Exploring the Use of Second Screen Devices During Live Sports Broadcasts to Promote Social Interaction

Marco Cruz[1], Teresa Romão[1(✉)], Pedro Centieiro[1,2], and A. Eduardo Dias[1,2]

[1] NOVA Lincs, Faculdade de Ciências e Tecnologia, Universidade NOVA de Lisboa, 2829-516 Caparica, Portugal
mas.cruz@campus.fct.unl.pt, tir@fct.unl.pt, pcentieiro@gmail.com

[2] Viva Superstars Digital Media Lda, Madan Parque, Rua dos Inventores, 2825-182 Caparica, Portugal
eduardo@vivasuperstars.com

Abstract. The rise of mobile technology has transformed the once passive activity of watching a live sports broadcast into an active experience. Nowadays, it is common practice for sports fans to communicate, interact and share information with others through social mobile applications not only after, but also during the broadcast of a live sport event. However, sometimes the discussion between fans is not contextualised and the social applications used by them lack tools to register moments that can promote social discussions. Furthermore, not all sports fans can watch an event TV broadcast, making it impossible to express a concrete opinion about it. To address this issue, we developed ReactIt, a system developed for smartphones and smartwatches, that allows users to share automatically generated videos containing specific moments of a football match along with their emotional reaction, to engage fans and promote social interaction between them. Results from user tests were very positive regarding the interaction with both devices, and users manifested great interest in using ReactIt in a real life environment.

Keywords: Smartphone · Smartwatch · Second screen · Emotional reactions
Video sharing · Social interaction · Social network · Sports events

1 Introduction

Sports have the ability to bring people together. The competitiveness and the uncertainty of the end result are two factors that lead people to watch a sport activity. Since the Neolithic age of 7000 BC, there are indications of sports assisted by crowds, where there are evidences showing a wrestling match surrounded by people watching it [1]. This proves that competition is something that is in our blood, as well as the enjoyment of seeing others compete, which has made the world of sports evolve so much, from ancient times to the present. These days, sports continue in constant evolution, thanks to the use of new technologies and rules that allow a fairer and more balanced competition.

Sports in general have the ability to make fans emotionally engage with the event. Since sports are competitive physical activities, it is natural that our emotional state

A. D. Cheok et al. (Eds.): ACE 2017, LNCS 10714, pp. 318–338, 2018.
https://doi.org/10.1007/978-3-319-76270-8_23

changes during a sports event, where the emotions and the level of satisfaction of the spectators are directly related with the performance of the team they support. Watching a sport event confers a more social and global sense of experience, due to the existing social platforms. Increasingly, fans turn to social online platforms to communicate, interact and share information with other viewers during the broadcast of an event, providing a less lonely experience, and giving the feeling of watching the event together with the other fans. Even after an event, the discussion continues on these social platforms, where users share news associated with the event, support and indignation messages, as well as photos and videos containing moments of the event. As long as the content shared arouses a positive or a negative reaction, it will promote social interactions. Videos are one of the best types of content to engage users on social platforms, especially in the context of sports. The fact that different fans may have different opinions regarding specific moments of an event, means that videos have the ability to promote social discussion, and that is something we took advantage of, in this work.

Nowadays people have the habit of having their mobile phone, tablet or laptop nearby while watching television [2]. With the impetus these devices had in recent years, several concepts for second screen applications have been explored in the sports field [3, 4]. At this time, the most used devices for the use of second screen applications are smartphones and tablets [5], due to their mobility. Although smartwatches are not yet so popular and have not been exploited in this context, due to their recent market introduction, they have enormous potential for the development of social applications. These devices can be best suited for applications that require short and fast interactions than other mobile devices. In addition, they have the constant ability to monitor the user's contextual and physiological data.

Given the emotional impact of sports events and people's interest in expressing their opinions and emotions on social platforms during an event, we developed ReactIt, a new concept that emotionally engages sports fans, allowing a more social and entertaining experience. It allows the sharing of automatically generated videos by the system that contains specific moments of a football match, promoting social interactions between fans, through their reactions (opinions and emotions). The system was developed for smartphone and for smartwatch, which is a device that has not yet been much explored in the world of second screen applications, and has features that a smartphone does not have. User tests were conducted to evaluate the concept provided by ReactIt, the users' reactions, the system's usability, and to extract insights for future work.

2 Related Research

People are inseparable from their mobile devices, even at home, where they keep their devices near while watching TV. To take advantage of this behaviour, new second screen applications are appearing on the market. Due to the huge variety of existing second screen applications, and to the different forms of interaction provided by them, a large number of applications were studied [6], where the authors classified their functionalities according to the type of interaction they allow, being these, social sharing, gamification and extras, and expanded experience. The work described in this paper focuses on social

sharing, which allows a Human-to-Human interaction where people share and interact with others, such as exchanging opinions on what they are watching or even sharing content related to the broadcasted show. Several studies have been conducted in this area, such as [7], where it is concluded that viewers are more motivated to share messages in real time, when they are watching television alone, in order to feel more connected within a community of users, even knowing that the message may not be seen by anyone. Other studies [8, 9] concluded that during the broadcast of a television show, viewers are more likely to share personal opinions and messages not addressed to anyone, just wanting to be part of a larger group.

Sports in general are undoubtedly one of the most talked about themes on social network, generating millions of live reactions. They have the ability to emotionally engage fans because of its nature. For this reason, second screen applications are the perfect combination when viewing sports events live broadcasts. Fans are not so socially involved when watching a sports event at home, compared to the fans that are on the venue. In order to solve or at least soften this problem, new concepts were developed and tested, allowing the fans to establish a greater emotional connection during a game. Among them is WeFeel [3], a system that allows users to share their emotions and opinions in real time through a mobile device during a sports event TV broadcast. Users can express their emotional state in the different moments of the match, through a set of emotions available on the application, and complement it with a comment. The system presents users' emotions and comments on the television screen rather than on the mobile device, thus creating a different experience where the users are not forced to turn the attention away from the television to visualize the reactions of their friends.

Another concept that also allows fans to share their opinions is WorldCupinion [4]. This system aimed to understand whether mobile devices could serve as a communication channel to share non-verbal information that represents emotional reactions during the transmission of sport event on television. To see if real-time sharing of emotions was an appealing concept, WorldCupinion was tested during the FIFA World Cup in 2010, as it is an event of enormous interest to the public around the world, and where spectators are extremely emotionally involved with the event. In WorldCupinion, users could choose the team they wanted to support, and express their thoughts during a match, through a set of opinions available on the application, and also observe the opinions of the other users.

The developed system (ReactIt), goes beyond simply sharing opinions and emotions with the other fans. When a user shares an emotion or opinion which is associated with a match moment, the system automatically generates a video that contains the shared match moment and makes it available to all his friends. This way, friends may watch the match moment before reacting to it, even when they are not watching the match on TV, promoting social interaction no matter where or when.

3 ReactIt

Like any other second screen application, the goal of ReactIt is to improve the user experience during a television broadcast, in this case during the broadcast of sports

events, in particular football. ReactIt explores not only the use of smartphones, but also smartwatches in order to allow fans to express themselves. The system allows the sharing of reactions (opinions and emotions) along with the videos containing the corresponding moments of a sports event, engaging and promoting social interactions between the fans. The idea of ReactIt is to enable a quick and simple way to share our emotional state regarding a match moment, with our friends and other users that also use ReactIt, as well as to see how they react to the same match moment. Just as fans express their opinions and emotions with their friends at the venue or in public places, such as a cafe or a bar, we want to encourage the fans that are at home, to do the same. When a user shares a match moment, a small video is automatically generated by the server. This video has a 10 s length and contains the specific moment that the user registered through ReactIt.

When reacting to a match moment shared by a friend, the user downloads the associated video and reacts to it (expresses an opinion and emotion). Since users are used to share information on social networks (including videos), ReactIt allows an easy way to share videos during a match, generating social interactions between fans. And because of this functionality, the use of ReactIt can also be extended to users who cannot watch the match live on television. The idea of generating a video is simple: the user is not required to immediately react to a match moment shared by a friend at the time the share is made. Since there is a video associated with that moment, the user can choose to react during an eventless period of the match, for example when the ball goes out of the field, or when the match is over. Thus, when the user wants to react to the moment shared by his friend, he knows exactly what he is reacting to, since he can watch the video first. All the match moments that were shared throughout the match and the reactions expressed by the users, are stored in the system. Thus, at the end of the match, it is possible to make an analysis of the users reactions regarding the different moments shared during the match.

ReactIt can be used by any kind of sports fan who would like to be aware of the important moments of a match in real time, whether he is watching the match live on television or not (as illustrated by Fig. 1). Thus, a possible use of this system can be seen as follows:

1. The user has a mobile device (a smartphone or a smartwatch) with ReactIt installed, and he is in the comfort on his sofa watching a sports event on the television. At some point in the match, the referee awards a penalty that leaves the fans divided over his decision. The user registers the moment of the foul with a simple touch in the centre of the screen of the mobile device (Fig. 2a) and then reacts through a set of available opinions and emotions (Fig. 2b and c). The user wants to know the reaction of his friends and shares the moment he registered associated with his own reaction, with simply 3 touches (more details in the next sub-section).
2. His friends, who may or may not be watching the match, and who also have the application on their devices, receive a push notification (alert).
3. When they touch on the notification, they watch a video that contains the last 10 s prior to the time when the moment was registered. After watching the video, they may react by choosing an opinion and an emotional state.

4. The user who registered the moment is notified as soon as his friends react, and can make an analysis of the data, consulting the different shared moments of the match and the results obtained regarding the opinions and emotions expressed by their friends.

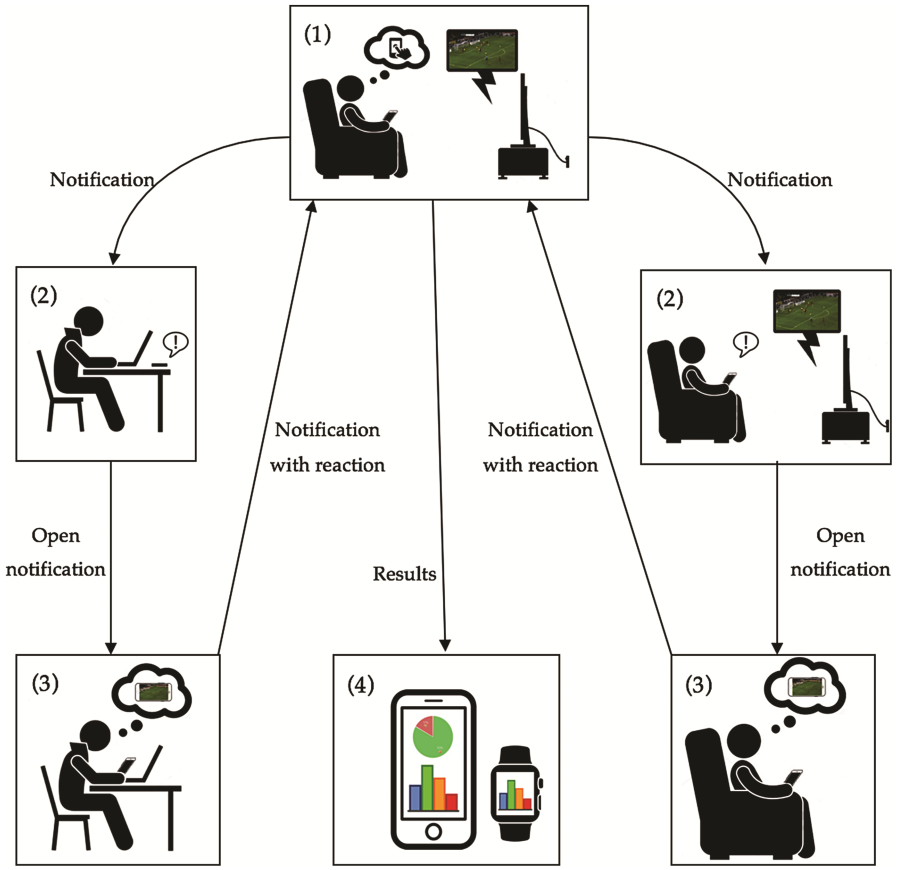


Fig. 1. ReactIt – system usage example.

3.1 Smartphone Application

The application is composed by 3 sections: registration of a match moment, visualization of match moments and users' reactions, and user profile (Fig. 2). These sections are accessed through a menu at the bottom of the screen (tab bar). The menu is always visible, in order to allow the user to quickly access any of the sections.

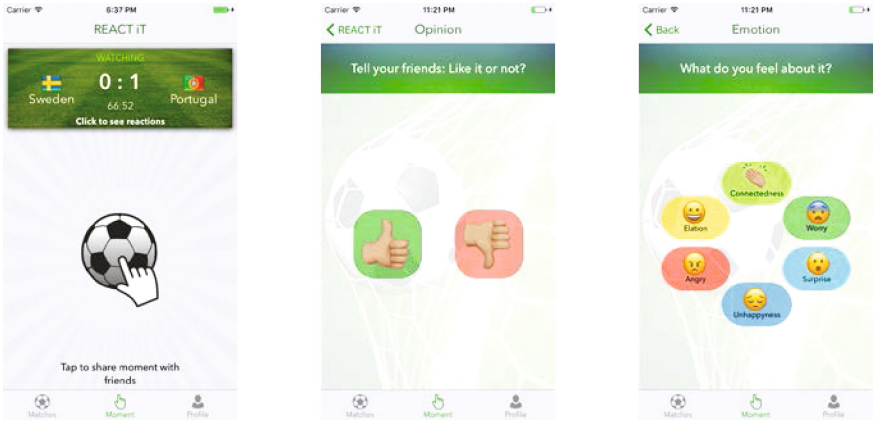


Fig. 2. Sharing a video of a match moment through ReactIt using the smartphone. (a) Initial screen where a moment can be registered. (b) Opinion selection screen. (c) Emotion selection screen.

The application was designed in a clear and intuitive way, allowing users to perform any task, in a simple and fast way, through a minimal number of interactions. The goal is not to divert the focus too much from first screen, the television displaying the match. So, in order to react to a match moment, users have to classify the moment with a "thumbs up" or "thumbs down", which is a type of classification that users are already familiar with, from other social networks like YouTube. This classification allows the users to have a better perception of the positive and negative opinions of the fans regarding the different actions in the match. In addition to the opinion a user may have regarding a match moment, we find that emotions are an essential aspect in applications developed for communication between viewers during a live broadcast, since it allows a more detailed reaction. Take for instance the introduction of emotions by Facebook in 2016. This was one of the biggest changes to Facebook in recent years, as it moved away from the simplistic and iconic "thumbs up" interaction to a set of six different emotions (like, love, haha, sad, wow, and angry), in order to allow users to better express themselves (and ultimately, to further analyse users' interaction with content). In our case, we used an emotions assessment interface inspired in the one used by WeFeel [3]. This is based on the CAAT's model [11], proposed by Cardoso et al., which was built upon Plutchik's Circumplex Model of emotions [12]. The final model (used in a sport context) contains 6 emotions [13] (anger, connectedness, unhappiness, elation, surprise and worry) associated with a colour.

Figure 2 illustrates the process of a user sharing a video of a match moment with his own associated reaction. The user starts by registering the moment by touching on the ball which is centred on the screen (Fig. 2a). Then he gives his opinion (Fig. 2b) and next, he selects an emotion through our emotions assessment interface (Fig. 2c).

Once a user selects the emotion, this information is sent to the server application, which starts generating the corresponding match moment as follows:

1. The server stores the match moment timestamp (T_1) when the user registers the moment on the initial screen (Fig. 2a) and not when an emotion is selected (Fig. 2c). This way, users can take time to react without worrying about losing the moment.
2. Taking into account T_1, the server application checks if there is a registered moment in the last 15 s prior to T_1. If that is the case, it means another user already registered that moment, and the server aggregates them. Otherwise, it starts cutting a video segment starting at T_1–10 s (T_0) and ending at T_1. In our case, and since we were using a video file on a local server, we used the timestamp of the video. In a real context, while watching a live stream of an event, since the user obtains the video directly from the TV station, it is necessary to use a UTC timestamp in order to identify the different match moments.
3. Then, the server creates the video segment between T_0 and T_1, saves it locally, generates a URL, and associates it to the corresponding match moment and reaction shared, so other users can access it through the mobile application. The aggregation mechanism is necessary in a system like this, so it does not create multiple video segments for the same match moment that was registered by the users with just a few seconds difference.
4. A push notification is sent to all user's friends so they can react to that moment.

When a friend touches on the notification the application downloads the 10-s video, and as soon as he finishes watching the video, he may react giving his opinion and selecting an emotional state.

There are two types of notifications in ReactIt. When a user shares a moment, all his friends receive a yellow notification (Fig. 3a), in order to inform them that someone is asking his opinion. As soon as his friends react to the match moment he shared, the user receives a green notification (Fig. 3b). This is a response notification that specifies the opinion, the emotion, and the corresponding time of the moment (expressed in "minutes:seconds").

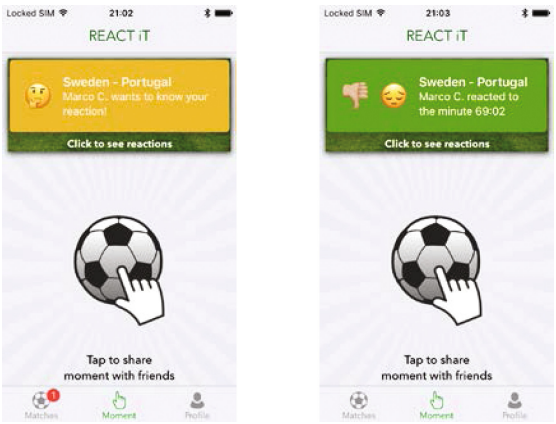


Fig. 3. Different notifications used on the smartphone application. (a) User receiving a yellow notification. (b) User receiving a green notification. (Color figure online)

The system stores every moment shared during the match, so no one is required to immediately react after receiving a notification. Since each moment has a video associated with it, users can choose to react when they want, either during eventless periods of the match, in the half time or when the match is over.

By selecting "Matches" in the lower menu of the screen, users can select the match where there are still moments to react to (Fig. 4a). On this screen the idea is to prioritize the matches that are being broadcasted live, and whose teams belong to the list of favourite teams of the user (defined in the user profile). When selecting a match, the user has access to a list with all the moments shared during that match (Fig. 4b). Each moment has an associated avatar of the user who shared the match moment. It is possible for multiple users to share one match moment at or near the same time. In this situation, the system aggregates the two (or more) shares into one, only generating the video of the first share, and displaying an image with an aggregation of the users' avatars. Below the match time, it is possible to know how many friends reacted to that moment, and on the right side how many users (worldwide) in the system reacted to the same moment. When a certain moment becomes popular, that is, when at least 50% of the users reacted to that moment, a red trending icon is shown.

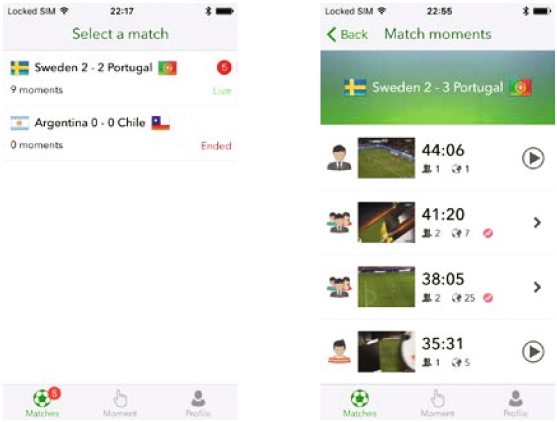


Fig. 4. (a) List of matches ordered by the user favourite teams (finished matches are at the end of the list). (b) List with all the moments shared during a match.

In this list there may be match moments that the user has not yet reacted, such as the ones at minutes 35:31 and 44:06 which have a "play" icon on the right side. When the user selects them, the video corresponding to that moment is played and once it is finished, the system asks for the user's reaction. The system only allows the user to see the other users' reactions to a match moment, when he already reacted to it. The idea is that the user must not be influenced by the opinions of the other users. The remaining moments that the user has already reacted to, such as the ones at minutes 38:05 and 41:20 (in Fig. 4b), have an arrow on the right side, which upon selection allows the user to access the match moment details screen (Fig. 5). In these screens, users can see the

distribution of the users' opinions through a pie chart (Fig. 5a), and the distribution of the emotions through a bar chart (Fig. 5b). Above the charts, users can switch between reactions from friends and reactions from all users of the system (worldwide). By scrolling down, it is still possible to see the friends' opinions and emotions individually.

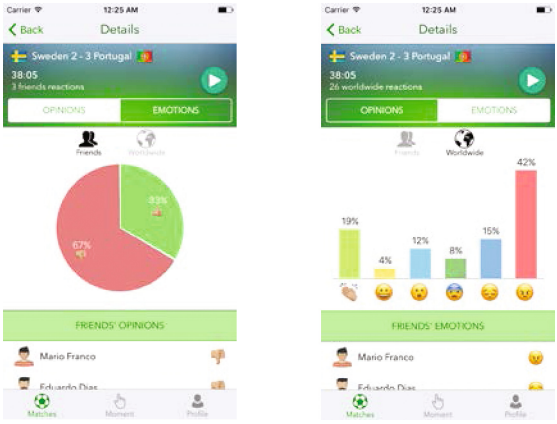


Fig. 5. Details of a match moment (smartphone): (a) User's friend opinions pie chart. (b) Users worldwide emotions bar chart.

The last section is the user profile section. This section was populated with placeholder data (e.g. the user's favourite teams, city and country) and during our tests it did not require user interaction (although users could interact with it). The goal was for users to feel that they were using a real application, hence the addition of a feature of this kind, which is included in any social network application.

3.2 Smartwatch Application

Since ReactIt is an application that requires short and fast interactions when registering a match moment, we decided to explore the use of smartwatches for this type of quick interactions. It is quicker to share a match moment through a smartwatch, unless the user is constantly with the smartphone in hand waiting to register a moment when something interesting happens in the match. The system was developed for Apple Watch, which has a feature that keeps the device on standby when it is not being used, saving energy. When the user turns the wrist in order to use the smartwatch, it automatically activates and opens the last application, allowing users to quickly interact with it.

Due to the small screen space, we do not include access and management of the user profile on the smartwatch, being only possible to access it through the smartphone. In addition, some changes had to be made to the interface. In the smartwatch application, users react to a moment through an opinion and an emotional state, like they do in the smartphone application. However, the emotions assessment interface had to be adapted

to fit the screen, without deviating much from the WeFeel' model [3]. Figure 6 shows the different screens that allow a user to share a match moment on the smartwatch, and react through an opinion and an emotion.

Fig. 6. Sharing a video of a match moment through ReactIt using the smartwatch. (a) Initial screen where a moment can be registered. (b) Opinion selection screen. (c) Emotion selection screen.

Notifications are an important feature in smartwatches since they allow to perceive important information with gentle alerts on the wrist (like small vibrations and alert sounds). That is why ReactIt also has a notification control system in the smartwatch. As already mentioned, a user can receive two types of notifications (Fig. 7): when a friend shared a moment and he wants to know the user's reaction, and another to inform the user about a friend's reaction to a moment he shared.

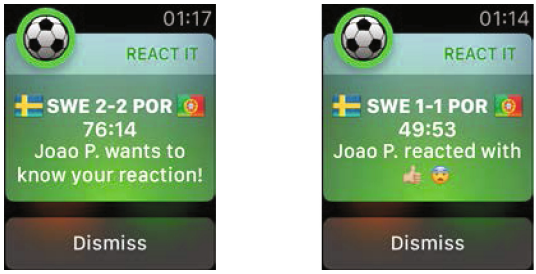


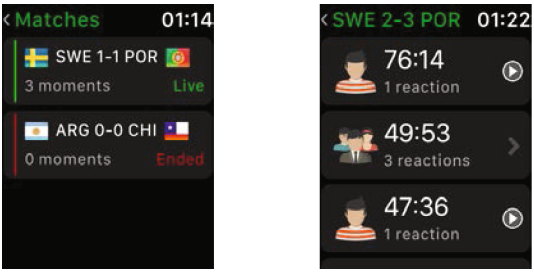
Fig. 7. Different types of notifications used on the smartwatch application. (a) User receiving a push notification when a friend shared a moment. (b) User receiving a push notification when a friend reacted to a moment.

Just like the smartphone application, when a user receives a notification to react to a match moment, he can choose to see it later, through the "Dismiss" button or touch on the notification, and watch the video containing the moment (which is something possible with an Apple Watch). Therefore, we included the possibility of watching the video through the smartwatch with a zoom effect (Fig. 8). This zoom cuts the sides of the video, but since in football the camera is always focused on the ball, the relevant

video content are usually in the centre, so it is unlikely to miss a moment due to the lateral cuts of the video.

Fig. 8. Video with a modified resolution on the smartwatch.

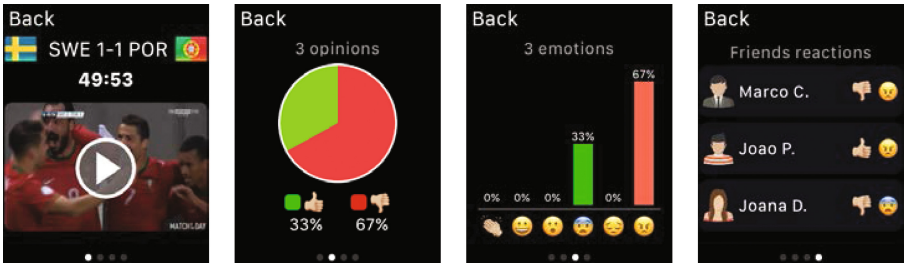
The screens that contain the list of the different matches (Fig. 9a) and all the moments shared during a match (Fig. 9b) were adjusted taking into account the characteristics of the smartwatch. Because of the small screen space, the teams are identified by their abbreviation, since the full name would take up too much space or simply would not fit. Also for space reasons, the video thumbnail was removed and placed in the match moment details screen.



a) b)

Fig. 9. (a) List of matches on the smartwatch. (b) List of moments shared during a match on the smartwatch.

The details of a match moment in the smartwatch application are presented differently than in the smartphone application. There are no tabs because they are inconsistent with the interface design for smartwatches, so a page-based navigation was used, where the user simply swipes left or right to see the details of a moment (Fig. 10).



a) b) c) d)

Fig. 10. Details of a match moment on the smartwatch application. (a) Accessing the video. (b) User' friends opinions pie chart. (c) Users worldwide emotions bar chart. (d) Friends' individual opinions and emotions.

Wearables typically have the capability to monitor user physiological data. At this stage, ReactIt was developed for Apple Watch, which contains a heart rate sensor. Since watching a sports event can be very emotional for the fans, ReactIt continuously captures the user's heart rate when watching a live broadcast. At the end of the match, the smartwatch application synchronizes the user's heart rate data with the smartphone, where the user can see a chart with the heart rate values throughout the match (Fig. 11), by accessing the user profile. This data shows in which moments of the match the user was more emotional. For now, this information is only for the curiosity of the users, but in the future we intend to relate it with the shared match moments and the corresponding emotions, and study those relations.

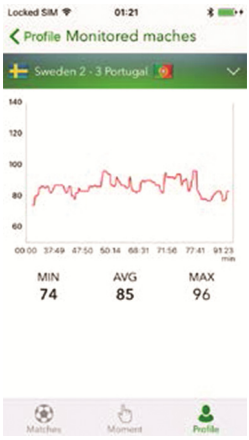


Fig. 11. User's heart rate throughout a match displayed on the smartphone application.

4 Evaluation

User tests were conducted to evaluate the concept provided by ReactIt, the users' reactions and the system usability, and to extract insights for future work.

4.1 Participants and Methodology

User tests were conducted with a total of thirty-one participants, with ages 17–45 years ($\bar{x} = 26.06$, $\sigma = 6.32$), where eighteen participants (fifteen were male and three were female) tested the smartphone prototype running on iPhones and thirteen participants (eleven were male and two were female) tested the smartwatch prototype running on an Apple Watch Series 0. Some of the test sessions were carried out with three participants using the system simultaneously, and some with two participants. Before starting the tests, we explained the ReactIt's concept to the participants, and during the tests, we observed the behaviour of the participants, took notes, and provided assistance if anyone had a problem.

ReactIt was tested in a room with a Smart TV in the centre where a football match was displayed. A summary of a match between the Portuguese national team and the Swedish national team from the qualifier for the FIFA World Cup 2014 was used during the tests. Some important moments of the game were selected and compiled in a 12-min video which contained fouls, dangerous plays and goals from both teams. All reactions during the tests were stored in the system, so in each test users could see the reactions of all the participants from the previous tests, that on a real environment would be all the users of the system.

After the match was finished, participants were asked to answer a questionnaire with which we evaluated the ReactIt's usability and entertainment value.

4.2 Questionnaire

Two questionnaires were created, one for the smartphone test and another for the smartwatch test, as there were some specific features of each device that we wanted to test. The questionnaires were divided into 3 sections. The first section included participants' personal data, such as age, sex, and some habits they had while watching sports events broadcasts on television. This section contained the same statements in both questionnaires. The second section focused on usability and entertainment aspects, where we intended to evaluate the entertainment concept provided by ReactIt, as well as usability and user experience aspects. This section had a few different statements in both questionnaires. And finally, the general aspects, where we wanted to know if the participants found the concept interesting and if they would use the application in a real life environment. The last two sections (2 and 3) comprised statements to be rated using a Likert-type scale, which ranged from 1 ("strongly disagree") to 5 ("strongly agree"). Table 1 presents section 2 statements for the smartphone questionnaire, Table 2 presents section 2 statements for the smartwatch questionnaire, and Table 3 presents section 3 statements, which are the same for the smartphone and the smartwatch questionnaires.

Table 1. Usability and entertainment section for the smartphone questionnaire.

Statements
2. Usability and entertainment
2.1. I immediately understood how to share a moment with my friends
2.2. I can quickly share a moment with my friends without losing focus on the match
2.3. I did not miss any important moment while sharing a match moment with my friends
2.4. It is easy to access my friends' reactions
2.5. It is easy to understand my friends' reactions
2.6. The notification colour helps distinguish between a friend asking for my reaction and a friend that reacted to a match moment I shared
2.7. I am likely to react to game moments shared by my friends during the match
2.8. I am likely to react to game moments shared by my friends during the half time or when the match ends
2.9. ReactIt makes me feel like I am watching the match with friends
2.10. Even if I was not watching the game on TV, I think I could be aware of the most important moments of the match through ReactIt

Table 2. Usability and entertainment section for the smartwatch questionnaire.

Statements
2. Usability and entertainment
2.1. I immediately understood how to share a moment with my friends
2.2. I can quickly share a moment with my friends without losing focus on the match
2.3. I didn't miss any important moment while sharing a match moment with my friends
2.4. It is easy to access my friends' reactions
2.5. It is easy to understand my friends' reactions
2.6. I was able to understand the content of the videos
2.7. I like the idea of being able to check my heart rate throughout the match
2.8. I'm likely to react to game moments shared by my friends during the match
2.9. I'm likely to react to game moments shared by my friends during the half time or when the match ends
2.10. ReactIt makes me feel like I am watching the match with friends
2.11. Even if I was not watching the game on TV, I think I could be aware of the most important moments of the match through ReactIt

Table 3. General aspects section for the smartphone and smartwatch questionnaires.

Statements
3. General aspects
3.1. I liked to use ReactIt
3.2. It is easy to learn how to use ReactIt
3.3. I find ReactIt an interesting concept

4.3 Results and Discussion

During the test sessions, users were free to share and react to any moments of the match. In total, 174 moments of the match were registered by the participants, and there was a total of 334 reactions to those registered moments. Figure 12 presents the relation between the most important moments of the match video and the number of reactions expressed by the participants.

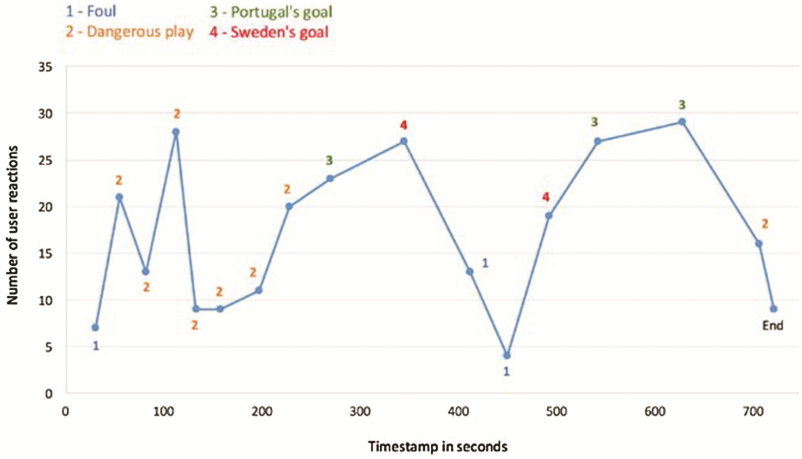


Fig. 12. Relation between the most important moments on the video and the users' reactions.

In an analysis of the first section of both questionnaires (personal data and sports habits), we observed that the majority of the participants (51.6%) watch sports events on television on a weekly basis, 22.6% on a monthly basis, 16.1% watches it fortnightly, and only 9.7% rarely watches sports events on TV.

The most used devices by the participants during the broadcast of a sport event are the smartphone (71%), the computer (42%), and the tablet (29%). 16% of the participants stated they did not use any device. From the participants who use a device, 55% access social networks to perform activities related to the event, 48% browse the web, 39% participate in chat conversations, 23% exchange SMS with their friends, and only 3% make voice calls. These results show that users are used to interact with other viewers or their friends during live broadcasts on television.

Lastly, we have found out that 32% of the participants have the habit of discussing event situations frequently, through technological means, 32% only discuss sometimes, 20% rarely discuss, and 16% discuss very often.

Smartphone results. Regarding the results of the usability and entertainment section of the smartphone questionnaire (Fig. 13), the results show that the vast majority of participants (77.7%) strongly agree that it is easy to understand how to share a moment of the match with friends (statement 2.1 in Table 1). The results of statements 2.2 and 2.3 were positive, but not as positive as we expected. Although most have agreed that

ReactIt allows one to quickly share a moment without losing focus on the match (statement 2.2), some have had a neutral response (22.2%) and others have disagreed (11,1%). Regarding the statement 2.3, 33.3% of the participants strongly agreed that they did not lose any important situation while sharing a moment of the match, 27.8% agreed, and 38.9% were neutral. Since the presented video was a compilation with some important moments of a match (not a complete match), it contained a greater frequency of important moments than a complete match. In this case, there was little time (only about 30–40 s) between two important moments, so participants did not have much time to share, react or explore the application without losing any important situation in the video. Instead, during a complete match, there are many more eventless periods in which users can take advantage of to react and explore the application.

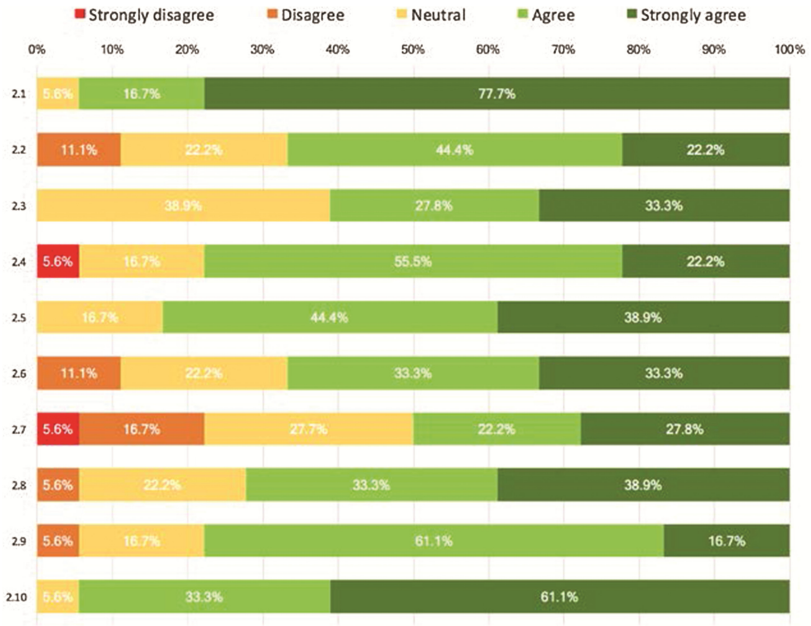


Fig. 13. Results from the usability and entertainment section of the smartphone questionnaire.

Most participants agreed (55.5%) that it was easy to access their friends' reactions (statement 2.4), and 22.2% strongly agreed. But there were also those who remained neutral (16.7%) and those who disagreed (5.6%). After the tests, in an informal conversation with the participants, we noticed that some of them did not realize that they could also access their friends' reactions by touching on the notifications they received. Despite this, participants were able to understand the different charts with the distribution of their friends' opinions and emotions (statement 2.5), where 38.9% strongly agreed and 44.4% agreed. Since notifications are an essential part of the application, it is important that they be as intuitive as possible. We also tried to understand, through statement 2.6, whether the different colours of the notifications helped the participants to identify the different types of notifications 33.3% of participants strongly agreed and another

33.3% agreed. There were participants with a neutral response (22.2%) and some disagreed (11.1%). In conversation with the participants, we understood that several participants immediately understood the different notification' types as soon as they received one of each type, others only realized after they have received several notifications.

With statements 2.7 and 2.8, we wanted to understand the participants' habits when using ReactIt. More precisely, when they are most likely to react to match moments shared by their friends. We found that 50% of the participants (27.8% strongly agree and 22.2% agree) stated that they were likely to react to match moments shared by their friends during the match, and 72.2% (38.9% strongly agree and 33,3% agree) stated that they were likely to react during the half time break, or after the match is over. We believe the answers to these statements were also negatively influenced by the video we presented. In a real match, it is expected that the users would use the application more often during the match, since there are a lot of eventless periods where users can take advantage to interact with the application.

Statement 2.9 has allowed us to evaluate and validate the concept provided by ReactIt. The idea of the system is to make fans feel like they are watching the match within a community. The results show that most participants felt they were watching the match with their friends, where 61.1% agreed and 16.7% strongly agreed. The notifications, the sharing of small videos containing specific moments, and the fact that reactions are shown in a chart are characteristics of the application that give users the feeling that they are watching the match in a community.

As already mentioned, ReactIt can also be used by users who are not watching the sports event. Since each moment has an associated video, they can visualize and react to the match moments shared by their friends who are watching it on TV. The results of the last statement (2.10) were very positive. The vast majority considered that even if they were not watching the match on TV, they could be aware of the most important moments of the match (33.3% agreed and 61.1% strongly agreed).

Regarding the results of the general aspects section, participants liked to use ReactIt (statement 3.1 in Table 3) on the smartphone, where 55.5% agreed and 38.9% strongly agreed. The vast majority of the participants strongly agreed (77.8%) that it is easy to learn how to use the system (statement 3.2). Also, a great enthusiasm was demonstrated during the tests. Almost everyone (44.4% agreed and 50% strongly agreed) found ReactIt an interesting concept (statement 3.3).

Smartwatch results. The results of the usability and entertainment section of the smartwatch questionnaire (Fig. 14) were also positive. The results show that all the participants immediately understood how to share a moment (statement 2.1 in Table 2), where 53.8% strongly agreed and 46.2% agreed. Since sharing a moment is an important feature in ReactIt, it is important to be as intuitive as possible.

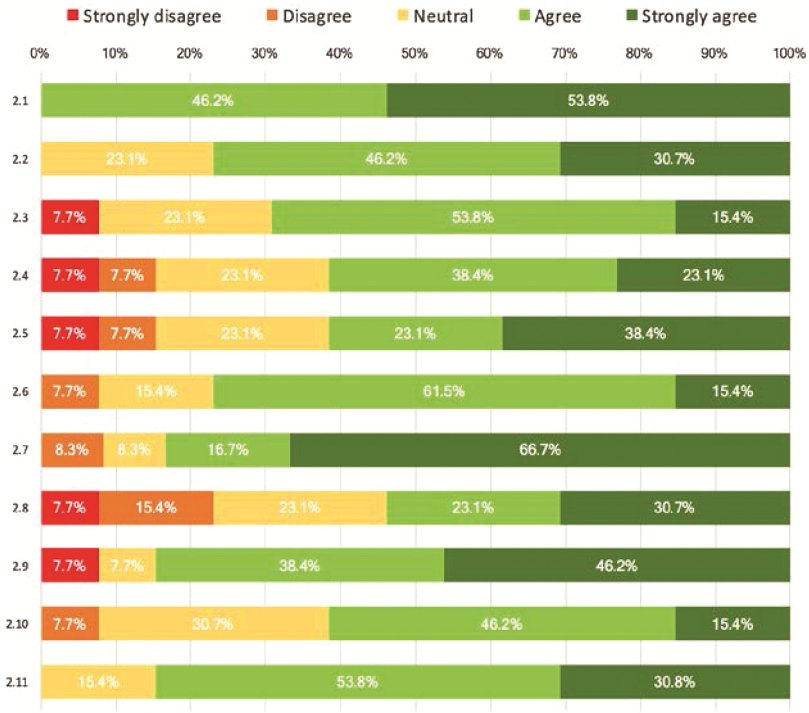


Fig. 14. Results from the usability and entertainment section of the smartwatch questionnaire.

As with the smartphone application, most participants were able to share moments of the match with friends without losing focus on the game (statement 2.2), where 30.7% strongly agreed and 46.2% agreed. Most of the participants also considered that they did not miss any important moment of the match while they were sharing moments (statement 2.3). The results to these statements were a little more positive for the smartwatch, which may indicate that this device is more suitable for this type of interaction (a possibility we need to further explore).

The results of the smartwatch regarding statements 2.4 and 2.5 were mostly positive. 61.5% (38.4% agreed and 23.1% strongly agreed) of the participants considered it easy to access friends' reactions (statement 2.4), as well as 61.5% (23.1% agreed and 38.4% totally agreed) of the participants were able to understand their friends' reactions (statement 2.5). But there were also participants who had a less positive feedback. During the course of the tests, we noticed that most users, upon receiving a notification with a reaction from a friend, did not touch on it to view the different charts with the distribution of the reactions, unlike participants who used a smartphone did. We believe that the fact that the participants were not familiar with the device (as acknowledged from the first section of the questionnaire regarding the personal data and sports habits) contributed to the less positive results regarding statement 2.4 and consequently of statement 2.5.

Regarding statement 2.6, the results showed that the vast majority of the participants (61.5% agreed and 15.4% strongly agreed) understood the content of the videos, showing that smartwatches can be used to clearly present football videos.

Participants were very enthusiastic to see their heart rate throughout the match (statement 2.7). The vast majority (66.7% strongly agreed and 16.7% agreed) liked the idea of the smartwatch being able to capture their heart rate during the match, and accessing a chart with the results at the end of the match, through the smartphone.

Results of participants' habits regarding when they are most likely to react to match moments, were similar to the results of participants who tested ReactIt on the smartphone. 53.8% (23.1% agreed and 30.7% strongly agreed) of the participants are likely to react to moments shared by their friends during the match (statement 2.8), and 84.6% (38.4% agreed and 46.2% strongly agreed) would react during the half time break or after the match is over (statement 2.9). Again, we believe that during a real match, users will have more interest and time to interact with the application.

Most users who used the smartwatch application thought that ReactIt made them feel like they were watching the match with their friends (statement 2.10), where 46.2% agreed and 15.4% strongly agreed. As already mentioned, there were some participants who did not immediately understood how to access their friends' reactions, which may justify the less positive results, where 30.7% gave a neutral response and 7.7% disagreed. Like the participants who used the smartphone, the vast majority considered that, even if they were not watching the match on TV, they could be aware of the most important moments through the application (statement 2.11), where 53.8% agreed and 30.8% strongly agreed.

Regarding the results of the general aspects section, participants also liked to use ReactIt (statement 3.1 in Table 3) on the smartwatch (61.5% agreed and 30.8% strongly agreed). Although the majority found that the system is easy to learn by using the smartwatch application (30.8% agreed and 46.2% strongly agreed), there were some participants who had a less positive opinion (15.4% were neutral and 7.6% disagreed). The results of the statement 3.3 were similar to the ones obtained for the smartphone application. Participants found ReactIt an interesting concept, with the results divided by approximately 50% between strongly agree and agree.

Finally, when informally asked, users promptly considered the video feature (the possibility of watching a video of an important moment of the match) as the most distinctive feature that would make them use ReactIt over other social applications they use to exchange comments and opinions while watching a TV show.

5 Conclusions and Future Work

This paper presents a system that enables sports fans to have a more social and enjoyable experience while watching sports events on television. It allows users to share automatic generated videos, that contains a specific moment of a football match, with their friends in a simple and non-intrusive way, in order to create social interactions between the fans. This feature not only allows users that are watching the match to later analyse all the

match moments, but it also allows users that cannot watch the match (and would like to), to follow the match and to be aware of its important moments.

The feedback received during the tests was very positive. The vast majority of the users considered that ReactIt was easy to learn and they liked to use both devices. They also found it an interesting concept and were very enthusiastic about using it in a real life environment, such as watching a football match on TV in the comfort of their sofa. This satisfaction was evident not only on the users who tested ReactIt on the smartphone, but also on those who used the smartwatch application. This is very encouraging since so far this device has not been so much explored in the development of second screen applications. Furthermore, with the feedback we received, we could validate the idea that these devices can also have a place in the second screen applications world. Although the results of the user tests were very encouraging, further tests should be performed in the future to overcome the limitations of the accomplished ones, such as testing the application during a real life football match TV broadcast (90 min) with different users interacting with the applications at the same time in different locations, to evaluate their experience in a real environment.

The tests were performed in a controlled environment, and therefore we did not take into account the fact that users may be watching the match on different TV providers, and the broadcast delays of the match, since at this stage, the focus was to test the concept with the different devices and see how users interact with them. In the future we intend to explore a possible synchronization mechanism to fix the problem regarding the broadcast delays, and at the same time adapt the aggregation algorithm used when different users register the same moment, so it can work on a real environment with thousands of simultaneous users.

We explored this concept in the context of football, as it is one of the most watched sports in the world, but this concept can be applied to any sport, or other TV broadcast genre, that users would like to exchange opinions and emotions about.

Acknowledgements. This work is funded by FCT/MEC NOVA LINCS PEst UID/CEC/04516/2013.

References

1. Debate. Is technology good for our society? http://bit.ly/29qhgcJ. Last accessed 31 July 2017
2. Businessinsider. What People Are Really Doing When They Pretend to Watch TV (2014). http://read.bi/1mc88Lw. Last accessed 31 July 2017
3. Centieiro, P., Cardoso, B., Romão, T., Dias, A.E.: If you can feel it, you can share it!: a system for sharing emotions during live sports broadcasts. In: Proceedings of the 11th Conference on Advances in Computer Entertainment Technology (ACE 2014), Article No. 15 (2014)
4. Shirazi, A.S., Rohs, M., Schleicher, R., Kratz, S., Schmidt, A.: Real-time nonverbal opinion sharing through mobile phones during sports events. In: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI 2011), pp. 307–310. ACM Press (2011)
5. Statista. Statistics and facts on second screen usage. http://bit.ly/29lu3kF. Last accessed 31 July 2017

6. Morales, G.D.F., Shekhawat, A.: The future of second screen experience. In: Workshop on Exploring and Enhancing the User Experience for Television (CHI 2013) (2013)
7. Schirra, S., Sun, H., Bentley, F.: Together alone: motivations for live tweeting a television series. In: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI 2014), pp. 2441–2451 (2014)
8. Murkherjee, P., Wong, J., Jansen, B.: Patterns of social media conversations using second screens. In: Proceedings of the International Conference on BigData/SocialCom/CyberSecurity (ASE 2014) (2014)
9. Wohn, D.Y., Na, E.: Tweeting about TV: sharing television viewing experiences via social media message streams. First Monday **16**, 3–7 (2011)
10. Nielsen. Super Bowl 50: Nielsen Twitter TV Ratings Post-Game Report (2016). http://bit.ly/1O3ttyb. Last accessed 31 July 2017
11. Cardoso, B., Romão, T., Correia, N.: CAAT: a discrete approach to emotion assessment. In: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems Extended Abstracts (CHI EA 2013), pp. 1047–1052. ACM Press (2013)
12. Plutchik, R.: The nature of emotions. In: Emotion: Theory, Research, and Experience. Theories of Emotion, vol. 1, pp. 35–56. Academic Press, New York (1980)
13. Lee, S., Heere, B., Chalip, L.: Identifying emotions associated with professional sport team brands. In: Proceedings of the Conference of the North American Society for Sport Management (NASSM 2013), Hackney, pp. 390–391 (2013)