StoryMotion: A Collaborative Recommendation Tool for StoryTelling through Photos

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ABSTRACT

In this paper, we present a proposal of a recommendation tool for creating collaborative image stories called StoryMotion. This system will allow users to put their images and photos together in a single story, performed in a semi-automatic way. Any users are free to continue the story as they want, though they can not change what has already been put into it. By doing so, StoryMotion gives its users freedom on the creation process at the same time as it guarantees the authorship of each participant in the story. This can lead to stories that comprehend scopes such as Education, Tourism and Politics. Throughout this paper, it will be described our motivations and theoretical foundation that led to projecting StoryMotion, how our prototype works, its major components and experimental evaluation. After presenting a brief overview of related works, we discuss about our research findings and future work.

Categories and Subject Descriptors

H.4 [**Information Systems Applications**]: Miscellaneous

General Terms

Design

Keywords

Storytelling, Collaborative, Recommendation

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1. INTRODUCTION AND MOTIVATION

Information and communication technologies have been at a fast development rate over the last decades. Its users became more participatives, as they could create and modify content. Projects such as the AIDS Quilt, the Ribbon Project and the Clothesline Project [5] would work with concepts that later would be the foundation of today's Web 2.0. Human interaction would transform individual items into collaborative media and products, showing that group work supported by the media have a notable potential in scopes such as education and public awareness.

Innovations from Web 2.0, like media created by the consumer and the sharing of content and information, helped on the creation process of what is called Social Web [4]. Its main goal is to support and promote interaction between its users, as seen in games, online shopping and social networking websites like Facebook and MySpace. Sharing online media and creating products in a collaborative environment have become a common behavior for people with access to the latest technologies. Amid this state we present StoryMotion: an environment for semi-automatic creation of collaborative content through photos captured by its own users.

Photo sharing usually involves storytelling: its owner wants to tell a story about a photo or through photos. The collaborative content created through StoryMotion will be a short animated GIF based on photos from multiple users. Stories will be composed by these photos, accordingly to users' ideas. Therefore, StoryMotion is able to reach several fields of application, such as Education, Politics, Tourism and Entertainment. However, how should a prototype be developed so it enables semi-automatic production of collaborative stories through photos?

Systems that use recommendation combines several computational techniques to select custom items based on the interests of users and the context in which they are inserted [6]. Such items can take very different shapes, like books, movies, news, music, videos, ads, sponsored links, web pages, products from a virtual store, etc. Companies like Amazon, Netflix and Google are recognized by the in-

tensive use of recommendation systems, which are used to gain great competitive advantage. In this sense, techniques used in recommendation systems and applied to a tool can help the storyteller in the search for photos to compose our story, reducing the effort in locating such photos.

The aim of this study is to project a collaborative recommendation tool for storytelling, called StoryMotion. The main contributions of this work are: (1) a full prototype implementation of the our approach; (2) an application of a recommendation technique for photos; (3) experimental evaluation and discussion's results by an analysis of the tool's use; (4) directions for future related work.

This paper is divided in the following sections: we start by presenting the Theoretical Aspects used to create StoryMotion, showing a brief background information about storytelling and digital media. Then, we describe how our StoryMotion prototype works, explaining its major components. Next, we describe our Experimental Evaluation and the data collected. We then present an overview of Related Works. Lastly, we discuss over our Conclusions and Future Work.

2. THEORETICAL ASPECTS

Storytelling has been present since the beginning of the history of man. Cave paintings, ancient hieroglyphs, writing systems, all of these methods were used to propagate knowledge through generations. Being a valuable form of human expression, Storytelling involves a two-way interaction between storytellers and listeners through the use of language, vocalization, physical movement and/or gesture [11]. It always presents a story and encourages the listener's imagination. The creation of actions, characters, and events of the story is based on experiences, beliefs, and understandings. In the end, the listener becomes a co-creator of the story.

Storytelling can be combined with other art forms such as cinema, games and theatre, blending almost imperceptibly [14]. Nowadays, digital technologies brought new multimedia features to storytelling, such as graphics, audio, video, and Web publishing. Because of that, the interaction between storytellers and listeners has changed. They no longer need to be in the same physical space and stories can be told with different techniques and elements. Internet users perform both activities, by creating, modifying and exploring content.

Social networking websites and mobile apps are examples of environments that allow users to create and share stories, whether they are composed by a single element or a combination of those. Facebook stories are told through posts where users can tag each other and add texts, photos, videos and links to other online content. Mobile apps such as Vine, Instagram and Flipagram allow users to post photos and short videos, share them online and link them to other social media. As result of the interaction in today's Social Web, storytelling has turned into a part of our everyday life.

One technique that can be used to develop photos' recommendation is clustering. This technique is a way to organize data by grouping sets of these, from the highest similarity degree among the data of the same set of another, based on some predetermined criteria. The similarity concept is a key for the construction of a cluster, for if two patterns are similar according to some criterion used by the clustering technique employed, then will be grouped in the same cluster, otherwise they will be grouped in different clusters [15].

Therefore, the definition of measures to compare patterns belonging to the same feature space is essential for most clustering processes. The most popular metric for calculating similarities between continuous features is the Euclidean distance. The Euclidean distance is a mathematical concept which represents the smallest distance between two points [10]. To develop the photos' recommendation on StoryMotion, we implemented the Euclidean distance for all the keywords of all the photos in StoryMotion database. In the prototype described in this article, the distance was determined manually, only to validate the feasibility of the technique. In future versions, we understand that this process can be automated for features where users can associate similarity (distance) with photos of other users.

The final collaborative content created through StoryMotion will be an animated GIF that contains a sequence of photos. Although it might not be as fluid as a video, it is based on another art form called Stop Motion [3]. This art form is an animation technique that uses a sequential arrangement of different photos to simulate movement. These photos are called frames. The illusion of movement is created when a physically manipulated object or character is moved in small increments between each frame. Then, these photos are played as a continuous sequence and the objects appear to move on their own. Since StoryMotion's stories will be told through photos only, this technique is a recommended method for users to create their stories. However, users are free to create stories according to their imagination, meaning that they can use whichever technique they choose.

Stories can be used for purposes such as propagating knowledge, teaching and entertainment [14]. They can have different scripts, such as linear ones or a broken alternative order. The StoryMotion environment will use a hypermidia approach [7], since it will provide a more efficient performance than a linear approach. The linear approach has limitations as its participants collaborate to a story with a single outcome, leading to a possible demotivation due to the lack of freedom to add new ideas and paths to the story. On a hypermedia approach, participants are allowed to share and reuse stories, continuing other people's stories with its own ideas. Therefore, StoryMotion will provide: an easy, semi-automatic creation process, preserving the original stories as well as providing freedom to stories outcomes; multimedia links for a flexible access to multiple stories; and a collective authorship sense, as it will preserve the stories from their original ideia to all outcomes created by other users.

3. STORYMOTION ARCHITECTURE

StoryMotion is implemented as a web application. Web applications developed for environments provide different characteristics, among which, we can mention the ease of access and the distribution of computing resources. The computa-

tional distribution provides a greater load decentralization for the applications and makes the applications more fault tolerant [12]. An overview of the StoryMotion architecture and their components are shown in Figure 1.

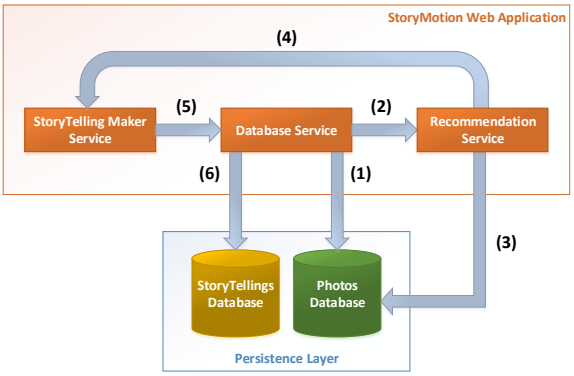

Figure 1: StoryMotion's architecture

The StoryMotion's architecture was divided into two layers. The first layer is responsible for deployment the web application. This layer contains all flows of application and services implemented for StoryMotion. The second layer is responsible for managing databases. This layer utilizes two databases. A database named *Photos Database* is used to store the photos and their metadata. The other database called *StoryTellings Database* is used to persist the storytellings that were generated from the photos selected by users.

The *Database Service* component interacts directly with the persistence layer, recovering photos/storytellings and also performing storage. All StoryMotion web pages use the *Database Service* to view and/or persist the data through your web forms. This storage or retrieval flow of photos and their metadata may be represented by arrow (1). Already the arrow (6) illustrates the storage or retrieval of StoryTellings.

The flow shown by arrow (2) represents the recommendation photos functionality from queries on a given theme. The *Recommendation Service* performs the photos selection from the clustering technique, calculating the similarity by Euclidean distance on the keywords by chosen theme. This action of photos selection by *Recommendation Service* is represented by arrow (3). After the photos recommendation results, the user can filter the photos that he wants.

To create the storytelling, user-selected photos are used as input to the *StoryTelling Maker Service*, action represented by the arrow (4). The *StoryTelling Maker Service*, in turn, run the photos clustering algorithms and produce an animated GIF. Finally, this animated GIF persisted into *StoryTellings Database*. For this, the *StoryTelling Maker Service* communicates with the *Database Service* to persist the animated GIF in *StoryTellings Database*, this action illustrated by the arrow (6).

4. STORYMOTION OVERVIEW

The design and implementation of the StoryMotion prototype aimed to provide an environment that would allow its users to create an account, upload their photos, search recommended images and create their stories. As seen in Figure 2, the login page contains a welcome message to its visitors, whether they are registered or not. Users can choose between signing up or logging in, in case they already have an account. The image shown in this page exemplifies how StoryMotion's stories are composed by a sequence of photos from multiple users.

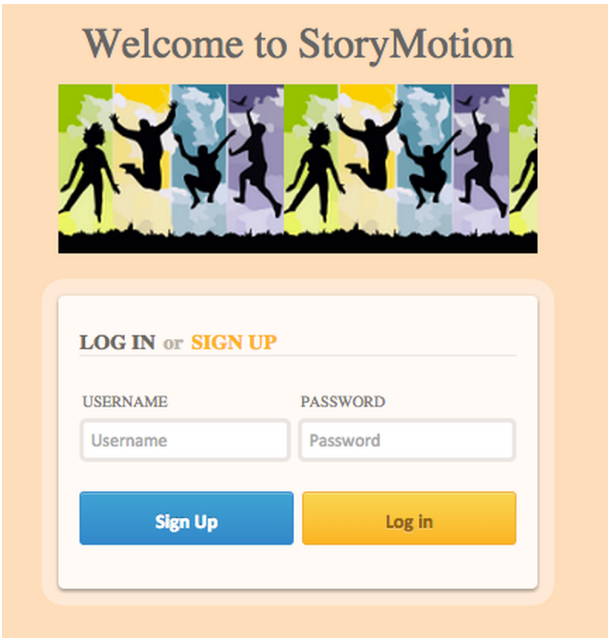

Figure 2: The login page.

The sign up page shown in Figure 3 contains the same image and welcome message as in Figure 2, but also a form for new users to enter their account information. This prototype asks for a name, a username and a password. After creating an account, users can then log into the system to upload their photos and create their stories.

Figure 4 shows the home page of a user. After logging in, users can visualize their own photos and stories, add a new photo or create a new story. There is also a header bar that greets the user and contains the log out button. Photos and stories are put together in different lists. The photo list is shown in the left area of the page, while stories are shown in the right area. Each photo has a description that contains the date and time of their creation, the name of the image file and which keywords were used by its owner to describe them. Stories have a description that shows the date and time of their creation and the theme keyword of the story. Our prototype last two pages are accessed through the "Add Photo" and "Create Storytelling" buttons.

Figure 5 shows the upload form for each photo the user wants to add. After choosing from local files which picture to add, the user needs to insert which keywords will be linked to the photo. These keywords are used for image search when creating a new story, so users are expected to contribute

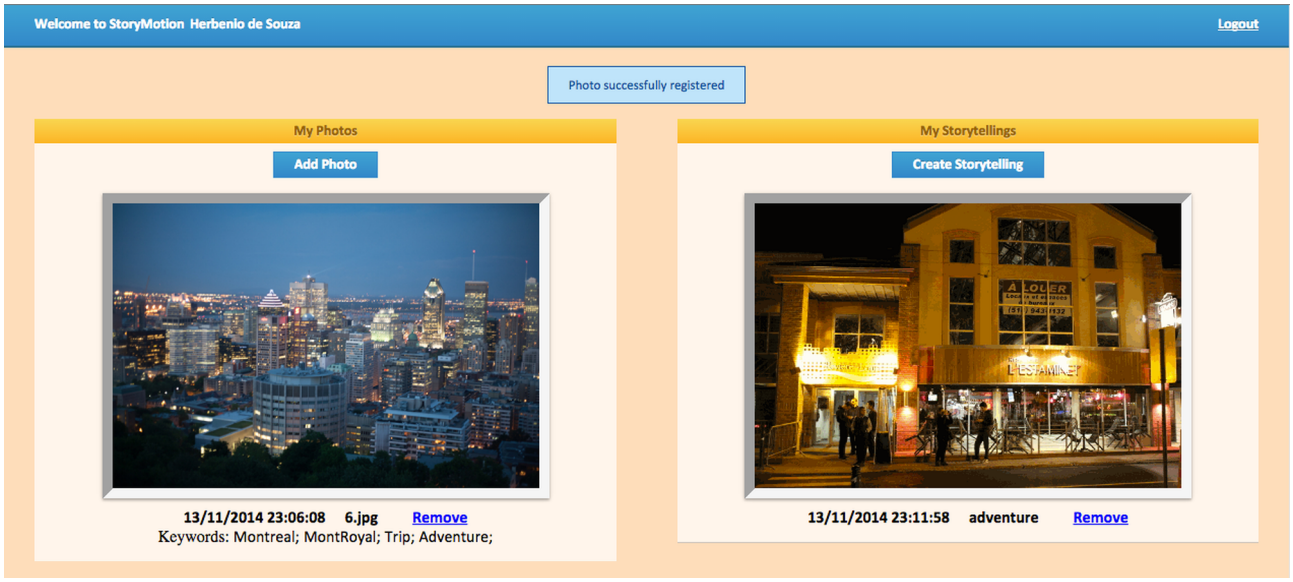

Figure 4: User's home page.

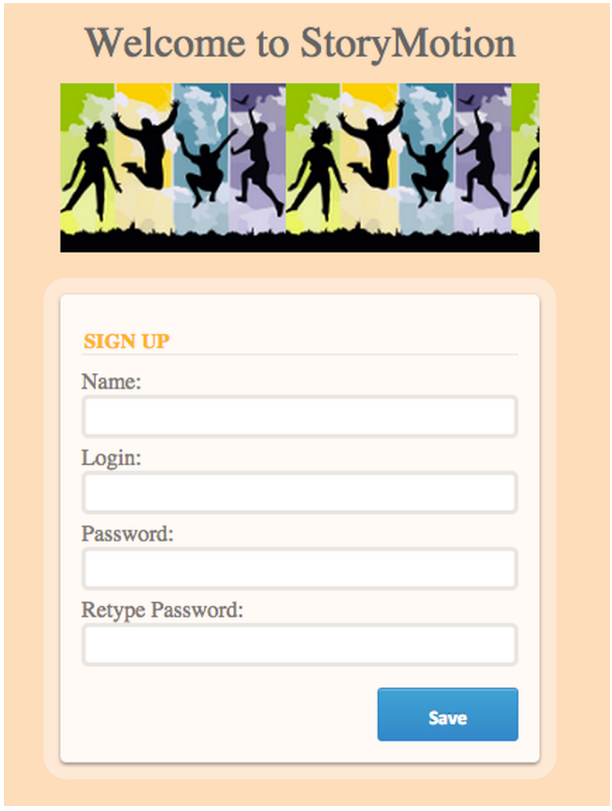

Figure 3: The sign up page.

with important database information.

Figure 6 shows the form to create a new story. Users can search photos through a theme keyword. The system will then recommend which photos are related to the chosen theme. After that, users choose which photos are going to take part in their story, and also add a description and a delay time between photos. The delay time should be in milliseconds, so that users have a higher variety of how fast they want to play a photo sequence. Doing so allows users to work with techniques such as Stop Motion, letting them decide which frame rate they want to work with.

5. EXPERIMENTAL EVALUATION

The main goal of this study was to project an environment that enable a semi-automatic production of collaborative stories through photos. To test if such idea could be considered relevant, we invited students to create stories through photos using our prototype. We collected quantitative and qualitative data by means of an online form after each user was done testing our prototype. Using Google Forms, we divided our questions into three areas: socioeconomic status, use and experience of digital media, and opinion about the StoryMotion prototype.

The evaluation was conducted with a total of ten students. The participants were chosen to represent a variety of user type, including professionals and students from different areas. The participants varied in gender (6 male, 4 female), age (between 18 and 35), level of education (6 undergraduates, 4 graduates) and income (8 low-income, 2 middle-

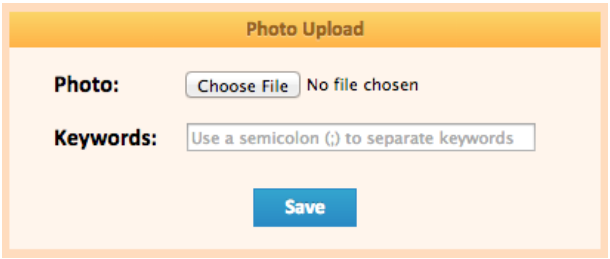

Figure 5: Photo upload form.

Figure 6: Storytelling creation page.

income). All participants would spent a minimum of four hours per day on the Internet. All participants were users of social media, and nine participants would spent at least four hours per day on these media. Eight participants were in favor of using photos, GIFs and videos on social media (2 exceptionally favorable, 6 favorable), one was unfavorable and one was neutral/did not use those services. When asked about what did they think about creating collaborative GIFs with other users, six participants were in favor (2 exceptionally favorable, 4 favorable) and four were neutral/did not use those services. Lastly, the participants varied in their opinion about their experience with the StoryMotion prototype (2 great, 3 good, 4 fair, 1 bad) and if they think StoryMotion achieved its purpose of facilitating the creation process of stories through photos (3 great, 4 good, 3 fair). The Figure 7 shows the objective questions and the answers obtained by the ten users who participated in the StoryMotion's evaluation.

Each evaluation session consisted of three parts: introduction, tasks and questionnaire. The introdution phase started with a presentation about what is the StoryMotion prototype and what were our goals with the development of such an environment. The following phase was about user testing. We asked participantes to perform three tasks: create a new account and log in, upload two or three photos and create a new story. Since all tests were done on the same machine, participants had to take turns using our prototype. We have also provided groups of three to five photos for each participant. These photos were separated in different, local pastes and had the same theme, in order to increase the chance of participants working with other user's photos. Lastly, our testers were asked to answer our online form and submit their opinions for later analysis.

Sessions were conducted in different places. Three participants tested on their own house, three tested on a common area of their university and four tested inside their classroom

1. What is your sex?				
A) Male: **6**			B) Female: **4**	
2. What is your current age?				
A) Less than 16: **0**	B) 16 to 20: **2**	C) 21 to 25: **2**	D) 26 to 30: **5**	E) 30 or older: **1**
3. What is your highest degree or level of education?				
A) Some high school: **0**	B) High school graduate: **0**	C) Some college: **6**	D) Bachelor's degree: **4**	E) Master's degree: **0**
4. What is your monthly household income?				
A) Less than R$ 1.449,99: **8**	B) R$ 1.450,00 to R$ 2.899,99: **2**	C) R$ 2.900,00 to R$ 7.249,99: **0**	D) R$ 7.250,00 to R$ 14.499,99: **0**	E) R$ 14.500 or more: **0**
5. How much time do you spend on the Internet each day?				
A) Less than 2: **0**	B) 2 to 4: **0**	C) 4 to 8: **4**	D) More than 8: **6**	
6. How much time do you spend on social media each day?				
A) Less than 2: **0**	B) 2 to 4: **1**	C) 4 to 8: **6**	D) More than 8: **3**	E) Do not use social media: **0**
7. What is your opinion about the use of photos, GIFs and videos on social media?				
A) Exceptionally favorable: **2**	B) Favorable: **6**	C) Unfavorable: **1**	D) Exceptionally unfavorable: **0**	E) Neutral/Do not use: **1**
8. What do you think about creating animated GIFs together with other people?				
A) Exceptionally favorable: **2**	B) Favorable: **4**	C) Unfavorable: **0**	D) Exceptionally unfavorable: **0**	E) Neutral/Do not use: **4**
9. How would you define your usage experience with Storymotion?				
A) Very good: **2**	B) Good: **3**	C) Fair: **4**	D) Poor: **1**	
10. What do you think of Storymotion regarding its purpose of facilitating the creative process of stories through pictures?				
A) Very good: **3**	B) Good: **4**	C) Fair: **3**	D) Poor: **0**	

Figure 7: Objective questions

after class was over. All tasks and questionnaires were performed in the same device, a 13-inch MacBook Pro running

OS X 10.9.5 Mavericks. StoryMotion was running locally, but Internet access was necessary so users could submit their answers. Before all sessions began, StoryMotion database was already populated with fifty images, all of which were similar to the images provided to each user. This was done in order to provide a better experience for users when testing StoryMotion, increasing the amount of images recommended on the story creation task.

One important information gathered through our evaluation was the high chance of an environment such as StoryMotion to succeed on helping people to create collaborative stories. Figures 8 and 9 contain graphical representations of the data that we believe most correspond to this line of thought. Users who agree with using photos, GIFs and videos on social media, and also with creating GIFs in collaboration, would benefit from our idea. That is already the majority from our participants. Also, we believe that neutral participants could turn into favorable. That is because we believe they either do not know any other environment that offers what StoryMotion does, or they were not attracted by it. By polishing our prototype and going foward with more studies around this research subject, we believe we can attract users that are favorable and neutral, consequently increasing StoryMotion's relevance.

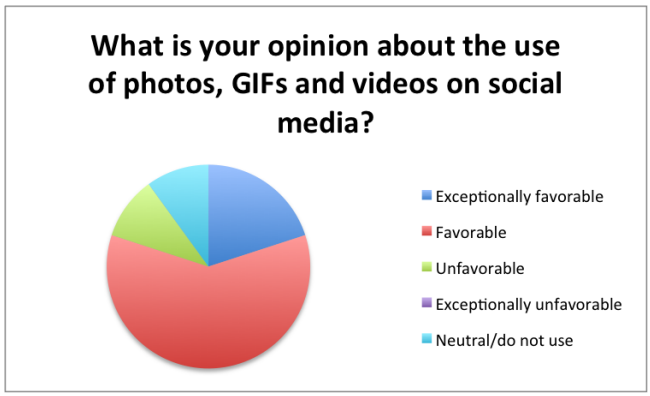

Figure 8: Use of photos, GIFs and video on social media.

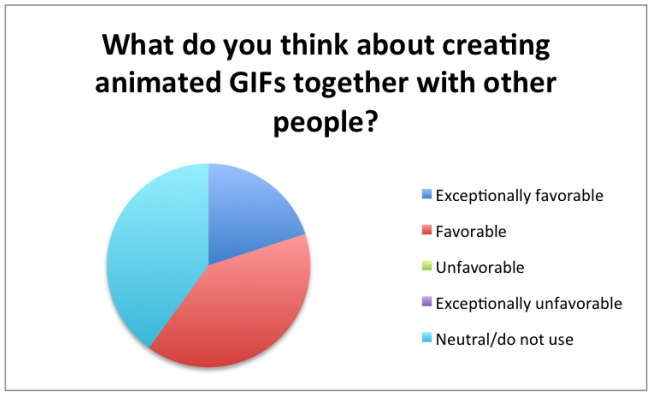

Figure 9: Creating GIFs together with other people.

We have also collected suggestions from our participants, and what they believe StoryMotion has of positives and negatives. Most negatives aspects are about interface design and system usability. Other aspects were the lack of more features in order to stand out over existing systems, and the lack of more elements to compose a story. Positive aspects were about how StoryMotion was a fun, easy to use and practical system. Also, being Web oriented and providing collaborative features made the idea promising. Most suggestions from participants were also about usability and interface design, such as explanatory texts, different layouts and previews of photos and stories. There were also recommendations like adding the option to change the privacy of photos and the function to crop images, so that users can work only with what they consider relevant to their story. These aspects were taken into consideration and merged with our plans for future work, which we will discuss later on this paper.

Lastly, Figures 10 and 11 are graphical representations of the data collected that reinforce the high potential that is inherent in StoryMotion. We believe the results were promising for StoryMotion prototype, since the majority of participants considered it either good or fair. The prototype needs further improvements to test if StoryMotion can reach higher ratings, since most of them might have been hindered due to usability and design complaints previously discussed.

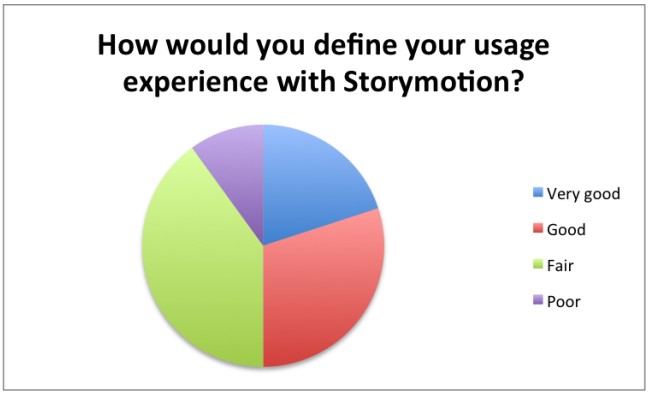

Figure 10: StoryMotion's usage experience.

Figure 11: StoryMotion and its purpose.

6. RELATED WORK

The design of StoryMotion prototype has been influenced by two main related work areas: photo sharing and collabora-

tive storytelling. The information gathered served to decide about what StoryMotion would focus on and how it would work.

The interaction between users of a system is an important factor when its purpose is to promote the production of artifacts in group activities. Tools such as Personal Digital Historian [13] and Pass-Them-Around [8] are examples of how to promote interaction among collocated users through photo sharing. Users of Personal Digital Historian sit around a table where the tool is projected. It focuses on the conversation between users rather than the perfomance of the storyteller, supporting flexible narratives and organizing its material based on four questions essential to storytelling: who, where, when and what. The Pass-Them-Around prototype tries to emulate characteristics of sharing traditional paper photos by using the spatial arrangement of people. It also describes two types of behavior when users talk about photos, storytelling and reminiscence, and how people shifted from telling stories about pictures, to telling stories with pictures.

The introduction of Web 2.0 and the Social Web brought new features to support the collaborative construction of online products. By using web-based collaborative hypertext systems known as wiki, students can produce collaborative storytelling [2]. Désilets and Paquet point out how children would design and write these collaborative stories. They would describe a scenario and draw a map with all different paths a story could take, and each of them would be responsible for creating a certain part of the story.

Systems like Zuzie [9] and initiatives like PoliCultura [1] are good examples of collaborative storytelling environments. Zuzie is an expressive activity program and a support system for collaborative storytelling based on multiple compositions. Its authors believe that repeating the story creation and storytelling stages, done by multiple users through figures and backgrounds, can help users to discover new points of view, opinions and experiences. PoliCultura is a large-scale initiative in which students and teachers collaboratively create a multimedia story. Its users choose a topic they wish to gather material about, then they search for content and organize it in a digital multimedia story. After evaluating a first version, they produce the final version of the story and publish it on the PoliCultura portal.

Multimedia stories created in collaboration can bring various benefits. For instance, its users increase their curiosity and knowledge about digital technologies and improve abilities like critical thinking and synthesis. They also boost their abilities of expression and interpretation of stories through the addition of new points of view and opinions. By usign an online environment, participants from different locations can create stories together and learn from different cultures. StoryMotion differs from these applications as it provides a web solution for semi-automatic creation process of collaborative stories focused on recommended photos and metadata.

7. CONCLUSION AND FUTURE WORK

As described in this paper, we proposed a collaborative web-based recommendation tool for storytelling focused on digital photos. To achieve our goal, we created a prototype named StoryMotion. This prototype allows users add photos and create stories from recommended images. It encourages people to work with collaborative content and to try out different techniques to create their photo story. Our work yielded valuable information about the potential contained in collaborative environments such as StoryMotion. Regarding our prototype, results show that it still needs enhancement on its usability and interface design. Putting together our future plans with the data collected from our evaluation, we have set what are the next steps to this research.

StoryMotion's interface needs a rework. Buttons need different colors for better identification, as well as new units for cancelling actions. Recommended photos were considered too small, while photos and stories lists on the home page were too big. They need a suitable layout in order to improve efficiency and not compromise quality. Labels need to be more intuitive and input forms need explanation for each field, as well as a preview feature to show users which images they are working with. Another suggestion was to rearrange the components inside the form to create a new story, making page navigation and the search for images more intuitive.

Users also asked for an easier way to upload a photo, like drag-and-drop function, selecting multiple photos and the option to use the same tags to describe all of them. They would also like to reorder the sequence of photos when creating a new story, as well as add filters and crop images so they can show only what they consider relevant in a picture.

Besides these suggested improvements, we have also set a list of features that could potentially improve the efficacy of StoryMotion. The first would be an image recognition technique in order to detect images considered offensive or inappropriate, and also the option to report images. This is a very important feature in order to provide a safe environment for its users.

Secondly, the option to set images as private or public. This feature is also about safety and privacy. Some users like to control who have access to their files, only allowing previously authorized people to use their photos. This is a desirable feature, but it should be designed in a way that does not compromise the system overall efficacy.

Lastly, each story could have two more elements: audio and subtitles. Subtitles would not only offer another form of interaction, but also expand the point of views of each stories. Keeping the same photos and changing only its subtitles, or vice versa, can lead to different meanings of a story. The audio component would work the same way. It could be used to include a narration, a background soundtrack or sound effects. However, due to the collaborative aspect of our stories, including an audio component might involve a complex implementation and an inharmonious result.

The challenges ahead are to continue this research and check how its potential grows, making improvements and polishing the StoryMotion prototype, following how technology evolves and testing its enjoyability.

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