring 2020), education has partially (and sometimes completely) switched to remote mode. For example, in the current academic semester (January-June 2022), despite some improvement in the epidemiological situation, most lectures at SPbPU are held online for the entire semester. At the same time, more than 8600 foreign students are currently studying at SPbPU [1], and the knowledge of the Russian language of some of these students is not good enough (since most of them also studied Russian remotely). Therefore, hearing information from lectures is problematic for many of them. Such a system would also be very useful for Russian-speaking students, since in this way it is possible to automate the creation of an electronic lecture notes.

### Problem statement, review of analogues

When developing a transcription system, the following tasks were set:

- The client part of the system should be as light as possible - it is needed only for downloading video / audio and outputting the final text, all the main

resource-intensive operations are carried out on the server;

- The system should be centralized and accessible to all teachers and students of SPbPU;
- The system should "understand" the Russian language well, but at the same time allow the output of the final text in English and other languages.

Let's consider similar transcription systems that can work with the Russian language:

1) Azure Cognitive Services [2] is a collection of customizable pre-built AI models that can be used to add AI to applications. Speech SDK allows us to create voice applications, transcribe speech to text with high accuracy, produce natural-sounding text-to-speech voices, translate spoken audio, use speaker recognition during conversations, and explore with a no-code experience and create custom models tailored to our app. The disadvantage of this SDK is the worse work with the Russian language than the method we have chosen (see below), the high cost (and now the impossibility of a legal purchase on the territory of Russia).

2) Google Speech-to-Text [3]. One of the best solutions for English. Among other things, the API allows speech adaptation by the ability to provide hints to boost the transcription accuracy of rare and

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domain-specific words or phrases. The API allows us to choose from a set of trained models for voice control, phone calls, and video transcription, optimized for the quality requirements of a particular domain. Cons - payment for portions of the translation, which measured in increments rounded up to 15 seconds, and problems currently with payment from Russia.

3) VideoScripto [4]. According to the developers, it is a tool for modern speech recognition. However, it was not possible to verify this - a subscription is needed to test the application, the site has problems with browsers other than Chrome. It is not specified which API the authors use.

4) SnatchBot [5]. According to the developers, SnatchBot incorporates its proprietary machine learning expertise and uses the most advanced deep-learning neural network algorithms to audio for speech recognition with high accuracy. Cons - the system only works with audio files or a microphone, not video. Also, you have to pay to use the system.

5) Speechpad [6]. The application allows us to translate audio texts from html5 video and audio formats, as well as from youtube videos. For html5 video and audio formats, you need to specify the URL of the media file, to play a youtube recording, you need to enter the ID of this entry in Youtube. Cons - the impossibility of directly downloading files (without specifying the URL); working only with the Chrome browser; it is not clear which API the authors use.

6) Voco [7]. Voco.Professional and Voco.Enterprise enable speech recognition from audio recordings. The conversion is carried out in a special plug-in for the MS Word editor with the display of the audio recording in the player and the connection of the sound with the recognized text. Recognition is performed locally on the user's computer, which ensures Voco's performance even in the absence of a network. Cons - works with audio files only (or a microphone), not video files. Also, you have to pay to use the system.

7) RealSpeaker [8]. It is a transcription service for audio or video files. It works with a large number of languages, including Russian. Cons - the first one and a half minutes are decrypted for free, then you need to pay 8 rubles for each minute. Also, a disadvantage for some teachers may be the fact that within 24 hours the working file is available to everyone and cannot be hidden - all user files are saved in the "My Media" folder. It is not specified which API the authors use.

8) Transcribe by Wreally [9]. The service, in which we can transcribe a file or dictate the text ourselves, supports self transcription (since 2011) and automatic transcription (since 2018). Machine learning is used, and the accuracy, according to the authors, reaches 90%. Cons - with Automatic Transcription, given the amount of computing

resources needed, authors charge an hourly rate to process transcripts.

9) Speechnotes [10]. Speechnotes is based on Google's speech-recognition engines. Therefore, the accuracy, according to the authors, reaches 80-95%. Cons - per minute payment for service.

10) Zapisano.org [11]. Unlike previous systems, this is a platform where not software, but professional transcribers will prepare text or subtitles for you. The price of each transcript is individual - it all depends on the complexity of the work, but it is high for mass use by teachers and students.

11) Yandex SpeechKit [12]. SpeechKit provides two ways to recognize speech:

a) Streaming recognition is used for real-time recognition. With streaming recognition, SpeechKit receives short audio fragments and sends the results, including intermediate ones, within the same connection.

b) Recognition of audio files. SpeechKit can recognize audio recordings both synchronously and asynchronously. Synchronous recognition has strict limits on file size and duration and is suitable for single-channel audio recognition up to 30 seconds. Asynchronous recognition can handle multi-channel audio recordings. The maximum length of a file is 4 hours.

Audio recognition in any mode occurs in three stages:

- Highlighting words. For each word, several hypotheses are put forward.

- Word recognition. The language model tests hypotheses and determines how the new word is consistent with previously recognized words.

- Word processing. In the recognized text, numerals are converted to numbers and some punctuation marks (such as hyphens) are placed, after which the result is sent in the response body.

This review did not include popular transcription systems that do not work with Russian, such as Rev [13], Transcription Panda [14], GoTranscript [15], Temi [16], Express Scribe Pro [17] and others.

The authors of this article already had experience with Russian language processing applications from Yandex (see, for example, [18]), and we liked this experience. The use of Yandex SpeechKit is not free, but SPbPU has currently received a grant from Yandex. Therefore, it was decided to use Yandex SpeechKit.

### System description

Based on the requirements received, a client-server architecture was chosen with a server located in the spbstu.ru domain. The server is located at speech.open.spbstu.ru and its appearance is shown in Fig. 1. When creating the site, Laravel framework [19] was used. Let us briefly describe the procedure for working with the service. After authorization, go to the /files section to upload a video file (or audio file).

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Uploading is done using the “Add file” button (see Fig. 2). The next step after uploading the file is to receive a token from Yandex - the “Get Token” button is used for this (see Fig. 2). The next step is to extract the audio channel from the video file (the first audio channel is currently being extracted, plans for the near future include selecting an audio channel to extract from the file and mixing the audio channels), for this, the FFmpeg library is used [20]. To do this, use the “Convert” button. This button also uploads the extracted audio to Yandex Cloud. After some time, the system will give the status OK and you can perform the following steps. To send the text for analysis and recognition, you need to click the “Recognize” button - after that, the analysis will be performed using the link to the audio file in Yandex Cloud using Yandex SpeechKit. The system will record the analysis operation code and start recognition. The average

recognition time is estimated as follows: recognition time = audio duration / 10. For example, for an audio duration of 60 minutes (1 hour), the recognition time will be about 6 minutes. If the procedure was successful, then you can click “Get status” and get the result of the analysis. If there is no result, then the “Get status” button will not disappear. The speech is broken down into phrases - the recognized text itself in the form of a numbered set of phrases will be available by pressing the “Get Text” button. The recognition quality depends on the original audio quality. According to our estimates, for studio recording the accuracy reaches 95%, for conference video - 85%-90%. You can also get subtitles for the original video file - for this, our system brings the object from Yandex to the .vtt format. An example of recognizing a lecture on thermodynamics is shown in Fig. 3.



Fig. 1. System appearance

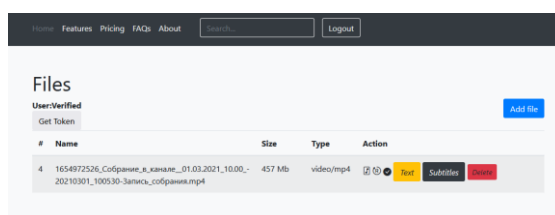


Fig. 2. File handling process

61: немецкий физик вот да значит в девятьсот шестом году  
62: предположил  
63: что при низких температурах теплоемкость сильно зависит от температуры  
64: сильно так сильно что ее нельзя выносить со знака интеграла  
65: да эта функция сильно зависит от температуры причем как она зависит  
66: она достаточно быстро уменьшается с уменьшением температуры  
67: соответственно выносить значит еще раз говорю за знак интеграла нельзя да это будет уже тоже функция f  
68: вот и соответственно  
69: если эта функция такая то что здесь у нас получается величина порядка нуля  
70: поэтому уже никакого противоречия не будет ну и соответственно у нас нерст выдвинул свою  
71: постулат или так теорема или еще называют третье начало термодинамики  
72: при абсолютном нуле температуры  
73: энтропия принимает постоянное значение с нуля

Fig. 3. Recognized speech example

## Conclusion

Currently, the system is being actively tested by SPbPU teachers. We received a lot of positive

feedback, as well as ideas for improving the system, which we are going to implement in the near future.

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