Video Analysis for Interactive Story Creation: The Sandmännchen Showcase

Miggi Zwicklbauer[1], Willy Lamm[1], Martin Gordon[1],
Konstantinos Apostolidis[2], Basil Philipp[3], Vasileios Mezaris[2]

[1] Rundfunk Berlin-Brandenburg, Berlin, Germany
[2] CERTH-ITI, Thessaloniki, Greece
[3] Genistat, Zürich, Switzerland

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Introduction

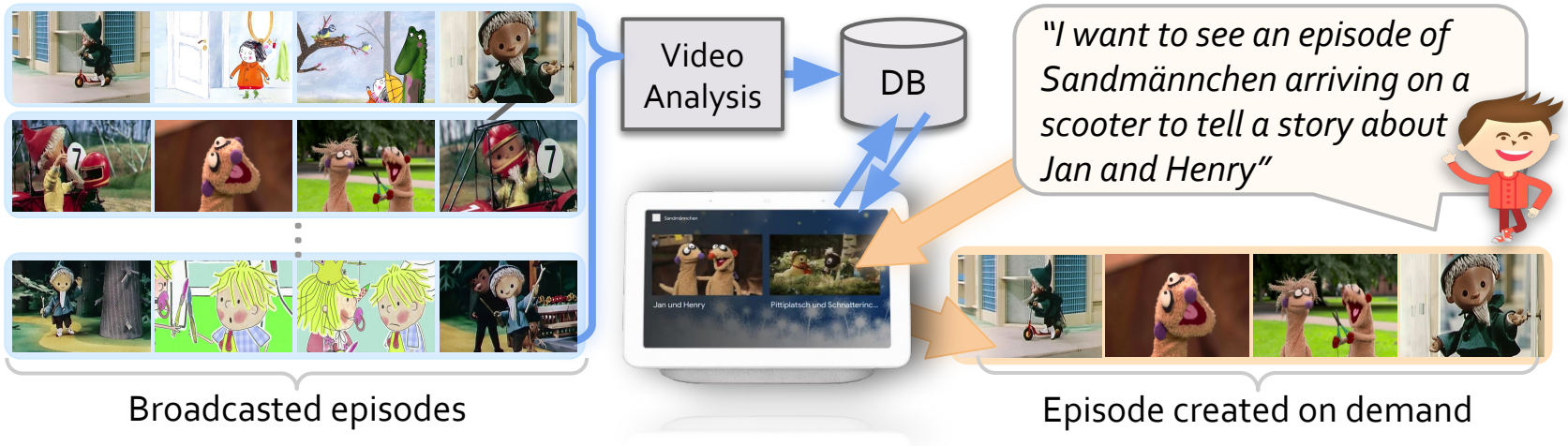
- The days of a passive public depending upon a handful of selected broadcasters for their information and entertainment are long gone
- Thanks to the internet, professional content creators and owners can create new, or reinvent existing, broadcast channels to successfully find an audience for their content

Introduction

- In the ReTV project we have intensively explored and researched how end users can benefit from AI-based recommendation and user profiling systems
- We present a method to interactively create a new Sandmännchen story
- Sandmännchen is a well-known children's programme from Rundfunk Berlin-Brandenburg (rbb)
- Seven-minute show broadcasted daily
- Targeted at pre-school children and accompanies them to bed with a bedtime story at 18:00

Introduction

- We built a smart speaker application which:
  - Interacts with the user
  - Selects appropriate segments from a database of episodes
  - Combines them to generate a new story



Video Analysis framework

- To be able to create customized Sandmännchen episodes, we constructed a video analysis framework.
- The goal:
  - Fragment a Sandmännchen episode taking into consideration the peculiarities of the application domain
  - Annotate the main story part with the main involved character

Video Analysis - Temporal Segmentation

- Each Sandmännchen episode has three parts:
  - The introductory part
  - The main part of the episode
  - The closing part

Video Analysis - Temporal Segmentation

- In order to segment an episode to its three parts, we must detect:
  - The intro transition (i.e., transition from the introductory part to the main story)
  - The outro transition (i.e, transition from the main story to the closing part of the episode)

Video Analysis - Temporal Segmentation

- In most cases, the frames around the intro and outro transitions contain a characteristic camera zooming in and out from a screen, respectively
- The screen is different every time, sometimes being a TV screen, other times being just a projection on wall
- The zooming is accompanied with a fading transition, where in most cases the camera zooming fades out to a white frame

Video Analysis - Temporal Segmentation

- We trained a Random Forest classifier on a set of 5 simple frame features that are able to capture the variations of the sought transitions:
  - Edge Change Ratio (ECR)
  - Homogeneity
  - Blackness/Whiteness
  - Blurriness
- We also implemented a DCNN-based method to segment the video to shots by adopting and extending a method of the literature

Video Analysis - Temporal Segmentation

- To detect the three parts of a Sandmännchen episode we employ the Random Forest classifier model for classifying the video frames into two classes: “normal frame” and “transition frame” (frame-level inference)

Video Analysis - Temporal Segmentation

- Taking a further step and not relying solely on the frame-level inference we incorporate the results of shot segmentation for making a video-level prediction
- This is accomplished by employing the following simple domain rules:
  - For a frame to be considered a “transition frame”, it must belong to either the first or the last 1/3 of the video
  - For a frame to be considered a “transition frame”, it must additionally have a temporal distance of no more than four seconds from a shot boundary

Video Analysis - Character Annotation

- The main story deals with a different protagonist each time
- The protagonist can be:
  - a single character (Kalli - a blonde boy) or
  - a character set, which will always appear together (e.g., Rita und das Krokodil - Rita and her very hungry friend, Crocodile)

Video Analysis - Character Annotation

- We selected a subset of 11 out of the total 30 characters/characters set, as can be seen in the table in this slide

Herr Fuchs und Frau Elster
Jan und Henry
Kalli
Der kleine König
Der kleine Rabe Socke
Die Moffels
Meine Schmusedecke
Pittiplatsch, Schnatterinchen und Moppi
Plumps
Pondorondo
Rita und das Krokodil

Video Analysis - Character Annotation

- We decided to employ a DCNN model of the EfficientNet state-of-the-art architecture
- We utilized the weights of an ImageNet pre-trained EfficientNet instance as the initial weights of our model and then fine-tuned it to detect the character of the main story

Video Analysis - Character Annotation

- Our model annotates each frame of an input video with the detection score for each one of the 11 characters/character sets (frame-level character inference)
- Video-level prediction: performing a majority voting over the frame-level predictions, since a Sandmännchen episode deals with the same character/characters set in its entire main story part

Video Analysis Service

- The discussed video analysis techniques have been incorporated into a video analysis component
- This component is deployed as a REST service that:
  - retrieves a video file
  - performs the temporal segmentation of a Sandmännchen episode
  - analyzes the main part to identify the main character, and
  - stores the results in a JSON-structured file which can be downloaded using a specific type of call

Evaluation of Temporal Segmentation

- Using the Random Forest classifier for the detection of the transitions (frame-level inference) → 88.5% F-score
- Employing the additional domain rules, for the prediction of transitions (video-level inference) → 91.7% F-score

Evaluation of Character Annotation

- Using the DCNN model for the frame-level predictions, we observed classes that perform very well but also classes with noticeably bad performance. This is due to:
  - Varying difficulty of detecting each character/characters set due to its specific characteristics
  - The main character/characters set are not necessarily depicted in all analyzed frames
- After employing majority voting to infer video-level predictions → 100% accuracy for all classes

Abendgruß Application

- The Abendgruß is designed for the use with smart speakers with display
- The first prototype was developed as an action for Google Assistant, focusing on the Google Nest Hub
- We use Google's Dialogflow, a chatbot framework integrated with the Google Assistant

Abendgruß Application Voice Commands

- When a user speaks to the Abendgruß application on the Google Assistant, their commands are sent to Dialogflow and mapped to API calls
- Those calls are then sent to the Abendgruß API, which either returns options for the user to choose from, or the customized video in the final step

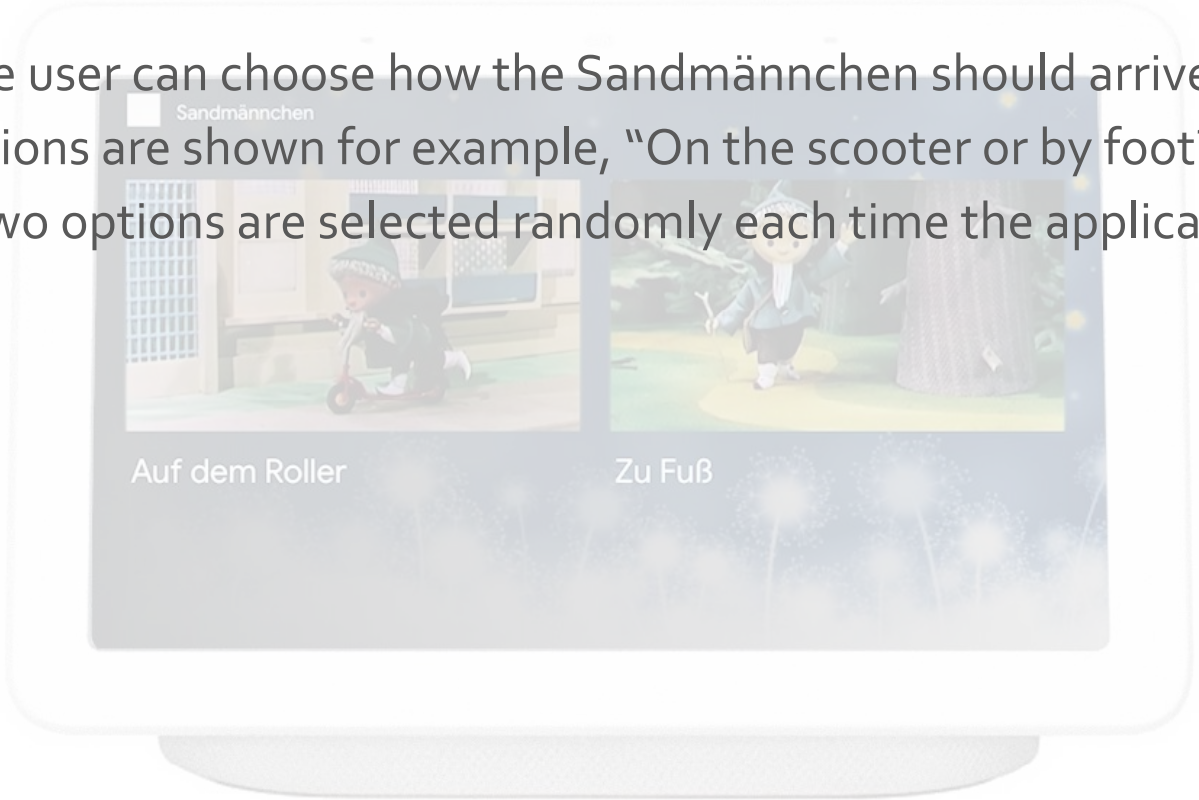
Abendgruß Application

- To start Abendgruß, the user has to say “OK, Google, speak to Abendgruß”
- The Nest Hub answers: “All right, I'm starting the test version of Abendgruß”
- The application opens
- The user sees the start screen and gets a welcome combined with a call to action: “Hello! To watch your own Abendgruß, say the word ‘Abendgruß’”

Abendgruß Application

Abendgruß Application

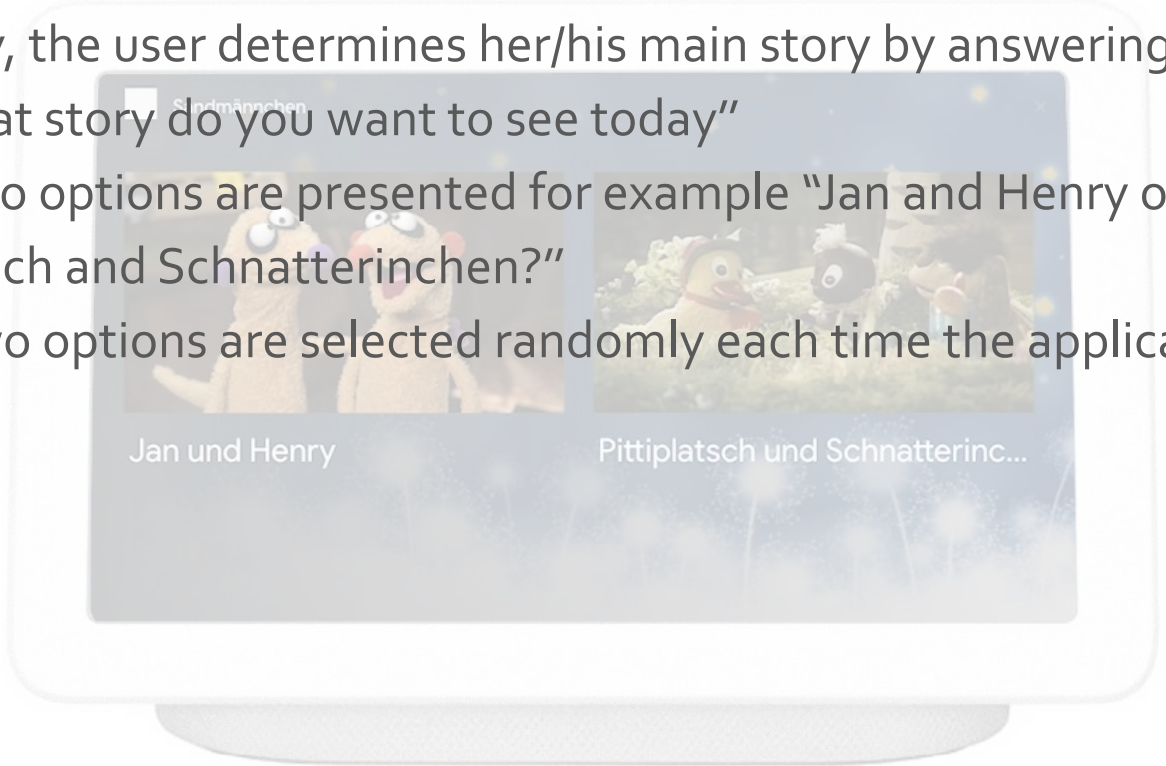
- First, the user can choose how the Sandmännchen should arrive
- Two options are shown for example, “On the scooter or by foot?”
- These two options are selected randomly each time the application is used



Abendgruß Application

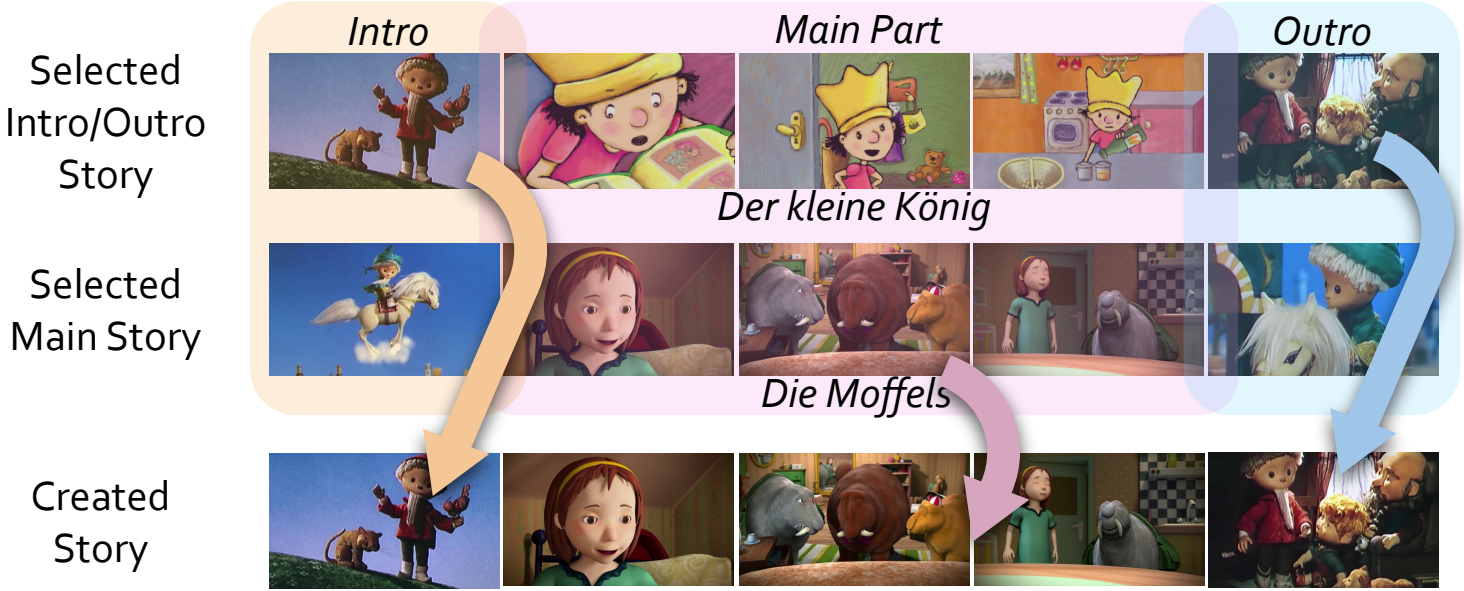
Abendgruß Application

- Secondly, the user determines her/his main story by answering the question “And what story do you want to see today”
- Again two options are presented for example “Jan and Henry or the Pittiplatsch and Schnatterinchen?”
- These two options are selected randomly each time the application is used



Abendgruß Application

- The Abendgruß application finally shows an automatically-generated Sandmännchen video



Thank you!

Contact:
Vasileios Mezaris, bmezaris@iti.gr

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