




nowUP: A System that Automatically Creates TV Summaries Based on Twitter Activity

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Abstract. Users post a lot of related TV information on social networks while they are watching TV, mostly in a connected way with the highlight moments of the TV shows. This paper reports on the nowUP project, targeted at the development of a service that automatically creates summaries of TV programs based on the buzz on social networks. The project premise relies on the idea that social media buzz has the potential to be used as an automatic editorial criterion. In this framework, the project goals include the development of a solution that automatically produces TV summaries of popular television programs (like football matches, talent or reality shows) based on the Twitter activity. The solution is based on a data-mining engine that processes the activity of this social network looking for tweets related with TV shows. Based on the program metadata it indexes the twitter activity; correlates tweets; and creates clusters of peaks, being the relevant clusters associated with the TV highlights. With this, a specific developed video engine automatically edits and creates a full video summary (an edited sequence of TV highlights) and publishes it in an online platform. The paper reports on the solution architecture and features and on the results of its preliminary evaluation. The results show that the solution was very successful in achieving the project main goal and the users are willing to have access to this type of social buzz-based video summaries.

Keywords: TV summaries · Highlights · Editing · Twitter · Evaluation

1 Introduction

Globally, personalization technologies have been adapting contents and preparing the most suitable ones to the users, as in the case of news curation. In addition, video contents take an important role in the users' consumption behavior, competing with newspapers, radio, books, games and podcasts among many others [1]. Media corporations therefore need to increase the users' relation with TV shows, providing customizable content. This includes providing shorter video clips like TV summaries of the programs regularly consumed by the viewers, providing a short and quick overview of past TV shows. This is especially relevant in the actual TV ecosystem where catch-up TV [2] actually allow users to quickly review previously broadcasted programs - however without offering an outline/preview of these contents. Though, taking

in consideration the significant manpower needed to create TV summaries, establishing an automatic alternative for its creation will be a significant outcome.

In this context, the research team was motivated by the opportunity to use the social media buzz as an editorial criterion. Actually, users post a lot of related-TV information on social networks while they are watching TV and, as we observed, the timing of these posts is very close to the most important moments of the TV shows, being it a goal in a football match or an excellent performance of a contestant of a talent show. It was this relationship that the researchers of this project tried to explore aiming to create a system allowing the automatic creation of video summaries of talent shows or sports matches, based on the social activity related to its highlights.

According to Viacom [3], American viewers engage in social networks in an average of ten TV-related activities a week. The extent to which this type of activities is done around premium programs such as Idols, Secret Story and even soccer games and political debates is somehow transversal to many countries. Nielsen Twitter TV Ratings concerning US are quite impressive: in 2014 several TV programs generated millions of tweets resulting in more than a billion impressions each week [4]. In Europe these numbers are also quite expressive. For instance in UK, a study from Kantar Media [5] (about Twitter TV Ratings) shows that in a period of 5 months there were about 40,5 million TV-related tweets, being sport programs the most popular closely followed by entertainment shows. These dynamics strengthen the potential of social networks activity acting as an indicator of the “hot” moments of TV shows. With this in mind a working prototype using Twitter data was developed, combining data mining features with automatic video editing capabilities, to produce summaries for high popularity TV programs like sports or talent shows.

This paper is organized as follows. An initial state-of-the-art concerning solutions for the creation of TV related videos is presented in the next session. Then, in Sect. 3, the nowUP service features are described. Sections 4 and 5 reports on the evaluation process along with the conclusions towards the relevance of such a system and its efficiency when compared to regular editorial manually created summaries. The final section presents the most relevant conclusions.

2 Related Work

2.1 Social Platforms for the Curation of TV Moments

The Twitter Amplify [6] service enables broadcasters to share video content in real time, giving users the opportunity to watch it without leaving Twitter. This solution also manages the distribution and the discovery of that content, allowing for example users to retweet their favorite videos making them available to their own followers, widening the scope of videos in a broader setting [6]. The biggest advantage for content providers is that Twitter Amplify allows them to distribute content as paid information sources by integrating funded sponsors and partners’ content [7].

The Wild Moka solution allows ingesting any video stream (including live TV) and, from pre-patented algorithms, enriching the video content in real time, complementing the flow with metadata from any source and in any format [8]. “Canal +”

(French leader in pay-TV services) adopted the WildMoka Moments Share for its use [9]. This social application allows sharing TV moments from streaming content. In this way, the viewer can select a set of pictures or a short video clip and share it with its friends via various social networks (Twitter, Facebook, Google+ or Pinterest) [10]. In addition to this functionality, the shared content may be supplemented with additional information, such as advertisements, promotional messages or #hashtags. Another WildMoka application is the Wild Moments Replay [11]. This solution allows the viewer to review the most appreciated moments of a TV show. The application is especially focused on sports programs due to their own characteristics. Users are able to access their favorite moments through several mechanisms. These moments are automatically generated by video analyzing algorithms.

The Moments Capture application automatically detects TV key moments within a program: TV commercials, the beginning and end of the program, chapters and scenes, key moments as goals in sports events and musical performances in television programs [12]. Despite the automatic selection of key moments these solutions are based exclusively on video analysis and metadata.

With the Tellyo application viewers can capture short TV content into video clips (via a mobile device) and instantly share those moments on social networks with their friends enriched with textual comments. Additionally, users have the ability to navigate through other TV moments shared by friends and other users [13].

TV Timelines [14] is a Twitter feature that has been available since March 2015 and aggregates TV-related content through an interface within the Twitter app. This feature consists of a dedicated page for each TV show, which includes the official TV show and actors' accounts and tweets, tweets featuring video excerpts and other media as well as all tweets about the show.

2.2 Aggregation Platforms for Social Networks TV Related Activities

The Nielsen Social platform [15] identifies, collects and analyses, in real-time, conversations in Twitter for all programs within the most popular television channels, using this data to enhance: (i) the Nielsen Social Guide Intelligence - the component that provides the social commitment towards TV; (ii) Nielsen Twitter TV Ratings - the solution that measures the reach of TV programs in Twitter conversations, and; (iii) Nielsen Twitter TV APIs that provide data to enhance social and second screen applications [16].

The Social EPG application of the Dutch station Veronica enables its viewers to know the activity that is being generated on social networks for a given program while zapping through the EPG. As an example it allows to know that a particular live program is generating a greater number of tweets than others being aired at the same time. Users are able to use that buzz to take decisions on programs they want to watch [17].

2.3 The User Perspective

Creating video summaries implies mechanisms to condense or summarize the original video by analyzing all the contents of the original video sequence. These mechanisms can be based on text descriptions, visual appearances and audio, among others [18]. However, certain actions, facts or opinions are likely to be omitted from these solutions [19]. Alonso & Shiells proposed to create a timeline based on the “peaks” of comments made on Twitter for a live event. The authors verify that the most reported events were not only the goals since users also considered other events important. In this framework, these are important elements that deserve attention during the creation of a football match summary, but are typically omitted from algorithmic solutions. It means that it is possible to track a sports event through Twitter posts without losing relevant events. Thereby creating summaries should be seen as one more tool that can enhance the viewing experience and an entertainment or information activity [1].

Taking into account the increasingly connection between data in social networks and TV content, the hypothesis that a system enabling the user to watch summaries of its favorite TV programs, based on the social networks activity, seems promising. As is shown in the next section, the nowUP project aimed creating a suitable way to integrate the best social network TV related content and deliver it to the viewer.

3 The nowUP Features

As referred, the main goal of nowUP is to automatically create TV highlights of popular television programs (like football matches; talent or reality shows) based on the buzz on social networks, specifically twitter activity. In addition, it was also aimed to integrate the most relevant tweets as oracles of the correspondent TV highlights. Figure 1 presents its system architecture – data flows according the numbers shown in the figure.

3.1 An Overview of the Creation Process

The solution incorporates different modules:

- The metadata analysis module (TV Pulse): this module is responsible for getting information about the shows and related information on social networks. First, it extracts information from the EPG about TV shows (1) (program name and synopsis and time/date of airing) and then searches, through data mining analysis, for activity on Twitter related to these TV shows. Tweets are then analyzed, associated to the related TV show and the most commented moments are identified. In addition, the API extracts the most relevant tweets for later use;
- The video editing module: the following module is responsible for obtaining the TV program video (2). For this, the cloud DVR infrastructure from a telco partner is used. With this information it produces the segmentation and subsequent aggregation of content (video and text) to be used in the final summary. For that an FFmpeg multimedia framework was used. This segmentation uses as reference the

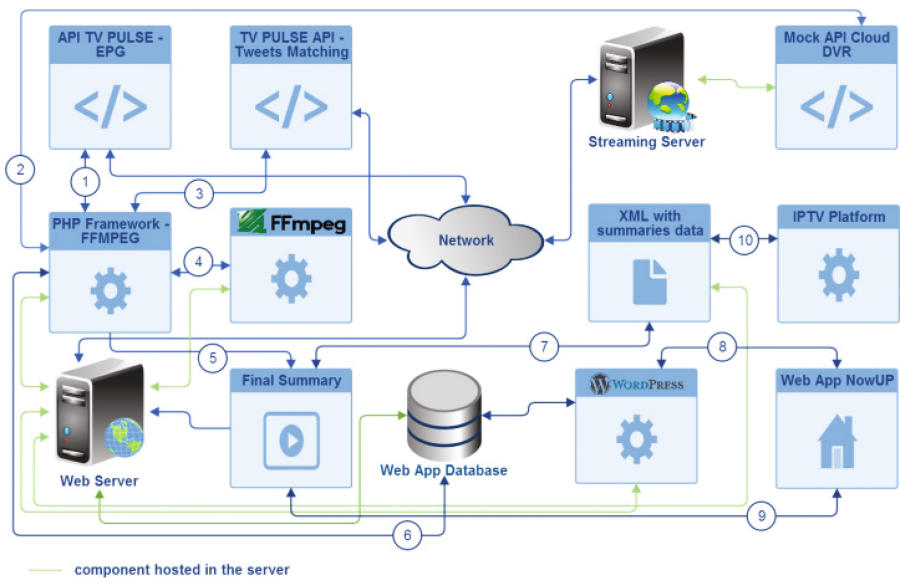


Fig. 1. The nowUP system architecture

peak events detected in the first module, clipping a subset of video for each event (3 and 4).

- The video enhancement module: in order to produce the final summary a visual separator is introduced between each clip (Fig. 2), along with an oracle with the most popular tweet (5) (Fig. 3).

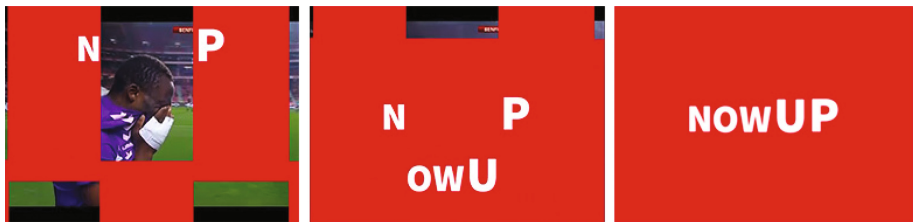


Fig. 2. The events separator included in the summary

The completed clips are presented in a web portal and complementary made available to be viewed when accessing the corresponding catch-up TV program, through the IPTV interface (6 to 10).

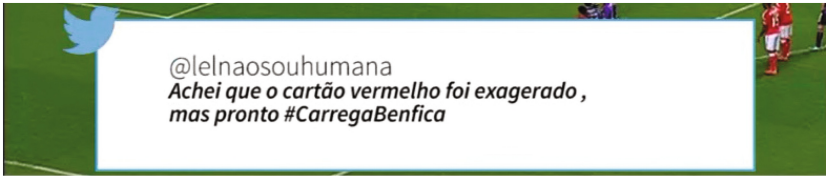


Fig. 3. Oracle with the most relevant tweet related to a specific event.

3.2 Clips Duration

Along with the technical challenges related with data mining, other concerns were taken into consideration. First there was the need to define the length of each clip as part of the highlight. The data-mining module allowed identifying the peak moments but not the duration of such moments. In a preliminary research made by the team (not presented in this paper) an analysis of four TV programs (two football matches and two entertainment shows) was carried to determine the duration of the video segments to be used in the summaries along with the elapsed time between the actual event and the peak on Twitter. The results have shown that the TV genre influences the length of the segments and the reaction to peak events on Twitter. With this information, the segments duration and time correlation with Twitter events were defined for each genre.

3.3 The Meta Information Visual Presentation

The challenges included not only the correct data selection but also building a coherent visual and cinematic approach to the TV summaries. An empirical analysis of different TV programs and highlights was carried and a visual separator was prepared. Graphically, the separator includes the nowUP logo inserted with a visual transition (Fig. 2).

Considering the fact that the most relevant events were detected based on the social activity, there is an additional probability that the most important tweet of an event cluster is closely related with that event. Therefore, on top of each segment, and for a limited period of time, a visual oracle is superimposed. This oracle includes the most relevant tweet correlated with that event, providing a sense of commentary (usually based on audio in traditional TV summaries). With this approach, the team wanted to validate if the oracle had the potential to reinforce the perception of the social related dynamics of the corresponding TV program.

Once all segments are prepared, all the insertions introduced and all the oracles superimposed, the TV summary is ready to be used.

3.4 Delivering It to the Users

To provide access to the TV summaries, a web portal was developed (Fig. 4). It includes the following sections: (i) Homepage - a mosaic of most relevant highlights (based in the social network buzz); (ii) “Search” and “Most Viewed” – alternative ways to find TV summaries; (iii) “Contributors” – the Twitter users are the (subsidiary) editorial staff of

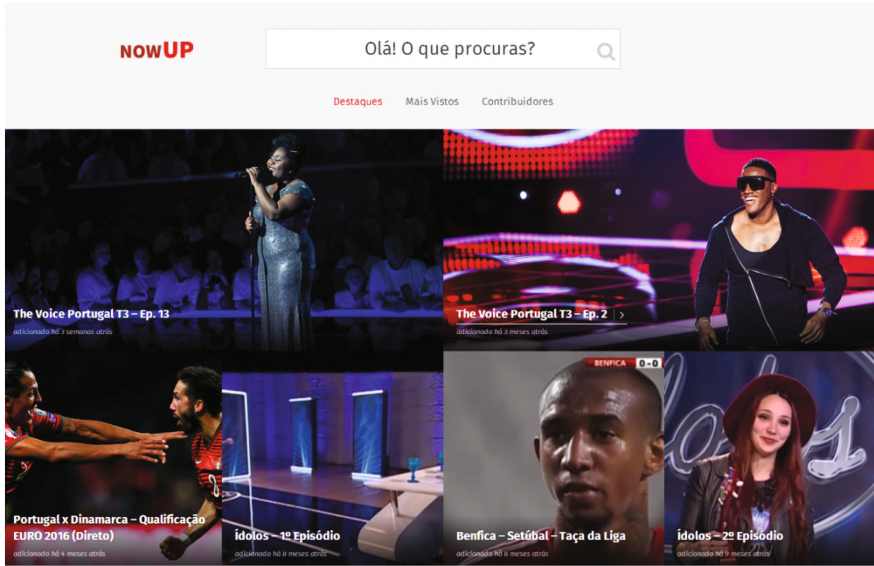


Fig. 4. The web portal home page

nowUP. In that sense, it includes the most important contributors for nowUP (i.e. the ones which tweets were considered as top tweets on an TV event); (iv) “Video details” – for each TV summary the user is presented with detailed information, including: a timeline showing the most relevant events that were detected and used in the video, the number of tweets processed, and other social related statistics.

4 The Evaluation Process

In the scope of the project goals, once the working prototype was concluded an evaluation was prepared.

This evaluation was targeted at: (i) understanding the users’ perceptions towards an automatic solution for creating TV summaries using social network activity as the editorial criteria; (ii) comparing the perceived quality of the nowUP summaries versus official (traditional) editorial summaries; (iii) evaluate the user experience related to the nowUP portal, and; (iv) gather the user expectations and motivations towards using this solution in the future.

The tests were carried in the research lab and at the participants’ home. In the lab a comfortable and similar to the home environment was prepared. All the tests were made in late afternoon, after the working or studying day. As for the equipment, a computer, a desk and a chair were the needed materials. The characterization of the participants was made through a semi-structured questionnaire [20]. This type of survey was chosen not only to ease the data processing, but also to give interviewees some freedom in their answers. A Google Docs form was used and content analysis was made to interpret the responses from participants. The questionnaire was structured

into four main parts, namely: (i) Personal Information; (ii) Television Habits and Preferences; (iii) TV and Social Networks – behaviors towards television consumption and correlated use of social networks; (iv) TV summaries consumption.

4.1 The Evaluation Sessions Structure

The evaluation sessions included the following steps:

- the participants' characterization;
- a small presentation of nowUP, about 7/8 min divided into four main parts: 1- the main design motivation and the context that surrounds it; 2- the correlation between TV content and Twitter generated content; 3- the overall process for the automatic creation of summaries; 4- the overall structure of the website. This presentation was supported by a short set of slides and images;
- the participants' interaction with the nowUP website. For this a script of tasks was handled inviting the users to explore the different sections of the website. The experience was tracked by two data collection techniques, direct observation and a semi-structured survey.

After the hands on session a second survey was delivered to the users. This survey aimed to address the following topics: usefulness of the features; ease of use; satisfaction and future expectation of use; and expectations for the integration of nowUP in an iTV service. Participants were also able to address other topics they found relevant towards the service.

The last part of the tests was focused on the evaluation of the video summaries. For this, participants were invited to watch two types of video summaries: (i) the nowUP summaries concerning a football match (sports genre) and the 'The Voice' talent show (entertainment genre), and; (ii) official and editorial created (by the TV show producers) video summaries for the same TV programs. For the evaluation of emotional reactions transmitted by the nowUP summaries, the research team used the SAM - Self-assessment Manikin [21]. The SAM-Manikin is an assessment method based on 3 sets of simple drawings that directly assess the pleasure, arousal, and dominance associated with the user's affective reactions to some certain stimuli (in this case the TV summaries). This data collection instrument was used immediately after the visualization of each nowUP summary. Just after this, participants had the chance to watch the correspondent official TV summaries and, to conclude, a third semi-structured questionnaire was delivered. This survey was structured into three parts, part 1 about the sports program and part 2 about the entertainment program. Participants had to assign the degree of agreement with four statements concerning the perceived level of: relevance of the content of summaries, extent of information, relevance of the textual (tweets) information; disturbance of the twitter information delivered in nowUP oracles. In the third and final part participants were questioned regarding: their preference between the nowUP summaries and the official editorial summaries; and about their prediction regarding a future use of it via its Web Portal or its integration in an IPTV service.

4.2 The Sample Characterization

With regard to the choice of participants an intentional non-probabilistic sampling was used [22], as participants in the sample were selected by convenience by the research team according to a considered set of criteria, namely their patterns of TV watching and social network behaviors.

Personal information – The sample consisted of 20 participants (10 males and 10 females) with an average age of 28 years old, with different educational and work professional areas. Regarding the complete qualifications, most of participants had a master degree (7), followed by K12 education (6 – bachelor students). Four had completed the bachelor degree and three a technical course. All participants had social network accounts, namely in Facebook and twelve also on Twitter. Finally, the majority of participants (eighteen) subscribed a pay-TV service.

TV habits and preferences – considering the TV viewing habits, most participants watched TV mainly in the afternoon and at night. At night eight participants watched between 1 and 2 h and six less than 1 h. The overall average during workdays was close to 2 h a day. On the other hand, at the weekend participants generally spent more time watching TV (close to 3 h and 30 min per day). Considering the TV genres, participants preferred films and series, with a preference level of 4.0 (in a scale of 1 to 5), followed by entertainment shows with 3.5. Sports and news got a close preference level at 3.4.

Social networks and TV – the majority of participants (12) were used to follow comments about TV shows on social networks with 8 denying this behavior. Considering the moment chosen to track those comments, 4 referred to do it only after the end of the show but 8 said to do it during and after the TV show. Despite 12 participants having an active behavior on tracking social networks, only 4 were used to regularly comment about the TV shows on social networks.

TV summaries consumption – finally, participants were asked to say if they were used to watch TV summaries and if so, where. A total of 14 participants stated having this behavior using official TV related shows websites to do it (10), video sharing web-sites (9) and social networks (9). Concerning the moment when they watched those summaries, 11 said to do it in the day after the broadcast of the TV show, 9 during the following week and 6 just after the show.

5 Results

The evaluation results presented in this section are mainly related to users' perception on the nowUP features, expectations for future use along with the preferences towards nowUP summaries vs official summaries.

5.1 Participants' Emotional Reactions

Participants' emotional reactions towards the two nowUP summaries were assessed through the SAM-Manikin scale, where scores go from 1 to 9. As depicted in Fig. 5, both nowUP summaries got positive values (>5) in the two evaluated emotional dimensions (in this study the SAM "sense of control" dimension was discarded).

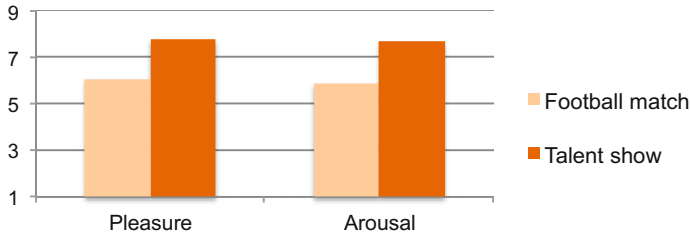


Fig. 5. The participants' emotional reactions to the nowUP summaries.

Despite the fact that the levels of “pleasure” and “arousal” are quite balanced when taking in consideration each type of TV genre; the entertainment summary (The Voice program) scored globally higher than the sports summary (more 28% in the “pleasure” and 31% in the “arousal”).

5.2 Characteristics of the nowUP Summaries

After the reported assessment, participants had the chance to watch the correspondent official TV summaries and were then asked to state their level of agreement with a set of sentences comparing the perceived level of the characteristics of nowUP summaries with those of official summaries (Fig. 6). Participants scored their level of agreement with each sentence using a 5-point Likert scale (Totally disagree, Partially disagree, Neutral, Partially agree, Totally agree). However, for a clearer interpretation of the results a (WA) weighted average ($-2, -1, 0, 1, 2$) was adopted in the graphics.

Regarding the relevance of the content, the gathered answers show that participants found that nowUP summaries provide content with higher significance as compared with official summaries. When the TV genre is considered, it can be seen that the

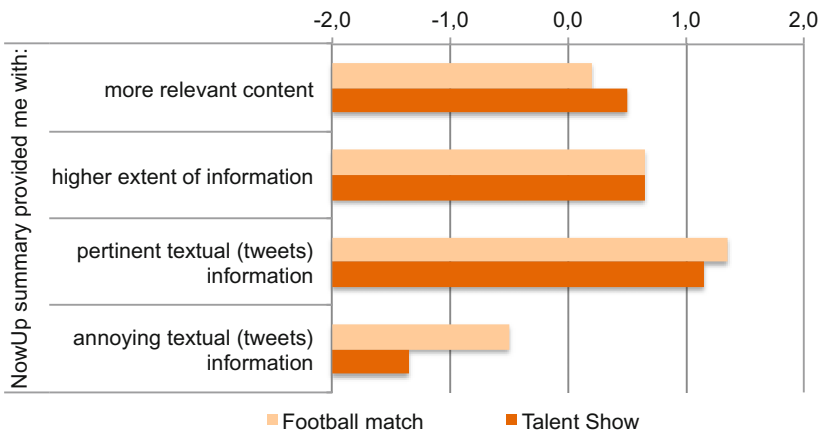


Fig. 6. Participants' perceived opinions of nowUP summaries characteristics (WA).

entertainment nowUP summary got a clearer positive result (the weighted average 25% better than neutral) than football match (nowUP) summary (10% better than neutral).

The answers to the next sentence (related with the extent of information associated with the nowUP summaries when compared with the official summaries) strengthened the relevance of the nowUP concept. In this case, the offset to the neutral value was 33% for both summaries (Sports and Entertainment), indicating that participants found that nowUP gives them more information.

It is important to stress that the aforementioned results may be more linked with the pertinence of the textual information coming from the tweets – those that interleave each TV highlight (see Fig. 3) – than with the video information. The corresponding weighted averages (1,4 – for the football summary and 1,2 for the talent show), with related offsets of 68% and 58% from the neutral value, are clearly a positive indicator of the suitability of the adopted approach to build the video oracles. This is even clear when looking to the level of disagreement that participants showed regarding the potential disturbance of the textual information of those oracles. With offsets to the neutral value of 25% (in the case of the football summary) and 68% (for the talent show), the added value of the information from the tweets is clear.

5.3 Comparison Between nowUP and Official Summaries

In the final part of the test sessions, participants were asked to give their global opinion on the type of summary they most liked (nowUP versus official). They were also asked to freely justify the main reason supporting their choice.

To make a synthesis of the results gathered about each one of the summaries genres (football match versus talent show) a qualitative exploration was made through content analysis. Based on the gathered answers, it was decided to group the answers in a total of 4 categories.

Regarding the football match, as depicted in Fig. 7, it is possible to observe a global split preference (by a total of 10 participants in each case) between the two types of summaries. 10 of the participants preferred the nowUP summary - due to a perceived better aggregation of the most interesting moments (3 participants) and due to the reported importance of its correlation with the Twitter discussions (7 participants); while the official summary was the choice of the remaining 10 participants (9 considered it more complete than the nowUP summary and 1 valued the inclusion of the remarks from the TV commentator).

When considering the talent show there was a clear preference for the nowUP summary: the official summary only accounted the preference of 2 participants (stating it was more complete), while the remaining 18 participants found that the nowUP summary aggregates the most interesting moments (12 participants) and valued its connection with the Twitter discussions (6 participants).

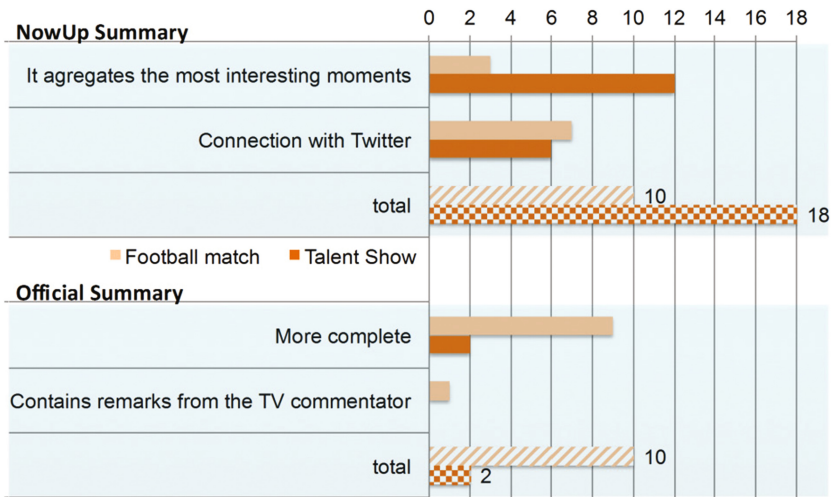


Fig. 7. Reasons for the preference towards a type of summary (nowUP (top) and official (bottom)).

5.4 The nowUP Integration on TV

As participants at this stage of the test sessions had already a significant understanding of the nowUP concept they were asked if they would use the service if integrated in an IPTV platform; how many times a week and how the integration should be made (if integrated in the EPG or in a specific area of the user interface). Table 1 summarizes the gathered answers.

5.5 Prediction of Future Use

Finally, participants were asked about their predictions regarding the type of summaries they would watch if nowUP was available. The gathered answers are summarized in Table 2.

Table 1. Opinions about the nowUP integration on TV

Participants predicting that:	#
Would use the service over an IPTV platform	18
Would use it once a week	10
Would use it more than 3 times a week	8
The service integration should be made inside the EPG	16
The service integration should be made in a specific area	4

Table 2. Prediction of future use of nowUP.

Participants predicting that they would watch:	#
Only the nowUP summaries	1
Only the official summaries	1
Both type of summaries	18

6 Conclusions

Despite the limited number of participants involved in the test sessions and the fact that only 2 nowUP summaries were evaluated, the results reflect interesting readings.

Globally, the nowUP concept was validated as an interesting approach to automatically create TV summaries with potential gains in the value chain of TV producers. Actually, the nowUP approach in addition to be able to support cost reductions may also provide a narrative more suitable to the expectations of younger generations. The assessment of participants' emotional reactions towards the nowUP summaries reinforces this idea.

The nowUP summaries were not only considered as being slightly more relevant than the correspondent official summaries but also providing more information. This seems to be correlated with the inclusion of tweets in the overlaid oracles. This solution as a way to complement the separators, which are automatically inserted between the highlights, seems to be a suitable approach.

When comparing the two TV genres at stake (sports – a football match; and entertainment – a talent show), the evaluation results show that the nowUP strategy may be more suitable when the TV programs lack typical and clearly predicted highlights (easier to find in, as an example, sports TV programs). The usual peak moments for a football match are the goals and referees' polemical decisions, while a talent show presents a higher number of subjective reasons for a moment to be considered relevant or popular. In this scope, the crowd activity seems to be a suitable editorial criterion for this type of TV moments.

As a final remark, this study is not only relevant for its outcomes but also a stimulus for further research, namely further validation with a higher number of participants and a larger diversity of TV genres and also applying the technical approach to other sources of information, namely other Social Networks.

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