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*Odessa National Academy  
of Food Technologies*



**International Competition of Student Scientific Works**

**BLACK SEA SCIENCE 2021**

**Information Technology, Automation and Robotics**

**Proceedings**

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## **ANALYSIS OF LIP-SYNC TECHNOLOGIES AND POSSIBLE WAYS TO IMPROVE THEM**

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**Abstract.** *Lip-sync technology advanced over the years. From hand drawn and synced images of first animated movies, to human live performances on stage, then on screen and finally – using advanced neural networks and variety of other techniques, to automate this process.*

*This work covers a bit of a history behind the lip-sync, dives into technologies of present and discusses about future possible growth ways.*

*The objective of this work is to provide reader with information about past and present techniques of lip-sync.*

**Keywords:** *lip-sync, neural networks, wavelet transform, animation, translation, GAN, LST.*

### **I. INTRODUCTION**

Lip-sync can be described in different ways: a) transferring the voice actor's articulation to a cartoon character; animating the mouth; b) synchronizing the sound and visuals. In this work, we will look at how lip-sync has evolved, what it has come to, and finally, how it might evolve.

### **II. LITERATURE ANALYSIS**

#### **2.1. Lip-sync appears.**

The idea of lip-sync, or sound dubbing, emerged almost immediately with the advent of sound movies. It's believed that one of the first films in which songs were recorded separately in the studio, was the legendary American musical Broadway Melody of 1929.

During production, studio executives were unhappy with the sound of one of the musical's most dynamic and striking numbers, Painted Doll. Sound engineer Douglas Shearer suggested a solution that was a real breakthrough - to record the song separately. The actors, in their turn, would perform the number to the already prepared track. This helped preserve the technical complexity and visual impact of the performance without sacrificing quality.

Then in the 50's with the development of cinema, lip-sync became even more popular. The technique was also popular for use in various television programs. The viewers' skepticism of lip-sync slowly subsided and attitudes improved. Its use became common practice.

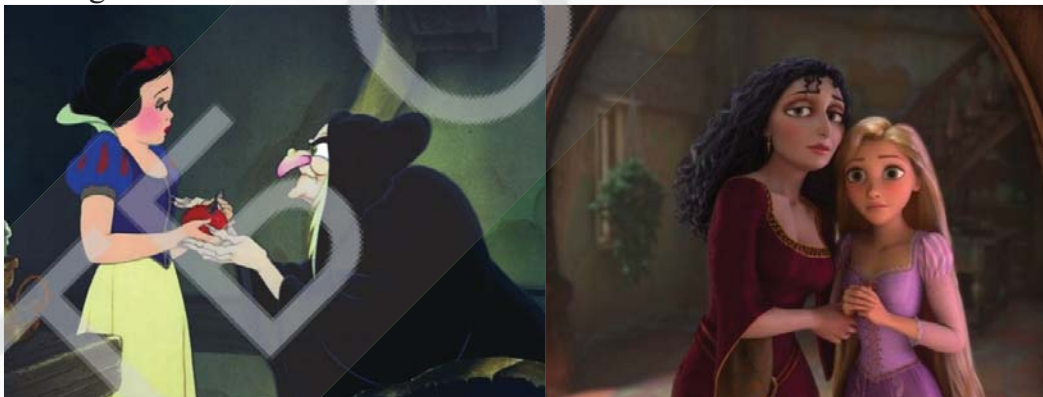
The normalization of lip-sync and "Scopitons" - music machines invented in France that could play video - also normalized. In the 60's they were installed in bars and cafes. The user could choose the video himself. Most often it was the

performances of artists, in which they sang along with the soundtrack. We can say that these were the first prototypes of music videos. In 1981, a channel with music videos MTV appeared. Partly because of this, lip-sync finally gained a foothold in the music medium. [1]



The use of lip-sync can also be found in animation. The example of Disney's first full-length animated film "Snow White and the Seven Dwarfs" shows that it was a very difficult and long process. More than 100 animators worked on the project for three years, more than a million drawings were made, but the final version of the cartoon included about 250,000 [2].

Due to the fact that nothing stands still and everything evolves, the animation process is now more streamlined. Nowadays, Disney uses computer animation, and the first groundbreaking cartoon was "Rapunzel: The Tangled Story. Animations that evolved from a million drawings came to computer animation, that is, in its own way a breakthrough.



## **2.2. Neural networks.**

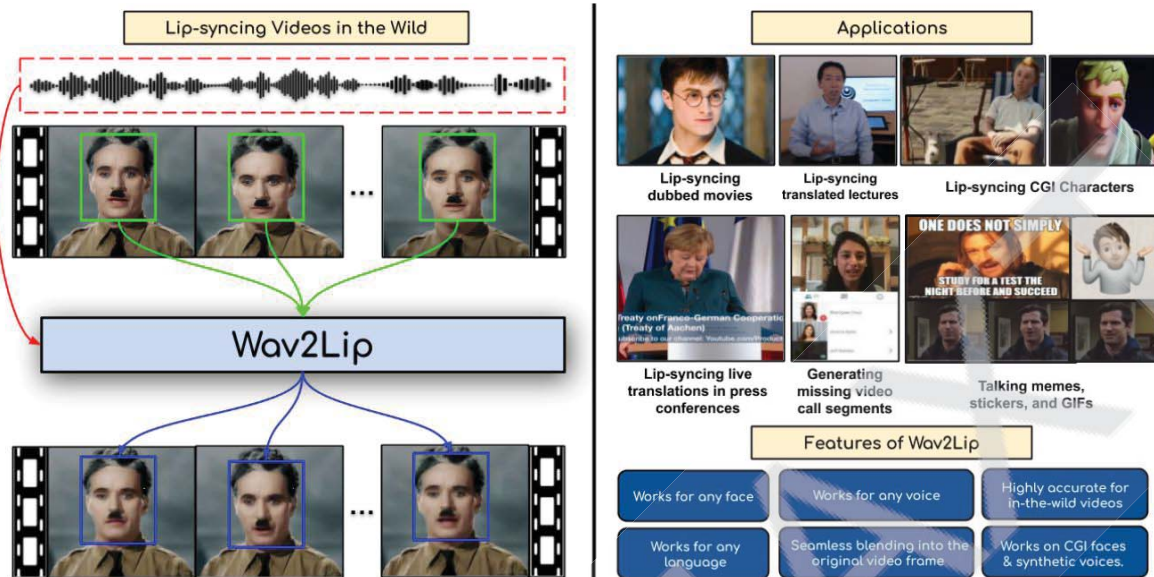
As you may have noticed earlier - lip sync is a complex and painstaking work of actors and animators, but even such material can easily be ruined by mistakes on the part of both the actors and the people behind the voiceover.

Therefore, there was a need for a quality lip sync with minimal cost to the creator, and at the same time - a high quality of the material.

As in many other industries, it is logical to use neural networks to solve such complicated tasks.

So to solve translation problems, a Wav2Lip [3] -like neural network can be used, which analyzes both audio and video signals to find the face of the person speaking and analyzing the sound to find the spoken sounds that have a bright

articulation.



The main difference between this neural network and all the subsequent networks that are specified in this paper is the presence of several neural networks for one common goal, but two different tasks.

So the main task is the phoneme recognition and face generation, but there is also a second network, which analyzes and evaluates the quality of the generated material, concerning the presence of artifacts images, and artifacts generated by the speech apparatus.

The same neural network shows the best results on test material, in the synchronization and quality sections of the generated material. The result becomes a little worse if the second network responsible for evaluating of the material is given more frames to evaluate. LipGAN uses only one frame, and while this makes a more synchronized video, in practice the quality of the articulation plays a greater role for people, taken into consideration that the time errors are not that great. As shown in table, if you increase the number of frames to analyze them from 1 to 5, the accuracy drops from 79% to almost 92%, and the other metrics become better about a third.

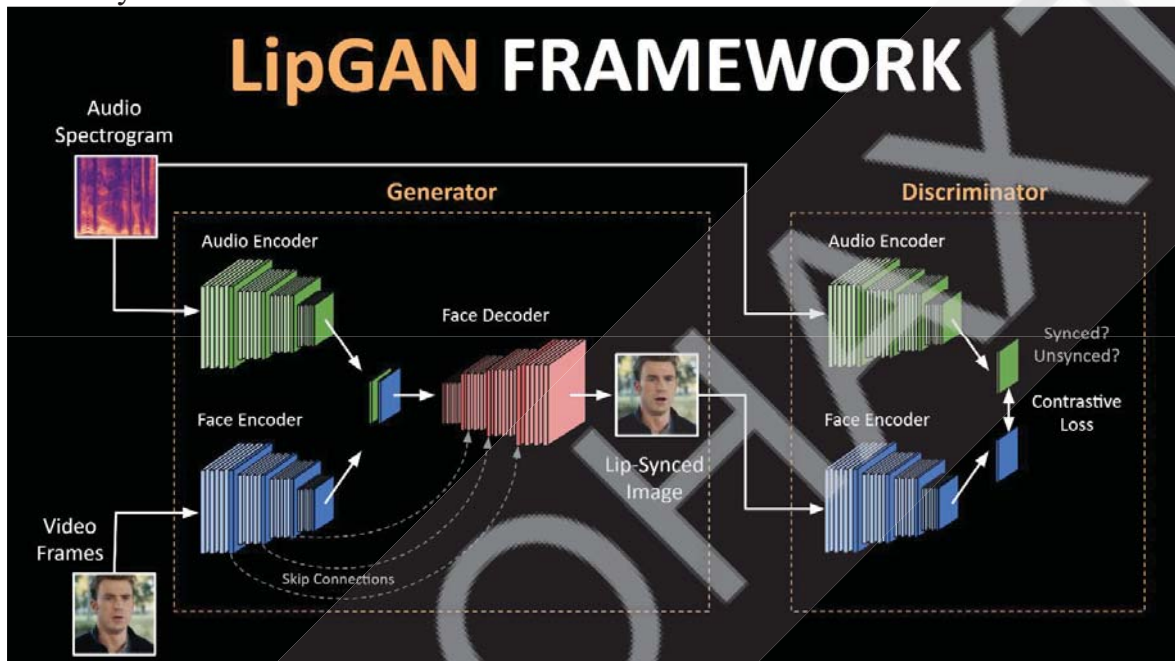
Model	Fine-Tuned?	Off-sync Acc.	LSE-D	LSE-C
LipGAN $Tv=1$	✓	55.6%	10.33	3.19
$Tv = 1$	×	79.3%	8.583	4.845
$Tv = 3$	✓	72.3%	10.14	3.214
$Tv = 3$	×	87.4%	7.230	6.533
$Tv = 5$	✓	73.6%	9.953	3.508
$Tv = 5$	×	91.6%	6.386	7.789

It is also clear that such a neural network is applicable only to those works where the talking person is a human being.

However, it is not always necessary to translate a work or a speech, for example, if during the training it became necessary to show a historical figure with his quote; earlier you would have to draw a face, or to stick the drawn out lips to the

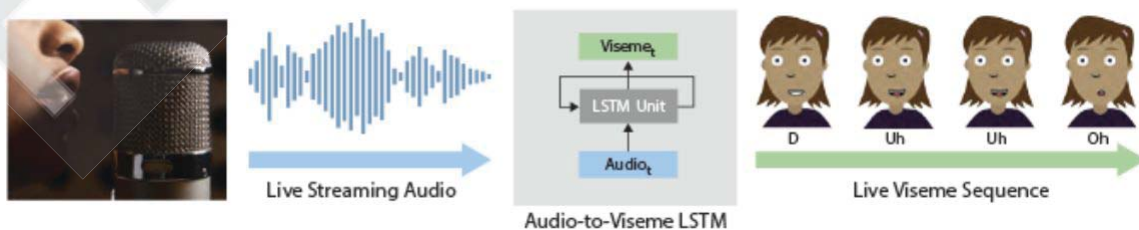
portrait of the personality, which spoils the overall importance of the quote and gives comical effect.

Using LipGAN [4] you can solve this problem, and a few others along the way. LipGAN neural network analyzes the video stream, which can be a static picture and the sound track, and outputs a realistic video with synchronized mouth and sound movements. So, for example, you can "animate" Elizabeth I and give her own quote at history class.



The same technology, according to the authors, will allow game developers to create believable facial animations for the characters of their games with multiple localizations.

However, if you are the author of your own animations or a streamer that doesn't want to show his face, CharacterLipSync [5] can help you. This neural network uses pre-drawn emotions and sounds to create a video stream in real time. It can be used with or without face tracking. Like all neural networks above, it analyzes the audio track, but the video signal here is completely generated without tracking (which is often done during streaming), so the neural network not only analyzes the audio and picks up the mouth for the character it needs now, but also creates a transition between each shift, which manually takes much longer time to do even if all the mouths were placed at once.



One of the phoneme detection techniques can be the use of a wavelet transformations [6], which use neural networks to adjust the coefficients. Using these

transformations, it is possible to find the boundaries of phonemes. A phoneme is the one of the smallest units of speech that make one word different from another word. It is possible to select phoneme from sound library, and this is also a good job for neural networks. Selection of the threshold coefficient shows how small is the difference between the sounds should be in order to differentiate the phonemes. For example, when the coefficient is small, some closely spaced sounds can repeat the previous ones, or form fused phonemes. Therefore, choosing the right ratio is important in order to properly identify the current sound, which will allow us to make a better-looking lip-sync.

### **III. OBJECT, SUBJECT, AND METHODS OF RESEARCH**

Object of study: Methods of lip-sync (-s), history of lip-sync (-s).

Subject of study: Possible improvements to current lip-sync methods (-a).

Research methods used in this research: analysis of scientific literature and publications, generation of possible ways to improve current methods.

### **IV. RESULTS**

Using the above mentioned methods in combination with, for example, a silent access interface(SAI), it is possible to increase the accuracy of phoneme recognition, which will increase both the quality of their placement due to the fact that the neural network will spend less time searching for them, and the visual quality due to the released time. The same without the use of SAI, but taking advantage of some features of the organism, which were investigated during the creation of such interfaces. Having a picture of proper quality, you can analyze the shifts of the throat during a conversation, or, if possible, analyze the movements of the tongue and changes in the shape of the mouth. The last two tips are much better applicable to people voicing recordings, but the combination with SAI will improve accuracy for all sides of the recording.

We can also point out that with a better machine vision algorithm and more accurate calibration of the estimation for the Wav2Lip network, better generation quality results and more accurate timing can be achieved.

And since the world's technology giants like Nvidia, Samsung and others have recently created products using this technology, there is a possibility of its improvement in the near future.

### **V. CONCLUSIONS**

In conclusion, we can say that lip-sync technology has evolved since the middle of the last century, and continues to evolve to this day. Using modern methods of analysis and synthesis it is possible to create creative works faster and easier than ever before. What a time to be alive!

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## **CYBERSECURITY AS A METHOD OF COMBATING UNAUTHORIZED INFLUENCE IN THE FIELD OF INFORMATION SECURITY**

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**Abstract:** *The article describes the main problems, the protection of user's data, methods of combating unauthorized impact in the field of information security. Comparison of antivirus programs.*

*This work demonstrates that at the moment there are still many people who can be cyberattacked in obtaining important information.*

**Keywords:** *cybersecurity, password, protection, data, hacking, phishing, antivirus.*

### **I. INTRODUCTION**

Today we cannot imagine our life without technologies. They have flooded the world, helping, entertaining, educating us. Almost everyone has his own smartphone, laptop or computer, which contains confidential information. But many of us make mistakes that can cause to obtaining that information, by third persons. Just then we think of cybersecurity. It has become an important component of our digital lives.

Unfortunately, every year some of the most popular passwords make it to the top are: 123456, 123456789, qwerty and so on (full list[1]). This means that many devices are exposed to threats of hacking and obtaining confidential information. At the same time, everyone knows not to use easy passwords, and many sites and applications are already prompting about the security of the passwords entered, and are trying to prevent logging in with simple passwords. Also one of the most popular ways of obtaining data is phishing, which is a type of Internet scam aimed at gaining

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The collection includes student works of the participants of the competition, which were not included in the number of prize-winners. The texts of the competitive works are published in the form in which they were submitted by the authors. The authors of the articles are responsible for the content and form of submission of the material.

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