



# LEAD ME Winter Training School Madrid 2021

**Media Accessibility Training: Sign Language and Subtitling for the Deaf and Hard-of-hearing**



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# AUTOMATIC SUBTITLE GENERATION SYSTEM WITH ARTIFICIAL INTELLIGENCE ASSISTANCE IN TVE

Laura Feyto Álvarez

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**LEAD-ME**



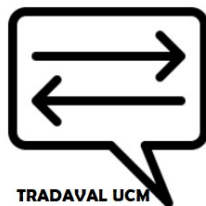
Funded by the Horizon 2020 Framework Programme of the European Union

- **Introduction:**
  - Who we are and where we are
  - Overview of accessibility services at TVE
- **Automatic subtitling project:**
  - The need
  - Development
  - Results
  - The future

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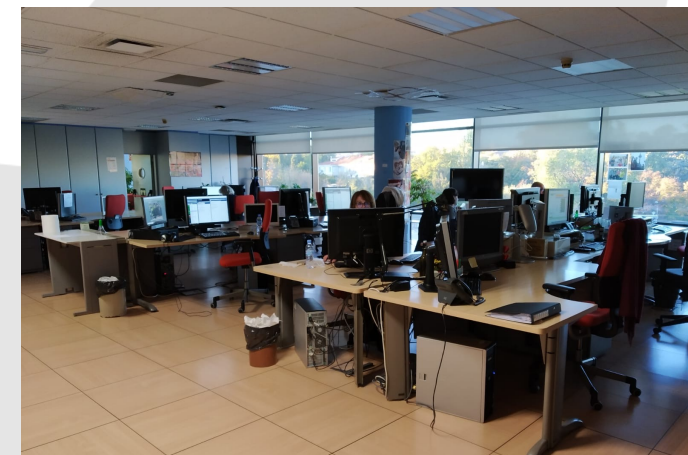
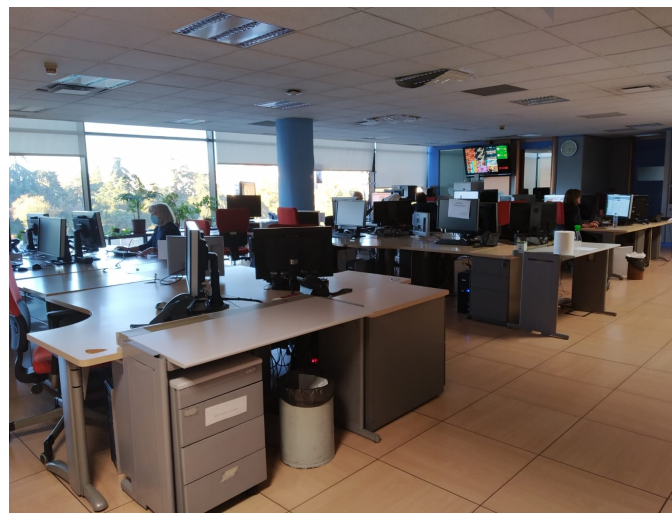
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## Introduction

- **We are a 40 people team**
- **We are on the 3<sup>th</sup> floor in Torrespaña Building A**
- **We work 365 days, 21,5 hours per day (from 05:30 h to 03:00 h)**



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## Introduction

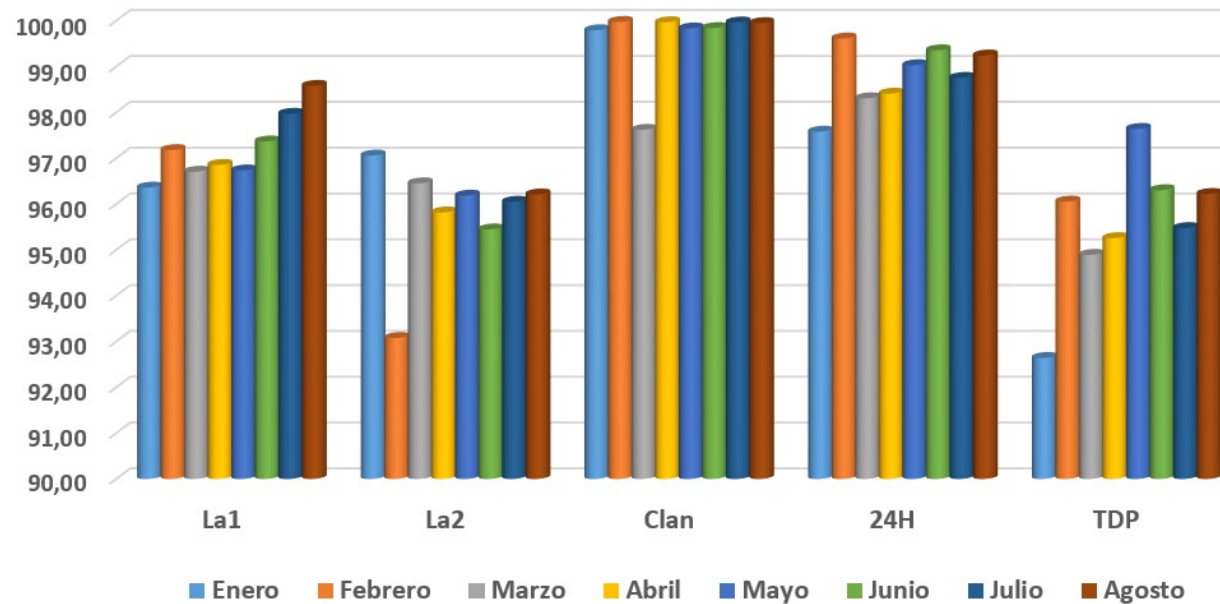
- **TVE is a public broadcaster**
- **Is therefore obliged to meet certain requirements in terms of accessibility.**
- **These requirements are reflected in the audiovisual law.**
  - 90% subtitled programming
  - 10 hours per week with sign language
  - 10 hours per week with audio description

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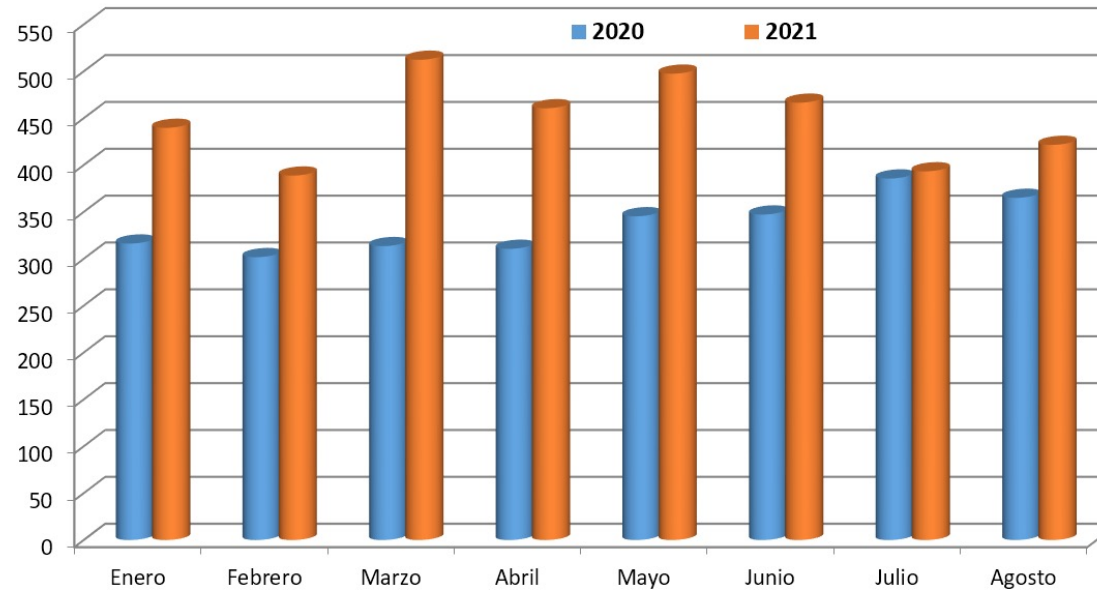


## subtitled hours during early 2021



- 1 star tve HD
- 2 euro tve
- 24h ame tve
- tdp asia tve
- clan

## Audiodescribed programs during early 2021



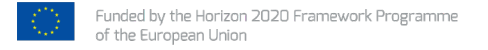
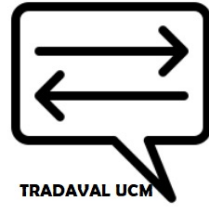
1  
2  
clan



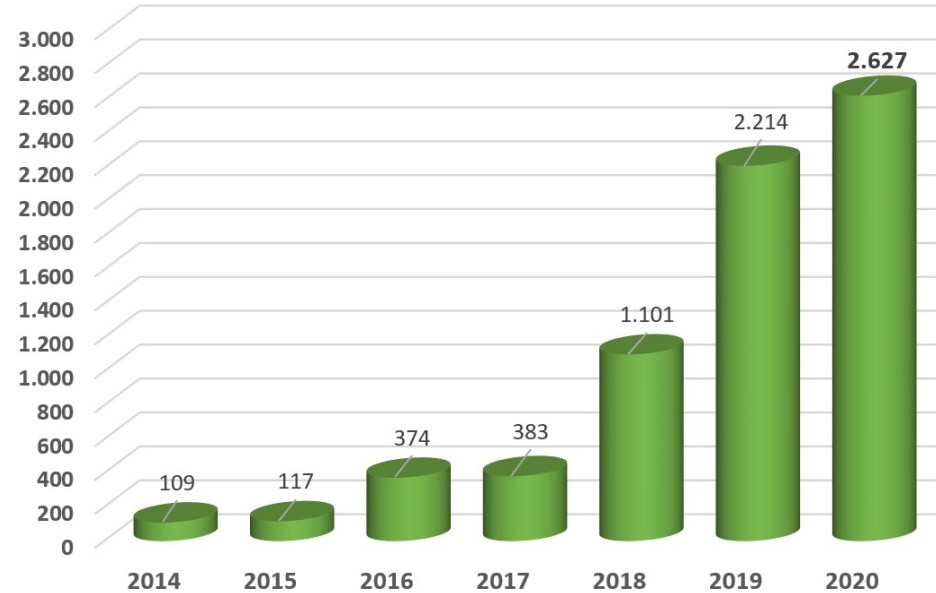
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## Sign language evolution in the last years



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## Automatic Subtitle Generation System with A.I. assistance in TVE

### The need:

- We have 17 territorial centers in which its regionals news programs are broadcast simultaneously
- 11 of these centers use only Spanish language in their programs.
- The impossibility of bringing together 11 stenotypists or 11 re-speakers simultaneously to do manual subtitling for these live news programs led TVE to use a cloud-based automatic live subtitling system.

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## Automatic Subtitle Generation System with A.I. assistance in TVE

### The need:

- 9 Autonomous Communities: La Rioja, Madrid, Murcia, Extremadura, Asturias, Cantabria, Andalucía, Castilla la Mancha, Castilla León and Aragón
- A regional program in Canarias
- 2 daily regional news broadcasted (14:00 and 16:00 hours) in each Community.

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# Automatic Subtitle Generation System with A.I. assistance in TVE

## Development

- An automatic captioning system developed by softLab research group at the University Carlos III of Madrid
- This system does not require human interaction.
- To perform its functionality, the system only needs the audio of the program to generate the captions through a speech-to-text cloud service.

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# Automatic Subtitle Generation System with A.I. assistance in TVE

## Development

The system is divided into two components:

- hardware
- software

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# Automatic Subtitle Generation System with A.I. assistance in TVE

## Development

Hardware: consists of two main elements:

- the bridges
- the cloud services

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# Automatic Subtitle Generation System with A.I. assistance in TVE

## Development

- The bridges are responsible for connecting TVE equipment to the cloud services. The system uses two types of bridges.

Audio bridges: obtains the live audio signal from TVE. It then sends the audio to the cloud services through a cable connection to the internet.

Caption bridge: receives a stream of encoded captions from the cloud and send them to the closed captioning broadcast equipment through RTVE's internal network

- The cloud services are a set of processes hosted in the cloud that are responsible for performing the operations necessary to convert the audio stream into a live caption stream.

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# Automatic Subtitle Generation System with A.I. assistance in TVE

## Development

### Software:

regarding to the cloud services, these are the most complex part of the system. It contains a series of sequential services, which are responsible for detecting the speech in the audio and obtain the corresponding text for live transmission.

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# Automatic Subtitle Generation System with A.I. assistance in TVE

## Development

### Sequential services:

- Gatekeeper.
- Recognizer.
- Diarizer.

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# Automatic Subtitle Generation System with A.I. assistance in TVE

## Development

### Sequential services:

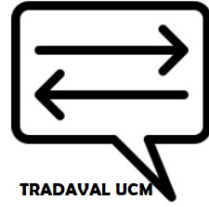
- Gatekeeper: It starts receiving audio from the audio bridge before the start of the newscast, it waits to receive the headline tune of the newscast, indicating that the newscast has started. As soon as the start of the program is detected, it passes the audio to the rest of the system to start the captioning output.

In the case the tune is not detected, there is a timeout to start captioning.

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# Automatic Subtitle Generation System with A.I. assistance in TVE

## Development

### Sequential services:

- Recognizer: it progressively receives the audio from de Gatekeeper, initiating the speech-to-text (S2T) or automatic speech recognition (ASR) process to convert it into a text.

Additional information is added in the text like punctuation, pauses, reliability of each word or time in wich it is pronounced in the audio.

And some substitutions are made in the text like change of numbers to digits or Roman numerals, among others.

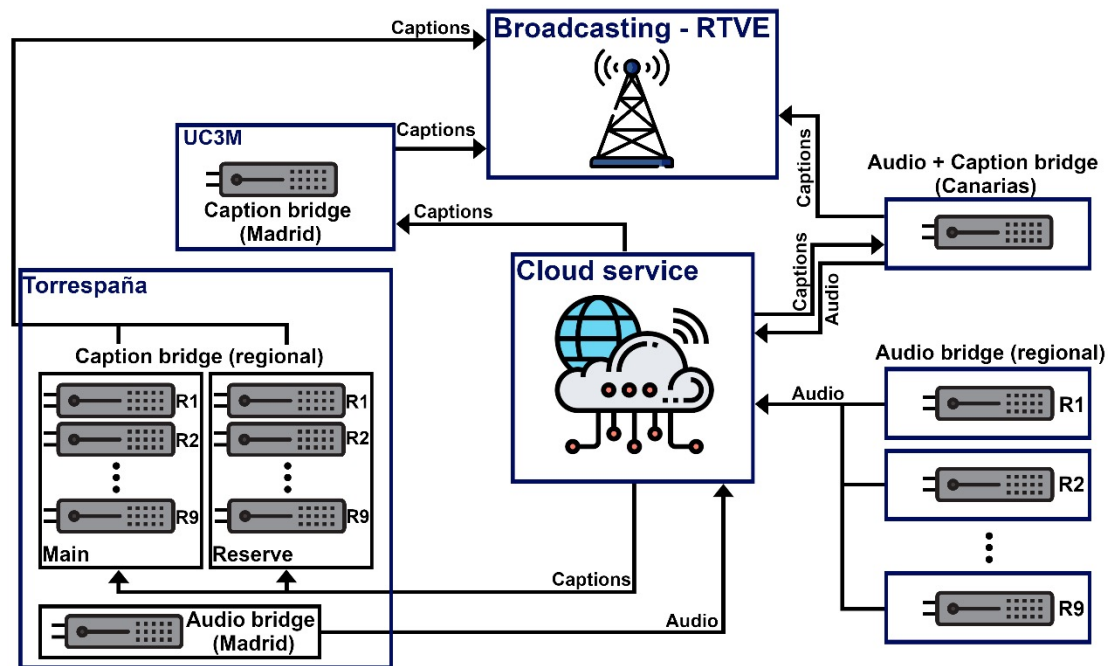
- Diarizer: it is a preliminary version

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# Automatic Subtitle Generation System with A.I. assistance in TVE

## Development





## Automatic Subtitle Generation System with A.I. assistance in TVE

### Results

- The accuracy of the captions generated by the system is in a range between 3,8% and 7,9% in terms of WER
- The average latency of the captions generated by the system is between 2,2 y 6,54 seconds in relation to the audio used by the system
- The average accuracy is between 85,16 y 92,06 %

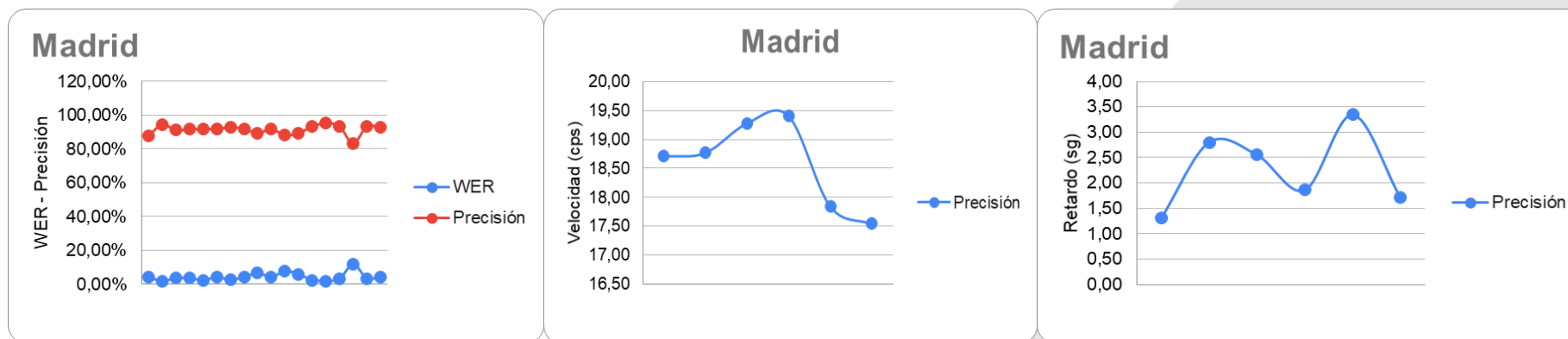
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# Automatic Subtitle Generation System with A.I. assistance in TVE

## Results



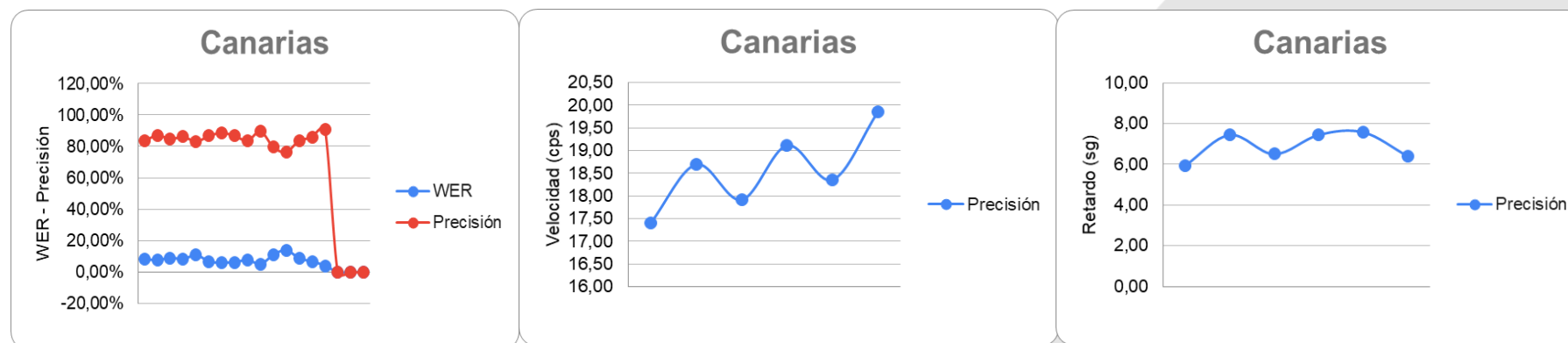
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# Automatic Subtitle Generation System with A.I. assistance in TVE

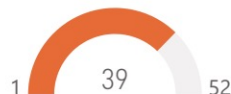
## Results





## RESULTADOS SUBTITULADO AUTOMÁTICO

Semana



243

Muestras analizadas

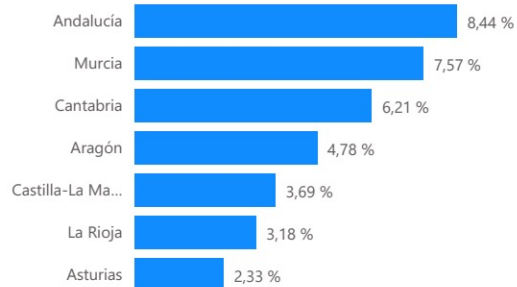
90,79

Precision % Media

4,89

WER % Media

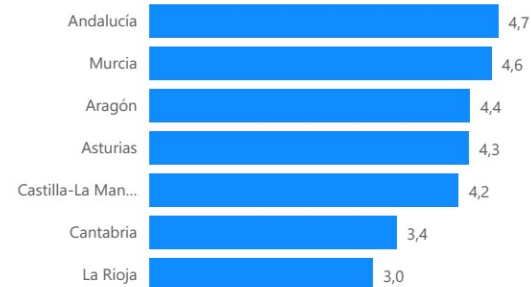
### WER Semanal (%)



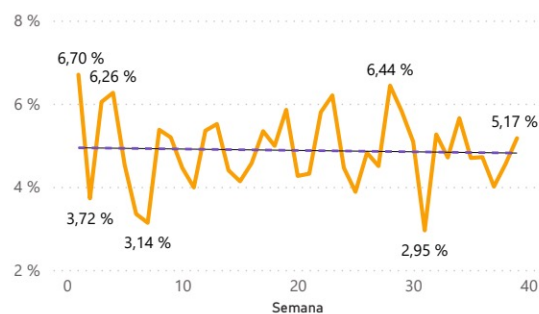
### Precisión Semanal (%)



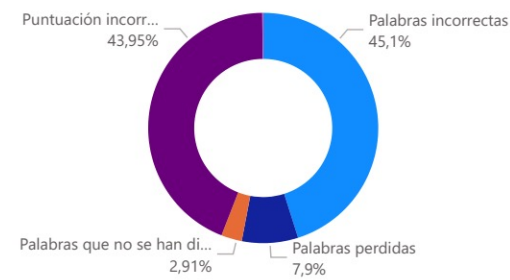
### Retardo Semanal (seg)



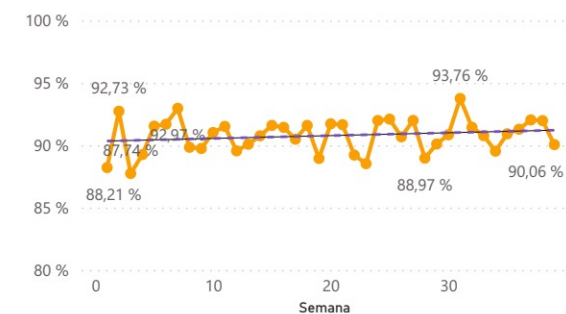
### Evolución WER



### Distribución de errores



### Evolución de Precisión



## Results

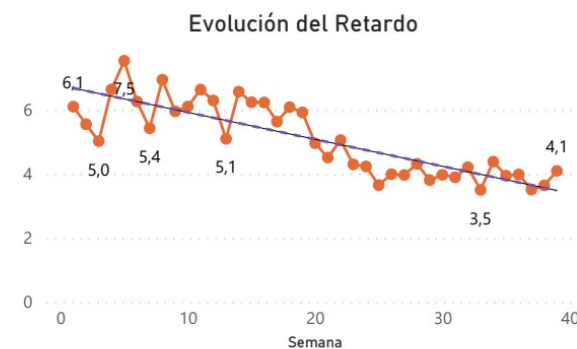
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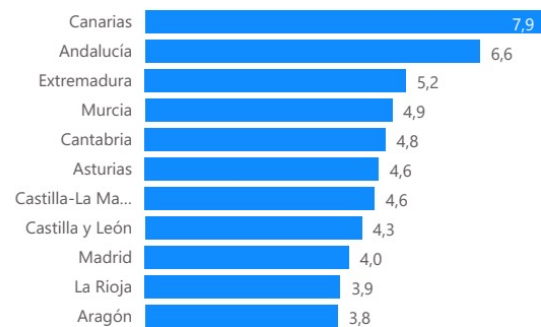
## Results

Territorial ▼

☐ Andalucía  
☐ Aragón  
☐ Asturias  
☐ Canarias  
☐ Cantabria  
☐ Castilla y León  
☐ Castilla-La Mancha  
☐ Extremadura  
☐ La Rioja  
☐ Madrid  
☐ Murcia



WER Medio (%)



Precisión Media (%)



Retardo Medio (seg)



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# Automatic Subtitle Generation System with A.I. assistance in TVE

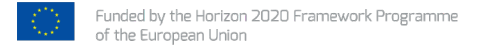
## The future

- **Improve the diarizer**
- **Improve accuracy**

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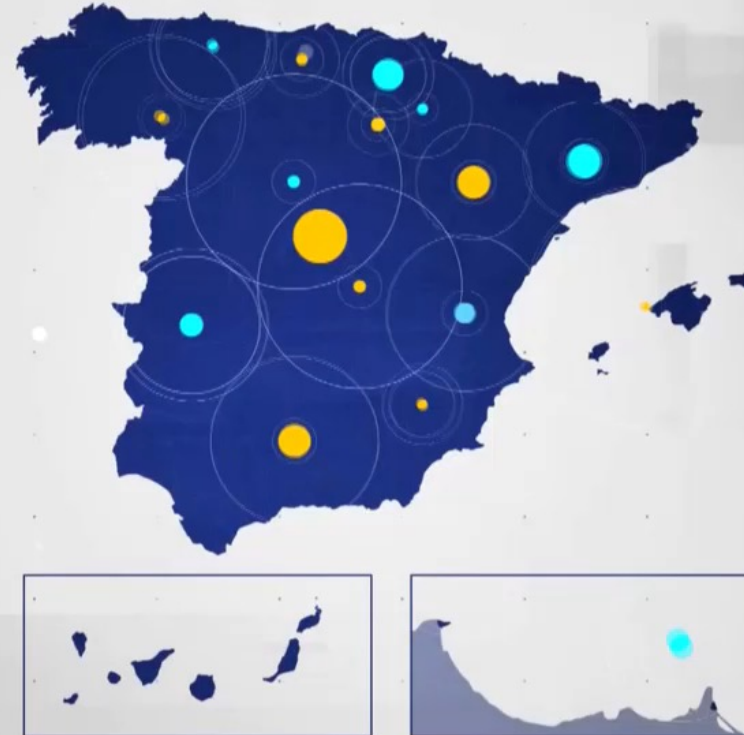
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And the example!

La1HD 16/11/2021 14:00:00. 01



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# Thanks for your attention!

If you have any questions, please don't hesitate to contact me: [laura.feyto@rtve.es](mailto:laura.feyto@rtve.es)

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